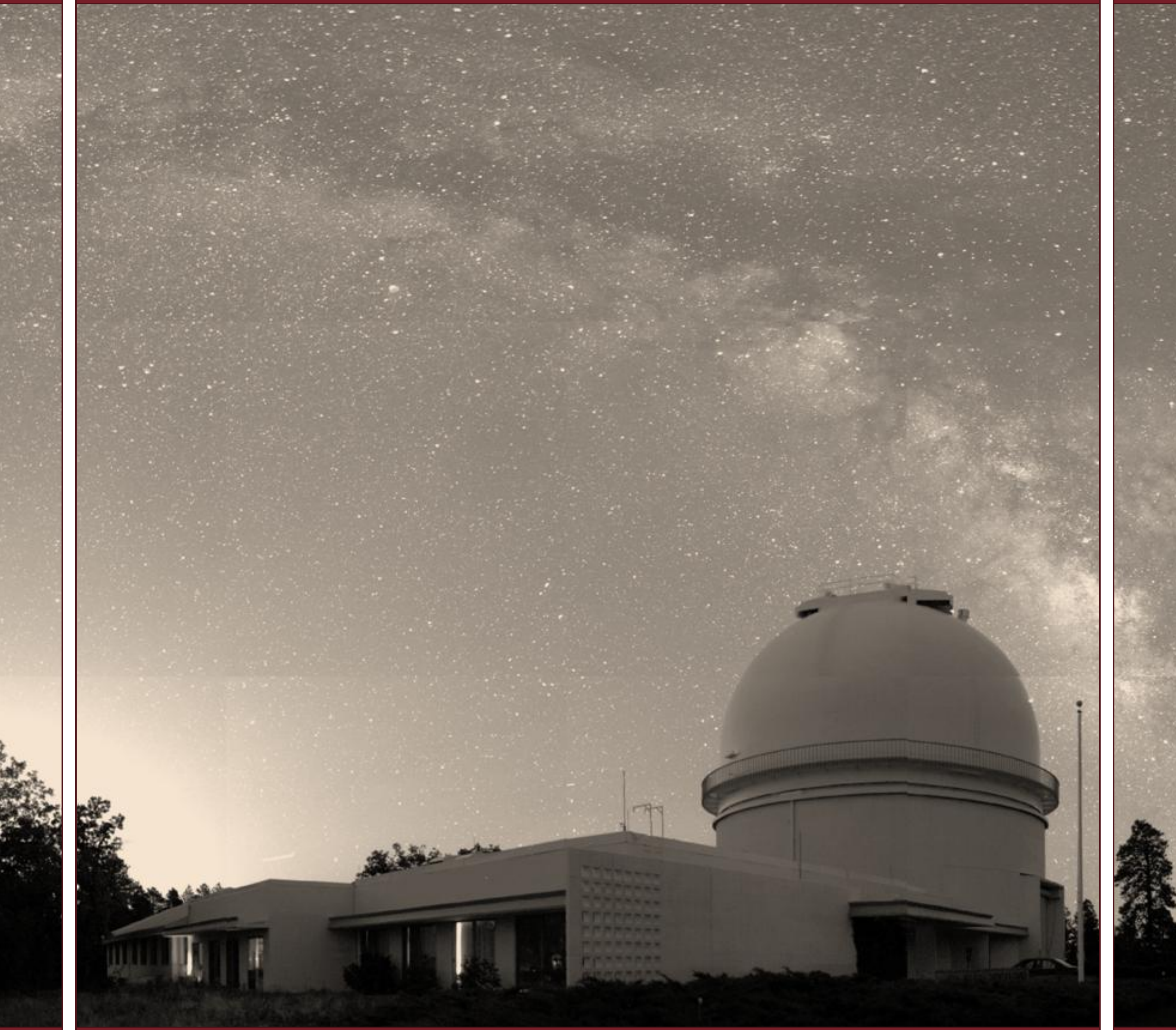
Integrated Natural Resources Management Plan

for

Naval Observatory Flagstaff Station

Flagstaff, Arizona



Final

May 2012

Integrated Natural Resources Management Plan

U.S. Naval Observatory Flagstaff Station
Flagstaff, Arizona

Final
May 2012

Prepared for:

U.S. Department of the Navy
U.S. Naval Observatory Flagstaff Station
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Flagstaff, Arizona 86001-8521
(520) 779-5132

and

Naval Air Facility El Centro
Environmental and Natural Resources Division
1605 3rd Street
Building 504 (Code 83)
El Centro, CA 92243-5001

Under
Contract No. N68711-05-D-8004/0018

with

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INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN
U.S. Naval Observatory Flagstaff Station

Approving Official

Captain Devon Jones, U.S. Navy
Commanding Officer,
NAF El Centro
El Centro, California

28 JAN 13
Date

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INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN
U.S. Naval Observatory Flagstaff Station

Approving Official

Michael D. Remington

Michael Remington, U.S. Navy
Installation Environmental Program Director,
NAF El Centro
El Centro, California

1/3/13
Date

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INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN
U.S. Naval Observatory Flagstaff Station

Approving Official

Paul Shankland
Director
Naval Observatory Flagstaff Station
Flagstaff, Arizona

9 Jan 2013
Date

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INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN
U.S. Naval Observatory Flagstaff Station

Concurring Agency

Joy E Nicholopoulos

Acting

Dr. Benjamin N. Tuggle
Regional Director
U.S. Fish and Wildlife Service
Region 2, Albuquerque Office
Albuquerque, New Mexico

DEC 17 2012

Date

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INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN
U.S. Naval Observatory Flagstaff Station

Concurring Agency

Larry D Voyles

Larry D. Voyles
Director
Arizona Game and Fish Department
Phoenix, Arizona

11/21/2012
Date

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Post Office Box 1306
Albuquerque, New Mexico 87103

In Reply Refer To:
FWS/R2/FAC-ARD/068339

JUN 2 1 2018

Memorandum

To: Regional Director, Southwest Region

From: Assistant Regional Director, Fish and Aquatic Conservation 6-20-18

Subject: Request for Concurrence to the 2012 Naval Observatory Flagstaff Station Integrated Natural Resources Management Plan (INRMP)

Our office and staff collaborated with Naval Observatory Flagstaff Station during development of their 2012 INRMP and concurred with the natural resource management goals and objectives at that time. We believe the natural resources management actions contained in the INRMP are appropriate to achieve the conservation, protection, and management of wildlife and plant resources, while considering the military operations, as required by the Sikes Act. These goals and objectives represent the mutual agreement of the cooperating parties concerning the conservation, protection, and management of natural resources on Naval Observatory Flagstaff Station, Arizona. There are no changes to the 2012 INRMP. We request your signature as concurrence to renew the 2012 INRMP for continued operation and effect for fiscal years 2017 - 2022.

Please contact the Regional Sikes Act Coordinator, Allison Arnold at 505-512-490-0057, extension 242, if you have questions or need additional information.

Enclosures

✓ Concur

Regional Director

June 21, 2018
Date

M18-03272400

DEPARTMENT OF THE NAVY
NAVAL AIR FACILITY EL CENTRO
1605 3RD STREET BLDG 214
EL CENTRO, CA 92243

5090
Ser N45E/064
5 Mar 18

Mr. Ty E. Gray
Director
Arizona Game and Fish Department
5000 West Carefree Highway
Phoenix, AZ 85086-5000

Dear Mr. Gray,

The Naval Observatory Flagstaff Station (NOFS) completed its Integrated Natural Resources Management Plan (INRMP) in May 2012. The Arizona Game and Fish Department reviewed the document and signed the INRMP. Per the requirements of the Sikes Act, a review for operation and effect is required no less than every five years. This letter serves as a request to conduct a review for operation and effect on the NOFS INRMP.

Our mission has not changed and there are no new occurrences of listed species on the installation.

An annual Metrics Review meeting is conducted with your agency's participation, in which a full review of the INRMP is completed each year. The latest metrics meeting was completed in October 2017 with Ms. Hannah Griscom, representing the Arizona Game and Fish Department.

We request your written concurrence the current INRMP is sufficient for the management of our natural resources and that you concur with our management strategies. Please signify this by signing the following page and returning this letter for inclusion in the INRMP..

Thank you for your assistance in this important matter. My point of contact is Mr. Robert Powell, NOFS Natural Resources Manager; he can be contacted (760) 339-2530 or by email at robert.j.powell4@navy.mil.

Sincerely,

B. A. ALFONZO
Captain, U.S. Navy
Commanding Officer

The Arizona Game and Fish Department concurs with the Naval Observatory Flagstaff Station that, the current Integrated Natural Resources Management Plan for Naval Observatory Flagstaff Station finalized in May 2012 is sufficient for managing their natural resources.

Mr. Ty E. Gray
Director
Arizona Game and Fish Department

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Executive Summary

This Integrated Natural Resources Management Plan (INRMP) is to provide Naval Observatory Flagstaff Station (NOFS) with a basis and criteria for sound land use and management of natural resources that is integrated with its U.S. Navy mission. The Sikes Act Improvement Act of 1997 (Sikes Act [as amended]) committed the U.S. Department of Defense (DoD) to prepare and implement INRMPs for its installations. Naval Air Facility (NAF) El Centro is the land manager for NOFS, and is responsible for development and operational activity.

The NOFS functions as an observing station of the United States Naval Observatory (USNO) based in Washington, D.C. The USNO is one of the oldest scientific agencies in the country. It is the preeminent authority in the areas of precise time and astrometry, and distributes earth orientation parameters and other astronomical data required for accurate navigation and fundamental astronomy. It is administered by the Naval Oceanography and Meteorology Command.

The Observatory consists of 287 acres, is located in Coconino County, Arizona, five miles west of the city of Flagstaff on Route 66. It is bordered by Coconino National Forest, Arizona State Trust, and private lands. The primary land use in the region is timber harvest, recreational tourism, and human settlement.

The mission of NOFS is to:

- Make, analyze, and interpret such astrometric and photometric dark sky observations as are required to fulfill the mission of the USNO;
- Conduct a research program to improve the observational methods and the accuracy of astronomical data required by the Department of the Navy (DoN) and other components of the DoD; and
- Perform such other functions or tasks as may be directed by higher authority.

Consistent with the INRMP management goals, the 2012 INRMP Update proposes best practices in the following eight resource management strategies.

- Conducting new studies and surveys.
- Rearranging encroachment planning priorities to set a higher priority on lighting and other issues that affect the dark, clear sky needed for nighttime astronomic observation.
- Reducing the carbon footprint of routine operations and maintenance, as well as participating in climate change study.
- Controlling invasive species.
- Conducting erosion control.
- Developing an interpretive venue to include signage and a conservation garden.
- Developing new monitoring priorities for forest health.
- Encouraging participation in regional, interagency partnerships.

Projects and activities are proposed in three broad management categories: forestry management; fish and wildlife management, land management, and fire management.

Forest Management

The forest management objectives at NOFS are to: 1) maintain the timber stands in a healthy, productive condition that will decrease the number of pines per acre, increase tree and stand vigor and enhance structural diversity of both pines and oaks; 2) support the military mission by maintaining land availability and use options and soil stability along forest access roads; 3) preserve the stands with particular attention to those seeming to have the greatest future potential for Mexican spotted owl habitat; 4) integrate forest management with other natural resources disciplines and programs to protect natural resource attributes associated with the forested acreage on NOFS. Some of the proposed activities include:

- Monitoring microhabitat plots, updating forest inventory, surveying for disease and insect infestation and preparation of plan revisions will be conducted over the next 5 years.
- Utilizing sanitation or salvage logging if conditions warrant, such as natural windthrow, deadfall or pest infestation/outbreak, landslide, and fire.
- Allowing large pines and oaks that succumb to natural causes be left on the forest floor as large organic debris to the maximum practicable extent.
- Protecting snags and downed large organic debris. In addition, trees deemed unique or of special interest for wildlife, such as advanced second growth specimens, isolated relict old growth, trees with large limbs or cavities, or less prevalent species will be protected in any service contracts and field marked with signs or paint prior to advertisement of the contract.
- Treating logging slash, the residual scrap tops, limbs and non-merchantable logs after harvest by lopping and scattering or piling or windrowing. Concentrations of slash will be removed to a minimum of 25 feet from roads and structures.
- Evaluating and protecting cultural sites or artifacts if discovered.
- Periodically removing or trimming trees naturally encroaching on the roads.
- Removing or trimming individual trees to remove obstructions to the telescopes.
- Provide for reforestation as necessary in open areas apparently still unforested since the 1950s. In areas of heavy grass and/or brush competition, spot application of herbicides may be used as part of the pre-planting site treatment. All herbicide applications will be in complete compliance with DoD requirements as described in Instruction 4150.7, which establishes the DoD Pest Management Program. Prescribed fire may also be used for this purpose.
- Developing a Forest Understory Enhancement Plan to benefit wildlife focus species, to include consideration of beneficial pollinators, managing light reflectance, and controlling erosion. Prescribed burning may be used for this purpose.
- Conducting a botanical inventory within the next two years for potential existence of rare plants, forest pests such as dwarf mistletoe, and invasive weeds.

Fish and Wildlife Management

- Focusing the fish and wildlife management under the INRMP on baseline inventories, management focus species such as cavity-nesting birds and other species identified in the Arizona Comprehensive Wildlife Conservation Plan (Arizona's State Wildlife Action Plan), and ongoing trend monitoring in relation to the timber management program and integrated with results of botanical surveys and weather effects.
- Continuing bird surveys at point count stations and monitoring the breeding bird survey route for the property.
- Trapping feral cats and submitting them to the local animal control officer.
- Periodically conducting small mammal surveys to track trend in prey base of spotted owls and other raptors.
- Leaving all naturally downed logs undisturbed on the forest floor, unless inadvertently moved as part of the logging process, to provide habitat for wildlife including small mammals, salamanders, insects, and other arthropods.
- Supporting a big game corridor study with agency partners.
- Supporting an oak/snag study with agency partners.

- Supporting an invertebrate survey to include prey base, pest, and beneficial pollinator habitat assessment.
- No changes are proposed to the timber management/removal program that might be inconsistent with prior evaluations and the Biological Opinions and other Section 7 Endangered Species Act consultations with the U.S. Fish and Wildlife Service.

Land Management

- Tracking weather data and relate to results of resource monitoring.
- Using aerial photography of the property at 1:12,000 scale every 3-5 years in conjunction with ground-based plant surveys to characterize forest densities and habitat characteristics and monitor other management issues, such as erosion.
- Keeping a cumulative map and record of surveys and findings on sensitive species in order to enhance understanding of their needs and status.
- Participating in climate change study with regional partners, focusing on a species vulnerability assessment for cavity nesting wildlife, the interaction of climate change with fire, and large ranging mammals.
- Evaluating the area south of the transit telescope for remedial treatments to restore and stabilize the soil surface, profile and vegetative cover.
- Selective tree cutting in drainages, and establishing buffer strips to protect drainages from damage by forestry operations. Using logging slash in some cases to reduce, trap or repair historic erosion.
- Installing water bars, retaining walls, or diversion culverts in high runoff areas.
- Using drought-tolerant native plants in all landscaping.
- Implementing dedicated monitoring and eradication programs for invasives, beginning with surveys to identify and map all infestations on the property, prioritizing treatment areas based on known aggressiveness of invasives, extent of infestation, and threat risk to native plants and animals;
- Maintaining inventory and appropriate buffering of jurisdictional waters and wetlands of the U.S. known from the property.
- Developing an interpretive nature hiking trail between the middle operations building and the lower building;
- Developing an interpretive kiosk and display adjacent to the main parking lot, to include a demonstration garden that demonstrates water sustainability techniques, pine-oak forest diversity, and beneficial pollinator species.
- Providing interpretive material about local habitats, plants, and wildlife through the development of brochures, on-site interpretive signage, and a field guide for wildlife viewing.

Fire Management

Preventing catastrophic, stand-replacing fires is of paramount concern to NOFS, because of the threat to the integrity of the property and astrometric equipment. The recently-completed timber thinning program addressed this fire risk and forest health for the near future. However, consistent with the forestry management objective, prescribed burning may be implemented at NOFS.

- Prescribed burning would be used as necessary, primarily to reduce the fuel load for fire protection but also to improve understory structure and condition, and enhance the amount, distribution and nutritional value of wildlife forage plants. It is anticipated that a maximum of 40 acres may be burned in any given year, subject to adjustments for weather, topography, fuel conditions, etc. This may not be in a contiguous block but comprised of smaller, irregular patches. It is not anticipated that burning will be conducted every year but rather on an as needed basis depending upon the amount, condition and location of fuel.

- Ensuring the necessary assets are available to suppress fires that start or are threatening the NOFS property and neighbors for DoN will formalize a Mutual Assistance Agreement with the city of Flagstaff, U.S. Department of Agriculture (USDA) Forest Service, and other partners as appropriate.

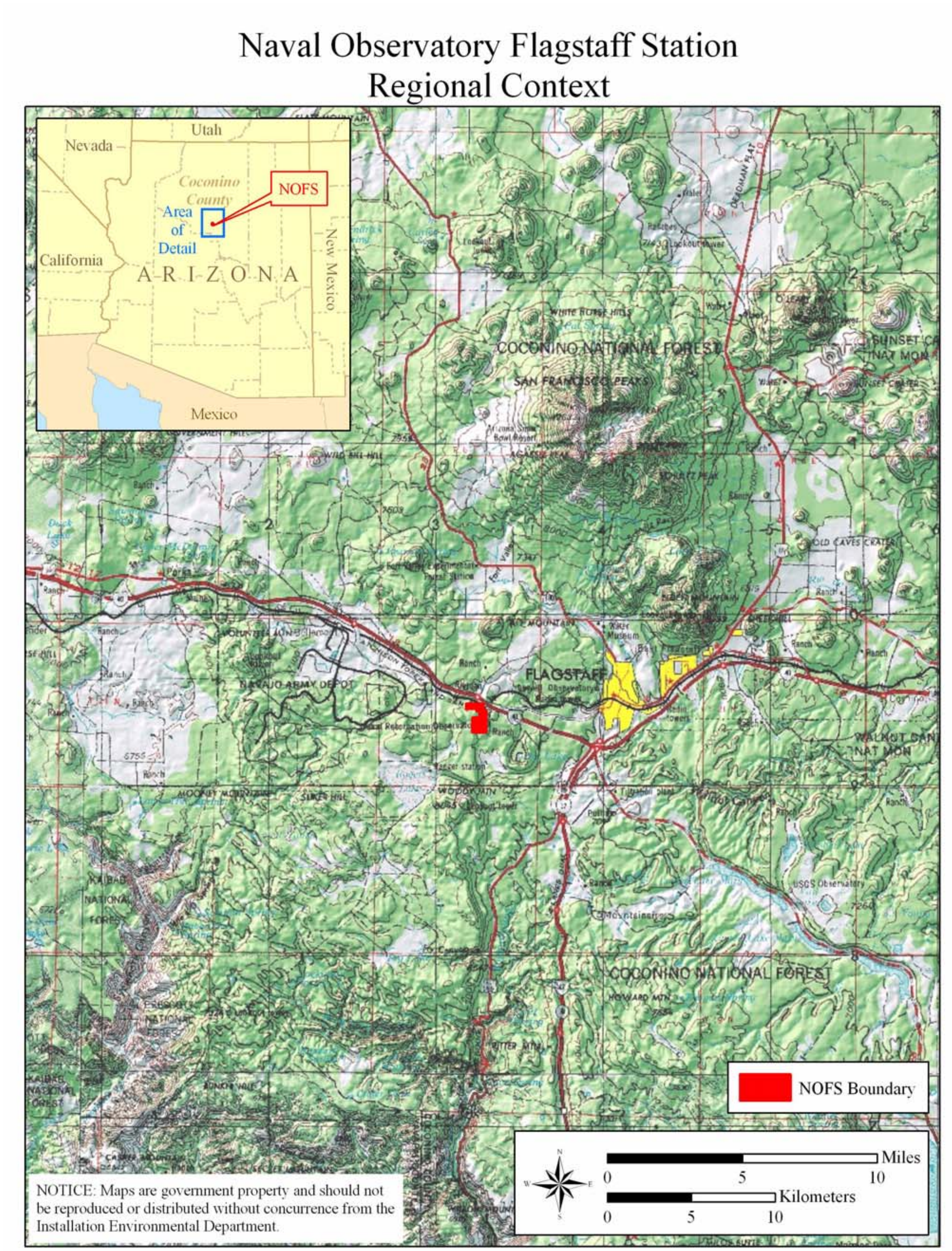
1.0 Introduction

1.1 Purpose

This Integrated Natural Resources Management Plan (INRMP) is to provide Naval Observatory Flagstaff Station (NOFS) with a basis and criteria for sound land use and management of natural resources and integrated with its U.S. Navy mission. The Sikes Act Improvement Act of 1997 (Sikes Act [as amended]) committed the U.S. Department of Defense (DoD) to prepare and implement INRMPs for installations such as NOFS.

The U.S. Naval Observatory (USNO) is one of the oldest scientific agencies in the country. Established in 1830 as the Depot of Charts and Instruments, its primary mission was to care for the U.S. Navy's chronometers, charts, and other navigational equipment. Today, USNO is the preeminent authority in the areas of precise time and astrometry, and distributes earth orientation parameters and other astronomical data required for accurate navigation and fundamental astronomy. It is administered by the Naval Oceanography and Meteorology Command.

Established in 1955 a few miles west of Flagstaff, Arizona (Map 1-1), NOFS is USNO's dark-sky site for optical and near-infrared astronomy. U.S. Naval Observatory performs an essential scientific role for the United States, DoD, and U.S. Department of the Navy (DoN). Its mission is to: make, analyze, and interpret such astrometric and photometric dark sky observations as are required to fulfill the mission of USNO; conduct a research program to improve the observational methods and the accuracy of astronomical data required by the Navy and other components of DoD; and perform such other functions or tasks as may be directed by higher authority. To fulfill this mission, NOFS' activities include: determining the positions and motions of the earth, sun, moon, planets, stars and other celestial objects, providing astronomical data; determining precise time; measuring the earth's rotation; and maintaining the Master Clock for the United States. Observatory astronomers formulate the theories and conduct the relevant research necessary to improve these mission goals. This astronomical and timing data, essential for accurate navigation and the support of communications on earth and in space, is vital to the Navy and DoD. It is also used extensively by other agencies of the government and the public at large.



Map 1-1. Location of Naval Observatory Flagstaff Station, Flagstaff, Arizona.

1.2 INRMP Scope

This INRMP's scope is defined by the Sikes Act (as amended) and in Department of Defense Instruction (DoDINST) 4715.03 18 March 2011 and the Navy's Environmental and Natural Resources Procedures Manual (Naval Operations Instruction [OPNAVINST] 5090.1C CH-1). This INRMP is considered a long term document, with updates to be made as necessary. The Sikes Act (as amended) stipulates that this INRMP provides for:

- Conservation and rehabilitation of the natural resources on military installations;
- Sustainable, multipurpose use of the resources;
- Public access to facilitate their use, subject to safety requirements and military security; and
- Specific natural resources goals and objectives and time frames for acting on them.

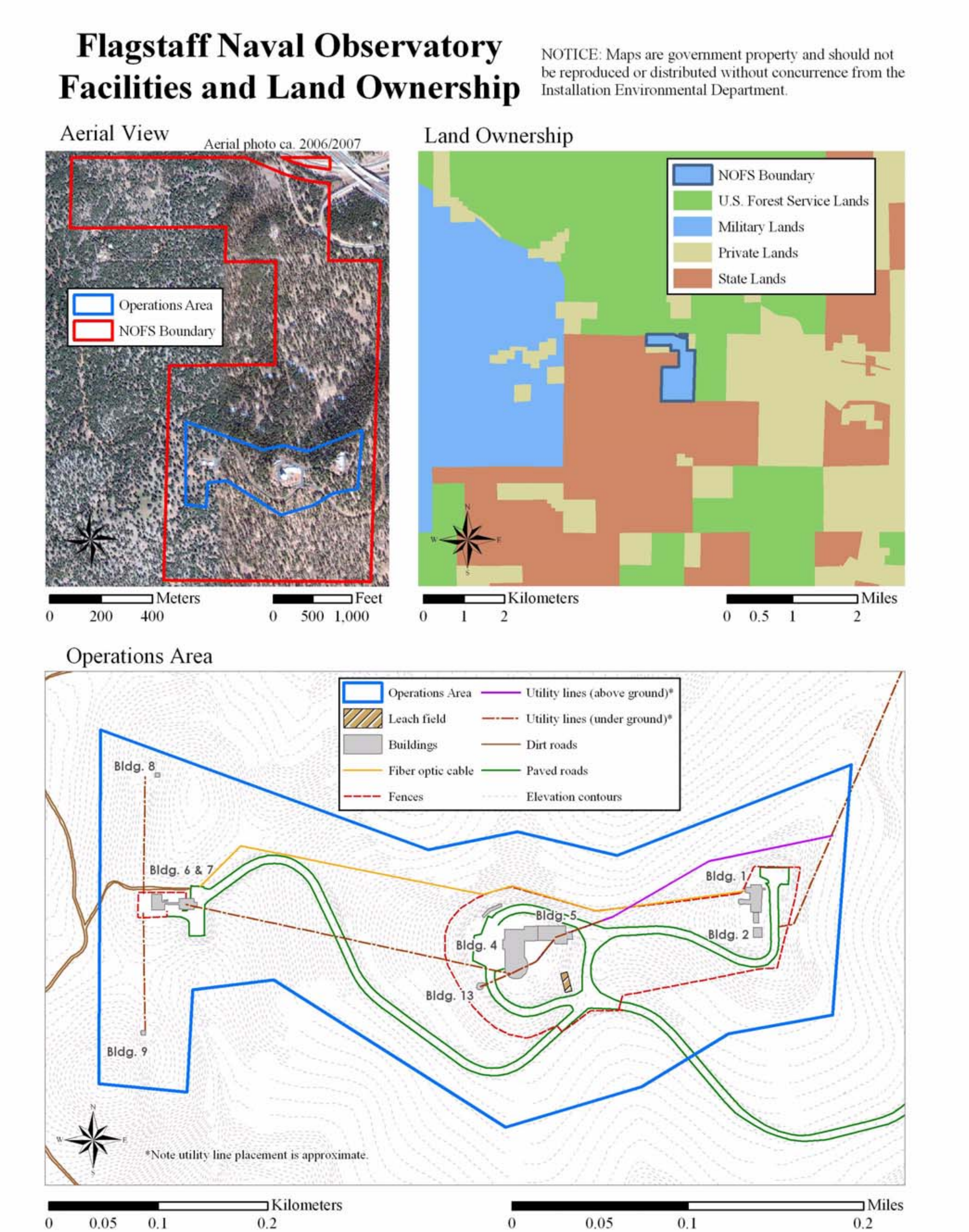
Organization of this INRMP follows the 2006 DoD Template for INRMPs (Office of Undersecretary of Defense [OUSD] Acquisition, Technology and Logistics Memorandum, 14 August 2006 [DoD 2006]). It is Navy guidance to use the DoD template. Since Navy guidance (both Chief of Naval Operations [CNO] Guidance of April 2006 [DoN 2006 INRMP Guidance for Navy Installations, and OPNAVINST 5090.1C CH-1 is more comprehensive than that identified in the DoD Template, additional material is added in the chapters or in the Appendices to ensure compliance with all documents.

There are presently two USNO sites in the Flagstaff area: NOFS and the Navy Prototype Optical Interferometer (NPOI), located on nearby Anderson Mesa at Lowell Observatory. The facilities at NOFS are located in an operations area of about 38 acres (Map 1-2) on land that is held in fee by the U.S. Navy (see Table 1-1). These facilities support the investigation of astronomy equipment, satellite research, development of navigational and community programs, and research and development in the fields of astrometric physics, radar and meteor astronomy, solar spectroscopy, and upper air physics.

The NPOI site is under a Special Use Permit with the U.S. Forest Service (USFS). It is the largest operating optical telescope in the world, operated by NOFS cooperatively with the Naval Research Laboratory and Lowell Observatory. The NPOI is a Y configuration of optical sidereostats. The inner fixed stations are used for astrometry while stations on the outer arms, out to an eventual separation of more than 300 meters (m), are used for imaging stars. The stations are connected by vacuum beam lines. Fast delay lines in the main control building and long delay lines outside are used to adjust the optical phases to allow coherent combinations of up to six sidereostats. Used for astrometry and astronomical imaging, NPOI is a distributed aperture optical telescope.

An installation is responsible for conservation, protection, and management of natural resources on all lands within its boundaries. Even if an Installation Commander requires a tenant, lessee, or permittee to complete natural resource management actions, as part of the terms of occupancy or lease, an installation is still ultimately responsible for those leased or occupied lands and must address management of those lands in an INRMP.

In order to document the real estate status of the property Table 1-1 provides a summary of leases, easements and other agreements related to NOFS. The 17 May 2005 Office of the Secretary of Defense (OSD) Supplemental Guidance Concerning Leased Lands states that the INRMP must: "… address resource management on all of the lands for which the subject installation has real property accountability, including lands occupied by tenants or lessees or being used by others pursuant to a permit, license, right of way, or any other form of permission."



Map 1-2. Naval Observatory Flagstaff Station property and surrounding ownership.

Table 1-1. Real estate agreements related to Naval Observatory Flagstaff Station.[a]

Agreement	Date	Grantor/Grantee	Use	Acres
NOY(R) 65138	4 January 1957	Agreement between The State of Arizona and The United States of America	The United States of America has selected the hereinafter described land near Flagstaff, Arizona as a suitable and desirable site for the location and operation of a U.S. Naval Observatory Substation; and (a) it is desirable and considered in the best interest of the State of Arizona that said Observatory should be located within said State and on certain land situated in the County of Coconino, Arizona, described as the SE1/4 of section 22, Township 21 North, Range 6 East, G.&S.R.B.& M.; and the use of said premises has been acquired by the Government from the State of Arizona and the Government proposes to acquire the said property; (b) in consideration of the premises and the mutual advantages accruing to the parties hereto, the State of Arizona, in order to assure the proper functioning of said observatory, undertake and agrees, insofar as it lawfully can do so, to prohibit the establishment of industrial facilities on those State owned lands described as Sections 21, 22, 26, 27, and 28, in Township 21 North, Range 6 East, G.&S.R.B.& M.	287 Acres
Special Use Permit NF(R) 4892	3 June 1980	National Forest	The subject project includes regrading the inside shoulder and flattening the side slopes in the cut sections of the Flagstaff Naval Observatory access road (approximately 2,800 linear feet), clearing and grubbing of timber and debris, and cleaning out clogged drainage structure.	4.4285 Acres
Utility Easement	21 October 1987	Notre Dame Development Corporation; Daniel W. Hill and Anne L. Hill; CLK Equity Investments, Inc. - Grantor. Sidney J. Harris - Grantee	Utility Easement 8 feet in width, with the right to operate, repair, replace, maintain, and remove utility lines and/or other utility services or appurtenant facilities at any reasonable time, and to trim or remove any trees or shrubs that in the judgment of the Grantee may interfere with the construction or endanger their operation. Grantor grants placement of anchors where necessary to support the lines within easement. Located on a portion of the Northeast quarter of Section 22, Township 21 N, Range 6 E, G.&S.R.B.& M, South 8 feet of the W half or the NE quarter of the NE quarter, all in Section 22, Township 21 N, Range 6 E.	Acreage not stated in easement document.
Lease N6247487RP00A60	30 January 1987	Notre Dame Development Corporation - Grantor. United States of America - Grantee	Authorizes use of approximately 78 acres for Government purposes. Lease beginning 1 January 1988 and ending 31 December 1988.	78 Acres
N6247488RP00A22 and N6247488RP00A23	21 October 1987	Sidney J. Harris - Granto; Robert E. Fried and Margo J. Fried - Grantor. Notre Dame Development Corporation; Daniel W. Hill and Anne L. Hill (Jomoco, Inc. Successors-in-interest); CLK Equity Investments, Inc.	Location: NW 1/4 NE 1/4 and the NE 1/4 NW 1/4 of Section 22; NE 1/4, Section 22Township 21 North, Range 6 East G.&S.R.B.& M. Grantor: (a) Will restrict use of the Premises to single family residential use and will neither subdivide nor develop the Premises for other purposes except that the existing private observatory is an acceptable use.(b) Will ensure that outside lighting conforms to City of Flagstaff lighting code, will shield all outside lighting and will not install and outside lighting fixtures that exceed 4000 lumens.	10.42 Acres
Offer to Sell Real Property N6247488RP00A91	24 August 1988	Notre Dame Development Corporation and others- Vendors.	78 acres with exceptions for rights of way and easements for railroad, Interstate 40, Highway 66, private to Section 22, township 21 N Range 6 East G.&S.R.B.& M.	78 Acres
Amendment to Grant of Easement N6247488RP00A23	2 December 1999	Robert E. Fried and Marian L. Holmes-Fried - Grantor. USA - Grantee	The purpose of the said grant of Easement was to restrict any development which may conflict with the operation of the U.S. Naval Observatory, Flagstaff Station, Flagstaff, Arizona.	78 Acres

a. In addition to the above, the following easements are adjacent to NOFS property, based on Naval Facilities Engineering Command (NAVFAC) records: a Utility Easement running W ½ NE ¼ NE ¼,E ½ NW ¼ NE ¼ of the parcel and is 8 feet wide (March 11, 1987); a no-abandonment right-of-way reverter bordering the NOFS access road to the west. Old "66" has a 400' wide reverter on abandoned land west of the NOFS access road; a centerline 30' Ingress and Egress easement west of the access road; and an approximate alignment right-of-way (B-3) running just north of the NOFS access road.

1.3 INRMP Goals and Objectives

A Goal Statement, as defined in this INRMP, sets the course towards a successful plan. It defines an end outcome or result rather than an activity or process. INRMP goals should endure for 20 years, as a guideline.

Goal 1: Mission Sustainability. Guarantee full and complete implementation of the NOFS mission as an observing station of the USNO program, providing local administration and logistic support to the Flagstaff Astrometric Detachment, while minimizing environmental impacts and meeting all environmental compliance responsibilities.

Goal 2: Forest Health. Protect, sustain, and restore the natural Ponderosa pine and pine-oak ecosystem and biodiversity of NOFS natural resources, while achieving no net loss to the military mission.

Goal 3: Organizational Health. Provide the organizational capacity, technical support, and communication necessary for effective natural resources planning and daily administration of this INRMP.

In contrast to a goal, an objective (for the purposes of this INRMP) should be achievable within five years or so. An objective describes a desired future condition or successful outcome that reflects and tiers off of the goal statement, and includes a metric for attaining the objective such as a standard, quantity, or timeframe. The objective should be as quantifiable as possible. It should avoid saying *how* the objective is to be achieved, but rather *what* is to be achieved.

Table 1-2 summarizes the objectives of this INRMP within the framework of the three goals. The 2006 DoD Template for INRMPs (OUSD Memorandum, 14 August 2006) assigns certain program elements to be discussed in Chapter 4 and an objective is developed for each of these; however, certain of these elements do not apply to NOFS. Not included below are: coastal/marine management, agricultural outleasing, bird/animal strike hazard, and floodplains management.

Table 1-2. Goals and objectives of this INRMP.

Goal 1: Guarantee full and complete implementation of the NOFS mission as an observing station of USNO, providing local administration and logistic support to the Flagstaff Astrometric Detachment, while minimizing environmental impacts and meeting all environmental compliance responsibilities.

Topic	Objective	Objective I.D.
Supporting Sustainability of the Military Mission and the Natural Environment	Anticipate and protect against all encroachment on resources available for fulfilling the military mission, and provide for the conservation of environmental resources that are key to sustaining the military mission.	1.1
Compliance with Natural Resource Laws	Implement the overall goals and objectives of the Endangered Species Act (ESA), Clean Water Act, and other laws with respect to long-term military mission sustainability and ecosystem management.	1.2
National Environmental Policy Act (NEPA) Compliance	Ensure that land use planning decisions protect the mission of NOFS by seeking to resolve land use conflicts through the NEPA process.	1.3
	Conduct planning of mission activities having potential environmental effects by applying NEPA's requirements and policies to enhance mission-related use and stewardship of natural resources.	1.4
	Complete construction projects that enhance and support current or planned operations on NOFS, while minimizing adverse effects to the natural and human environments and complying with environmental laws in a cost-effective manner.	1.5
	Seek opportunities for streamlining environmental assessment and review.	1.6
Beneficial Partnerships and Collaborative Resources Planning	Be proactive in cooperative resources planning partnerships to create regional conservation, ecosystem, and watershed solutions of mutual benefit while also protecting the military mission.	1.7
Public Access and Outdoor Recreation	Ensure public access is restricted to temporary uses that are compatible with NOFS mission, natural resources responsibility, safety, and security.	1.8
Public Outreach	Build a strong conservation ethic and personal commitment to natural and cultural resources stewardship through the promotion of education and awareness of the unique environmental setting and history of NOFS, as well as the NOFS mission.	1.9
Encroachment Partnering	Use partnerships and collaborative plans to benefit control of light pollution and other encroachment on the NOFS mission.	1.10
State Wildlife Action Plan and Regional Wildlife Plans	Seek consistency with the goals and objectives of regional wildlife plans, such as the Mexican spotted owl recovery plan and the Arizona Game and Fish Department's Comprehensive Wildlife Conservation Plan, where consistent with local NOFS mission and natural resources priorities.	1.11

Goal 2: Protect, sustain, and restore the natural Ponderosa pine and pine-oak ecosystem and biodiversity of NOFS natural resources, while achieving no net loss to the military mission.

Topic	Objective	Objective I.D.
Achieving No Net Loss to the Capability of Lands to support the Observatory mission	Support the military mission by sustaining a dark sky, low risk of smoke, pollen and dust to telescope operation, and low risk of high severity wildfire.	2.1
	Safeguard the mission by maintaining access and operation of roads, utilities, and other infrastructure to their original design standard or better, while protecting wildlife habitat, sensitive species, soil productivity, watershed functions, and water quality.	2.2
	Maintain right-of-ways along roads and utility corridors for safety and consistent with Navy stewardship of the property.	2.3
	Anticipate and prevent emergency infrastructure problems to ensure human health and safety while minimizing damage to sensitive natural resources.	2.4

Table 1-2. Goals and objectives of this INRMP. (Continued)

	Ensure no net loss of available land and operational carrying capacity for military support while pursuing environmental protection needs (DoDINST 4715.03).	2.5
Environmental Sustainability	Identify and implement means and metrics to promote environmental sustainability and comply with Executive Order (EO) 13423, Strengthening Federal Environmental, Energy, and Transportation Management.	2.6
	Maintain the condition of the forest within its historic range of variation, with consideration of the possible effects of global warming with regard to forest health, weather extremes, and fire regime.	2.7
Sensitive Species Management	Provide for the protection and enhancement of sensitive plants and habitats, as a proactive strategy to prevent contributing to further declines, and with a focus on the Mexican spotted owl and other cavity-nesting and snag-dependent species.	2.8
Wetlands	Protect the integrity and functional values of headwaters, waters of the U.S., and wetlands.	2.9
Natural Resources Law Enforcement	Take measures to prevent use of the property by unauthorized personnel and activities that are not consistent with the mission.	2.10
Fish and Wildlife Management	Enhance, restore, and sustain the natural diversity and long-term viability of the ecological and evolutionary processes in all natural communities and wildlife habitats consistent with DoD ecosystem management policy (DoD 1994), as the first step toward promoting species biodiversity. Comply with the ESA and contribute to the conservation of the Mexican spotted owl.	2.11
Forest Management	Maintain the forest in a resilient, productive condition, that provides for tree and stand vigor and the structural diversity of both pines and oaks.	2.12
	Preserve those stands with the greatest future potential for Mexican spotted owl support as a priority, as long as fire control and dark sky objectives can be met.	2.13
	Provide for pine and oak snags, down and dead woody material, and the wildlife that use them, such as snag-dependent and cavity-resting species.	2.14
	Treat slash to minimize damage to the environment and maximize wildlife values where possible and consistent with other objectives.	2.15
Vegetation and Plant Communities	Provide a sound basis for management and design of low landscaping and groundskeeping immediately around occupied buildings that is compliant with EO 13123 Greening the Government Through Efficient Energy Management and EO 13112 Invasive Species.	2.16
	Conserve water, protect water quality, reduce runoff and erosion, and decrease plant nutrient loss by reducing the demand for water in landscaped settings in compliance with EO 13123 Greening the Government Through Efficient Energy Management.	2.17
Migratory Birds	Conserve viable habitat for migratory birds that use or may use NOFS for stopover resting, feeding, and nesting, with an emphasis on snag-dependent and cavity-nesting birds, and these region and focus species: northern goshawk, cordillean flycatcher, olive-sided flycatcher, and purple martin.	2.18
Invasive Species	Eradicate or control the spread and prevent the introduction of invasive species with priority on those with greatest potential for spread, out-competing native plants, and degrading habitats in compliance with EO 13112 Invasive Species.	2.19
Pest Management	Establish an awareness and prevention program for hantavirus.	2.20
	Promote the use of best practices to avoid harm to non-targeted native species when controlling pests.	2.21
	Prevent and control wildlife damage.	2.22
	Participate in regional rabies control.	2.23
Land Management	Protect and restore soil productivity, watershed functioning, water quality, and wildlife habitat through effective implementation of Best Management Practices to prevent and control soil erosion	2.24
	Prevent non-point source pollution from excessive erosion attributed to structures, roads, and forest management practices.	2.25
	Provide for reseeding as necessary in open or disturbed areas.	2.26
	Protect cultural sites.	2.27
	Protect visual aesthetics.	2.28
	Provide for an integrated approach to trend monitoring and data management to provide better understanding of the patterns and underlying processes of natural resources, especially in relation to the forest management program, fire management, forest health, and protecting effects on the function of the telescope and other mission-related activities.	2.29
GIS and Database management	Ensure the technically sound, practical and appropriate use of library and computer technology to manage, analyze, and communicate natural resources information in support of management decisions.	2.30

Table 1-2. Goals and objectives of this INRMP. (Continued)

Outdoor Recreation	Promote compatible, sustainable outdoor recreation opportunities which enhance quality of life for NOFS personnel, while conserving natural resources, without compromising the mission.	2.31
Wildland Fire	If consistent with protecting mission-related operations, participate in prescribed burning operations with adjacent land managers to maintain a low risk of high-severity fire.	2.32
	Manage the risk of high severity wildfire by maintaining an open stand structure that prevents crown fires, and by minimizing fuel loads, especially ladder fuels.	2.33
	Establish a process and standards for avoiding wildfire ignition and quickly and effectively suppressing wildfires threatening the property and facilities.	2.34
Training Natural Resources Personnel	Provide sufficient technical support to staff as well as training and networking opportunities to achieve INRMP goals and objectives and ensure a knowledge of compliance with other applicable laws, such as the ESA.	2.35

Goal 3: **Provide the organizational capacity, technical support, and communication necessary for effective natural resources planning and daily administration of this INRMP.**

Topic Area	Objective	Objective I.D.
Facilitating Adaptive Implementation	Improve and refine natural resources management, by adaptively adjusting success criteria and priorities based on past accomplishments, new risks and threats, new biological information, and changes in policy.	3.1
	Incorporate a dynamic, continuous process for decision-making, including future changes or additions to the INRMP.	3.2
	Ensure that all avenues are investigated and sought for achieving the goals and objectives of this INRMP, for the best possible management and most efficient use of resources and funding.	3.3
Cooperative Agreements for Implementing INRMP Goals and Objectives	Enter into Cooperative Agreements to implement regional and local ecological goals in this INRMP. Work cooperatively with partner agencies to monitor natural resources availability and adaptively manage forests to ensure long-term sustainability of ecosystems on NOFS. Work with stakeholders/agencies in updating the INRMP.	3.4

1.4 Responsibilities

Management authority for NOFS lands falls under the Commander Navy Installations Command (CNIC), and Commander Navy Region Southwest (CNRSW). NOFS is considered part of the installation at Naval Air Facility El Centro (NAFEC) for management of natural resources. The Director of NOFS has responsibility for implementation of the INRMP.

The Naval Facilities Engineering Command Southwest (NAVFAC SW) provides technical support, assistance, and contracting authority on request. NAVFAC SW also provides assistance with INRMP implementation.

The Naval Facilities Engineering Command Northwest (NAVFAC NW) provides technical assistance through the Navy Forester and funding for the forest management program. The NAVFAC NW Forest Management Program ensures staffing, funding and equipment to carry out any and all forestry consultations, operations, and projects in furtherance of INRMP objectives.

1.4.1 NOFS Internal Stakeholders

The internal stakeholders are the Director of NOFS, the Commanding Officer of NAFEC, and Installation Environmental Program Director at NAFEC. Indirectly, other Navy stakeholders include NAVFAC SW and NAVFAC NW.

1.4.2 External Stakeholders

INRMPs are to be developed in cooperation with and the concurrence of the U.S. Fish and Wildlife Service (USFWS) and the state fish and wildlife agency, in this case, Arizona Game and Fish Department (AZGFD). Signatures on the document reflect the mutual agreement of all parties. Other external stakeholders include neighboring private landowners, the Coconino National Forest, Coconino County, and the city of Flagstaff.

1.5 Authority

The Sikes Act (as amended) is the authority under which this INRMP is produced. It stipulates that this INRMP provides for:

- conservation and restoration of natural resources;
- sustainable, multipurpose use of resources;
- public access to facilitate their use, subject to safety requirements and military security;
- specific natural resources goals and objectives, and time frames for acting on them;
- fish and wildlife management, land management, and forest management;
- fish and wildlife habitat enhancement or modifications;
- wetlands protection, enhancement, and restoration, where necessary for support of fish, wildlife, or plants;
- integration of and consistency among various activities conducted under the INRMP;
- enforcement of natural resources laws and regulations;
- no net loss in the capability of the military installation lands to support the military mission of the installation; and
- such other activities as the Secretary of the Navy (SECNAV) determines appropriate.

1.6 Stewardship and Compliance

For the purposes of this INRMP, the terms *compliance* and *stewardship* have specific meanings as criteria for implementing project lists. Overall project or activity rankings are aligned with OPNAV N45 Environmental Readiness Levels (ERLs) to ensure the installation's highest priorities are promoted in future budget cycles. The highest priority ERL4 is assigned to projects or activities based compliance with legal requirements, such as under the Endangered Species Act (ESA), Clean Water Act (CWA), or Migratory Bird Treaty Act (MBTA). Alternatively, a project or activity may be considered good land stewardship but is not considered a legal obligation, and this investment may yield only undefined future benefits. High priority compliance projects to comply with legal obligations are generally funded within annual budget constraints, but future federal budgets could decrease available funding for both compliance and lower ranked stewardship projects. Annual funding for all conservation projects are ranked on a regional basis and each project must compete for available funds among multiple Navy installations. It's the Navy's policy to promote long term mission and environmental sustainability measures, including good stewardship practices, and all valid compliance and stewardship requirements are submitted for consideration during budget programming cycles.

The budgeting plan for the INRMP is based on programming and budgeting priorities for conservation programs described in DoDINST 4715.03. Funds will be requested for tasks within the INRMP, with priority given to Class I, II, and III projects, in that order, based on this guidance. The DoDINST 4715.03 defines four classes of conservation programs; *compliance* activities fall into the first three classes and *stewardship* activities fall into the fourth class. Accordingly, the projects recommended in this INRMP have been prioritized based on compliance and stewardship criteria. Funding at the level of the installation is routinely programmed every two-three years in advance of project implementation.

Compliance

1. *DoD Class 0: Recurring Natural and Cultural Resources Conservation Management Requirements.* These are activities needed to cover the recurring administrative, personnel, and other costs associated with managing DoD's conservation program that are necessary to meet compliance requirements (federal and state laws, regulations, Executive Orders [EOs], and DoD policies) or that are in direct support of the military mission. Also included are environmental management activities associated with the operation of facilities, installations, and deployed weapons systems.
2. *DoD Class I: Current Compliance.* These projects and activities are needed because an installation is currently out of compliance (has received an enforcement action from a duly authorized federal or state agency, or local authority); has a signed compliance agreement or has received a consent order; has not met requirements based on applicable federal or state laws, regulations, standards, Presidential EOs, or DoD policies; and/or are immediate and essential to maintain operational integrity or sustain readiness of the military mission. This also includes projects and activities needed that are not currently out of compliance (deadlines or requirements have been established by applicable laws, regulations, standards, EOs, or DoD policies, but deadlines have not passed or requirements are not in force) but shall be if projects or activities are not implemented in the current program year.
3. *DoD Class II: Maintenance Requirements.* These are projects and activities needed that are not currently out of compliance (deadlines or requirements have been established by applicable laws, regulations and standards, EOs, or DoD policies, but deadlines have not passed or requirements are not in force), but shall be out of compliance if projects or activities are not implemented in time to meet an established deadline beyond the current program year.

Stewardship

4. *DoD Class III: Enhancement Actions, Beyond Compliance.* These are projects and activities that enhance conservation resources or the integrity of the installation mission, or are needed to address overall environmental goals and objectives, but are not specifically required under regulation or EO and are not of an immediate nature.

Navy policy requires funding of all DoD Class 0 and Class I projects. The Navy funding programming hierarchy of recurring and non-recurring projects consists of four ERLs (DoN INRMP Guidance for Navy Installations, April 2006):

Environmental Readiness Level 4:

- Supports all actions specifically required by law, regulation or EO (DOD Class 0, I, and II requirements) just in time.
- Supports all DoD Class 0 requirements as they relate to a specific statute such as hazardous waste disposal, permits, fees, monitoring, sampling and analysis, reporting and record keeping.
- Supports recurring administrative, personnel and other costs associated with managing environmental programs that are necessary to meet applicable compliance requirements (DoD Class 0).
- Supports DoD policy requirement to comply with overseas Final Governing Standards and Overseas Environmental Baseline Guidance Document.
- Supports minimum feasible Navy executive agent responsibilities, participation in OSD sponsored inter-department and inter-agency efforts, and OSD mandated regional coordination efforts.

Environmental Readiness Level 3:

- Supports all capabilities provided by ERL 4.
- Supports existing level of Navy executive agent responsibilities, participation in OSD sponsored inter-department and inter-agency efforts, and OSD mandated regional coordination efforts.

- Supports proactive involvement in the legislative and regulatory process to identity and mitigate requirements that will impose excessive costs or restrictions on operations and training.
- Supports proactive initiatives critical to the protection of Navy operational readiness.

Environmental Readiness Level 2:

- Supports all capabilities provided under ERL 3.
- Supports enhanced proactive initiatives critical to the protection of Navy operational readiness.
- Supports all Navy and DoD policy requirements.
- Supports investments in pollution reduction, compliance enhancement, energy conservation and cost reduction.

Environmental Readiness Level 1:

- Supports all capabilities provided under ERL 2.
- Supports proactive actions required to ensure compliance with pending/strong anticipated laws and regulations in a timely manner and/or to prevent adverse impact to Navy mission.
- Supports investments that demonstrate Navy environmental leadership and proactive environmental stewardship.

1.7 Review and Revision Process

Department of Defense policy requires installations to review INRMPs annually in cooperation with two primary parties to the INRMP (USFWS and the state fish and wildlife agency). Annual reviews facilitate adaptive management by providing an opportunity for the parties to review the goals and objectives of the plan, as well as establish a realistic schedule for undertaking proposed actions. As this plan is considered a long term document with no set expiration date, the annual review process allows a yearly opportunity for updating the plan when necessary.

Section 101(b)(2) of the Sikes Act (as amended) specifically directs that the INRMPs be reviewed as “to operation and effect” by the primary parties “on a regular basis, but not less often than every five years”, emphasizing that the review is intended to determine whether existing INRMPs are being implemented to meet the requirements of the Sikes Act (as amended) and contribute to the conservation and rehabilitation of natural resources on military installations. The OSD guidance (17 May 2005) states that joint review should be reflected in a memo or letters.

Recent guidance on INRMP implementation interpreted that the five-year review would not necessarily constitute a revision, that this would occur only if deemed necessary. The Annual Review process is conducted every year during the Annual Natural Resources Metrics Meeting and is broadly guided by the DoD Environmental Conservation Program (DoDINST 4715.03) and by OPNAVINST 5090.1C CH-1. The following policy memoranda clarified procedures for INRMP reviews and revisions:

- Deputy Undersecretary of Defense for Installations and the Environment (DUSD[I&E]) Policy Memorandum of 10 October 2002, which replaced a 1998 policy memorandum.
- Assistant Deputy Undersecretary of Defense (ADUSD) for Environment, Safety and Occupational Health (ESOH) Policy (01 November 2004 Memorandum).
- ADUSD for ESOH Policy (September 2005 Memorandum).

The INRMP Implementation Guidance (10 October 2002 Memorandum) improved coordination external to DoD (USFWS, state agencies, and the public) and internal to DoD (military operators and trainers, cultural resources managers, pest managers). It also added new tracking procedures, called metrics, to ensure proper INRMP coordination occurred and that projects were implemented.

The Supplemental DoD INRMP Guidance (01 November 2004 Memorandum) further defined the scope of the annual and five-year review, public comment on INRMP reviews, and ESA consultation. A formal review must be performed by "the parties" at least every five years. Informal annual reviews are mandatory to facilitate adaptive management, during which INRMP goals, objectives, and "must fund" projects are reviewed, and a realistic schedule established to undertake proposed actions. The outcome of this joint review should be documented in a memorandum or letter summarizing the rationale for the conclusions the parties have reached. This written documentation should be jointly executed or in some other way reflect the parties' mutual agreement.

The Supplemental DoD INRMP Guidance (September 2005) stated that all INRMPs must address resource management on all of the lands for which the subject installation has real property accountability, including lands occupied by tenants or lessees or being used by others pursuant to a permit, license, right of way, or any other form of permission. Per this memo, installation commanders may require tenants, lessees, permittees, and other parties that request permission to occupy or use installation property to accept responsibility, as a condition of their occupancy or use, for performing appropriate natural resource management actions. This does not, however, obviate the need to address natural resource management on any such lands in the INRMP.

Public Comment on INRMP Reviews Legislative Language Section 2905 of the Sikes Act (as amended) required the Secretary of each Military Department to provide the public an opportunity for the submission of comments on the initial INRMPs prepared pursuant to new Section 101(a)(2) of Sikes Act (as amended). The Environmental Readiness Program Manual (OPNAVINST 5090.1C CH-1) also requires that the public have the opportunity to comment on initial INRMPs.

An INRMP is a public document that requires the mutual agreement of the installation, USFWS, and state fish and wildlife agencies; therefore, it is crucial that a common understanding be reached regarding which projects contained in a draft INRMP are most likely to be funded under existing policy. The installation shall provide the public with a meaningful opportunity to review and comment upon the initial draft INRMP and initial draft INRMP revision (other than minor technical amendments). Concerning the length of public review, barring extraordinary circumstances, the public should be afforded a minimum of 30 days to review and comment (CNO Guidance April 2006).

Section 2905(d) (1) of the Sikes Act (as amended) (10 USC 671a) requires each military department to provide an opportunity for the submission of comments on the initial INRMP prepared pursuant to new section 101 (a) (2) of the Sikes Act (as amended). There is no legal obligation to invite the public to either review or to comment upon the parties mutually agreed upon decision to continue implementation of an existing INRMP without revision.

If the parties determine that revisions to an INRMP are necessary, public comment shall be invited in conjunction with any required National Environmental Policy Act (NEPA) analysis (OPNAVINST 5090.1C CH-1). If limited revisions are thought to be required, and these revisions are not expected to result in biophysical consequences materially different from those anticipated in the existing INRMP and analyzed in an existing NEPA document, then neither additional NEPA analysis nor an opportunity for public comment should be necessary. If more substantial revisions to an INRMP are thought to be required, and those revisions are expected to result in biophysical consequences materially different from those anticipated in the existing INRMP and analyzed in an existing NEPA document, then a new or supplemental NEPA analysis must be prepared and the public provided a reasonable opportunity to comment on the revised INRMP.

1.8 Management Strategy

Department of Defense and Navy Instructions mandate an ecosystem framework and approach for the INRMP (DoDINST 4715.03 and OPNAVINST 5090.1C CH-1). Ecosystem management in DoD draws on a long-term vision of integrating ecological, economic and social factors. This approach shall take a long-term view of human activities, including military uses, and biological resources as part of the same environment. The goal is to preserve and enhance ecosystem integrity, and to sustain both biological diversity and continued availability of those resources for military readiness and sustainability and other human uses (as defined in OPNAVINST 5090.1C CH-1). Managing for sustainability and ecosystem management are both approaches that attempt to integrate long-term goals with short-term project lists.

The ecosystem mandate is accomplished by applying principles of sustainable use at several scales–emphasis on partnerships, public outreach, long-term monitoring, and adaptive management. Consistent with Navy policy, ecosystem-based management shall include (OPNAVINST 5090.1C CH-1):

- A shift from single species to multiple species conservation.
- Formation of partnerships necessary to consider and manage ecosystems that cross boundaries.
- Use of the best available scientific information and adaptive management techniques.

An Adaptive Management approach is also a separate requirement for INRMPs under (DoD 4715.03), when it states: "Incorporate a dynamic, continuous process for decision-making, including future changes or additions to the INRMP."

Cooperative management of NOFS's wildlife is required under the Sikes Act (as amended) and the Fish and Wildlife Coordination Act. Installations are encouraged to work with other organizations, agencies, and individuals both on and off the installation throughout the planning process (OPNAVINST 5090.1C CH-1). Like NEPA, the Fish and Wildlife Coordination Act is essentially procedural as no specific outcome is mandated.

1.9 Integration With Other Plans

This INRMP is fully integrated with the comprehensive planning of the USNO, the NOFS Master Plan (1985), and all other installation planning processes, including NEPA documents and biological assessments. To be comprehensive, all of the existing planning-related documents should become integrated. Department of Defense policy seeks to ensure that current and planned installation activities (e.g. site development plans, construction requests, site approval requests, host-tenant agreements, and outleases) are effectively coordinated and consistent with activities described in this INRMP.

Designed to facilitate compliance with natural resources protection laws, this INRMP integrates the military mission and natural resources components of all NOFS plans, and meets the requirements of the Sikes Act (as amended) and all applicable DoD, DoN, and NOFS plans.

An Encroachment Action Plan (see Section 3.6: Encroachment Partnering) for NOFS was completed in 2008. It is a strategic plan which guides the military in protecting the local mission and ensuring compatible development with surrounding jurisdictions and agencies.

The Navy and NOFS intend to implement recommendations in this INRMP within the framework of regulatory compliance, national Navy mission obligations, anti-terrorism and force protection limitations, and funding constraints. Any requirement for the obligation of funds for projects in this INRMP shall be subject to the availability of funds appropriated by Congress, and none of the proposed projects shall be interpreted to require obligation or payment of funds in violation of any applicable federal law, including the Anti-Deficiency Act, 31 USC § 1341, et seq.

2.0 Current Conditions and Use

2.1 Property Description

2.1.1 Locations

The NOFS property, which consists of 287 acres, is situated in the mountainous region of Coconino County, five miles west of the city of Flagstaff, and approximately 140 miles north of the city of Phoenix. It lies within a vast forest matrix of National Forest System (Coconino National Forest) and other federal, state, and private lands.

2.1.2 Regional Land Use

Naval Observatory Flagstaff Station is bordered by national forest, Arizona State Trust, and private lands. The primary land use in the region is timber harvest, recreational tourism, and urban development. Seasonal livestock grazing is also widespread on public lands of the area.

Terrestrial Anthropogenic Change

The ponderosa pine (*Pinus ponderosa*) forests of Arizona and New Mexico provided a source of food, building materials, and other resources for the Native Americans that once inhabited the entire region (Latta et al. 1999). The ecoregion began to experience large changes in its ecological character during the period of Euro-American colonization. Prior to 1848, few Europeans inhabited the area (Latta et al. 1999). After the civil war, domestic livestock production became the dominant industry (Latta et al. 1999). Subsequently, railroads allowed for the exploitation of timber on a massive scale, with logging activities flourishing during the 1870s and 1880s (AZGFD 2006). Ponderosa pine was the primary target of these efforts, supplying many of the timbers required for the construction of the transcontinental railroad, mining operations, and buildings (AZGFD 2006).

Anthropogenic alterations in the historical fire regime resulted in one of the most significant changes to the ponderosa pine forest ecosystem. In xerophytic forests, frequent low intensity fires (every 2-12 years) were part of the evolutionary history. These fires burned through the grasses in the understory, leaving the crowns of the forest untouched, and leaving an open canopy structure with patchy tree distribution (White 1985; Cooper 1961; Covington and Moore 1994, as cited in Moir et al. 1997). This fire regime reduced ground fuels, thinned smaller diameter trees, and invigorated the understory.

Years of fire suppression policies, logging of big timbers, and over-grazing have contributed to creation of dense, young to middle-aged stands throughout the forest (Latta et al. 1999). Large forested areas exhibiting these characteristics are especially prone to insect infestation and high severity fire (Latta et al. 1999). In spite of significant declines in logging during the 1990s, concerns over high fuel loads and bark beetle (*Dendrotonus* sp.) infestation have renewed interest in region-wide thinning (removing the number of stems/acre) for forest health (AZGFD 2006). Recent silvicultural treatments at NOFS are very much in step with this trend.

As the ecoregion's population has increased, there has been a concomitant demand for recreational opportunities. Recreational activities such as hiking, fishing, and off-highway vehicle use, are beginning to surge. Additionally, rural housing developments are becoming more popular; the partial development of Dry Lake, just several miles southeast of NOFS is an illustrative example. The AZGFD (2006) notes that a majority of the ecoregion's land is within public ownership, allowing for large-scale natural resources protection given effective partnering and planning amongst federal, tribal, and state landowners. A majority of the coniferous forests within the ecoregion are on federal land, including the Coconino National Forest that flanks the NOFS property.

2.1.3 History and Pre-Military Land Use

2.1.3.1 Pre-Military Use

Prior to the property being acquired by the military, the site was owned by the state of Arizona. The property is situated within the Mogollon Rim formation, a majority of which consists of steep slopes covered in ponderosa pine forest, that at one time had measured 300 miles long and 24 to 40 miles wide (Ashworth 1991). In 1878 the first land surveyor, John Harris, Deputy Surveyor of the U.S. Geological Survey (USGS) examined the land in the Flagstaff area. In his report, Harris noted that the area was not conducive to farming, and historically, the Flagstaff area became known for sheep herding and ranching. Both sun and shaded areas of the forest were filled with high-growing grasses used by deer and antelope as a food staple. When ranchers used it for cattle, the thin soil could not support the heavy grazing (Ashworth 1991), and native grasses did not return to their previous abundance.

- **Sheepherders, cattle companies, logging locomotives and the Division of Forestry were working simultaneously in the Flagstaff area in the late 1800s.**

There were four interests involved at once in the Flagstaff area in the late 1800s. These were sheep herders, cattle companies, logging locomotives (Arizona Lumber and Timber [AL&T]), and the Division of Forestry, under the U.S. Department of Agriculture (USDA). The sheepherders held allotments according to prior use, cattle companies held land titles, AL&T held lease agreements, and eventually the USFS used the top of nearby Woody Mountain as a lookout site.

In order to aid in cooperation of all interests, in 1905, foresters serving under President Roosevelt began to create a “system of controlled grazing that would work” for the national forests (Ashworth 1991). They established permits which required fees to control, not prohibit, grazing. However, in the Flagstaff area, the land had already been extensively used for sheep and cattle grazing.

- **By 1904, loggers had clear-cut around Flagstaff for 25 years. Studies on the reproduction of trees were initiated at Forest Experiment Stations in 1908, of which Flagstaff was the first.**

In 1904, a survey of forest conditions by the USGS had established that before logging, the average age of pines in Woody Mountain had been 190 years. At the time of that survey, loggers had clear-cut around Flagstaff for twenty-five years (Ashworth 1991). There were few restrictions on logging until 1904, when the federal government became involved in a signed agreement with AL&T. By that time, most of the trees on Woody Mountain were cut and removed. In 1908, Forest Experiment Stations were established to study forest ecology and the first one was set in the ponderosa pine forest nine miles north of Woody Mountain. Forest planting, and studies into the failure of trees to reproduce, began.

In the 1930s, due to the cancellation of lumber and timber contracts, AL&T was no longer able to maintain the logging railroad or operate trains. Rails were removed and ranchers used sections for cattle guards. Roads replaced the railroad tracks. The depression also hit the cattle companies and the herds were down to nearly nothing. The remaining sheep were kept moving in an effort to prevent over-grazing in the area.

By the early 1950s most old growth trees were harvested in the Flagstaff area. It is assumed that this was when the property was last commercially harvested.

2.1.3.2 Historic Military Use

Naval Observatory Flagstaff Station was originally established on 14 October 1955, because its remoteness provided the key combination of high-altitude, dark sky without urban light interference, and a comparatively pollution-free atmosphere. The USNO in Washington D.C. had become severely limited due to the level of pollutants and light in the atmosphere.

The Flagstaff area was relatively undeveloped during the 1950s. Limited water resources seemed to guarantee slow growth at the time. The forty-inch telescope was installed in 1954. After leasing the land for the first few years, 160 acres were withdrawn from the State in 1957 (Refer to Table 1-1). A 61-inch telescope was added in 1964 and a 24-inch telescope was added in 1971. The same year an additional 40 acres, adjacent to the northeast boundary, was purchased to prevent development close to the facility that would lighten the dark sky. Another 87 acres were purchased in 1988 for the same reasons, near Interstate 40 (I-40) in the north half of Section 22. The total area remains at 287 acres.

- **In 1954 a forty-inch telescope was installed at NOFS. A sixty-one inch telescope was added in 1964, and a twenty-four inch telecope in 19 71.**

2.1.4 Military Mission

The NOFS functions as an observing station of USNO. It provides local administration and logistic support to the Flagstaff Astrometric Detachment. The Flagstaff Astrometric Detachment's mission is to make, analyze, and interpret such astrometric and photometric dark sky observations as are required to fulfill the mission of USNO; to conduct a research program to improve the observational methods and the accuracy of astronomical data required by the Navy and other components of the DoD; and to perform such other functions or tasks as may be directed by higher authority.

2.1.5 Operations and Activities

The facilities at NOFS support the investigation of astronomy equipment, satellite research, development of navigational and community programs, and research and development in the fields of astrometric physics, radar and meteor astronomy, solar spectroscopy, and upper air physics. The current facilities at NOFS include six buildings, parking lots, potable water tanks, supporting utilities, a security fence, and access road. These occupy about two acres of NOFS, less than one percent of the total acreage.

Paved roads access the main facility and two smaller developed sites to the east and west (Map 2-2) that are situated in a fenced compound. These roads are scheduled for occasional routine repairs, generally between May and September. Unpaved roads are infrequently maintained and some are badly rutted. Naval Observatory Flagstaff Station has little incentive to repair these roads as the surrounding forest is used for no other purpose than a light and pollution buffer.

An overhead utility line links the three sites. Communication among the sites is facilitated by laser beam transmissions. Water is not available locally and is trucked in and stored in four storage tanks at two of the buildings. In each case one tank is for domestic supply and the other is for fire protection.

Due to the site's high elevation, winter temperatures are often below freezing, and construction and maintenance may be limited to the 120-day frost-free season.

U.S. Naval Observatory maintains a research partnership with the Lowell Observatory, and as a key component of this partnership has built a NPOI on nearby Anderson Mesa. The NPOI uses a series of small mirrors rather than one large one, thereby improving the resolution of images through the telescope. The interferometer is expected to be important to new astronomical discoveries by increasing accuracy of star positioning and global positioning by a factor of 100.

Naval Observatory Flagstaff Station confines its activities and construction to within a 38-acre Operations Area, as shown on Map 1-3. This provides opportunities for management of the remaining property for forest health, safe fuel loads, and wildlife habitat. The needs of NOFS are not likely to extend beyond the proposed Operations Area for several reasons, including:

- Light pollution from Flagstaff and vicinity;
- Few peaks on which to put a telescope;
- Lack of water and high cost of developing other utility corridors;
- Additional environmental heat and light contribution of any structure, which affects astronomic viewing conditions;
- Budget constraints; and
- Lack of developable sites outside the Operations Area.

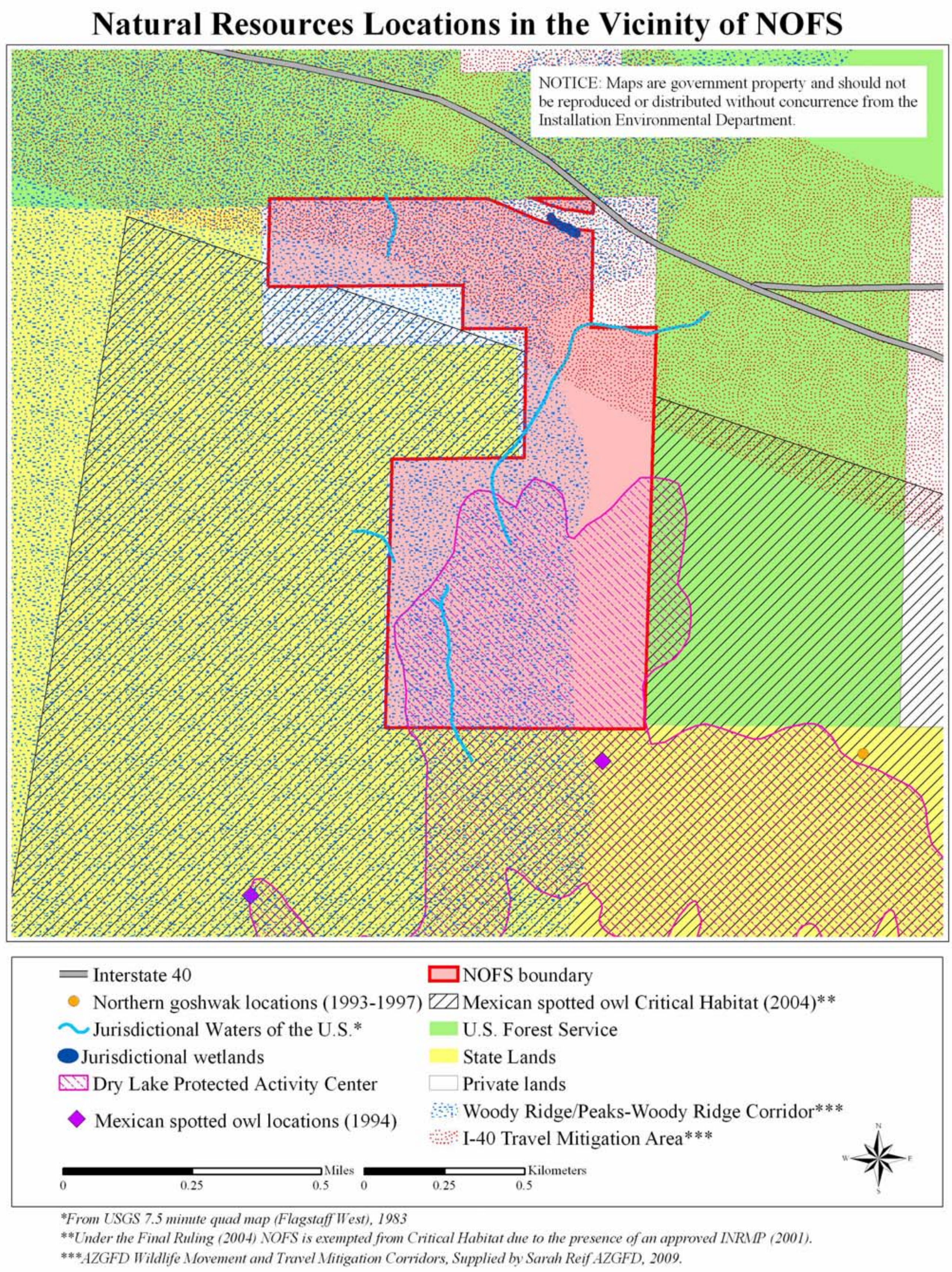
Routine and emergency maintenance is ongoing as needed, occurs completely within the Operations Area, and includes:

- Road maintenance, including road repairs using typical hot asphalt equipment and cold patching and removal of trees and tree parts encroaching on the road.
- Snow plowing, which is conducted by the County in return for using the NOFS turnaround area. Black cinder is usually dropped for traction and no salt or chemical melting is used.
- Building maintenance and repair including, but not limited to, painting and cement patching.
- Minor erosion control around structures.
- Utility corridor maintenance including tree trimming.
- Trimming branches, topping, or removal of trees that obstruct the telescopes or interfere with the laser path between buildings.

2.1.6 Natural Resources Constraints Map

Map 2-1 shows the locations of mapped natural resources within NOFS and the immediate vicinity. The property contains a small area of jurisdictional wetlands and several stream segments that are classified as jurisdictional waters of the U.S. (see Section 2.2.5 Hydrology, Watersheds, and Waters/Wetlands of the United States; Tierra Data Inc. 2004). National Forest lands border the property to the north and east, while state of Arizona lands lie to the south and west.

The southern portion of the property lies within a Dry Lake Protected Activity Center (PAC) for the Mexican spotted owl (*Strix occidentalis lucida*). The Mexican Spotted Owl Recovery Plan (USFWS 1995b) recommends designating PACs at known owl locations. Critical habitat for the Mexican spotted owl lies outside of the property boundary to the south, east, and west, although NOFS lands were excluded from designation in the final critical habitat rule (USFWS 2004; see Section 2.3.2.1: Threatened and Endangered Wildlife Species).



Map 2-1. Natural resources locations at Naval Observatory Flagstaff Station and vicinity.

2.1.7 Opportunities Map

The DoD guidance for INRMPs requires provision of an "Opportunities" map showing potential buffer areas and corridors that meet an installation's mission requirements and could function as an encroachment buffer with non-DoD partners in some form of real estate agreement.

Map 2-2 depicts NOFS and the surrounding area. NOFS is bordered by National Forest lands to the north and east, and by state of Arizona lands to the south and west, with some privately owned lands as well. Note the proximity of the city of Flagstaff, representing a light pollution concern. Refer to Section 3.6: Encroachment Partnering for a detailed treatment of the encroachment threats and opportunities. Refer to Appendix B for a description of Coconino County Parks and Recreation Program projects.

2.2 General Physical Environment and Ecosystems

2.2.1 Climate and Weather

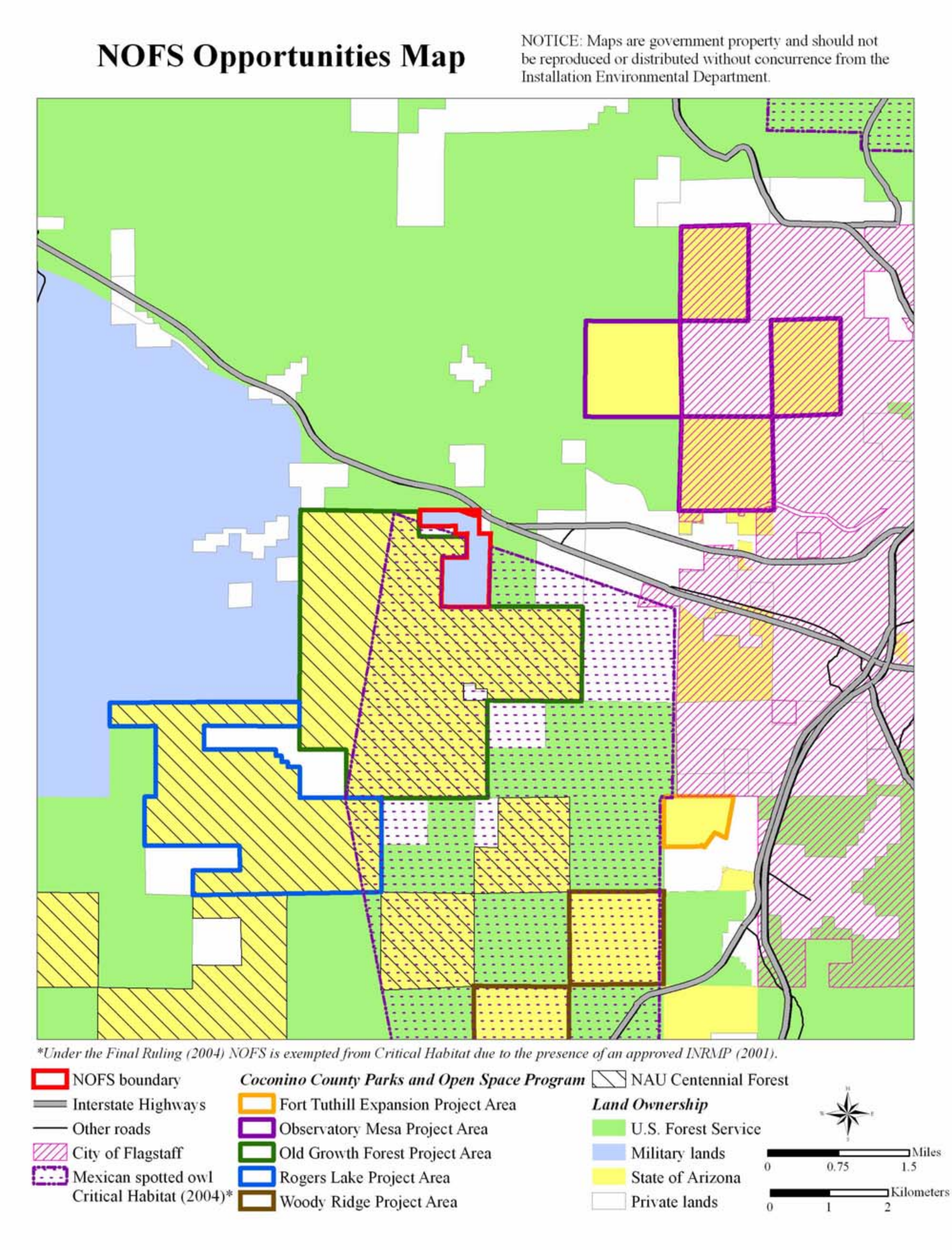
Due to the location of Flagstaff at an elevation of roughly 7,000 feet, in between Mount Humphreys, the highest point in Arizona at 12,000 feet, and Verde Valley with elevations close to 3,000 feet, the weather can be adequately described as both erratic and extreme. For example, spring may span the months of January to June (the average date of the last spring freeze is June 8) yet only a few days within those months may display typical spring weather. There is a wide variation between the high and low temperatures in Flagstaff (Refer to Table 2-1). As altitude increases, temperature normally decreases. However, at night, heat is rapidly released from the earth, which cools the ground and creates a cold layer of air at a lower elevation. This forms an inversion where temperature actually increases with altitude (Meyers 1993). This process is strongest in winter due to solar reflection off snow during the day, which keeps the ground from absorbing heat. Therefore, at night heat is lost at a faster rate then it is gained.

Table 2-1. Average monthly climatic variables for Flagstaff, Arizona (WRCC website 2012).

Variable[a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg Max Temp (F)	42.9	44.5	51.8	57.5	69.6	78.8	82.2	78.6	73.1	62.4	52.1	43.4	61.4
Avg Min Temp (F)	17.4	19.1	23.1	27.8	35	41.9	51.5	50.3	42.1	31.1	23.1	16.7	31.6
Average Monthly Precipitation (inches)	1.64	1.54	1.37	1.07	0.45	0.3	2.57	2.73	2.41	1.58	1.18	1.56	18.38

a. Period of Record: Jul 1996 to Dec 2008.

Unlike inversion, humidity in Flagstaff follows a very regular pattern and is considered inversely proportional to temperature. So, when temperature is lowest at dawn, humidity is highest. The average annual humidity at Flagstaff is 53 percent, which rises slightly in the winter months, but then plunges dramatically in May and June (Meyers 1993). April marks a type of transition to the extremely arid months of May and June in which summer thunderstorms frequently surprise visitors and locals alike with quick relief and occasionally an inch of rain in an hour and pea-sized hail. The moisture for such storms comes from the southeast, but surface heating of the land is what may trigger the storm. There is warm, moist, and unstable air at the beginning of July due to the counterclockwise airflow around the Bermuda High as it expands westward. The monsoon season begins in May and ends in September, while Flagstaff's Indian Summer may extend into November. Every five to seven years, a Pacific hurricane or tropical storm affects Arizona causing flooding from continual days of rain.



Map 2-2. Opportunities map. Operations areas and facilities at Naval Observatory Flagstaff Station.

Winter unofficially begins in October, when cold fronts pass over Arizona causing shifts in wind direction and an arrival of colder air. Annual precipitation in the Flagstaff area averages 21.5 inches/year. Winter storms continue into May with heavy storms occurring mainly from mid-November to mid-April. This precipitation occurs when moisture-laden air of a Pacific storm is forced upslope, where it cools and condenses into rain, snow, or fog with roughly half of the annual precipitation occurring as snow (Meyers 1993). However, there may be periods of dryness if the storms move north or if a high pressure system develops in the Great Basin.

Regional Climate Change

The Environmental Protection Agency (EPA) estimates average temperatures across Arizona may rise 5 degrees Fahrenheit (F) by 2100 as global warming continues. This warming is anticipated to intensify fluctuations in precipitation across the southwestern region, to create heavier rainfall and flooding events in winter, as well as to exacerbate drought conditions and wildfires in summer. Global warming will most likely bring less snow to NOFS and surrounding environs, reducing summer flows into downstream watercourses.

Climate change will pose challenges and necessitate flexibility for forest management. Historical and recent studies of fire and forest die-off show increases in temperature positively affect insect infestation rates and fire frequency (Breshears et al. 2005; Swetnam and Baisan 2003). Climatic warming will also have effects on invasive species, forest stand timber yield, stocking and density. As temperature and evaporation rates increase, forests maintained in less dense conditions will likely be more resistant to both insects and fire than those with higher density conditions. The recently completed thinning (2001-2009) of ponderosa pine stands at NOFS should improve stand resiliency and crown fire resistance under an elevated temperature milieu.

2.2.2 Ecosystem Context

Naval Observatory Flagstaff Station occurs within the biogeographical unit known as the Arizona–New Mexico Mountains Ecoregion (AZGFD 2006).[1] Covering an area of 6 million acres, this ecoregion extends across central Arizona, and eastward into New Mexico, and into a small portion of western Texas (Refer to Map 2-3). Annual precipitation ranges from 11 to 30 inches, with winter snows and summer monsoons feeding important river systems such as the Little Colorado, the Gila, the Mimbres, the Verde, and numerous man-made impoundments (AZGFD 2006). Conifer dominated communities account for over half the region's vegetative cover, with high elevation tundra and Great Basin grassland/desert scrub dominating its elevational extremes, 12,643 feet and 4,000 feet respectively (AZGFD 2006).

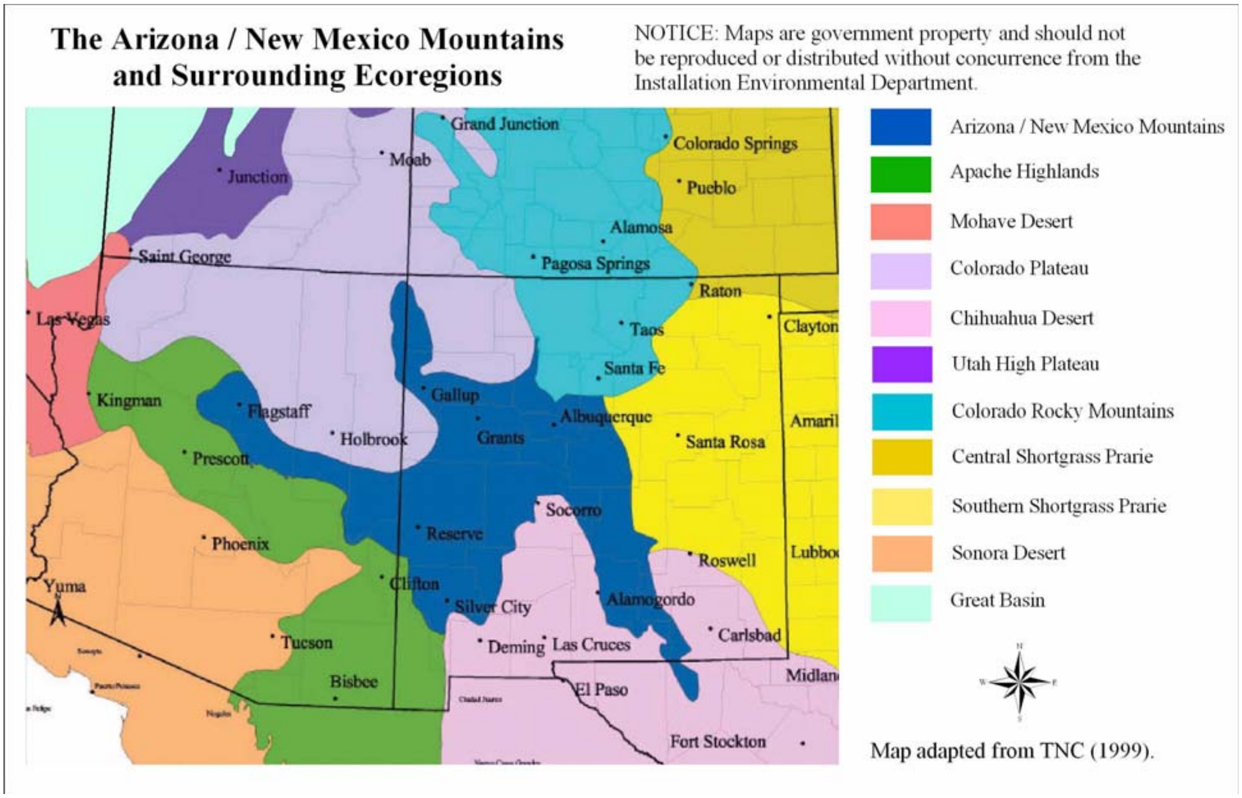
The NOFS is located in the western arm of the Arizona–New Mexico Mountains ecoregion, within the largest contiguous stand of ponderosa pine in the world. Skirting the southern rim of the Colorado Plateau and north of the Mogollon Rim, this nearly 300-mile strip of unbroken forest (25–40 miles wide) ranges in elevation from 6,500 feet to 8,500 feet (Cooper 1960, as cited in Latta et al. 1999).

While ponderosa pine is the dominant species throughout this forested zone, community composition varies with respect to biophysical variables including but not limited to elevation, soils, rainfall, fire regime, and successional stage. Elevational changes confer general trends in species composition within ponderosa pine dominated forests. At high elevations associated trees are: white fir (*Abies concolor* var. *concolor*); Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* ssp. *glauca*); blue spruce (*Picea pungens*); quaking aspen (*Populus tremuloides*); Gambel oak (*Quercus gambelii*); and

1. **The 'ecoregion' is the Arizona Game and Fish Department's unit of conservation focus, and is more or less delineated as a contiguous area united by common biophysical parameters. The AZGFD has adopted these units for conservation planning from The Nature Conservancy's Ecoregional Conservation approach (TNC 1999), which in turn adapted them from work by Bailey et. al. (1994) of the USFS.**

southwestern white pine (*Pinus strobiformis*) (Burns and Honkala 1990). At lower elevations associated trees are; Rocky Mountain juniper (*Juniperus scopulorum*), alligator juniper (*J. deppeana*), and Utah juniper (*J. osteosperma*) (Burns and Honkala 1990). In the mid-elevation ponderosa pine forests at NOFS (7,575 feet at its highest) Gambel oak is the second most important large tree component.

There exists some debate regarding the characterization of the 'natural' forest stand structure of the region. Research identifies ponderosa pine forests as being made up of many small and evenly-aged groups (Burns and Honkala 1990). However more recent research indicates that the pre-European stand structure of old growth ponderosa pine forests was a true unevenly aged, and unevenly sized, structure (Long and Smith 2000; Mast et al. 1999).



Map 2-3. The Arizona/New Mexico Mountains Ecoregion (adapted from The Nature Conservancy 1999).

This ecoregion contains more avian and mammal species than any other place in the Southwest (The Nature Conservancy [TNC] 1999). Conservative estimates identify more than 110 species of mammals, 210 species of breeding birds, 67 species of reptiles, 19 species of amphibians, and 20 species of fish (TNC 1999). The region is also home to over 200 species of plants, 30 of them classified as rare or endangered by federal or state governments (TNC 1999).

Locally, the vicinity of NOFS presents valuable habitat for a broad range of species, including several sensitive species, notably the federally threatened Mexican spotted owl. The recently delisted bald eagle (*Haliaeetus leucocephalus*) is known to use the Rogers Lake area and other adjacent lands to NOFS for winter foraging and roosting activities (S. Hedwall, *pers. comm.*). In addition to sensitive species, geographic features such as Woody Ridge to the south of NOFS provides connectivity to the Mogollon Rim, an important natural corridor for a variety of wildlife, such as pronghorn (*Antilocapra americana*), black bear (*Ursus americanus*), and wild turkey (*Meleagris gallopavo*). See Appendix D for a list of species found during wildlife surveys conducted on NOFS before the development of this INRMP.

2.2.3 Topography

The NOFS property is mostly hilly, with various telescopes perched atop the highest ridge. Elevation ranges from a low of 7,305 feet above sea level to a high of 7,575 feet at Building 1. The hills have relatively steep sides with slopes generally ranging from 20 percent to over 40 percent (Map 2-4), which restricts future development to the tops of the knolls or the ridgelines between the knolls.

2.2.4 Geology and Soils

The Four Corners area, where Utah, Colorado, New Mexico, and Arizona come together, was once a broad coastal area where sediments deposited for millions of years. These sediments extended hundreds of miles and rarely varied more than a few dozen feet above or below sea level. Today that ancient rock record stands at 5,000–6,000 feet above sea level, as part of a geographic province known as the Colorado Plateau. The Colorado Plateau extends from northern Arizona through northwest New Mexico and western Colorado up through Utah to the Wyoming border.

Between 70 million and 30 million years ago, an area of light, partially molten rock 100 miles deep within the earth's mantle elevated a 130,000 square mile block of earth's crust up 3,500 to 4,500 feet. As what would become known as the Colorado Plateau rose in elevation, the processes of erosion stripped away and shaped layers of sediment to produce what we see today (Jackson 1999).

The Mogollon Rim, a broad expanse of nearly horizontal strata, is just 24 miles south of Flagstaff and comprises the southern edge of the Colorado Plateau. There is nearly a vertical mile of difference between the seared deserts of central Arizona and the forested highlands of Flagstaff and the surrounding San Francisco mountains (Jackson 1999).

Large eruptions within the San Francisco volcanic field began about five million years ago about thirty miles west of Flagstaff. The Colorado Plateau had already uplifted and Kaibab and Moenkopi sedimentary layers were exposed. Over thousands of millennia, nearby eruptions created hundreds of lava domes, cinder cones, and lava flows giving northern Arizona its mountainous terrain. This volcanic field stretches for about fifty miles from east to west and thirty one miles north to south. Flagstaff lies on the southern margin of this lava field (Jackson 1999).

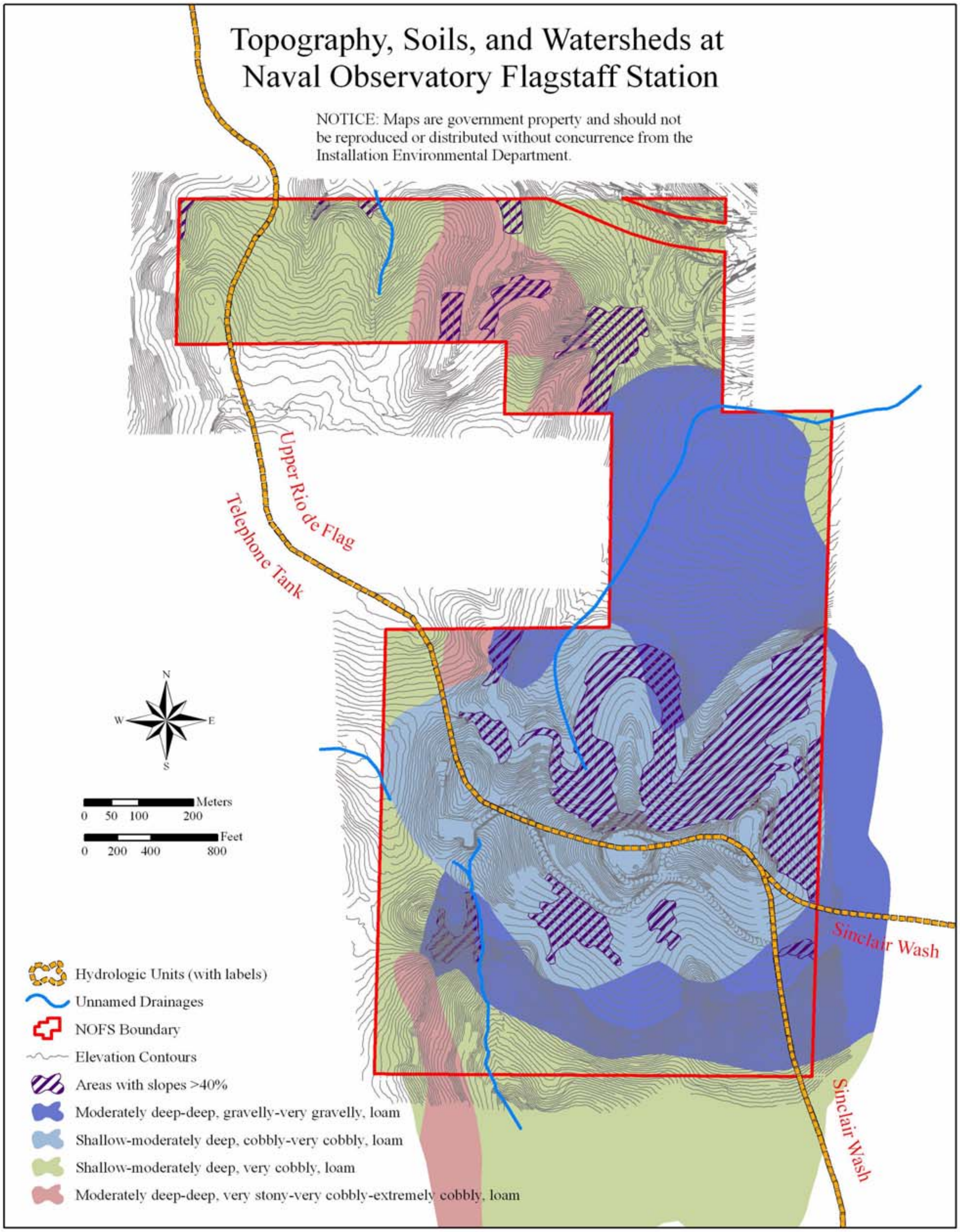
Many of the eruptions that formed the present landscape of Flagstaff were created from about 600,000 to 300,000 years ago. Some geologists have hypothesized that the eastern summit of the San Francisco stratovolcano (called "the Peaks") collapsed about 500,000 years ago, leaving behind the inner basin and a rim of peaks that dominate the skyline of Flagstaff (Jackson 1999).

NOFS is located on a dacite lava flow associated with San Francisco Mountain. Dacite flows more slowly than other molten rocks of basaltic or andesitic origin due to a higher silica content. Its resistance to flow is great enough that it forms lava domes, like lava-filled blisters that swell as dacite flows into its core (Jackson 1999). The last eruption of the San Francisco stratovolcano occurred nearly 200,000 years ago.

The Oak Creek Fault is located less than a quarter mile from NOFS, about 700 feet west of the western boundary. It trends true north and south and follows along the course of the Oak Creek to the Val Verde Valley. In the vicinity of NOFS, the fault is up thrown 500 feet to the west and is marked by a steep cliff. The fault disappears under blanketing lava flows before reaching the railroad tracks. The length of the main portion of the fault is approximately 30 miles. It has been classified as inactive; however, any future development should be located 50 to 100 feet on either side of the fault line at a minimum.

The soils of the site are mostly basaltic, cinders or benmorite residuum or alluvium. Brolliar-Sponsellar is the primary type which is typically found on the high basaltic and volcanic plateaus of the area (DoN 1987). The soils are reddish brown, moderately deep, and fine textured clays mixed with stony and cobbly clays. There is a severe erosion hazard on the steeper slopes, and most of the site is limited by low soil strength, affecting trafficability and risk of soil damage when wet. Some areas are limited by shrink-swell clays, or excessive stones or cobbles.

All of the soil types on Navy property are rated for a 65 percent potential canopy cover of ponderosa pine. Map 2-4 depicts the soils of NOFS (USFS 1995b).



Map 2-4. Topography and soils of Naval Observatory Flagstaff Station.

2.2.5 Hydrology, Watersheds, and Waters/Wetlands of the United States

Watersheds, Runoff, and Water Quality

The area around Flagstaff receives a relatively large amount of precipitation for the state of Arizona. The average precipitation is 22 inches, most of it in the form of snow. Although the amount of precipitation in Flagstaff is high, the ample porosity of the surface rocks allows the precipitation to seep into the soil, minimizing the amount of runoff that would be expected. For this reason, most of the ground water supplies are deep and contain little water.

The majority of the creeks in the area are seasonal, with Oak Creek the only perennial stream located several miles to the southeast of the property. The surface water drains into the Verde River, runs through the Gila River and ends up in the Colorado River. Usually after heavy rains, water flows from many courses including the sole perennial stream, Oak Creek. Some water courses are made into small lakes by the activity of lava flows damming the water way.

Waters of the United States and Wetlands

The value of the ecosystem functions provided by wetlands belie their small area. They can profoundly affect the natural vitality of a region. The reason there has been a national focus on wetlands is in part because so few remain from presettlement times. In Arizona, 36 percent are estimated to be lost to conversion to farmland, flood control, water diversion and urban development (Dahl 1990). This has been detrimental to bird, mammal, fish and other wildlife populations. Also, wetland degradation can be caused by seemingly unrelated or indirectly connected activities, such as changes in upstream drainage contours, altered runoff from upslope developments including roads, pumping, or plowing too deeply in a claypan. Effects originating off-site have necessitated comprehensive regulation in order to adequately protect wetland resources.

Section 404 of the CWA gave regulatory authority over waters of the U.S., which includes wetlands, to the EPA. The EPA delegated this authority to the U.S. Army Corps of Engineers (USACE), but retains veto power over permit decisions. The agencies and jurisdictions involved in Arizona wetland regulation are shown in Table 2-2.

Executive Order 11990 Protection of Wetlands (EO 11990 24 May 1977 [U.S. President 1977], 42 FR 26961) requires federal agencies to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when:

- Acquiring, managing, and relinquishing of federal lands and facilities;
- Providing federally undertaken, financed, or assisted construction and improvements; and
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

Since the issuance of this EO, the focus of national policy has shifted from "minimizing" destruction, loss, and degradation of wetlands to "no net loss" of wetlands in carrying out the above federal activities.

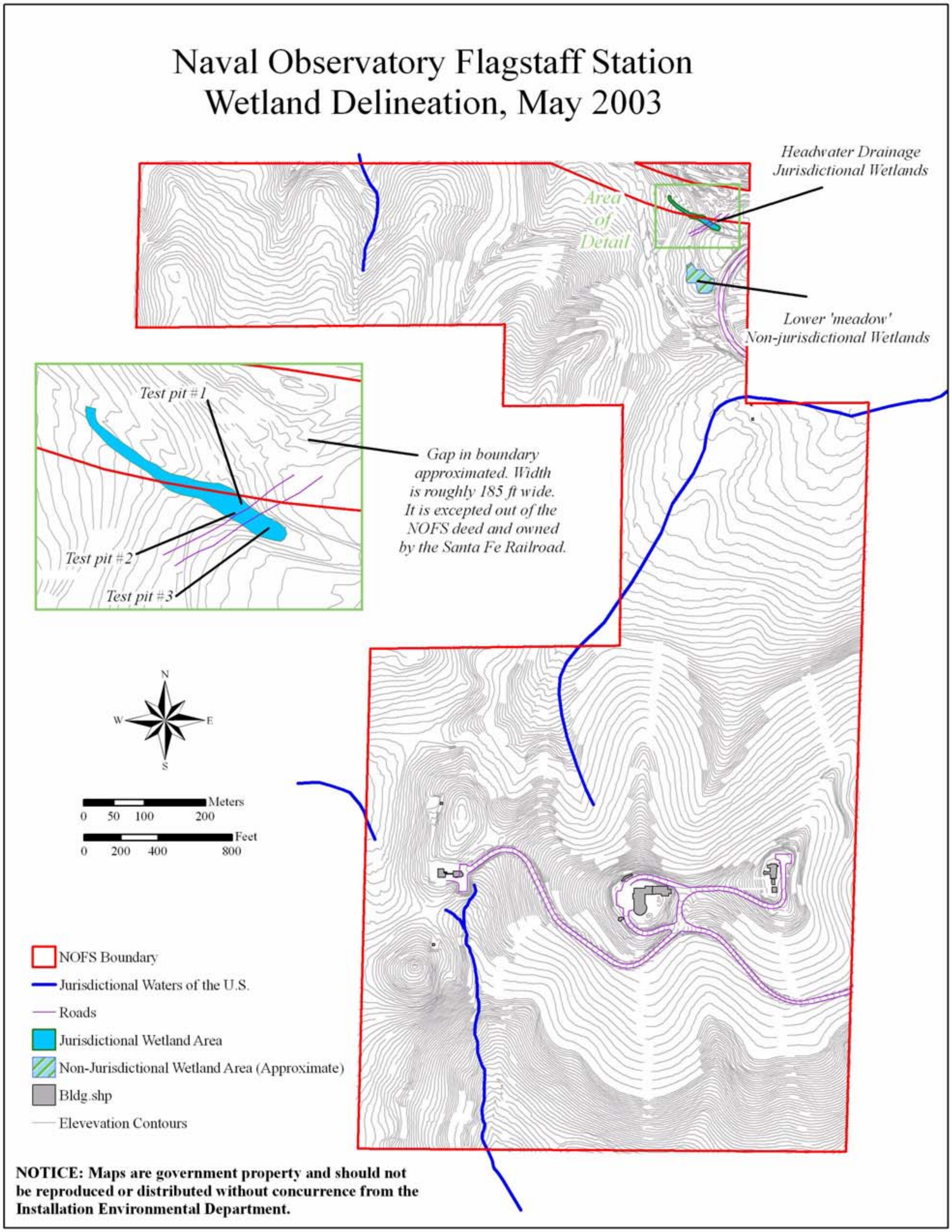
A jurisdictional wetland delineation and determination of waters of the U.S. on the property of NOFS was conducted in May 2003 (Tierra Data Inc. 2004) to identify the legal boundaries within which the USACE has regulatory jurisdiction. One jurisdictional wetland and several waters of the U.S. were identified, as shown on Map 2-5. The waters of the U.S. were identified because these are drainages on NOFS property which have a distinct bed on bank, and they drain into the Verde River, then into the Gila River, and then to the Colorado River, which is a traditional navigable water. The wetland identified met the USACE three parameter test for hydric soils, plants, and hydrology. Survey results require verification by USACE. Such verification would normally be requested if a project were proposed that would require disturbance of a drainage area, but could be requested at any time. If a road realignment or other project is proposed, potential wetlands and waters of the U.S. within and outside the construction footprint may be quickly field-checked, then evaluated for mitigation requirements.

Table 2-2. Jurisdictional authorities over wetlands and other regulated waters.

Agency	Law / Regulation	Authority	Jurisdiction
U.S. Environmental Protection Agency	Clean Water Act	Enforcement; veto power over a USACE issued permit.	Waters of the U.S. including wetlands.
	NEPA	Comment only.	
U.S. Army Corps of Engineers	Clean Water Act, Section 404	Regulates dredge and fill.	Waters of the U.S. including wetlands Navigable Waters (subject to ebb and flow of the tide or could be used for interstate or foreign commerce).
	Rivers and Harbors Act, Section 10	Regulates construction of structures, dredge and fill.	
	NEPA	Comment only.	
U.S. Fish and Wildlife Service	Fish and Wildlife Coordination Act	Review and comment only.	Waters of the U.S. including wetlands.
	Endangered Species Act	USACE must consult with USFWS on the issuance of 404 permits if there may be effects to threatened and/or endangered species as a result of the permitted action.	
	NEPA	Under NEPA, the USFWS has the ability to review and comment on proposed actions.	
Natural Resources Conservation Service	Food Security Act, 59 CFR 12, January 19, 1994	Regulates activities in agricultural areas.	Farmed wetlands associated with agricultural lands. (USACE responsible in some counties where Natural Resources Conservation Service has not implemented its authority.)
	NEPA	Comment only.	
State and Regional Water Quality Control Boards. 401 Certification is handled by the Arizona Department of Environmental Quality.	Clean Water Act, Section 401	Issues water quality certification, which is required for 404 permit.	Waters of the U.S. including wetlands.
	Clean Water Act, Section 402	Regulates discharge of waste.	
	NEPA	Comment only.	

Water Usage

Due to the limited amount of surface and ground water, the majority of water used at NOFS is trucked in by private contractor. The trucked-in water usually originates from ground water collected in pipes from the upper, interior valley of the San Francisco Peaks; at times it comes from Williams or Bellmont. The water is stored in four tanks. One storage tank is within Building 1, and a 6,000-gallon elevated storage tank is located adjacent to Building 1. An 18,000-gallon ground-level storage tank, as well as an additional 18,000-gallon tank, is located adjacent to Building 4. At each of the two sites, one tank is for domestic supply and the other is for fire protection. The water in the tanks, although arriving as potable water, may be designated as non-potable according to whether or not it meets the Safe Drinking Water Quality Standards. Because the water is stored on site for long periods of time, the water may deteriorate or become contaminated. Water is monitored by NOFS for Total Hardness, Total Alkalinity, Total Chlorine, pH, and Free Chlorine to determine its potability. If the water does not meet established standards, action must be taken to correct the problem. Bottled water is also purchased for drinking.



Map 2-5. Wetlands and waters of the U.S. at Naval Observatory Flagstaff Station (based on Tierra Data 2004).

2.3 General Biotic Environment

2.3.1 Plant Communities and Flora

Ponderosa Pine-Gambel Oak Forest

A ponderosa pine forest dominates NOFS property, with some meadow swales (Refer to Map 2-6, and Map 4-1 in Chapter 4 for the timber harvest prescription). Ponderosa pine accounts for 65 percent of the canopy cover (Grinder and Krausman 1998). Gambel oak is interspersed among the pines, most notably on the knoll that supports the primary telescope and facility. Arizona fescue (*Festuca arizonica*) is the most common understory species. Areas of mature pine and larger oaks occur in two drainages north of the main facility. Map 2-6 shows a breakdown of dense and sparse stands of pine-oak before thinning, and areas on the property with slopes greater than 40 percent, which have been correlated with potential Mexican spotted owl nesting habitat (USFWS 1995a).

Debate continues about the pre-European condition of ponderosa pine forests of the southwest. However, it is generally agreed that current tree densities are unprecedented (Dahms and Geils 1997). The historic condition likely included a range of natural variability and a mosaic of forest conditions, including both open, park-like areas and dense clumps or stringers of trees. Indeed, it is generally agreed that current tree densities are significantly higher than historic densities, and old-growth forest conditions are generally lacking (Covington and Moore 1994b). Fire suppression and modified land use practices with the arrival of European settlement are believed to be the cause of the change.

The recent history of forest management on NOFS can be surmised from the existing timber stands. The majority of existing trees are about 50 to 180 years old. This indicates that most of the acreage was harvested prior to Navy acquisition of the property. The subsequent reforestation on areas harvested resulted from natural seeding coinciding with favorable environmental conditions for the establishment of new stands of timber. Since ponderosa pine dominated the acreage adjacent to harvested areas, it was the primary tree available to provide seed. In climatic regimes conducive to its growth, ponderosa pine produces an abundance of seed which can germinate best on the sparsely vegetated mineral soils associated with this area. In the absence of periodic fires, naturally established stands of ponderosa pine tend to be very dense, often containing more than 2,000 stems per acre at an early age. The existing stands on the Navy property have established by natural recruitment, not by direct seeding. Since the Navy acquired NOFS property in 1955, there has been little active forest management. Prior to recent thinning operations on the Navy property, unnatural tree densities were inhibiting Gambel oak production, impeding old growth conditions, and creating unsafe fire risk for Navy facilities on the property. The most recent (2000) forest activities have concentrated on Geographic Information System (GIS) inventory and mapping of the stands throughout NOFS. This digitized information has been used to produce this INRMP.

Portions of the forest were surveyed in March 1997, with 100 percent sampling of oaks within the bounds of the survey. Table 2-3 compares northern and southern portions of the cruised area (area inventoried for timber harvest) for oaks. The northern portion is cooler because of north-facing slopes, and includes some steep canyon draws containing about 20 acres of dense pines. These areas may provide more suitable habitat for Mexican spotted owls compared to the south facing slopes of the NOFS property during summer based on Barrows and Barrow (1978) observation that these owls show signs of heat stress when temperatures exceed 82-88°F (28-31° Celsius [C]).

Table 2-3. Results of 100% sample of oaks surveyed in 1997 throughout most of NOFS property, with exception of a small portion north of the paved access road, east of the fenced observatory compound, and south of the power line.

	South	North
Average Number Trees/Clump	5.5	5.4
Basal Area/Clump	2.09 per acre	2.39 per acre.
Average Oak Diameter	7.40 inches	8.03 inches
Number of Oaks greater or equal to 8.1 inches diameter at breast height (DBH) per acre	15.04 per acre	11.55 per acre
Number of Clumps with trees greater or equal to 8.1 inches DBH per acre	6.85 per acre	4.60 per acre
Basal Area/Acre	18.1 inches	13.7 inches
Trees/Acre	48.0	30.7

The recently completed thinning operations (2001-2009) at NOFS have resulted in a new forest structure. Section 4.6: Forest Health Management describes the forest management program at NOFS and Map 4-2 depicts the seven categories of prescriptions for the property's forest.

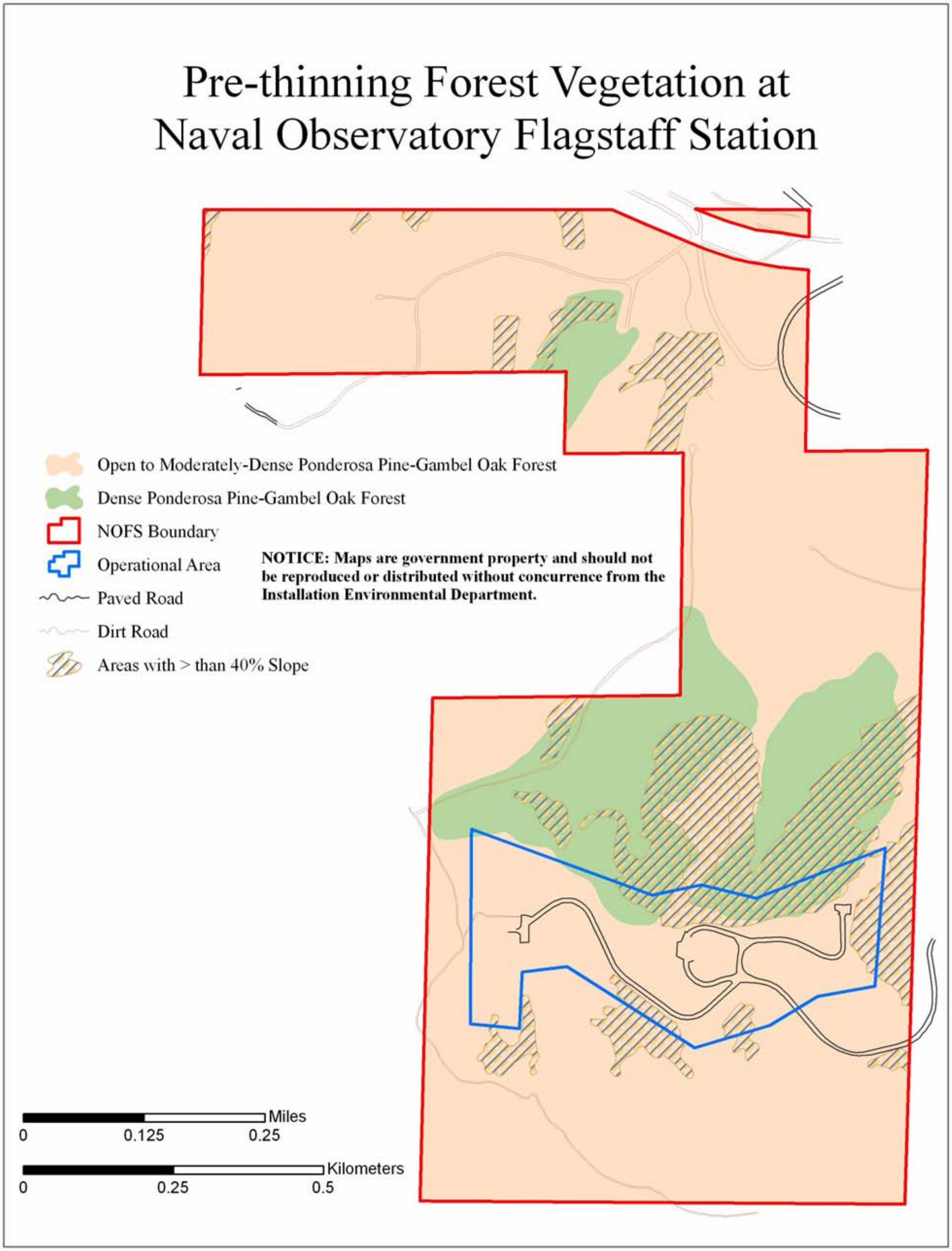
NOFS has recently begun a program to monitor snags within the 287-acre property (Ingraldi and Bayless 2005). The baseline data collected as part of this survey will be used to monitor trends in snag density, quality, and wildlife use over time. Of the 193 snags observed and marked, 95 percent were ponderosa pine and five percent Gambel oak. Approximately 60 percent of the ponderosa snags were within the 18- to 24-inch diameter class. In southwestern ponderosa pine forests the USFS recommends a minimum of 4.9 snags/ha for trees >18 inches diameter at breast height (DBH) (USFS 1996, as cited in Ingraldi and Bayless 2005). Ingraldi and Bayless (2005) determined that NOFS falls below this recommended management standard with 1.1 ponderosa pine snags/ha in this size class. They recommended that all snags and coarse woody debris be retained during future forest treatment projects.

Grassland

Approximately three hectares of NOFS are predominately grassland, presumably formed during timbering operations in the 1930s. Grasses include Arizona fescue, mountain muhly (*Muhlenbergia montana*), screwleaf muhly (*Muhlenbergia* sp.), pine dropseed (*Sporobulus* sp.), black dropseed (*Sporobulus interruptus*), bottlebrush squirreltail (*Sitanion* sp.), and blue grama (*Bouteloua gracilis*). Other common species are western yarrow (*Achillea lanulosa*), American vetch (*Vicia* sp.), Arizona pea (*Dalea* sp.) and silverstem lupine (*Lupinus* sp.) (Grinder and Krausman 1998). This habitat is small and discontinuous and is represented in Map 2-6 within the category of 'Open to Moderately Dense Ponderosa Pine-Gambel Oak Forest.'

Southwestern Dwarf Mistletoe

While a native, southwestern dwarf mistletoe (*Arceuthobium vaginatum*) can infest southwestern ponderosa pine forest and increase the risk of insect outbreaks and wildfire depending on the history of fire suppression and timber cutting practices, mistletoe currently has not been identified as a problem in the forest on the property and has a recognized role in the ecology of southwestern forests (Van Devender and Hawksworth 1986).



Map 2-6. Pre-thinning forest vegetation at Naval Observatory Flagstaff Station. Mapping was conducted before thinning was initiated in 2001. Refer to Map 4-1 in Chapter 4 for timber harvest prescription.

Plant List

Various surveys (Grinder and Krausman 1998) have documented individual plant species as part of or incidental to the main purpose of the survey. All species found were common to the area. For a full species list of known plants at NOFS, see Appendix D.

2.3.1.1 Special Status Plant Species

No federal or state listed threatened or endangered plant species are known historically or currently on NOFS property. However, based on the Arizona Heritage Data Management System there are two plant species of varying degrees of special status known to occur within five miles of NOFS; Arizona leatherflower (*Clematis hirsutissima arizonica* syn. *C.h. hirsutissima*) and Flagstaff pennyroyal (*Hedeoma diffusum*).

Arizona Leatherflower *(Clematis hirsutissima arizonica syn. C.h. hirsutissima)* *USFWS: SPECIES OF CONCERN*

■ **Arizona leather flower.**

Photo from centerforplantconservation website, *Accessed 4/20/12.*

The Arizona leather flower is a herbaceous perennial. It is designated as a federal Species of Concern. It is found only in northeastern Arizona in three areas; Walnut Canyon near Flagstaff, the Kaibab National Forest in Coconino County, and near Canyon de Chelly in Apache County (AZGFD 1998). It is found between 6,900 and 8,500 feet in elevation in the ponderosa pine forest community. It also grows on Kaibab limestone outcroppings on north, south, southeast and east exposures. More specifically, it needs rocky hillsides with a 12-40 percent slope and an aspect range of forty degrees west and forty degrees east of north. Leaf litter is unusually high in some areas where young plants grow and it is hypothesized that the litter creates a high humidity that aides in seed germination.

Because of its restricted habitat requirements and distribution, logging, recreational activities, and land developments could pose threats. Insects and browsing animals also feed on the seeds in fall. The USFS has created 100-foot buffer zones around known populations growing in timber sale areas (AZGFD 1998).

Flagstaff Pennyroyal (*Hedeoma diffusum*) *USFS: SENSITIVE*

■ **Flagstaff pennyroyal.**

Photo from swbiodiversity.org, *Accessed 4/23/12*

Flagstaff pennyroyal is a herbaceous perennial which is naturally rare. It is a USFS Sensitive Species and on the Navajo Endangered Species List. Its entire range is north-central Arizona; the San Francisco Plateau of the Colorado Plateau Province; Flagstaff and southward in Coconino and Yavapai counties (AZGFD 1995). It is part of the Petran Montane Conifer Forest plant community, associated with ponderosa pine and Gambel oak. It is restricted to small scattered Kaibab limestone and sandstone outcrops in relatively undisturbed habitat. This species is sensitive to competition. It prefers rock pavement, cliff, limestone and sandstone break habitats and roots in the shallow soil of crevices and weathered pockets. It occurs between 4,500 and 7,000 feet on 0-10 percent slopes with a canopy cover of 0-86 percent. Prescribed burning may be necessary to maintain populations by removing overstory and clearing litter. It is threatened by urban expansion but is stable in Wilderness Areas. Forestry activities, excessive grazing, and throw down camping may be detrimental (AZGFD 1995).

2.3.1.2 Non-native Invasive Plants

■ **Invasive weeds have been observed at NOFS and may be documented during focused surveys at NOFS in the future.**

During 1996–1997 surveys, Grinder and Krausman (1998) did not record invasive weeds for NOFS. Ornamental exotics were confined to the landscaped areas around the facilities. However, subsequent anecdotal observations of invasives in May 2001 indicate they are encroaching, especially along the roadways and in disturbed soil around the new addition to the Observatory building (Kellogg, *pers. obs.*, 2001). Bindweed (*Convolvulus* sp.) has established around the new construction and is of particular concern for its ability to persist and spread to outcompete native plants. Mullein (*Verbascum thapsis*) was also seen near structures in other areas of the property, Dalmation toadflax *(Linaria dalmatica)* persists along the roadway edges, and three Russian olives (*Elaeagnus angustifolia*) are located adjacent to the parking lot or along the access road to Buildings 6 and 7. Other invasives may be discovered during focused surveys.

2.3.2 Fauna

With a total of 85 species, the wildlife found on NOFS is typical of species common in ponderosa pine vegetation associations (Refer to Appendix D for a full species list and associated studies). In addition, the continued management for Gambel oak and ponderosa pine snags creates an opportunity to host a higher diversity of birds and mammals at NOFS (See Section 2.3.1: Plant Communities and Flora for a description of the current snag monitoring program at NOFS).

Birds

Comprehensive point counts were conducted at ten established bird count points in 1992, 1996-1997, 2002 and 2005. General avian observations were recorded in 1994, 1996 and 1997 by NAVFAC SW Ornithologist, Timothy Burr. From these efforts, a total of 60 bird species have been recorded at NOFS from 1992–2005 (Shepherd and Burr 2006[1]).

In 2005, with the effort of two observers, two 10-minute surveys were conducted at each of ten count stations each day for four consecutive days. This resulted in an effort of 200 minutes/day, for a four-day total of 800 count minutes. Sixteen species/200 minutes of effort were detected on day one, 20 species/200 minutes on day two, 20 species/200 minutes on day three and 22 species were recorded in 200 minutes on day four. During these four days, 26 unique species were recorded (Shepherd and Burr 2006). No AZGFD Wildlife of Special Concern or other sensitive species were observed during the 2005 surveys. Night time target surveys were not conducted for the nocturnal Mexican spotted owl, and it was not recorded, nor was the northern goshawk (*Accipter gentilis antricapillus*), a diurnal raptor that may utilize NOFS for foraging (Shepherd and Burr 2006).

Species most frequently encountered included the mountain chickadee (*Poecile gambelii*), pygmy nuthatch (*Sitta pygmaea*), white-breasted nuthatch (*Sitta carolinensis*), and western wood-pewee (*Contopus sordidulus*). Species observed once during the 2005 surveys included the chipping sparrow (*Spizella passerina*), Hutton's vireo (*Vireo huttoni*), pine siskin (*Carduelis pinus*), and red-tailed hawk (*Buteo jamaicensis*). Other species encountered infrequently included the American crow (*Corvus brachyrhynchos*), cordilleran flycatcher (*Empidonax occidentalis*), common raven (*Corvus corax*), and Townsend's solitaire (*Myadestes townsendi*) (Shepherd and Burr 2006).

Many bird species that were not recorded in earlier surveys were detected during the 2005 survey, including Hutton's vireo, zone-tailed hawk (*Buteo albonotatus*), great horned owl (*Bubo virginianus)*, common nighthawk (*Chordeiles minor*), red-faced warbler (*Cardellina rubrifrons*) and Virginia's warbler (*Vermivora virginiae*). In contrast, many of the species that were not recorded in 2005 had been observed earlier in earlier studies. The 2005 surveys were conducted during the summer and would have missed migrating or winter residents, such as ferruginous hawk (*Buteo regalis*), ruby-crowned kinglet (*Regulus calendula*), and white-crowned sparrow (*Xonotrichia leucophyrys*). Those species recorded during two or more past surveys and not observed in 2005 were the sharp-shinned hawk (*Accipiter striatus*), the wild turkey, acorn woodpecker (*Melanerpes formicivorus*), brown creeper (*Certhia americana*), mountain bluebird (*Sialia currucoides*), Grace's warbler (*Dendroica graciae)*, olive warbler (*Peucedramus taeniatus*) and red crossbill (*Loxia curvirostra*) (Shepherd and Burr 2006).

Three of the most abundant birds recorded in 2005 were also found to be abundant by Grinder and Krausman (1998). The mountain chickadee, pygmy nuthatch and the white-breasted nuthatch are considered resident or short-distance migrants within the ponderosa pine forests of northern Arizona (Ehrlich et al. 1988; Rosenstock 1996). These also tend to form large foraging flocks and are often recorded in large numbers. The western wood-pewee was abundant in 2005, and not during 1996–1997 (Grinder and Krausman 1998). The western wood-pewee is a neotropical migrant that breeds in North America, prefers to reside in woodlands and forests and is often found in edge

1. For tabular summaries of avian species observed from 1992-2005 at NOFS see Pages 10-12 of Shepherd and Burr (2006) in Appendix D.

habitat (Bemis and Rising 1999). Since forest thinning at NOFS began in 2001, an increase in edge habitat and open canopy has occurred here. The forest thinning, which appears to have enhanced the preferred habitat for the pewee, has likely led to this documented increase in numbers. The change in forest habitat at NOFS may also be influencing the occurrence and abundance of other bird species (Shepherd and Burr 2006).

The 2005 survey effort recorded seven species of birds not listed in the 2001 INRMP: zone-tailed hawk, great horned owl (*Bubo virginianus*), common nighthawk, Hutton's vireo, red-faced warbler, Virginia's warbler and the brown-headed cowbird (*Molothrus ater*). Compilation of the past surveys showed that Grinder and Krausman (1998) had observed the brown-headed cowbird. The 2005 survey effort resulted in the observation of six new species at NOFS. Without regular baseline inventories, monitoring the health and stability of bird populations utilizing the habitat would otherwise be impossible. Given the recent forest thinning and its potential to affect avian species' use of NOFS, monitoring populations on a regular basis is advised (Shepherd and Burr 2006).

A flammulated owl was observed during 1996-1997 bird surveys, by Randall-Parker (1994) and again in 2005 by Shepherd and Burr (2006). Randall-Parker reported that this species may breed on Navy property. It was previously listed as Sensitive by the USFS (Grinder and Krausman 1998) but is no longer on the Peaks/Mormon Lake Districts Sensitive Species List (USFS 2009). It is federally protected as a migratory bird. The flammulated owl (*Otus flammeolus*) is a migrant that breeds in mature and old ponderosa pine and mixed-conifer forests. It nests in cavities and may congregate into loose colonies for breeding. It favors locations with small openings and edges and scientists have noted that owl pairs in old ponderosa pine/Douglas-fir territories have greater reproductive success. Flammulated owls are nocturnal and feed primarily on insects and occasionally small rodents or birds (McCallum 1994). The recent thinning at NOFS which retained snags, as well as the snag monitoring study at NOFS (Appendix D) is consistent with maintaining and monitoring a key habitat component favorable to this species.

Six species of woodpeckers that are likely to inhabit the ponderosa pine forests at NOFS. These are the downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), northern flicker (*Colaptes auratus*), acorn woodpecker, Lewis's woodpecker (*Melanerpes lewis*), and Williamson's sapsucker (*Sphyrapicus thyroideus*). Generally the low-impact operational activities at NOFS are well suited to maintaining woodpecker populations. The emphasis on retaining and monitoring snags, and encouraging understory growth by creating patches of openings as well as creating a mosaic of forested habitat at NOFS can be beneficial for the maintenance woodpecker populations. For more information on these species refer to Appendix Q.

Bats

Five species of sensitive bats are likely to inhabit the ponderosa pine forests at NOFS. These are: Allen's big-eared bat (*Idionycteris phyllotis*), long-eared myotis (*Myotis evotis*), Arizona myotis (*Myotis occultus*), fringed myotis (*Myotis thysanodes*), and long-legged myotis (*Myotis volans*). The low-impact operational activities at NOFS are well suited to maintaining bat populations. The forest thinning operations (2001-2009) at NOFS have also created a mosaic of stands that supports understory growth for the production of prey species, and enhanced foraging areas. The opening of the forest canopy may have temporarily negatively affected roosts in occupied snags due to alterations in the snags' micro-climate. For more information on these species refer to Appendix Q.

Terrestrial Mammals

The status of ungulate mammals on NOFS is not well known, although due to the small size of the property larger mammals are not supported in great numbers. The property may, however, represent an important part of home ranges and migratory corridors. A survey by Grinder and Krausman of the University of Arizona (1999) reported the following large mammals: gray fox (*Urocyon cineoargenteus*), coyote (*Canis lantrans*), bobcat (*Lynx rufus*), elk (*Cervus canadensis*), and mule deer (*Odocoileus hemionus*). They also documented sightings by NOFS personnel, which added a collared peccary (*Tayasu tajacu*), mountain lion (*Felis concolor*), porcupine (*Erethrizon dorsatum*), raccoon (*Procyon lotor*), and skunks (probably *Mephitis mephitis*).

The one-mile section of highway containing the I-40 underpass at NOFS has the second highest frequency of mule deer-vehicle collisions along I-40 (J. Gragnon *pers. comm.*). Elk hits are relatively lower along this section as opposed to other sections of I-40, but still exist, and cameras would be an effective method to gather information (J. Gragnon *pers. comm.*). Maintaining trees on either side of the highway would be an effective method to promote mule deer use of the underpass. Mule deer use these trees as staging areas when making movements across the highway corridor through underpasses.

While known to have large ranges, black bears are known to inhabit the local forest. Generalized wildlife surveys conducted at NOFS (Grinder and Kausman 1998) observed mammals that are typical of ponderosa pine forest, and identified by trapping, sightings, or other sign nine species of small mammals during 1996 and 1997[1]. These provide an important food source for species like the Mexican spotted owl, other raptors, and larger mammalian carnivores that are present at NOFS. A list of wildlife for the property is contained in Appendix D.

Other Wildlife

No permanent water sources are available for fish habitat or fishing opportunities at NOFS.

While insect pests are monitored at NOFS, presently almost nothing is known about the full invertebrate diversity on NOFS.

Herpetological surveys were conducted as part of the generalized faunal survey of 1996 and 1997 (Grinder and Krausman 1998). A list of herpetological species known to inhabit NOFS is presented inAppendix D.

2.3.2.1 Threatened and Endangered Wildlife Species

Mexican Spotted Owl

■ **Mexican spotted owl.**

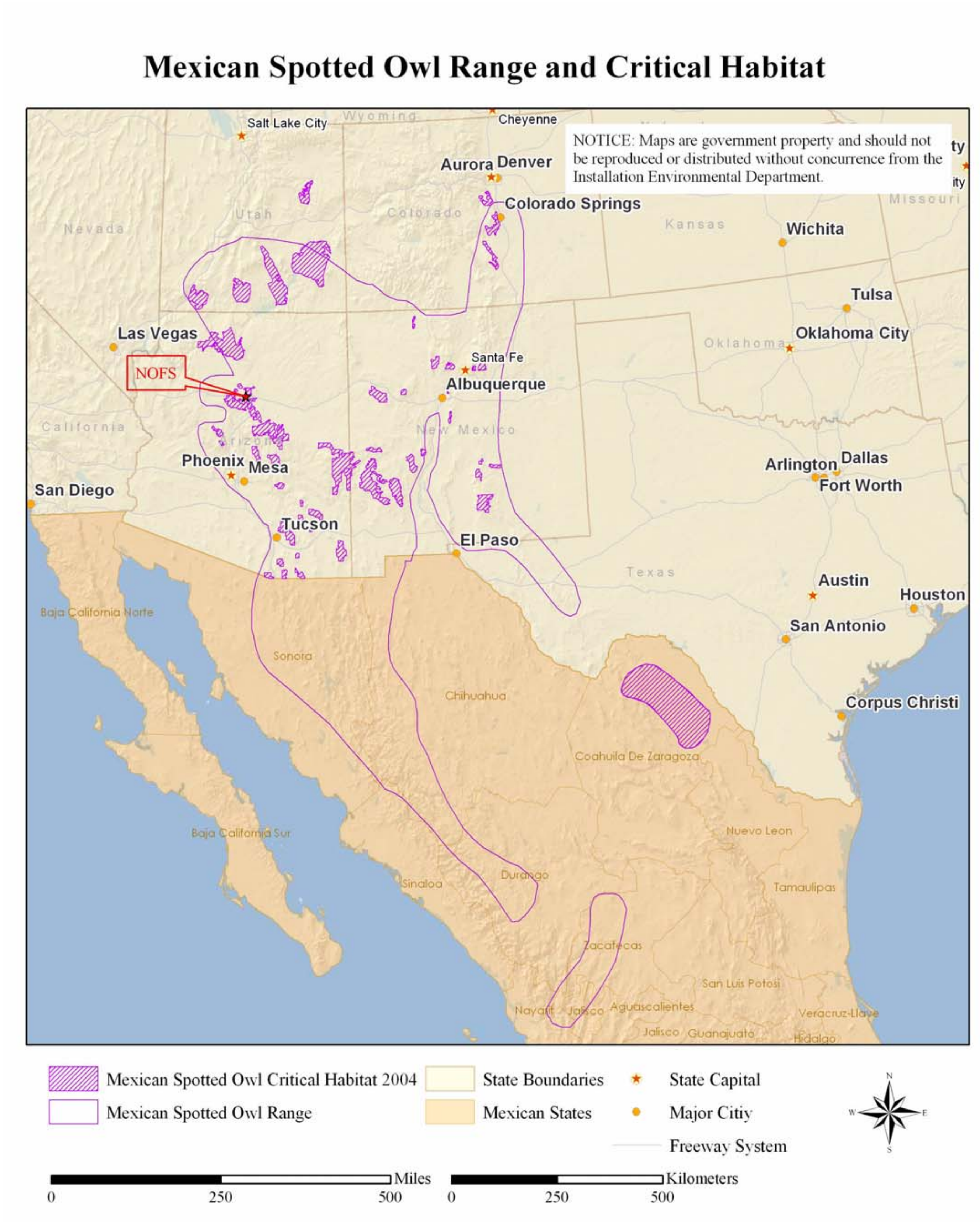
Photo from Tierra Data Inc.

The Mexican spotted owl is the widest ranging of three subspecies of spotted owl known in North America. It is found in the rocky mountains of central Colorado and southern Utah, throughout much of Arizona, western and central New Mexico, a small portion of southwestern Texas, and a significant amount of territory in northwestern Mexico (American Ornithologists Union 1983; USFWS 1995b; McDonald et al. 1991) (Map 2-7). It was listed as threatened in 1993, under the ESA of 1973, as amended.

Life History

The Mexican spotted owl's breeding season varies across its range; in Arizona courtship begins in March with most eggs laid 30 days later in late March or early April, hatching by late May. Nestlings fledge four to five weeks after hatching and disperse mid-September to early October (Ligon 1926; Johnson and Johnson 1985; Skaggs 1988; USFWS 2001). Eggs have been found as early as March 2 or laid as late as mid-May (Skaggs 1988), with variation attributed to latitude and altitude (Forsman *et. al.* 1984) or renesting following nest failure (Ganey, pers. comm. 1997; Kroel and Zwank 1991). The nest is tended solely by the female, and the male owl provides food to the female until the owlets are two weeks old. Spotted owls usually do not breed until their third year and may forgo breeding for one or more seasons at a time. Forsman (1984) found an average of only 62 percent of adult northern spotted owls nest in any one year.

1. Full flora and fauna surveys are scheduled for 2010.



Map 2-7. Mexican spotted owl range and critical habitat areas in relation to Naval Observatory Flagstaff Station (NOFS property is not critical habitat).

Predator/Prey Relationships

Mexican spotted owls commonly consume small/medium size rodents such as woodrats, mice, and voles, as well as bats, birds, reptiles and arthropods. Primary predators of the Mexican spotted owl include the great horned owl, northern goshawk, and red tailed hawk. Great horned owls were the suspected predator of three radio-tagged Mexican spotted owls (Ganey and Balda 1989; Skaggs 1990). Skaggs (1988) saw a red-tailed hawk almost capture a Mexican spotted owl, and a red-tailed hawk was the suspected predator of an owl in another incident (Skaggs 1990). Goshawks are also known predators of juvenile northern spotted owls (Forsman et al. 1984; Gutierrez 1985; Miller and Meslow 1985; Anderson et al. 1990). The peregrine falcon (*Falco peregrinus*) may prey on, but are not generally considered predators of, the Mexican spotted owl (USFWS 1995b). Mexican spotted owl preference for structurally complex forest sites may be a means of avoiding great horned owls as the Mexican spotted owl is smaller, with smaller wing size, allowing greater maneuverability in more dense forests.

Habitat Use

Over half of known owl sites are in the Upper Gila Mountain Recovery Unit that includes the Flagstaff area. Here owls use a wide variety of habitat types, but are most commonly found in mature mixed-conifer and ponderosa pine-Gambel oak forests (USFWS 2001). Mexican spotted owl nests in Arizona are found at elevations from 4,100-8,150 and located on all slope aspects. Most nests are located on the lower third of steep slopes and in the upper half of the tree. Canopy closure measured at six nest sites averaged 82 percent (Ganey and Balda 1988). Mexican spotted owls do not build nests but use stick nests built by other birds, debris platforms in large conifers, cliff ledges, potholes on steep walled canyons, mistletoe infections in older Douglas firs (*Pseudotsuga menziesii*), and large cavities in old trees[1]. The majority of nesting and roosting in mixed conifer forests appears to occur in Douglas fir trees, while foraging by owls involves a wider variety of forest conditions (USFWS 2001).

Roosting during the day may be in understory trees smaller in height and diameter than the dominant or codominant trees in a stand and in a more dense, closed canopy. If the roost is at a higher elevation, perching is less dependent on north aspect and less dense lateral cover, and tends to be in large overstory trees. These stands are likely to have moderate to dense shrub cover suggesting that availability of prey is not a primary roosting consideration (Ganey and Balda 1988). Spotted owls are heavily feathered and are said to be inefficient at dissipating body heat. Habitat on a north slope, near water or in a canyon that receives cold air drainage helps the owl compensate for heat intolerance. Such sites are up to 6°C cooler (Barrows and Barrows 1978). Owls show signs of heat stress when temperatures exceeded 27-31°C and begin gular fluttering at temperatures between 28-31°C (Barrows and Barrows 1978). The fluttering cools the owl by increasing evaporative heat loss. Other postural means of cooling include exposing pads of the feet, exposing legs, erecting contour feathers and drooping wings.

Foraging habitat includes an abundance of perches, many downed logs, presence of rock outcrops and an open to moderately open shrub layer. Ganey and Balda (1988) observed Mexican spotted owls feeding by moving from tree to tree, launching attacks from less than five meters in height above their prey. Mexican spotted owls clearly use a wider variety of forest conditions for foraging than they use for roosting (Ganey and Balda 1994; USFWS 2004).

Mexican Spotted Owl Recovery Plan

A recovery plan[2] for the subspecies was released in December 1995 (hereafter referred to as USFWS 1995b). In the Final Rule to designate Critical Habitat for the Mexican spotted owl published on 31 August 2004, 69 FR 53181-53298, it is stated, under the Summary of Changes From the Proposed Rule, that “Fort Carson, Colorado, Fort Huachuca, Arizona, and the U.S. Naval Observatory Flagstaff Station, Arizona, are excluded because they have final INRMPs and are consistent with the 2004 National Defense Authorization Act (Public Law [PL] 108–136, November 2003), Section 318, Military Readiness and Conservation of Protected Species which amended section 4(a)(3) of the Act” (USFWS 2004).

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1. For an inventory of snags at NOFS see Appendix D (Ingraldi and Bayless 2005).

The largest concentration of known Mexican spotted owl sites in the United States occurs in the Upper Gila Mountain Recovery Unit, of which NOFS is a part, with over half the known individuals. Although the observatory property lies within critical habitat, it is exempted from mandatory regulations regarding critical habitat due to the existence of an approved INRMP (2001). Nonetheless, the recovery plan for the Mexican spotted owl identifies three other habitat management classifications that provide protection for the Mexican spotted owl. These are: protected areas (including PACs, reserved lands, and unaltered steep slopes), restricted areas, and other forest and woodland types (Refer to Table 2-4). Of these various habitat designations, NOFS's property includes three: two forms of protected areas (in the form of a PAC and unaltered steep slope habitat), and restricted areas (in the form of restricted pine-oak habitat). The USFWS requires consultation at NOFS because of the presence of these habitat designations surrounding the station. Suitable protected and restricted habitat (USFWS 1995b) exists on NOFS that is capable of supporting the life history phases of the Mexican spotted owl (e.g., nesting, roosting, foraging, and/or dispersal).

Table 2-4. Habitat designations for the protection of the Mexican spotted owl and presence on Naval Observatory Flagstaff Station.

Habitat Designation	Sub-category	Management Guidelines Exist[a]	Presence on NOFS
Protected	Protected Activity Centers	Yes	Dry Lake PAC
	Reserved	Yes	No
	Protected Steep Slopes	Yes	Pine-Oak Habitat with slopes > 40%
Restricted		Yes	Pine-oak Habitat
Other Forest Types		No	No

a. In addition to the specific guidelines, the following general guideline applies to all levels of owl protection: before implementing any management action that will alter habitat structure, owl inventories must be conducted in all areas with any potential Mexican spotted owl use.This INRMP recommends annual monitoring for the Mexican spotted owl.

Table 2-5 shows surveys for the Mexican spotted owl that were conducted in the vicinity of the Dry Lake PAC at NOFS.

Protected Activity Centers

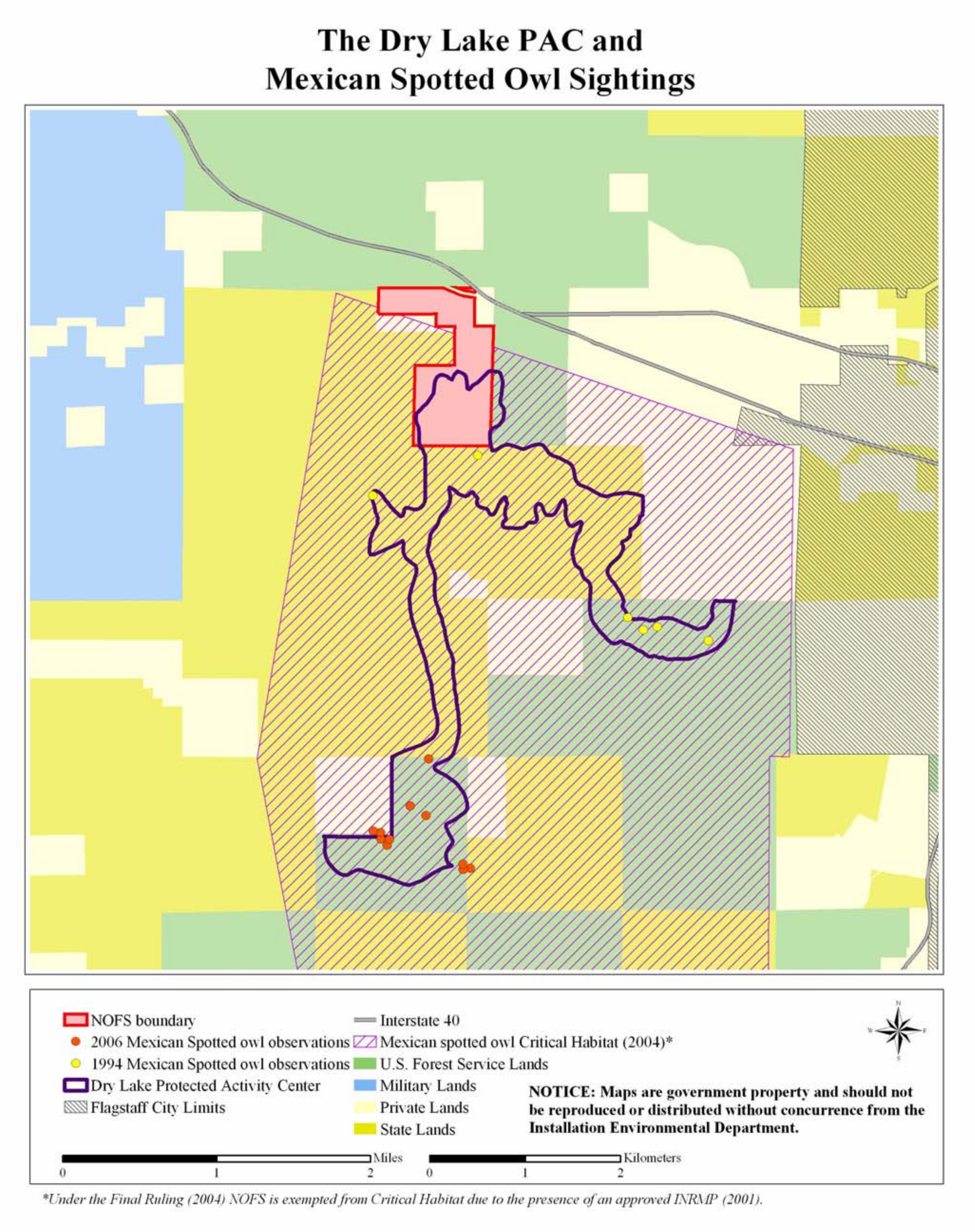
The Recovery Plan for the Mexican spotted owl recommends establishing PACs around known Mexican spotted owl activity centers (USFWS 1995b). The southern portion of NOFS is designated as part of the Dry Lake PAC (Map 2-8). These areas were established to protect all known locations where Mexican spotted owls have been sighted from 1989 through the life of the Recovery Plan that have suitable physical and biological properties to support Mexican spotted owl nesting, roosting, and foraging activities. Table 2-5 provides survey sightings for the Mexican spotted owl in the vicinity of the Dry Lake PAC. As a general rule, PACs encompass no less than an area of 600 acres (243 hectares) and typically support up to 75 percent of a foraging area for an owl.

2. Recovery plan longevity is determined by the success of recovery efforts, and will be in effect for twenty years. After implementation, the Recovery Plan will be reviewed in five years to determine its efficacy in conservation of the owl. If the five year review deems the plan to be insufficient for conservation efforts, the plan will be adapted to be more effective in spotted owl recovery efforts.

Table 2-5. Mexican spotted owl surveys in the vicinity of the Dry Lake Protected Activity Center.

Year	Surveyor	Sightings By Occupancy Classification[a]	Survey Range	Comments
2008	Cooperative Park Studies Unit at Northern Arizona University	No Mexican spotted owl (MSO) detected.	Dry Lake PAC and NOFS	
2006	US Geological Survey (USGS)	7/6 Two MSOs detected during nighttime visit. Follow up daytime visit resulted in no detections on 7/7. 7/8 Single MSO response but, no response during daytime follow-up visit on 7/9. 8/4 Two MSOs response during nighttime visit. 8/5 Two MSOs during daytime follow up visit. 8/17 Single MSO Response, visually observed three MSOs. No detection on 8/18 daytime follow up visit.	Dry Lake PAC and NOFS	15 nights between 1 March - 31 August. All sightings concentrated on the southern end of the Dry Lake PAC. No detections on NOFS.
2004	USGS	No responses or locations.	Dry Lake PAC	March 28 - July 31
2003	USGS	No responses or locations.	Dry Lake PAC	March 28 - July 31
2002	Arizona State Lands Department (ASLD)	No responses or locations.	Dry Lake PAC	
2001	McGuinn	7/8 Single audio. 7/10 Single visual. 7/11 No response.	Dry Lake PAC	Eastern portion of PAC on USFS and Arizona State Lands. No responses during three 2001 surveys prior to 7/8 response.
Summer 1999	Nagiller[a]	No responses or locations.	Dry Lake PAC, with emphasis on Naval Observatory lands	Complete protocol surveys.
Summer 1997	Randall-Parker[b]	No responses or locations.		
September 1996	Randall-Parker and Grinder [c]	No responses or locations.	Dry Lake PAC	Survey late and not a complete season.
Summer 1996	Pajkos[d]	No responses or locations.	Dry Lake PAC	Not protocol.
October 1995	Ganey[e]			Radio-telemetered dispersing juvenile flew between south Flagstaff and Navajo Depot.
Summer 1995	Pajkos	No responses or locations.	Dry Lake PAC	
Summer 1994	Randall-Parker	Single confirmed: 6/29 Single visual. 7/06 Single audio, female. 7/14 Single visual. 7/19 Single audio, daytime. 7/31 Single audio.	Dry Lake PAC	
June 1994	Pajkos	6/28 Single confirmed (visual, probably female); probable several other audios same night.	Dry Lake PAC	
Summer 1993	Pajkos Randall-Parker	No responses or locations.	Dry Lake PAC	
Summer 1990-92	Pajkos	No responses or locations.	Woody Mountain	

[a] Nagiller, S.J. 2000. 1999 surveys for the Mexican spotted owl in the vicinity of the U.S. Naval Observatory, Flagstaff, Arizona. Prepared under Contract for the U.S. Navy, San Diego, CA.
[b]Randall-Parker, Tammy; U. S. Forest Service. Flagstaff, AZ.
[c]Grinder, Martha; University of Arizona at Tucson, surveyor under contract to U.S. Navy.
[d]Pajkos, Keith; Timber Suspense Program Manager, Arizona State Land Department. Flagstaff, AZ.
[e]Ganey, Joe; U.S. Forest Service Research Station. Flagstaff, AZ.



Map 2-8. The Dry Lake Protected Activity Center and property ownership in the vicinity of Naval Observatory Flagstaff Station.

There are eight specific management guidelines that pertain to the designation and implementation of PACs:

1. Establish PACs at all known owl sites from 1989 through the life of the Recovery Plan.
2. No harvest of trees >22.4 centimeters (cm) (9 inches) DBH.
3. Harvesting wood for fuel within PACs should be managed in such a way as to minimize effects on the owl, its prey, and their habitats.
4. Road or trail building in PACs should be generally avoided but may be allowed on a case-specific basis if pressing management needs can be demonstrated.
5. Implement a fire risk abatement program with appropriate treatments.
6. Within remaining PACs, light burning of ground fuels may be allowed within 500 acres surrounding the 100 acre PAC centers, on a case-specific basis.
7. Within PACs treated to reduce fire risk, pre- and post-assessments of habitat conditions and owl occupancy must be completed.
8. If a stand-replacing fire occurs within a PAC, timber salvage plans will be evaluated on a case-specific basis.

Protected Steep Slope Habitat

In addition to PACs, the Recovery Plan also identifies protected steep-slope habitat, which consists of areas with mixed conifer and pine-oak types with a slope greater than 40 percent where timber harvest has not occurred in the past 20 years. The property contains about 20 acres of dense pine-oak on slopes greater than 40 percent in two north-facing drainages which is suitable for nesting.

The management guidelines for steep slopes that are outside of the PACs and the bottom of steep canyons consist of:

1. Within mixed-conifer and pine-oak stands, allow no harvest of trees >22.4 cm (9 inches) DBH on any slopes greater than 40 percent where timber harvest has not occurred in the past 20 years.
2. Thinning of trees <22.4 cm DBH are allowed as long as habitat components are retained, i.e. large logs >30 cm DBH, grasses, forbs, and shrubs. Emphasis of the spatial configuration of treatments should be to mimic natural mosaic patterns.
3. Prescribed natural fire and the creation of fire breaks is also permitted on a case-specific basis.

Restricted Mixed-Pine and Pine-Oak Habitat

The management guidelines listed above protect existing nesting and roosting habitat. The potential exists for Mexican spotted owl use other, unoccupied areas in the future assuming that the current distribution is limited by the availability of extant nesting habitat. As such the Recovery Plan presents guidelines that are stratified by broad vegetative cover types: mixed-conifer, pine-oak forest, and riparian areas. The recovery plan, in conjunction with a subsequent clarification letter from the USFWS regional director to the leader of the recovery team (USFWS 2001a) presents the following overriding guidelines for mixed-conifer and pine-oak cover types:

1. Manage mixed-conifer and pine-oak forest types to provide continuous replacement nest habitat over space and time.
2. Incorporate natural variation, i.e. irregular tree spacing and varied patch and stand sizes, into management prescriptions to attempt to mimic natural disturbance patterns.
3. Maintain all species of native vegetation in the landscape, including early serial species.
4. Allow natural canopy gap processes to occur.

More specific guidelines are intended to minimize threats to the Mexican spotted owl and provide management flexibility:

1. Management emphasis should be placed on uneven-aged stands.
2. Extend rotation ages for even-aged stands to >200 years.

3. Within pine-oak types, emphasis should be placed on retaining existing large oaks and promotion of additional large oaks.
4. Retain all trees >61 cm (24 inches) DBH unless overriding management situations demand removal for human safety and/or property.
5. Except for treatments designed to reduce the risk of stand replacing wildland fire, retain hardwoods, large down logs, and snags.
6. Priority should be placed on reducing identified risks to Mexican spotted owl habitat.
7. No stands that meets threshold conditions can be treated in such a way as to lower that stand below those conditions until ecosystem assessments can document that a large surplus of these stands exist at larger landscape levels.

Wildland Fire and the Recovery Plan

High-severity fire may result in complete loss of Mexican spotted owl habitat. As such, the recovery plan requires implementation of fire risk abatement management plans which include the implementation of permitted seasonal burns, review of all timber salvage plans (should a fire occur with in the PAC), and pre- and post-assessments of owl habitat and owl occupancy following mechanical removal of fire hazards. In addition, all road and trail development will be avoided in PACs with the exception of demonstrated pressing management needs. Section 7 consultation with the USFWS is required by the ESA if any action authorized, funded, or carried out by a Federal agency may result in effects to listed species. Section 10 allows the USFWS to issue incidental take permits to State or private entities following development of a Habitat Conservation Plan.

2.3.2.2 Special Status Wildlife Species

Observed or Potentially Occurring Special Status Species

- **No federal or state listed threatened or endangered species are known historically or currently on NOFS; however, there are seven species of varying degrees of special status known to occur within five miles of NOFS.**

Due to the small size of NOFS property and its position within a vast forested network of private, state, and national forest system lands, it is difficult to attach a unique or substantial contribution of the property to persistence and viability of regional habitats and wildlife and rare plant populations.

In addition to the Mexican spotted owl, based on the Arizona Heritage Data Management System there are seven wildlife species of varying degrees of special status with the potential to be affected by natural resources management at NOFS. While most of these species have not yet been found at NOFS, in the absence of confirmatory surveys it is possible that they are indeed present because the property lies within the historic or present range of a species and contains the proper habitat conditions. Of the species listed below, only the northern goshawk has been documented near (not on) NOFS. This was a foraging female observed 1993-1995 (Pat Hall, *pers. comm.*, 1997).

- Bald eagle (*Haliaeetus leucocephalus*)
- Northern goshawk (*Accipiter gentilis atricapillus*)
- Allen’s big-eared bat (*Idionycteris phyllotis*)
- Fringed myotis (*Myotis thysanodes*)
- Long-eared myotis (*Myotis evotis*)
- Long-legged myotis, or hairy-winged Myotis (*Myotis volans*)
- Occult little brown bat (*Myotis lucifugus occultus*)

- **A flammulated owl, listed as sensitive by the USFS, was observed during 1996-1997 avian surveys.**

In addition to the species listed above from the Arizona Heritage System, a flammulated owl has been documented at NOFS (sightings listed below).

Table 2-6 depicts the status of the observed or potentially occurring special status species at NOFS.

Table 2-6. Status of special status species observed or with potential to occur on Naval Observatory Flagstaff Station.

	Status*					IUCN*** Red List	
Species	USFWS	BLM	USFS	State	BCC?**	State Rank	Global Rank
Bald eagle (*Haliaeetus leucocephalus*)	Delisted†	None	S	WSC	Yes†	S3	G5
Flammulated owl (*Otus flammeolus*)	SC	S	S	None	Yes	None	G4
Northern goshawk (*Accipiter gentilis atricapillus*)	SC	None	S	WSC	No	S2,S3B,S4N	G5
Mexican spotted owl (*Strix occidentalis lucida*)	FT	None	None	None	N/A	S3	G3
Allen's big-eared bat (*Idionycteris phyllotis*)	SC	S	None	None	N/A	S2,S3	G3, G4
Fringed myotis (*Myotis thysanodes*)	SC	S	None	None	N/A	S3, S4	G4, G5
Long-eared myotis (*Myotis evotis*)	SC	S	None	None	N/A	S3, S4	G5
Long-legged myotis (*Myotis volans*)	SC	S	None	None	N/A	S3, S4	G5
Occult little brown bat (*Myotis lucifugus occultus*)	SC	S	None	None	N/A	None	G5

*** Status Codes:**

USFWS: FT= Federally Listed as Threatened Under the Endangered Species Act. SC= Species of Concern.
BLM: S= Sensitive.
USFS: S= Sensitive.
State: WSC= Wildlife of Special Concern.

**** BCC = USFWS Bird of Conservation Concern (2008).**

***** International Union for Conservation of Nature and Natural Resources.**

IUCN Red List State: S2= Imperiled. S3= Vulnerable. S4= Apparently secure. B= Breeding. N= Nonbreeding.
IUCN Red List Global: G3= Vulnerable. G4= Apparently secure. G5= Secure. Delisted= species formerly listed as protected under ESA.

† On 09 July 2007, the bald eagle was removed from the federal list of threatened and endangered species; as of 06 March 2008, the bald eagle population of the Sonoran Desert area of central Arizona are listed as a threatened species under a special rule.

Bald Eagle (Haliaeetus leucocephalus) *USFWS: DELISTED, TAXON RECOVERED*

The bald eagle was listed as endangered in 1978 in 43 states (including Arizona) and threatened in five others (USFWS 1982). In 1995 the species was downlisted to threatened in all recovery regions of the lower 48 states and completely delisted the species from the ESA on 09 July 2007. On 06 March 2008, the U.S. District Court for the District of Arizona amended the Service's 09 July 2007 final rule, which removed eagle populations nationwide from the federal list of threatened and endangered species. The court reversed the delisting for bald eagles in the Sonoran Desert area of central Arizona and as of 06 March 2008, bald eagles in the Sonoran Desert area of central Arizona were again listed as a threatened species under a special rule. This area does not include the NOFS. Nonetheless the bald eagle is still protected by the Bald and Golden Eagle Protection Act and the MBTA. Moreover, there is a five year post-delisting probation period where the eagle's success will be evaluated.

In Arizona, breeding bald eagles were first reported in 1890 (AZGFD 2010). Currently there are 50 known breeding sites for bald eagles in the state, primarily in central Arizona at elevations between 300-1400 m (1000-4400 feet), all but two of which are within one mile of a creek, lake, or reservoir (Jacobsen et al. 2006). Bald eagles are known from Camp Navajo, where a night roosting behavior study is currently underway. Bald eagles are also known to use the Rogers Lake area and other adjacent lands to NOFS for winter foraging and roosting activities (S. Hedwall, USFWS, *pers. comm.*).

■ **Bald eagle.**

Photo from USGS government info-center website, *Accessed 1/08/08.*

Bald eagles will feed on just about anything easy to catch, primarily fish, but they will also eat birds, amphibians, reptiles, small mammals, and carrion (AZGFD 2010). Fish species most commonly eaten are suckers, catfish, carp, bass, and crappie. Less commonly eaten fish are roundtail chub, green sunfish, bluegill, tilapia, and rainbow trout.

Compared to bald eagles in more northern areas, in Arizona bald eagles breed earlier in the year (AZGFD 2010), laying 1–3 eggs from December–March. Bald eagles generally place their nests on cliff ledges, rock pinnacles, and in cottonwood trees, but may also nest in junipers, pinyon pines, sycamores, willows, ponderosa pines, snags[1], and occasionally artificial structures[2]. The eggs hatch in 35 days and the young fledge in about 12 weeks (May and June), during which time both adults share nesting duties. The fledglings are almost completely dependent upon the adults for food until they migrate north, about 45 days after fledging (AZGFD 2010).

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1. **For an inventory of snags at NOFS see Appendix D (Ingraldi and Bayless 2005).**
2. **See** Section 2.3.1: Plant Communities and Flora **for a description of the current snag monitoring program at NOFS.**

Productivity rates are closely associated with breeding density, food, and weather. In Arizona, bald eagle nest productivity is lower than in other areas throughout North America (AZGFD 2010). From 1975 to 1984, average productivity rates were 0.92 young per occupied breeding area when the number of breeding areas was below 20; since then the average has been 0.78. Productivity rates in Alaska, Florida, Washington, and Wisconsin, averaged 0.96 young per occupied breeding area.

Although bald eagles are known to have a winter roost on lands adjacent to NOFS (Rogers Lake area), there are several locations on NOFS with large yellow pines that could provide winter roost opportunities for eagles. Current forest management is consistent with maintaining this habitat.

■ **Immature northern goshawk**

Photo from USGS government infocenter website, *Accessed 3/27/07.*

Northern Goshawk (Accipiter gentilis atricapillus) *USFWS: SPECIES OF CONCERN*

The northern goshawk has received some attention within federal land management agencies, primarily because of a recognized affiliation with old growth habitats and concern over population declines. It has no federal protected status under the ESA, but is federally protected as a migratory bird. The principle forest types that the goshawk uses in the Southwest are ponderosa pine (about 74 percent of the non-reserved forested area on NOFS), mixed species (about 23 percent), and spruce fir (about 3 percent). Nests are generally built in stands that are older-aged forests, have a high density of large trees, and high tree canopy cover. Nest stands are usually on cool, shady, northwestern or northeastern slopes or in drainages or canyons bottoms, often near streams (USFS 1991; AZGFD 2003a). The recent forest thinning at NOFS favoring larger trees (Appendix K) is consistent with the habitat requirement for this species.

*Allen's Big-Eared Bat (*Idionycteris phyllotis*) USFWS: SPECIES OF CONCERN*

Allen's big-eared bat is a federal Species of Concern. It is most often found at elevations between 3,500 and 7,500 feet in ponderosa pine, pinyon-juniper, Mexican woodland, and riparian areas of sycamores (*Platanus* spp.), cottonwoods (*Populus* spp.), and willows (*Salix* spp.). There are typically boulder piles, cliffs, rocky outcropping or lava flows near areas were they are collected. They are fairly common in tree roosts in the Coconino and Apache-Sitgreaves National Forests. Along with tree roost, they also roost in caves and abandoned mine shafts (AZGFD 2001). The recent thinning at NOFS is consistent with management recommendations for bats as outlined in the Forest Bats of Northern Arizona (AZGFD 2007) presented in Appendix Q.

*Fringed Myotis (*Myotis thysanodes*) USFWS: SPECIES OF CONCERN*

The fringed myotis is a federal Species of Concern. Fringed myotis occur primarily in middle elevation habitats ranging from deserts, grasslands, and woodlands (4,000-8,437 feet). Fringed myotis bats tend to roost in the open in tightly packed groups and have been recorded roosting in rock crevices, caves, mines, large snags, under exfoliating bark, and in buildings (AZGFD 2003b). Fringed myotis eat mostly small beetles (73 percent frequency), but moths are also taken. Observations indicated slow, highly maneuverable flight with foraging occurring in and around vegetation. This bat may land to pick up prey from the ground (AZGFD 2003b).The recent thinning at NOFS is consistent with management recommendations for bats as outlined in the Forest Bats of Northern Arizona (AZGFD 2007) presented in Appendix Q.

*Long-Eared Myotis (*Myotis evotis*) USFWS: SPECIES OF CONCERN*

■ **Long-eared myotis**

Photo from Tom Murray http://www.pbase.com/tmurray74/favorite_nature, Accessed 1/08/08.

The long-eared myotis is a federal Species of Concern. Long-eared myotis are categorized as "hovering gleaners" which feed by taking prey from the surface of foliage, tree trunks, rocks, or ground (AZGFD 2003c). Females give birth to one young per year in late June or July. The long-eared myotis inhabits ponderosa pine or spruce-fir forests of Arizona up to 10,000 feet elevation. During the summer months these bats roost in small groups of 12 to 30 individuals in rock outcroppings, tree cavities, under peeling bark, in stumps, caves, mines, sink holes, lava tubes, or in abandoned buildings (AZGFD 2003c). Large diameter trees and snags seem to be the preferred tree roost sites (Rabe et al. 1998; Waldien et al. 2000). The long-eared myotis is moderately common in areas of suitable habitat but may be threatened by loss of suitable roost sites throughout its range (AZGFD 2003c).The recent thinning at NOFS is consistent with management recommendations for bats as outlined in the Forest Bats of Northern Arizona (AZGFD 2007) presented in Appendix Q.

Long-Legged Myotis (Myotis volans) USFWS: SPECIES OF CONCERN

The long-legged myotis is a federal Species of Concern. It is primarily a coniferous forest bat (6,600-10,000 feet), and utilizes a variety of roosts including abandoned buildings, cracks in the ground, crevices in cliff faces and spaces behind exfoliating tree bark (AZGFD 2003d). In the summer, they apparently do not use caves as a daytime roost site. The species forms large nursery colonies, often numbering in the hundreds and in the Southwest, they give birth to single young earlier in the season than most other bats (AZGFD 2003d). The recent thinning at NOFS is consistent with management recommendations for bats as outlined in the Forest Bats of Northern Arizona (AZGFD 2007) presented in Appendix Q.

Occult little brown bat (Myotis lucifugus occultus) USFWS: SPECIES OF CONCERN

The occult little brown bat is one of 84 North American species within its genus. Once considered a subspecies of *Myotis lucifugus*, genetic evidence now supports its status as a full species (Piaggio et al. 2002). It is a federal Species of Concern. In the southwest, the species has been observed foraging under large cottonwoods and in orchards in the lower elevations. The species prefers to feed over water or open habitats (AZGFD Heritage Data Management System [HDMS] 2009). At high elevations they usually forage at low levels over and around water. During the summers in Arizona, the occult little brown bat is usually found in ponderosa pine and oak-pine woodlands near water. Colonies have been found in buildings and in crevices between timbers of a highway bridge. No hibernacula (the shelter of a hibernating animal) have been found in Arizona. It is most common between about 6,000-9,000 feet in elevation, though there are some records from lower elevations (AZGFD 1997).The recent thinning at NOFS is consistent with management recommendations for bats as outlined in the Forest Bats of Northern Arizona (AZGFD 2007) presented in Appendix Q.

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3.0 Environmental Management Strategy and Mission Sustainability

The purpose of this chapter is to establish a tangible link between managing the natural environment and sustaining the military mission. It establishes sustainability metrics for natural resources for core requirements of the Sikes Act (as amended): sustainable military land use, natural resources compliance, beneficial collaboration with agency partners, and public access and outreach.

3.1 Sustainability of the Military Mission and the Natural Environment

This chapter addresses Objectives 1.1 through 1.11, and 2.1 through 2.5 as stated in Chapter 1.

3.1.1 The NOFS Navy Mission

The primary mission of NOFS is:

- To make, analyze, and interpret such astrometric and photometric dark-sky observations as are required to fulfill the mission of USNO;
- To conduct a research program to improve the observational methods and the accuracy of astronomical data required by the Navy and other components of DoD; and
- To perform such other functions or tasks as may be directed by higher authority.

NOFS has four telescopes in routine operation (plus a fifth telescope, used on occasion). Missions supported by these telescopes include:

- Extremely accurate position determination of objects that appear close together in the sky.
- Establishment of all-sky background reference catalogs of positions, motions, and brightnesses of natural objects (stars, galaxies, quasars) against which satellites and weapons systems can be measured and which space-based systems need to determine their attitude and orientation in space for geo-location and targeting.
- Space Situational Awareness and Space Object Identification.

- Development and evaluation of new instruments, techniques, and software for improving position determination.
- Position determination for objects of interest to the National Aeronautics and Space Administration for navigating interplanetary missions.
- Tracking thousands of asteroids to improve the knowledge of their orbits.
- Astronomical research.

U.S Naval Observatory operates the following telescopes at NOFS:

1.55-meter Kaj Strand Astrometric Reflector. The largest telescope operated by the USNO, it is designed to produce extremely accurate astrometric measurements in small fields, and has been used to measure the distances of faint stars.

1.3-meter Reflector. The newest telescope at NOFS, this instrument was completed in 1999. Operated automatically, this telescope offers wide-field imaging abilities for the installation.

1.0-meter Ritchey-Chretien Reflector. Originally located at the Naval Observatory in Washington, this telescope was relocated to Flagstaff in 1955. Used for a variety of imaging and photometric programs by NOFS, this telescope is the largest and last Ritchey-Chretien telescope designed and built by George W. Ritchey.

Navy Prototype Optical Interferometer (NPOI). Located off-station at Lowell Observatory's Anderson Mesa site, the NPOI is a joint project of USNO, the Naval Research Laboratory, and Lowell Observatory. The NPOI is a new generation telescope that can determine the positions of stars to accuracies of one-hundredth that of conventional ground-based optical instruments, providing the necessary reference points for precise guidance and targeting systems as well as for a variety of astronomical purposes.

3.1.2 Integrating Navy Mission and Sustainable Land Use

Sustaining the Navy mission at NOFS means protecting the capacity and flexibility of NOFS to accomplish its work while achieving environmental compliance and stewardship. Since most of the land surrounding the operations area functions as a buffer to provide these necessary conditions, sustainable land use and a healthy forest are mutually compatible. While most day-to-day activities at NOFS have little potential to impact natural resources, natural resources provide a key role in maintaining favorable conditions for astronomy. The key elements for protecting these condition are:

- Controlling light sources that would interfere with telescope operation.
- Controlling particulate matter pollution that decreases atmospheric transparency and contaminates telescope optics.
- Managing the risk of high severity wildfire by maintaining an open stand structure that prevents crown fires, and by minimizing fuel loads, especially ladder fuels.

An impact to the mission would occur if mission-related work is prevented or unreasonably delayed. This would occur if prescribed or wildland fire or forest management necessitate the closing of the telescope due to airborne dust and particulates, or if light encroachment from urban development interferes with the dark sky conditions needed for astronomic viewing.

3.1.3 Relationship to Other Operation Area Plans

This INRMP is consistent with the NOFS Master Plan (1985) and the NOFS Encroachment Action Plan discussed in Section 3.6. Encroachment Partnering.

Objective: Anticipate and protect against all encroachment on resources required to fulfill the military mission.

Navy Mission Sustainability Objective

I. Sustain a dark sky, low risk of particulate pollution, and low risk of high severity wildfire.

II. Safeguard the mission by maintaining access and operation of roads, utilities, and other infrastructure to their original design standard or better, while protecting wildlife habitat, sensitive species, soil productivity, watershed functioning, and water quality.

■ **See also Section 3.6: Encroachment Partnering**

III. Maintain right-of-ways along roads and utility corridors for safety and consistent with Navy stewardship of the property. Review utility easement agreement to ensure practices used to clear utility right-of-ways are consistent with fire safety and other management in this INRMP.

IV. Anticipate and prevent emergency infrastructure problems to ensure human health and safety while minimizing damage to sensitive natural resources.

V. Ensure no net loss of available land and operational carrying capacity for military support while pursuing environmental protection needs.

- *A.* Review existing and anticipate potential conflicts of adjacent land uses with facility activities, especially with regard to night lighting, smoke, and dust.
    - *1.* Continue soliciting notification from neighboring landowners when prescribed burns are about to take place.
    - *2.* Continue attendance and vigilant commenting on changes in land use codes, lighting policies, and nearby development.
        - *a.* Comment vigilantly on the Regional Land Use and Transportation Plan, currently the most significant encroachment threat to NOFS.
        - *b.* NOFS should seek a letter under USNO/Naval Oceanographer's Admiral signature to the Mayor of Flagstaff and to the Coconino County Board of Supervisors stating the importance of NOFS to the Navy mission and requesting consideration of NOFS concerns in the Regional plan.
        - *c.* Seek a letter under USNO/Naval Oceanographer's Admiral signature to the USFS in order to further the control of land exchange of USFS land near NOFS. The Coconino National Forest is currently under revision, and this presents a window of opportunity to coordinate on this issue. The letter would be to formalize an agreement with the USFS about the disposition of lands designated for possible exchange. As of writing, the acting USFS Exchanges and Sales program manager is Steve Rinella (202-205-1792) at the USFS Lands and Realty Management Office in Washington D.C.
        - *d.* Support establishment of Northern Arizona University (NAU) Centennial Forest on adjacent State Trust lands as the preferred use of these lands, to prevent their privatization. Continue to allow NAU to lead this effort, since they are best connected to State government, and have an additional advantage in that use of these lands is required under the State constitution to benefit State schools. Another equivalent use, such as part of the County's Open Space program, that maintains the property in a manner consistent with preventing on the NOFS mission, may also be acceptable.
    - *3.* Maintain active participation in the Flagstaff sector of the International Dark-Sky Association and other local non-governmental organizations (NGOs) concerned with preservation of dark skies.

4. Seek to secure dark skies by maintaining a natural forest buffer adjacent to NOFS, such as by acquiring conservation easements. Maintain active participation in open space planning efforts in conjunction with the USFWS, AZGFD, Coconino County, and Camp Navajo, in pursuit of this strategy.
5. Seek to purchase property in order to prevent encroachment. If advantageous, purchase conservation easements so that NOFS can control development on adjoining lands. In addition, or alternatively, purchase the right to use a property commercially, or the rights to control and monitor lighting. For example, in one instance, a neighbor wanted an easement on NOFS property to bring power to a residence. NOFS agreed to the easement, and in return exercises control over the use of lighting on the property, and maintains access to verify these controls.
6. Investigate options for assisting local agencies in replacing nonconforming lighting to current lighting codes, thus decreasing light pollution.

3.1.4 Sustainability of the Natural Environment

- **This section addresses initiatives resulting from two EOs regarding pollution prevention and other "green" sustainability practices. Climate change initiatives are also included.**

Sustainability is the capacity to achieve the missions of the U.S. Navy into the future without decline to the natural resource assets that support these missions, and without compromising the growth of future natural resources assets. As treated in this INRMP, the topic of sustainability incorporates the conservation of forest health in the face of long-term threats including climate change, and implementation of two EOs that address environmental management in the use of resources in the workplace, energy, and transportation.

Sustainability in Use of Natural Resources and Preventing Pollution

Energy, transportation, and day-to-day resources used in the workplace are sources of pollutants and waste. According to EO 13423 (January 2007) Strengthening Federal Environmental, Energy, and Transportation Management, sustainability of the natural environment means "to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations of Americans."

Executive Order 13148 of 21 April 2000 Greening the Government through Leadership in Environmental Management directed federal agencies to establish Environmental Management Systems (EMS) to achieve their internal pollution prevention goals through repeatable and consistent control of operations at all appropriate facilities. The DoN implements this through CNO policy (06 December 2001) Navy Environmental Management System Policy. The EMS is a formal management framework that provides a systematic way to review and improve operations, create awareness, and improve pollution prevention performance. According to CNO guidance, systematic environmental management as an integral part of day-to-day decision making and long-term planning processes is an important step in supporting mission readiness and effective use of resources. The most significant resource for every organization is their senior leadership's commitment and visibility in EMS implementation and sustainability. A robust EMS is essential to sustaining compliance, reducing pollution and minimizing risk to mission. The Navy EMS conforms to the International Organization for Standardization 14001:2004 EMS standard.

This EO required that each federal agency conduct a self audit of pollution prevention practices using an accepted EMS framework. Components of the approach include: advancing the national policy that, whenever feasible and cost-effective, pollution should be prevented or reduced at the source. Funding for regulatory compliance programs shall emphasize pollution prevention as a means to address environmental compliance. Each agency must reduce its use of toxic chemicals and hazardous substances; reduce the toxic release inventory and off-site transfers of toxic chemicals for treatment and disposal; develop a plan to phase out the procurement of Class I ozone-depleting substances for all nonexcepted uses; and promote the sustainable management of federal facility lands through the implementation of cost-effective, environmentally sound landscaping practices, and programs to reduce adverse impacts to the natural environment.

Sustainability in the Face of Climate Change

The evidence for human caused climate change is extensive and has generated consensus in the scientific community (Government Accounting Office [GAO] 2007; Gitay et al. 2002; Oreskes 2004). Addressing climate change poses a new challenge for natural resources managers who will need, in addition to understanding ecosystems as they function now and in the past, to anticipate future changes in ecosystem structure and function (GAO 2007; Glick et al. 2011). This is a task made more difficult due to the likelihood of emergent climates that do not have a present day analog.

- **According to Navy guidance, addressing climate change poses a new challenge for natural resources managers who will need to understand the changes in ecosystem structure and function anticipated from climate change, in addition to understanding ecosystems as they function now and as they have in the past.**

Identifying and adapting to the likely effects of climate change calls for a proactive rather than reactive approach to maintain cost effective programs and meet legal requirements to manage natural resources. Collaboration is particularly important as species and their assemblages are anticipated to shift in response to changing climate. There will not be a cookbook for managing under climate change but in some ways it will not be so different than managing under the present climate with all its variability. Climate change can be looked at as one more factor in a dynamic system.

Approaches to addressing climate change generally include one or more of the following three items: mitigation, adaptation, and research. Mitigation within the context of climate change refers to activities designed to reduce human impacts on the climate. Adaptation refers to activities that reduce the projected effects of a changing climate. Most of the focus within INRMPs will be on adaptation and research as mitigation generally falls outside of the realm of natural resources management.

Important concepts in adaptation to climate change are: *Resilience* - can something rebound from a disturbance (fire, flood) or extreme climatic event (drought) and *Sustainability* - does the long term rate of regeneration equal the rate of mortality or loss (could think of in terms of living organisms or resources like soils). One way to think about them is that under a stable climate we also manage for resilience and sustainability; climate change adds another stressor that can have direct and indirect impacts. When one takes this view an obvious place to begin is to evaluate whether the things we currently do to promote resilience and sustainability need to be modified. Glick et al. (2011) propose four broadly applicable adaptation strategies including the reduction of stressors, management of ecosystem function, the protection of refugia and habitat connectivity, and the restoration and proactive management of habitat.

The ecosystem effects of climate change will likely be incremental and challenging to separate from other drivers of ecosystem change. Addressing impacts to threatened and endangered species and their habitats from global climate change and developing modifications to natural resources management strategies to address them will require an adaptive process of developing, validating, and improving models in the creation of forecasts needed to inform management and perform comprehensive threats analyses.

Steps in this area of specialized forecasting can include the following:

1. Assess the vulnerability of species and ecosystems to climate change. Glick et al. (2011) state that climate change vulnerability assessments provide two important steps in adaptation planning. These steps are: A) identifying which species or systems are likely to be most strongly affected by projected changes; and B) understanding why these resources are likely to be vulnerable, including the interaction between climate shifts and existing stressors.
2. Identify trends in climate variability under the existing climate.
3. Add climate change to the threats analysis prepared as part of the INRMP process.
4. Participate in regional efforts to adapt to climate change, including identification and managment of migratory pathways to support species movement and habitat shift by use of existing borderlands, mitigation banks, and conservation buffers.
5. Once vulnerability assessments are completed update Best Management Practices (BMPs) to address the risks posed by climate change to unique landscapes, ecosystems and habitats.
6. Use already existing regional conservation partnerships and alliances to share information and collaborate across jurisdictions.

DoDINST 4715.03 states that to the extent practicable all installations use the best science available to 1) utilize existing tools to assess the potential impacts of climate change to their natural resources, 2) identify significant natural resources that are likely to remain on DoD lands or that may in the future occur on DoD lands and, 3) when not in conflict with mission objectives, take steps to implement adaptive management to ensure the long-term sustainability of those resources.

- **Regulatory drivers for climate change work on military bases include: 1) The Conservation Programs on Military Reservations Act (Sikes Act [as amended]) and 2) The Council on Environmental Quality (CEQ) draft administrative guidance which treats climate change impacts within NEPA documents. (CEQ Chairman Memorandum for Heads of Federal Departments and Agencies-Draft NEPA Guidance on Consideration of the effects of Climate Change and Greenhouse Gas Emissions, 18 February 2010).**

Regulatory drivers for climate change work on military bases include:

- The Conservation Programs on Military Reservations Act (Sikes Act (as amended) requires preparation of INRMPs in cooperation with the USFWS, a Service within the Department of Interior.
- The Council on Environmental Quality (CEQ) draft administrative guidance addresses the treatment of climate change impacts within NEPA documents. (CEQ Chairman Memorandum for Heads of Federal Departments and Agencies-Draft NEPA Guidance on Consideration of the effects of Climate Change and Greenhouse Gas Emissions, 18 February 2010). In this draft guidance, relevant to the preparation of environmental impacts analysis under NEPA to support INRMP decision-making, agencies are to use the NEPA process to "reduce vulnerability to climate change impacts, adapt to changes in our environment, and mitigate the impacts of Federal agency actions that are exacerbated by climate change" (CEQ Draft Guidance at Section I, para. 6).

Ecological Sustainability and Climate Change Objective

Objective: Maintain forest structure and function within its historic range, with allowances for actions required to address the anticipated reductions in precipitation, higher overall temperatures, and increase in fire potential associated with global climate change.

I. Identify and monitor forest species that can be indicators of a healthy forest, such as cavity-dependent and snag-dependent species. For example:

A. Protection of all Gambel oaks.

B. Overwintering cavity nesters that prefer larger trees, such as the hairy woodpecker, and the northern flicker.

C. Brown creeper because it uses snags for nesting.

D. Pygmy nuthatch because it is a tree trunk forager that is also a secondary cavity nester.

E. Presence of olive-sided flycatcher *(Contopus cooperi),* which needs mature stands of trees adjacent to meadows and is on the Audubon Watch List.

F. Squirrels because they need tree cavities.

G. Protection of all snags that are not hazard trees.

II. Identify conditions and monitor for a healthy prey base for the Mexican spotted owl.

III. Identify conditions of the understory that sustain forest health and biodiversity. Seek to improve the understory vegetation and soil condition.

IV. Consider climate-change related steps in the area of specialized forecasting vulnerabilities for NOFS natural resources, to include the following:

A. Participate in climate change study with regional partners, focusing on a vulnerability assessment for cavity nesting wildlife, the interaction of climate change with fire, and large ranging mammals.

B. Identify trends in climate variability under the existing climate.

C. Add climate change to the threats analysis prepared as part of this INRMP process, including annual updates and Metrics meetings.

D. Participating in regional efforts to adapt to climate change, including identification of migratory pathways to support species movement and habitat shift by use of existing borderlands, mitigation banks, and conservation buffers.

E. Once vulnerability assessments are completed, update BMPs to address the risks posed by climate change to local landscapes, ecosystems, and habitats, especially those supporting vulnerable species.

F. Use already existing regional conservation partnerships and alliances to share information and collaborate across jurisdictions.

G. Ensure that installation personnel have access to climate change education and outreach. Examples of resources include:

1. USFS Climate Change Resource Center maintains a site with formal training, tools, and information for land managers: www.fs.fed.us/ccrc/.

2. The Strategic Environmental Research and Development (SERDP) program website contains links to DoD sponsored research on natural resources conservation and climate change: www.serdp.org/ Program-Areas/Resources-Conservation-and-Climate-Change.

3. A number of online training resources can be used to develop a basic understanding of climate science and adaptation planning, including:

a. DoD Video Responding to Climate Change: http://www.dod-workshops.org/files/ClimateChange/CC-Animation.html.

b. USFS short course "Adapting to Climate Change": www.fs.fed.us/ccrc/hjar/index_st.html

Objective: Identify and implement means and metrics to promote environmental sustainability and comply with Executive Order 13423.

Energy and Transportation Sustainability Objective

I. Determine specific means to comply with the requirements to improve efficiency in the use of nonrenewable resources. Goals for strengthening federal agencies' management of the environment, energy, and transportation were established in the recent EO 13423 (January 2007), and can be used to guide NOFS in improving efficiencies. Figure 3-1 describes objectives of EO 13423 in more detail. Section 2 of the EO directs federal agencies to implement sustainable practices for:

- Energy efficiency and reductions in greenhouse gas emissions.
- Use of renewable energy.
- Reduction in water consumption intensity.
- Acquisition of green products and services.
- Pollution prevention, including reduction or elimination of the use of toxic and hazardous chemicals and materials.
- Cost-effective waste prevention and recycling programs.
- Increased diversion of solid waste.
- Sustainable design/high performance buildings.
- Vehicle fleet management, including the use of alternative fuel vehicles and alternative fuels and the further reduction of petroleum consumption.
- Electronics stewardship.

■ **According to EO 13423, sustainability of the natural environment means to create and maintain conditions permitting fulfillment of the social, economic, and other requirements of present and future generations. Goals for strengthening federal management of the environment, energy, and transportation were established under this EO. These goals are used to guide NOFS in improving efficiencies.**

A. Establish a demonstration garden that features sustainable water use and highlights beneficial pollinators as a theme.

■ **Establish a demonstration garden that features sustainable water use and highlights beneficial pollinators as a theme.**

II. Summarize possible sustainability metrics so that NOFS can respond to requests from within DoD or other federal agencies for regional data compilations and reporting. Consider the following metrics:

A. Improving soil health by reducing erosion and maintaining adequate ground cover and organic matter conditions for soil productivity.

B. Reduce threats such as populations of invasive or noxious weeds, and insect or disease outbreaks.

C. Prevent shading or overtopping of Gambel oaks by pines.

D. Use mechanical, integrated pest management, or (preferably) prescribed fire treatments to maintain a sustainable forest and a fire safe condition for the forest and to maintain the forest within its historic range of variation. Seek a means of reporting forest health based on departure from historic range of variation.

E. Reduce particulate matter and volatile organic compounds. Investigate the purchase of alternative fuel vehicles for official uses when replacing vehicles.

F. Consider sustainable paint alternatives when painting is needed, such as water-dispersible chemical agent resistant coating paint.

Figure 3-1. Objectives of Executive Order 13423.

CONTENT OF EXECUTIVE ORDER 13423 "STRENGTHENING FEDERAL ENVIRONMENTAL, ENERGY, AND TRANSPORTATION MANAGEMENT"

- Agency heads are directed to implement the appropriate sustainable practices and an appropriate Environmental Management System, including the appropriate management training, review, and audit procedures.
- A designated civilian officer, responsible for implementation of this order within the agency, will have the authority to monitor and report on related activities and success to the Chairman of the Council on Environmental Quality. "In light of subsection 317(e) of the National Defense Authorization Act for Fiscal Year (FY) 2002 (PL 107 107), not later than January 1 of each year through and including 2010, the Secretary of Defense shall submit to the Senate and the House of Representatives a report regarding progress made toward achieving the energy efficiency goals of the Department of Defense."
- Improve energy efficiency and reduce greenhouse gas emissions through a reduction of energy intensity by three percent annually through FY 2015, or thirty percent by the end of FY 2015, relative to a baseline of FY 2003.
- Ensure that at least half of the required renewable energy used by the agency in a FY comes from new sources, and to the extent feasible, the agency should implement renewable energy generation projects on agency property for agency use
- Beginning in FY 2008, reduce water consumption intensity, relative to baseline FY 2007, by 2 percent annually through the end of FY 2015, or 16 percent by the end of FY 2015.
- Require in agency acquisitions of goods and services use of sustainable environmental practices and use of paper of at least 30 percent post-consumer fiber content.
- Ensure that the agency: reduces the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of; increases diversion of solid waste as appropriate; and maintains cost effective waste prevention and recycling programs in its facilities.
- Ensure that new construction and major renovation comply with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding (2006), and that fifteen percent of the existing Federal capital asset building inventory of the agency, as of the end of FY 2015 incorporates the sustainable practices in the Guiding Principals.
- Ensure that, if the agency operates a fleet of at least 20 motor vehicles, the agency, relative to a baseline of FY 2005: Reduces the fleets total consumption of petroleum products 2 percent annually through FY 2015; Increases the total fuel consumption that is non-petroleum based by 10 percent annually; and Uses plug-in hybrid (PIH) vehicles when PIH vehicles are available at a cost reasonably comparable, to non-PIH vehicles.
- Ensure that when acquiring electronic products, meets at least 95 percent of those requirements with an Electronic Product Environmental Assessment Tool (EPEAT)-registered electronic product, unless there is no EPEAT standard for such product, enables the energy star feature on agency computers and monitors, and establishes and implements policies to extend the useful life of agency electronic equipment, and uses environmentally sound practices with respect to disposition of agency electronic equipment that has reached the end of its useful life.

3.2 Natural Resources Consultation Requirements

Consultation with the USFWS is required if an action with potential to affect a federally listed species, such as the Mexican spotted owl, is proposed. Consultation may result in the production of a concurrence letter or biological opinion (BO) when it is determined that an action may adversely affect a listed species or designated critical habitat. A BO describes the proposed action and reviews relevant biological information on federally listed species potentially affected by the action. It determines take, reasonable and prudent measures to limit take, and specifies terms and conditions of the action to be exempt from Section 9 of the ESA.

Naval Observatory Flagstaff Station has determined that only one federally listed threatened or endangered species, the Mexican spotted owl, has potential to be found within the vicinity of the project. Although critical habitat has been designated for the Mexican spotted owl, NOFS lands were not included in that designation. However, approximately 124 acres of NOFS falls within the Dry Lake PAC for the Mexican spotted owl as defined by the USFWS. The USFWS assumes the entire PAC to be occupied because of the presence of suitable habitat.

A series of BOs have been issued to NOFS since 1998 (refer to Appendix I for a copy of the BO and Section 7 Consultations). Due to the need to silviculturally thin the forest to reduce fire hazard, a biological assessment was completed in 1997 (Tierra Data Systems 1997). NOFS entered into Section 7 consultation with the USFWS seeking a programmatic long term (10 years) BO and incidental take permit based on the need to modify potential habitat to prevent a fire hazard. A BO (2-21-97-F-110) was issued by the USFWS on 23 July 1998. Due to changes in acreage in the proposed operation of 2002, the Navy requested reinitiation of a formal consultation. A revised BO (02-21-97-F-0110-R1) was reissued on 29 August 2003 (Appendix I). Other consultations on NOFS and the Mexican spotted owl include those on specific tree removal (2-21-01-I-371), exotic weed control (02-21-03-I-0202), and the erosion control program (02-21-04-I-0175) (copies of all can be found in Appendix I). Following completion of the INRMP, NOFS will request formal Section 7 consultation under the ESA to add prescribed burning to the forest management plan.

3.3 Planning for NEPA Compliance

NEPA is the basic national charter for the protection of the environment. It is a procedural planning tool which primarily requires a clear evaluation of all federal decisions potentially affecting the human environment. The NOFS must consider the environmental consequences of its actions before a commitment is made to proceed. However, NEPA itself does not prevent activities from being implemented. Unlike many other environmental regulations, the Act is not an enforcement tool punishable by fines for non-compliance.

The NEPA statute (as amended, 42 USC 4321-4370) and CEQ regulations (40 CFR parts 1500-1508) combine to represent the letter and spirit of NEPA. In addition, CEQ has issued some very helpful guidelines: Forty Questions (1981a); Scoping Guidance (1981b); and Guidance Regarding NEPA Regulations (1983) (*In*: Bass and Herson 1993).

The CEQ regulations and guidelines intend that federal agencies use procedures which will reduce paperwork and delay but will ensure adequate analysis (40 CFR 1500.4-1500.5; CEQ 1983). For example, expanding the number of projects or actions which deserve categorical exclusions (often referred to as CXs or CatExs, hereinafter CatExs) is one opportunity for improvement. Excessive documentation for CatEx projects is also discouraged. At NOFS, the environmental protection specialist at NAF El Centro is the lead for all NEPA planning processes, responsible for the documentation of all CatEx projects.

- **NEPA documentation for NOFS projects is currently provided by NAVFAC SW.**

Specific policy for compliance with procedural requirements was issued under a Navy Instruction (OPNAVINST 5090.1C CH-1). A proposed federal agency action is first reviewed to see if it can qualify for a CatEx (usually small, routine projects with no potential significant environmental effect; categories are identified in agency NEPA policies) or other exemption to the process. If not, then an Environmental Assessment (EA) is prepared. If the EA concludes adverse environmental impacts will not be significant, then the agency can file a Finding of No Significant Impact (FONSI), followed by its chosen action. If the proposed project has the potential to significantly affect the quality of the human environment, then the Environmental Impact Statement (EIS) process must be followed. Briefly, these steps are: Notice of Intent, Scoping Process, Draft EIS, agency/public Review and Comment, Final EIS, Record of Decision, and agency action. At NOFS, EAs and EISs are prepared jointly by the Natural Resources

Specialist at NAVFAC SW assigned to NAF El Centro, along with the environmental protection specialist based at NAF El Centro. The process of implementing NEPA can provide a useful planning tool to clearly evaluate the effects of decisions on the natural resources at the installation. However, it can cause considerable delay to projects if not all parties are involved in the process early in the planning process.

- **Land use and NEPA planning functions need to be assigned together with as much accountability as possible to ensure integration of proposed DoD actions.**

Initial planning stages of proposed DoD actions must also be integrated with the NEPA process "to ensure that planning and decisions reflect environmental values, to avoid delays later in the process, and to preclude potential conflicts" (32 CFR Ch.1, Part 188). To accomplish this integration, land use and NEPA planning functions need to be assigned together, with as much accountability as possible.

An EA has been prepared for this INRMP and addresses prescribed fire as a new management tool, recommended in this INRMP as described in Section 4.6: Forest Health Management.

Objective for NEPA Planning

Objective: Conduct planning of mission activities having potential environmental effects by applying NEPA's requirements and policies to enhance the mission-related use and the stewardship of natural resources.

Objective: Seek opportunities for streamlining environmental assessment procedures.

I. Ensure that land use planning decisions protect the mission of NOFS by seeking to resolve land use conflicts through the NEPA process.

- *A.* Ensure NEPA documentation is current for all activities.
- *B.* Conduct Environmental Quality Assessment annually.
- *C.* Conduct Environmental Compliance Evaluation every three years.

II. Assess the environmental consequences of each proposed action that could affect the natural environment, and address the significant impact of each action through analysis, planning, mitigation, and prevention.

- *A.* Ensure that any proposed NOFS action that has the potential for physical impact on the human environment undergoes the NEPA process, unless it is excluded in a previous document.
  - *1.* Include new activities, substantive changes in continuing actions, specific actions, or adoption of programs, for example: routine grounds maintenance such as erosion control measures or the use of herbicides and pesticides.
  - *2.* Conduct a thorough evaluation, including prior public comments, of a project to preclude preparation of NEPA documentation at an inappropriate level (i.e. CatExs, EA, EIS).

III. The NEPA planning process should facilitate project planning and integrate project-specific plans with overall land use and natural resources management plans.

- *A.* Integrate NEPA planning early with regular planning functions of each office.
  - *1.* Develop a brief manual (10 pages or fewer) of environmental precautions and other materials that would provide natural resources orientation and compliance guidelines for NOFS personnel. The manual would include BMPs for routine maintenance practices, and prevention practices for erosion, invasive species prevention. It would include a site approval form and decision guide for projects that require environmental documentation or consultation.
  - *2.* Technical assistance should be provided by staff to support other offices, when needed, before and after a proposed action is submitted for NEPA review, giving guidance on:

- *a.* Project design, site selection, and scope of work.
- *b.* Development of reasonable alternatives, including alternative sites.
- *c.* Selection of appropriate mitigations so the proposal integrates mitigation from the beginning; mitigation design should remain flexible and creative, and not cookbook.
- *d.* Importance of implementing BMPs as mitigation measures for environmental protection.

B. Communicate directly with all affected parties during the NEPA process to avoid misunderstandings and delays.

- *1.* Contact off-site interested and affected agencies and parties as soon as possible on projects with potentially significant environmental impacts, particularly if controversial.
- *2.* Cooperate with state and local agencies to the maximum extent practicable to fully address joint needs: environmental research and studies, public hearings and scoping sessions, EAs, and EISs.
- *3.* Consult with federally-recognized Indian tribes.

IV. Seek CatExs for actions which have been found not to have a significant effect on the human environment, individually or cumulatively.

A. Develop a list of actions which occur on NOFS regularly that experience has indicated will not individually or cumulatively have a significant effect on the human environment. An example may be the need to periodically trim or remove trees obstructing the telescopes.

B. Ensure that a CatEx determination is appropriate.

- *1.* Consider whether the cumulative effects of several small actions would cause sufficient environmental impact to take the actions out of the categorically excluded class (CEQ 1983). Coordinate with the Natural Resources staff to help ensure against this.
- *2.* Avoid procedures which would require the preparation of additional paperwork to document an activity that has been categorically excluded.

V. Prepare a concise EA when a CatEx cannot be used, or the significance of the impacts are unknown. EAs will follow a generic format containing:

A. Brief issue identification, following a structured scoping process.

B. A reasonable range of alternatives. In addition to the Proposed Action and the No Action alternatives, at least one other should be considered.

C. Summary of environmental impacts of the proposed action and the alternatives.

D. Documented references concerning proposed mitigation measures, some similar EAs, and pertinent studies in bibliography.

E. List of agencies and persons consulted.

F. No more than 15 pages in length.

VI. Ensure the EIS process is focused on major projects significantly affecting the quality of the human environment.

A. Reduce paperwork and delay during the EIS process:

- *1.* Follow CEQ requirements as well as CEQ's informal guidance for reducing excessive paperwork with EISs.
- *2.* Review existing Navy orders for NEPA to determine how the procedures could be more efficient in the EIS process while emphasizing real environmental issues and alternatives.

VII. All land use decisions should be supported by a concise record of the basis for the decision. NEPA documentation shall be used as this record.

3.4 Beneficial Partnerships and Collaborative Resources Planning

Cooperative management of NOFS' wildlife is required under Sikes Act (as amended) and the Fish and Wildlife Coordination Act. Like NEPA, the Fish and Wildlife Coordination Act is essentially procedural as no specific outcome is mandated. The USFWS and AZDGF have a statutory obligation to review and coordinate on INRMPs. Recognizing this key, three-way partnership in preparing, reviewing, and implementing INRMPs among the DoD, U.S. Department of Interior (DoI), USFWS, and State fish and wildlife agencies, a Tripartite Agreement was signed in January 2006. The AZDGF and other State fish and wildlife agencies were represented by the International Association of Fish and Wildlife Agencies. The desire is for "synchronization of INRMPs with existing Fish and Wildlife Service and State natural resource management plans" and "mutually agreed-upon fish and wildlife service conservation objectives to satisfy the goals of the Sikes Act (as amended)."

The Sikes Act (as amended) provides a mechanism whereby the DoD and DoI and host states cooperate to plan, maintain, and manage fish and wildlife on military installations. Sikes Act (as amended) provisions and cooperative agreements for outdoor recreation, such as for hunting and fishing, are implemented nationally by a Memorandum of Understanding (MOU) between the DoD and DoI. This INRMP requires collaboration by USFWS and AZGFD as part of the Sikes Act (as amended). The Sikes Act (as amended) no longer requires a Cooperative Agreement with the USFWS or AZGFD as a separate document; however, the 17 May 2005 DoD guidance states that joint review should be reflected in a memo or letters, and INRMPs do require collaboration by both agencies.

- **Department of the Navy policy calls for its installations to expand involvement in regional ecosystem planning, management and restoration initiatives.**

The DoN policy calls for its installations to expand involvement in regional ecosystem planning, management, and restoration initiatives (DoN 1994a). Establishing cooperative planning efforts with surrounding land agencies and individuals will benefit NOFS' natural resources and those of the entire region. Cooperative planning can also reduce the costs of actions that require management across boundaries such as erosion control or biological surveys.

3.4.1 Regional Biodiversity and Conservation Planning

Currently, NOFS is an active partner in the Encroachment Action Plan (EAP) Team as discussed in Section 3.6. Encroachment Partnering. In addition to this partnering association geared specifically towards encroachment issues, NOFS should remain proactive in regional resources planning issues in order to ensure its military mission as well as its own natural resources management goals and objectives are met. "Partnerships" among private, local, state, tribal, and federal interests are vital to help realize ecosystem management, the basis for management of DoD lands and waters (DoD 1994a). Federal agencies have legal obligations toward listed species like the Mexican spotted owl, and 'preserving all the parts' is central to the ecosystem management approach mandated by DoD. At the same time, ecosystem management involves going beyond merely addressing short-term, single species management confined to individual land parcels. The Recovery Plan for the Mexican Spotted Owl (USFWS 1995b) attempts to make recommendations for forest management that benefit many species, using the owl as a kind of umbrella species. Emphasis is on developing sound strategies to maintain ecosystem processes and long-term forest health for all species native to the southwestern ponderosa pine ecosystem that might otherwise fall through the cracks with a solely single-species management focus. The habitat needs of these native species likely represents a range of plant species composition and structural conditions found historically in the area, rather than any one set of habitat conditions. Ecosystems and the species that populate them also transcend administrative boundaries, and their conservation can best be accomplished through cooperative ventures.

The consortium of federal, state, and local partners under the Greater Flagstaff Forests Partnership (GFFP) is particularly relevant. The three primary goals of GFFP are:

- Restore the natural ecosystem functions-within the range of natural variability-of the ponderosa pine forests in Flagstaff's Urban Wildland Interface.
- Manage forest fuels within the Urban Wildland Interface to reduce the risk of high severity fire.
- Research, test, develop, and demonstrate key ecological, economic, and social dimensions of restoration efforts.

Although the NOFS property is small, it has a role to play in regional fire management and ecosystem function. The Navy should at least coordinate regularly with GFFP as a local land steward with common management issues. The planned forest management on the NOFS property and pre- and post-thinning microhabitat monitoring will likely contribute to land management and scientific understanding and be of considerable interest to GFFP.

Collaboration and Partnership Objective

Objective: Be proactive in cooperative resources planning partnerships to create regional conservation, ecosystem, and watershed solutions of mutual benefit while also protecting the military mission.

Objective: Seek consistency with the goals and objectives of regional wildlife plans, such as the Mexican spotted owl recovery plan and the AZGFD's Comprehensive Wildlife Conservation Plan, where consistent with local NOFS mission and natural resources priorities.

I. Continue to participate in the EAP and seek to purchase land as an additional buffer to protect the military mission.

See also Section 3.6: Encroachment Partnering

II. Participate in regional conservation and ecosystem planning efforts, in collaboration with other government agencies.

See also Section 3.7: State Wildlife Action Plan and Regional Wildlife Plans

A. Base NOFS' involvement on the following criteria:

1. Evaluation of agreements that may encumber land or resources now or in the future. Emphasize the critical importance of ensuring continuation of the military mission and its unique attributes which cannot be replaced.

2. Evaluation of the potential benefits to NOFS' natural resources.

B. Pursue pertinent DoD ecosystem management policies, including:

1. Maintain and improve the sustainability and biological diversity of the ecosystem at the local landscape and other relevant ecological scales.

2. Promote development of the best available scientific and field-tested information for use in land management decisions.

3. Actively support U.S. Navy and USFWS partnering.

4. Become a nonbinding partner in the Grand Canyon Forest Partnership.

C. Through the NOFS Natural Resources Partnering Team, NOFS will incorporate components of Arizona's Comprehensive Wildlife Conservation Strategy (CWCS) through the identification of management focus species from the CWCS. NOFS will participate in regional monitoring efforts as appropriate.

See also Section 3.7: State Wildlife Action Plan and Regional Wildlife Plans

D. As appropriate, NOFS will consider participating in regional ecosystem and conservation planning efforts such as Landscape Conservation Cooperatives, and other regional working groups.

III. Seek fire planning partnerships and consider prescribed burns conducted with adjacent landowners if compatible with the telescope and mission activities.

IV. Consult with USFWS and AZGFD at least annually to fulfill Sikes Act (as amended) provisions and related interagency cooperative agreements.

A. Ensure compatibility with INRMP goals, objectives, and policies as well as internal consistency in future inter-agency agreements and plans.

B. Involve state and federal resources agencies in the implementation of INRMP objectives and policies when practicable.

C. Promote information sharing and scientifically-based, coordinated data collection and management planning.

D. The AZGFD's Project Evaluation Program should be contacted to determine if an action will impact wildlife resources. As appropriate, the Flagstaff Regional Office of AZGFD may also be notified of projects in addition to the Project Evaluation Program, or the USFWS.

E. Continue to participate in the NOFS Natural Resources Partnering Team in order to identify and (potentially) address agency concerns informally in advance of project proposals. The NOFS Partnering Charter is noted below Figure 3-2).

F. Support State Wildlife Action Plan (SWAP) goals and objectives (see Section 3.7: State Wildlife Action Plan and Regional Wildlife Plans).

G. Support USFWS regional goals such as the Recovery Plan for the Mexican spotted owl as well as local collaborative efforts such as the Greater Flagstaff Forests Partnership.

H. Review metrics for the installation so that questions in the INRMP metrics builder online can be answered annually. See Table 5-1 through Table 5-5 in Chapter 5 for an example of NOFS natural resources metrics.

Figure 3-2. Naval Observatory Flagstaff Station Partnering Charter.

FINAL CHARTER FOR NOFS PARTNERING TEAM

Vision

The DoN, USFWS, AZGFD, and ASLD will compose the Natural Resources Partnering Team (NR Partnering Team) that will work cooperatively to maximize natural resources stewardship at NOFS while meeting national defense requirements.

Mission

The Natural Resources Partnering Team will implement and develop the INRMP and revise as necessary. The Partnering Team will also coordinate issues and projects proposed as part of the NOFS natural resources program while meeting NOFS operational goals.

Goals and Objectives of Cooperation

- Openly discuss and seek to understand each other's rules, policies, and practices.
- Maintain compliance with policies, regulations and laws.
- Resolve natural resources problems and issues as they arise.
- Establish trust and respect among all stakeholders.
- Coordinate natural resources project development with all stakeholders.
- Meet annually (or more frequently if needed) to develop future projects and to discuss issues that may affect natural resources at NOFS.
- Maintain continuity of habitat with adjacent lands.

Goals and Objectives of the Natural Resources Program

- Develop innovative solutions that enable NOFS to meet it's mission while protecting natural resources.
- Seek to identify mitigation alternatives that protect natural resources at NOFS and enable the Navy to meet its mission critical objectives.
- Promote habitat stewardship.
- Maximize fire protection for the Observatory.
- Promote plant and animal community diversity.
- Conduct research and monitoring activities as appropriate.

Measures of Success

- Sustained and consistent attendance of Team members at Team activities.
- Implementation of solutions regarding natural resources issues guided by the policies, rules and mission requirements of the Team member's respective agencies.
- Complete an annual review and five-year revision of the NOFS INRMP in a timely and cooperative fashion.
- Demonstrate ability to resolve conflict in a positive and timely manner.

3.5 Public Access and Outreach

3.5.1 Public Access

Department of Defense installations are to provide for sustained public access and use of natural resources for educational or recreational purposes when such access is compatible with mission activities, and with other considerations such as security, safety, or resources sensitivity (DoD 1996[1]). The NOFS is not open to the public; however, only the areas immediately around buildings and facilities are fenced. This has led to some trespassing concerns on the undeveloped portions of the installation.

There are numerous unpaved roads leading onto the property from adjacent federal and state lands. Occasionally NOFS personnel have found evidence of camping or firewood cutting on installation property. These activities could potentially affect wildlife, serve as ignition sources for wildfire, and pose liability problems for the Navy.

The Navy is required to provide outdoor recreation and interpretive opportunities to the public where and when it is compatible with military needs. Outdoor recreation, as defined for the purposes of this section, is the active use of the installation's natural resources for recreation and physical exercise.

There is no special demand for use of NOFS property for recreational access, neither by the public nor its DoD employees. The forested areas of the installation do not provide any unique activities that are not already available on the thousands of acres of surrounding USFS land.

NOFS also does not have the water, facilities, or funds to support a formal visitor program for interpretative purposes. However, local schools can and do arrange occasional field-trips to the Observatory. The nearby Lowell Observatory has a well-developed public program and interested parties are directed to visit this privately-owned facility.

NOFS does not have the capability for an extensive public access and recreation program for several reasons, including the following.

- There are general security and liability issues, and the telescope instrumentation is sensitive to radio interference, smoke, and light that could arise from greater public use of the property.
- Fresh water must be trucked in to the facility from off site, and there are currently inadequate water supplies to support a formal visitor program and large numbers of public visitors (although drop-in tours are sometimes supported).
- Any outdoor recreation that might be provided should be non-mechanized to provide fire safety, and day use only.
- NOFS is small and surrounded by thousands of acres of National Forest recreational land available to the public.

There is no current authorized hunting and fishing on the property, and hunting is not encouraged. Despite the inappropriateness of a formal recreation and public access program, local schools are allowed to conduct field trips at NOFS and bicyclists occasionally come up to the Observatory and do a turnaround. Additionally, NOFS participates in a week-long Festival of Science held in the area, along with the University, USGS, city of Flagstaff and others. A contest placed in the newspaper, the *Arizona Daily Sun*, allows people a chance to Name an Asteroid.

Consistent with the Sikes Act (as amended), when planning for public access NOFS makes considerations for disabled American veterans, military dependents with disabilities, and other persons with disabilities to the extent reasonably practicable and when not in conflict with the military mission.

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1. **DoDINST 4715.03 -Environmental Conservation Program Issued 18 March 2011. Available online at: http://www.dtic.mil/whs/directives/corres/dir.html**

Public Access Objective

Objective: Limit public access to temporary uses that are compatible with NOFS mission, natural resources responsibility, safety, and security.

I. Establish clear, coherent policies regarding public access to NOFS.

A. Planning for public access shall consider, but not be limited to, the following topics (DoDINST 4715.03):

1. Eligible users of installation resources and facilities, including the installation's method of determining user eligibility and priorities
2. Procedures required for the public to gain access
3. Accessible and off-limits resources, areas and facilities
4. Areas designated for special use
5. Points of access and egress
6. Periods of access
7. List of permitted and prohibited activities
8. Schedule of fees and charges and who collects and keeps the funds
9. Personal injury and property liability policy
10. Access agreements with agencies and organizations, including Native American access to traditional cultural sites
11. Installation-established access quotas to reflect installation operational and wildlife carrying capacity.

B. Protect sensitive resources from incompatible public uses.

C. Provide access for agencies and others to conduct natural resources research on the installation to the extent it does not interfere with the military mission or resources sensitivity. Any studies or surveys must be approved by the Commanding Officer.

D. Continue to allow volunteer organizations to harvest native seed on a case-by-case basis.

II. Take active measures to discourage trespass.

A. Install locked gates across entrances to dirt roads to prevent unauthorized vehicular traffic.

B. Annually check that all no trespassing signs around the property boundary are still intact.

C. Report any incidences of trespass to local law enforcement agencies including the USFS or state land agencies.

D. Ensure that maps and any other informational materials provided by adjacent land owners to the public clearly show the boundaries of NOFS.

III. As appropriate with the mission and to the extent practical, support access for disabled American veterans, military dependents with disabilities, and other persons with disabilities.

3.5.2 Public Outreach

Objective: Build a strong conservation ethic and commitment to natural and cultural resources stewardship through the promotion of education and awareness of the unique environmental setting and history of NOFS, as well as the NOFS mission.

Public Outreach Objective

I. Continue to participate in the annual science festival.

II. Continue to allow occasional visitations by school groups as resources and time provide. Provide education/visits of cavity-nesting species in the forest.

III. Identify astronomy and natural resource themes for public outreach. Examples are cavity-nesting species including birds, bats, etc.

- *A.* NOFS should routinely produce press releases for venues such as the Society for Environmental Journalists or the Navy Currents magazine.
- *B.* Produce a NOFS natural resources brochure and other educational materials.
- *C.* Develop a conservation kiosk or other interpretive signs in the Operations Area. Integrate with a demonstration garden that emphasizes beneficial pollinators and sustainable water use practices. Partner with local native plant and garden clubs as appropriate. Consider establishing bat boxes on-site to promote awareness and interest in bats as an important component of the native ponderosa pine-Gambel oak forest. Consider the opportunity to enhance bird habitat in the garden plan, such as the use of artificial aids, such as nest boxes for bluebirds.
- *D.* Continue to participate in the local Festival of Science event.
- *E.* Support and encourage local school field trips.

3.6 Encroachment Partnering

Naval Observatory Flagstaff Station is the largest collection of Navy telescopes, and contains the single largest telescope operated by the Navy. There is currently no other Navy facility capable of performing its mission. If the Navy were to move this capability to another site due to local sky degradation (e.g. light pollution), it would cost tens of millions of dollars.

- **No other Navy facility can perform the mission of NOFS. The largest collection of Navy telescopes, including the single largest telescope operated by the Navy, is located here.**

The natural resources management program must provide for forest health and conserving native diversity to the maximum extent possible, while providing the necessary dark sky conditions for telescopes, fire safety, and protection from airborne particulates that could affect the telescope lenses.

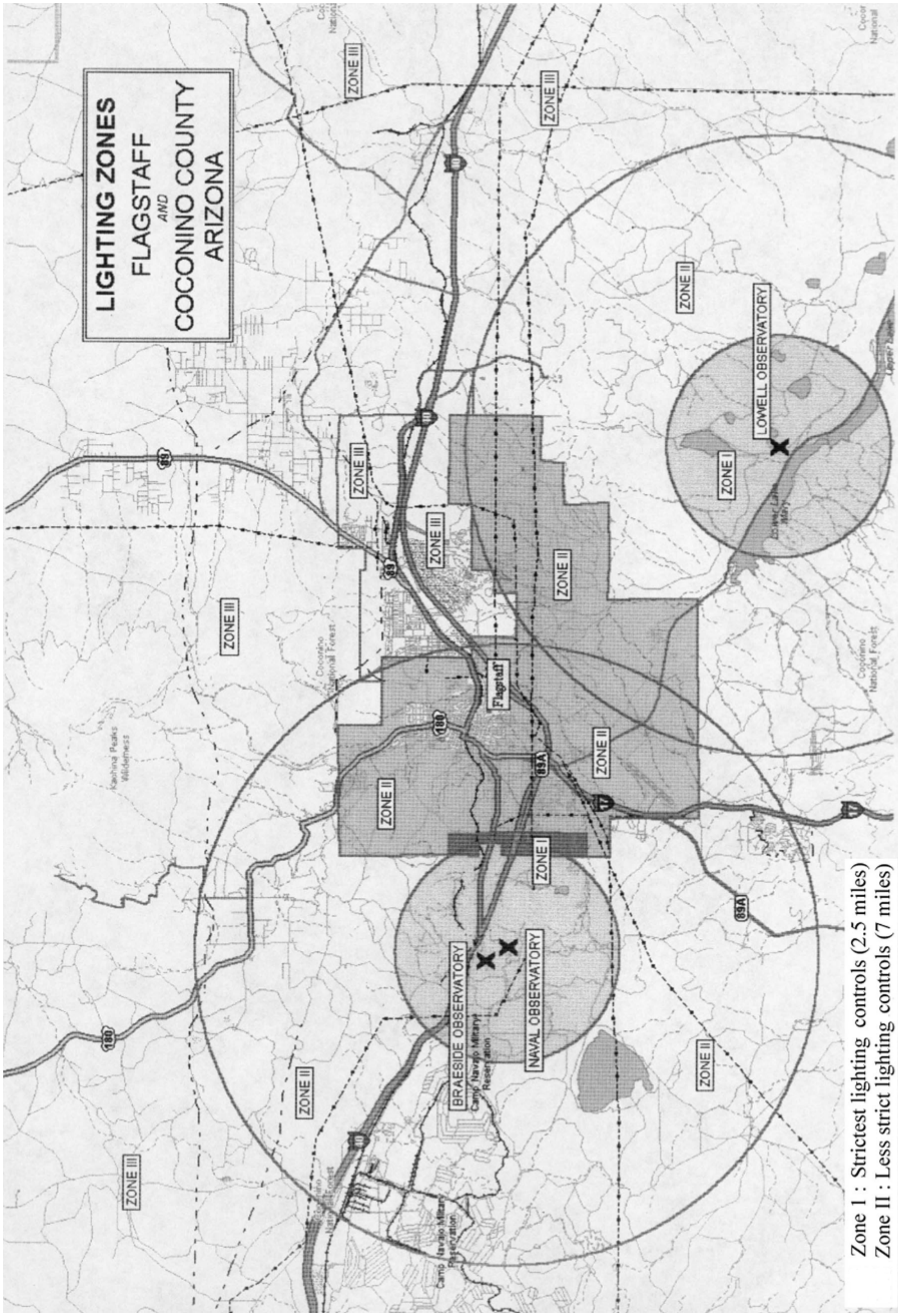
The Navy definition of encroachment is defined in OPNAVINST 11010.40: “Any Navy or non-Navy action planned or executed in the vicinity of a Naval activity or operational area which inhibits, curtails, or possesses the potential to impede the performance of the mission of the Naval activity.” The instruction also defines encroachment to be any lack of action by the Navy to coordinate with local jurisdictions, monitor the development plans of adjacent communities, or adequately manage facilities and real property.

The FY 2003 Defense Authorization Act included a provision, codified as Title 10 USC 2684a, which provided a new tool to help control encroachment by executing agreements with public and private partners to acquire real estate interests near installations to help preclude environmental restrictions on military training and testing operations. Areas suitable for these encroachment partnering agreements are to be identified during the development and revision of INRMPs and mapped as a GIS theme and reported up the chain to program needed funding (CNO Guidance April 2006). The idea is to work with installation planners to identify natural areas adjacent to the installation, that if set aside through these agreements, can protect current and future mission requirements. CNIC N46 is the resource sponsor for encroachment partnering projects.

Photo 3-1 depicts a Google Image™ aerial view of NOFS looking towards Flagstaff in an east north-easterly direction from an altitude of approximately 18,000 feet. The Dry-Lake subdivision is readily apparent in the view, illustrative of recent developments between the city boundaries and NOFS.

Encroachment of local communities and their associated activities is a very important issue to NOFS. Regional light usage is a concern, and neighboring land use codes require vigilant monitoring. Also, smoke generated by forest practices and the emission of radio waves in large quantities on neighboring property can be problems. Light usage and land use within 2.5 miles of the Observatory is of highest concern. Coconino County and the city of Flagstaff identify this area as Zone 1 (Refer to Map 3-1). In order to promote the relationship of distance to lighting pollution, three astronomical zones (Zone I-III) were established, with the strictest lighting controls in the zones containing the observatories (Refer to Table 3-1 for specific Zone regulations). Zone I encompasses all land within a 2.5-mile concentric area surrounding each of the following locations: the Kaj Strand telescope at the Naval Observatory, the Hall telescope at Lowell Observatory on Anderson Mesa, and Roden Crater. Developed in a joint venture with scientists from the Naval Observatory, these zones were established to encompass the expected-high density development in the vicinity of NOFS, including Flagstaff Ranch. The second zone was established at a distance where the impacts of outdoor lighting would fall to one-half of the impact exhibited within the first zone.

Photo 3-1. Aerial view of Naval Observatory Flagstaff Station depicting encroachment liabilities. Imagery provided by Google Earth™ accessed June 1, 2007.



Map 3-1. Lighting zones for Flagstaff, Coconino County, Arizona (see Table 3.1 for explanation of zones).

Table 3-1. Flagstaff Lighting Code: Zone Regulations (Coconino County Zoning Ordinance, accessed at the Coconino County Website.)

ZONE 1 SPECIAL REQUIREMENTS:

- A. Total outdoor light output (excluding streetlights used for illumination of public rights-of-way) of any development project in Zone I shall not exceed 25,000 lumens per net acre, averaged over the entire project. Non-LPS lighting permitted in Table 10-08-002-0005 is limited to a total of 5,500 lumens per net acre, except that lamp(s) emitting no more than 4,720 lumens per single family dwelling unit or duplex dwelling unit for residential outdoor lighting purposes are exempt from the shielding requirements of Table 10-08-002-0005, though they must conform to all other applicable restrictions. Single-family attached units (e.g. townhouses), and multi-family residential units are limited to 2360 lumens of unshielded lights per unit.
- B. Outdoor recreational facilities are not subject to the lumens per net acre limit set in this Subsection. However, no such facility in Zone I shall be illuminated after 9:00 pm, except to conclude a scheduled recreational or sporting event in progress prior to 9:00 pm.
- C. Outdoor internally illuminated advertising signs shall be constructed with an opaque background and translucent letters and symbols. (Opaque means that the material must not transmit light from an internal illumination source.) Lamps used for internal illumination of such signs shall not be included in the lumens per net acre limit set in this Section. Such signs shall be turned off at 9:00 pm or when the business closes, whichever is later.
- D. Class 3 lighting must be extinguished at 9:00 pm or when the business closes, whichever is later, except that low-wattage holiday decorations may remain on all night from November 15 through January 15.

ZONE II SPECIAL REQUIREMENTS:

- A. Total outdoor light output (excluding streetlights used for illumination of public rights-of-way) of any development project in Zone II shall not exceed 50,000 lumens per net acre, averaged over the entire project. Furthermore, no more than 5,500 lumens per net acre may be accounted for by lamps in unshielded or partially-shielded fixtures permitted in Table 10-08-002-0005, except that lamp(s) emitting no more than 4,720 lumens per single family dwelling unit or duplex dwelling unit for residential outdoor lighting purposes are exempt from the shielding requirements of Table 10-08-002-0005, though they must conform to all other applicable restrictions. Single-family attached units (e.g. townhouses), and multi-family residential units are limited to 2360 lumens of unshielded lights per unit.
- B. Outdoor recreational facilities are not subject to the lumens per net acre limit set in Subsection 10-08-002-0007.A. However, no such facility in Zone II shall be illuminated after 11:00 pm, except to conclude a scheduled recreational or sporting event in progress prior to 11:00 pm.
- C. Outdoor internally illuminated advertising signs shall be constructed with an opaque background and translucent letters and symbols, or with a colored (not white, cream, off-white, or yellow) background and lighter letters and symbols. Lamps used for internal illumination of such signs shall not be included in the lumens per net acre limit set in this Section. Such signs shall be turned off at 11:00 pm or when the business closes, whichever is later.
- D. Class 3 lighting must be extinguished at 11:00 pm or when the business closes, whichever is later, except that low-wattage holiday decorations may remain on all night from November 15 to January 15.

ZONE III SPECIAL REQUIREMENTS:

- A. Total outdoor light output (excluding streetlights used for illumination of public rights-of-way) of any development project in Zone III shall not exceed 100,000 lumens per net acre, averaged over the entire project. Furthermore, no more than 5,500 lumens per net acre may be accounted for by lamps in unshielded or partially-shielded fixtures permitted in Table 10-08-002-0005, except that lamp(s) emitting no more than 4,720 lumens per single family dwelling unit or duplex dwelling unit for residential outdoor lighting purposes are exempt from the shielding requirements of Table 10-08-002-0005, though they must conform to all other applicable restrictions. Single-Family attached units (e.g. townhouses), and multi-family residential units are limited to 2360 lumens of unshielded lights per unit.
- B. Outdoor recreational facilities are not subject to the lumens per net acre limit set in Subsection 10-08-002-0008.A. However, no such facility in Zone III shall be illuminated after 11:00 pm except to conclude a scheduled recreational or sporting event in progress prior to 11:00 pm.
- C. Outdoor internally illuminated advertising signs shall either be constructed with an opaque background and translucent letters and symbols or with a colored (not white, cream, off-white or yellow) background and lighter letters and symbols. Lamps used for internal illumination of such signs shall not be included in the lumens per net acre limit set in the Subsection. Such signs shall be turned off at 11:00 pm or when the business closes, whichever is later.

The following summarizes the general status of encroachment issues for NOFS.

City and County Plans. NOFS has received much support from both the City and the County, and is routinely supported, such as when they opposed a nearby zoning change to commercial. The local lighting code broke new ground and is recognized internationally for both limitations on lights per acre and limiting lums to 25,000/acre. In order to promote a compact land use pattern, the Flagstaff Area Regional Land Use and Transportation Plan (Regional Plan) designated Urban and Rural Growth Boundaries (UGB) with sufficient land inside the boundaries to meet the needs of the Flagstaff metropolitan region for the next 30 years or more. The intent of these growth boundaries is to limit sprawl, protect open spaces, and assure that growth occurs in areas where services can be efficiently provided.

Although development is restricted outside the UGB, the end of the western boundary is still roughly one-half mile outside of the boundary of the observatory. This section of the UGB does, however, encase the subdivisions that were discussed earlier in Chapter 2 and therefore, is predicted to have the most impact on the observatory. Due to the constraint on development that the UGB poses, expansions of those communities are more profitable to the developers than in the past. This will in essence be a driving force for the developments. If development increases, light pollution from artificial lighting closely associated with subdivisions and suburbs will increase as well.

Private Development. Private lands occupy 2.8 square miles, or 1,800 acres within 2.5 miles of NOFS, most to the east and southeast. Flag Ranch subdivision, with a golf club and business park, has recently been established about one mile away (the zoning change occurred in 1980s). This will bring more people and potential visitors to NOFS, as well as potential trespass or demand for outdoor recreation values. The city of Flagstaff plans to annex Flagstaff Ranch. NOFS has opposed commercial rezoning within 2.5 miles of NOFS, and has been consistently supported by county planners.

State Lands. The Arizona State Lands Department (ASLD) has a long-term lease with NAU to manage the 'Centennial Forest,' an experimental forest on lands directly adjacent to NOFS. The Centennial Forest (NAU) manages more than 47,000 acres around the city of Flagstaff. The lease does not protect the lands from being sold should the ASLD receive a request to purchase any of these lands. NAU hopes to negotiate a more permanent agreement with ASLD in the future.

Arizona Preserve Initiative. The Arizona Preserve Initiative (API) advocates for the conservation of designated state trust lands, especially environmentally sensitive parcels surrounding urban and rural areas, although it is currently in suspension due to challenges over the legislation’s constitutionality. The certain types of land that could be included would be parks and trails, ranches and farms, and would add to the open space of Arizona amidst the expansion of cities and towns. It was signed into law in the spring of 2006.

A parcel could be classified under the API if the parcel is located within one mile of municipalities of less than 10,000 people, or if the land is within three miles of municipalities with a population equal to or more than 10,000 people. With amendments made in 1997, 1998, and 1999, lands were added to the list of parcels that could be considered for conservation. If a parcel of land is not already classified for conservation under API, the state or local government, business, state land lessee, or citizens can petition to the State Land Commissioner to have that piece of land reclassified for the purpose of conservation.

As an open space-planning tool, the API identifies key features and resources that need to be protected from encroachment. Legally, all state land is to be leased or sold to increase funds for the trust; when a restriction is placed on the type of usage of State Trust Lands, this defeats the purpose and therefore unconstitutional.

Arizona Department of Transportation. Arizona Department of Transportation (ADOT) has installed high-mast lighting on poles more than 100 feet tall over the new interchange for I-40 and I-17. These provide 10 percent of the light put out by the entire city of Flagstaff. However, ADOT is not required to comply with local requirements such as the city of Flagstaff lighting codes. Although ADOT supports the local community, NOFS has been unsuccessful in pressuring them to shield their lights or use low pressure sodium to reduce the lum output (these are preferred because of their narrow spectral output).

U.S. Forest Service. USFS lands border NOFS to the east and north, and include about six square miles within 2.5 miles of NOFS. In 1983/1984, land exchange of federal lands led to privatization of about 300 acres within one-half mile of NOFS. At NOFS’ request, the USFS imposed a 10-year moratorium (until the mid-1990s) on further exchanges in the area. In 1993/1994, NOFS initiated discussions with the USFS to extend the moratorium. The USFS has assured NOFS verbally that there was no intention to exchange further lands near NOFS. NAVFAC SW has been unsuccessful in securing a signed written agreement from the USFS to this effect.

The USFS' Townsite Act allows in the 11 western states for the purchase of up to 640 acres of USFS land adjacent to an established city. The land can be sold for fair market value so long as the land will be purchase for the well being and benefit of the existing city. Any plans for development that would alter characteristics of the community currently in existence will be denied. The applicant needs to show further that the benefits of the land for the community will be greater than if the land would be retained under the USFS.

Objective for Encroachment Partnering

Objective: Continue to collaboratively plan to acquire buffer properties that, when combined with additional purchases by individual partners, will effectively curtail urban encroachment within the vicinity of NOFS, as well as allow open space and natural resources benefit for agency partners.

I. Naval Observatory Flagstaff Station should continue to partner with the following organizations/agencies to acquire or otherwise secure high priority locations to prevent light encroachment on dark sky conditions needed to sustain the mission:

- Encroachment Action Plan Team. As the blueprint for an installation's Encroachment Management Program, an EAP provides a formal structure for proactive identification and management of existing and emerging encroachment challenges. The developing EAP for NOFS contains an identification, quantification, and prioritization of potential encroachment challenges it faces. It also offers recommended preventive or corrective actions, strategies, and tactics that can be proactively implemented by NOFS to manage those encroachment challenge.[1]
- Arizona Game and Fish Department.
- Coconino County Parks and Open Space Program.
- U.S. Fish and Wildlife Service.
- Other local Department of Defense agencies such as Camp Navajo.

II. Continue to comment on development projects that may affect lighting, dust, or other effects on the mission at NOFS.

A. Develop community partnerships and partnerships with other observatories to prevent encroachment.

3.7 State Wildlife Action Plan and Regional Wildlife Plans

Arizona Comprehensive Wildlife Conservation Plan

Congress asked each state to develop a Wildlife Action Plan to examine the health of wildlife and prescribe actions to conserve wildlife and vital habitat before they become more rare and more costly to protect. In response, AZDFG developed Arizona's CWCS (AZGFD 2006). The CWCS plans for the conservation of species and their habitats and recommends conservation actions that address stressors to habitats. It calls for partnerships between a multitude of institutions in Arizona with a stake in wildlife and land management. The CWCS provides guidance to these partnering institutions by identifying wildlife and habitat conservation goals and information needs at a strategic level.

The AZDFG first identified its Species of Greatest Conservation Need. It then collected information on the distribution and abundance of species of wildlife, including low and declining populations, that are indicative of the diversity and health of the state's wildlife. Working at large and small landscape scales, the plan first develops conservation actions to address stressors to habitats. This approach is meant to benefit all wildlife,

- **For measures regarding how NOFS will coordinate with Arizona's Wildlife Action Plan, see Section 3.4.1: Regional Biodiversity and Conservation Planning.**

1. The EAP was completed in October of 2008. As of writing, the EAP is awaiting formal approval by the Commanding Officer of the Navy Region Southwest, which must occur prior to implementation.

including both vulnerable and common species, by managing for the habitat and resources upon which they depend. An example of this type of conservation action would be to identify important wildlife movement corridors and protecting them to minimize habitat fragmentation. To facilitate conservation of many species acting at different scales, Arizona's CWCS uses a multi-scale approach to classifying habitat types within Arizona. At the finest scale, specific habitat features (such as snags, nesting cavities, or caves) that are necessary for the well being of many species were identified.

Conservation strategies for Arizona's CWCS are:

Conserving wildlife habitat

- Promote the restoration and protection of aquifers, springs, streams, rivers, lakes, and riparian systems. Support regulations ensuring minimum instream flow and water rights for wildlife resources.
- Perform landscape classification analyses to identify sensitive habitats, core wildlife areas, and important wildlife corridors.
- Acquire ecologically important lands, access agreements, conservation easements, and/or water rights.
- Support State planning efforts to address drought issues as they relate to wildlife resources.
- Promote maintenance and restoration of habitat connectivity by removing or modifying barriers, protecting corridors and riparian areas, and using wildlife-friendly roadway crossing structures.
- Promote maintenance and restoration of habitat connectivity by removing unneeded fences, by using wildlife-friendly barriers in future projects and when replacing old fences.

Maintaining and re-establishing habitat and habitat connectivity

- Develop standards for new road, utility and power lines construction, and modification of existing structures and corridors to reduce impacts to wildlife.
- Promote implementation of recovery plans, habitat conservation plans, and other cooperative agreements for sustaining wildlife resources. Develop plans to conserve priority conservation species (Focal Community; Responsibility, and Vulnerability categories) that are not sufficiently addressed under existing plans.
- Manage so as to sustain or enhance sport fish and native fish populations.
- Develop contingency plans for rapid salvage of wildlife populations threatened with extirpation in situations of imminent habitat loss.
- Maintain and construct new wildlife water developments. Encourage conversion of livestock waters so they are also continuously usable by wildlife.
- Collaborate with partners to evaluate sampling techniques, reduce duplication of effort, and develop pathogen decontamination protocols to limit impacts to wildlife.
- Collaborate with partners on disease/pathogen/parasite issues to wildlife including: development of action plans to manage existing sources, identify and respond to new threats, and to educate the public.
- Evaluate, update, and enforce existing AZGFD regulations to address evolving concerns about hybridization, nuisance animals, illegal stocking, and spread of animals used for bait.

Wildlife management

- Reduce/eliminate the effects of feral animal populations in sensitive habitats or near wildlife populations of concern.
- Educate the public about the impacts of free-ranging or feral animals, release of nonnative species, and illegal stocking of fish and live bait on wildlife resources. Increase enforcement of existing laws and promote more stringent laws prohibiting the release of domestic or nonnative animals into the wild.
- Utilize education and enforcement to promote human behavior that does not encourage wildlife to become a nuisance (for example: feeding wildlife, securing waste containers, and storage of food).

- Increase awareness of effects of feeding and litter on wildlife.

Public education and law enforcement to benefit wildlife and wildlife habitat

- Increase public awareness of how water conservation and ensuring instream flow can benefit wildlife.
- Encourage the use of low water-use native plants in landscaping.
- Educate the public regarding identification of contaminants, release prevention, and impacts to wildlife and habitats. Promote alternatives that reduce release of contaminants.
- Encourage cooperative clean up efforts of wildlife habitats.
- Increase public awareness of the potential effects of various types of recreation on wildlife resources. Encourage responsible outdoor recreation through education (for example: *Stay on the Trails, Leave No Trace, Be Bear Aware, Stop Aquatic Hitch-hikers*), enforce existing laws, and encourage development of new legislation.
- Inform the public and land management agencies on the effects of illegal harvest of wildlife.
- Cooperate with land management agencies to increase enforcement of existing laws.
- Support prevention and suppression of accidental or arson-caused wildfire through information and education and enforcement of appropriate regulations.
- Educate the public on the importance of community focal species (including predators, prey, wide ranging species, keystone species, etc.) for ecosystem health.
- Provide recommendations to state and federal partners on the development of new land management plans or revising existing plans as they relate to wildlife resources.
- Cooperate with state, federal, tribal, and local government partners to develop and implement watershed management plans that incorporate wildlife and habitat values.
- Prevent loss and degradation of sensitive habitats through involvement of planning efforts with local governments, private landowners, and agency/tribal land managers.
- Promote restoration of natural fire regimes for improving grassland and forest health.
- Promote adoption of sustainable forage management standards and guidelines for livestock and wildlife.
- Promote conservation of sensitive areas and habitats for wildlife.
- Encourage development and implementation of standards and guidelines for mining and landfill operations that consider the needs of wildlife resources.
- Encourage land management agencies to manage road and trail networks to ensure sustainable wildlife resources in balance with recreational opportunities, economic pursuits, and rural development.

Representing wildlife values in multiple-use planning

- Coordinate with land managers, counties, municipalities and private sector partners to promote ecologically sensitive design of recreational facilities such as campgrounds, parks, golf courses, ski resorts, etc.

Representing wildlife values in other processes

- Coordinate to reduce impacts to wildlife along the US-Mexico border.
- Encourage the operation of dams, canals, and diversions for improving or maintaining wildlife resources. Promote wildlife values in building new, renovating existing, or removing old water retaining structures.
- Promote programs for eliminating or limiting the spread of invasive plants and animals, and the conservation or reintroduction of native populations.
- Limit the spread of invasive plants and promote the restoration of native vegetation in disturbed areas.

- Support land management and regulatory agencies in enforcing Best Management Practices to prevent the introduction of toxins into ecosystems.
- Promote the use of engineered wetlands, discharge basins, and augmented riparian vegetation to pre-treat water prior to release into riparian systems. Promote the use of treated effluent to create wildlife habitat.
- Cooperate with land management agencies and municipalities on revising waste management plans to minimize impacts to wildlife resources.
- Public education and law enforcement to benefit wildlife and wildlife habitat.

Much of the CWCS is devoted to the description of focus management species and mitigation of indirect and direct anthropogenic stressors to wildlife populations. For montane conifer forest ecosystems in Arizona, within which NOFS is embedded, the CWCS groups the following stressors in seven broad categories (listed below). Some of these stressors are only peripherally relevant to natural resources planning at NOFS (i.e. game animals and sport fish, livestock management, wind-harnessing turbines, etc.) and thus are not addressed in this INRMP. The stressors that are relevant to NOFS are followed by a cross-reference to their associated section in this INRMP.

Stressor Category: CHANGES IN ECOLOGICAL PROCESSES

- Altered river flow regimes (Section 4.2: Wetlands and Wetland Habitat Management, Section 4.11 Land Management)
- Unnatural fire regimes (Section 2.1.2: Regional Land Use, Section 2.2.2: Ecosystem Context, Section 4.6: Forest Health Management, Section 4.7: Wildland Fire Management)
- Streambank alteration/channelization (Section 4.2: Wetlands and Wetland Habitat Management, Section 4.11 Land Management)
- Loss of keystone species (Section 4.4 Fish and Wildlife Management)
- Insect Infestation (Section 4.4 Fish and Wildlife Management)
- Management for game animals and sport fish
- Habitat degradation/shrub invasions (Section 3.1.4: Sustainability of the Natural Environment, Section 2.3.1.2: Non-native Invasive Plants)
- Habitat fragmentation/barriers (Section 3.1.2: Integrating Navy Mission and Sustainable Land Use, Section 3.4.1: Regional Biodiversity and Conservation Planning, Section 3.6: Encroachment Partnering, Section 4.4: Fish and Wildlife Management)

Stressor Category: *CLIMATE CHANGE*

- Drought (Section 3.1.4: Sustainability of the Natural Environment, Section 2.2.1: Climate and Weather)

Stressor Category: *CONSUMPTIVE USE OF BIOLOGICAL RESOURCES*

- Grazing by ungulates
- Forest and woodland management - consumptive use (Section 2.1.2: Regional Land Use, Section 2.1.3.1: Pre-Military Use, Section 4.6: Forest Health Management)

Stressor Category: *HABITAT CONVERSION*

- Livestock management
- Rural development (Section 3.1.2: Integrating Navy Mission and Sustainable Land Use, Section 3.4.1: Regional Biodiversity and Conservation Planning, Section 3.6: Encroachment Partnering)
- Recreational sites/facilities

Stressor Category: *INVASIVE SPECIES*

- Nuisance plants (Section 3.1.4: Sustainability of the Natural Environment, Section 2.3.1.2: Non-native Invasive Plants, Section 4.6: Forest Health Management, Section 4.9: Invasive Species Management)
- Feral animals (Section 4.10: Pest Management)
- Disease/pathogens/parasites (Section 4.6: Forest Health Management, Section 4.9: Invasive Species Management)
- Nuisance animals (Section 4.10: Pest Management)

Stressor Category: *NON-CONSUMPTIVE RESOURCES USE*

- Dispersed camping (Section 4.13: Outdoor Recreation)
- Motorized recreation off-trail (Section 4.13: Outdoor Recreation)
- Stressor Category: Pollution (Section 4.11: Land Management)
- Highway/roadway de-icing
- Illegal dumping/littering
- Noise pollution

Stressor Category: *TRANSPORTATION AND INFRASTRUCTURE*

- Power lines/wind-harnessing turbines
- Roads for motor vehicles (Section 3.5.1: Public Access, Section 4.2: Wetlands and Wetland Habitat Management)
- Unauthorized roads and trails (Section 3.5.1: Public Access, Section 4.2: Wetlands and Wetland Habitat Management)

Treating over 796 wildlife species from 14 vegetation associations and six ecoregions, the CWCS identifies 24 species as so called 'tier 1a and 1b', as those of greatest conservation need (Table 3-2). A subset of these are known in the area from the vicinity of NOFS by the AZGFD HDMS (2007), and a smaller set of these have been observed at NOFS.

Table 3-2. Tier 1a and 1b species of greatest conservation need in Montane Conifer Forests from Arizona's Comprehensive Wildlife Conservation Strategy (AZGFD 2006) .

Scientific Name	Common Name	CWCS[1]	AZGFD HDMS[2]	Confirmed sighting on or in the vicinity of NOFS[3]
Amphibians				
*Bufo microscaphus**	Arizona toad	X		
*Rana chiricahuensis**	Chiricahua leopard frog	X		
*Rana pipiens**	Northern leopard frog	X		
*Rana yavapaiensis**	Lowland leopard frog	X		
Birds				
Accipiter gentilis atricapillus	Northern goshawk	X	X	
Buteogallus anthracinus	Common black-hawk	X		
Catharus ustulatus	Swainson's thrush	X		
Contopus cooperi	Olive-sided flycatcher	X		X
Falco peregrinus	American peregrine falcon	X		
Haliaeetus leucocephalus	Bald eagle	X	X	X
Otus flammeolus	Flammulated owl			X
Picoides dorsalis	American three-toed woodpecker	X		X
Pinicola enucleator	Pine grosbeak	X		
Progne subis arboricola	Western purple martin	X		
Sphyrapicus nuchalis	Red-naped sapsucker	X		X
Strix occidentalis lucida	Mexican spotted owl	X	X	X
Crustaceans and Mollusks				
*Discus shimekii cockerelli**	Cockerell's striate disc (snail)	X		
Mammals				
*Canis lupus baileyi**	Mexican gray wolf	X		
*Cynomys gunnisoni**	Gunnison's prairie dog	X		
Euderma maculatum	Spotted bat	X		
Eumops perotis californicus	Greater western mastiff bat	X		
Myotis evotis	Long-eared myotis		X	
Myotis lucifugus occultus	Occult little brown bat		X	
Myotis thysanodes	Fringed myotis		X	
Myotis volans	Long-legged myotis		X	
Idionycteris phyllotis	Allen's big-eared bat		X	
Lasiurus blossevillii	Western red bat	X		
*Microtus mexicanus hualpaiensis**	Hualapai Mexican vole	X		
*Microtus mexicanus navaho**	Navajo Mexican vole		X	
Nyctinomops macrotis	Big free-tailed bat	X		
Sorex nanus	Dwarf shrew	X		

*Presumed not to occur at NOFS due to NOFS location being outside established range and/or habitat requirements.
1. Tier 1a and 1b species of greatest conservation need in Montane Conifer Forests from Arizona's Comprehensive Wildlife Conservation Strategy (AZGFD 2006).
2. Species with potential to be affected by natural resources management at NOFS based on the Arizona Game and Fish Department's Heritage Data Management System (AZGFD HDMS 2007).
3. Species from CWCS and/or AZGFD HDMS lists that are known to occur on or within the vicinity of NOFS (For full list see Appendix D).

Mexican Spotted Owl Recovery Plan

■ See also Section 4.1.1: Sensitive and Endangered Wildlife Species, Section 3.4.1: Regional Biodiversity and Conservation Planning, and Section 3.6: Encroachment Partnering.

■ **OPNAVINST 5090.1C CH-1 states that the Navy will use its authorities to further programs for the conservation and recovery of federally listed endangered and threatened species.**

Section 7(a)(1) obligates all federal agencies to utilize their authorities to further the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species, and the ESA sets up cooperative federal participation in conservation planning for listed species. The Navy Instruction OPNAVINST 5090.1C CH-1 states that the Navy will use its authorities to further programs for the conservation and recovery of federally listed endangered and threatened species.

The Mexican spotted owl recovery plan (December 1995) is currently under revision. The purpose of the Recovery Plan is to outline the steps necessary to remove the Mexican spotted owl from the list of threatened species. The Recovery Plan provides a basis for management actions to be undertaken by land-management agencies and Indian Tribes to remove recognized threats and recover the spotted owl. The Recovery Plan contains five basic elements:

1. A recovery goal and a set of delisting criteria.
2. Provision of three general strategies for management that provide varying levels of habitat protection.
3. Recommendations for population and habitat monitoring.
4. A research program to address critical information needs.
5. Implementation procedures with oversight and coordination responsibilities.

The Recovery Plan recommendations are a combination of: 1) protection of both occupied habitats and unoccupied areas approaching characteristics of nesting habitat, and 2) implementation of ecosystem management within unoccupied but potential habitat. The Plan applies ecosystem management in two slightly different ways. Within unoccupied mixed-conifer and pine-oak forest on <40 percent slope, general (coarse filter) and specific (fine filter) guidelines are identified to provide a sustainable quantity of replacement nest habitat across the landscape. Within other unoccupied forest and woodland types (e.g. ponderosa pine, spruce-fir, aspen, and pinyon-juniper), general guidance is provided for managing the landscape to meet multiple ecosystem management objectives including spotted owl foraging and dispersal habitat. Alleviating threats to Mexican spotted owls is the management priority; thereafter, or in coordination with alleviating threats, other management priorities (such as creating replacement owl habitat) should be pursued. Two primary threats identified in the Recovery Plan are catastrophic wildfire and the widespread use of even-aged silviculture.

4.0 Program Elements

This chapter spells out management strategies for natural resources viewed in an ecosystem context. By identifying the physical, chemical, and biological roots of the natural resources values that exist at NOFS with an ecosystem approach, there is a better chance of conserving them.

4.1 Threatened and Endangered Species Management and Species Benefit, Critical Habitat, and Species of Concern Management

Due to the small size of NOFS property and position within a vast forested network of private, state, and national forest system lands, it is difficult to attach a unique or substantial contribution of the property to the viability of regional habitats and wildlife and rare plant populations. While no federal or state listed threatened or endangered species are known historically or currently on NOFS property, NOFS contains suitable restricted and protected (portion of the Dry Lake PAC) Mexican spotted owl habitat.

The thinning operations completed in 2011 include land within the PAC and were the subject of a formal consultation with the USFWS. The 2003 BO (refer to Appendix I), concluded that the thinning operations were not likely to jeopardize the continued existence of the species and anticipated that two Mexican spotted owls (one pair) and/or associated eggs/juveniles associated with the Dry Lake PAC may be taken following full implementation of the thinning prescription. The incidental take will be in the form of harm or harassment due to long-term habitat alteration. The terms and conditions of the revised BO require NOFS 1) to conduct thinning operations outside of the breeding season; 2) to use prescribed fire in accordance with the Mexican spotted owl recovery plan; and 3) to monitor the habitat for one year after the action. The USFWS recommended that NOFS work with both AZGFD and Coconino County to acquire more land within the Dry Lake PAC, and minimize impacts of thinning by cooperating with the USFWS and the AZGFD.

4.1.1 Sensitive and Endangered Wildlife Species

4.1.1.1 Mexican Spotted Owl

Navy and other natural resources professionals, permitted in conducting surveys for the Mexican spotted owl using the prescribed protocol, have conducted both informal and protocol surveys in the Dry Lake PAC or vicinity since 1990. The surveys have not detected any owls or owl responses on Navy lands. Under this INRMP, the Navy forest land included in the PAC is considered habitat that contributes to the conservation of the species by acting as a buffer, future occupied habitat, a nest site, and wildlife corridor. NOFS's overall role in owl conservation is probably best maximized by managing forest conditions to meet the requirements of the Recovery Plan for the Mexican Spotted Owl and minimize the risk of high-severity fire in owl habitat.

Objectives for Conservation Benefit to the Mexican Spotted Owl

- **See also Appendix F Critical Habitat Issues and INRMP Benefits for Endangered Species.**

Objective: Provide a conservation benefit to the Mexican spotted owl by ensuring against catastrophic loss of habitat by uncontrolled wildfire, by maintaining a healthy forest, and by providing for the protection of oaks and growth of large pines for coming decades.

I. Manage the NOFS forest land that lies within the Dry Lake PAC in accordance with federal law, regulations and EOs in order to provide a direct benefit to the species and to conservation efforts, including the Recovery Plan for the Mexican Spotted Owl (USFWS 1995b).

II. Seek to acquire additional land as a buffer against mission encroachment and for additional benefit to the Mexican spotted owl by preventing additional habitat fragmentation.

III. Take measures to reduce the risk of canopy fire in the forest. Refer to Section 4.6: Forest Health Management for greater detail.

IV. Conduct annual monitoring of Mexican spotted owl presence and document owl use of NOFS lands.

V. In accordance with Sikes Act (as amended) requirements, begin implementing the INRMP upon approval. The natural resources professionals at NOFS, NAVFAC NW and NAVFAC SW will implement this Plan in a coordinated manner to achieve prescriptions and goals.

VI. NAVFAC NW is responsible for planning, budgeting and executing forest management activities in coordination with the installation. A professional forester will manage forest resources, including preparation and oversight of forestry service and sales contracts and monitoring the use of reimbursable forestry funds provided to support the program. NAVFAC provides the technical and administrative functions of this program. The NAVFAC NW Forest Management Program will ensure staffing, funding and equipment to carry out any and all forestry consultations, operations and projects in furtherance of the INRMP's objectives.

VII. Provide assurances that the conservation effort will be effective.

A. The following criteria will be considered when determining the effectiveness of the conservation effort:

1. Biological goals (broad guiding principles for the program) and objectives (measurable targets for achieving the goals);

2. Quantifiable, scientifically valid parameters that will demonstrate achievement of objectives, and standards for these parameters by which progress will be measured;

3. Provisions for monitoring and, where appropriate, adaptive management;

4. Provisions for reporting progress on implementation (based on compliance with the implementation schedule) and effectiveness (based on evaluation of quantifiable parameters) of the conservation effort; and
5. A duration sufficient to implement the plan and achieve the benefits of its goals and objectives.

B. Broad guiding principles for this program are: to protect the Navy's forest land within the PAC; to conduct microhabitat monitoring; to conduct Mexican spotted owl surveys; to enhance and treat both the adjacent protected steep pine-oak forest areas and restricted pine-oak forests, to encourage late-successional stage forest structure; and to conduct forest management operations in an integrated, multi-disciplinary manner in support of the base mission and natural resources conservation. Measurable targets for achieving these goals will be the protection and integrity of the PAC area forest land to enhance structural and biological diversity.

C. Quantifiable parameters for demonstrating achievement of these objectives include the number of acres of PAC forest land managed; acres of forest with improved structural diversity following silvicultural treatment; the number of acres of unoccupied but suitable habitat preserved; and others as appropriate to specific resources issues.

D. Monitoring will be achieved through field and office review of protected and treated areas. Treated areas will be monitored through the approved microhabitat monitoring protocol; large organic debris will be assessed using a USFS photo guide. Treatments will be evaluated over multiple plan lifetimes to determine efficacy.

E. Progress on implementation will be documented stand by stand or by areas treated and by microhabitat plots monitored over time. This information will be added to the GIS database for evaluation and inclusion in the subsequent INRMP revision.

VIII. This Plan will remain in effect for five years from the date of approval, at which time it will be reviewed and revised as appropriate up to 20 years to maintain resources protection and enhancement consistent with stated policies and goals. This continuing form of iterative management will assure application of BMPs based on knowledge then available and in light of stand history, treatment efficacy, and microhabitat monitoring data. It is expected that any and all renewals and reviews of this INRMP will include continuation of these management practices.

4.2 Wetlands and Wetland Habitat Management

Objective: Protect the integrity and functional values of wetlands so that no net loss occurs to these values.

Objective for Wetlands

I. Wetlands will be protected in accordance with applicable law and regulation. There are no plans now or in the future to harvest in wetlands, and no riparian areas exist at NOFS.

- **EO 11990: Protection of Wetlands directs all federal agencies to "take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands." Under this EO, agencies are also required to consider "factors relevant to a proposal's effect on the survival and quality of the wetlands." One such factor is the "...maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources..."**

II. Establish buffer strips to protect waters of the U.S and all headwater swales from damage by forestry or any other operations. No tree cutting in drainages is anticipated.

III. Control erosion and non-point sources of water pollution where it occurs on the property.

A. Evaluate the drainage south of the transit telescope for remedial treatments to restore and stabilize the soil surface, profile and vegetative cover. Treatment may include weed-free straw mulch incorporated into the soil with fertilizer (and gypsum if the pH needs adjustment), broadcast native grass seed that is certified weed-free, and jute netting cover.

B. Avoid use of pesticides or herbicides in a manner that contributes to water pollution. The avoidance of pesticides and herbicides is consistent with the DoDINST 4150.07 on DoD Pest Management.

4.3 Law Enforcement of Natural Resources Laws and Regulations

Objective for Natural Resources Law Enforcement

Objective: Discourage use of the property by unauthorized personnel and activities that are not consistent with the mission.

I. Take steps to discourage and minimize the impacts of unauthorized access using appropriate signage in key access areas.

II. Provide for enforcement of natural resources laws and regulations by professionally trained personnel (DoD 1996).

4.4 Fish and Wildlife Management

This section addresses the needs of species and species groups through the use of ecosystem management. According to Navy guidance (OPNAVINST 5090.1C CH-1 and INRMP Guidance for Navy Installations 2006), an ecosystem management approach must be incorporated into the INRMP as the basis for planning and management. The Navy has adopted ecosystem management with the overarching goal to "maintain and improve the sustainability and native biological diversity of ecosystems while supporting human needs, including the military mission." The guidance requires a shift from single species to multiple species conservation. It emphasizes partnerships, and the use of best scientific information.

A premise of this INRMP is that management on a project-by-project basis is inadequate to manage ecosystem integrity because the scale and time frame associated with projects is unlikely to consider all the resources, processes, and interdependencies that may be affected. At the same time, viewing issues on an ecosystem level may allow some important management concerns to fall through the cracks.

Generally, the idea of an ecosystem approach is to identify a process or a species that indicates the "health" of a system, but there are differing definitions of ecosystem health. Ideally the suite of indicators should represent key information about structure, function, and composition of the ecosystem (Dale and Beyeler 2001). For example, to determine the energy flow of an ecosystem, one might decide that the number of trophic levels would be a good indicator to determine "health" of the system.

One goal of this plan should be to prevent species and processes that are currently healthy from becoming threatened and unbalancing the ecosystem. Thus, some healthy processes and species populations must be monitored and managed.

The general synopsis of the elements to be included in this INRMP to promote an ecosystem approach for natural resource management at NOFS is: habitat first, use of focal management species, partnerships, and adaptive management.

The habitat or ecosystem (rather than individual species) focus of this INRMP is expected to result in integrated recommendations which will serve to protect NOFS and target area communities as a whole. The key is to strike the acceptable balance between natural habitat values and the NOFS mission.

- **See also Section 4.6: Forest Health Management.**

Objective: Enhance, restore, and sustain the natural diversity and long-term viability of the ecological and evolutionary processes in all natural communities and wildlife habitats consistent with DoD ecosystem management policy (DoD 1994), as the first step towards promoting species biodiversity.

Objectives for Wildlife Stewardship and Management

I. Protect the migratory corridors of big game animals by avoiding the establishment of a perimeter fence unless absolutely necessary. If a fence becomes necessary, construct using AZGFD big game fence specifications (Appendix J).

II. Protect and enhance landscape-level habitat values by adopting and implementing policies which protect large patch sizes, maintain connectivity and dispersal corridors, and establish buffer zones.

A. Establish prescriptions for specific habitat for each vegetation community type, including desired understory conditions, to support fire management, prey base, focal species, and other forest habitat planning. This will support the Forest Understory Enhancement Plan (see Section 4.6: Forest Health Management).

- **To enhance forest conditions for wildlife, prescriptions for each vegetation community, including the understory, should be established to support fire management, enhance the prey base for Mexican spotted owl, support cavity-nesting birds and other focal species, and achieve other forest health objectives. See also Section 4.6: Forest Health Management.**

III. Minimize habitat fragmentation by:

A. Aligning roads to avoid fragmentation.

B. Concentrating facilities.

C. Maintaining continuity with off-site open space.

1. Delineate and maintain connectivity between habitat patches to link foraging and nesting areas, foster population dispersion and recolonization potential, and increase the area available for foraging.

2. Promote quantity and quality of water for wildlife.

IV. Continue to identify and monitor habitat values for Mexican spotted owl and other native wildlife on NOFS in relation to the forest management program.

A. Identify habitat values for the Mexican spotted owl. As part of this effort, continue the monitoring of snags at NOFS.

B. Establish targets for identifying a spectrum of habitat types and conditions native to the area, including use of the focal management species concept.

C. Protect and enhance community-level habitat values by adopting and implementing policies that preserve structural and species biodiversity.

1. Ensure the forest maintains structural diversity while recognizing the need for some spatial homogeneity to reduce light reflectance.

- **Ensure the forest maintains structural diversity while recognizing the need for some spatial homogeneity to reduce light reflectance.**

D. Monitor habitat condition and the effectiveness of management activities.

1. Maintain over the long term microhabitat or other suitable trend monitoring plots to understand the effects of thinning and reforestation activities on forest health and habitat diversity.

V. Encourage study sites for research by local university professors, graduate students, and state and federal wildlife agencies, especially for long-term monitoring using the 1998 pre-thinning surveys as a baseline for comparing with post-thinning conditions. See also Section 4.6: Forest Health Management.

VI. Conduct periodic, phased plant and animal surveys over ten years representing the full range of taxonomic groups, tying into compatible sampling locations where possible.

- **Implement yearly bird occupancy surveys at point count stations already established. Consider establishing a breeding bird survey route.**

A. Implement yearly bird occupancy surveys at point count stations already established and in use on the property and consider establishing a breeding bird survey route.

B. Conduct bi-annual small mammal surveys to track trends in the prey base of Mexican spotted owls and other raptors and to understand the effects of forest management. Methodologies used will be similar to those used in prior surveys by Grinder and Krausman (1998) that will allow for the comparison of trends.

- **Make a plant collection for the property. Monitor for occurrence and spread of dwarf mistletoe during plant surveys.**

C. Make a plant collection for the property. Conduct botanical surveys every five years by stratifying searches to be sure that low vs. moderate vs. high canopy densities are sampled as well as oaks. Monitor for occurrence and spread of dwarf mistletoe during plant surveys.

D. Compare results of microhabitat monitoring for the Mexican spotted owl with other plant and animal surveys. The Mexican spotted owl microhabitat monitoring is based on USFS Region 3 (1998) protocols.

E. Tie in with regional monitoring of spread of potentially harmful insects and dwarf mistletoe.

VII. Conduct general surveys for amphibian and reptile fauna every three years in order to obtain a more comprehensive list of the species present at NOFS.

VIII. Determine the abundance and diversity of invertebrate species on NOFS.

A. Conduct basewide surveys to develop a baseline invertebrate species list, and relate to forest pests, other vegetation and animal surveys, and weather conditions. Assess use of NOFS natural resources by beneficial pollinator insects, birds, or bats.

B. Plant pollination by insects is essential to human health, global food webs, and protection of biodiversity. Pollination is a globally important ecosystem service.

1. Assess beneficial pollinator use of NOFS lands.
    - *a.* Recognize pollinator habitat and the associated diversity of ground cover conditions and foraging plants that benefit them.
    - *b.* Identify potential threats to pollinator habitat.
    - *c.* Reduce or mitigate threats to pollinator habitat.
2. Monitor and enhance NOFS lands for use by beneficial pollinators, especially those determined to be at risk by the Xerces Society for Invertebrate Conservation (www.xerces.org).
    - *a.* Develop and implement a monitoring plan for pollinator species.
    - *b.* Assess use of bare soil areas by beneficial pollinator species, and maintain them if determined to be important.

c. Identify land management practices that benefit pollinators in order to develop impact avoidance and minimization measures. These may include prescribed fire, post-thinning treatment practices, habitat restoration, and pesticide application.

d. Establish a demonstration venue that emphasizes beneficial pollinators and sustainable water use practices. Integrate with the conservation kiosk or other interpretive signs in the Operations Area (See also Section 3.5.2: Public Outreach). Partner with local native plant and garden organizations as appropriate.

1. For benefiting pollinator species, provide for both nectar and rearing areas. Ensure plant species have varying bloom periods. Consider access to water and nesting sites. Control or remove invasive species. Limit use of pesticides and chemicals.

- **Establish a demonstration venue that emphasizes beneficial pollinators and sustainable water use practices.Integrate with the conservation kiosk or other interpretive signs in the Operations Area. Partner with local native plant and garden organizations as appropriate (See also Section 3.5.2: Public Outreach).**

4.4.1 Bats

In 2003, the AZGFD released their bat conservation plan (Hinman and Snow 2003). Of the 28 species of bats found in Arizona, all but six are known to occupy forested habitats (Hinman and Snow 2003). Ponderosa pine forests at the regional scale provide foraging habitat, maternity and hibernation roosts, and travel corridors for bats (Hinman and Snow 2003).

To help conserve bat populations Hinman and Snow (2003) suggest the following recommendations. Logging and forestry practices that leave mixed-aged stands and/or preserve older trees and snags should be encouraged. Forestry practices that manage for mixed-aged stands, and preserve large trees and snags should be encouraged. Loss of snags and roosting areas should be mitigated through construction of manmade roosts and use of artificial bark on existing trees. Development and urbanization that leads to loss of roosting and foraging habitat should be contained where possible to maintain undisturbed areas of forest.

Concomitantly with the redevelopment of the INRMP, NOFS has begun a program to monitor snags within the 287-acre property (Ingraldi and Bayless 2005). The baseline data collected as part of this survey will be used to monitor trends in snag density, quality, and wildlife use. This INRMP also recommends the use of bat boxes to both supply extra roosting habitat, and discourage use of buildings as roosts.

Bat Management

I. Ensure that pest management of bats minimizes impacts to species' populations.

A. Work with state and federal agencies to host bat surveys if it does not interfere with the military mission.

B. Inspect for presence of roosting bats before implementing any building and demolition projects.

C. Discourage habitation of occupied buildings through appropriate and biologically acceptable measures.

1. Exclude access to bat roosting sites after maternity season and before winter hibernation. No attempt to move animals shall be made during these vulnerable periods of seasonal occupancy.

2. Explore potential for bat exclusion devices for facilities as a priority to eliminate the cost of cleaning and worker health risk.

D. Test the relocation of bat colonies to alternative roosting sites. Install bat boxes to encourage bats away from buildings (Appendix L).

E. Educate personnel about the need for non-lethal control measures and the benefits of sustaining bat populations. Consider establishing bat boxes onsite to promote awareness and interest in bats as an important component of the native ponderosa pine forest (see also Section 3.5.2: Public Outreach).

F. Coordinate with AZGFD regarding methods of excluding, relocating, or attracting bats.

4.5 Migratory Bird Management

- **Bird species protected under the MBTA play important roles in the ecosystem as predators and prey. There are at least 59 species of birds which have been observed at NOFS.**

At least 59 species of birds have been observed at NOFS (Shepherd and Burr 2006), all of which are protected under the MBTA, whether they actually migrate or are resident year-round. These species play important roles in the ecosystem as predators and prey. Birds help control populations of forest insects and rodents and act as seed dispersers for many plants. Some of these species, such as the hairy woodpecker, Steller's jay (*Cyanocitta stellari*), and brown creeper probably reside on the premises year-round. The relatively low impact of operations at NOFS is amenable to the habitat requirements of these birds. As such, additional management prescriptions for these species are unnecessary.

Other native birds on NOFS are migratory. These birds either spend the winter in the area and move north during the spring and summer, or they arrive during the spring and summer from farther south to breed. Most migratory birds at NOFS probably come to breed or use the location as a migration stopover. As a result of documented population declines, migratory birds are the subject of an international conservation effort. As an important biological resource and a good indicator of ecosystem health, NOFS's bird population must be managed effectively and in accordance with applicable resources laws.[1]

The USFWS has recently changed the regulations governing migratory bird permitting as outlined in the Federal Register Vol. 72 No.193 56926-56929. These amendments to 50 CFR Part 21 allow removal of migratory birds (other than federally listed threatened or endangered species, bald eagles, and golden eagles) from inside buildings in which the birds may pose a threat to themselves, to public health and safety, or to commercial interests.

The AZGFD has a growing list of species-focused management programs. Map 4-1 is a model for avian species richness in ponderosa pine forests in the vicinity of NOFS (http:// www.forestera.nau.edu).[2] Regional management recommendations of species that have the potential to occur on NOFS are described as follows.

Avifaunal Management

The DoD policy states that migratory bird programs shall be established in support of and consistent with the military mission. A means of achieving these strategies is offered through the Partners in Flight (PIF) cooperative program, established in 1991. PIF is a cooperative effort of federal, state, foundations, businesses, and conservation organizations, was established in the early 1990s to promote conservation of avifauna through science-based management, cooperation between organizations, and funding of conservation-related research. The DoD has developed its own contributing chapter to the PIF program, called the DoDPIF in an effort to offer coordinated framework for incorporating migratory bird habitat management efforts into INRMPs (DoDPIF 2007). The DoD's strategy focuses on inventory, on-the-ground management practices, education, and long-term monitoring (DoDINST 4715.03). In 1999, in association with the Arizona chapter of PIF, the AZGFD released their Bird Conservation Plan for all regions of the state (Latta et al. 1999). Bird species of concern inhabiting ponderosa pine associations, and thus potentially those at NOFS, are addressed specifically. The following sections state the management recommendations of the four species given special attention under the plan (Latta et al. 1999). These recommendations are consistent with the BO and the objectives of forest management at NOFS.

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1. Bald eagles are also known to use the Roger's Lake area and other adjacent lands to NOFS for winter foraging and roosting activities (S. Hedwall, USFWS, pers. comm.).

2. This is model is based on observed region wide variations in avian species richness in relation to slope, tree density, and basal area. For any specific project level work expected to affect avifauna, on-site studies would be required to assess localized bird populations.

Region-wide management recommendations by species

- Northern goshawk observed at properties adjacent to NOFS.
  - Maintain old growth and mature forest with scattered small openings, a relatively open understory, a well developed herbaceous shrub layer, large snags, large dead and down woody material. Maintain a relatively dense canopy in nest areas.
- Olive-sided flycatcher observed at NOFS (Shepherd and Burr 2006).
  - Manage forests for uneven stand structure. Retain tallest snags.
- Cordilleran flycatcher observed at NOFS (Shepherd and Burr 2006).
  - Maintain dense canopy closure in mid- to late-successional stages of dense, shady forest habitat with an understory of oak and sufficient dead and down trees for nesting substrate.
- Purple martin (*Progne subis*) not observed at NOFS.
  - Maintain tall snags in forest openings.

Migratory Bird Legal Context

The MBTA of 1918 (16 USC 703-711) is legislation that covers species protected under four international treaties. These treaties are agreements between the U.S., Canada, Mexico, Japan, and Russia and protect most species of birds. The MBTA prohibits the taking or pursuing of migratory birds, their eggs, feathers, or nests. Game birds are listed and protected except where specific seasons, bag limits, and other factors govern their hunting. Exceptions are also made for some nuisance pests, which have standing federal depredation orders (e.g. yellow-headed, red-winged, tri-colored, Rusty and Brewer's blackbirds, cowbirds, all grackles, crows, magpies, rock doves, European starlings, and house sparrows).

- **The MBTA of 1918 covers species protected under four international treaties.**

The USFWS has sole authority for coordinating and supervising all federal migratory bird management activities, including enforcement of federal migratory bird statutes regulating the taking of protected species (game and nongame) by individuals and federal agencies. The MBTA provides the USFWS the opportunity to comment on projects potentially affecting bird species, and their habitats, that are not protected under the ESA. Violations of the MBTA can result in fines of up to $2,000 or two years imprisonment. Therefore, if a project has the potential to affect nesting birds or nesting substrate (including the trimming of nest trees) a qualified biologist from NAVFAC SW should be contacted to determine if there will be any violations of the MBTA. Biologists are deemed “qualified” through a combination of education and experience with the MBTA.[1]

- **The USFWS has sole authority to coordinate and supervise all federal migratory bird management activities. The MBTA provides the USFWS an opportunity to comment on projects potentially affecting bird species, and their habitats, that are not protected under the ESA.**

MOU between the USFWS and DoD

In 2001, President Clinton issued EO 13186, requiring that federal agencies whose actions may affect migratory birds to develop and begin implementing, within two years, an MOU with the USFWS aimed at conserving these birds. It also established a federal interagency Council for the Conservation of Migratory Birds to help agencies implement the EO. In addition, the EO required NEPA evaluations to include effects on migratory birds and that advance notice or annual reports must be made to the USFWS concerning actions which result in the taking of migratory birds. The EO also required agencies to control the establishment of exotic species that may endanger migratory birds and their habitat.

The USFWS/DoD MOU (FR 30 August 2006) that evolved out of the requirements of the EO addresses the conservation of migratory birds on military lands in relation to all activities except readiness. The MOU does not authorize any take. In April 2007, further guidance was issued by the Under Secretary of Defense for Acquisition, Technology and Logistics on implementing the MOU to Promote the Conservation of Migratory Birds between the USFWS and DoD in accordance with EO 13186 (DoD 2007).

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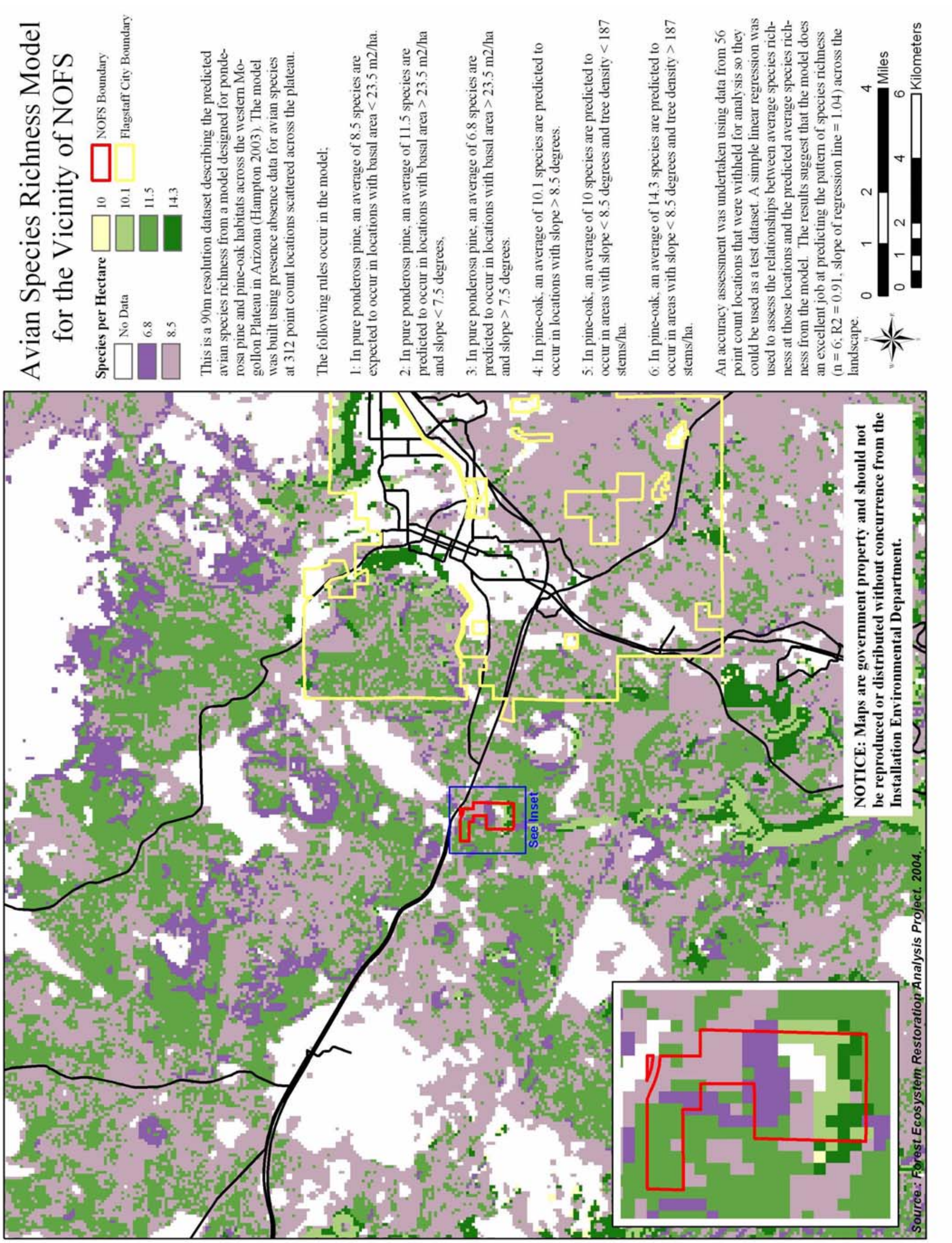
1. For more information on the ways in which DoD supports migratory birds See “Avifaunal Management” on page 4-8.



Map 4-1. Model for avian species richness in ponderosa pine forests in the vicinity of Naval Observatory Flagstaff Station.

This 2007 guidance covers all activities at NOFS, including natural resources management, routine maintenance and construction, industrial activities, and hazardous waste cleanups. The guidance emphasizes interdisciplinary collaboration in framework of North American Bird Conservation Initiative (NABCI) Bird Conservation Regions, collaborative inventory and long-term monitoring.

Migratory Bird Rule

In an effort to provide guidance for conflicts arising between military readiness activities and the MBTA, the USFWS issued the final rule on Migratory Bird Permits: Take of Migratory Birds by the Armed Forces (50 CFR Part 21 in the 28 February 2007 Federal Register, pages 8931-8950), hereinafter, Migratory Bird Rule. The Migratory Bird Rule authorizes the military to *take* migratory birds during military readiness exercises under the MBTA without a permit, but if the military determines that the activity will significantly affect a population of migratory birds, they must work with the USFWS to implement conservation measures to minimize and/or mitigate the effects.

The authorization for take requires an understanding of the definition of the following highlighted terms:

- *Population*, as used in Section 21.15, is a group of distinct, coexisting (conspecific) individuals of a single species, whose breeding site fidelity, migration routes, and wintering areas are temporally and spatially stable, sufficiently distinct geographically (at some time of the year), and adequately described so that the population can be effectively monitored to discern changes in its status.
- *Significant* adverse effect on a population, used in Section 21.15, means an effect that could, within a reasonable period of time, diminish the capacity of a population of migratory bird species to sustain itself at a biologically viable level. A population is biologically viable when it's ability to maintain it's genetic diversity, to reproduce, and to function effectively in it's native ecosystem, are not significantly harmed. This effect may be characterized by increased risk to the population from actions that cause direct mortality or a reduction in fecundity. Assessment of impacts should take into account yearly variations, and migratory movements of the impacted species. Due to the significant variability in potential military readiness activities and the species that may be impacted, estimates of significant measurable decline will be determined on a case-by-case basis.

Conservation measures undertaken under the Migratory Bird Rule require monitoring and record-keeping for five years from the date the Armed Forces commence their conservation action. During INRMP reviews, the Armed Forces must report to the USFWS migratory bird conservation measures implemented and the effectiveness of the conservation measures in avoiding, minimizing, or mitigating take of migratory birds.

Many questions remain about how to implement the Migratory Bird Rule. Uncertainty remains regarding how the evaluation of significance is to be addressed. Since the impact assessment must be conducted on populations of migratory birds, there will mostly be a need to collect more refined population baseline data.

Objective for Migratory Birds

Objective: Conserve viable habitat for migratory birds that use NOFS for stopover resting, feeding, and nesting, with an emphasis on snag-dependent and cavity-nesting birds, and these region and focus species: northern goshawk, cordillean flycatcher, and olive-sided flycatcher.

- **Guidance from the Undersecretary of Defense for Acquisition, Technology and Logistics on implementing the MOU to Promote the Conservation of Migratory Birds between the USFWS and DoD in accordance with EO 13186 covers all activities at NOFS, including natural resources management, routine maintenance and construction, industrial activities, and hazardous waste cleanups. The guidance emphasizes interdisciplinary collaboration in framework of NABCI Bird Conservation Regions, collaborative inventory and long-term monitoring.**

I. Determine the status, health, and habitat use of migratory birds, raptors, and non-native species emphasizing snag-dependent and cavity-nesting species.

A. Collaborate with interagency and non-governmental partners within the framework of NABCI Bird Conservation Regions, especially on inventory and long-term monitoring.

1. Use cooperative assistance from wildlife agencies, non-governmental organizations, and volunteers to collect needed data.

2. Encourage university-level research.

B. Identify and monitor forest species that can be indicators of a healthy forest, such as cavity-dependent and snag-dependent species. For example:

1. Presence of large Gambel oaks at a specified number per hectare.

2. Overwintering cavity nesters that prefer larger trees, such as the hairy woodpecker, and the northern flicker.

3. Brown creeper as a potential forest health indicator species because it relies on dead trees for nesting habitat.

4. Pygmy nuthatch as a potential forest indicator species as it relies on trees for both foraging and nesting habitat.

5. Presence of olive-sided flycatcher, which needs mature stands of trees adjacent to meadows and is on the Audubon Watch List.

6. Squirrels because they need tree cavities.

C. Expand the seasons during which migratory birds are currently monitored in order to improve understanding of the use of NOFS lands. Currently, point counts are conducted in June only. The purpose is to increase regional understanding of the management focus species identified in regional conservation plans. Establish a Christmas Bird Count volunteer birder program for wintering birds (Audubon 2007).

1. As part of these surveys evaluate if a non-native species is having a direct effect on a sensitive native species, so that appropriate removal actions for pest species. For example if cowbirds are observed to be breeding at NOFS, install cowbird traps.

II. Protect the sustainability of indicator bird populations and their habitat.

A. Restrict disturbance of nesting and breeding grounds during critical periods. Incorporate this restriction as a mitigation for proposed projects.

B. Consider the following opportunities for enhancement of bird habitat:

1. Use of artificial aids, such as nest boxes for bluebirds.

2. Choose appropriate native food plants for landscaping.

3. Protect areas of dense vegetative cover.

4. Prevent noxious weeds from taking over native habitats.

C. If it is determined that a non-native species is having a direct effect on a sensitive native species, take appropriate removal actions for pest species. For example if cowbirds are observed to be breeding at NOFS, install cowbird traps.

D. Protect native species populations from the lethal effects of human facilities and activities, where this does not conflict with safety concerns and the military mission.

1. Limit the use of rodenticides and herbicides. Remove any dead or dying rodents from a treated area to reduce the possibility of secondary poisoning.

E. Take bird population into consideration when reviewing all projects, scopes of works, contracts, and agreements associated with construction and/or vegetation manipulations or removal.
   1. Projects should be phased to avoid disturbing nesting birds.
   2. If nesting birds or eggs are encountered within a project area, the contractor must immediately notify the Contracting Officer or Project Manager and not attempt to remove the bird or its nest from the area.

F. Cooperate with large-scale efforts to research, monitor, and manage migratory bird populations.
   1. Participate in the PIF program as appropriate (contact DoDPIF program coordinator for more information). Consult bird conservation measures from Arizona PIF plan (BLM 2007).

III. Increase awareness of migratory bird stewardship strategies.

A. Prepare educational materials regarding NOFS's migratory birds and management practices. Include information on what personnel can do to help, species lists, and activities detrimental to migratory birds.

B. Prepare a natural resources brochure on NOFS resources as well as its astronomy operation.

C. Promote activities aimed at increasing fledging success and decreasing overall bird mortality.
   1. Trap feral cats and take them to the local animal control officer.

IV. Encourage study sites for research by local university professors and graduate students, especially long-term monitoring using the 1998 pre-thinning surveys as a baseline for comparing with post-thinning conditions.

4.6 Forest Health Management[1]

The authority and requirement to have a Forest Management Plan for forested Navy installations is contained in an array of laws and DoD, DoN and NAVFAC Instructions and directives cited elsewhere in this INRMP. For example, 32 CFR 190 "prescribes policies and procedures for an integrated program for multiple-use management of natural resources on property under DoD control." Title 10 U.S. Code, Section 2665 authorizes the sale of forest products as well as reimbursement for the costs of managing forest resources for timber production. This is administered in accordance with DoDINST 7310.5 Accounting for Production and Sale of Forest Products. The Comptroller of the Navy (NAVCOMPT) Manual, Volume 3, paragraphs 07150 and 035475-79 provide guidance on funding, accounting, and fiscal reporting procedures. The Timber Conservation and Shortage Relief Act of 1990 prohibits export of unprocessed timber originating from federal lands west of the 100th meridian. OPNAVINST 5090.1C CH-1 discusses requirements, responsibilities and policy for natural resources management for Navy ships and shore activities.

- **32 CFR 190 "prescribes policies and procedures for an integrated program for multiple-use management of natural resources on property under DoD control." Title 10 USC, Section 2665 authorizes the sale of forest products as well as reimbursement for the costs of managing forest resources for timber production.**

Annual DoN Forestry Program expenditures will normally not exceed annual income from the sale of forest products; however, costs may exceed income when managing for wildlife resources values, or fire risk reduction. Due to the very low level of anticipated activity under this INRMP, forest management administrative costs or projects in any one given year will exceed income from the property in that same year. However, deposits from other forested Naval activities generate sufficient funds to cover expenses, and planning and budgeting constraints enforce economic investment of available funds for production and sale of forest products.

1. This section addresses forest health generally, for a specific discussion of objectives related to wildland fire management, refer to Section 4.15.

The Navy Forest Management Program is administered in consonance with applicable law and regulation. Planning, budgeting, fiscal management, reporting and implementation will be in accordance with DoD program requirements, including forest management initiatives, mission support, positive community relations and public affairs, ecosystem forest management on a watershed basis, and environmental protection.

- **There are five primary considerations in forest management on NOFS: 1) The need to reduce the risk of stand-replacing wildfire and provide a forest condition closer to the native ecosystem; 2) Continuing to provide some uniform coverage of trees to avoid excessive light reflectance that interferes with the telescopes; 3) Clear viewing skies free of light reflectance and particulate matter for operation of Observatory telescopes; 4) Addressing the habitat needs of the Mexican spotted owl and other management focus species; and 5) Snag and Gambel oak protection as wildlife habitat.**

In accordance with DoD and DoN requirements, the Navy Forest Management Program is centrally funded and executed through NAVFAC. The Forester, NAVFAC NW, Silverdale, Washington, provides professional forestry services to manage and develop the forest resources, the economical production of forest products and the conservation of related resources. The Forester will prepare, and review with NOFS, the forestry Annual Increments of work.

There are five primary considerations in forest management on NOFS:

1. The need to reduce the risk of stand-replacing wildfire and provide a forest condition closer to the native ecosystem;
2. Continuing to provide some uniform coverage of trees to avoid excessive light reflectance that interferes with the telescopes;
3. Clear viewing skies free of light reflectance and particulate matter for operation of Observatory telescopes;
4. Addressing the habitat needs of the Mexican spotted owl and other management focus species; and
5. Snag and Gambel oak protection as wildlife habitat.

Recent Forest Management at NOFS

An intensive inventory of the oaks in spring 1997 on the main portion of the station revealed that the pines posed a significant threat to the oaks by overtopping them, growing up around or through the oaks. Without intervention through silvicultural treatments or reintroduction of fire, the pines had the potential to shade out the oaks.

Objective for Forest Health Management

Objective: Monitor trends in snag density, quality, and wildlife use over time.

I. Continue the program to monitor snags within the NOFS property.

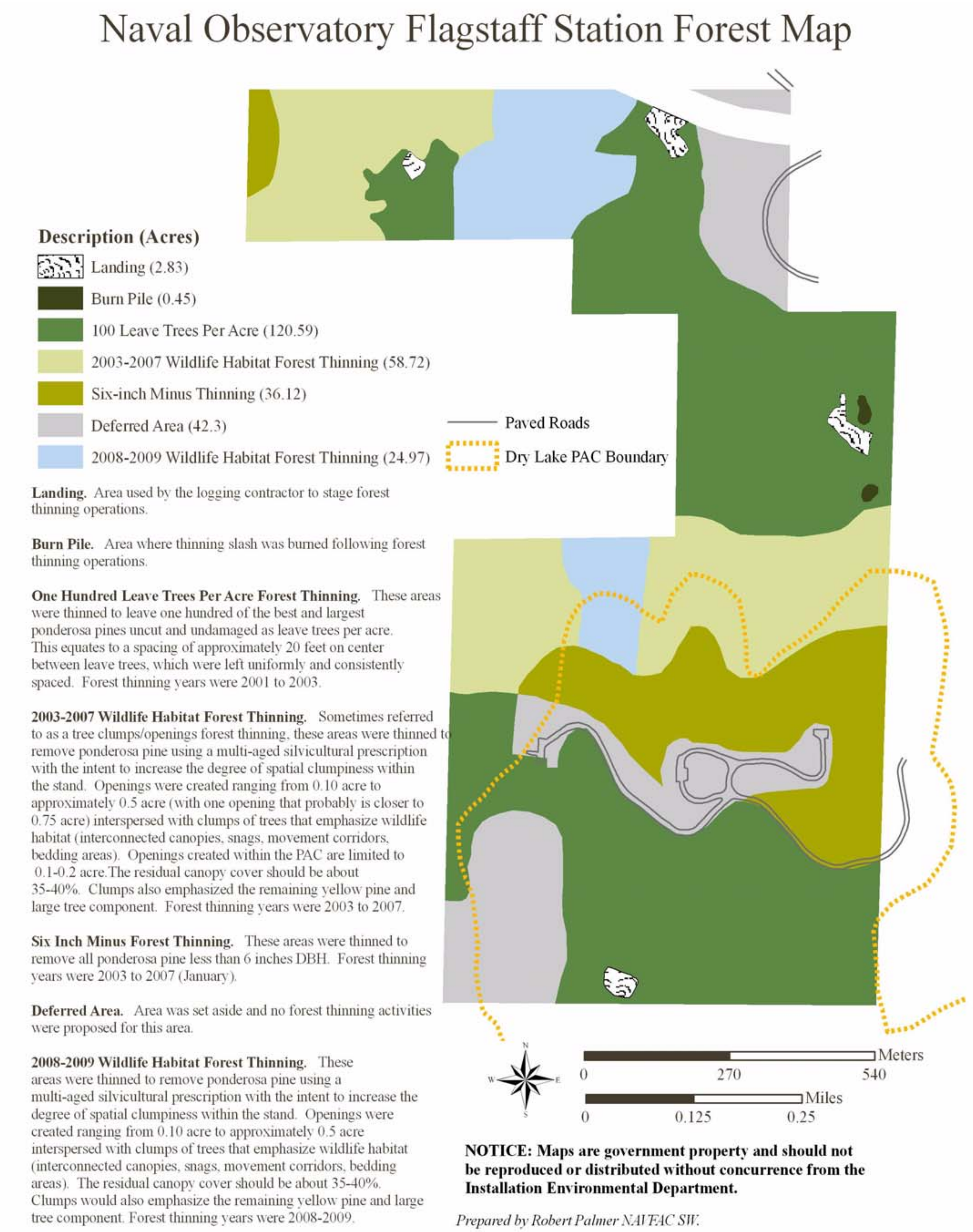
A. Use baseline data collected to monitor trend.

II. Bring NOFS up to the USFS recommended minimum of 4.9 snags/ha for trees > 18 inches dbh for southwestern ponderosa pine forests.

A. Retain all snags and coarse woody debris during future forest treatment projects.

Given the restricted use of fire as a silvicultural tool on Navy lands at the time, foresters opted to reducing the number of pine stems around and in oak trees in order to protect, preserve and perpetuate the oak fraction in the forest.

In 2001, NOFS began a thinning treatment on its forested areas (Refer to Table 4-1 and Map 4-2). The effects of forest thinning treatment was analyzed by the USFWS (BO 2-21-97-F-110, and BO Amendment 29 August 2003). Between 2001 and 2003, approximately 120 acres were thinned to leave one hundred of the best and largest ponderosa pines uncut and undamaged as leave trees per acre. This equates to a spacing of approximately 20 feet on center between leave trees, which were left uniformly and consistently spaced. In 2003, NOFS entered into a planning partnership with the USFWS, AZGFD, and the ASLD. As a result of this partnership between 2003 and 2007 two new prescriptions were implemented; a wildlife habitat forest thinning, and a six-inch minus forest thinning.



Map 4-2. Forest thinning treatments conducted at Naval Observatory Flagstaff Station.

Table 4-1. Acreages of forest thinning types at Naval Observatory Flagstaff Station as of June 2007.

Acres	Description
120.59	100 leave trees per acre
0.45	Burn pile
42.3	Deferred area
24.97	Future wildlife habitat forest thinning
2.83	Landing
36.12	Six inch minus thinning
58.72	Wildlife habitat forest thinning
286.00	TOTAL[a]

a. This total reflects small GPS errors resulting in an omission of 1 acre for the entire base, which is 287 acres.

As of 2007, 58.72 acres (with another 24.97 acres proposed for 2008 and 2009) have been thinned as wildlife habitat forest areas to remove ponderosa pine using a multi-aged silvicultural prescription with the intent to increase the degree of spatial clumpiness within the stand. Openings were created ranging from 0.10 acre to approximately 0.5 acre (with one opening that probably is closer to 0.75 acre) interspersed with clumps of trees that emphasize wildlife habitat (interconnected canopies, snags, movement corridors, bedding areas) leaving a residual canopy cover of about 35-40 percent. Clumps also emphasized the remaining yellow pine and large tree component. The six-inch minus areas (36.1 acres) were thinned to remove all ponderosa pine less than 6 inches dbh. In addition to the treated areas, refer to Map 4-2 for locations and descriptions of landings, burn piles, and deferred areas.

Long-Term Plans for Forest Management at NOFS

- **The next major forest thinning treatment at NOFS is anticipated to occur around 2055. Areas presently thinned as 100 leave trees per acre would be allowed to grow until the pine canopies have intermingled, in order to provide maximum suppression of reflectance and stabilize soils through natural leaf fall mulching.**

The next major forest thinning treatment at NOFS is anticipated to occur around 2055 (Briggs, *pers. comm.*, 2007). Areas presently thinned as 100 leave trees per acre would be allowed to grow until the pine canopies have intermingled, in order to provide maximum suppression of reflectance and stabilize soils through natural leaf fall mulching. Other thinning categories are expected to remain the same.

The use of prescribed fire as an element to manage forest health and the potential for catastrophic wildfire is considered an essential tool. The reintroduction of fire as an element in this effort would be considered under circumstances that could contribute to overall forest habitat management goals without jeopardizing NOFS property, functions, and operations.

- **Prescribed burning will be used as necessary to reduce the fuel load, improve understory structure and condition, and enhance the amount, distribution and nutritional value of wildlife forage plants, habitat for focal species, habitat for beneficial pollinators, and based on a Forest Understory Enhancement Plan.**

Prescribed burning will be used as necessary to reduce the fuel load, improve understory structure and condition, and enhance the amount, distribution and nutritional value of wildlife forage plants, habitat for focal species, habitat for beneficial pollinators, and based on a Forest Understory Enhancement Plan. Particular care will be given, prior to any prescribed burn, to assure that oak stems/boles/canopies/snags/and pines >24 inches[1] will be protected to the extent practicable consistent with use of prescribed burning. With the oaks as a linchpin of forest composition, the conditions for oak survival growth and canopy development will be enhanced. One criterion for prescribed burn in the presence of oaks will be to prevent scorching of oak root crowns and boles. This may involve active protection measures such as pulling leaf litter away from close proximity to the oaks, initiating burns when moisture conditions would preclude ignition of oak leaf litter near the stem, scraping fuel breaks around clumps of oaks. It is anticipated that burning will occur when there is sufficient understory vegetation (grasses and forbs) to carry a fire in an efficient and

1. These can be protected by lining the duff layer away from the bole of the tree or snag.

effective burn. One goal will be a mosaic of understory/litter ages across the Navy property. It is anticipated that a maximum of 40 acres may be burned in any given year, subject to adjustment for weather, topography, fuel conditions, etc. This may not be in a contiguous block, but comprised of smaller, irregular patches. It is not anticipated that burning will be conducted every year due to fuel amounts, conditions and locations. Of paramount concern are the safety of personnel, Observatory facilities and the oak fraction of the forest. The periodicity of burning, both in general and on a rotational basis on any given tract of land or across the entire Navy property, will depend on fuel accumulation and condition to initiate and carry a fire in accordance with the prescription, fuel distribution and weather conditions. The Navy will seek to coordinate its burning plans and scheme with adjacent property owners to maximize benefits and safety and to reduce costs.

Objectives for Forest Management

Objective: Maintain the forest stands in a healthy, productive condition that will control the number of pines per acre, increase tree and stand vigor and enhance structural diversity of both the pines and the oaks.

Objective: Maintain soil stability along forest access roads, and soil productivity of the forest.

Objective: Conserve the stands with particular attention to those seeming to have the greatest future potential for Mexican spotted owl habitat, as long as fire control and dark sky objectives can be met.

Objective: Integrate forest management with other natural and cultural resources disciplines and programs to protect natural and cultural resources attributes associated with the forested acreage on NOFS.

Objective: Provide for pine and oaks, down and dead woody material, and the wildlife that use them such as snag-dependent and cavity-nesting species.

I. Individual trees may occasionally need to be removed or trimmed if they present obstructions to the telescopes, or pose a safety hazard to humans and/or property (including roads/highways). Trimming or cutting will be conducted de minimus, or the minimum level necessary for clear viewing or safety. Any cutting of trees over nine inches dbh in the PAC following thinning operation already covered by the BO with USFWS, will be coordinated in advance with the USFWS. As of writing no tree cutting, only tree topping or trimming for the telescopes' viewscape is anticipated in the time frame of the INRMP. No cutting of oaks is foreseen, unless for the purposes of minimizing threats to human safety and/or property.

  A. Natural regeneration of native tree species is expected to diversify stands thinned or replanted, resulting in a species mix that will be more resistant to insect and disease attack through the synergistic effects of species and wildlife habitat diversities.

  B. Sanitation or salvage logging may occur if conditions warrant, but is not expected to occur during the life of this INRMP.[1]

    1. The benefits of mistletoe should be considered before any decision is made on sanitation or salvage logging. Mistletoe is a natural component of ponderosa pine forests, and provides forage and nesting habitat for a large variety of birds and mammals.

1. During a field trip soon after the escaped USFS prescribed fire in October of 2008 (Refer to Map 4-4), Navy resource staff and AZGFD and USFWS determined that salvage logging of burnt standing trees was unnecessary. The standing burnt trees were providing an insect forage resource for woodpeckers; there was no indication that standing burnt trees were posing any hazard to human safety or that their eventual deadfall would create any unnatural fire risk.

C. Routine monitoring and early treatment of trees for disease and beetle infestation is expected to obviate the need for patch cutting or other unplanned removal of trees that would exacerbate light reflectance problems and interfere with the telescope operations and the NOFS mission. If harvesting of trees becomes advisable within the PAC, USFWS will be notified prior to implementation of the action.

D. Protect all snags, hollow logs and wildlife trees, and downed large organic debris unless they present a hazard to humans and/or property. In addition, trees deemed unique or of special interest for wildlife, such as advanced second growth specimens, isolated relict old growth, trees with large limbs or cavities, or less prevalent species, will be protected to the extent that they do not interfere with human safety or pose a hazard to property. Trees naturally encroaching on the roads may need to be periodically removed or trimmed. Trees encroaching on right-of-ways will be thinned out to 24 feet on center and 15 feet from the edge of the pavement.

E. Snags and downed hollow logs, important to cavity-nesting birds and other animals, will be left uncut except when determined by the NAVFAC NW Forester to present a safety hazard and no alternatives are available for working around the snag.

II. Insect and disease problems have not reached problematic proportions on the NOFS in recent years. Any such infestations or outbreaks will be dealt with using the best science and management practices available.

III. Improve the herbaceous understory to achieve multiple objectives: decreasing snow reflectance, reducing pollen production which may also interfere with telescope lenses by emphasizing grasses over pines, reducing fugitive dust, enhancing habitat for beneficial pollinators, and increasing granivores (animals that eat grass seed) to improve foraging for the Mexican spotted owl.

A. Develop an understory enhancement planting pilot project that can achieve the above objectives.

B. Follow the recommendations of the Forest Thinning Understory Restoration Plan developed by the Natural Resources Conservation Service (NRCS) (see Appendix K) for understory seeding mix.

IV. Monitoring microhabitat plots, updating forest inventory, surveying for disease and insect infestation, completion of forest thinning activities, and preparation of plan revision will be the prominent work items over the next several years.

V. Investigate desirability of seeding or planting trees and/or understory natives in open areas.

A. Plantings may be conducted where trees have been damaged by storm, disease, fire or insect infestation and subsequently salvaged. In addition, landings and burn pile areas may also be planted or reseeded with native plants.

B. Planting conifer seedlings will be by hand. Hand planting is more expensive than seeding, but affords more rapid and dependable stand establishment and can provide positive influence on stand species composition and structure. Some planting areas will involve site preparation at each planting spot.

C. When designing the spacing and the patterning of tree planting, foresters will consider the values of fire control, maintaining dark sky condition, and wildlife habitat enhancement.

VI. Develop a prescribed burn plan reviewed by the forest management partnering team, including the Navy, USFWS, and AZGFD. The prescribed burn plan differs from a fire management plan in that the prescribed burn plan addresses particular burn events, whereas a fire management plan is developed for long-term fire planning including a framework for fire prevention, fuels management, and fire control, as well as environmental and public health considerations.

VII. Steep drainages will incur the minimum amount of cutting required for fire control during any sanitation or salvage logging that may be necessary with a pest or disease outbreak. To help maintain slope stability, any future salvage patch cuts on slopes over 15 percent should be less than five acres in size with some individual trees left in order to resemble a savannah-type habitat, with no adjacent parcels patch cut until regeneration has reached an average height of 14 feet. However, patch cutting is a worst case scenario, and is not anticipated during the life of this INRMP. If harvesting of trees becomes advisable within the PAC, consultation with USFWS will be initiated and concluded prior to implementation of the action.

VIII. Increase density of snags toward the USFS standard.

IX. All naturally downed logs will be left undisturbed on the forest floor, unless inadvertently moved as part of the logging process, or to the maximum practicable extent, to provide habitat for wildlife including small mammals, salamanders, insects, and other arthropods.

4.7 Wildland Fire Management[1]

The recently implemented thinning at NOFS (2001-2009) was undertaken to prevent high-severity wildfire, and to promote forest health. A twenty-foot spacing between trees was prescribed on 250 acres, while 37 acres were left untreated. The mixture of treated and untreated areas should allow for species that prefer more open mature forests (northern goshawk), as well as those that prefer mixed stands with higher densities (olive-sided flycatcher, and the cordilleran flycatcher). Careful monitoring of snags has begun across the entire property to track wildlife use and snag quality (Ingraldi and Bayless 2005).

NOFS cannot implement certain routine measures for forest fire abatement available to other property owners. While NOFS routinely is asked or forced to close its viewing window when neighboring landowners/agencies conduct prescribed burns, this essentially shuts down observation until the smoke has cleared and the telescope lenses are not at risk. Exceptional astronomic viewing occurs in the fall when clear skies are common, and this is also the period when prescribed burning is typically conducted. Firebreaks are an unacceptable means of fire control because they cause soil disturbance and inordinate amounts of bare ground. This causes excessive fugitive dust. Thinning the forest excessively increases light reflectance from bare ground that interferes with telescope viewing, especially in winter when snow is on the ground.

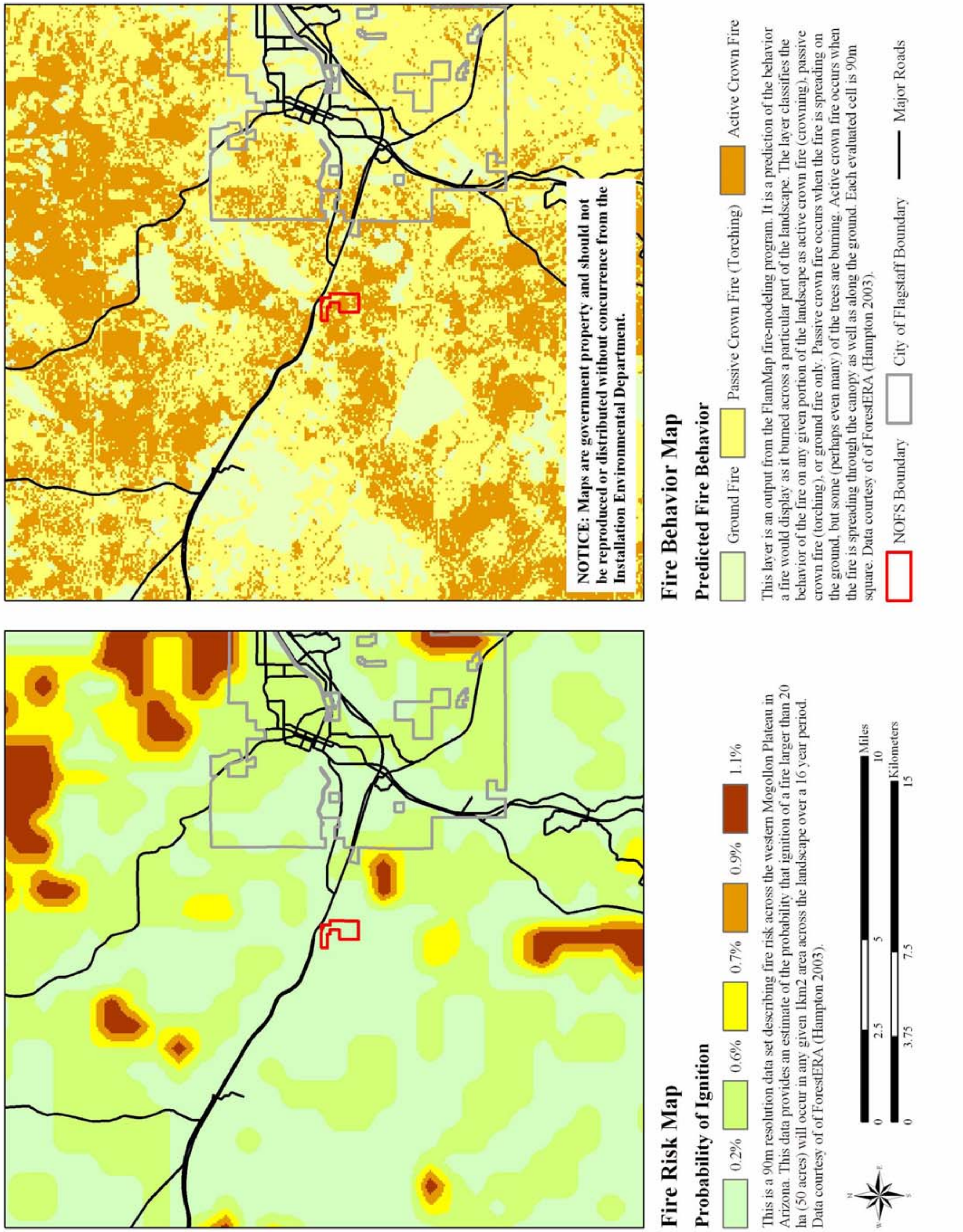
The risk of high severity wildfire has evolved over that of 100 years ago when surface fires caused by both lightning or Native American land management practices were extremely common. With the arrival of European settlers and expanding human settlement, changing land uses and fire suppression has allowed excessive fuel build-up in the forest, and the parallel danger of crown-replacement fires. The result has been a drastic increase of severe wildfires in recent decades (Biswell 1972; Harrington 1982). The Pumpkin Wildfire in 2000 at Kendrick Peak, north of NOFS reportedly had flame

1. This section addresses wildland fire management specifically, refer to Section 4.6 for a discussion of forest health and management objectives more generally.

lengths of 200-300 feet and is a local example of the potential for high severity, stand-replacing fires in contemporary southwestern ponderosa pine forests. This is of paramount concern to NOFS because of the current build-up of its forest fuels, its exposure to lightning strikes, and its increasingly urban interface providing a potentially high risk of fuel ignition. Topography and winds can easily carry a fire starting on state lands onto NOFS property from the southwest, with the steep drainages that harbor the best Mexican spotted owl habitat being most at risk. For the Observatory site, fire frequency is estimated at 2.9 fires over 10 years. That rate has increased from the previous 10-year period rate of 1.4 fires (Krushak, *pers. comm.* 1997). Modeled fire liabilities are presented in Map 4-3. Note that these models were developed in 2003, prior to recent thinning on the USFS lands in the vicinity of NOFS. Thinning tends to reduce fire liabilities.

Besides risk to facilities and personnel, a number of forest management concerns are primarily attributable to post-settlement fire exclusion and the resulting increased tree density (Cooper 1960; Biswell 1972; Weaver 1974; Covington and Sackett 1992; Covington and Moore 1992):

- Overstocked patches of saplings and pole-sized trees
- Reduced tree growth and increased mortality, especially of the oldest trees
- Decreased decomposition rates
- Stagnated nutrient cycles
- Eruption of insects and diseases
- Decreased herbaceous and shrub forage quality and quantity
- Ecosystem simplification (increasing dominance of ecosystem productivity by ponderosa pine and its dependent food webs)
- Higher fuel loads
- Increased vertical fuel continuity due to dense sapling and pole patches
- Greater canopy closure and landscape homogeneity
- Higher severity and destructive potential of wildfires
- Decreased stream flow and onsite water balance
- Less wildlife habitat for species dependent on herbaceous vegetation
- Low aesthetic values



Map 4-3. Predicted fire liabilities and behavior in the vicinity of Naval Observatory Flagstaff Station.

Lightning has been a consistent cause of fires in southwestern forests for centuries, the Flagstaff area having one of the highest lightning strike rates in the country. A strike will not start a fire unless it meets with easily ignited fuel like pine needles, grass or pitch. Hot dry weather with gusty winds and intense lightning storms creates an environment highly susceptible to fire, and Flagstaff has some of the most critical fire weather of any region in the country. “There’s always plenty of lightning especially around Flagstaff [to provide ignition when fuels reach a critical level]” (Lathom, *pers. comm.* 1997).

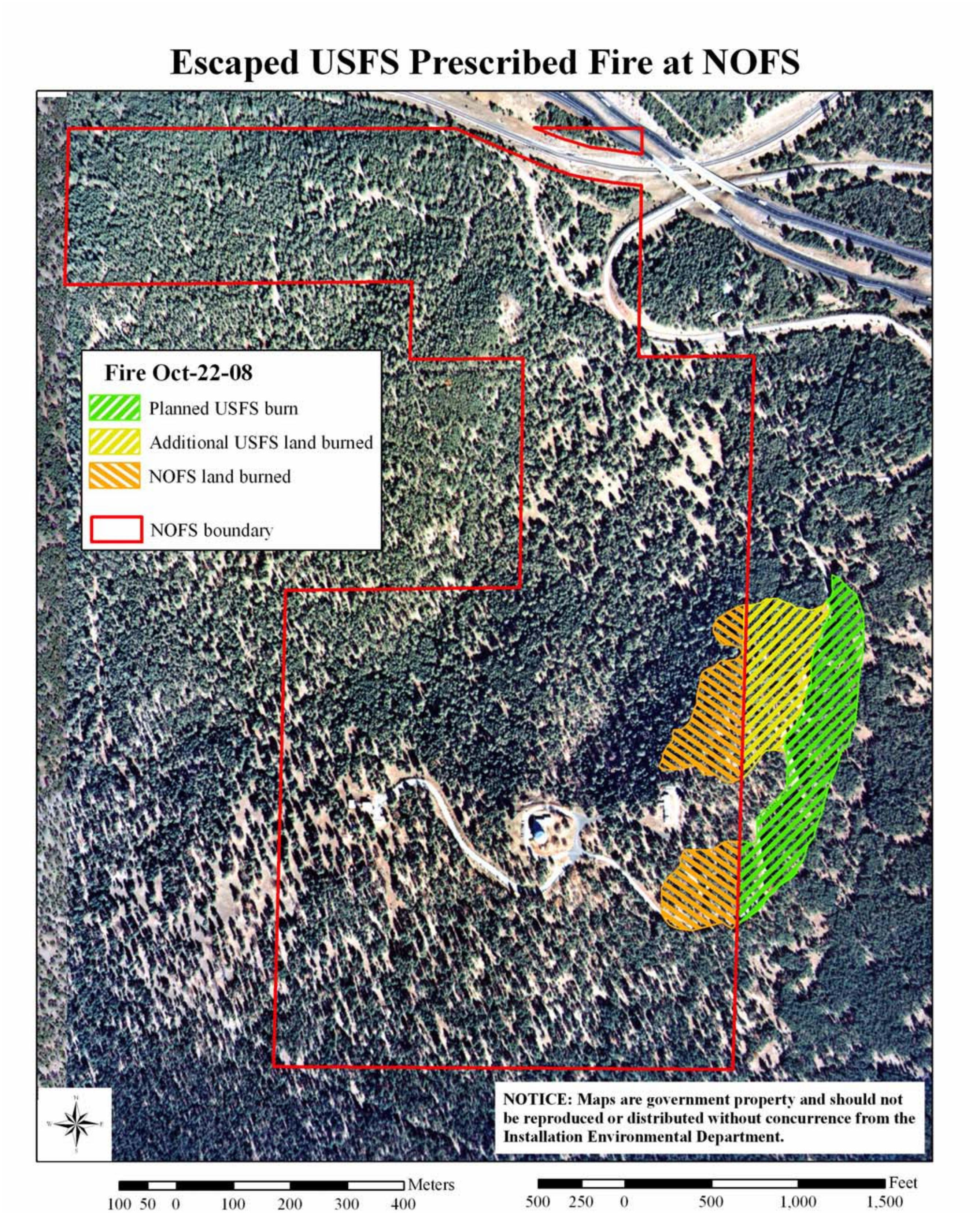
Coconino National Forest has the highest number of fire/acres on protected national forest in the region. On the Peaks district there are over 300 fires per year, half being lightning caused, and half human caused. A few fires per year within miles of the Observatory are started as a result of abandoned camp fires and transient traffic travelling the route of the interstate (Farnsworth, *pers. comm.* 1997).

The only recorded fire at NOFS in recent decades was in 2008. On 22 October 2008 the USFS was conducting a prescribed fire on adjacent land to the east that was supposed to finish at the access road (Refer to Map 4-4). The fire unexpectedly jumped the road in two places, however due to the recent thinning, fuels were low, and only understory shrubs and grasses burned. A total of 9.8 acres of forest on the NOFS property burned as a result of the fire.

The remote location, paucity of structures and improvements and types of uses do not warrant stationing fire suppression assets at the NOFS. Generally, forest fire detection would be by observation from the station or adjacent lands. Given the controls on recreational access, the most common source of ignition, human activity, is limited to industrial areas and the transient sheep camp.

Naval Observatory Flagstaff Station currently has no formal agreement for fire fighting resources, with first response for an emergency fire coming from Navajo Army Depot. A fire alarm is set up to send a signal to Camp Navajo, who will either respond or call Flagstaff to respond if possible.

Prescribed burning will be used to reduce the fuel load, improve understory structure and condition and enhance the amount, distribution and nutritional value of wildlife forage plants.



Map 4-4. The 22 October 2008 escaped prescribed burn, originating on U.S. Forest Service lands to the east.

Particular care will be given, prior to any prescribed burn, to assure that oak stems/boles/canopies will be protected to the extent practicable consistent with use of prescribed burning. With the oaks as a linchpin of forest composition, it is beneficial to enhance the conditions for oak survival, growth and canopy development. One criteria for prescribed burn in the presence of oaks will be to prevent scorching of oak root crowns and tree trunks. This may involve active protection measures such as pulling leaf litter away from close proximity to the oaks, initiating burns when moisture conditions would preclude ignition of oak leaf litter near the stem, scraping fuel breaks around clumps of oaks, etc.

It is not anticipated that burning will be conducted every year due to fuel amounts, conditions and locations. Of paramount concern are the safety of personnel, observatory facilities and the oak fraction of the forest. It is anticipated that burning will occur when there is sufficient understory vegetation (grasses and forbs) to carry a fire in an efficient and effective burn. One goal will be a mosaic of understory/litter ages across the Navy property. It is anticipated that a maximum of 40 acres may be burned in any given year, subject to adjustment for weather, topography, fuel conditions, etc. This may not be in a contiguous block, but comprised of smaller, irregular patches.

The periodicity of burning, both in general and on a rotational basis on any given tract of land or across the entire Navy property, will depend on fuel accumulation and condition to initiate and carry a fire in accordance with the prescription, fuel distribution and weather conditions. The Navy will seek to coordinate its burning plans and scheme with adjacent property owners to maximize benefits and safety and to reduce costs.

Objective for Wildland Fire Management

Objective: Manage the risk of high severity wildfire by maintaining an open stand structure that prevents crown fires, and by minimizing fuel loads, especially ladder fuels.

Objective: Establish a process and standards for avoiding wildfire ignition and quickly and effectively suppressing wildfire threatening the property and facilities.

Objective: If consistent with protecting mission-related operations, participate in prescribed burning with neighbors to maintain a low risk of high severity fire.

Objective: If consistent with protecting mission-related operations, coordinate the INRMP with an existing fire management plan owned by a neighboring agency. This will help support forest thinning and wildfire management through an organized plan and documentation of NOFS management.

I. Sustain a low risk of particulate pollution and low risk of high severity wildfire.

II. Establish a Mutual Assistance Agreement with the city of Flagstaff, USFS, and other partners with the necessary assets to suppress fires that start or are threatening the NOFS property.

III. If broadcast burning can be conducted in a manner acceptable to NOFS, duff around large or snag oaks and pines will be scraped or lined to protect the trees from fire. The burning prescription will be such that the result will be a low-intensity fire that protects the dead and down material which supports the prey base for the Mexican spotted owl and other species. Such burning is also valuable for increasing the probability of natural forest regeneration.

- *A.* For broadcast burning, a permit would be sought from the Arizona Department of Environmental Quality to ensure there would be no effects on the city of Flagstaff, since prevailing winds come from the southwest.

B. Any burning will follow USFWS Mexican Spotted Owl Recovery Plan guidance and requirements and local air pollution control district "burn/no-burn" day status. All appropriate local emergency response districts/agencies will be notified in advance of the burn to assure adequate coordination. Representatives of the USFWS will be invited to attend.

C. If additional fuel reduction is needed, consideration will be given to hand pruning pine limbs to a specified distance above grade.

D. Additional pruning of lower limbs might be considered 5 to 10 years after the first pruning.

E. If acceptable to the Observatory, up to 100 thinning debris (slash) piles might be burned per year.

IV. Ensure that timber sale contracts provide necessary safeguards to prevent wildfire starts during forest management operations.

V. If prescribed burning for preparing a seed bed is desirable within the PAC boundary, the Navy will consult in advance with the USFWS.

4.8 Vegetation Management

Based on general vegetation surveys conducted in 1996, no sensitive plants with federal status are currently known to occur on the NOFS property. However, two USFS sensitive species are known locally from the Coconino Forest and might be found on the property. More recent and focused rare plant surveys are lacking.

Objective for Plant Communities and Rare Plants

Objective: Provide for the protection and enhancement of sensitive plants and habitats, as a proactive strategy to prevent contributing to further declines, and with a focus on the Mexican spotted owl and other cavity nesting and snag-dependent species.

I. Conduct botanical surveys every five years. Document the presence/absence of each rare or sensitive plant species that may occur.

A. Also search for invasive weeds based on a noxious weed target list and map for control efforts.

B. Document the location and spread of dwarf mistletoe.

C. Maintain a NOFS plant collection.

II. Avoid impacting rare or sensitive plants during control of invasive plants.

III. Keep a cumulative map and record of surveys and findings on sensitive species in order to enhance understanding of their needs and status.

4.9 Invasive Species Management

- **The Noxious Weed Control Act requires federal land managers cooperate with state and federal agencies to manage undesirable plants. It mandates a program and a person be assigned to deal with unwanted plants, funding, cooperative agreements, and the use of integrated pest management systems. The military point of contact for the Act is the Armed Forces Pest Management Board (Established by OPNAVINST 6250.4A).**

Invasive species are a threat to diverse and healthy ecosystems. They can alter ecosystems to the extent that they no longer support their native functions. They change ecosystem dynamics by changing soil nitrogen cycling, out-competing natives for water, and predisposing an area to wildfire by providing fuel where there otherwise might not be enough ground cover to carry a fire. Invasive weeds can pose a serious long-term threat to habitats. Several possess the ability to completely change the structure of vegetation, making it unsuitable to most native wildlife species. Sensitive and declining wildlife and plant species are particularly at risk from these weeds.

Other weeds that occur in very low numbers or seem innocuous for years may expand their range dramatically and become a difficult pest under the right environmental conditions. These conditions might include a year with very late rains, or a flood that results in heavy sedimentation of drainages in the case of riparian weeds.

A list of recommended plants for landscaping use can be found in Appendix M. These species have been selected by Navy landscape architects for use on installations. Guidelines for ratios of natives verses non-natives are given.

- **Actions will be taken to prevent the introduction of invasive species, monitor for their presence, and respond rapidly to eliminate them (EO 13112 February 1999).**

An EO signed in February 1999 (EO 13112) directed federal agencies to identify and control invasive species. The order stipulates that actions will be taken to prevent the introduction of invasive species, monitor for their presence, and respond rapidly to eliminate them.The DoD subsequently issued a memorandum of compliance with this EO. An effective way to implement these actions is through the Federal Noxious Weed Act of 1975 that requires federal land managers cooperate with state and federal agencies to manage undesirable plants. It mandates that a program and a person be assigned to deal with unwanted plants, funding, cooperative agreements, and the use of integrated pest management systems. The military point of contact for the Act is the Armed Forces Pest Management Board (Established by OPNAVINST 6250.4A). The mission and responsibilities of the Air Force Pest Management Board are contained in DoD Directive 6050.10. DoDINST 4150.7 establishes the DoD Pest Management Program and describes its general requirements.The Instruction states the Navy's pest management policy and requires a comprehensive Pest Management Plan. Coordination requirements are not stated. The Instruction discusses the need to control pest outbreaks which affect the military mission, damage property or impact the welfare of people. Chapter 17 of OPNAVINST 5090.1C CH-1 requires that the use of pesticides comply with applicable regulations to prevent pollution. In addition to these requirements, additional stipulations may be added to meet specific needs.

Locally, the Northern Arizona Weed Council coordinates weed control efforts between landowners and land managers in the San Francisco Peaks Weed Management Area. The USGS conducts a Southwest Exotic Plant Mapping Program to monitor the distribution of weeds by way of various partnerships and collaborators. The Arizona Department of Agriculture maintains an Arizona Noxious Weed List to help landowners target their efforts at detection, control and monitoring.[1]

In 2004, the USFS completed an EIS for treatment of noxious and invasive weeds in the Coconino, Kaibab, and Prescott National Forests. The EIS authorizes "treatment of invasive species, prioritizing roads and other travel quarter where weeds gain entry and other invasive species" (Farr, *pers. comm.* 2007).

Objective for Control of Invasive Weeds

Objective: Eradicate or control the spread and prevent the introduction of invasive species with priority on those with greatest potential for spread, out-competing native plants, and degrading habitats.

I. Prevent new invasions.

1. This list may be seen at: http://www.usgs.nau.edu/swemp/Info_pages/states/arizona/azdespp.html.

A. Develop a plan for detection, monitoring, and treatment of invasive species using principles of integrated pest management to prevent and suppress pest infestations in a cost-effective, environmentally sound manner.

B. As part of the invasive species management program, the effects of herbicide use was evaluated for effects on the Mexican spotted owl through an informal Section 7 Consultation concluded on 28 April 2003. For a copy of the document see Appendix I.

II. Implement monitoring and eradication programs as needed based on established criteria. These criteria include prioritization based on known aggressiveness of invasive species, extent of infestation, and threat or risk to native plants and animals.

A. Identify and map all infestations of invasive plants.

B. Focus on potential invasives that may infest trails and landings created by per-commercial thinning operations conducted from 2001-2003, along roadways, and along utility rights-of-way.

C. Initially target the following areas and species for control:

1. Bindweed and other nonnative invasives in the disturbed soil around the new Building 4.

2. Mullein around the buildings and other areas.

3. Russian olive trees on the access road and adjacent parking lot to Buildings 6 and 7, and any other locations.

4. Dalmation toadflax along roadways.

5. Russian knapweed (*Rhaponticum repens*) if it is detected on the property.

D. Coordinate timing of control of invasives near the property boundary with adjacent landowners and managers (National Forest, state, and private) to achieve maximum control and minimize cross-boundary reinvasions.

E. Restoration, construction, and mitigation plans should include contingencies for removing invasives as they appear and for implementing new control measures as they become available.

F. Control programs should cause the least possible disturbance to native species and communities.

III. Develop a list of methods for control and adapt as needed.

A. Use one of these methods: hand grubbing, hand pulling, hand rogueing; mowing; use of weed seed-free mulches and seed mixes; use of approved insects and pathogens; or use of herbicidal spot treatments or backpack spraying. There will be no aerial application of chemicals by either fixed wing or rotary aircraft.

B. Select methods based on these criteria:

1. Health and human safety

2. Effectiveness

3. Economic efficiency

4. Environmental acceptability and compatibility

C. The annual combination of methods to be used may vary with experience.

D. The following herbicides are used locally on Forest Service lands for weed control and should be evaluated for their compatibility with DoD pest management standards: chlorsulfuron; clopyralid; 2,4-D; dicamba; glyhosate; imazapyr; metsulfuron methyl; picloram; sultometuron; sultumeturon methyl; and triclopyr.

IV. In concert with the Integrated Ecological Monitoring Program, monitor invasive weeds and those which have the potential to become noxious by remapping every three to five years. Monitoring is key to detect occurrence and trends of invasives.

4.10 Pest Management

Some species of mice, in particular the deer mouse (*Peromyscus maniculatus*), are vectors for disease. Hanta Pulmonary Syndrome (HPS) or hanta virus could be a potential concern in areas of infestation. This is a potentially lethal virus transmitted to humans through the inhalation of aerosolized rodent urine, feces, or saliva. HPS has been reported in northeastern Arizona and measures should be taken to eliminate rodents when discovered within buildings. If rodents are a persistent problem, periodic testing of rodents may be appropriate to determine if they are carriers of the virus. Prevention is the best strategy, accomplished by taking practical steps to minimize contact with rodents. HPS is not contagious from person to person in the United States.

A finding of 16 skunks infected with rabies out of 70 skunks tested in northwestern Arizona required federal health officials to call into effect a 90-day pet quarantine in May 2001. The quarantine required all cats and dogs to be kept inside a fence, house, or on a leash during the 90 days and encouraged pet vaccination against rabies. Because infected animals are hard to identify until later stages of the disease, recommendations are to keep pets away from wild animals, not to leave food out, and ensure that garbage is inaccessible to animals. Some signs that an animal is infected with rabies are: animals that are usually nocturnal are coming out in the daytime; rabid animals show no fear of humans and may appear unusually friendly; rabid bats fall to the ground; and rabid animals may show unprovoked aggression or strange behavior. The only definitive way to diagnose rabies is to examine the brain tissue after an animal has died. There is a human treatment, if administered prior to the onset of symptoms, called post exposure prophylaxis (PEP) that can be injected rather painlessly into the arm. After symptoms of rabies occur in humans, there is no treatment.

Objectives for Pest Management

Objective: Establish an awareness and prevention program for rabies.

I. Educate NOFS personnel to report pest observations, and remove as necessary. If an animal suspected of carrying rabies or other disease is spotted, Animal Control in Flagstaff should be contacted at (520) 774-1414.

II. If a person has made physical contact with an animal that has any possibility of having rabies, they should wash the wound with soap and water and seek medical attention immediately.

III. Ensure that NOFS personnel abide by the guidelines of federal health officials during rabies outbreaks.

IV. Indoor Prevention.

- *A.* Keep a clean work environment, especially kitchen facilities. Keep food covered in rodent-proof containers.
- *B.* Keep a tight-fitting lid on garbage, discard uneaten pet food at day’s end.
- *C.* Set and keep spring-loaded rodent traps. Set traps near baseboards because rodents tend to run along walls and in tight spaces rather than in the open. Seal all entry holes 1/4 inch-wide, or wider, with lath screen or lath metal, cement, wire screening, or other patching materials inside and out.

Objective: Promote the use of best management practices to avoid harm to non-targeted native species when controlling pests.

I. Set EPA-approved rodenticide with bait under plywood or plastic shelters along baseboards. These are sometimes known as covered bait stations. Follow product use instructions carefully, since rodenticides are poisonous to pets as well as humans.

II. Outdoor Prevention.

A. Use metal flashing around the base of wooden, earthen or adobe homes to provide a strong metal barrier. Install so that the flashing reaches 12 inches above ground and six inches into the ground.

B. If possible, locate woodpiles and garbage cans 100 feet or more from buildings and elevate to eliminate possible nesting sites.

C. Encourage the presence of natural predators, such as non-venomous snakes, owls and hawks.

D. Ensure pest management is consistent with the objectives in Section 4.4.1: Bats.

4.11 Land Management

In much of the western U.S., thunderstorms in the months of July and August provide at least half of the annual precipitation. With trees and vegetation burned off and the ground left bare or close to it, the speed and amount of water runoff may increase above the level to which the system has adapted; especially in severe fires where a hard shell has formed over the soil, keeping water from soaking through. The runoff carries dirt, ash, and debris, which may clog waterways, culverts, and reservoirs.

An eroded area exists in the drainage just south of Building 1, the transit telescope. Additional erosion has been identified along the utility line road leading to the northeast from the Operations Area.

Federal land managers are required to control and prevent erosion by conducting surveys and implementing conservation measures (Soil Conservation Act; PL 74-46; 16 USC 5901). This includes both point-source (originating from a single location such as a culvert) and nonpoint-source (originating from a dispersed area) erosion, especially that which may affect water quality.

Erosion prevention and control becomes a Class I funding action on NOFS when it affects habitat or nests of the federally threatened Mexican spotted owl or jurisdictional waters of the U.S. Since avoiding soil disturbance is not always possible, the following measures for soil erosion prevention and control are recommended.

Objective: Protect and restore soil productivity, watershed functioning, water quality, and wildlife habitat through effective implementation of Best Management Practices[1] to prevent and control soil erosion.

Objective for Land Management

I. Minimize soil disturbance and compaction.

II. Maintain soil stability along forest access roads, and soil productivity of the forest.

1. For examples of Best Management Practices in Arizona, see Arizona NEMO program (AZNEMO 2007).

A. Implement erosion control measures based on the needs of each type of erosion source.

B. Stabilize soil through protection of existing cover. Revegetate slopes near buildings in the Operations area with locally native species.

C. Install water bars, retaining walls, or diversion culverts in areas of high runoff.

1. Install water bars along the utility line road.

2. Retaining walls should be considered along the uphill edges of roads where the road has created a significant cut bank.

3. A system of cement diversion culverts or rock lined channels may be appropriate for vegetated slopes.

D. Provide for reseeding as necessary in open or disturbed areas. Follow the recommendations of the Forest Thinning Understory Restoration Plan developed by NRCS (see Appendix K) for understory seed mix.

III. Control expansion of erosion scar and stabilize the existing erosion in the drainage south of the transit telescope. Evaluate for remedial treatments to restore and stabilize the soil surface, profile and vegetative cover. Treatment may include weed-free straw mulch incorporated into the soil with fertilizer (and gypsum if the pH needs adjustment), broadcast native grass seed that is certified weed-free, and cover with jute netting.

IV. Use selective cutting and buffers in wetlands and treat erosion problems before they become a problem.

V. Control drainage from roads and buildings to prevent excess runoff and erosion by ensuring proper drainage.

Objective: Prevent non-point source pollution from excessive erosion attributed to structures, roads and logging practices.

I. Non-point source pollution has not been a widespread problem on NOFS because of the minimal disturbance to soils, the good vegetative cover and infrequency of silvicultural treatment. One area of concern may be a site south of the transit telescope. It will be evaluated for remedial treatments to restore and stabilize the soil surface, profile and vegetative cover. Natural development of the forest, timing of silvicultural treatments, choices of low-impact technologies and improving understory vegetation will protect the soils. Improved road maintenance practices and road closures have reduced the amount of disturbed soil. Wind erosion will be prevented by maintaining the vegetative cover, slash treatment and windrows to provide windbreaks.

II. Avoid use of pesticides or herbicides in a manner that contributes to pollution. The avoidance of pesticides and herbicides is consistent with DoDINST 4150.07 on DoD Pest Management.

Objective: Provide a sound basis for management and design of low landscaping and grounds keeping immediately around occupied buildings that is compliant with EO 13123 and EO 13112.

Objective: Conserve water, protect water quality, reduce runoff and erosion, and decrease plant nutrient loss by reducing the demand for water in landscaped settings, in compliance with EO 13123.

I. Reduce use of water for landscaping while continuing to provide a quality working environment to NOFS personnel.

A. Reduce water wastage and use drought-tolerant plants as appropriate.

B. Investigate the possibility of using reclaimed water or collected natural rainfall for irrigation.

II. Conduct an audit of routine maintenance practices to support EO 13112, reduce the carbon footprint of routine activities, and maximize “green” measures for managing stormwater such as the use of bioswales, and achieve more environmentally sustainable practices.

III. Preserve views from NOFS property.

IV. Protect cultural sites.

V. Protect visual aesthetics. When developing silvicultural treatments, seek to reduce any visual impacts of mechanical treatments including thinning, sanitation and salvage removals.

VI. Develop a long-term monitoring program for assessing condition and trend of the forest, relate to wildlife habitat values, and evaluate for sensitive species, pests, and disease. Integrate into the program regular and routine monitoring of best management practices, new or changed erosion, sensitive plant species, invasive species, and forest pests and disease.

VII. Track weather data and relate to results of resources monitoring.

VIII. Take aerial photography of the property at 1:12,000 scale every 3-5 years and use in conjunction with ground-based plant surveys to characterize distribution of canopy densities across the property.

4.12 Data Management and Geographical Information Systems

Natural resources information management is complex because ecosystems and spatial data are complex. Computers have greatly enhanced access to land-based information. In particular, GIS and image-interpretation software help in the efficiency and effectiveness of environmental analysis and review. They have allowed managers to become more adaptive in their decision-making, providing a means to organize and update many types of resource data, as well as to test assumptions and play out management scenarios. They can play a critical role in helping land managers conceptualize problems at landscape or ecosystem levels.

Objective for GIS and Data Management

Objective: Ensure the technically sound, practical and appropriate use of library and computer technology to manage, analyze, and communicate natural resources information in support of management decisions.

I. Facilitate better natural resources decisions by improving the capability to access, organize, and analyze maps, inventories, remotely-sensed data, and other natural and cultural resources planning documents.

A. Seek out and use existing technology and make strategic investments in new technologies and creative, innovative management techniques to solve local or regional environmental problems.

1. Identify data needs and priorities. Document the current and future data needs for all installation land use functions, including why and when the information is needed, procedures for database development and prioritization of projects.

2. Develop record keeping protocols for wildlife sightings on NOFS.

3. Build and catalog a library of real estate documents, legal agreements, and resource materials to enhance day-to-day capability and reporting of natural and cultural resources concerns.

a. Acquire copies of all real estate documents, including all rights-of-ways and easements, legal agreements, and resource materials and store and catalog them.

B. Require that all projects produced for NOFS deliver GIS data in whatever in the most current and appropriate format.

II. Coordinate the integration of natural resources information with mission-related planning.

A. Use installation master (or site development) plans to integrate natural resources management objectives with mission activities and facilities development on DoN lands.

B. Write a policy for the sharing of NOFS land use data.

1. When appropriate, share GIS land use data with persons outside the installation to justify preemptive action against encroachment pressures.

2. Develop provisions and policies for sharing appropriate natural resources information with tribes, federal and state agencies, nongovernmental organizations, researchers, and the general public (DoD 1996).

III. Strengthen the scientific basis for natural resources management by integrating research and management (DoD 1996).

A. Incorporate information from federal and state agencies regarding natural resources shared with NOFS.

B. Ensure that management decisions are based upon the most recent and scientifically-sound information.

4.13 Outdoor Recreation

In response to the Sikes Act (as amended), a MOU between DoI and DoD was signed which requires all military installations to develop outdoor recreation plans where there are suitable resources for such a program consistent with national security. However, a determination has been made that provision of a formal public recreation program is not appropriate for NOFS. Refer to Section 3.5.1: Public Access for a discussion of the reasoning why NOFS discourages public access.

Nonetheless, there may be recreational opportunities for the staff that are consistent with the military mission and perhaps provide quality-of-life benefits. There are currently no formal hiking trails; however, there are ample locations for the staff to enjoy this activity. Similarly, in the past there was a cross-country ski trail used by installation personnel, which has not been used in recent years. A dedicated co-use trail might be considered. Constructing interpretive elements along the trail with bird boxes (e.g. blue birds, kestrels), or bat boxes, and a picnic table would offer expanded outdoor opportunities for staff.

Consistent with the Sikes Act (as amended), when planning for outdoor recreation NOFS makes considerations for disabled American veterans, military dependents with disabilities, and other persons with disabilities. This is done to the extent reasonably practicable, when topographic, vegetative, and water resources allow access for such persons without substantial modification to the natural environment.

Outdoor Recreation Objective

Objective: Promote compatible, sustainable outdoor recreation opportunities which enhance quality of life for NOFS personnel, while conserving natural resources, without compromising the mission.

I. Take advantage of opportunities for improving the quality of the workplace for NOFS personnel through outdoor recreation opportunities that are consistent with the military mission.

  A. Consider a dedicated co-use ski/hiking/interpretive trail. Constructing interpretive elements along the trail with bird boxes (e.g. blue birds, kestrels), or bat boxes, and a picnic table would offer expanded outdoor opportunities for staff.

  B. As appropriate with the mission and to the extent practical, support outdoor access for disabled American veterans, military dependents with disabilities, and other persons with disabilities.

4.14 Training of Natural Resources Personnel

Objective for Training Natural Resources Personnel

Objective: Provide sufficient technical support to staff as well as training and networking opportunities to achieve INRMP goals and objectives.

I. Seek a balanced, multiple-use natural resources program through professional management (Real Estate Operations and Natural Resources Management Procedural Manual NAVFAC P-73 Volume II 1987).

II. In order to support compliance with environmental laws, ensure environmental staff receive ongoing training and professional development through attendance at workshops, classes, training, and conferences.

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5.0 INRMP Implementation

The Sikes Act (as amended) requires INRMPs to be implemented. Implementation anticipates the execution of all *must fund* projects and activities in accordance with specific timeframes identified in the INRMP. An INRMP is considered to be implemented if an installation:

- Actively requests, receives, and uses funds for *must fund* projects and activities;
- Ensures that sufficient numbers of professionally trained natural resources management personnel are available to perform the tasks required by the INRMP;
- Coordinates annually with all cooperating offices; and
- Documents specific INRMP action accomplishments undertaken each year.

Since the Sikes Act (as amended) requires implementation of the INRMP, there is a clear fiscal connection between INRMP preparation, revision, implementation and funding. Indeed, failure to prepare and implement the INRMP provides a potential cause of action under the Sikes Act (as amended). Accordingly, it is vital that budget personnel understand and participate in the INRMP process. Funding to implement natural resources management will largely come from program sources.

SECNAVINST 6240.6E assigns responsibility for establishing, implementing, and maintaining the natural resources programs under the jurisdiction of SECNAV to CNIC. Regional command and coordination is provided by the major claimant, CNRSW. NAVFAC SW is responsible for providing technical assistance.

5.1 Summary of the Process of Preparing Project Prescriptions

The project prescriptions were developed cooperatively with both internal and external stakeholders. A summary of these project rationales is in Appendix B.

While preparing project prescriptions consideration should be given to developing projects forwarded by the Observatory. There may be several possibilities for construction activities within the Operations Area in the next five years. NOFS has identified them, but they have not been approved or funded at this time.

- A small seeing telescope that measures the baseline of the sky and atmospheric conditions for the larger telescopes may be restored on the site in either an existing location (previously used for this) or another location within the Operations Area.
- Water storage tanks for Buildings 1 and 4 need replacement. New tanks may be either above or below ground. No trees need to be removed for this replacement.
- A remote possibility is to put an underground fiber optics line along the existing utility corridor that connects the three developed sites on NOFS. This would involve digging a shallow trench, with no tree removal. Communication among the three sites is currently by laser beam transmission. This normally suffices except when snow on trees bends branches and gets in the laser path. Lines would go between Buildings 4, 6, 7, and 1.

- An infrared telescope at Building 1 has been considered. The project remains unfunded but was on the books for FY99. An infrared telescope can operate despite light pollution, so it is one of the few telescope options still open for NOFS. No removal of trees is currently anticipated; however, some use of heavy equipment would be required.
- The parking lot size at the eight-inch telescope (Buildings 6 and 7) may be expanded. No plans exist for this very conceptual expansion at this time. Tree removal is currently not anticipated.
- The Security Officer from Washington D.C. would like a perimeter fence around the entire NOFS property; however, local staff believe the more than five-mile fence is unreasonably costly, so have not agreed to its installation. The effects of such fence would need to be evaluated with respect to wildlife movement. Security also wants a front gate that is always locked, with a gatehouse and turn-around area for cars to exit if it is locked.

5.2 Achieving No Net Loss

The Sikes Act (as amended) and DoD guidance require that INRMPs ensure that *no net loss* of available land and operational carrying capacity for military support occurs while pursuing environmental protection needs.

NOFS' mission has, overall, been relatively compatible with natural resources management. The requirement for a large forested area around NOFS to reduce snow glare has precluded options for development, timber harvest, and off-road vehicle access. It has left contiguous areas of native habitat largely intact. Future changes in military requirements can be accommodated while continuing to provide sanctuary to wildlife and plant communities.

NOFS accomplishes this *no net loss* policy by:

- Maintaining a healthy forest in a fire-safe condition, using principles of sustainability and ecosystem management to balance short-term projects with long-term goals.
- Working with neighbors and other agencies to plan for encroachment of light and particulate pollution.
- Aligning infrastructure to contribute to the military mission of NOFS and concentrating it in the Operations Area.
- Continuing to use NEPA documentation to guide specific projects and document choices.

5.3 Use of Cooperative Agreements

Navy guidance on INRMPs states: "Installations are encouraged to work with other organizations, agencies, and individuals both on and off the installation throughout the planning process. Building partnerships with the right organization(s) is essential for ecosystem management. Cooperative Agreements (CAs) are one means to accomplish this kind of partnership. Indeed, the Sikes Act (as amended) states that the Secretary of Navy can enter into CAs with states, local governments, nongovernmental organizations, individuals, and with other agencies (inter-agency agreements) to provide for: 1) the maintenance and improvement of natural resources on, or to benefit natural and historic research on, DoD installations; (2) the maintenance and improvement of natural resources located off of a DoD installation if the purpose of the cooperative agreement or interagency agreement is to relieve or eliminate current or anticipated challenges that could restrict, impede, or otherwise interfere with, whether directly or indirectly, current or anticipated military activities.

In order to use a CA, substantial involvement is expected between the Navy and the State, local government, or other recipient when carrying out the activity contemplated in the agreement. CAs provide a mutually beneficial means of acquiring, analyzing, and interpreting natural resources data, which can then be used to inform natural resources management decisions. CAs are funded by the Navy and produce information that can be used to help resource managers achieve project-specific compliance with environmental laws.

- **Cooperative Agreements are one means to establish beneficial INRMP partnerships.**

5.4 Funding and INRMP Implementation

The Navy and NOFS intend to implement recommendations in this INRMP within the framework of regulatory compliance, national Navy mission obligations, anti-terrorism and force protection limitations, and funding constraints. Any requirement for the obligation of funds for projects in this INRMP shall be subject to the availability of funds appropriated by Congress, and none of the proposed projects shall be interpreted to require obligation or payment of funds in violation of any applicable federal law, including the Anti-Deficiency Act, 31 USC § 1341, et seq.

- **The funding strategies described here are implemented when projects are defined and prioritized, as for this INRMP in Appendix B.**

For the purposes of this INRMP, the terms stewardship and compliance have specific meanings as criteria for implementing project lists. Project rankings are assigned based on whether an activity is mandatory to comply with a legal requirement such as under the ESA, CWA, or MBTA. Alternatively, a project may be considered good land stewardship but is not considered an obligation for NOFS to be found in compliance with environmental laws. Projects considered necessary to comply with the law are generally funded within budget constraints, whereas stewardship projects are ranked lower for funding consideration when projects are competed among multiple installations. Current policy is, however, that they will eventually be funded.

The funding strategies described here are implemented when projects are defined and prioritized, as for this INRMP in Appendix B. The budgeting plan for the INRMP is based on programming and budgeting priorities for conservation programs described in OPNAVINST 5090.1C CH-1.

5.4.1 Environmental Readiness Program Assessment Database

Environmental Portal and the Environmental Program Requirements Web (EPRWeb) is an optimized online database used to define all programming for the Navy's environmental requirements. EPRWeb records data on project expenditures, and provides immediate, web-based access to requirements entered by the multiple Navy environmental programs, including Environmental Compliance, Pollution Prevention, Conservation, Radiological Controls and Range Sustainment as related to environmental costs on military ranges. It is the Navy's policy to fully fund compliance with all applicable federal, state and local laws; EOs; and associated implementing rules, regulations, DoD Instructions and Directives, and applicable international and overseas requirements (OPNAVINST 5090.1C CH-1). All natural resources requirements are entered into the EPRWeb and that they are available for review/approval by the chain of command by the dates specified in the Guidance letter that is provided annually by CNO (N45). This database is the source document for determining all programming and budgeting requirements of the Environmental Quality Program. EPRWeb is also the tool for providing the four Environmental Readiness Level (ERL) capabilities used in producing programming and budgeting requirements for the various processes within the budget planning system.

5.4.2 Navy Assessment Levels for Budget Prioritization

Four Navy ERLs have been established to enable capability-based programming and budgeting of environmental funding, and to facilitate capability versus cost trade-off decisions. ERL4 is considered the absolute minimum level of environmental readiness capability required to maintain compliance with applicable legal requirements. Navy policy requires funding of all DoD Class 0 and Class I projects. The Navy funding programming hierarchy of recurring and non-recurring projects consists of four ERLs. The definitions of ERL1 through ERL4 follow:

1. **Environmental Readiness Level 4**
   - Supports all actions specifically required by law, regulation or Executive Order (DoD Class I and II requirements) just in time.
   - Supports all DoD Class 0 requirements as they relate to a specific statute such as hazardous waste disposal, permits, fees, monitoring, sampling and analysis, reporting and record keeping.
   - Supports recurring administrative, personnel and other costs associated with managing environmental programs that are necessary to meet applicable compliance requirements (DoD Class 0).
   - Supports minimum feasible Navy executive agent responsibilities, participation in OSD sponsored inter-department and inter-agency efforts, and OSD mandated regional coordination efforts.
2. **Environmental Readiness Level 3**
   - Supports all capabilities provided by ERL4.
   - Supports existing level of Navy executive agent responsibilities, participation in OSD sponsored inter-department and inter-agency efforts, and OSD mandated regional coordination efforts.
   - Supports proactive involvement in the legislative and regulatory process to identity and mitigate requirements that will impose excessive costs or restrictions on operations and training.
   - Supports proactive initiatives critical to the protection of Navy operational readiness.
3. **Environmental Readiness Level 2**
   - Supports all capabilities provided under ERL3.
   - Supports enhanced proactive initiatives critical to the protection of Navy operational readiness.
   - Supports all Navy and DoD policy requirements.
   - Supports investments in pollution reduction, compliance enhancement, energy conservation and cost reduction.
4. **Environmental Readiness Level 1**
   - Supports all capabilities provided under ERL2.
   - Supports proactive actions required to ensure compliance with pending/strong anticipated laws and regulations in a timely manner and/or to prevent adverse impact to Navy mission.
   - Supports investments that demonstrate Navy environmental leadership and proactive environmental stewardship.

5.4.3 DoD Funding Classifications

- **See Appendix B for a Project Implementation Summary list containing projects, funding classes and funding sources.**

Funds will be requested for tasks within the INRMP, with priority given to Class 0, I, II, and III projects, in that order, based on this guidance. The DoDINST 4715.03 document defines four classes of conservation programs; compliance activities fall into the first three classes and stewardship activities fall into the fourth class. Accordingly, the projects recommended in this INRMP have been prioritized based on compliance and stewardship criteria. Four programming and budgeting priority levels are detailed as shown in Section 1.6: Stewardship and Compliance.

5.4.4 Funding Sources

The costs of implementing natural resources management actions may be funded from a variety of sources. Funding sources should be reviewed carefully to identify qualifying projects. There are restrictions on how different Navy funding sources for natural resources management may be used. It is important that appropriate funding sources are used and that EPR exhibits clearly justify funding requests so that: 1) natural resource funds are distributed widely and 2) funding levels are not threatened by use of resource funds in ways that are inconsistent with funding program rules. Execution of this plan by the federal government is contingent on the availability of funds properly allocated to the plan in accordance with applicable law. All natural resources projects must be addressed in the INRMP.

See Appendix B for a Project Implementation Summary list containing projects, funding classes and funding sources.

5.4.4.1 Navy Working Capital Fund

This is a revolving fund that is generated by fees for services and used to pay expenses. Many natural resources projects are funded through the Navy Working Capital fund. All projects submitted must be in the INRMP, or a clear justification for their ommission must be provided. These funds are generally not available for Navy level 2-5 projects (See Section 5.4.2: Navy Assessment Levels for Budget Priorities above).

5.4.4.2 DoD Legacy Funds

The Legacy Resource Management Program was established in 1990 to provide financial assistance to DoD installations in preserving the natural and cultural resources. The program assists DoD in protecting and enhancing resources while supporting military readiness. Eligible projects may involve regional ecosystem management initiatives, habitat preservation, archeological investigations, and/or invasive species control. Pre-proposals for Legacy projects are due in March and are submitted using the Legacy Tracker website at http://www.dodlegacy.org. Project proposals are reviewed by the Navy chain of command.

5.4.4.3 Operations and Maintenance

Operations and Maintenance (O&M) funding for natural resources projects may be acquired directly from other departments.

5.4.4.4 O&M Environmental Funds

Environmental funds are a subset of O&M funding primarily used for compliance-related needs.

5.4.4.5 DoD Forestry Reserve Funds

Forestry funds are accumulated from the sale of timber products on DoD installations. From the revenues generated, a portion is used to reimburse installations for forest management expenses. The excess revenue is divided, 40 percent and 60 percent, between the state and the DoD Forestry Reserve Account, respectively. Funds from the DoD Forestry Reserve Account are available to support natural resources projects including reforestation, disease and insect control, planning, and personnel training.

5.4.4.6 Agricultural Outlease Funds

Money collected through the leasing of Navy-owned property for agricultural use is directed back into the natural resources program and reallocated throughout the Navy by NAVFAC headquarters. These are the broadest use funds available exclusively to natural resources managers. Accepted uses for the revenues from agricultural outleasing include preparation and revisions of INRMPs and implementation of INRMPs.

NAVFAC sends a request for project proposals for agricultural outleasing funds to the regions and installations around November of each year. Proposals are reviewed by the EFD, and recommended projects are forwarded to NAVFAC headquarters for final review and project selection. The amount of funding available through this program varies from year to year. In the past, this has been one of the more consistent sources of funding for implementing projects in INRMPs that are not Level 1 requirements. However, in recent years this funding source has been steadily diminishing, so it may no longer be a consistent source of dollars.

5.4.4.7 Special Initiatives

The DoD or Navy may establish special initiatives to fund natural resources projects. Funding is limited.

Objective for Facilitating Implementation

Objective: Ensure that all avenues are investigated and sought for achieving the goals and objectives of this INRMP, for the best possible management and most efficient use of funds.

I. Identify new funding sources from federal, state, local, and nonprofit organizations with an interest in achieving the goals and objectives of this INRMP in partnership with NOFS.

II. Track implementation to guide and learn from past experience.

- *A.* Derive the most benefit possible from learning and experience by documenting it and disseminating the information to others.
- *B.* The GIS database (ARC/INFO) established for this INRMP should be maintained to track updates on various implementation activities, such as results of resources inventories, and locations of restoration projects.

III. Identify and ensure departments prioritize and allocate funding to support compliance requirements.

- **A Sikes Act (as amended) CA, developed with State agencies, universities, non-governmental organizations, and individuals, typically provides a vehicle to accomplish work addressed in the INRMP. Other options include contracts, in-house self-help processes, and use of volunteers from conservation programs such as the Student Conservation Association.**

- *A.* Funds will be requested for tasks within the INRMP, with priority given to Class 0, I, II, and III projects, in that order, based on guidance in DoDINST 4715.03. Additional guidance from CNIC for classifying funds is provided in Programming and budgeting priorities for Conservation Programs (from CNO *F*unding Guidelines from the Program Objective Memorandum Fiscal Year 2004 Naval Environmental Requirements Guidebook).
- *B.* *Must fund* conservation requirements are those projects and activities that are required to meet recurring natural and cultural resources conservation management requirements (Class 0) or current compliance (Class 1 and 2) needs.
  - *1.* Meet with legislative directive, EOs and any legal requirement supported by laws and regulations found, but not limited to:
    - *a.* Federally threatened and endangered species surveys
    - *b.* Baseline wetland delineations
    - *c.* Mapping (GIS Data) of federally threatened and endangered species
    - *d.* Mapping (GIS Data) of critical habitat

2. Meet the USFWS special management criteria for threatened and endangered species management.
3. Integral support of mission readiness, training requirements, and land sustainability. Examples include:
   a. Prevention of resources loss or degradation (e.g. soil loss, erosion control)
   b. Baseline data collection support and long-term trend monitoring efforts
4. Provide for qualified natural resources personnel.

IV. Identify new funding sources from federal, state, local, and nonprofit organizations with an interest in achieving the goals and objectives of this Plan in partnership with NOFS. These often require cost-sharing with a non-federal organization. This funding opportunity should be sought for projects that are not Class 0 or 1 *must fund* items, tied directly to regulatory compliance. Examples are watershed management, habitat enhancement, or wetland restoration.

A. Monitor websites that keep track of funding opportunities for environmental stewardship.

B. Apply for grants in partnership with local non-profits or other agencies.

- **Due to the alternating cycle of the DoD awards competition and updating of the other awards programs, competition guidance will be promulgated on an annual basis. Navy activities should look for the Call for Nominations in August (OPNAVINST 5090.1C CH-1).**

V. Develop an award to be given to DoD staff for exceptional performance in natural resources work conducted at NOFS.

VI. Continue to ensure effective communication, adaptive oversight and policy leadership through the DoN Natural Resources Strategic Plan.

5.5 INRMP Annual Review

Department of Defense policy requires installations to review INRMPs annually in cooperation with the two primary parties to the INRMP (USFWS and the state fish and wildlife agency). Annual reviews facilitate adaptive management by providing an opportunity for the parties to review the goals and objectives of the plan, as well as establish a realistic schedule for undertaking proposed actions. As a guide for addressing annual INRMP review, the Navy Natural Resources (NR) Metrics. These NR Metrics can be used to gather and report essential information required by Congress, EOs, existing U.S. laws, and the DoD. There are seven Focus Areas that comprise the NR Metrics to be evaluated during the annual review of the Natural Resources Program/INRMP.

1. Ecosystem Integrity
2. Listed Species and Critical Habitat
3. Fish and Wildlife Management for Public Use
4. Partnership Effectiveness
5. Team Adequacy
6. INRMP Project Implementation
7. INRMP Impact on the Installation Mission

A copy of the most recent NR Metrics questions are presented in Table 5-1 through Table 5-7. NR Metrics are found on the Navy Conservation website.

Section 101(b)(2) of the Sikes Act (as amended) specifically directs that the INRMPs be reviewed "as to operation and effect" by the primary parties "on a regular basis, but not less often than every five years", emphasizing that the review is intended to determine whether existing INRMPs are being implemented to meet the requirements of the Sikes Act (as amended) and contribute to the conservation and rehabilitation of natural resources on military installations. The OSD (17 May 2005) guidance states that joint review should be reflected in a memo or letters.

Recent guidance on INRMP implementation interpreted that the five-year review would not necessarily constitute a revision, that this would occur only if deemed necessary. The Annual Review process is broadly guided by the NAVFAC Environmental Conservation Program Directive (DoD 4715.03) and by OPNAVINST 5090.1C CH 1. The following policy memoranda clarified procedures for INRMP reviews and revisions:

- DUSD(I&E) Policy Memorandum 10 October 2002, which replaced a 1998 policy memorandum.
- Assistant Deputy Undersecretary of Defense (ADUSD) for Environment, Safety and Occupational Health (ESOH) Policy (01 November 2004 Memorandum).
- (ADUSD) for (ESOH) Policy (September 2005 Memorandum).

The INRMP Implementation Guidance (10 October 2002 Memorandum) improved coordination external to DoD (USFWS, state agencies, and the public) and internal to DoD (military operators and trainers, cultural resources managers, pest managers). April 2006 guidance added new tracking procedures, called metrics, to ensure proper INRMP coordination occurred and that projects were implemented. It also covered how to address the no net loss to military lands requirement, to be reported annually.

The Supplemental DoD INRMP Guidance (01 November 2004 Memorandum) further defined the scope of the annual and five-year review, public comment on INRMP reviews, and ESA consultation. A formal review must be performed by the parties at least every five years. If an INRMP is determined to meet the requirements of the Sikes Act (as amended) and contributes to the conservation and rehabilitation of natural resources, it may not need to be revised. Informal annual reviews are mandatory to facilitate adaptive management, during which INRMP goals, objectives, and *must fund* projects are reviewed, and a realistic schedule established to undertake proposed actions. The outcome of this joint review should be documented in a memorandum or letter summarizing the rationale for the conclusions the parties have reached. This written documentation should be jointly executed or in some other way reflect the parties' mutual agreement.

DoD policy requires installations to review INRMPs annually in cooperation with the parties to the plan. The Annual Review is to be conducted in collaboration with the appropriate Installation Commander, and in cooperation with the USFWS and the State Fish and Wildlife agency(s).This less formal review of INRMP goals, objectives, and schedule may also be memorialized through an exchange of letters or memoranda.

The 2004 guidance also clarified that public review of INRMPs will normally take place through the NEPA process when INRMPs undergo substantial revisions that result in biophysical consequences materially different from those anticipated in the existing INRMP. However, there is no legal obligation to invite the public to review or comment upon the parties' mutually agreed upon decision to continue implementing an existing INRMP without revision.

Finally, the 2004 guidance stated that it is expected that INRMPs will incorporate by reference the results of an installation's previous species-by-species ESA consultations, including any reasonable and prudent measures that may have been provided in an incidental take statement. As a consequence, neither a separate biological assessment nor a separate formal consultation should be needed unless an INRMP contains management strategies for multiple species (listed or not) that may affect listed species or their critical habitat not addressed in previous consultations. In this case, Section 7 consultation will be needed on these actions prior to their implementation.

The Supplemental DoD INRMP Guidance (September 2005) stated that all INRMPs must address resource management on all of the lands for which the subject installation has real property accountability, including lands occupied by tenants or lessees or being used by others pursuant to a permit, license, right of way, or any other form of permission. Per this memo, installation commanders may require tenants, lessees, permittees, and other parties that request permission to occupy or use installation property to accept responsibility, as a condition of their occupancy or use, for performing appropriate natural resource management actions. This does not, however, obviate the need to address natural resource management on any such lands in the INRMP.

According to Public Comment on INRMP Reviews Legislative Language Section 2905 of the Sikes Act Improvement Act of 1997 [16 USC 670a note] the Secretary of each Military Department is required to provide the public an opportunity for the submission of comments on the initial INRMPs prepared pursuant to new Section 101(a)(2) of the Sikes Act (as amended). The installation shall provide the public with a meaningful opportunity to review and comment upon the initial draft INRMP and initial draft INRMP revision (other than minor technical amendments). Concerning the length of public review, barring extraordinary circumstances, the public should be afforded a minimum of 30 days to review and comment (CNO Guidance April 2006).

The most recent guidance on INRMP reviews is found in DoDINST 4715.03. The Annual Review reports on the status of INRMP implementation toward meeting natural resources conservation program measures of merit to DUSD (I&E) at each Environmental Management Review and to Congress in the Defense Environmental Programs ARC. The report summarizes:

- Each installation's compliance with Sikes Act (as amended).
- Annual feedback received from the USFWS or NOAA Fisheries Service.
- Annual feedback received from the state fish and wildlife agency.
- Funding requirements per Fiscal Year needed to implement the INRMP: the amount required for recurring projects, and the amount required for non-recurring projects.

According to OPNAVINST 5090.1C CH-1, Annual Reviews must verify that:

- Current information on all conservation metrics is available.
- All *must fund* projects and activities have been budgeted for and implementation is on schedule.
- All required trained natural resources positions are filled or are in the process of being filled.
- Projects and activities for the upcoming year have been identified and included in the INRMP. An updated project list does not necessitate revising the INRMP.
- All required coordination has occurred.
- All significant changes to the installation's mission requirements or its natural resources have been identified.
- The INRMP goals and objectives remain valid.

An EA has been prepared for this INRMP and addresses prescribed fire as a new management tool, recommended in this INRMP as described in Section 4.6: Forest Health Management.

Objective for INRMP Annual Review

Objective: Improve and refine natural resources management, by adaptively adjusting success criteria and priorities based on past accomplishments, new risks and threats, new biological information, and changes in policy. Incorporate a dynamic, continuous process for decision-making, including future changes or additions to the INRMP.

I. Provide a notice to prepare or revise the INRMP to the USFWS Field Office and AZGFD. Ensure that the USFWS Regional Sikes Act (as amended) Coordinator is notified.

II. Comply with recent CNIC guidance (April 2006) on INRMPs and compliance with the Sikes Act (as amended).

- *A.* All INRMPs shall be reviewed annually by the DoD installation with the cooperation of the USFWS and the State fish and wildlife agency, and others with a stake in the outcome of the INRMP at the discretion of the Conservation Program Manager. Annual reviews shall verify that:
    - *1.* Current information on all conservation metrics is available.
    - *2.* All *must fund* projects and activities have been budgeted for and implementation is on schedule.
    - *3.* All required trained natural resources positions are filled or are in the process of being filled.
    - *4.* Projects and activities for the upcoming year have been identified and included in the INRMP. An updated project list does not necessitate revising the INRMP.
    - *5.* All required coordinations have occurred.
    - *6.* All significant changes in the installation's mission requirements or its natural resources have been identified.
    - *7.* Minor changes should be made to the INRMP following annual reviews that will prevent the need for a more costly and time-consuming revision following the five -year review. Therefore, it is the Navy's intent that each installation fully document annual reviews and work with USFWS and state partners to utilize the annual review process to meet the five-year formal review requirement whenever possible.
- *B.* Conduct formal reviews every five years with USFWS and state partners. During these reviews, it may be determined that an installation's current INRMP is effective and is not in need of revision. With agreement from USFWS and state partners, thorough written documentation of the annual informal reviews may be used to substitute for the five-year formal review, thereby reducing the demands on installation commanders.
- *C.* Establish a mutually agreed-upon, realistic schedule to undertake proposed actions.
- *D.* The outcome of this joint review should be documented in a memorandum or letter summarizing the rationale for the conclusions the parties have reached. This written documentation should be jointly executed or in some other way reflect the parties' mutual agreement.

III. Fulfill the reporting requirements of new measures to promote better understanding of the health of Navy conservation programs, using the INRMP Metrics Builder as defined by CNIC. This is a new set of metrics for Navy natural resources programs that measure conservation impacts on installation missions and the success of partnerships with the USFWS and State fish and game agencies as required by the Sikes Act (as amended). See Figure 5-1 for an example of the natural resources metrics builder scorecard.

A. Conduct a performance measure based self review annually, with sample questions as shown in Table 5-1 through Table 5-7. These tables use the Navy and Marine Corps Natural Resources Metrics Builder Reference Guide (04 May 2005), and add NOFS-specific questions.

B. Develop specific questions to support the annual review process from the NOFS's perspective.

IV. Track implementation to guide and learn from past experience.

A. Derive the most benefit possible from learning and experience by documenting it and disseminating the information to others.

B. The GIS database (ARC/INFO) established for this INRMP should be maintained to track updates on various implementation activities, such as results of resources inventories, and locations of restoration projects.

The Secretary of Defense is required by the Sikes Act (as amended) to submit a report to Congress by 01 March annually, detailing the number of INRMPs in effect, the amounts expended on conservation activities pursuant to the INRMPs, and an assessment of the extent to which the INRMPs comply with the Sikes Act (as amended). The DoD has established the following formal measures of merit to produce the end-of-year Interim Progress Review and annual Environmental Quality Report to Congress to meet both internal and Congressional requirements. See Figure 5-1 and Table 5-1 through Table 5-7 for an example of the metrics measurements for installations in general and NOFS specifically. U.S. Navy metrics support information, including clarifying definitions, can be found in Appendix P. Information contained in this INRMP aids in answering metrics questions.

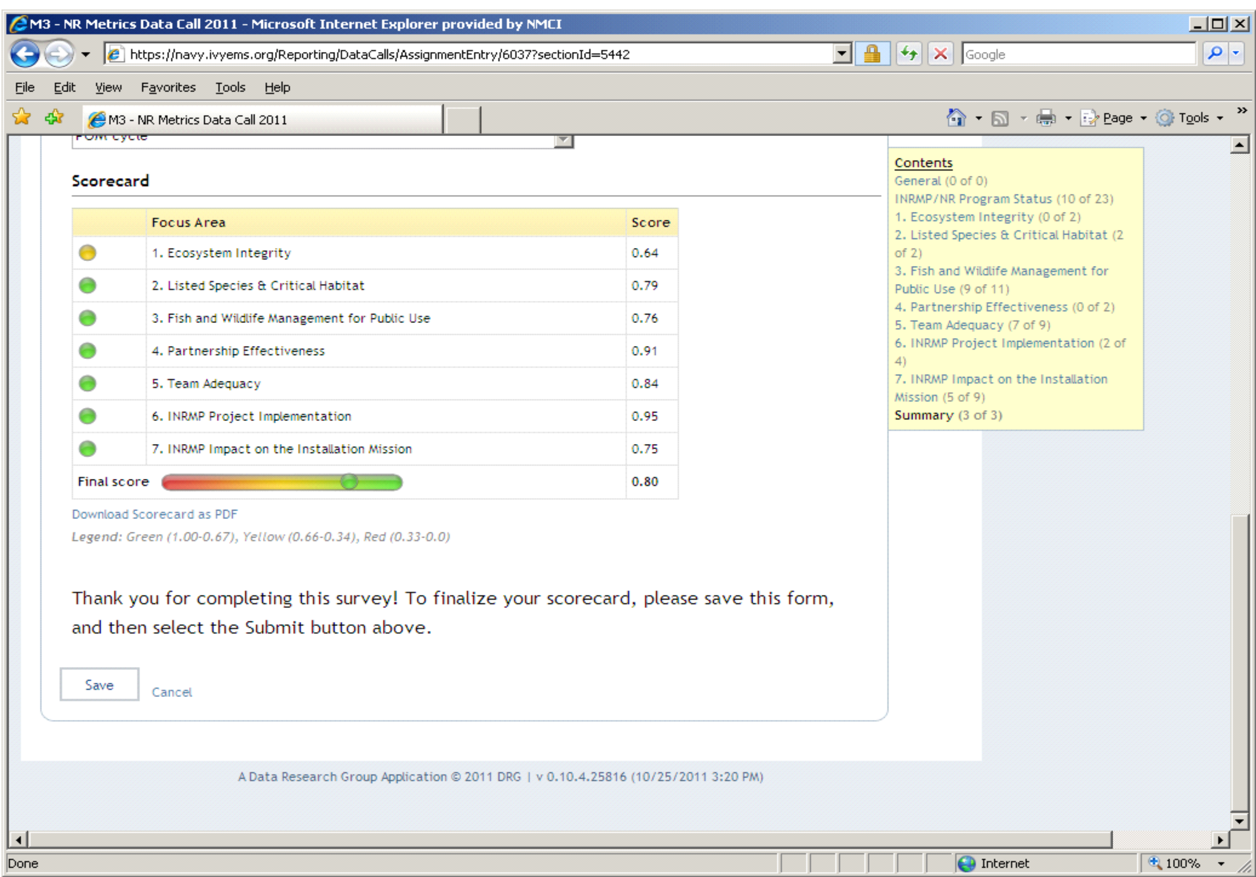

Figure 5-1. Example of a natural resources metrics builder scorecard. NR metrics are found on the Navy Conservation website.

Table 5-1. Scorecard of Navy metrics for INRMP Project Implementation, which can be used for self-evaluation or for INRMP annual reviews.

Question	Score: Yes/No or Scale of 0 to 4
INRMP PROJECT IMPLEMENTATION	
Has the project been entered into the EPRWeb/CompTRAK for the current fiscal year?	**Yes/No**
Was this project included in the POM cycle for the year of execution?	**Yes/No**
Did the installation/NRM receive the appropriate funding for this project?	**0: No funding** **1: 1% to 25% funding** **2: 26% to 50% funding** **3: 51% to 76% funding** **4: 76% to 100% funding** **5: Received additional funding**
For the current Fiscal Year, identify percent of project goals and objectives completed	**0: No goals/objectives completed** **1: 1% to 25%** **2: 26% to 50%** **3: 51% to 76%** **4: 76% to 100%**
Use of resources other than or in addition to O&M funding to accomplish the project (i.e. University, inhouse, volunteers, SERDP, etc.)	**Yes/No/NA**
Are project objectives/tasks on track as planned?	**0: Not completed** **1: 1% to 25% completed** **2: 26% to 50% completed** **3: 51% to 76% completed** **4: 76% to 100% completed**

Table 5-2. Portfolio of Navy metrics for Listed Species and Critical Habitat, which can be used for self-evaluation or for INRMP annual reviews .

Question	Score: Yes/No or Scale of 0 to 4
ASSESSMENT OF LISTED SPECIES, SPECIES AT RISK & CRITICAL HABITAT (DETERMINE IF CONSERVATION EFFORTS ARE EFFECTIVE AND IF THE INRMP PROVIDES THE CONSERVATION BENEFITS NECESSARY TO PRECLUDE DESIGNATION OF CRITICAL HABITAT)	
Has the habitat been mapped in GIS format for federally listed species?	**Yes/No**
How well are USFWS species benefit recommendations/ conditions being met on the installation?	**0 - None** **1 - Minimal** **2 - Moderate** **3 - Good** **4 - Excellent**
To what degree have listed, candidate and proposed species projects been funded?	**0 - No funding** **1 - 1% to 25% funded** **2 - 26% to 50% funded** **3 - 51% to 75% funded** **4 - 76% to100% funded**
Do existing surveys provide adequate data on habitat conditions?	**Yes/No**
Do existing surveys provide adequate data on population presence, numbers and trends?	**Yes/No**
To what extent do INRMP projects and programs provide a benefit to federally listed species?	**NA** **0 - No benefit** **1 - Minor benefits (invasive species removal, pest/disease prevention)** **2 - Moderate benefit (Habitat restoration/enhancement)** **3 - Significant benefit (combination of minor and moderate benefits)** **4 - Major benefit (Increased population, demonstrated conservation trends)**

Table 5-2. Portfolio of Navy metrics for Listed Species and Critical Habitat, which can be used for self-evaluation or for INRMP annual reviews (Continued).

To what extent do INRMP projects and programs benefit Candidate species? Has INRMP implementation and the overall natural resources programs benefited candidate species in the past year?	**NA** **1 - Minor benefits (invasive species removal, pest/disease prevention)** **2 - Moderate benefit (Habitat restoration/enhancement)** **3 - Significant benefit (combination of minor and moderate benefits)** **4 - Major benefit (Increased population, assisted with prevention of federal listing)**
To what extent do INRMP projects and programs benefit Species At Risk*?	**NA** **0 - No benefit** **1 - Minor benefits (invasive species removal, pest/disease prevention)** **2 - Moderate benefit (Habitat restoration/enhancement)** **3 - Significant benefit (combination of minor and moderate benefits)** **4 - Major benefit (Increased population, assisted with prevention of state/candidate listing)**

**** Species at risk are defined as native, regularly occurring species in the United States that are not federally listed under the U.S. Endangered Species Act, but are either: a) Candidates for listing under the U.S. Endangered Species Act, or b) Critically imperiled (rounded global rank of G1 or T1) or Imperiled (rounded global rank of G2 or T2), according to the NatureServe conservation status rank criteria.***

Table 5-3. Portfolio of Navy metrics for Partnership Effectiveness, which can be used for self-evaluation or for INRMP annual reviews.

Question	Score: Yes/No or Scale of 0 to 4
PARTNERSHIP EFFECTIVENESS	
How well has the management of the program supported geographical USFWS objectives? Regional efforts include: the Chesapeake Bay initiative, the Migratory Bird Initiative, and the Fish Habitat Initiative.	**0: Not supported** **1: Minimally supported** **2: Satisfactorily supported** **3: Well supported** **4: Very well supported**
How well has the management of the program supported State conservation plans and objectives?	**0: Not supported** **1: Minimally supported** **2: Satisfactorily supported** **3: Well supported** **4: Very well supported**
How well has the management of the program supported other local/regional/national conservation initiatives?	**0: Not supported** **1: Minimally supported** **2: Satisfactorily supported** **3: Well supported** **4: Very well supported**
Is there adequate collaboration between Partners? Do you meet and/or share information regularly? Rate the level of cooperation between Navy, USFWS, State and any other major partner.	**0: No collaboration** **1: Minimal collaboration** **2: Satisfactory collaboration** **3: Effective collaboration** **4: Highly effective collaboration**
Is there satisfactory cooperation between Partners? Rate the level of cooperation between Navy, USFWS, State and any other major partner.	**0: No cooperation** **1: Minimal cooperation** **2: Satisfactory cooperation** **3: Effective cooperation** **4: Highly effective cooperative**
Is natural resources program execution meeting stakeholder expectations?	**0 - Dissatisfied** **1 - Minimally satisfied** **2 - Somewhat satisfied** **3 - Highly satisfied** **4 - Completely satisfied**

Table 5-4. Scorecard of Navy metrics on Fish and Wildlife Management for Public Use, which can be used for self-evaluation or for INRMP annual reviews.

Question	Score: Yes/No or Scale of 0 to 4
FISH AND WILDLIFE MANAGEMENT AND PUBLIC USE	
Are sustainable harvest goals effective? To what extent was the sustainable harvest of plants, fish and wildlife populations through public recreational use effective in supporting ecosystem management goals? (i.e., deer off runway, healthy game populations, BASH reduction)	**0 - Not effective (populations densities extreme, damage to the ecosystem) 1 - Minimal effectiveness (Over harvest, disruption to ecosystem balance) 2 - Moderate effectiveness (No improvement in the populations, management issues remain) 3 - Effective (Sustainable harvest achieved) 4 - Very effective (Sustainable harvest with improving ecosystem trends, and public recreational opportunities met)**
Availability of public recreational opportunities? To what extent were recreational activities such as bird watching, hiking, watchable wildlife programs made available to the public?	**0 - No public access provided 1 - Low opportunities 2 - Moderate opportunities 3 - Good opportunities 4 - Excellent opportunities**
Was public outreach provided? To what extent did the installation develop and provide public outreach (environmental educational opportunities, natural resources field trips/tours, pamphlets)?	**0 - No public outreach provided 1 - Low outreach 2 - Moderate outreach 3 - Good outreach 4 - Excellent outreach**

Table 5-5. Portfolio of Navy metrics for Team Adequacy, which can be used for self-evaluation or for INRMP annual reviews.

Question	Score: Yes/No or Scale of 0 to 4
ASSESSMENT OF TEAM ADEQUACY FOR NATURAL RESOURCES MANAGEMENT (DETERMINE IF THE NATURAL RESOURCES TEAM IS ADEQUATELY SUPPORTED AND APPROPRIATELY TRAINED TO IMPLEMENT INRMPS)	
Is there an adequately trained government Natural Resources Manager located at the installation?	**NA/Yes/No**
Are there enough natural resources professionals at the installation to meet current requirements?	**NA/Yes/No**
Is NAVFAC and Regional support adequately utilized? Has the installation received support from the NAVFAC Field Offices and/or Navy and Marine Corps Regional Commands, as needed?	**0: No support 1: Minimal support 2: Satisfactory support 3: Well supported 4: Very well supported**
Is contractor or other agency support adequately utilized to implement the INRMP? Do you use contractors to develop and implement the INRMP?	**0: Not utilized 1: Minimally utilized 2: Satisfactorily utilized 3: Well utilized 4: Very well utilized**
Is USFWS support adequate? Has the installation sought and received support from the local USFWS and State wildlife agencies, as needed?	**0: No support 1: Minimal support 2: Satisfactory support 3: Well supported 4: Very well supported**
Is State support adequate? Has the installation sought and received support from the local USFWS and State wildlife agencies, as needed?	**0: No support 1: Minimal support 2: Satisfactory support 3: Well supported 4: Very well supported**
Are volunteers adequately utilized? To what extent are volunteers utilized to support the program?	**0: No opportunities 1: Few opportunities 2: Enough opportunities 3: Many opportunities 4: Very many opportunities**
Is the team adequately trained to accomplish duties to ensure natural resources compliance? Are training needs being met in accordance with staff Individual Development Plans (IDP)?	**0: No training 1: Minimally trained 2: Moderately trained 3: Well trained 4: Very well trained**

Table 5-6. Scorecard of Navy metrics for Ecosystem Integrity, which can be used for self-evaluation or for INRMP annual reviews. Metrics which must be submitted by the installation are provided by CNIC and are bolded.

Question	Score: Yes/No or Scale of 0 to 4
ECOSYSTEM INTEGRITY	
What is the general team consensus of overall habitat type integrity?	**NA** **0: No integrity** **1: Low integrity** **2: Medium integrity** **3: High integrity** **4: Very high integrity**
If habitat indicator(s) are identified on the installation, what is the current population status/trend?	**NA** **0: Poor** **1: Fair** **2: Good** **3: Very good** **4: Excellent**
If specific results of any biological studies completed in the past year indicate the health of the habitat, identify the rated condition.	**NA** **0: Poor** **1: Fair** **2: Good** **3: Very good** **4: Excellent**
Have there been recent, beneficial habitat conversions? (i.e. loblolly pine to long-leaf pine, tame grass to natural prairie)	**NA** **0: No habitat benefit** **1: Few habitat benefits** **2: Moderate habitat benefits** **3: Significant habitat benefits** **4: Very significant habitat benefits**

Table 5-7. Scorecard of Navy metrics for INRMP Impact on the Installation Mission, which can be used for self-evaluation or for INRMP annual reviews.

Question	Score: Yes/No or Scale of 0 to 4
INRMP IMPACT ON THE INSTALLATION MISSION	
Has coordination between natural resources and operators been successful/ effective? Coordination examples include: maps, signage, pamphlets, other communications, orientations, meetings, training, etc.	**0 - No coordination** **1 - Minimal coordination** **2 - Satisfactory coordination** **3 - Effective coordination** **4 - Highly effective coordination**
To what level do natural resources compliance requirements impede the installation's ability to support the operational mission?	**0 - Cannot accomplish mission requirements** **1 - Meet mission requirements, but with significant work-arounds** **2 - Meet mission requirements, but with minimal work-arounds** **3 - Meet mission requirements, but with diminished value** **4 - Accomplish all mission requirements with no work-arounds**
Has there been a net loss of training lands?	**0: Yes, to such degree that a training activity could not be conducted on base** **1: Yes, the loss resulted in modification of the training so that it could be conducted on the base** **2: Yes, a loss occurred but it only affects future training activities** **3: No loss occurred** **4: No loss occurred and the base was able to recover areas for training previously lost due to natural resource requirements.**
Does the INRMP process effectively consider current mission requirements?	**0 - Strongly disagree** **1 - Disagree** **2 - Not sure (neutral)** **3 - Agree** **4 - Strongly agree**

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Appendix A: Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ADOT	Arizona Department of Transportation
ADUSD	Assistant Deputy Undersecretary of Defense
AL&T	Arizona Lumber and Timber
API	Arizona Preserve Initiative
ASLD	Arizona State Lands Department
AZGFD	Arizona Game and Fish Department
BLM	Bureau of Land Management
BMP	Best Management Strategy
BO	Biological Opinion
C	Celsius
CA	Cooperative Agreement
CatEx	Categorical exclusion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CNIC	Commander Navy Installations Command
CNO	Chief of Naval Operation
CNRSW	Commander Navy Region Southwest
CWA	Clean Water Act
CWCS	Comprehensive Wildlife Conservation Strategy
dbh	diameter at breast height
DoD	U.S. Department of Defense
DoDINST	U.S. Department of Defense Instruction
DoI	U.S. Department of the Interior
DoN	U.S. Department of the Navy
DUSD(I&E)	Deputy Undersecretary of Defense for Installations and the Environment
EA	Environmental Assessment
EAP	Encroachment Action Plan
EIS	Environmental Impact Statement
EMS	Environmental Management Systems
EO	Executive Order
EPA	Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
EPR	Environmental Program Requirements
ERL	Environmental Readiness Level
ESA	Endangered Species Act
ESOH	Environment, Safety and Occupational Health
F	Fahrenheit
FONSI	Finding of No Significant Impact
FR	Federal Register
FT	fFederal Threatened Species

Acronym/Abbreviation	Definition
FY	Fiscal Year
GAO	Government Accounting Office
GFFP	Greater Flagstaff Forests Partnership
GIS	Geographic Information System
ha	hectare
HDMS	Heritage Data Management System
HPS	Hanta Pulmonary Syndrome
INRMP	Integrated Natural Resources Management Plan
IUCN	International Union for Conservation of Nature
m	meter
MBTA	Migratory Bird Treaty Act
MOU	Memorandum of Understanding
NABCI	North American Bird Conservation Initiative
NAFEC	Naval Air Facility El Centro
NAU	Northern Arizona University
NAVCOMPT	Comptroller of the Navy
NAVFAC	Naval Facilities Engineering Command
NAVFAC NW	Naval Facilities Engineering Command Northwest
NAVFAC SW	Naval Facilities Engineering Command Southwest
NEPA	National Environmental Policy Act
NGO	Non-governmental organization
NOFS	Naval Observatory Flagstaff Station
NPOI	Navy Prototype Optical Interferometer
NR	Natural Resources
NRCS	Natural Resources Conservation Service
O&M	Operations and Maintenance
OPNAVINST	Naval Operations Instruction
OSD	Office of the Secretary of Defense
OUSD	Office of the Undersecretary of Defense
PAC	Protected Activity Center
PEP	post exposure prophylaxis
PIF	Partners in Flight
PIH	Plug-in hybrid
PL	Public Law
SAIA	Sikes Act Improvement Act
SC	Species of Concern
S	Sensitive
SECNAV	Secretary of the Navy
SERDP	Strategic Environmental Research and Development
SWAP	State Wildlife Action Plan
TNC	The Nature Conservancy
UGB	Urban Growth Boundary
USACE	Army Corps of Engineers
USC	U.S. Code
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service

Acronym/Abbreviation	Definition
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNO	U.S. Naval Observatory
WSC	Wildlife of Special Concern
WRCC	Western Regional Climate Center

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Appendix B: Natural Resources Management Project Prescriptions

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Appendix C: List of Projects

NAVAL OBSERVATORY FLAGSTAFF STATION INRMP PROJECTS 2013 TO 2022

2013

1. Exotic weed control (not funded).
2. Bird surveys (funded).
3. Mexican spotted owl surveys (funded).
4. Pile burning (funded).

2014

1. Exotic weed control.
2. Oak/snag study.
3. Bird surveys.
4. Pile burning.
5. Natural resources administration.
6. Forest thinning.
7. Erosion control and road closures
8. Conservation kiosk.
9. Prescribed fire management.
10. Baseline herpetological surveys

2015

1. Exotic weed control.
2. Bird surveys.
3. Mexican spotted owl surveys.
4. Wildlife corridor study (study starts).
5. Natural resources administration.
6. Oak/snag study.
7. Pile burning.
8. Sustainability/conservation demonstration and natural resources brochure.
9. Botanical survey, vegetation map, start plant collection.
10. Prescribed fire program.
11. Habitat prescriptions, including desired understory, to support fire management, prey base, focal species, and other forest habitat planning.
12. INRMP revision.

2016

1. Exotic weed control.
2. Bird surveys (point counts and survey routes), add breeding bird survey route to point count stations.
3. Wildlife corridor study (carry-over work).

4. Interpretive kiosk.
5. Rare plant and vegetation survey.
6. Wildland fire and forest understory (prey support, diversity, cavity nesters, other focus species, beneficial pollinators) management plan.
7. Prey-base surveys including small mammals, invertebrates, and trend for Mexican spotted owl and other management focus cavity or snag dependent species.
8. Baseline invertebrate species list, forest pest assessment, beneficial pollinator assessment, management and monitoring plan for pollinator species.

2017

1. Exotic weed control.
2. Mexican spotted owl surveys.
3. Wildlife corridor study (carry-over work).
4. Oak/snag study.
5. Prescribed fire treatment.
6. Wildlife drinker.
7. Invertebrate surveys, including beneficial pollinator habitat assessment.
8. Natural resources administration and bird surveys.
9. Interpretive nature trail.

2018

1. Exotic weed control.
2. Wildlife corridor study (carry-over work).
3. Prescribed fire treatment.
4. Natural resources administration and bird surveys.
5. Oak/snag study.
6. Herpetological surveys.
7. Climate change audit and “green” stormwater management solutions.

2019

1. Exotic weed control.
2. Bird surveys.
3. Mexican spotted owl surveys.
4. Wildlife corridor study (carry-over work).
5. Prescribed fire treatment.
6. Mexican spotted owl prey base surveys.

2020

1. Exotic weed control.
2. Wildlife corridor study (carry-over work).
3. Oak/snag study.
4. Prescribed fire treatment.

2021

1. Exotic weed control.
2. Mexican spotted owl surveys.
3. Wildlife corridor study (carry-over work).

4. Prey-base surveys including small mammals, invertebrates, and trend for Mexican spotted owl and other management focus cavity or snag dependent species

2022

1. Exotic weed control.
2. Bird surveys.
3. Wildlife corridor study (carry-over work).

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Appendix D: Surveys

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D.1 Species List

The following species list has been compiled from surveys conducted on the Naval Observatory Flagstaff Station prior to development of this INRMP. All birds are from: Tiffany M. Shepherd and Timothy Burr 2006. *General Avian Surveys at the U.S. Naval Observatory Flagstaff Station, 2005.*

Wildlife species with special status are the olive flycatcher, flammulated owl, red-faced warbler, ferruginous hawk, and Grace's warbler. These are noted in the list as Birds of Conservation Concern.[1]

D.1.1 Plant Species List

Gymnosperms

Cupressaceae
Juniperus sp. juniper, cedar
Juniperus communis common juniper
Pinaceae
Pinus ponderosa ponderosa pine
Pseudotsuga menziesii Douglas fir

Dicots

Araliaceae
Hedera helix English ivy
Asclepiadaceae
Asclepias sp. milkweed
Asteraceae
Achillea millefolium Western yarrow
Agoseris glauca var. laciniata (=A. arizonica)
Antennaria parvifolia mountain pussytoes
Antennaria rosulata kaibab pussytoes
Artemisia carruthii Carruth's sagewort
Erigeron canus Hoary flebane
Erigeron speciosus var. *macranthus* Aspen fleabane
Forsythia sp. forsythia
Gutierrezia sarothrae broom snakeweed
Helianthus annuus common sunflower
Hieracium Fendleri Fendler's hawkweed
Hymenopapus mexicanus Mexican woolywhite
Hymenoxys bigelovii bitterweed
Hymenoxys richardsonii bitterweed
Packera (=Senecio) multilobatus lobeleaf groundsel
Senecio spartioides broom groundsel
Solidago velutina (=S. sparsiflora) goldenrod
Townsendia exscapa stemless daisy
Berberidaceae
Berberis repens creeping barberry
Boraginaceae
Lithospermum multiflorum purple gromwell
Brassicaceae
Lepidium spp. peppergrass, pepperwort
Cactaceae
Echinocereus trichidiatus var. *melanacanthus* Claret cup cactus
Mammillaria grahamii (=Mammillaria arizonica) fishhook cactus

1. BCC status is based on the USFWS 2008 Birds of Conservation Concern list for Regions 16 and 34.

Opuntia phaeaceantha tulip prickly pear
Opuntia macrorhiza (=O. plumbea) western pricklypear
Caprifoliaceae
Sambucus racemosa var. *microbotrys [S. microbotrys]* red elderberry
Chenopodiaceae
Chenopodium album Lamb's quarter's, pigweed
Convolvulaceae
Convolvulus arvensis bindweed, orchard morning-glory
Elaeagnaceae
Elaeagnus angustifolia Russian olive
Euphorbiaceae
Euphorbia brachycera (=E. lurida) horned spurge
Fabaceae
Astragalus sp. milkvetch
Lathyrus lanszwertii (=L. arizonicus) Arizona pea
Lathyrus graminifolius grassleaf pea
Lathyrus laetivirens (=L. leucanthus) Aspen pea
Lotus wrightii Wright's deer vetch
Lupinus argenteus silverstem lupine
Lupinus kingii King's lupine
Medicago lupulina black medick
Robinia neomexicana New Mexico locust
Vicia americana American vetch
Fagaceae
Quercus gambelii gambel oak
Geraniaceae
Geranium richardsonii Richardon's geranium
Oleaceae
Syringa vulgaris common lilac
Polygonaceae
Eriogonum alatum winged buckwheat
Eriogonum racemosum redroot buckwheat
Ranunculaceae
Thalictrum fendleri meadow rue
Resedaceae
Oligomeris linifolia lineleaf whitepuff
Rhamnaceae
Ceanothus fendleri Fendler ceanothus
Rosaceae
Fragaria virginiana (=F. ovalis) wild strawberry
Dasiphora floribunda (=Potentilla fruticosa) bush cinquefoil
Potentilla hippiana woolly cinquefoil
Potentilla subviscosa clubleaf cinquefoil
Pyracantha sp. firethorn
Rosa woodsii (=R. arizonica) Arizona rose
Rubiaceae
Houstonia wrightii Wright's bluets
Scrophulariaceae
Linaria dalmatica dalmation toadflax
Linaria vulgaris butter-and-eggs
Pedicularis centranthera juniper lousewort
Penstemon ambiguus bush penstemon
Penstemon barbatus golden beard penstemon
Verbascum Thapsus common mullein
Solanaceae
Lycium brevipes boxthorn
Lycium cooperi peach thorn
Sterculiaceae
Fremontodendron mexicanum

Monocots

Cyperaceae
Carex praegracilis clustered field sedge
Poaceae
Schizachyrium scoparium (=Andropogon scoparius) little bluestem
Aristida arizonica Arizona three-awn
Aristida purpurea var. *fendleriana* Fender's three-awn
Blepharoneuron tricholepsis pine dropseed
Bouteloua gracilis blue grama
Bromus inermis smooth brome
Bromus tectorum crested wheatgrass
Eragrostis sp. love grass
Festuca arizonica Arizona fescue
Koeleria macrantha (=K. cristata) junegrass
Muhlenbergia montana mountain muhly
Muhlenbergia virescens screwleaf muhly
Poa fendleriana ssp. *longiligula [P. longilgula]* muttongrass
Elymus elymoides ssp. *californicus (=Sitanion hystrix)* bottlebrush squirreltail
Sporobolus interruptus black dropseed
Iridaceae
Iris missouriensis Rocky Mountain iris
Orchidaceae
Corallorhiza maculata summer coralroot
Corallorhiza striata striped coral root

D.1.2 Wildlife Species List

REPTILES

SQUAMATA

Iguanidae
Phrynosoma douglassi short horned lizard
Scincidae
Eumeces multivirgatus many-lined skink
Sceloporus undulatus Eastern fence lizard
Colubridae
Thamnophis elegans Western terrestrial garter snake

BIRDS[1]

(All listed birds are considered migratory under the Migratory Bird Treaty Act)

FALCONIFORMES

Accipitridae
Accipiter cooperi Cooper's hawk
Accipiter striatus sharp-shinned hawk
Buteo albonotatus zone-tailed hawk
Buteo jamaicensis red-tailed hawk
Buteo regalis ferruginous hawk (**BCC**)

CICONIIFORMES

Cathartidae
Cathartes aura turkey vulture

1. Based on Table 2 from Shepard and Burr (2006).

GALLIFORMES

Phasianidae

Meleagris gallopavo wild turkey

COLUMBIFORMES

Columbidae

Columba fasciata band-tailed pigeon
Zenaida macroura mourning dove

STRIGIFORMES

Strigidae

Aegolius acadicus northern saw-whet owl
Bubo virginianus great horned owl
Otus flammeolus flammulated owl (**BCC**)

CAPRIMULGIFORMES

Caprimulgidae

Chordeiles minor common nighthawk

APODIFORMES

Trochilidae

Selasphorus platycercus broad-tailed hummingbird

Apodidae

Aeronautes saxatalis white-throated swift

PICIFORMES

Picidae

Colaptes auratus northern flicker
Melanerpes formicivorus acorn woodpecker
Picoides pubescens downy woodpecker
Picoides villosus hairy woodpecker
Sphyrapicus nuchalis red-naped sapsucker
Sphyrapicus thyroideus williamson's sapsucker

PASSERIFORMES

Tyrannidae

Contopus cooperi olive-sided flycatcher
Contopus sordidulus western wood-pewee
Empidonax occidentalis cordilleran flycatcher

Hirundinidae

Tachycineta bicolor tree swallow
Tachycineta thalassina violet-green swallow

Icteridae

Molothrus ater brown-headed cowbird

Corvidae

Corvus brachyrhynchos American crow
Corvus corax common raven
Cyanocitta stelleri Stellar's jay
Nucifraga columbiana Clark's nutcracker

Parulidae

Cardellina rubrifrons red-faced warbler (**BCC**)
Vermivora virginiae Virginia's warbler

Paridae

Poecile gambeli mountain chickadee

Sittidae

Certhia americana brown creeper
Sitta pygmae pygmy nuthatch
Sitta carolinensis white-breasted nuthatch

Troglodytidae

Troglodytes aedon house wren

Muscicapidae

Catharus guttatus hermit thrush

Myadestes townsendii Townsend's solitaire
Sialia mexicana western bluebird
Sialia currucoides mountain bluebird
Turdus migratorius American robin
Regulidae
Regulus calendula ruby-crowned kinglet
Regulus satrapa golden-crowned kinglet
Peucedramidae
Peucedramus taeniatus olive warbler (**BCC**)
Vireonidae
Vireo gilvus warbling vireo
Vireo huttoni Hutton's vireo
Vireo plumbeus plumbeous vireo
Emberizidae
Dendroica coronata yellow-rumped warbler
Dendroica graciae Grace's warbler (**BCC**)
Junco hyemalis dark-eyed junco
Junco hyemalis caniceps dark-eyed "grey-headed" junco
Pipilo maculatus spotted towhee
Spizella passerina chipping sparrow
Zonotrichia leucophrys white-crowned sparrow
Fringillidae
Carduelis pinus pine siskin
Loxia curvirostra red crossbill
Cardinalidae
Pheucticus melanocephalus black-headed grosbeak
Thraupidae
Piranga ludoviciana western tanager

MAMMALS

LAGOMORPHA

Leporidae
Sylvilagus floridanus Eastern cottontail

RODENTIA

Sciuridae
Eutamias cinereicollis gray-collared chipmunk
Sciurus aberti Abert's squirrel
Spermophilus lateralis golden-mantled ground squirrel
Spermophilus variegatus rock squirrel
Cricetidae
Peromyscus boylii brush mouse
Peromyscus maniculatus deer mouse
Peromyscus leucopus white-footed mouse
Neotoma mexicana Mexican woodrat
Erethizontidae
Erethizon dorsatum porcupine

CARNIVORA

Canidae
Canis latrans coyote
Urocyon cineoargenteus gray fox
Procyonidae
Procyon lotor raccoon
Mustelidae
Mephitis mephitis striped skunk
Felidae
Felis concolor mountain lion
Felis rufus bobcat
Lynx rufus lynx

ARTIODACTYLA

Cervidae
Cervus elaphus nelsoni Rocky Mountain elk
Odocoileus hemionus mule deer
Tayassuidae
Pecari angulatus peccary, javelina

BCC: Bird of Conservation Concern
FT: Federally Threatened

D.2 Forest Inventory Tables

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Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 1 - STAND DATA

Type Group	Stand No.	Acres	Type	Dec. Origin	Site Index	Species	# Trees	Basal Area s.f.	Ave DBH In.	Cubic Volume Gross C c.f.	Cubic Volume p.a.i. C.c.f.	Cubic Volume Net C. c.f.	Scribner Volume Gross M b.f.	Scribner Volume p.a.i. M b.f.	Scribner Volume p.a.i. %	Scribner Volume Net M b.f.
30	1	62.6	P3,3	93	76	TOTAL	6,379	7,249	12.8	1,350	4.0	1,280	283	2.7	0.9%	268
						D	0		0.0	0		0	0			0
						H	0		0.0	0		0	0			0
						RC	0		0.0	0		0	0			0
						OP	300		21.7	162		150	50			47
						PP	6,078		12.3	1,189		1,129	233			221
						TF	0		0.0	0		0	0			0
						SS	0		0.0	0		0	0			0
						RA	0		0.0	0		0	0			0
						O	0		0.0	0		0	0			0
						BC	0		0.0	0		0	0			0
28	2	5.1	P4/3,2	89/93	91	TOTAL	490	517	12.3	102	0.4	95	25	0.2	1.0%	23
						D	0		0.0	0		0	0			0
						H	0		0.0	0		0	0			0
						RC	0		0.0	0		0	0			0
						OP	30		23.1	23		21	8			7
						PP	387		12.7	75		71	16			15
						TF	0		0.0	0		0	0			0
						SS	0		0.0	0		0	0			0
						RA	0		0.0	0		0	0			0
						O	73		10.5	4		4	1			1
						BC	0		0.0	0		0	0			0

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 1 - STAND DATA

Type Group	Stand No.	Acres	Type	Dec. Origin	Site Index	Species	# Trees	Basal Area s.f.	Ave DBH In.	Cubic Volume Gross C c.f.	Cubic Volume p.a.i. C.c.f.	Cubic Volume Net C. c.f.	Scribner Volume Gross M b.f.	Scribner Volume p.a.i. M b.f.	Scribner Volume p.a.i. %	Scribner Volume Net M b.f.
28	3	48.7	P4/3,2	89/93	91	TOTAL	4,675	4,938	12.3	971	3.6	907	235	2.3	1.0%	219
						D	0		0.0	0		0	0			0
						H	0		0.0	0		0	0			0
						RC	0		0.0	0		0	0			0
						OP	282		23.1	216		196	72			65
						PP	3,691		12.7	715		676	154			145
						TF	0		0.0	0		0	0			0
						SS	0		0.0	0		0	0			0
						RA	0		0.0	0		0	0			0
						O	701		10.5	40		36	10			9
						BC	0		0.0	0		0	0			0
29	4	25.5	P4/3,3	86/93	65	TOTAL	2,423	2,685	12.6	561	1.1	522	160	0.6	0.4%	149
						D	0		0.0	0		0	0			0
						H	0		0.0	0		0	0			0
						RC	0		0.0	0		0	0			0
						OP	230		23.6	239		222	92			85
						PP	2,193		11.6	323		300	69			64
						TF	0		0.0	0		0	0			0
						SS	0		0.0	0		0	0			0
						RA	0		0.0	0		0	0			0
						O	0		0.0	0		0	0			0
						BC	0		0.0	0		0	0			0

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 1 - STAND DATA

Type Group	Stand No.	Acres	Type	Dec. Origin	Site Index	Species	# Trees	Basal Area s.f.	Ave DBH In.	Cubic Volume Gross C c.f.	Cubic Volume p.a.i. C.c.f.	Cubic Volume Net C. c.f.	Scribner Volume Gross M b.f.	Scribner Volume p.a.i. M b.f.	Scribner Volume p.a.i. %	Scribner Volume Net M b.f.
29	5	25.1	P4/3,3	86/93	87	TOTAL	2,385	2,643	12.6	553	1.9	514	158	1.2	0.7%	147
						D	0		0.0	0		0	0			0
						H	0		0.0	0		0	0			0
						RC	0		0.0	0		0	0			0
						OP	226		23.6	235		219	90			84
						PP	2,159		11.6	318		295	68			63
						TF	0		0.0	0		0	0			0
						SS	0		0.0	0		0	0			0
						RA	0		0.0	0		0	0			0
						O	0		0.0	0		0	0			0
						BC	0		0.0	0		0	0			0
28	6	88.8	P4/3,2	89/94	81	TOTAL	8,525	9,004	12.3	1,771	5.7	1,654	429	3.9	0.9%	400
						D	0		0.0	0		0	0			0
						H	0		0.0	0		0	0			0
						RC	0		0.0	0		0	0			0
						OP	515		23.1	393		357	131			119
						PP	6,731		12.7	1,304		1,233	280			265
						TF	0		0.0	0		0	0			0
						SS	0		0.0	0		0	0			0
						RA	0		0.0	0		0	0			0
						O	1,279		10.5	73		65	18			16
						BC	0		0.0	0		0	0			0

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 1 - STAND DATA

Type Group	Stand No.	Acres	Type	Dec. Origin	Site Index	Species	# Trees	Basal Area s.f.	Ave DBH In.	Cubic Volume Gross C c.f.	Cubic Volume p.a.i. C.c.f.	Cubic Volume Net C. c.f.	Scribner Volume Gross M b.f.	Scribner Volume p.a.i. M b.f.	Scribner Volume p.a.i. %	Scribner Volume Net M b.f.
28	7	12.1	P4/3,2	82/94	75	TOTAL	1,162	1,227	12.3	241	0.6	225	58	0.4	0.6%	54
						D	0		0.0	0		0	0			0
						H	0		0.0	0		0	0			0
						RC	0		0.0	0		0	0			0
						OP	70		23.1	54		49	18			16
						PP	917		12.7	178		168	38			36
						TF	0		0.0	0		0	0			0
						SS	0		0.0	0		0	0			0
						RA	0		0.0	0		0	0			0
						O	174		10.5	10		9	2			2
						BC	0		0.0	0		0	0			0
0	8	12.1	O													
28	9	3.4	P4/3,2	82/94	75	TOTAL	326	345	12.3	68	0.2	63	16	0.1	0.6%	15
						D	0		0.0	0		0	0			0
						H	0		0.0	0		0	0			0
						RC	0		0.0	0		0	0			0
						OP	20		23.1	15		14	5			5
						PP	258		12.7	50		47	11			10
						TF	0		0.0	0		0	0			0
						SS	0		0.0	0		0	0			0
						RA	0		0.0	0		0	0			0
						O	49		10.5	3		2	1			1
						BC	0		0.0	0		0	0			0

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 1 - STAND DATA

Type Group	Stand No.	Acres	Type	Dec. Origin	Site Index	Species	# Trees	Basal Area s.f.	Ave DBH In.	Cubic Volume Gross C c.f.	Cubic Volume p.a.i. C.c.f.	Cubic Volume Net C. c.f.	Scribner Volume Gross M b.f.	Scribner Volume p.a.i. M b.f.	Scribner Volume p.a.i. %	Scribner Volume Net M b.f.
0	10	6.9	O													
0	11	0.6	O													

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 1 - STAND DATA

Type Group	Stand No.	Acres	Type	Dec. Origin	Site Index	Species	# Trees	Basal Area s.f.	Ave DBH In.	Cubic Volume Gross C c.f.	Cubic Volume p.a.i. C.c.f.	Cubic Volume Net C. c.f.	Scribner Volume Gross M b.f.	Scribner Volume p.a.i. M b.f.	Scribner Volume p.a.i. %	Scribner Volume Net M b.f.
TOTALS - FOREST LAND																
		271.3					26,364	28,609	100	5,617	17.5	5,260	1,366	11.2	0.8%	1,276
# Stands	8															
NON-FOREST LAND																
		19.6														
# Stands	3															
GRAND TOTAL																
		290.9														

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 2 - STAND DATA BY DECADE OF ORIGIN

Acres	Dec. Origin	Species	# Trees	Basal Area s.f.	Ave DBH In.	Cubic Volume Gross C c.f.	Cubic Volume p.a.i. C.c.f.	Cubic Volume Net C. c.f.	Scribner Volume Gross M b.f.	Scribner Volume p.a.i. M b.f.	Scribner Volume Net M b.f.
23	0	TOTAL									
88.8	89/94	TOTAL	8,525	9,004	12.3	1,771	5.7	1,654	429	3.9	400
		D	0			0		0	0		0
		H	0			0		0	0		0
		RC	0			0		0	0		0
		OP	515			393		357	131		119
		PP	6,731			1,304		1,233	280		265
		TF	0			0		0	0		0
		SS	0			0		0	0		0
		RA	0			0		0	0		0
		O	1,279			73		65	18		16
		BC	0			0		0	0		0
15.5	82/94	TOTAL	1,488	1,572	12.3	309	1	289 0	75	0.4	70
		D	0			0		0	0		0
		H	0			0		0	0		0
		RC	0			0		0	0		0
		OP	90			69		62	23		21
		PP	1175			228		215	49		46
		TF	0			0		0	0		0
		SS	0			0		0	0		0
		RA	0			0		0	0		0
		O	223			13		11	3		3
		BC	0			0		0	0		0

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 2 - STAND DATA BY DECADE OF ORIGIN

Acres	Dec. Origin	Species	# Trees	Basal Area s.f.	Ave DBH In.	Cubic Volume Gross C c.f.	p.a.i. C.c.f.	Net C. c.f.	Scribner Volume Gross M b.f.	p.a.i. M b.f.	Net M b.f.
62.6	93	TOTAL	6,379	7,249	12.8	1,350	4.0	1,280	283	2.7	268
		D	0			0		0	0		0
		H	0			0		0	0		0
		RC	0			0		0	0		0
		OP	300			162		150	50		47
		PP	6,078			1,189		1,129	233		221
		TF	0			0		0	0		0
		SS	0			0		0	0		0
		RA	0			0		0	0		0
		O	0			0		0	0		0
		BC	0			0		0	0		0
53.8	89/93	TOTAL	5,165	5,455	12.3	1,073	4.0	1,002	260	2.5	242
		D	0			0		0	0		0
		H	0			0		0	0		0
		RC	0			0		0	0		0
		OP	312			238		216	79		72
		PP	4,078			790		747	170		161
		TF	0			0		0	0		0
		SS	0			0		0	0		0
		RA	0			0		0	0		0
		O	775			44		39	11		10
		BC	0			0		0	0		0

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 2 - STAND DATA BY DECADE OF ORIGIN

Acres	Dec. Origin	Species	# Trees	Basal Area s.f.	Ave DBH In.	Cubic Volume Gross C c.f.	Cubic Volume p.a.i. C.c.f.	Cubic Volume Net C. c.f.		Scribner Volume Gross M b.f.	Scribner Volume p.a.i. M b.f.	Scribner Volume Net M b.f.
50.6	86/93	TOTAL	4,807	5,328	12.6	1,114	3.0	1,035	0	318	1.7	296
		D	0			0		0		0		0
		H	0			0		0		0		0
		RC	0			0		0		0		0
		OP	455			474		441		182		169
		PP	4,352			640		595		137		127
		TF	0			0		0		0		0
		SS	0			0		0		0		0
		RA	0			0		0		0		0
		O	0			0		0		0		0
		BC	0			0		0		0		0
TOTALS - FOREST LAND												
271.3			26,364	28,609	62.4	5,617	17.5	5,260	0	1,366	11.1	1,276
NON-FOREST LAND												
23												
GRAND TOTAL												
294.3												

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 3 - HABITAT DATA BY CRUISED STANDS

Type Group	Stand No.	Acres	Type	Dec. Origin	Vol/ac M b.f.	Dominant Understory*		Vol. Down Woody cu.ft/ac	Ave Dia. Down Woody	Ave. Dia. Snags	# Snags Acre
30	1	62.6	P3,3	93	4	Fescue	25%	436	12.3	12.4	4.0
28	2	5.1	P4/3,2	89/93	5	Fescue	35%	536	13.3	22.6	0.5
28	3	48.7	P4/3,2	89/93	5	Fescue	35%	536	13.3	22.6	0.5
29	4	25.5	P4/3,3	86/93	6	Fescue	40%	0	0.0	0.0	0.0

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 3 - HABITAT DATA BY CRUISED STANDS

Type Group	Stand No.	Acres	Type	Dec. Origin	Vol/ac M b.f.	Dominant Understory*		Vol. Down Woody cu.ft/ac	Ave Dia. Down Woody	Ave. Dia. Snags	# Snags Acre
29	5	25.1	P4/3,3	86/93	6	Fescue	40%	0	0.0	0.0	0.0
28	6	88.8	P4/3,2	89/94	5	Fescue	35%	536	13.3	22.6	0.5
28	7	12.1	P4/3,2	82/94	5	Fescue	35%	536	13.3	22.6	0.5
0	8	12.1	O								
0	9	3.4	P4/3,2	82/94	5	Fescue	35%	536	13.3	22.6	0.5
0	10	6.9	O								
0	11	0.6	O								
TOTALS - FOREST LAND		267.9				Average:		97	2.4	4.1	0.1
# Stands	7										
NON-FOREST LAND		23									
# Stands	4										
GRAND TOTAL		290.90									
# Stands	11										

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 4 - TYPE GROUP SUMMARY

GROUP	CALL		# Trees per ac.	Basal Area/ac s.f.	Ave DBH In.	Net VOLUME PER ACRE b.f.		Cu. Feet	# Plots	SE %
						Compartment All Stands Combined			125	5.21%
28	P4/3,2	TOTAL	96.0	101.4	12.3	4,501		1,863	86	7%
		D								
		H								
		OP	5.8		23.1	1,336		402		
		PP	75.8		12.7	2,984		1,388		
		LP								
		TF								
		SS								
		RA								
		O	14.4		10.5	181		73		
		BC								
29	P4/3,3	TOTAL	95.0	105.3	12.6	5,848	0	2,046	15	10%
		D								
		H								
		RC								
		OP	9.0		23.6	3,340		871		
		PP	86.0		11.6	2,508		1,175		
		TF								
		SS								
		RA								
		O								
		BC								

Naval Observatory Station, Flagstaff
COMPARTMENT 18

TABLE 4 - TYPE GROUP SUMMARY

GROUP	CALL		# Trees per ac.	Basal Area/ac s.f.	Ave DBH In.	Net VOLUME PER ACRE b.f.	Net VOLUME PER ACRE Cu. Feet	# Plots	SE %
					Compartment All Stands Combined			125	5.21%
30	P3,3	TOTAL	101.9	115.8	12.8	4,286	2,044	24	7%
		D							
		H							
		RC							
		OP	4.8		21.7	750	240		
		PP	97.1		12.3	3536.0	1804.0		
		TF							
		SS							
		RA							
		O							
		BC							

D.3 NOFS Bird Survey Report

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Final Report:

General Avian Surveys at the U.S. Naval Observatory Flagstaff Station, 2005

Prepared By:

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12 September 2006

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INTRODUCTION

The objective of this project is to provide the Navy with baseline bird survey information, including abundance and species diversity, for the United States Naval Observatory, Flagstaff Station, Flagstaff, Arizona (USNOFS; the station). These surveys fulfill requirements outlined in the 2001 USNOFS Integrated Natural Resources Management Plan (INRMP) by providing information about bird species that use the observatory for stopover, resting, feeding, and nesting. To complete the objective, point count surveys were conducted for four consecutive days during the summer of 2005 at ten established count stations throughout the observatory property. This report will summarize results of the 2005 surveys as well as provide a brief summary of general avian surveys and observations conducted at USNOFS from 1992 - 2005.

Study Area

The observatory is located in Coconino County, Arizona, approximately five miles west of the city of Flagstaff along Interstate 40. The property encompasses approximately 112 hectares (287 acres) at an elevation of 2269 meters (7445 feet) above sea level and is surrounded by U.S. Forest Service, Arizona State Trust, and private lands. The mission of the USNOFS is to conduct, analyze and interpret a variety of dark sky observations in order to fulfill the mission of the U.S. Navy. In order to accomplish this mission, Navy property surrounding observatory buildings is maintained as a mixed Ponderosa pine (*Pinus ponderosa var. scopulorum*) /Gambel oak (*Quercus gambelii*) forest, which functions as a light and pollution buffer (U.S. Navy 2001).

The Ponderosa pine/Gambel oak community located throughout the observatory is classified as Rocky Mountain Montane Conifer Forest (Brown 1994). Ponderosa pine constitutes approximately 65% of the canopy cover at USNOFS and the understory is comprised primarily of Arizona fescue (*Festuca arizonica*) (U.S. Navy 2001). The climate is characterized by two wet seasons separated by dry periods with an average yearly precipitation of 58 centimeters (23.2 inches) (Grinder and Krausman 1998). The average winter temperature is –1.2° C (30° F) while the average summer temperature is 17.5° C (64° F) (Grinder and Krausman 1998)

Past Avian Surveys

From 1992 through 2005, avian surveys were conducted intermittently at the observatory. Comprehensive reports were never compiled for these surveys, with the exception of seasonal surveys conducted by Grinder and Krausman from February 1996 – May 1997 (1998). We have compiled a list of recent USNOFS bird surveys and corresponding dates in an attempt to track the recent history of bird surveys on the property (Table 1). Table 1 contains all information available at the time of writing but may be missing some minor survey information. This report will present a brief summary of the known past avian surveys as well as a comprehensive description of the 2005 survey.

Forest Thinning

Over the past four years, the Navy has implemented prescribed thinning of the Ponderosa pine forest at USNOFS. The forest thinning treatment was undertaken in order to reduce wildfire hazards caused by long-term fire suppression as well as to promote the health of the forest (U.S. Navy 2001). It has been shown that thick stands of Ponderosa pine have led to a decrease in oak regeneration caused by the shading effects of the pine (U.S. Navy 2001). Silvicultural thinning treatments at USNOFS are summarized here due to their possible impact to bird communities throughout the property. From September 2001 through May 2004, the property was mechanically thinned in areas where machines could easily perform the job, and then during both the summer of 2004 and 2005, the forest was hand-thinned (R. Palmer pers. comm.). To date, 200 acres have been thinned with another 50 acres still to be treated (R. Palmer pers. comm.). For the station's remaining 37 acres of forest, there is currently no plan for thinning. The recent forest thinning at USNOFS has led to a more open canopy with a greater amount of edge habitat. This habitat alteration may lead to a change in the avian species composition, favoring species that prefer edge habitat.

Sensitive Avian Species

Sensitive bird species that may occur at USNOFS include the Mexican Spotted Owl (*Strix occidentalis lucida*) (MSO) and Northern Goshawk (*Accipter gentiles atricapillus*) (NOGO). The MSO is federally listed as threatened under the Endangered Species Act (USFWS 1993) and is considered threatened under Arizona Game and Fish Department's list, "Wildlife of Special Concern" (AGFD in prep.). The NOGO is considered a candidate "Wildlife of Special

Concern" species by the AGFD (AGFD, in prep.). The goshawk has not been recorded on observatory property but may utilize the site for foraging (U.S. Navy 2001). To date, no focused surveys for NOGO have been conducted at USNOFS. Surveys for the MSO have been conducted intermittently at USNOFS since 1994, and since this time, when a single MSO was observed on Arizona State land adjacent to the observatory, no MSOs have been recorded on the property (Johnson et al. 2005). See Appendix 1 for a summary of MSO surveys from 1994 – 2004 at the Dry Lake Protected Activity Center (PAC), which includes USNOFS land.

METHODS

Survey Compilation, 1992 - 2005

Surveys were compiled by looking through survey records provided by the staff of Naval Facilities Engineering Command Southwest (San Diego, CA). Survey records were then analyzed to determine the diversity of species observed at the station during the survey period available (1992 – 2005).

2005 Surveys

Starting on 28 June 2005, bird counts were conducted for four consecutive days at 10 count stations throughout USNOFS (Fig. 1). A numbered stake placed by Timothy Burr in June 1992 marked each station. On the morning of 28 June, beginning at approximately 0600, ten-minute point counts were initiated by Observer A (Tiffany Shepherd) at point count station 9 and simultaneously initiated by Observer B (Tim Burr) at station 10. Observer A continued ten-minute counts at each station, following the route: 9, 8, 7, 6, 5, 4, 3, 1, 2, and 10, while Observer B simultaneously followed the opposite route: 10, 2, 1, 3, 4, 5, 6, 7, 8, and 9. Each morning, the observers began the counts at approximately 0600, but switched starting locations with one another and followed the alternate route. The starting stations were located at opposite ends of the property to ensure that count stations were covered at various times throughout each morning. At each count station, a ten-minute survey was initiated, during which time the observer recorded all birds seen or heard. The ten-minute period was divided into 0-5 and 5-10 minute intervals. Each species/individual was recorded as an audio, visual, or audio/visual observation within each interval. Distance measurements were not estimated. In addition to bird species information, each observer also recorded percent cloud cover, wind speed, and temperature. All birds observed outside of the ten-minute counts were recorded as incidental observations, including, with the exception of swallows, birds that were observed to be flying overhead but not landing during the 10-minute count period. Completion of the survey route took approximately 3.5 hours each morning. Two observers were used to conduct the surveys in 2005 as part of the training for Observer A. Photographs (digital) were taken in the four primary compass directions at each census station at the conclusion of the surveys (Appendix 2).

RESULTS

Survey Compilation, 1992 - 2005

Avian surveys at USNOFS have not been conducted regularly. Table 1 provides a summary of observations and surveys performed from 1992 through 2005. In 1992, 1996-1997, 2002, and 2005, comprehensive point counts were conducted at the ten established bird count points. In 1994, 1996, and 1997, Timothy Burr recorded general avian observations during short visits to the observatory. These observations did not follow a protocol or take place at the established point count locations (T. Burr pers. comm.).

Table 2 provides a brief summary of bird species observed during the 1992 – 2005 survey period. The table is simply a compilation of bird species observed and should not be used to compare different years as the surveys were conducted during various seasons with inconsistent efforts. From 1992 through 2005, a total of 59 bird species have been recorded at USNOFS.

2005 Surveys

With the effort of two observers, two ten-minute surveys were conducted at each of ten count stations each day for four consecutive days. This resulted in an effort of 200 minutes/day, for a four-day total of 800 count minutes. Sixteen species/200 minutes of effort were detected on day one, 20 species/200 minutes on day two, 20 species/200 minutes on day three, and 22 species were recorded in 200 minutes on day four (Table 3). A total of 26 unique species were recorded during the four days of point counts. The Hutton’s Vireo (*Vireo huttoni*), a species not listed in the 2001 INRMP, was detected on day three. No AGFD “Wildlife of Special Concern” or other sensitive species were observed during the 2005 surveys. It is unlikely that the MSO would be recorded as it is a nocturnal species and nighttime target surveys were not conducted. The NOGO is a diurnal raptor that may utilize the station for foraging, but it was not recorded.

The total number of individuals observed for each species is graphed in Figs. 2 and 3. Species most frequently encountered included the Mountain Chickadee (*Poecile gambeli*), Pygmy Nuthatch (*Sitta pygmaea*), White-breasted Nuthatch (*Sitta carolinensis*), and Western Wood-Pewee (*Contopus sordidulus*). Species recorded only once during the surveys included the Chipping Sparrow (*Spizella passerina*), Hutton's Vireo, Pine Siskin (*Carduelis pinus*), and Red-tailed Hawk (*Buteo jamaicensis*). Other species encountered infrequently included the American Crow (*Corvus brachyrhynchos*), Cordilleran Flycatcher (*Empidonax occidentalis*), Common Raven (*Corvus corax*), and Townsend's Solitaire (*Myadestes townsendi*).

Incidental species observed at USNOFS are listed in Table 4. Incidentals included six species not recorded in the 2001 INRMP: Zone-tailed Hawk (*Buteo albonotatus*), Great-horned Owl (*Bubo virginianus*), Common Nighthawk (*Chordeiles minor*), Red-faced Warbler (*Cardellina rubrifrons*), Virginia's Warbler (*Vermivora virginiae*) and Brown-headed Cowbird (*Molothrus ater*).

DISCUSSION

Survey Compilation, 1992 - 2005

Many bird species that were not recorded in earlier surveys were detected during the 2005 survey, including the Hutton's Vireo, Zone-tailed Hawk, Great-horned Owl, Common Nighthawk, Red-faced Warbler, and Virginia's Warbler. The Hutton's Vireo is a year-round resident, which inhabits pine and pine-oak woodlands in Arizona (Davis 1995). Because of its range and habitat, it is likely this species occurs regularly at the station but has simply been overlooked in past surveys.

Many species were not recorded in 2005 that were observed during earlier surveys (Table 2). Some of these were not recorded because the 2005 surveys were conducted during the summer and would have missed migrating or winter residents, including Ferruginous Hawk (*Buteo regalis*), Ruby-crowned Kinglet (*Regulus calendula*), and White-crowned Sparrow (*Zonotrichia leucophrys*). Other birds such as Flammulated Owl (*Otus flammeolus*) may have been missed in 2005 because nocturnal surveys were not conducted. Bird species recorded during two or more past surveys but not observed in summer 2005 include Sharp-shinned Hawk (*Accipiter striatus*), Wild Turkey (*Meleagris gallopavo*), Acorn Woodpecker (*Melanerpes formicivorus*), Brown Creeper (*Certhia americana*), Mountain Bluebird (*Sialia currucoides*), Grace’s Warbler (*Dendroica graciae*), Olive Warbler (*Peucedramus taeniatus*), and Red Crossbill (*Loxia curvirostra*). These species may still occur at the station but were not seen in 2005. It should be noted that Wild Turkey has not been recorded in any bird surveys since 1994.

It is difficult to compare the 1992 - 2005 surveys due to inconsistency in seasons and effort. We recommend that future surveys be conducted using the 2005 protocol and point count stations so that survey results can be compared between years.

2005 Surveys

Three of the most abundant bird species recorded in 2005, Mountain Chickadee, Pygmy Nuthatch, and White-breasted Nuthatch, were also found to be abundant by Grinder and Krausman (1998). These three species are all considered to be resident or short-distance migrants within the ponderosa pine forests of northern Arizona (Ehrlich *et al.* 1996, Rosenstock 1996). These species also tend to form large foraging flocks and because of this are often recorded in large numbers. One species found to be very abundant in 2005, the Western Wood-Pewee, was not abundant during Grinder and Krausman’s 1996 - 1997 surveys (1998). The Western Wood-Pewee is a neotropical migrant that breeds in North America. It was recorded only five times during Grinder and Krausman’s spring survey and was not recorded during their summer survey (1998). In contrast, during the summer of 2005, this species was extremely abundant, being recorded 73 times during the four survey days. The Western Wood-Pewee prefers to reside in woodlands and forests and is often found in edge habitat (Bemis and Rising 1999). Since forest thinning at USNOFS began in 2001, an increase in edge habitat and open canopy has occurred throughout the station. The forest thinning, which appears to have enhanced the preferred habitat for the pewee, has likely led to this documented increase in numbers. The change in forest habitat at USNOFS may also be influencing the occurrence and abundance of other bird species.

The 2005 survey effort recorded seven species of birds not listed in the 2001 USNOFS INRMP, the Zone-tailed Hawk, Great Horned Owl, Common Nighthawk, Hutton’s Vireo, Red-faced Warbler, Virginia’s Warbler, and Brown-headed Cowbird. Compilation of the past surveys, though, showed that Grinder and Krausman (1998) had previously observed the Brown-headed Cowbird. Nevertheless, this year’s survey effort resulted in the observation of six new species at USNOFS. This outcome confirms that the Navy should continue regular avian surveys in order to track the diversity of birds using the forest at USNOFS.

RECOMMENDATIONS

1. These general bird surveys should be continued in order for the USNOFS to be able to adequately document changes in avian abundance and diversity. The frequency of these surveys should be biennial.

2. Although the additional observations of a second observer is beneficial and adds data, these surveys can be effectively accomplished using a single, trained observer who is familiar with both visual and audio cues of all bird species likely to occur on USNOFS.

3. Photographs (digital) should be taken at each bird point count station (as described in the methods section) each time the surveys are conducted.

4. At least two nights of nocturnal owl surveys should be added. If nocturnal surveys are incorporated into this avian survey methodology, they must be conducted by at least two people for safety reasons.

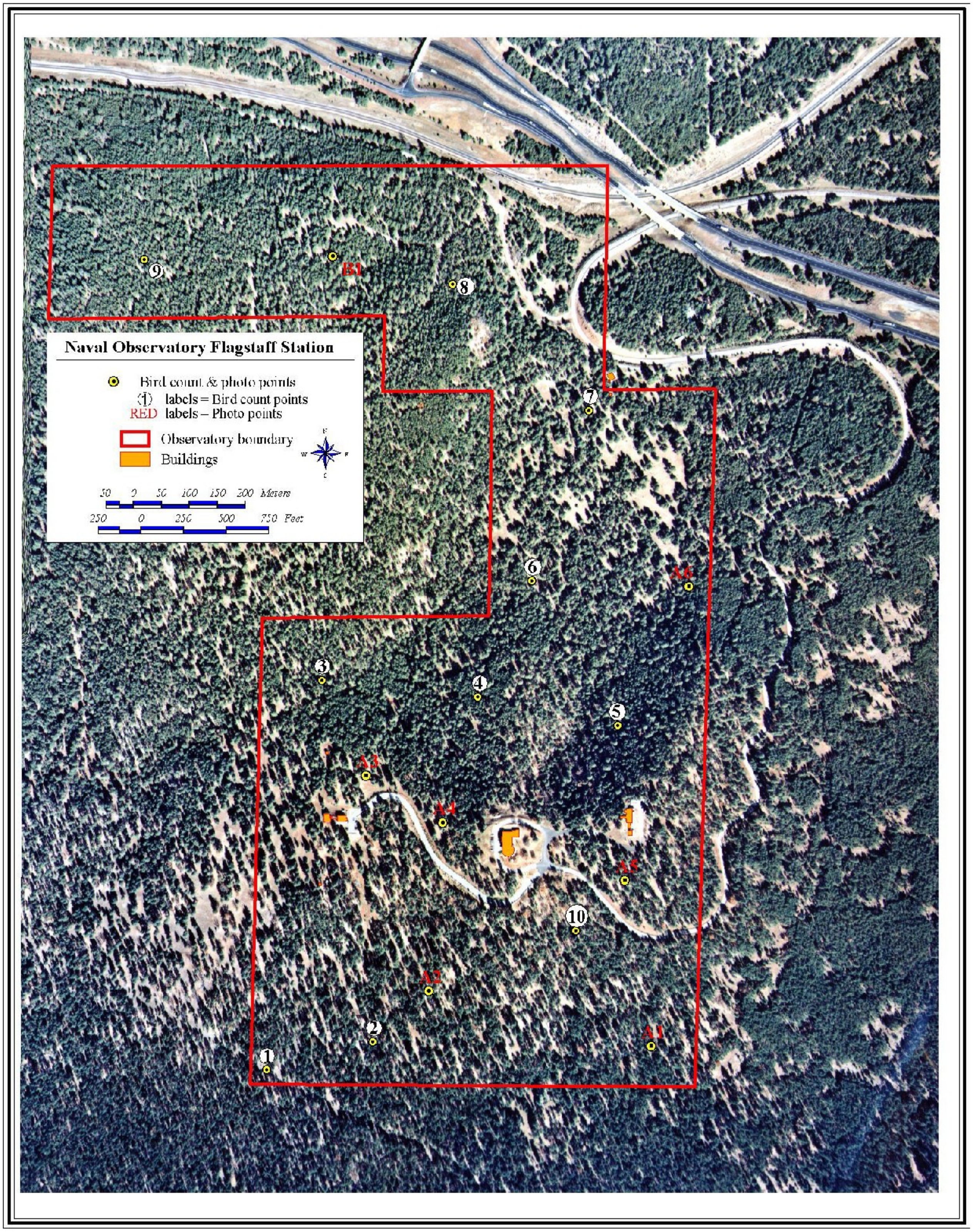

FIGURE 1. Map of USNOFS depicting bird point count locations.

TABLE 1. List of general avian surveys and observations conducted at U.S. Naval Observatory, Flagstaff from 1992 - 2005. Table may not be inclusive of all surveys conducted.

Survey Dates	Description	Conducted By
10-11 Jun 1992	Ten-minute point counts at ten count stations	Timothy Burr
25-27, 31 Oct 1994	General observations during the USNOFS boundary delineation.	Timothy Burr
Feb 1996 – May 1997	Ten-minute point counts at ten count stations conducted for each season: Feb 1996 (winter), Jul 1996 (summer), Nov 1996 (fall), and May 1997 (spring)	Martha Grinder and Paul Krausman (see Grinder and Krausman 1998)
25 Jul 1996	General observations	Timothy Burr
11 Jun 1997	General observations	Timothy Burr
25-28 Jun 2002	Eight-minute point counts at ten count stations	Timothy Burr and Trish Griffin
28 Jun - 1 Jul 2005	Ten-minute point counts at ten count stations	Timothy Burr and Tiffany Shepherd

TABLE 2. A List of Species observed at USNOFS from 1992 – 2005 including all incidental observations.

Species Observed[1]	Jun 1992	Oct 1994	Feb 1996-May 1997[2]	Jul 1996[3]	Jun 1997[2]	Jun 2002	Jun 2005
Turkey Vulture	X					X	X
Sharp-shinned Hawk	X				X		
Zone-tailed Hawk							X
Cooper's Hawk						X	
Red-tailed Hawk	X		X				X
Ferruginous Hawk		X					
Wild Turkey	X	X					
Flammulated Owl			X				
Great Horned Owl							X
Northern Saw-whet Owl			X				X
Common Nighthawk							X
Band-tailed Pigeon		X	X			X	X
Mourning Dove	X		X		X	X	X
White-throated Swift						X	
Hummingbird spp.	X					X	
Broad-tailed Hummingbird	X		X			X	X
Woodpecker spp.	X						
Acorn Woodpecker		X	X		X		
Downy Woodpecker						X	
Hairy Woodpecker	X		X			X	X
Williamson's Sapsucker		X					
Red-naped Sapsucker		X					
Northern Flicker	X	X	X		X	X	X
Olive-sided Flycatcher			X				
Western Wood-Pewee	X		X		X	X	X
Empidonax flycatcher	X						
Cordilleran Flycatcher			X		X	X	X
Plumbeous Vireo	X		X	X	X	X	X
Hutton's Vireo							X
Warbling Vireo			X				
Steller's Jay	X	X	X		X	X	X
Clark's Nutcracker			X				
American Crow		X	X			X	X
Common Raven		X	X		X	X	X
Swallow spp.	X						
Tree Swallow						X	
Violet-green Swallow	X		X				X
Mountain Chickadee	X	X	X	X	X	X	X
White-breasted Nuthatch	X	X	X	X	X	X	X
Pygmy Nuthatch	X	X	X	X	X	X	X
Brown Creeper		X	X	X		X	
House Wren			X				
Golden-crowned Kinglet			X				
Ruby-crowned Kinglet			X				

Mountain Bluebird	X		X				
Western Bluebird	X		X			X	X
Townsend's Solitaire		X	X			X	X
Hermit Thrush	X		X		X	X	X
American Robin	X	X	X		X	X	X
Virginia’s Warbler							X
Yellow-rumped Warbler	X		X		X	X	X
Grace's Warbler	X		X				
Red-faced Warbler							X
Olive Warbler			X			X	
Western Tanager	X		X		X	X	X
Spotted Towhee			X				
Chipping Sparrow			X				X
White-crowned Sparrow		X					
Dark-eyed Junco	X	X	X	X		X	X
Black-headed Grosbeak	X		X		X	X	X
Brown-headed Cowbird			X				X
Red Crossbill		X	X				
Pine Siskin			X				X
Total Number of Species	**28**	**19**	**42**	**6**	**17**	**30**	**35**

[1]Order and nomenclature follows American Ornithologists' Union Check-list (1998)

[2]Surveys conducted by Paul Krausman and Martha Grinder (1998)

[3]General observations by Timothy Burr

TABLE 3. Birds observed at U.S. Naval Observatory, Flagstaff during 2005 point count surveys.

Common Name[1]	Scientific Name	Alpha Code	Status[3]	Day 1	Day 2	Day 3	Day 4	**Total**
Red-tailed Hawk	*Buteo jamaicensis*	RTHA	RS	0	1	0	0	**1**
Mourning Dove	*Zenaida macroura*	MODO	RS	3	6	0	4	**13**
Broad-tailed Hummingbird	*Selasphorus platycercus*	BTAH	NT	0	3	5	6	**14**
Hairy Woodpecker	*Picoides villosus*	HAWO	RS, CV	2	1	1	7	**11**
Northern Flicker	*Colaptes auratus*	NOFL	RS, CV	5	1	6	6	**18**
Western Wood-Pewee	*Contopus sordidulus*	WEWP	NT	12	16	22	23	**73**
Cordilleran Flycatcher	*Empidonax occidentalis*	COFL	NT, CV	0	1	0	1	**2**
Plumbeous Vireo	*Vireo plumbeus*	PLVI	NT	6	7	5	6	**24**
Hutton's Vireo[2]	*Vireo huttoni*	HUVI	RS	0	0	1	0	**1**
Steller's Jay	*Cyanocitta stelleri*	STJA	RS	9	9	7	18	**43**
American Crow	*Corvus brachyrhynchos*	AMCR	RS	0	0	1	1	**2**
Common Raven	*Corvus corax*	CORA	RS	2	0	0	1	**3**
Violet-green Swallow	*Tachycineta thalassina*	VGSW	NT, CV	12	10	4	10	**36**
Mountain Chickadee	*Poecile gambeli*	MOCH	RS, CV	13	26	20	17	**76**
White-breasted Nuthatch	*Sitta carolinensis*	WBNU	RS, CV	11	11	17	22	**61**
Pygmy Nuthatch	*Sitta pygmaea*	PYNU	RS, CV	12	14	12	19	**57**
Western Bluebird	*Sialia mexicana*	WEBL	RS, CV	13	6	13	14	**46**
Townsend's Solitaire	*Myadestes townsendi*	TOSO	RS	0	0	0	2	**2**
Hermit Thrush	*Catharus guttatus*	HETH	RS	0	2	1	3	**6**
American Robin	*Turdus migratorius*	AMRO	RS	2	2	3	9	**16**
Yellow-rumped Warbler	*Dendroica coronata*	YRWA	RS	0	0	10	11	**21**
Western Tanager	*Piranga ludoviciana*	WETA	NT	4	6	6	5	**21**
Chipping Sparrow	*Spizella passerina*	CHSP	NT	0	0	1	0	**1**
Dark-eyed Junco	*Junco hyemalis*	DEJU	RS	5	10	10	10	**35**
Black-headed Grosbeak	*Pheucticus melanocephalus*	BHGR	NT	9	9	6	6	**30**
Pine Siskin	*Carduelis pinus*	PISI	RS	0	1	0	0	**1**
		TOTAL		**120**	**142**	**151**	**201**	**614**
		Number of Species		**16**	**20**	**20**	**22**	**26**

[1]Order and nomenclature follows American Ornithologists' Union Check-list (1998)

[2]Species not listed in the 2001 INRMP

[3]RS: resident or short-distance migrant; NT: neotropical migrant; CV: cavity nester (Ehrlich *et al.* 1996, Rosenstock 1996)

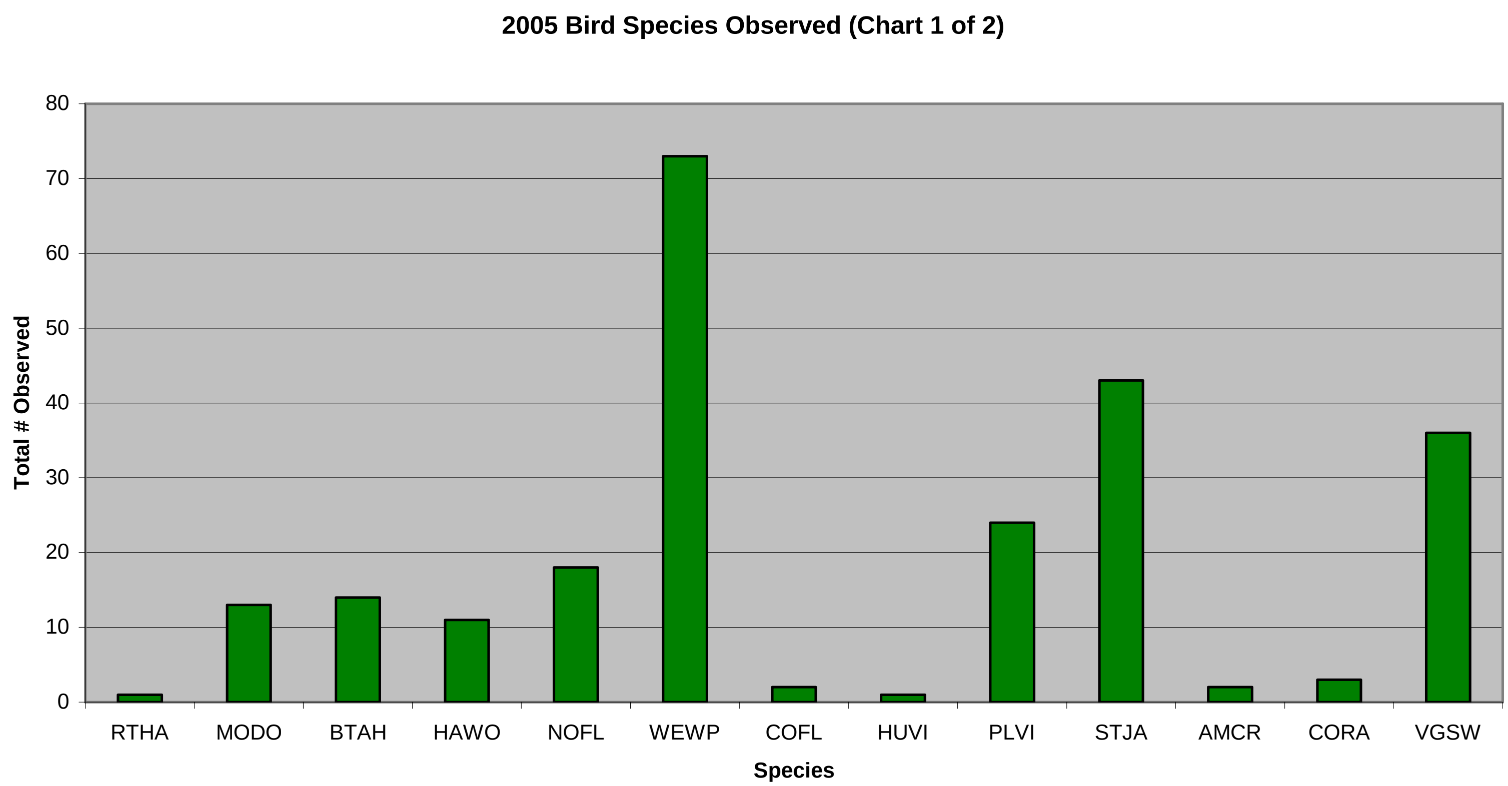

FIGURE 2. Total count for each bird species observed during 2005 point counts. Figure 2 displays half of species observed. Four-letter alpha code definitions are provided in Table 3.

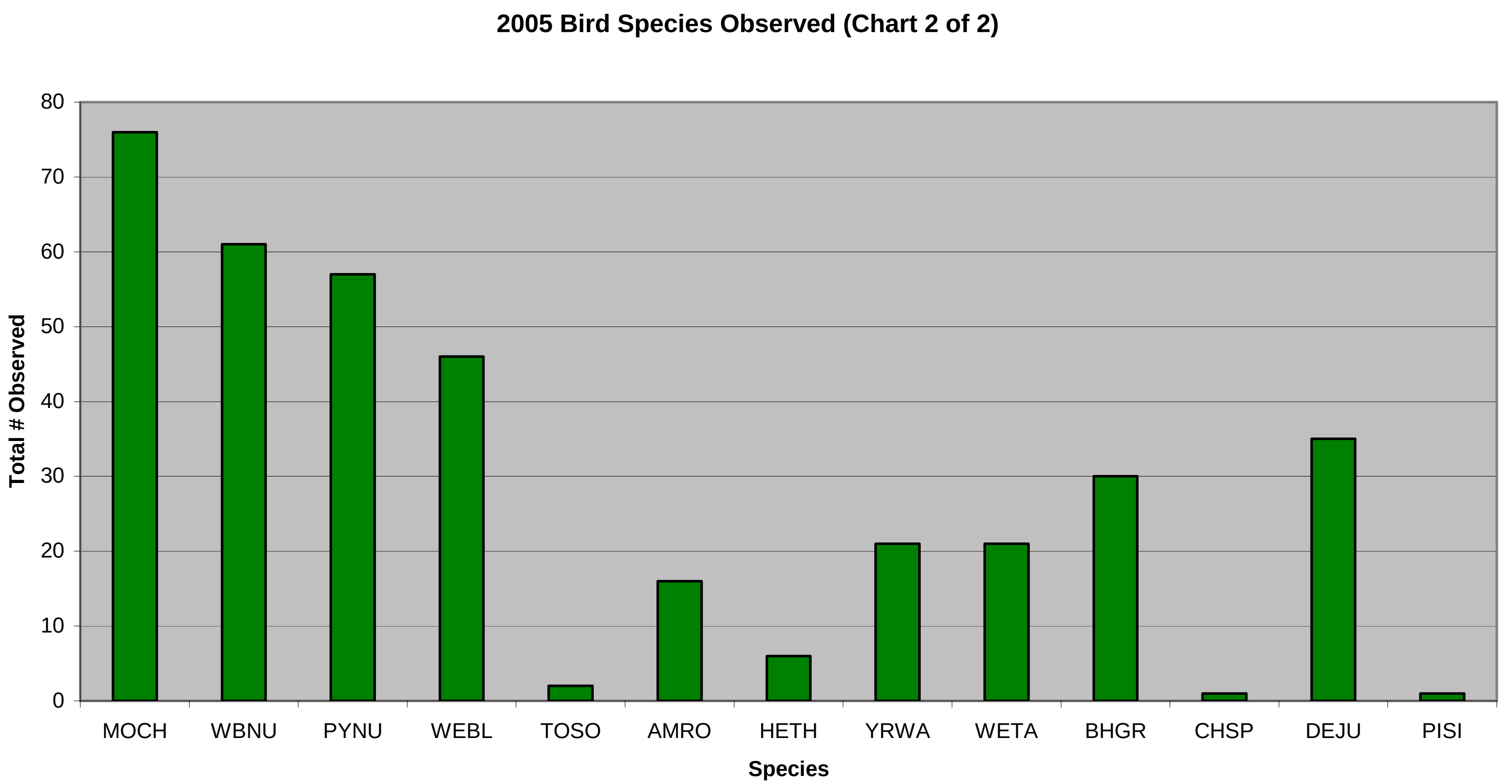

FIGURE 3. Total count for each bird species observed during 2005 point counts. Figure 3 displays half of species observed. Four-letter alpha code definitions are provided in Table 3.

Table 4. Species recorded during 2005 non-survey hours.

2005 Incidental Species	Date
Turkey Vulture	6/30/05
Zone-tailed Hawk[1]	6/30/05
Band-tailed Pigeon	6/28/05
Great Horned Owl[1]	6/29/05
Northern Saw-whet Owl	6/29/05
Common Nighthawk[1]	6/29/05
Virginia's Warbler[1]	6/28/05
Red-faced Warbler[1]	6/28/05, 6/29/05
Brown-headed Cowbird[1]	7/1/05

[1] Species not listed in 2001 INRMP

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APPENDIX 1. SUMMARY OF DOCUMENTED MEXICAN SPOTTED OWL OBSERVATIONS FOR THE DRY LAKE PAC*
1994 - 2004

Date	Location	Observation	Observer
1994			
6/28/94	T21N R6E, Section 27, NE quarter	Single MSO location; probably a dispersing juvenile (K. Pajkos 1/23/97)	ASLD
6/29/94	T21N R6E, Section 27, NW quarter	Single MSO response	ASLD
7/6/94	T21N R6E, Section 36, NW quarter	Female MSO response	USFS
7/14/94	T21N R6E, Section 35, NE quarter	Single MSO location	USFS
7/19/94	T21N R6E, Section 36, NW quarter	Single MSO response; Day and night surveys	USFS
7/31/94	T21N R6E, Section 36, NW quarter	Single MSO response	USFS
1995			
7/17/95	T21N R6E, Section 25, NW quarter	Single MSO location	USFS
1996			
		No MSO responses or locations	ASLD
1997			
		No MSO responses or locations; USN Observatory land and surrounding area surveyed	US Navy/USFS
1998			
		No MSO responses or locations	ASLD
1999			
		No MSO responses or locations; USN Observatory land and surrounding area surveyed	US Navy/USFS
2000			
		No surveys conducted	
2001			
7/8/01	T21N R6E, Section 35, NE quarter	Single MSO response	USFS
7/10/01	T21N R6E, Section 35, NE quarter	Single MSO location	USFS
2002			
		No MSO responses or locations	ASLD
2003			
3/28/03 – 7/31/03		No MSOs detected	USGS
2004			
3/28/04 – 7/31/04		No MSOs detected	USGS

*Information sources were a list (Summary of Owl observations for the Dry Lake [040231] MSO) provided by the USFS, Peaks Ranger District, an interview with Keith Pajkos, Arizona State Lands Division (ASLD) on 1/23/97, pers com with Keith Pajkos, and information provided in Johnson et al. 2005. 1994 is the first year that the USFS had survey and monitoring data for this Protected Activity Center (PAC). All surveys were conducted according to USFS Region 3 Survey Protocol.

APPENDIX 2. PHOTO POINTS TAKEN AT EACH BIRD COUNT STATION IN THE FOUR CARDINAL DIRECTIONS

Station 1: North View

East View

South View

West View

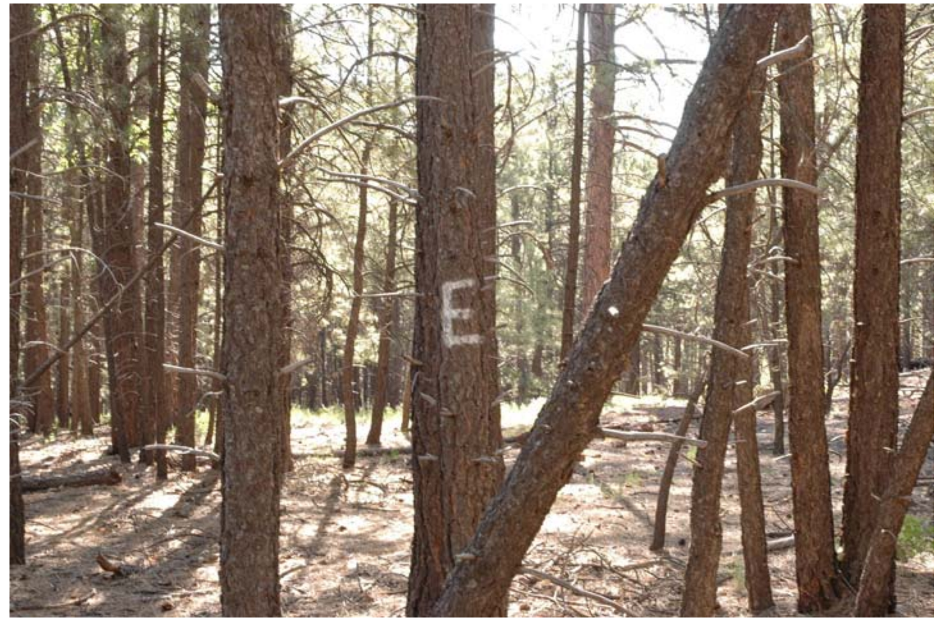
Station 2: North View

East View

South View

West View

Station 3: North View



East View

South View

West View

Station 4: North View

East View

South View

West View

Station 5: North View

East View

South View

West View


Station 6: North View


East View


South View


West View

Station 7: North View

East View

South View

West View

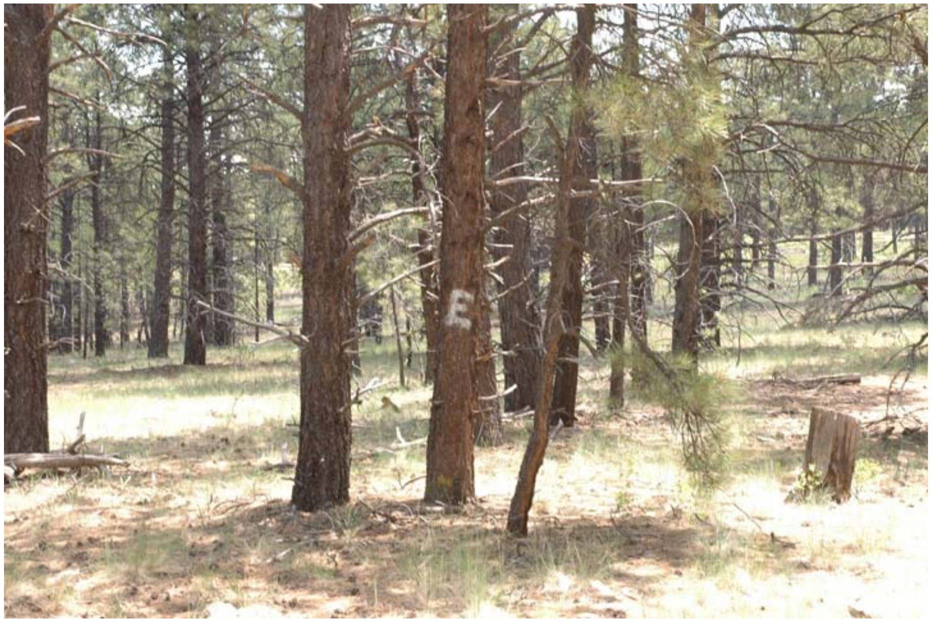
Station 8: North View

East View

South View

West View

Station 9: North View



East View

South View

West View

Station 10: North View

East View

South View

West View

D.4 Wetlands Delineation

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Naval Observatory Flagstaff Station

Wetland Delineation

May 2004

Naval Observatory Flagstaff Station

Wetland Delineation

May 2004

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Table of Contents

Naval Observatory Flagstaff Station

Wetland Delineation 2003

1.0 Introduction

This report is to delineate wetlands and the geographic extent of Waters of the U.S. on the property of Naval Observatory Flagstaff Station (NOFS). This work is necessary for land owners and managers to comply with Section 404 of the Clean Water Act (CWA) and other laws, which require that these ecologically valuable areas be protected. A jurisdictional wetland delineation and determination of Waters of the U.S. identifies the legal boundaries within which the U.S. Army Corps of Engineers (USACOE or Corps) has regulatory jurisdiction. Wetlands are a type and subset of Waters of the U.S. The Corps shares regulatory authority with the U.S. Environmental Protection Agency (EPA) over Waters of the U.S. under Section 404 of the CWA, Section 10 of the Rivers and Harbors Act of 1899, and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972.

Ecosystem functions in wetlands belie their small area. They can profoundly affect the natural vitality of a region. The reason there has been a national focus on wetlands is in part because so few remain from presettlement times. In Arizona, 36% are estimated to be lost to conversion to farmland, flood control, water diversion and urban development (Dahl 1990). This has been detrimental to bird, mammal, fish, and other wildlife populations. Also, wetland degradation can be caused by seemingly unrelated or indirectly connected activities, such as changes in upstream drainage contours, altered runoff from upslope developments including roads, pumping, or plowing too deeply in a claypan. Effects originating off-site have necessitated comprehensive regulation in order to adequately protect wetland resources.

Interpretation of the field data collected and conclusions about jurisdictional status in this report are subject to confirmation and review by the USACOE. They make the final jurisdictional determination, and should be contacted in cases where site-specific projects are being considered.

The objective of the wetlands inventory is to provide sufficiently detailed and accurate jurisdictional delineations to support the subsequent assessment of impact, permit processing and mitigation planning. The inventory addresses all potential regulatory boundaries and identifies other regulated water bodies and wetland-associated habitats (Cylinder *et al.* 1995).

2.0 Federal Wetland Regulations

Section 404 of the CWA gave regulatory authority over Waters of the U.S., which includes wetlands, to the EPA. The EPA delegated this authority to the USACOE, but retains veto power over permit decisions. The agencies and jurisdictions involved in Arizona wetland regulation are listed in Table 1.

“Waters of the U.S.” is the general category of regulated water bodies defined in the CWA. Discharges of dredge or fill into these water bodies are regulated under Section 404 of the Act. The USACOE’s jurisdiction in fresh waters includes the channel itself for Waters (defined by the Ordinary High Water Mark), to the outer edge of adjacent wetlands. Wetlands isolated from surface water bodies, such as vernal pools, also fall under Corps regulation. Some water bodies are specifically exempted, such as irrigation ditches or drainage ditches excavated in uplands. Other types of Waters of the U.S. are not intuitive, but are regulated. These include vernal pools, desert playas, ephemeral swales, desert arroyos, desert playas, seasonal ponds, reservoirs, farm or stock ponds fed by direct rainfall or impoundment (not by pumped water), artificial wetlands that receive water without artificial controls (such as pumps, valves, or gates), and farmed wetlands.

Table 1. Jurisdictional authorities over Wetlands and other regulated Waters. (Adapted from Cylinder et al. 1995)

Agency	Regulation	Authority	Jurisdiction
U.S. Environmental Protection Agency	Clean Water Act NEPA, CEQA	Enforcement; vetopower over a Corps-issued permit. Comment only.	Waters of the U.S, including wetlands.
U.S. Army Corps of Engineers	Clean Water Act, Section 404 Rivers and Harbors Act, Section 10	Regulates dredge and fill. Regulates construction of structures, dredge and fill.	Waters of the U.S, including wetlands. Navigable Waters (subject to ebb and flow of the tide and could be used for interstate or foreign commerce).
U.S. Fish and Wildlife Service	Fish and Wildlife Coordination Act Endangered Species Act CEQA, NEPA	Review and comment only. USACOE must consult with USFWS on 404 permits if endangered species on site. Comment only.	Waters of the U.S., including wetlands.
Natural Resource Conservation Service	Food Security Act, 59 CFR 12, January 19, 1994	Regulates activities in agricultural areas.	Farmed Wetlands associated with agricultural lands. (USACOE responsible in some counties where Natural Resource Conservation Service (NRCS) has not implemented its authority, mostly in the San Francisco Bay Area).
State and Regional Water Quality Control Boards	Clean Water Act, Section 401 Clean Water Act, Section 402 CEQA, NEPA	Issues water quality certification, which is required for 404 permit. Regulates discharge of waste. Comment only.	Waters of the U.S., including wetlands. Waters of the U.S., including wetlands.

3.0 Methods

All potential wetland areas were visited in the field for a total of one full day of field time. The methods used to delineate wetlands and Waters of the U.S. are as follows.

A. Compile and review existing resources:
   1. National Wetlands Inventory map from GIS; plant lists from the NOFS Integrated natural Resources Management Plan; NRCS Soil Survey for identification of hydric soils; USGS 1:24,000 topographic maps for hydrologic “blue lines;” and aerial photos (1996).
   2. Classify hydric vegetation based on USFWS classification of wetland and deepwater habitats (Reed 1988).

B. Determine areas supporting or with the potential to support hydrophytic vegetation, or sites adjacent to these (Federal Interagency Committee for Wetlands Delineation [FICWD] 1989).
   1. Record evidence supporting the three-parameter criteria for Section 404 wetlands on data forms from the 1987 Corps Wetlands Delineation Manual (USACOE 1987). In each location, a number of indicators are evaluated to determine if a site qualifies as a jurisdictional wetland under Section 404. Each of three criteria must be satisfied:
      a. Predominance of vegetation adapted to an anaerobic soil environment. Transects are walked across suspected wetland areas and points are established in all vegetation communities and near wetland boundaries in sufficient quantity to determine the wetland boundary. Areas estimated visually to have over 50 percent cover of obligate, facultative-wetland, or facultative plants are considered to have met the hydrophytic vegetation criterion of the three-criterion method set forth in USACOE (1987).
      b. Presence of hydric soils, that is, evidence of an anaerobic soil environment in the upper portion of the soil profile due to ponding, flooding, or saturation. Dig sample soil test pits to a depth of 30 cm (18 in). Check Munsell color charts, vertical streaking, high organic matter, mottling, and for spodic and organic pans. Indicate whether soils are similar or dissimilar to soil mapping unit from the Soil Survey. Observe the hole for standing water or seepage from nearby areas. This criterion is fulfilled if there is evidence of long-term reducing conditions.
      c. Presence of regular inundation or saturation for a sufficient duration to cause anaerobic conditions in the soil root zone, based on flow pattern, scouring, ponding and accumulation of debris and sediment.

C. Waters of the U.S. are defined by the jurisdictional scope of the CWA as ‘‘navigable waters,’’ defined in the statute as ‘‘waters of the United States, including the territorial seas’’ (CWA section 502(7), 33 U.S.C. 1362[7]). The "ordinary high water mark" on non-tidal streams is the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas. Federal regulatory jurisdiction, and powers of improvement for navigation, extend laterally to the entire water surface and bed of a navigable waterbody, which includes all the land and waters below the ordinary high water mark.

D. Map jurisdictional wetlands and jurisdictional non-wetland Waters of the U.S., as well as those nearby, and locations of test pits.

4.0 Site Description

4.1 Project Setting

NOFS consists of 287 acres of pine-oak woodland located in Coconino County, Arizona, five miles west of the city of Flagstaff on Interstate 40, and about 140 miles north of Phoenix on Interstate 17. NOFS is bordered by national forest, Arizona State Trust, and private lands. The primary land use in the region is timber harvest, recreational tourism, and human settlement. Seasonal livestock grazing is also widespread on public lands of the area.

4.2 Site History

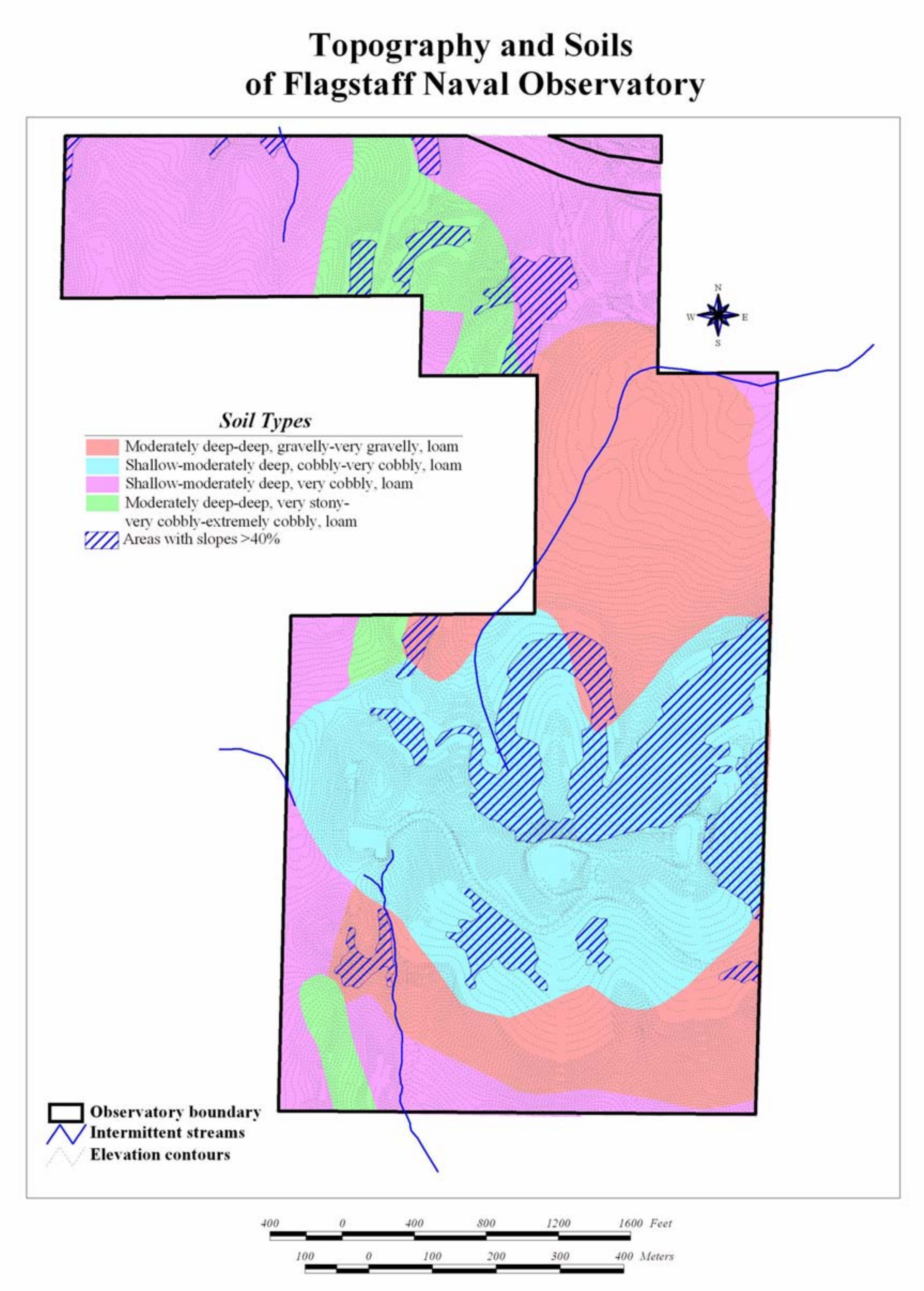
NOFS was originally established October 14, 1955, because its remoteness provided the key combination of high-altitude, dark sky without urban light interference, and a comparatively pollution-free atmosphere. The forty-inch telescope was installed in 1954. A 61-inch telescope was added in 1964 and a 24-inch telescope in 1971.

Historically, the Flagstaff area became known for sheep herding and ranching. Both sun and shaded areas of the forest were filled with high-growing grasses used by deer and antelope as a food staple. When ranchers used it for cattle, the thin soil could not support the heavy use, and native grasses did not return to their previous abundance. In the early 1950s most old growth trees were harvested in the Flagstaff area. It is assumed that this was when the property was last commercially harvested.

4.3 Topography and Soils

The 287 acres of NOFS, is mostly hilly, with three telescopes on top of knolls. Elevation ranges from a low of 7,305 feet above sea level to a high of 7,575 feet at Building 1. The hills have relatively steep sides with slopes generally ranging from 20% to over 40%, which restricts future development to the tops of the knolls or the ridgelines between the knolls.

The soils of the site are mostly basaltic, cinders or benmorite residuum or alluvium. Brolliar-Sponsellar is the primary type, which is typically found on the high basaltic and volcanic plateaus of the area (US Forest Service 1990). The soils are reddish brown, moderately deep, and fine textured clays mixed with stony and cobbly clays. There is a severe erosion hazard on the steeper slopes, and most of the site is limited by low soil strength, affecting trafficability and risk of soil damage when wet. Some areas are limited by shrink-swell clays, or excessive stones or cobbles. All of the soil types on Navy property are rated for a 65% potential canopy cover of ponderosa pine. The following map (Map 1) depicts the soils of NOFS (U.S.Forsest Service 1990). The level of soil resolution for soil survey maps is appropriate for planning purposes only. None of the mapped soils are listed as potentially hydric soil according to the national and local lists of hydric soils (USDA 1992). For wetland delineation, the soil on site does not always match the mapping unit for the type, and this is noted on the data sheet.



Map 1. Soils on Naval Observatory Flagstaff Station.

4.4 Climate, Weather, and Hydrology

Due to the location of Flagstaff at an elevation of roughly 7,000 ft, in between Mt. Humphreys, the highest point in Arizona at 12,000 ft, and Verde Valley with elevations close to 3,000 ft, the weather can be adequately described as both erratic and extreme. For example, spring may span the months of January to June (the average date of the last spring freeze is June 8) yet only a few days within those months may display typical spring weather. There is a wide variation in daily temperature in Flagstaff, commonly with a 30-40 degree difference between the high and low temperatures. As altitude increases, normally temperature decreases. However, at night, heat is rapidly released from the earth, which cools the ground and creates a cold layer of air at a lower elevation. This forms an inversion where temperature actually increases with altitude (Meyers 1993). This process is strongest in winter due to solar reflection off snow during the day, which keeps the ground from absorbing heat. Therefore, at night heat is lost at a faster rate then it is gained.

Unlike inversion, humidity in Flagstaff follows a very regular pattern and is considered inversely proportional to temperature. So, when temperature is lowest at dawn, humidity is highest. The average annual humidity at Flagstaff is 53%, which rises slightly in the winter months, but then plunges dramatically in May and June. April marks a type of transition to the extremely arid months of May and June in which summer thunderstorms frequently surprise visitors and locals alike with quick relief and occasionally an inch of rain in an hour and pea-sized hail. The moisture for such storms comes from the southeast, but surface heating of the land is what may trigger the storm. There is warm, moist, and unstable air at the beginning of July due to the counterclockwise airflow around the Bermuda High as it expands westward. The monsoon season begins in May and ends in September, while Flagstaff's "Indian Summer" may extend into November. Every five to seven years, a Pacific hurricane or tropical storm affects Arizona causing flooding from continual days of rain.

October unofficially begins winter when cold fronts pass over Arizona causing shifts in wind direction and an arrival of colder air. Winter storms continue into May with heavy storms occurring mainly from mid-November to mid-April. This precipitation occurs when moisture-laden air of a Pacific storm is forced upslope where it cools and condenses into rain, snow, or fog with roughly half of the annual precipitation occurring as snow (Meyers 1993). However, there may be periods of dryness if the storms move north or if a high pressure system develops in the Great Basin.

The area around Flagstaff receives a relatively large amount of precipitation for the state of Arizona. The average rainfall is 22 inches, most of it in the form of snow, which accumulates to an average depth of 99 inches (Western Regional Climate Center 2003). Although the amount of precipitation in Flagstaff is high, the ample porosity of the surface rocks allows the precipitation to seep into the soil and minimize the amount of runoff that would otherwise be expected.

The majority of the creeks in the area are seasonal, with Oak Creek being the only perennial stream nearby. The surface water drains into the Verde River, runs through the Gila River and ends up in the Colorado River at Yuma, Arizona. Usually after heavy rains, water flows from many courses including the sole perennial stream, Oak Creek. Some water courses are made into small lakes by the activity of lava flows damming the waterway.

Due to the absence of reliable surface or groundwater supplies, all water for NOFS is trucked in from offsite; there is no use of wells or other ground water.

Figure 1 depicts the probable freeze-free season for Flagstaff (Western Regional Climate Center 2003). The growing season is sometimes used to figure out the hydrological parameters of wetland evaluations, as areas that are inundated for a minimum duration qualify as potential wetlands under USACOE regulations.

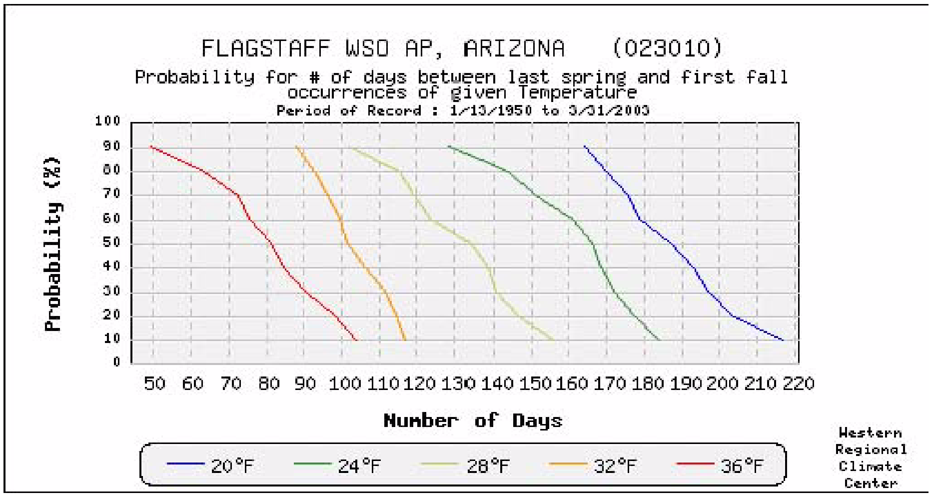


Figure 1. .Probable freeze-free period for various temperatures at Flagstaff, Arizona.

4.5 Vegetation

Two vegetation communities, one that lines a drainage of the installation study site and one that contains meadow vegetation (these are Sites 1 and 2 on Map 2), would be classified as "wetland" communities by the U.S. Fish and Wildlife Service (USFWS) and U.S Environmental Protection Agency (Ferren *et al.*1996 and Coward in 1979). However, this classification system is only useful for standardizing how plant communities are described, not for assessing jurisdictional status under the CWA. The vegetation classification includes:

Palustrine Emergent-Persistent (Carex-Iris) Seasonally Flooded Montane Drainage Swale or Vernal Meadow: Seasonally or temporarily flooded areas with herbaceous, perennial hydrophytes most of the growing season in most years.

The dominating vegetation on the NOFS property is a ponderosa pine *(Pinus ponderosa)* forest, with some meadow swales. Ponderosa pine accounts for 65% of the canopy cover (Grinder and Krausman 1998). Gambel oak *(Quercus gambelii)* is interspersed among the pines, most notably on the knoll that supports the primary telescope and facility. Arizona fescue *(Festuca arizonica)* is the most common understory species. Areas of mature pine and larger oaks occur in two drainages north of the main facility.

Approximately three hectares of NOFS are predominately grassland, presumably formed during timber operations in the 1930s. Grasses include Arizona fescue, mountain muhly *(Muhlenbergia montana),* screwleaf muhly *(Muhlenbergia* sp.*),* pine dropseed *(Sporobulus* sp.*),* black dropseed *(Sporobulus interruptus),* bottle-brush squirreltail *(Sitanion* sp.*),* and blue grama *(Bouteloua gracilis).* Other common species are western yarrow (*Achillea lanulosa),* American vetch *(Vicia* sp.*),* Arizona pea *(Dalea* sp.*),* and silverstem lupine *(Lupinus* sp.*)* (Grinder and Krausman 1998). Based on the existing species list, the plants listed in Table 2 may be used as national indicators for wetlands status and are known to occur on NOFS.

Table 2. List of plant species that occur in wetlands in Flagstaff, AZ. (Source: National List of Vascular Plant Species that Occur in Wetlands: 1996 National Summary)

Latin Name	Common Name	National Wetland Indicator
Juniperus communis	common juniper	NI
Sambucus racemosa	red elderberry	FACU
Chenopodium album	lamb's quarters, pigweed	FAC-
Achillea millefolium	western yarrow	FACU
Helianthus annuus	common sunflower	FAC-
Elaeagnus angustifolia	Russian olive	FACW-
Geranium richardsonii	Richardson's geranium	FAC
Lupinus kingii		FAC
Medicago lupulina	black medick	FAC
Vicia Americana	American vetch	FACU*
Thalictrum fendleri	meadow rue	FACU-
Houstonia wrightii	Wright's bluets	FACU
Verbascum thapsus	common mullein	NI
Carex praegracilis	clustered field sedge	FACW+
Muhlenbergia Montana	mountain muhly	UPL
Poa fendleriana	muttongrass	UPL
Iris missouriensis	iris	FACW-
Corallorhiza maculata	summer coralroot	UPL
Corallorhiza striata	coral root	UPL
Pinus ponderosa	Ponderosa pine	FACU
Pseudotsuga menziesii	Douglas fir	NI

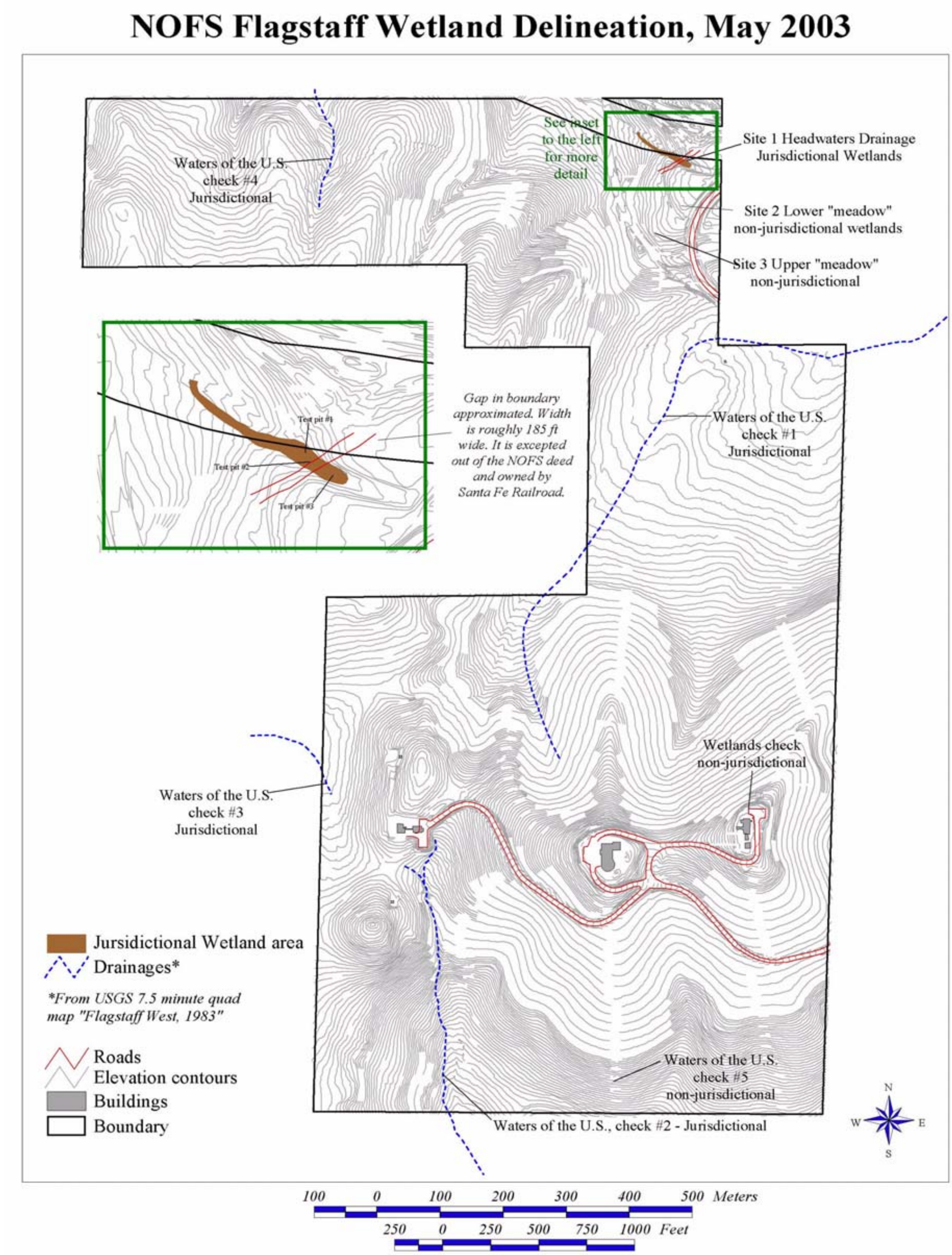
5.0 Results

The results of this field survey are preliminary and will require verification by USACOE. Such verification would normally be requested if a project were proposed that would require disturbance of a drainage area, but could be requested at any time. Sufficient information is laid out in this document such that, if a road realignment or other project is proposed, potential wetlands and Waters of the U.S. within and outside the construction footprint may be quickly field-checked, then evaluated for mitigation requirements.

The field evaluation of wetland communities occurred on May 22, 2003. Photos of the field-checked sites appear in Appendix A, and data sheets for sites evaluated for wetlands are in Appendix B. One jurisdictional wetland and several Waters of the U.S. were identified, as shown on Map 2.

Table 3. Preliminary Wetland/Waters of the U.S. determination for NOFS. Site descriptions refer to Map 2.

Site Description	Plant Community	Preliminary Wetland/Waters Determination
Railroad Drainage Site 1, west of road	*Carex-Iris* Headwater Drainage	Jurisdictional Wetland/Waters. Headwaters drainage qualified as regulated, “navigable” waters based on defined bed and bank, debris movement, specialized soil and vegetation, and root exposure.
Upper Meadow, Site 2	Ponderosa Pine Forest Headwater Meadow	Non-jurisdictional, non-wetland. Did not qualify based on vegetation, although sedges are present in low proportions.
Lower Meadow, Site 2	*Carex* Headwater Meadow	Non-jurisdictional Wetland. This site is dominated by the sedge *Carex praegracilis*, and is in a depression impounded by a paved road. This site is, on a preliminary basis, identified as a non-wetland based on insufficiently low chroma in soils. This may be due to insufficient time to develop characteristics due to recent impoundment of the site by the road, or due to insufficient inundation/soil saturation time due to a small watershed area. Both are assumed true. Also, the wetland call is based on confirmation that the immature plant in the meadow was *Medicago lupulina,* which has a facultative (FAC) rating under USACOE rules.
Waters of the U.S. Check 1	Ponderosa Pine Forest Headwater Drainage	Non-wetland, Jurisdictional Waters based on eroded channel, debris, USGS 7-1/2’ blue-line, and drainage into the Verde River, then the Gila River, then the Colorado River.
Waters of the U.S. Check 2	Ponderosa Pine Forest Headwater Drainage	Non-wetland, Jurisdictional Waters based on eroded channel, debris, USGS 7-1/2’ blue-line, and drainage into the Verde River, then the Gila River, then the Colorado River.
Waters of the U.S. Check 3	Ponderosa Pine Forest Headwater Drainage	Non-wetland, Jurisdictional Waters, based on eroded channel, debris, and extended USGS 7-1/2’ blue-line, and drainage into the Verde River, then the Gila River, then the Colorado River.
Waters of the U.S. Check 4	Ponderosa Pine Forest Headwater Drainage	Non-wetland, Jurisdictional Waters, based on eroded channel, debris, USGS 7-1/2’ blue-line, and drainage into the Verde River, then the Gila River, then the Colorado River.
Waters of the U.S. Check 5	Ponderosa Pine Forest Headwater Drainage	Non-wetland, Non-jurisdictional waters, based on disconnected swale, no debris movement, no USGS 7-1/2’ blue-line.



Map 2. Wetlands and Waters of the U.S at Naval Observatory Flagstaff Station.

Both Waters and wetlands fall under the same Section 404 rules. Mitigation for wetlands is usually conducted at a higher ratio than that for Waters alone.

Section 404 requires that any person, agency, or entity, either public or private, proposing construction activity in or near or altering any navigable water of the U.S. in wetlands or non-wetland Waters of the U.S. that requires dredging or filling be permitted. State water quality certifications (CWA Section 401) are also required. In Arizona, Section 10 of the Rivers and Harbors Act only applies to the Colorado River. The purpose of the law is to preserve the navigability of the nation's waters by prohibiting their unauthorized obstruction or alteration, and to restore and maintain the chemical, physical, and biological integrity of the nation's waters.

The law is administered by the U.S. Army Corps of Engineers' Arizona Section Office (Phoenix) that makes decisions on permits. Examples of activities that would require permitting are: actions that result in a discharge of dredged or fill material into Waters of the U.S., including wetlands, such as utility and road crossings, bridges, bank protection, boat launch ramps, sand and gravel mining, and fill associated with residential and commercial development. A project may qualify for a nationwide permit, an individual permit, a general permit, or a Letter of Permission.

Section 401 state water quality certification from the Arizona Department of Environmental Quality (ADEQ) is required prior to issuance of 404 permits from the Corps. The U.S. Fish and Wildlife Service, Arizona Game and Fish Department, State Historic Preservation Officer, and ADEQ are usually involved in the individual permit review process. Coordination with these agencies may facilitate the process.

The USACOE and EPA have joint enforcement authority to pursue civil and/or criminal penalties. Potential penalties for Section 404 violations include a maximum criminal fine of $50,000/day and imprisonment for up to three years and a maximum civil penalty of $25,000/day of violation.

Who to Contact for Further Information:

U.S. Army Corps of Engineers, Regulatory Branch
3636 N. Central Avenue, Suite 900
Phoenix, AZ 85012-1939
Phone (602) 640-5385
FAX (602) 640-2020

Arizona Department of Environmental Quality
Reuse and Federal Permits Unit
3033 N. Central Avenue
Phoenix, AZ 85012
Phone (602) 207-4697

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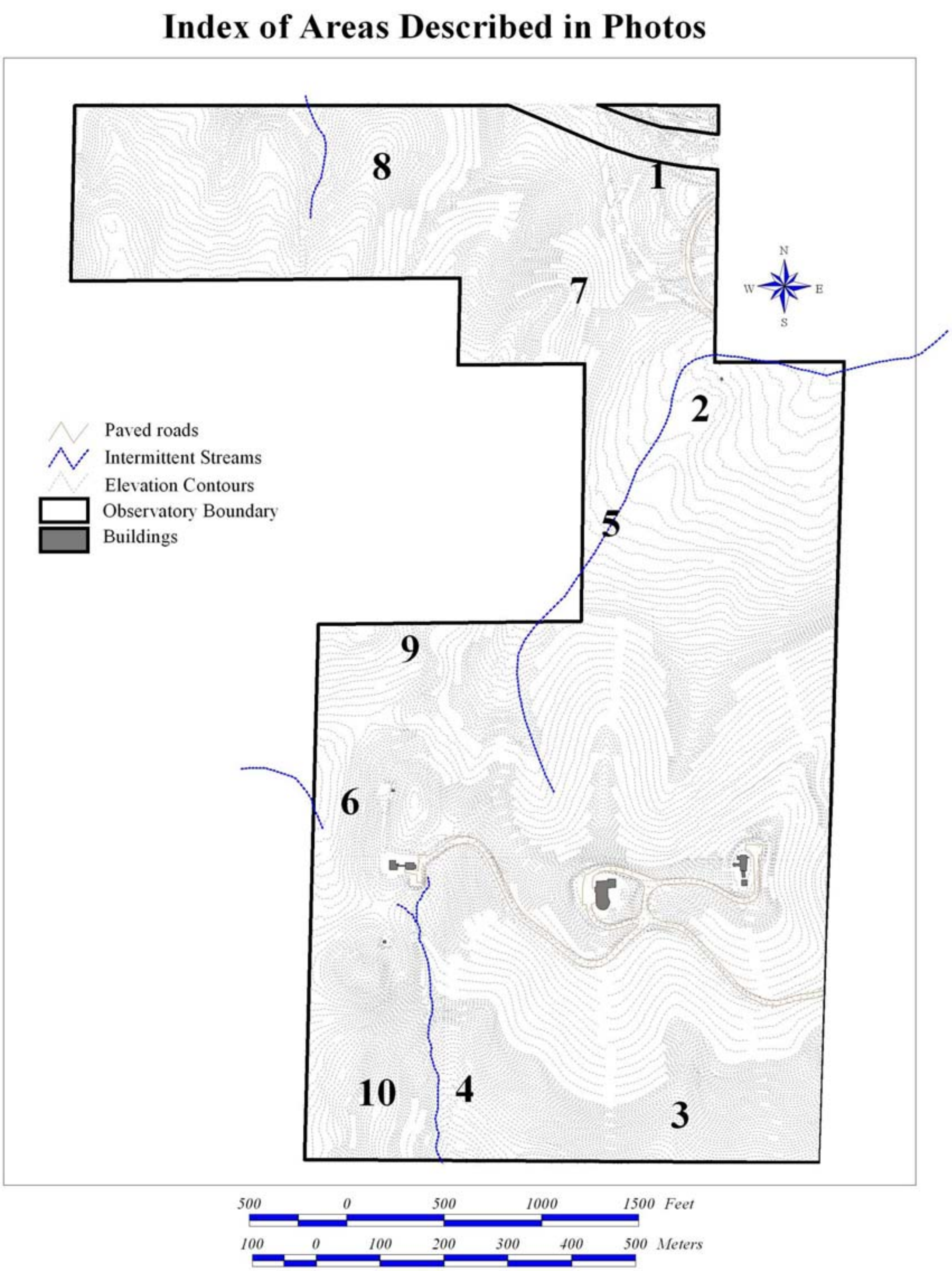
Appendix A: Photos

(See Index Map on following page for location of general areas referred to in photos. "Sites" are accompanied by data sheets found in Appendix B for evaluation as wetlands. When only the drainage pattern was evaluated for jurisdictional status [because the drainage was unvegetated], these are referred to as "Waters of the U.S. Checks.")



Index Map of visited areas shown in some photos.

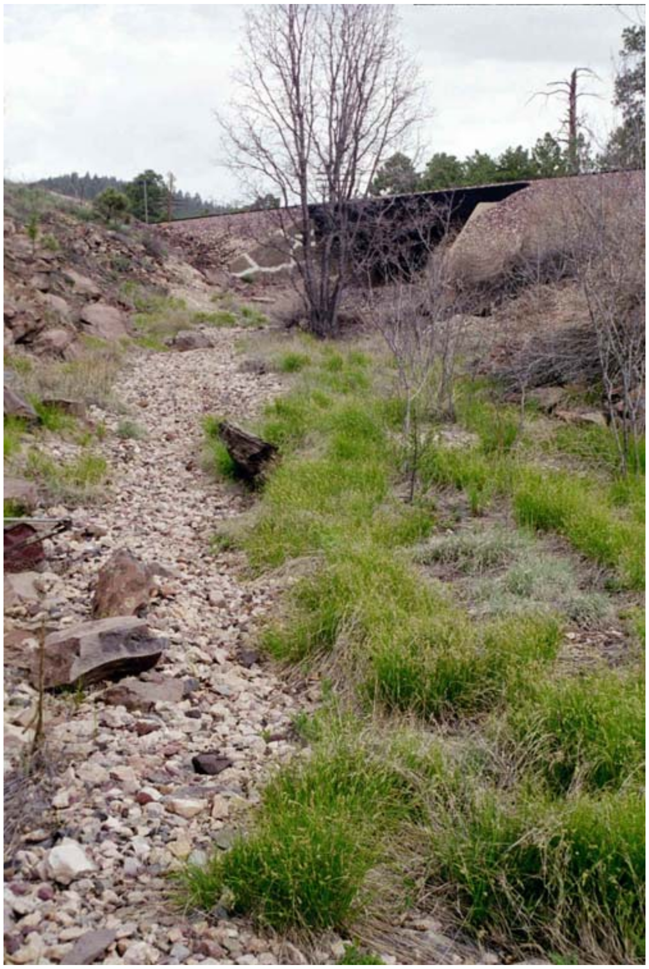


Photo 1. *Site 1, drainage under railroad track.*

Photo 2. *Site 1, railroad drainage swale.*

Photo 3. *Site 1, railroad drainage.*

Photo 4. *Site 1, on overflow swale.*

Photo 5. *Site 1, overflow swale, jurisdictional in lowest spots.*

Photo 6. *Site 1, Carex praegracilis*.

Photo 7. *Site 1, railroad drainage, Iris missouriensis*.

Photo 8. *Area 1, drainage under railroad track.*

Photo 9. *Site 2, on upper "meadow."*

Photo 10. *Area 2, "chipping meadow."*

Photo 11. *Area 2, "chipping area"*.

Photo 12. *Area 2, leading to road culvert, Waters of U.S. Check 1, jurisdictional.*

Photo 13. *Area 2, road culvert, Waters of U.S. Check 1, jurisdictional.*

Photo 14. *Area 4, drainage pattern leading to parking lot, non-jurisdictional.*

Photo 15. *Area 4, non jurisdictional headwaters, no deposition or bed, no debris movement, no blue line on USGS topo quad. However, becomes jurisdictional shortly below this.*

Photo 16. *Area 4, Waters of U.S. Check 2, jurisdictional, eroded bank caused by placement of dirt road in the channel downstream (R. Palmer, pers. comm. 2003). Root exposure, USGS blue line, debris movement, eroded channels are all indicators of Waters of the U.S.*

Photo 17. *Area 4, Waters of U.S. Check 2, jurisdictional.*

Photo 18. *Area 4, Waters of U.S. Check 2, jurisdictional.*

Photo 19. *Area 4, Waters of U.S. Check 2, headwater drainage.*

Photo 20. *Area 4, Waters of U.S. Check 2, some bed and bank definition, debris indicator, eroded channel.*

Photo 21. *Between Areas 5 and 9, this drainage pattern is an indicator of waters. Is connected to USGS blue line, but no bed or bank definition as yet.*

Photo 22. *Between Areas 5 and 9, Waters of U.S. Check 1, eroded channel, debris.*

Photo 23. *Between Areas 5 and 9, Waters of U.S. Check 1, eroded channel, debris.*

Photo 24. *Between Areas 5 and 9, Waters of U.S. Check 1, debris movement, connected to USGS blue line.*

Photo 25. *Between Areas 5 and 9, Waters of U.S. Check 1, channel connected to USGS blue line.*

Photo 26. *Area 8, culvert downslope.*

Photo 27. *Area 8, culvert upslope, Waters of U.S. Check No. 4, no deposition, no defined bed and bank.*

Photo 28. *Area 7, Waters of U.S. Check 4, culvert downslope, eroded channel and debris.*

Photo 29. *Area 8, Waters of U.S. Check 1, eroded channel.*

Appendix B: Naval Observatory Flagstaff Station Routine Wetland Determination Forms

ROUTINE WETLAND DETERMINATION

(1987 USACOE Wetlands Delineation Manual)

Project/Site: Naval Observatory Flagstaff Station (NOFS) **Applicant/Owner:** U.S. Navy NOFS/SWDIV **Investigator:** Liz Kellogg	**Date:**5-22-03 **County:** Coconino **State:** AZ
Do Normal Circumstances exist on the site? Yes_X No___ **Is the site significantly disturbed (Atypical Situation)?** Yes_X** No ___ **Is the area a potential Problem Area?** Yes___ No__X *Palustrine-persistent-emergent (Carex) seasonally flooded drainage swale wetland	**Community ID:** * **Transect ID:** Railroad Drainage **Plot ID:** 1 Low Point Ponderosa Pine Headwater Meadow Drainage Swale

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Festuca arizonica*	H	N/A	9. *Achillea millefolium*	H	FACU
2. *Geranium richardsonii*	H	FAC	10. *Convolvulus arvensis*	H	N/A
3. *Iris missouriensis*	H	FACW-	11. *Rosa arizonica*	H	N/A
4. *Carex praegracilis*	H	FACW+	12.		
5. *Hypochaeris glabra*	H	N/A	13.		
6. *Immature herb-Erigeron?*	H	--<1%	14.		
7. *Wyethia arizonica*	H	N/A	15.		
8. *Immature herb-Apiaceae?*	H	--<1%	16.		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 75%

Remarks: Area grazed/trampled by elk. *Rosa arizonica* occurs on margins and upslope, until canopy closes on *Pinus ponderosa.* Upland areas contain a small amount of *Carex* sp., <1% relative cover.

HYDROLOGY

_X_Recorded Data (Describe in Remarks): __Stream, Lake, or Tide Gauge _X_Aerial Photographs __Other __No Recorded Data Available **Field Observations:** Depth of Surface Water: ________(in.) Depth to Free Water in Pit: ________(in.) Depth to Saturated Soil: ________(in.)	**Wetland Hydrology Indicators:** **Primary Indicators:** __Inundated __Saturated in Upper 12 Inches __Water Marks __Drift Lines _X_Sediment Deposits _X_Drainage Patterns in Wetlands **Secondary Indicators (2 or more required):** __Oxidized Root Channels in Upper 12 in. __Water-Stained Leaves __Local Soil Survey Data _X_FAC-Neutral Test __Other (Explain in Remarks)

Remarks: **Drainage is altered due to railroad track construction. Contains rubble from armored embankment of railroad track. Appears to be articiially stabilized due to railroad track and trellis across drainage, but has clearly established bed and banks.

SOILS

Map Unit Name Brolliar-Sponsellar (Series and Phase):	Drainage Class:
Taxonomy (Subgroup):	Field Observations Confirm Mapped Type? Yes__ No X

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-4 in		10YR3/2			clay
4-11 in		7.5YR3/2			sandy clay
11-12 in		10YR3/2			clay (ribbons 2+ in)

Hydric Soil Indicators:

__Histosol
__Histic Epipedon
__Sulfidic Odor
__Aquic Moisture Regime
__Reducing Conditions
X Gleyed or Low-Chroma Colors
__Concretions
__High Organic Content in Surface Layer in Sandy Soils
__Organic Streaking in Sandy Soils
__Listed on Local Hydric Soils List
__Listed on National Hydric Soils List
__Other (Explain in Remarks)

Remarks: Brolliar-Sponsellar soil on U. S. Forest Service soils map not listed as hydric, but wetland inclusions are too small in area to show up. Clay cracks in low spots.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Wetland Hydrology Present? Hydric Soils Present?	Yes X Yes X Yes X	No__ No__ No__	Is this Sampling Point Within a Wetland?	Yes X	No__

Remarks:

ROUTINE WETLAND DETERMINATION

(1987 USACOE Wetlands Delineation Manual)

Project/Site: Naval Observatory Flagstaff Station (NOFS) **Applicant/Owner:** U.S. Navy NOFS/SWDIV **Investigator:** Liz Kellogg	**Date:**5-22-03 **County:** Coconino **State:** AZ
Do Normal Circumstances exist on the site? Yes_X_ No___ **Is the site significantly disturbed (Atypical Situation)?** Yes_X**_ No __ **Is the area a potential Problem Area?** Yes__ No__X *Palustrine-persistent-emergent (Carex) seasonally flooded drainage swale wetland	**Community ID:** * **Transect ID:** Railroad Drainage **Plot ID:** 2 Railroad Drainage bank Ponderosa Pine Headwater Meadow Drainage Swale

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Pinus ponderosa*	T	FACU	9.		
2. *Rosa arizonica*	S	N/A	10.		
3. *Aquilegia sp.*	H	FACW or FACW-	11.		
4. *Festuca arizonica*	H	N/A	12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		
Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 50%					
Remarks:					

HYDROLOGY

_X_Recorded Data (Describe in Remarks): __Stream, Lake, or Tide Gauge _X_Aerial Photographs __Other __No Recorded Data Available **Field Observations:** Depth of Surface Water: ________(in.) Depth to Free Water in Pit: ________(in.) Depth to Saturated Soil: ________(in.)	**Wetland Hydrology Indicators:** **Primary Indicators:** __Inundated __Saturated in Upper 12 Inches __Water Marks __Drift Lines __Sediment Deposits __Drainage Patterns in Wetlands **Secondary Indicators (2 or more required):** __Oxidized Root Channels in Upper 12 in. __Water-Stained Leaves __Local Soil Survey Data __FAC-Neutral Test __Other (Explain in Remarks)
Remarks: On bank about four feet above drainage	

SOILS

Map Unit Name Brolliar-Sponsellar (Series and Phase):	Drainage Class:
Taxonomy (Subgroup):	Field Observations Confirm Mapped Type? Yes__ No X

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-4 in		10YR2/2			clay loam (organic)
4-11 in		7.5YR2.5/2			gritty clay loam
11-12 in		10YR3/3			loam

Hydric Soil Indicators:

__Histosol
__Histic Epipedon
__Sulfidic Odor
___Aquic Moisture Regime
__Reducing Conditions
X Gleyed or Low-Chroma Colors
__Concretions
__High Organic Content in Surface Layer in Sandy Soils
__Organic Streaking in Sandy Soils
__Listed on Local Hydric Soils List
__Listed on National Hydric Soils List
__Other (Explain in Remarks)

Remarks: Brolliar-Sponsellar soil on U. S. Forest Service soils map not listed as hydric, but wetland inclusions are too small in area to show up. Clay cracks in low spots.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Wetland Hydrology Present? Hydric Soils Present?	Yes X Yes__ Yes__	No__ No X No X	Is this Sampling Point Within a Wetland?	Yes__	No X

Remarks:

ROUTINE WETLAND DETERMINATION
(1987 USACOE Wetlands Delineation Manual)

Project/Site: Naval Observatory Flagstaff Station (NOFS) **Applicant/Owner:** U.S. Navy NOFS/SWDIV **Investigator:** Liz Kellogg	**Date:**5-22-03 **County:** Coconino **State:** AZ
Do Normal Circumstances exist on the site? Yes_X No__ **Is the site significantly disturbed (Atypical Situation)?** Yes_X** No __ **Is the area a potential Problem Area?** Yes__ No__X *Palustrine-persistent-emergent (Carex) seasonally flooded drainage swale wetland	**Community ID:** * **Transect ID:** Railroad Drainage **Plot ID:** 3 Railroad Drainage overflow swale Ponderosa Pine Headwater Meadow Drainage Swale

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Carex praegracilis*	H	FACW+	9.		
2. *Iris missouriensis*	H	FACW-	10.		
3. *Rosa arizonica*	S	N/A	11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		
Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 100%					
Remarks:					

HYDROLOGY

_X_Recorded Data (Describe in Remarks): __Stream, Lake, or Tide Gauge _X_Aerial Photographs __Other __No Recorded Data Available **Field Observations:** Depth of Surface Water: ________(in.) Depth to Free Water in Pit: ________(in.) Depth to Saturated Soil: ________(in.)	**Wetland Hydrology Indicators:** **Primary Indicators:** __Inundated __Saturated in Upper 12 Inches __Water Marks __Drift Lines __Sediment Deposits _X_Drainage Patterns in Wetlands **Secondary Indicators (2 or more required):** __Oxidized Root Channels in Upper 12 in. __Water-Stained Leaves __Local Soil Survey Data __FAC-Neutral Test __Other (Explain in Remarks)
Remarks: **In drainage east of dirt road that impounds water from accessing the site except at high water (there is evidence that water crosses road here) at times.	

SOILS

Map Unit Name Brolliar-Sponsellar **(Series and Phase):**	**Drainage Class:**
Taxonomy (Subgroup):	**Field Observations** **Confirmed Mapped Type?** Yes__ No X

Profile Description

Depth (inches)	**Horizon**	**Matrix Color (Munsell Moist)**	**Mottle Colors (Munsell Moist)**	**Mottle Abundance/Contrast**	**Texture, Concretions, Structure, etc.**
0-4 in		5YR2.5/2			loamy clay
4-11 in		7.5YR2.5/2			loamy clay
11-12 in		10YR2/3			loamy clay

Hydric Soil Indicators:

__Histosol
__Histic Epipedon
__Sulfidic Odor
X Aquic Moisture Regime
__Reducing Conditions
X Gleyed or Low-Chroma Colors
__Concretions
__High Organic Content in Surface Layer in Sandy Soils
__Organic Streaking in Sandy Soils
__Listed on Local Hydric Soils List
__Listed on National Hydric Soils List
__Other (Explain in Remarks)

Remarks: Brolliar-Sponsellar soil on U. S. Forest Service soils map not listed as hydric, but wetland inclusions are too small in area to show up. Clay cracks in low spots.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Wetland Hydrology Present? Hydric Soils Present?	Yes X Yes X Yes X	No__ No__ No__	Is this Sampling Point Within a Wetland?	Yes X	No __

Remarks:

ROUTINE WETLAND DETERMINATION

(1987 USACOE Wetlands Delineation Manual)

Project/Site: Naval Observatory Flagstaff Station (NOFS) **Applicant/Owner:** U.S. Navy NOFS/SWDIV **Investigator:** Liz Kellogg	**Date:**5-22-03 **County:** Coconino **State:** AZ
Do Normal Circumstances exist on the site? Yes_X_ No__ **Is the site significantly disturbed (Atypical Situation)?** Yes_X_ No __ **Is the area a potential Problem Area?** Yes__ No_X_ Site has been logged of Ponderosa Pine	**Community ID:** Ponderosa Pine Headwater Meadow **Transect ID:** Upper Meadow **Plot ID:** 1 clearing

VEGETATION

Dominant Plant Species	**Stratum**	**Indicator**	**Dominant Plant Species**	**Stratum**	**Indicator**
1. *Festuca arizonica*	H-60%	N/A	9.		
2. *Blepharoneuron tric-holepsis*	H-27%	N/A	10.		
3. *Carex praegracilis*	H-8%	FACW+	11.		
4. *Antennaria parvifolia*	H-4%	N/A	12.		
5. *Achillea millefolium*	H-1%	FACU	13.		
6. *Pinus ponderosa*	T-100%	FACU	14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 33%

Remarks: Percentages are percent relative cover. Stumps of logged Ponderosa pine in clearing. *Rosa arizonica* occurs on margins of the clearing until canopy closes on *Pinus ponderosa.*

HYDROLOGY

_X_ Recorded Data (Describe in Remarks): __Stream, Lake, or Tide Gauge _X_Aerial Photographs __Other __No Recorded Data Available **Field Observations:** Depth of Surface Water: ________(in.) Depth to Free Water in Pit: ________(in.) Depth to Saturated Soil: ________(in.)	**Wetland Hydrology Indicators:** **Primary Indicators:** __Inundated __Saturated in Upper 12 Inches __Water Marks __Drift Lines __Sediment Deposits __Drainage Patterns in Wetlands **Secondary Indicators (2 or more required):** __Oxidized Root Channels in Upper 12 in. __Water-Stained Leaves __Local Soil Survey Data __FAC-Neutral Test __Other (Explain in Remarks)

Remarks: Did not find saturated soil or water

SOILS

Map Unit Name Brolliar-Sponsellar **(Series and Phase):**	**Drainage Class:**
Taxonomy (Subgroup):	**Field Observations Confirm Mapped Type?** Yes__ No X

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.

Hydric Soil Indicators:

__Histosol
__Histic Epipedon
__Sulfidic Odor
__Aquic Moisture Regime
__Reducing Conditions
__Gleyed or Low-Chroma Colors
__Concretions
__High Organic Content in Surface Layer in Sandy Soils
__Organic Streaking in Sandy Soils
__Listed on Local Hydric Soils List
__Listed on National Hydric Soils List
__Other (Explain in Remarks)

Remarks: Brolliar-Sponsellar soil on U. S. Forest Service soils map not listed as hydric, but wetland inclusions are too small in area to show up. Did not perform soil analysis because did not qualify as a wetland based on hydrology and vegetation.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Wetland Hydrology Present? Hydric Soils Present?	Yes__ Yes__ Yes__	No X No X No N/A	Is this Sampling Point Within a Wetland?	Yes__	No X

Remarks:

ROUTINE WETLAND DETERMINATION

(1987 USACOE Wetlands Delineation Manual)

Project/Site: Naval Observatory Flagstaff Station (NOFS) **Applicant/Owner:** U.S. Navy NOFS/SWDIV **Investigator:** Liz Kellogg	**Date:**5-22-03 **County:** Coconino **State:** AZ
Do Normal Circumstances exist on the site? Yes_X No__ **Is the site significantly disturbed (Atypical Situation)?** Yes__ No _X_ **Is the area a potential Problem Area?** Yes__ No__X *Palustrine-persistent-emergent (Carex) seasonally flooded drainage swale wetland	**Community ID:** Ponderosa Pine Headwater Meadow **Transect ID:** Lower Meadow **Plot ID:** 2 Low Point

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Carex praegracilis*	H-90%	FACW+	9.		
2. *Blepharoneuron tric-holepsis*	H-2%	N/A	10.		
3. *Antennaria parvifolia*	H-2%	N/A	11.		
4. *Achillea millefolium*	H-1-2%	FACU	12.		
5. *Medicago lupulina?*	H-2%	FAC	13.		
6. *Immature herb ?*	H-2%	N/A	14.		
7. *Wyethia arizonica*	H-1-2%	N/A	15.		
8.			16.		
Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 67%					
Remarks: Area is grazed/trampled by elk.					

HYDROLOGY

_X_Recorded Data (Describe in Remarks): __Stream, Lake, or Tide Gauge _X_Aerial Photographs __Other __No Recorded Data Available **Field Observations:** Depth of Surface Water: ________(in.) Depth to Free Water in Pit: ________(in.) Depth to Saturated Soil: ________(in.)	**Wetland Hydrology Indicators:** **Primary Indicators:** __Inundated __Saturated in Upper 12 Inches __Water Marks __Drift Lines __Sediment Deposits _X_Drainage Patterns in Wetlands **Secondary Indicators (2 or more required):** __Oxidized Root Channels in Upper 12 in. __Water-Stained Leaves __Local Soil Survey Data __FAC-Neutral Test __Other (Explain in Remarks)
Remarks: Area is a depression affected by impoundment by road. Based on weather station data, the site would have to be inundated or soils saturated for 12-13 days to qualify as wetland hydrology.	

SOILS

Map Unit Name Brolliar-Sponsellar (Series and Phase):			Drainage Class:		
Taxonomy (Subgroup):			Field Observations Confirm Mapped Type? Yes__ No X		
Profile Description					
Depth (inches)	**Horizon**	**Matrix Color (Munsell Moist)**	**Mottle Colors (Munsell Moist)**	**Mottle Abundance/Contrast**	**Texture, Concretions, Structure, etc.**
0-4 in		7.5YR3/2			clay loam
4-11 in		10YR3/3			clay loam
11-12 in		10YR3/3			clay

Hydric Soil Indicators:

- ___Histosol
- ___Histic Epipedon
- ___Sulfidic Odor
- ___Aquic Moisture Regime
- ___Reducing Conditions
- __Gleyed or Low-Chroma Colors
- __Concretions
- __High Organic Content in Surface Layer in Sandy Soils
- __Organic Streaking in Sandy Soils
- __Listed on Local Hydric Soils List
- __Listed on National Hydric Soils List
- __Other (Explain in Remarks)

Remarks: Brolliar-Sponsellar soil on U. S. Forest Service soils map not listed as hydric, but wetland inclusions are too small in area to show up. Soil either does not have sufficiently long inundation to develop low-chroma condition, or may have had insufficient time (needs 100s of years) to develop due to enhancement of anaerobic conditions created by road impounding of the site.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Wetland Hydrology Present? Hydric Soils Present?	Yes X Yes X Yes__	No__ No__ No X	Is this Sampling Point Within a Wetland?	Yes__	No X

Remarks:

This site is, on a preliminary basis, identified as a non-wetland based on insufficiently low chroma in soils. This may be due to insufficient time to develop characteristics due to recent impoundment of the site by the road, or due to insufficient inundation/soil saturation time due to a small watershed area. I am assuming both are true. Also, the wetland call is based on confirmation that the immature plant in the meadow was *Medicago lupulina*.

D.5 University of Arizona 1997 Surveys (Grinder et al. 1998)

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Flora and Fauna Surveys of

U.S. Naval Observatory, Flagstaff Station, Flagstaff, Arizona

31 January 1999

Contract Representative: Mr. Timothy Burr, Wildlife Biologist, Natural Resources Management Branch, Southwest Division, Naval Facilities Engineering Command, 1220 Pacific Highway, San Diego, California 92132-5178. Telephone: (619) 532-3745.

Agreement Number: N68711-95-LT-C051

Flora and Fauna Surveys of U.S. Naval Observatory, Flagstaff, AZ

Flora and Fauna Surveys of

U.S. Naval Observatory, Flagstaff, Arizona.

Prepared by:

Martha Grinder, The University of Arizona

Paul R. Krausman, The University of Arizona

Prepared for:

Southwest Division, Naval Facilities Engineering Command,

1220 Pacific Highway, San Diego, California 92132-5178, and

U.S. Naval Observatory, Flagstaff Arizona

30 December 1998

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Appendix K: Disk of Arc/Info 7.1.2 coverages for locations of vegetation transects, herpetofaunal traps and arrays, and small mammal trapping grids.

Abstract: We surveyed flora and fauna at the Naval Observatory (Observatory) in Flagstaff, Arizona, during February, July, and November 1996, and in May 1997. No threatened or endangered species of plants or animals were found; the flammulated owl (Otus flammeolus), a sensitive species on the USDA Forest Service list in the Peaks Ranger District, was observed. Vegetation was dominated by ponderosa pine (Pinus ponderosa), gambel's oak (Quercus gambeli) and associated grasses and forbs. We observed and/or trapped four species of reptiles throughout the survey period. We observed 17 bird species during February, 14 species in July, 7 species in November, and 37 species in May. We trapped five small mammal species during the four surveys; additional small and large mammals were observed during surveys but were not caught in traps. The ponderosa pine stands on the Observatory are representative of most ponderosa pine forests near Flagstaff, consisting mainly of once-logged pines, and inhabited by flora and fauna common to the vegetation zone. No recreational activities are presently allowed on the Observatory, a practice that could be continued to insure the presence of wildlife that can be adversely affected by humans.

INTRODUCTION

Our objective was to provide the Navy with status and distribution information for all species of flora and fauna and their communities occurring on the United States Naval Observatory, Flagstaff Station, Flagstaff, Arizona (Observatory), and those that are likely to occur but were not recorded during this study. We also identified any federally threatened, endangered, or proposed candidate species for federal listing, or those listed by the state of Arizona as threatened or endangered.

We conducted four surveys of the birds, mammals, reptiles, amphibians, and plants on the Observatory property. One survey each was conducted in winter, summer, and in autumn of 1996. A spring survey was conducted in May of 1997. No survey was conducted in the spring of 1996 because the property was closed due to an extremely high fire rating for this area. Scientific names are not included in the text for species listed in tables.

STUDY AREA

The 112-ha (287 acre) Observatory property is located in Coconino County, Arizona, approximately 10 km (6 miles) west of Flagstaff at an elevation of about 2256 meters (7445 ft). Vehicular access is limited to an access road from Interstate 40 and Highway 66. It is surrounded primarily by Arizona Trust lands and USDA Forest Service (USFS) lands, as well as some privately-owned land. The climate is cool and semi-arid with two wet seasons separated by drier periods. Average yearly precipitation is 58 cm (23.2 in; U.S. Dep. Commerce 1991). In winter there are snowstorms or rain with periods of cold-to-mild daytime temperatures. The mean winter temperature is -1.2 °C (30 °F). April, May, and June are dry and windy; July and August have periodic thunderstorms. The mean summer temperature is 17.5 °C (64 °F). Autumn is usually dry and clear. The yearly mean temperature is 8.15 °C (47 °F).

The Observatory is composed of a volcanic plateau with steep hillsides in a ponderosa pine and ponderosa pine - gambel oak forest. Ponderosa pine is a community of the Madrean montane conifer forests (Brown 1994). In some areas of the Observatory, the pine forest is park-like with scattered yellow-barked older trees interspersed with occasional groups of younger trees. Approximately 3 ha of the Observatory, near bird point count station 6 (Appendix C), is predominantly grassland, formed when timber operations in the 1930s cut ponderosa pine from these areas, leaving large open spaces (West. Div. Naval Facilities Engin. Command 1988). No grazing occurs on the Observatory. Grasses characteristic of the Flagstaff area include Arizona fescue, mountain muhly, pine dropseed, bottlebrush squirreltail, and blue grama (Lowe 1964, Gould and Shaw 1983).

METHODS

The major constraint to carrying out the tasks outlines in the Scope of Work was the closure of Coconino National forest adjacent to the Observatory during May and June , 1996. The closure prevented us from surveying the flora and fauna during the breeding season in 1996; a spring survey was conducted instead in May 1997.

Vegetation

We established line transects at 6 bird point count stations (Nos. 1, 3, 5, 7,8, and 9) to sample woody vegetation in February 1996 (Fig 1, Appendix A, K). Transects were 50-m long and extended from the bird point count stake in a direction determined at each point by a random spin of a hand-held compass. The directions walked from the bird point count stake were, for transect 1, 27°; transect 3, 142°; transect 5, 282°; transect 7, 251°; transect 8, 230°; transect 9, 150°. The transect from bird point count stake 5 was actually run from stake 5A, the location of which is about 30 m north and 20 m west of the original bird point count stake. The location of stake 5A is the one recorded in the coverage birdgps (Appendix K). Technicians walked the length of each transect and measured the number of centimeters on the transect that were intersected by each vegetation type. These measurements were used to estimate the species composition and percent cover of each species. In July 1996, we collected all forbs within 2 m of the transect along its length, and wherever encountered. We also collected forbs on two forays encompassing the entire length of the Observatory boundary and a large part of the interior of the Observatory. These forays were undertaken specifically to collect common forbs and to survey for sensitive plant species.

Reptiles and Amphibians

No surveys were conducted for reptiles or amphibians in February and November 1996 because the weather was too cold to expect herpetofaunal activity at these times. In July of 1996, 1 box trap was set up 150 m southwest (225°) of bird point count station 2 (Fig. 1, Appendix K) to capture large snakes and lizards. Also in July, 3 arrays of pit-fall traps (3 traps in 1 array, 2 traps in 2 arrays for a total of 7 pit-fall traps) were set up 50 m east of bird point count station 6 (Fig. 1, Appendix A, K) to catch smaller reptiles. The arrays were contiguous with one-another and were numbered, from south to north, 1 - 3. These traps were opened from 21 July through 3 August 1996, and 27 May through 30 May in 1997 for a total of 128 trap-nights. At the end of the final survey for reptiles, we removed all traps and arrays. In addition, 1 technician walked dirt roads throughout the interior of the Observatory during the July 1996 and May 1997 survey periods specifically for the purpose of surveying for reptiles. The survey walks encompassed open, park-like ponderosa pine stands, areas with a more closed canopy, and the meadow (Appendix C). All technicians noted all reptiles and amphibians observed during other activities on Observatory.

Birds

We sampled birds at 10 points throughout the Observatory (Fig. 1, Appendix A) The bird points are delineated by numbered stakes that were placed by T. Burr, (Wildlife Biologist, southwest division, Naval Facilities Engineering Command); their locations were recorded via GPS and are available from Tierra Data Systems (San Diego, CA). All bird point count stations are situated in ponderosa pine forest except for station 6, which is in a small meadow. Point counts began at or 30 minutes before dawn, and continued until all points had been surveyed. The duration of each survey was about 2 hours. Point counts lasted for 10 minutes at each station, during which time an observer recorded all birds seen or heard. No distance measurements were made; instead the number of birds observed was quantified on the basis of the time spent a each point count station. We recorded observations during the 10 minutes separately for the first 5 minutes, for the following 3 minutes, and for the final 2 minutes. This allowed us to test the efficacy of using 10 minutes versus 5 or 8 minutes as survey periods at point count stations. All birds observed during other field work were documented as incidental observations.

We surveyed for small owls on one night during each season, beginning at least 1 hour after sunset in all seasons. We played tape-recorded calls of the western screech owl (Otus kennicottii), flammulated owl, ferruginous pygmy owl (Glaucidium brasilianum), and northern saw-whet owl at each bird point count station. The call of 1 species was played for 30 seconds, followed by 2 minutes of silence, during which technicians listened for any response. The next species' call was then played until all 4 species had been played. The same procedure was repeated at each bird point count station. We surveyed large owls by following the United States Fish and Wildlife Service (USFWS) protocol, under permit number PRT-797128, for the

Mexican Spotted Owl (Strix occidentalis) from May - July 1997. We surveyed for large owls in 3 places on the Observatory: at the main Observatory buildings at the top of the hill, in the woods on the northeast side of that hill, and about 2 km down the road leading from the main Observatory buildings.

Mammals

We trapped small mammals with Sherman live traps in 4 grids placed with one corner at the numbered stake of bird point count stations 3, 6, 9, and 10 (Fig. 1, Appendix A, K). For the grid at bird point count station 3 we used the numbered stake as the northwest corner, for station 6 we used the stake as the southwest corner, for station 9 we used the stake as the southeast corner, and for station 10 we used the stake as the northwest corner. Seven traps were placed in each of 7 trap-lines ($\underline{N}$ = 49 traps/grid), which extended in the cardinal directions from the bird point count stakes. (Thus, for the grid at station 3 we laid out the grid to the south and east of the stake). Each trap was 15 m from adjacent traps, creating a 105 x 105 m trapping grid. We flagged the location of each trap on each grid. Traps were opened and baited with a peanut butter and rolled oats mixture at dusk, and were checked and closed at dawn for 3 consecutive days during each survey period. All trapped mammals were identified and released at the trap site. We did not systematically survey large mammals, but notes were made of all tracks and scat encountered, in addition to all mammals encountered. Finally, we recorded all observations of mammals made by Observatory employees throughout the year.

RESULTS

Vegetation

Ponderosa pine accounts for 65% of the canopy cover on the Observatory (Appendix E). Gambel oak comprises 3% of the canopy cover, and New Mexican locust has a coverage of

0.5%. In addition to the small xeric grass area surrounding bird point count station 6 (Appendix C) on the Observatory, many of the forested areas on the Observatory have places with open canopy; 30.5% percent of line transects were not covered by any woody vegetation. Common grasses and forbs in open areas include mountain and screwleaf muhly, pine dropseed, and Arizona fescue. western yarrow, American vetch, Arizona pea, and silverstem lupine (Table 1) We made no attempt to quantify the coverage of grasses or forbs.

No federally threatened or endangered grasses or forbs were found in the surveys, nor were any of the plants observed protected by the Arizona native plant law (Arizona Dep. Agric. 1993); therefore, we do not indicate locations of sightings on maps of the Observatory or with GPS coordinates.

In addition, no noxious weeds were found on the Observatory (Arizona Dep. Agric. 1996). Ornamental exotics are confined to areas around buildings (Fig. 1) and include crested wheatgrass, smooth bromegrass, Oregon grape, firethorn, forsythia, English ivy, lilac, and Russian olive (Table 1).

Reptiles

We caught an eastern fence lizard in a pit-fall trap in array 1 in July 1996 (Fig. 1, Table 2); additional eastern fence lizards were observed along dirt roads and in rocky outcrops throughout the Observatory in the July survey period during other activities. The trapped lizard was an adult male; we were not able to determine the sex of any reptiles that were not caught in traps. We observed numerous young short-horned lizards along dirt roads southwest of bird point count station 3 throughout the July 1996 survey, although none were caught in arrays or the box trap. In May 1997, a many-lined skink was found under a rock in the southwest section of the Observatory, and a western terrestrial garter snake was seen crossing a path, also in the southwest section of the Observatory. None of the reptile species observed are sensitive species, therefore, we do not indicate locations of sightings on maps of the Observatory or with GPS coordinates. Because the number of reptiles of each species that we observed on the Observatory was so low, it is difficult to quantify the abundance of any of these species on the Observatory.

Birds

We conducted 110-minute survey in each of 4 seasons at each of 10 bird point count stations, for a total effort of 100 minutes/season. We detected 17 bird species/100 minutes during February point count surveys, 14/100 minutes during the July survey, 7/100 minutes during the November survey, and 37/100 minutes during the May survey (Table 3, Appendix D, F). The flamulated owl was heard during the July 1996 survey from bird point count station 2. The location of the bird was not recorded via GPS because it is a mobile species an it was heard from a point that was already located via GPS. The flammulated owl is listed as a sensitive species by the USFS, Peaks ranger district. Mexican spotted owls (listed as threatened by both the USFWS and the state of Arizona) were surveyed according to USFWS protocols, but were never observed on the Observatory. Specific surveys for northern goshawks (listed as sensitive by the USFS, Peaks ranger district, and candidate by the state of Arizona) were performed on the Observatory, but no northern goshawks were observed.

The technician conducting the point count survey in May searched the areas immediately surrounding each point count station for nests in the afternoon following the surveys, but none were found. We did not search other areas for nests.

We divided bird data collected at point count stations into 3 time periods: 0-5 minutes, 5-8 minutes, and 8-10 minutes after the start of each point count. In February 15 species were observed during the first 5 minutes of observation; the common raven was observed only in the

5-8 minute period, and the brown creeper were observed only during the 5-8 minute and 8-10 minute time periods. In November, 6 species were observed during the first 5 minutes of observation; again, the common raven was observed only in the 5-8 minute period. In July, 12 species were observed during the first 5 minutes of observation; we observed the Townsend's solitaire and the broad-tailed hummingbird only during the 5-8 minute time period. The common raven, Townsend's solitaire and broad-tailed hummingbird are not abundant on the Observatory; the brown creeper is cryptically-colored and silent except during the spring, when it vocalizes with a single high, thin, note, and is therefore easy to overlook.

Mammals

We captured 45 small mammals in 2352 trap-nights during the 4 trapping sessions (Table 4, Appendix G). These included 1 gray-collared chipmunk, 3 brush mice, 3 white-footed mice, 36 deer mice, and 1 Mexican wood rat. Our trapping grids encompassed a total area of 4.41 ha, thus, the densities of trapped mammals were less than 1 chipmunk, wood rat, brush mouse, and white-footed mouse/ha. The density of deer mice was 8 individuals/ha. We also observed golden-mantled ground squirrels, rock squirrels, Abert's squirrels, and eastern cottontail rabbits but did not attempt to capture any of these mammals in traps, or estimate their densities on the Observatory.

We observed 2 mule deer during the July survey, and 3 mule deer and 3 elk during the May survey. No other large mammals were seen, but we observed tracks and scat of coyote, gray fox and bobcat during all surveys. The Observatory employees keep an incidental list of mammals seen on the Observatory (Table 5). Employees reported sightings of some mammals (coyote, gray fox, bobcat) for which we found sign but did not see during our surveys. In addition, 5 mammal species (collared peccary, porcupine, striped skunk, raccoon, mountain lion) have been seen by Observatory employees but were not detected during our surveys.

DISCUSSION

The discussion is divided into sections (vegetation, reptiles, birds, mammals) that parallel the sections in the methods and results portions of this document. None of the species discussed in these sections are sensitive, rare, or endangered on any state or federal lists. We address special status species that occur or may be expected to occur in and around the Observatory in 2 sections at the end of the discussion portion of the document. The fact that no such species occur on the Observatory may be due to its small area. The Observatory's small area may also account for the absence of some species that might be expected to be found under the conditions present there (Appendix H).

Vegetation

The ponderosa pine forest on the Observatory is similar in composition and structure to other nearby stands (Haldeman et al. 1973, Rosenstock 1996). Cooper (1960:160-161) recounts that:

> Reports of early visitors (to northern Arizona) indicate that the (ponderosa pine) forest was originally more open than it is today. Dense thickets of young ponderosa pine have covered much of the region since (1900). Accompanying the increase in young pines has been a decrease in grass cover and a shift in the botanical composition of the herbaceous vegetation...The most important change brought about by the white man has been the virtual exclusion of fire from the forests of the southwest. Under natural conditions, light surface fires, set by lightning or by Indians, burned through all parts of the pine forest at regular intervals of 3 - 10 years. These fires acted as natural thinning agents and reduced surplus fuel.

Frequent light fires, to which older pines are relatively immune, probably kept the understory free from younger trees until recently (Weaver 1951, Cooper 1960, Brown 1994). The understory was recently thinned on USFS lands adjacent to the Observatory to reduce the available fuel

(Appendix B), and this may return the ponderosa pine forest in the area to a state more similar to that which was in place before the intervention of man.

We make no analyses of the health of the timber on the Observatory, as such determinations should be left to a trained forester. There has been no timber harvest on the Observatory since the 1930s (West. Div. Naval Facilities Engin. Command 1988). There are ongoing discussions about the feasibility of thinning the timber on the Observatory, and the implications this might have for the Observatory's potential as Mexican spotted owl habitat (A. Bird, Observatory facilities manager, pers. commun.).

The woody and herbaceous vegetation on the Observatory is typical of what one would expect to find for that elevation and climate (Table 1, Kearney and Peebles 1960, Niehaus et al. 1984).

Reptiles

The eastern fence lizard is the most widespread, abundant lizard in the United States (Ferguson et al. 1983). Its range extends from southern South Dakota south to Illinois, and southwest New York, to central Florida, the gulf coast, southwest to Utah and central Arizona to the Atlantic coast. It lives in a variety of habitats including forests, woodland, prairie, brushy flatlands, sand dunes, rocky hillsides, and farmlands (Stebbins 1966); therefore, it can probably be found throughout the Observatory. It seeks shelter in bushes, trees, old buildings, woodpiles, rodent burrows, and under rocks, logs, or other objects on the ground. In forested parts of its range it climbs trees and when frightened keeps to the opposite side of the trunk. Where trees are scarce it is primarily a ground-dweller. It is active throughout the year in the southern part of its range. It feeds on insects, spiders, millipedes, snails and other small animals. Densities of the eastern fence lizard are greatest in late summer throughout its range. Mortality rates are about

50%. due primarily to predation. Males have a higher mortality rate than females, and male mortality is greatest in early spring during the period of territory establishment. Female mortality is greatest during egg-laying (Ferguson et al. 1983). Females lay 4 - 17 eggs from March through August (Stebbins 1985).

The short-horned lizard is a common lizard in Arizona (Killian 1954). Its range extends from southern Canada to southern Colorado, west to Arizona and east of the Cascade mountains in Oregon and Washington east to Kansas. It is chiefly a mountain-dweller in the southern part of its range. It can be found in a variety of habitats, from shortgrass prairie to pinyon-juniper forests (Stebbins 1966). The ground may be stony, sandy, or firm, but usually a loose top soil is present. Because of its cover requirements, this lizard is probably only present on the Observatory in the areas where we saw it, namely the dirt roads in the southwestern portion of the property and those traversing the old stump meadow near bird point count station 6. The short-horned lizard is active only during the day; it burrows into sand or dirt at night. It is more cold tolerant than the other horned lizards. The lizard's chief food is insects, especially ants. Five to 36 live young are borne by the female from July through September (Stebbins 1985).

The range of the many-lined skink extends from southern Nebraska to west Texas and central Chihuahua, Mexico, west to extreme western Arizona. Its distribution is spotty throughout its range. The many-lined skink lives in a variety of habitats, from shortgrass prairie to mountains (Stebbins 1966). It also occurs near human habitation, in vacant lots, city dumps, and backyards. Local habitats vary from creosote bush desert to dense streamside vegetation, and from arid to moist. The ground may be loamy, sandy, or rocky. This insectivorous skink is most often found under logs, boards, or, as on the Observatory, under rocks. It is likely to be found throughout the Observatory, especially in rocky places and along dirt roads. The female lays and tends a clutch of three to seven eggs in May and June (Stebbins 1985).

The range of the western terrestrial garter snake extends from central British Columbia to northern Baja California, and north to southern Colorado, western South Dakota and extreme western Oklahoma to the Pacific coast (Stebbins 1966). It occurs in a number of habitats, including grassland, woodland and forest from sea level to the mountains. It is often found in damp environments near water and occasionally far from water. On the Observatory, the snake can be found in the most dense areas of the forest, where moist conditions are most prevalent. When frightened, it seeks shelter in dense plant growth. Its food consists of slugs, earthworms, lizards, snakes, small mammals, and occasionally birds. The female bears 4 -19 live young from July to September (Stebbins 1985).

Both lizard species were captured in ponderosa pine communities near Kingman in northwest Arizona (Jones 1988) but neither the many-lined skink nor the western terrestrial garter snake were observed by Jones (1988). Jones' (1988) study, more intensive than this survey, used 5 arrays of pit-fall traps, for a total of 745 trap-nights, in addition to 10 road-riding transects and 15 field searches.

Birds

Bird species composition and habitat use.--A number of the bird species observed on the Observatory depend upon various aspects of ponderosa pine forests during their life cycle. Acorn woodpeckers rely on the larger gambel oaks in ponderosa pine forests for food; northern flickers are restricted in their distribution to forests with large trees in which to excavate nesting holes (Phillips et al. 1964). The brown creeper spirals down pines in search of insects, and nests behind slabs of bark. Red crossbills breed when and where abundant cone crops permit. The mountain chickadee, a common resident that is especially abundant during winter, forms wandering flocks in this season that provide a nucleus to which other small bird species are attracted. The Townsend's solitaire, a common summer resident, is the northern-most representative of its genus of mountain-dwelling birds (Phillips et al. 1964). The plumbeous vireo and the western bluebird are considered exclusive to ponderosa pine in Arizona; the pygmy nuthatch, violet-green swallow, American robin, white-breasted nuthatch, and Grace's warbler are considered characteristic of ponderosa pine (Haldeman et al. 1973).

Flammulated owls, neotropical migrants, have shown a preference for old trees and stands of ponderosa pine (Reynolds and Linkhart 1992). Owls in Colorado more often settled in areas dominated by older forest than younger forest when they returned in the spring to nest. They also use old trees and stands more often than younger ones, for foraging and from which to vocalize when defending their territories. Flammulated owls were not observed by Rosenstock (1996) in his survey of northern Arizona ponderosa pine forests; this may have been because of his census techniques, which did not include any nighttime surveys. Flammulated owls were also detected on the Observatory by USFS personnel conducting Mexican spotted owl surveys in June and July, 1997 (Randall-Parker 1998).

Our survey results paralleled those of Rosenstock (1996) who grouped the most abundant birds in northern Arizona ponderosa pine forests into 3 categories: residents, short-distance migrants, and neotropical migrants. The most abundant residents and short-distant migrants in his surveys, that were also in our surveys, were dark-eyed juncos, mountain chickadees, northern flickers, pygmy nuthatches, red crossbills, stellar's jays, white-breasted nuthatches, western bluebirds, and yellow-rumped warblers. The most abundant neotropical migrants in both surveys were broad-tailed hummingbirds, plumbeous vireos, and western tanagers. The most abundant cavity-nesters, which were also either resident/short-distance migrants or neotropical migrants, were mountain chickadees, northern flickers, pygmy nuthatches, white-breasted nuthatches, and western bluebirds. Because Rosenstock's (1996) conducted more surveys per season, he observed more species than we did; we did not observe any abundant species that he did not observe.

The least abundant species observed by both Rosenstock (1996) and our surveys were spotted towhees, ruby-crowned kinglets, and Clark's nutcrackers (residents/short-distance migrants) olive-sided flycatchers, and band-tailed pigeons (neotropical migrants). We also observed flammulated owls, northern saw-whet owls, golden-crowned kinglets, and mountain bluebirds, none of which were recorded by Rosenstock (1996).

Although the survey area on the Observatory was not large enough to correlate bird species abundance with differences in canopy cover and heterogeneity, it is interesting to note that Rosenstock (1996) found that the abundance of certain species in ponderosa pine forests was correlated to these two variables. Chipping sparrows and western bluebirds were negatively correlated with canopy cover, whereas pygmy nuthatches, violet-green swallows, Cordilleran flycatchers, and brown creepers were positively correlated with canopy cover. Chipping sparrows and Stellar's jays were positively correlated with canopy heterogeneity, but pygmy nuthatches, violet-green swallows, and Cordilleran flycatchers were negatively correlated with canopy heterogeneity.

Bird surveys are conducted yearly as a part of their natural resources management plan on Camp Navajo, an Army National Guard training center located about 20 km west of Flagstaff along highway 40 (exit 185). Camp Navajo encompasses over 11,200 hectares and much of this is ponderosa pine forest. Therefore, it is useful to compare surveys of Camp Navajo with surveys on the Observatory. Many more bird species were observed on Camp Navajo than on the Observatory, by virtue of the greater area and number habitats on the base, but 4 species found on the Observatory were not recorded at Camp Navajo. These species are the flammulated owl, northern saw-whet owl, hairy woodpecker, and olive-sided flycatcher (Wilcox et al. 1997). Except for the flammulated owl, these species are common in northern Arizona's ponderosa pine forests, and would be expected to be observed at Camp Navajo.

Past and present influences on bird abundance and species richness.--The Observatory has not been logged or grazed since the 1930s (West. Div. Naval Facilities Engin. Command 1988), but it may have supported such activities before that time, as did most of the ponderosa pine forests of the southwest (Scurlock and Finch 1997). Logging, fire exclusion, snag removal, loss of understory, and/or increases in the number of small trees have resulted in declines of bird species that are associated with burns, old-growth forests, open forests, and snags. These species include broadtailed hummingbirds, acorn woodpeckers, violet-green swallows, mountain chickadees, white-breasted nuthatches, brown creepers, western bluebirds, mountain bluebirds, American robins, red-faced warblers, lark sparrows, and chipping sparrows (Scurlock and Finch 1997). All of these species except red-faced warblers and lark sparrows occurred on the Observatory. Despite the increase in environmental protection legislation, ponderosa pine declined in extent and tree volume in Arizona and New Mexico between 1962 and 1986 (Raish et al. 1997). Currently, urbanization and the increasing number of people that come to ponderosa pine forests to recreate may pose an additional threat to ponderosa pine birds by creating open spaces that change the structure and vegetation composition of the habitat. Flagstaff is the largest city that is situated entirely within ponderosa pine forests, and is growing at a rate of 15% per year (Raish et al. 1997). Its 1990 population was 50,000; by 2040 its population is projected to be over 100.000. The increase of people in ponderosa pine forests may increase the number of nest predators such as domestic cats, and common ravens (Marzluff 1997).

Species observed on the Observatory which have exhibited historical declines in ponderosa pine forests include: broad-tailed hummingbirds, acorn woodpeckers, violet-green swallows, mountain chickadees, white-breasted nuthatches, mountain bluebirds, American robins, and chipping sparrows (Desante and George 1994). Species observed on the Observatory which use ponderosa pine forests, and are increasing (Desante and George 1994) include: American crows, cordilleran flycatchers, house wrens, Townsend's solitaires, hermit thrushes, plumbeous vireos, yellow-rumped warblers, Grace's warblers, and western tanagers. Brown-headed cowbirds are increasing their range. Changes in bird abundance are thought to be caused by climatic shifts, landscape modification, grazing, and shifts in vegetation composition (Brown and Davis 1995).

The evidence regarding the increase or decrease of various bird species in ponderosa pine forests is ambiguous, however. Hall et al. (1997) list additional species that appear to be declining on managed stands of ponderosa pine. These declining species are: band-tailed pigeons, mourning doves, hairy woodpeckers, western wood-pewees, common ravens, American crows, Clark' nutcrackers, red crossbills, pine siskins, black-headed grosbeaks, warbling vireos, plumbeous vireos, yellow-rumped warblers, Grace's warblers, pygmy nuthatches, and ruby-crowned kinglets. Increasing species are: red-tailed hawks, northern flickers, Stellar's jays, spotted towhees, red-breasted nuthatches, American robins, and western bluebirds. A comparison of this list with that of Desante and George (1994) reveals that 4 species considered to be increasing by Desante and George (1994), American crows, plumbeous vireos, yellow-rumped warblers, and Grace's warblers, are considered to be decreasing by Hall et al. (1997).

One species, the American robin, considered by Desante and George (1994) to be decreasing, is considered by Hall et al. (1997) to be increasing.

Mammals

Mammals trapped during surveys.-- Our overall trap success of 2%, while low, is similar to the 5% trap success (143 individuals in 2916 trap-nights) reported by MacVean (1996) for a study of small mammals in ponderosa pine forests on the Kaibab plateau, about 150 km northwest of the Observatory. Deer mice, the most commonly trapped species on the Observatory (Table 4), has been the most frequently caught species in other studies of small mammals in ponderosa pine (Goodwin and Hungerford 1979, MacVean 1996).

Three Peromyscus species were trapped during our survey. Deer mice, the most abundant Peromyscus species on the Observatory, are usually the most abundant mammal in the areas they occupy (Nowak 1991). Normal population densities of deer mice range from about 1/ha to 25/ha (Banfield 1974); the population on the Observatory falls within this range (8/ha). The range of the deer mouse extends from southwestern Alaska south throughout most of Canada and the United States except the southeastern states, into Mexico. Few other mammals can match the tolerance of the deer mouse for different conditions; it occurs in alpine areas, boreal forest, woodlands, grasslands, brushlands, deserts, and arid tropical areas. Deer mice are thus widely distributed throughout Arizona at all elevations, and are common and abundant in coniferous forests such as those found on the Observatory (Hoffmeister 1987). Their diet is primarily seeds, but may include nuts, berries, fruits, insects and other small invertebrates and carrion (Nowak 1991). They make nests of spheres of grass that are about 100 mm in diameter and are lined with down from plants or with shredded materials (Banfield 1974). These nests are made in or under logs, under debris, and in crevices of rocks and walls. Young are born every month of the year in

Arizona; the peak parturition month is April. Gestation is 21-30 days, and 94% of all females have been found to be carrying embryos (Hoffmeister 1987). The mean litter size for all Peromyscus is 3.4 young, and the ranges from 1 - 9 (Banfield 1974).

The white-footed mouse, similar in appearance to the deer mouse, is less common than the deer mouse in Arizona, but may be more common than is reported because is it often confused with the deer mouse (Hoffmeister 1987). Its range extends from southeastern Alberta and Nova Scotia to Arizona and the Yucatan peninsula, where it keeps mainly to deep woodlands and brushy areas (Nowak 1991). In Arizona, the white-footed mouse occurs near the lower little Colorado river, and along the Mogollon rim. It lives in thick grass and clumps of tamarisk, and feeds on an omnivorous diet of nuts, seeds, fruits, and invertebrates (Whitaker 1980). Young in Arizona are born from February through July, and August through October (Hoffmeister 1987).

The brush mouse, larger than the deer mouse and the white-footed mouse, occurs from northern California and northwestern Texas to Honduras (Nowak 1991). It can be found on mountain slopes at all elevations throughout Arizona except in the southwest corner of the state (Hoffmeister 1987). It lives in a variety of habitats, and is abundant in oaks, junipers, pinyons, around buildings, and caves and mine shafts, and in riparian areas. A skilled climber, this mouse often runs up trees to avoid predators (Whitaker 1980). Young are born from January through August, and in November and December (Hoffmeister 1987). Females may have several litters per year. Females born in the spring may be pregnant by August.

Two small mammals other than mice were also trapped during our surveys. The gray-collared chipmunk ranges from east-central Arizona to southwestern New Mexico. In Arizona, it occupies ponderosa pine forests and spruce-fir forests north of the Mogollon rim (above 2100 m; 7000 ft) from the San Francisco mountains just North of Flagstaff, southeast to the White

Mountains (Hoffmeister 1987). Its diet includes acorns, seeds, currants, green vegetation, mushrooms, and insects (Whitaker 1980). Breeding occurs from April through June, and gestation is 30 days (Hoffmeister 1987). The young nurse for 41 - 45 days. One litter of 4-6 young is produced per year.

The Mexican wood rat ranges from Colorado and southeastern Utah to western Honduras (Nowak 1991). It occurs above pinyon-juniper forests (1500m) in the mountains of the eastern half of Arizona, west to the Hualapi mountains and Prescott National Forest (Hoffmeister 1987). Only disjunct populations occur in Arizona because of the wood rat's dependence on coniferous habitat. It is a solitary rock-dweller, and builds elaborate nests composed of twigs, stems, foliage, bones, rocks, or whatever material is available, in crevices of rock outcrops. A nest may be added to by generations of wood rats, and can exceed two meters in diameter (Nowak 1991). The wood rat's diet consists almost entirely of plant tissues such s roots, stems, and leaves; seeds, and some invertebrates. It breeds from April through September and may have 2 litters per year.

Small mammals not trapped during surveys.-- Other small mammal species observed on the Observatory but not trapped, include the eastern cottontail, rock squirrel, the golden-mantled ground squirrel, the Abert's squirrel, and the porcupine. The range of the eastern cottontail extends from southern Manitoba and Quebec through the eastern and southwestern United States to western Costa Rica, Colombia and Venezuela (Nowak 1991). In Arizona, it ranges from the Hualapi to the White mountains and on various mountains in the southeast quarter of the state (Hoffmeister 1987). This most common cottontail species inhabits a great diversity of habitats, including fields, farms, woodlands, deserts, swamps, prairies, hardwood forests, rainforests, and boreal forests. In Arizona, the cottontail is found in interior chaparral, encinal woodlands, and

Mexican oak-pine forests from 1500 - 2500 m (5000 - 8000 ft). The cottontail does not dig burrows; it finds shelter in brush piles and shallow, cleared depressions in the soil (Nowak 1991). The cottontail can be seen at any time of the day or night, and it is active throughout the year. The cottontail's diet includes a wide variety of mostly herbaceous plants. In colder regions such as Flagstaff the cottontail also feeds on the bark and twigs of woody vegetation (Nowak 1991). This rabbit breeds year-round with many females having more than 1 litter per year. Gestation is usually 28 days, and young leave the nest at around 5 weeks of age. Juvenile females can breed during the year of their birth, and a few females have been observed to mate on the day they give birth. Although hunting is not allowed in national wildlife refuges and parks, no permit is required to hunt cottontails elsewhere throughout Arizona (Commission order 12, 1998- 1999 Ariz. Hunting Reg., Ariz. Game and Fish Dep.).

The range of the rock squirrel extends from the southwestern United States into northern and central Mexico (Nowak 1991). Its distribution in Arizona is nearly statewide; it is absent from the desert southwest (Hoffmeister 1987). The largest ground squirrel in Arizona, the rock squirrel is most common in rocks, slopes and canyon walls within its range. The squirrels of the rock squirrel's genus all construct burrows to which they retreat for shelter (Nowak 1991). The rock squirrel is active all year long, although it may retreat to its burrow during inclement weather, especially as green vegetation disappears. The squirrel's diet consists of seeds, nuts, grains, roots, bulbs, mushrooms, green vegetation, insects and other small invertebrates, and occasionally small vertebrates and birds' eggs. In southern Arizona, rock squirrels may have young as early as March, those in areas of longer winters have young in mid-May. Females can have 2 litters per season.

The range of the golden-mantled ground squirrel reaches from southwestern Canada down through the western United States. The Arizona range of the golden-mantled ground squirrel extends along the Mogollon plateau from the San Francisco to the White mountains (Hoffmeister 1987). It is found in coniferous forests (1500 - 3000 m; 5000 - 10000 ft)and often is associated with chipmunks of the genus Eutamias (western chipmunks). Like the rock squirrel whose genus it shares, this diurnal squirrel makes extensive burrow systems. Little is known about the breeding biology of the golden-mantled ground squirrel, but it probably breeds once per year, in April and May and has a gestation time of 30 days (Whitaker 1980).

The Abert's squirrel is found throughout the southwestern United States and northwestern Mexico. In Arizona, the range of the Abert's squirrel, extends along the Kaibab plateau, in the Chuska mountains, the south rim of the Grand Canyon, the Mogollon plateau, Sierra Anches, and the Apache mountains (Hoffmeister 1987). It has also been introduced to the Hualapi, Graham, Santa Catalina, and Prescott mountains. It inhabits ponderosa pine forests (2100 - 2700 m; 7000 - 9000 ft), where it spends most of its time in trees. Its diet consists of pine nuts, other seeds, fruits, buds, and young tree shoots. Mushrooms, insects, birds' eggs, and small birds may also be taken (Nowak 1991). The Abert's squirrel nests at least 5 m up in the branches or cavities of trees. Its nest, at least 5 m up in a tree, consists of a grass ball if in branches, or a grass-lined cavity. It mates in April and May and females have a gestation time of about 40 days. Litters of 2-5 young are usually mobile by August. These squirrels are often hunted for sport and food (Whitaker 1980), and Arizona Commission Order 11 allows them to be hunted during the fall throughout Arizona (1998- 1999 Ariz. Hunting Reg., Ariz. Game and Fish Dep.).

The single species of North American porcupine occurs from northern Alaska to Newfoundland and south to northern Mexico and Tennessee (Hall 1981). Its preferred habitat is forest with mixed hardwood and softwood trees, but it is highly adaptable and may even be found in open tundra, rangeland, and desert (Nowak 1991). The porcupine can be found throughout much of Arizona in forested, mountainous areas and, at lower elevations, in riparian areas (below 1200 m, 4000 ft; Hoffmeister 1987). It is absent from Arizona deserts. It is most abundant in coniferous forests where it seeks out rock piles, rocky slopes, caves, and mine shafts for shelter. It is primarily terrestrial, but it frequently climbs trees to heights of 18m to feed on bark (Nowak 1991). In coniferous forests such as those found on the Observatory, it spends most of its time during the spring and summer on the ground. The porcupine is primarily nocturnal and is active year-round (Whitaker 1980). Its winter diet consists mainly of evergreen needles and the cambium layer and inner bark of trees. During the spring and summer the porcupine eats buds, tender twigs, roots, stems, leaves, flowers, seeds, berries, nuts, and other vegetation (Nowak 1991). It is fond of salt and gnaws on bones and antlers found on the ground because of their high mineral content (Banfield 1974, Hoffmeister 1987). In the fall or early winter, males elaborately court females with extensive vocalizations and a comical dance (Banfield 1974). Females have a gestation time of205 - 217 days, and the young are born from April to June (Nowak 1991). Litters generally contain a single well-developed offspring, though there are rare records of twins. Porcupines may occupy the same den site for many generations.

Omnivorous and predatory mammals.-- The striped skunk, raccoon, gray fox, coyote, bobcat, and mountain lion discussed in the following paragraphs are mammals that are at least partly predatory in their food habits. Under Game Commission Order 13 (1998-1999 Ariz. Hunting Reg., Ariz. Game and Fish Dep.) they can all be legally hunted in Arizona in the late summer and fall without a permit.

The range of the striped skunk extends from southern Canada to northern Mexico in a variety of habitats including woods, grasslands, and deserts (Nowak 1991). The skunk can be found throughout Arizona at all elevations. It often lives close to water and in the mountains it lives in oak, ponderosa pine, and spruce-fir forests. It is usually active at dusk and throughout the night, and spends the day in a burrow, under a building, or in any dry, sheltered spot (Nowak 1991). The skunk remains in the same den for most of the year but females with young that are able to travel may change dens every few days to avoid predators. The skunk is omnivorous and its diet may include rodents, other small vertebrates, insects, fruit, grains, and green vegetation. Density estimates range from less than one to over 18 individuals per km^2 but most are 1 - 5 per km^2 (Wade-Smith and Richmond 1975). The skunk is generally solitary, especially in Arizona and throughout the southern part of its range; in the north, individuals may den together optimize winter survival and reproductive success (Nowak 1991). The striped skunk mates in February and March and females have a gestation time of 60 - 70 days. Four to seven young are born in mid-May; young are independent at 2 months of age (Whitaker 1980).

The raccoon can be found from southern Canada throughout the United States and south into Panama (Nowak 1991). The range of the raccoon in Arizona extends along waterways at all elevations in central and southeastern parts of the state (Hoffmeister 1987). It is found along the little Colorado and Colorado rivers, along mountain streams, and in many urban environments within its Arizona distribution, but no studies of raccoons have been conducted in the state; therefore little is known about its biology and life history there. In general, raccoons frequent timbered and brushy areas, usually near water (Nowak 1991). They are more nocturnal than diurnal, and are good climbers and swimmers. Raccoons in southern Arizona are active throughout the year, although north of the Mogollon rim they may become dormant in winter.

Their omnivorous diet consists mainly of crayfish, crabs, other arthropods, frogs, fish, nuts, seeds, acorns, and berries. The den is usually in a hollow tree with an entrance more than three meters above ground (Banfield 1974). The den may also be in a rock crevice, and overturned stump, a burrow made by another animal, or a human building. Except when females have newborn young, each den is usually occupied for only 1 or 2 days. In general, a female accepts only 1 male per season (Whitaker 1980). The male remains with the female for a week or more after mating then leaves to find another mate. Mating peaks in February and March, and litters of 1-7 young are usually born in April and May after a gestation period of 60 to 73 days. Yearling females can mate and all young disperse in the autumn after their birth.

The gray fox can be found from Oregon to southeastern Canada, south to Venezuela, and is most common in the arid regions of the southwestern United States and Mexico (Nowak 1991). It is found throughout Arizona in pinyon-juniper and lower elevations (500 - 1500 m; 1650 - 5000 ft) in open desert scrub, chaparral, oak or ponderosa pine (Hoffmeister 1987). The gray fox is sometimes called a tree fox because it frequently climbs trees, an unusual habit for a canid (Nowak 1991). Its diet includes many kinds of small vertebrates as well as insects and vegetable matter. The gray fox seems to take plant food more than do other foxes, and its diet may consist mostly of fruits and grains when these are ripe. Several sheltered resting spots may be used on different days (Nowak 1991), but the main den is in holes in the ground, rock piles, mine shafts, and tree hollows. Dens used for giving birth may be lined with vegetation (Trapp and Hallberg 1975). The gray fox is territorial (territory sizes range from 0.1 - 8.0 km^2), and each family group uses a separate area. The normal social unit is an adult pair and their young. The gray fox mates in February and March, and 2-7 young are born in April and May (Whitaker 1980). The gestation time has not been precisely determined but is thought to range from 51 to

63 days (Nowak 1991). The young are weaned at 3 months, and remain in the parental home range until January or February of the year following their birth (Nowak 1991). The male helps tend the young, but he does not den with them and the female.

The range of the coyote extends from Alaska to Nova Scotia, south throughout the United States and into Panama (Nowak 1991). It is found at all elevations in a wide variety of habitats throughout Arizona (Hoffmeister 1987). It is most common, however, in open grasslands, brush country, and broken forests. When it does not have young to care for, it seeks shelter in many places within its home range, usually under a bush or in a hollow dug into the ground. The natal den is located in such places as brush-covered slopes, hollow logs, and burrows made by the parents or other animals (Nowak 1991). Activity may take place at any time of the day, but is mainly nocturnal and crepuscular. About 90% of the diet is mammalian flesh, mostly jack rabbits, other lagomorphs, and rodents, but the coyote is a generalist and will also eat fruit, vegetation. Occasionally, the coyote will hunt cooperatively for larger mammals, especially deer; it will also eat the carrion of large mammals killed by other predators. It breeds from mid-January through mid-March, and females have a gestation time of 60 days (Bekoff and Wells 1986). One litter per year is produced in May or June, with an average litter size of 5 altricial pups. The pups are mobile enough to leave the den at 3 weeks; they can hunt alone at 4 months (Bekoff and Wells 1986). Adults do not mate for life, but both members of a mated pair care for the pups. Many coyotes are territorial, and scent mark around their home ranges to deter intruders (Windberg and Knowlton 1988).

The bobcat can be found from southern Canada to Baja California and central Mexico (Nowak 1991). The bobcat ranges throughout Arizona in a variety of habitats from desert to ponderosa pine. It prefers broken country with cliffs and rock outcrops, interspersed with grassland (Hoffmeister 1987). It is mainly nocturnal and terrestrial but climbs with ease (Nowak 1991). It stalks its prey with stealth and patience, then seizes it after a swift leap. The bobcat preys largely on hare and cottontail, but also eats mice, squirrels, porcupines and bats (Whitaker 1980). The bobcat is solitary and territorial (territory sizes range from two - 20 km^2); it marks its territory using feces, urine, scrapes, and gland secretions (Nowak 1991). Mating occurs in spring and a litter of 1-7 young are born in late April and early May, after a gestation of 50-60 days. Female bobcats may breed at 1 - 2 years of age, males are sexually mature at 2 years (Hoffmeister 1987).

The range of the mountain lion extends from the southern Yukon and Nova Scotia to southern Chile and Patagonia (Nowak 1991). It is found throughout Arizona in rocky or mountainous areas (Hoffmeister 1987). It can thrive in montaine coniferous forests, lowland tropical forests, swamps, grassland, dry brush country or an area with adequate cover and prey. The elevation range extends from sea level to at least 3300 m (Nowak 1991). There is usually no fixed den, except that used by females while raising young. Temporary shelter is taken in such places as dense vegetation, rocky crevices, and caves. The mountain lion may be active either during the day or at night. Throughout North America, including Arizona, the mountain lion's most consistently important food is deer. In Arizona, other important foods include cattle, domestic sheep, horses, peccaries, pronghorn, porcupine, jack rabbits, cottontails and beaver (Hoffmeister 1987). Lions may breed at any time of the year. The gestation period is about 96 days, and 1 - 6 spotted kittens are born (Hoffmeister 1987). Kittens stay with their mother until they are 15 - 22 months of age.

Ungulates.-- The range of the collared peccary reaches from Arizona and Texas south to northern Argentina (Nowak 1991). In Arizona, the collared peccary is found mostly south of the

Mogollon rim, although sightings of peccary do occur around Flagstaff (Hoffmeister 1987). They usually prefer desert scrub, thickets along creeks and old streambeds and retreat to nearby caves and crevices for protection. The collared peccary forms stable herds that defend year-round territories which range in size from 0.5 - 8.0 km^2. Herd sizes range from 2 - 50 animals. The speed, agility, and group defense of peccaries make them a formidable danger to dogs, coyotes, and even bobcats (Sowls 1984). When fleeing danger, they move with a fast running gait. They have poor vision and fair hearing, but an excellent sense of smell. The peccary is mainly vegetarian, and eats cactus fruit, berries, tubers, bulbs and rhizomes. They also consume grubs, snakes and small invertebrates occasionally. Young can be born in every month of the year, but in Arizona the peccary usually mates in February and March and gives birth during the summer. The usual litter size is 2. Gestation is 144 days, and the female cares for the young for 2 - 3 months.

The mule deer's range reaches from southern Yukon and Manitoba to Baja California and northern Mexico (Nowak 1991). It is found throughout most of Arizona, except the southwest corner of the state (Hoffmeister 1987). In northern Arizona, mule deer generally live in ponderosa pine, buckbrush, snowberry, and aspen forests. Elsewhere they live in chaparral and similarly xeric habitats. They prefer areas with enough vegetation for concealment but usually avoid dense forests (Nowak 1991). They walk about cautiously, flee from danger with a series of bounds, can run at speeds of up to 64 km/hr, and are excellent swimmers (Banfield 1974). They are generally most active at dawn and dusk. The diet includes grass, weeds, shrubs, twigs, mushroom, nuts, and lichens. The mule deer browses during the winter but grazes in summer. Individual home ranges vary widely but usually fall within the area of 24 - 137 ha for females and 97 - 356 ha for males (Nowak 1991). The basic social unit consists of an adult doe, her yearling daughter, and 2 fawns of the season. Adult males occur either alone or in small groups for most of the year (Banfield 1974). The rut begins in December, and mating occurs in December and January. Gestation is 203 days and young are born from July through September. A female has 1 - 2 fawns. Eighty percent of females 18 - 24 months old get pregnant, and in older females the pregnancy rate is higher. Mule deer can be hunted in the fall with a permit in Arizona (Commission Order 2, 1998-1999 Ariz. Hunting Reg., Ariz. Game and Fish Dep.).

The distribution of the elk is circumpolar and includes Europe, Asia Minor, China, southern Canada, most of the United States, and northern Mexico. The Merriam's elk, the subspecies of elk native to Arizona, was extirpated prior to 1900 (O'Neil 1985). Rocky Mountain elk were transplanted from Yellowstone National Park as early as 1913, and now occupy much of the suitable habitat north of the Mogollon rim (Wisdom and Thomas 1996). They summer in mountain meadows and forests, and winter in the lower elevations (Vavra 1992). Winter migration starts in late November, and summer migration begins in March or April. Up to 85% of the spring forage is grass, there is a shift to forbs and woody plants in the summer, browse and dried grass is taken in the fall, and shrubs and conifers extending above the snow line may be used in winter (Nelson and Leege 1982). Elk are gregarious and discrete herds form that occupy a definite area. They breed in September, and females have a gestation time of 8 months. A single calf is born that can stand soon after birth, follows the cow after 3 days, and grazes at 4 weeks of age (Nowak 1991). Elk can be hunted in the fall with a permit in Arizona (Commission Order 4, 1998-1999 Ariz. Hunting Reg., Ariz. Game and Fish Dep.).

None of the mammals discussed above are uncommon in Arizona or throughout their range. In all cases, the species found on the Observatory are representative of those that would be expected to be found in the habitat that occurs on the Observatory. A few species that might be expected to occur on the Observatory (Appendix H) were not found, possibly because of the Observatory's small area, the nocturnal and/or secretive habits of some species, or the limited duration of the survey. The previous discussion has focused on the range, distribution, habitat preferences, diet, and breeding biology of each species; further information about each species is available from Hall (1981), Hoffmeister (1987), and Nowak (1991). In addition, a detailed life history account has been compiled by the American Society of Mammalogists for all of the above species except the gray-collared chipmunk, brush mouse, white-footed mouse, deer mouse, and collared peccary (Appendix I).

Special status species

A computer search conducted by the Arizona Game and Fish Department of their Heritage Data Management System indicates that eight special status species (Arizona cinquefoil, Mogollon columbine, Arizona leather flower, Flagstaff pennyroyal, northern goshawk, Allen's big-eared bat, occult little brown bat, greater western mastiff bat) have been found within 8 km (5 miles) of the Observatory (Appendix J).

Mexican spotted owl

The Mexican spotted owl was listed as a federally threatened species on 16 March 1993 (USDI Fish and Wildlife Service 1995). The USFWS proposed critical habitat for the Mexican spotted owl on 7 December 1994, and published the final critical habitat rule on 6 June 1995. Since that time, the USFWS has been in consultation with action agencies on the effects of proposed and ongoing actions on critical habitat.

The primary administration of the lands supporting Mexican spotted owls is the USFS. Most spotted owls have been found within USFS Region 3 (including 11 National Forests in Arizona and New Mexico). The guidelines followed by the USFS in Region 3 require establishing management territories around all nesting and roosting spotted owls, as well as territorial owls detected at night for which daytime locations were not recorded. All management territories on Coconino National Forest (adjacent to the Observatory) have a 182-ha (450 ac) core area surround by 627 ha (1,550 ac) of the "best available" habitat, extending the area to 809 ha (2,000 ac) per management territory. Except for road construction, no habitat degradation is allowed within management territory cores. In the remainder of the management territory, management activities including timber harvest are limited to 209 - 314 ha (516 - 775 ac).

Several National Parks in Arizona, including Grand Canyon National Park, are known to support Mexican spotted owls (USDI Fish and Wildlife Service 1995). However, no specific management guidelines are in place for Mexican spotted owls on National Parks. Similarly, the Bureau of Land Management (BLM) in Arizona has no specific guidelines for managing spotted owls.

The Mexican spotted owl is considered a species of concern in Arizona (Arizona Game and Fish Department 1996). The Arizona Game and Fish Department has the authority to manage such species under provisions of Arizona Revised Statute 17, the goal of which is to maintain the state's natural biotic diversity by identifying and protecting species of concern. This status provides no special protection to a species, although it does provide a mechanism by which the state can allocate Heritage Program grants to fund research on the species.

The USFWS Mexican spotted owl recovery team designated 6 owl recovery units in the United States (USDI Fish and Wildlife Service 1995). The Observatory falls into the Upper Gila Mountains recovery unit; this unit has significant owl populations with the potential of being seriously impacted by fire and/or forestry practices. Between 1990 and 1993, 424 Mexican spotted owls were found in this recovery unit. The Upper Gila Mountains unit is considered a critical nucleus for the subspecies because of its central location within the owl's range and its seemingly high number of owls. Important objectives in the management of the spotted owl in this recovery unit are to address forest health problems, return forested ecosystems to conditions within their natural range of variation and to work toward a sustainable and resilient forest ecosystem.

The Mexican spotted owl occupies a broad geographic area (from central Utah and Colorado south through Arizona and New Mexico into southern Mexico) but does not occur uniformly throughout its range (USDI Fish and Wildlife Service 1995). Instead, the owl occurs in disjunct localities that correspond to isolated mountain systems and canyons. Along the Mogollon rim and north of the rim in Arizona where the Observatory is situated, spotted owls occur in mixed-conifer forests, ponderosa pine-gambel oak forests, rocky canyons, and associated riparian forests. The majority of owl nests appear to be in trees in uneven-aged, multistoried, closed-canopy forests. These conditions can be found in places on the Observatory, although the owl's most common nest tree, Douglas-fir, is not found on the Observatory.

Little is known about the owl's foraging habits (USDI Fish and Wildlife Service 1995). In general, owls use a wider variety of forest conditions for foraging than for roosting. On the Observatory, forest conditions range from closed-canopy to open canopy with varying numbers of snags, open areas, and large trees. All of these conditions can be used by owls for foraging. The prey base on the Observatory may be a limiting factor for foraging owls, however; we found only low-to-moderate densities of small mammals in our trapping grids on the Observatory.

Mexican spotted owls were first detected in the area of the Observatory in 1994, when responses were obtained at Dry Lake Crater (6 km southeast of the Observatory) and about 400m from the southeast corner of the Observatory during July of that year (Randall-Parker 1998). In

1997, the USFS conducted four complete surveys covering 1,375 ha (3,400 ac) on Observatory property and on adjacent State of Arizona and USFS property. These surveys, which consisted of a combination of calling points and leapfrog routes, expended 44.5 man-hours and resulted in no Mexican spotted owl responses or locations on or adjacent to the Observatory. The recommendations of the survey team are to continue to survey for owls in the area to determine future occupancy of the site.

CONCLUSIONS AND RECOMMENDATIONS

The 1996-1997 surveys of the flora and fauna on the Observatory documented a typical ponderosa pine vegetation association, with the related flora and fauna; we found no threatened or endangered species. The Navy policy of no hunting or other forms of recreation on the Observatory may be beneficial to ponderosa pine birds and mammals that are unaccustomed to the disturbance brought to ponderosa pine forests by the increasing number of humans that inhabit and recreate in it.

The conclusions of a biological assessment (Tierra Data Systems 1997) done for the owl on the Observatory are that because no owls have been documented using the Observatory, and because the Observatory property lies outside the designated critical habitat for the owl, no effects will occur. Therefore, the Navy seeks a 10-year incidental take permit for possible harassment of the owl so that the Observatory may carry out daily operation and future development plans of the Observatory within a defined operations area and conservation forest management, including thinning practices for wildfire prevention and for long-term forest health.

A biological opinion (2-21-97-F-110) was issued by the Arizona Field Office of the USFWS on July 23, 1998 in response to the Navy's biological assessment. The USFWS determined an incidental take of one Mexican spotted owl would occur and provided terms and conditions for minimizing take. Due to the difficulty in assessing the occurrence of incidental take, the USFWS tied the determination of incidental take to the prescription of the proposed forest thinning. The Observatory, with the assistance of South West Division, Naval Facilities Engineering Command technical experts, anticipates implementation of the forest prescription outlined in the biological assessment during fiscal year 1999.

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Table 1. Vascular plants found on the U.S. Naval Observatory, Flagstaff, February 1996-May 1997[1], organized alphabetically by scientific family name and within family, by scientific specific name. All species are common in the habitats where they are found.

COMMON NAME	SCIENTIFIC NAME	HABITAT DESCRIPTION[2]
Barberry Family	**Berberidaceae**	
Oregon grape[3]	(Berberis repens)	Mainly in coniferous forests
Borage Family	**Boraginaceae**	
Purple gromwell	(Lithospermum multiflorum)	Open pine woods
Cactaceae	**Cactus Family**	
Fishhook cactus	(Mammillaria arizonica)	Common 5000 - 8000'
Opuntia	(Opuntia plumbea)	Common in pine forests
Opuntia	(Opuntia phaeacantha)	Throughout Arizona
Composite Family	**Compositeae**	
Western yarrow[4]	(Achillea millefolium)	Mountains
Mountain pussytoes	(Antennaria parvifolia)	Common in mountains
Aspen fleabane	(Erigeron macranthus)	Oak thickets and pine woods
Forsythia[5]	(Forsythia sp.)	
Broom snakeweed	(Gutierrezia sarothrae)	Common, 3000-8000'
English ivy[5]	(Hedera helix)	
Common sunflower[3]	(Helianthus annuus)	Throughout Arizona
Mexican woolywhite	(Hymenopapus mexicanus)	Mountains
Bitterweed	(Hymenoxys richardsonii)	Mostly in pine forests

Table 1. Continued

COMMON NAME	SCIENTIFIC NAME	HABITAT DESCRIPTION[2]
Firethorn[5]	(Pyracantha sp.)	
Broom groundsel[4]	(Senecio spartioides)	Openings in pine forests
Goldenrod	(Solidago sparsiflora)	Pine forests, mountain meadows
Lilac[5]	(Syringa vulgaris)	
Cypress Family	**Cupressaceae**	
Common juniper	(Juniperus communis)	Common above 8000'
Oleaster Family	**Elaeagnaceae**	
Russian olive[5]	(Elaeagnus angustifolia)	
Beech Family	**Fagaceae**	
Gambel oak	(Quercus gambelii)	Throughout Arizona, 5000-8000'
Grass Family	**Gramineae**	
Arizona three-awn	(Aristida arizonica)	Rocky slopes, open woods
Fender's three-awn	(A. fendleriana)	Dry hills, open rocky ground
Pine dropseed[4]	(Blepharoneuron tricholepsis)	Dry or moist open woods
Blue grama	(Bouteloua gracilis)	Dry plains
Smooth brome[5]	(Bromus inermis)	Throughout North America
Crested wheatgrass[5]	(Bromus tectorum)	Throughout North America
Arizona fescue[4]	(Festuca arizonica)	Dry plains and open woods
Mountain muhly[4]	(Muhlenbergia montana)	Dry mesas and rocky plains
Screwleaf muhly[4]	(M. virescens)	Rocky hills and mesas

Table 1. Continued

COMMON NAME	SCIENTIFIC NAME	HABITAT DESCRIPTION[2]
Bottlebrush squirrel tail[4]	(Sitanion hystrix)	Rocky hills, open pine woods
Black dropseed	(Sporobolus interruptus)	Dry, rocky hillsides
Iris Family	**Iridaceae**	
Iris	(Iris missouriensis)	Wet meadows, 6000 - 9000'
Pea Family	**Leguminosae**	
Arizona pea[4]	(Lathyrus arizonicus)	Shady conifer forests, mountains
Wright's deer vetch[3]	(Lotus wrightii)	Very common in dry, open forests
Silverstem lupine[4]	(Lupinus argenteus)	Dry slopes, extremely common
Black medick[4]	(Medicago lupulina)	Occasional at roadsides
New Mexican locust	(Robinia neomexicana)	Common in coniferous forests
American vetch[4]	(Vicia americana)	Common in pine forests
Orchid Family	**Orchidaceae**	
Coral root	(Corallorhiza striata)	Deep shade of pine forests
Pine Family	**Pinaceae**	
Ponderosa pine[4]	(Pinus ponderosa)	Throughout Arizona 6000-9000'
Buckwheat Family	**Polygonaceae**	
Winged eriogonum[3]	(Eriogonum alatum)	Open forests, grasslands
Red root eriogonum	(Eriogonum racemosum)	Common in pine forests
Crowfoot Family	**Ranunculaceae**	

Table 1. Continued

COMMON NAME	SCIENTIFIC NAME	HABITAT DESCRIPTION[2]
Meadow rue	(Thalictrum fendleri)	Common in moist places in woods
No Common Name	**Rhamnaceae**	
Fendler ceanothus[4]	(Ceanothus fendleri)	Very common in pine forests
Rose Family	**Rosaceae**	
Wild strawberry[4]	(Fragaria ovalis)	Open woods, mountain meadows
Butter-and-eggs[3]	(Linaria vulgaris)	Disturbed places
Juniper lousewort	(Pedicularis centranthera)	Pine woods, mountains
Golden beard penstemon[3]	(Penstemon barbatus)	Common in mountains
Bush cinquefoil[4]	(Potentilla fruticosa)	Wet meadows
No Common Name	**Scrophulariaceae**	
Common mullein[3,6]	(Verbascum thapsus)	Common in disturbed places
Unknown family, ornamentals not native to Arizona		

[1] Order of listing, and nomenclature follow Lehr (1978).

[2] Habitat descriptions from Niehaus et al. (1984) and Kearney and Peebles (1960), where applicable.

[3] Found primarily or exclusively on disturbed sites, next to roads.

[4] Abundant throughout the Observatory.

[5] Ornamental vegetation, found around Observatory buildings.

[6] Exotic species, thought to be introduced after 1800 (Haughton 1978).

Table 2. Reptiles recorded during surveys at the U.S. Naval Observatory, Flagstaff, from February 1996-May 1997.[1]

COMMON NAME	SCIENTIFIC NAME	DATES OBSERVED	# OBSERVED	LOCATION FOUND
Many-lined skink	Eumeces multivirgatus	28 - 31 May 97	1	under a rock, northwest section of the Observatory
Short-horned lizard	Phrynosoma douglasii	27 - 30 July 96, 28 - 31 May 97	20 - 30	dirt roads near bird point count station three
Eastern Fence lizard	Sceloporus undulatus	27 - 30 July 96, 28 - 31 May 97	20 - 30	1 in a pit-fall trap (Fig. 1) others throughout the Observatory dirt roads and rocky outcrops
W. terrestrial garter snake	Thamnophis elegans	28 - 31 May 97	1	traversing a path, northwest sectio of the Observatory

[1] Order of listing, and nomenclature follows Collins (1990).

'able 3. Birds observed at U.S. Naval Observatory, Flagstaff, February 1996-May 1997

Species	Az Status[1]	Feb '96	July '96	Nov '96	May '97	Total
		Number of Birds Seen				
ed-tailed hawk (Buteo jamaicensis)	RS	1	0	0	1	2
and-tailed pigeon (Columba fasciata)	NT	0	0	0	4	4
Mourning dove[2] (Zenaida macroura)	RS	0	0	0	3	3
lammulated owl[3, 4] (Otus flammeolus)	**NT, CV**	**0**	**0**	**0**	**2**	**2**
orthern saw-whet owl[3] (Aegolius acadicus)	RS, CV	0	0	0	1	1
Broad-tailed hummingbird[2] (Selasphorus platycercus)	NT	0	2	0	3	5
Northern flicker[2] (Colaptes auratus)	RS, CV	10	2	0	2	14
corn woodpecker[5] (Melanerpes formicivorus)	RS, CV	1	0	0	4	5
airy woodpecker[2] (Picoides villosus)	RS, CV	5	2	1	2	10
Olive-sided flycatcher (Contopus borealis)	NT	0	0	0	1	1
estern wood-pewee[2] (Contopus sordidulus)	NY	0	0	0	5	5
ordilleran flycatcher[2] (Empidonax occidentalis)	NT, CV	0	4	0	5	9
Violet-green swallow[2] (Tachycinata thalassina)	NT, CV	0	12	0	6	18
eller's jay[2] (Cyanocitta stelleri)	RS	25	5	1	4	35
ark's nutcracker (Nucifraga columbiana)	RS	0	0	0	2	2
merican crow (Corvus brachyrhynchos)	RS	1	0	2	0	3
ommon raven (Corvus corax)	RS	1	0	1	2	4
ountain chickadee[2] (Parus gambeli)	RS, CV	12	30	0	6	48
own creeper[2] (Certhia americana)	RS	7	0	0	2	9

'able 3. continued.

Species	AZ Status	Number of Birds Seen Feb '96	July '96	Nov '96	May '97	Total
'Vhite-breasted nuthatch[2] (Sitta carolinensis)	RS, CV	16	6	2	3	27
Pygmy nuthatch[2] (Sitta pygmaea)	RS, CV	76	71	11	11	169
:ouse wren (Troglodytes aedon)	NT, CV	0	0	0	1	1
olden-crowned kinglet[3] (Regulus satrapa)	RS	5	0	0	0	5
Ruby-crowned kinglet (Regulus calendula)	RS	3	0	0	0	3
Western bluebird[2] (Sialia mexicana)	RS, CV	3	4	0	2	9
:ountain bluebird (Silia currucoides)	RS, CV	0	0	0	1	1
Townsend's solitaire (Mydestes townsendi)	RS	0	1	0	3	4
Hermit thrush[2] (Catharus guttatus)	RS	0	1	0	3	4
merican robin[2] (Turdus migratorius)	RS	1	7	0	6	14
''umbeous vireo[2] (Vireo plumbeus)	NT	0	7	0	6	13
Warbling vireo (Vireo gilvus)	NT	0	0	0	1	1
:llow-rumped warbler (Dendroica coronata)	RS	0	0	0	10	10
'ace's warbler[2] (Dendroica graciae)	NT	0	0	0	6	6
)live warbler (Peucedramus taeniatus)	NT	0	0	0	1	1
›lack-headed grosbeak[2] (Pheucticus melanocephalus)	NT	0	0	0	14	14
otted towhee (Pipilo maculatus)	RS	0	0	0	1	1
'hipping sparrow (Spizella passerina)	NT	0	0	0	2	2
)ark-eyed junco[2] (Junco hyemalis)	RS	18	3	0	7	28
›own-headed cowbird (Molothrus ater)	RS	0	0	0	2	2

'able 3. continued.

Species	AZ Status	Number of Birds Seen: Feb '96	July '96	Nov '96	May '97	Total
ˉVestern tanager (*Piranga ludoviciana*)	NT	0	0	0	5	5
Red crossbill (*Loxia curvirostra*)	RS	2	0	2	1	5
. ine siskin (*Carduelis pinus*)	RS	0	0	0	4	4

[1] RS = resident/short distance migrant; NT = neotropical migrant; CV = cavity nester (Ehrlich et al. 1988, ĸosenstock 1996)

Species that have been observed nesting in Ponderosa Pine forests near Flagstaff, Arizona (Haldeman et al. 1973).

[3] Species not observed by Rosenstock (1996) during the breeding season in Ponderosa pine forests.

[4] Listed as a sensitive species by the U.S.D.A. forest service, Peaks Ranger District.

Seen only at bird feeder near observatory buildings.

Table 4. Mammals observed by University of Arizona survey personnel on the U.S. Naval Observatory, Flagstaff, February 1996-May 1997.[1]

Common Name	Scientific Name	Observation type	Number Sighted
Eastern cottontail	Sylvilagus floridanus	sighted	abundant[2]
Gray-collared chipmunk	Eutamias cinereicollis	sighted, trapped	abundant, 1[3]
Golden-mantled ground squirrel	Spermophilus lateralis	sighted	abundant
Rock squirrel	Spermophilus variegatus	sighted	abundant
Abert's squirrel	Sciurus aberti	sighted	abundant
Brush mouse	Peromyscus boylii	trapped	4[4]
White-footed mouse	Peromyscus leucopus	trapped	3
Deer mouse	Peromyscus maniculatus	trapped	36
Mexican woodrat	Neotoma mexicana	trapped	1
Coyote	Canis latrans	scat, tracks	abundant
Gray fox	Urocyon cineoargenteus	scat, tracks	abundant
Bobcat	Lynx rufus	scat, tracks	abundant
Elk	Cervus elaphus	pellets, sighted	abundant, 3
Mule deer	Odocoileus hemionus	pellets, sighted	abundant, 5 - 10

[1] Order and nomenclature follows Jones et al. (1992).

[2] Abundant = seen on every survey.

[3] Refers to the number trapped over all surveys, on the Observatory.

[4] The brush mouse, white-footed mouse, deer mouse, and Mexican woodrat were not seen except when caught in live-traps.

Table 5. Wildlife sighted by Observatory employees, on U.S. Naval Observatory, Flagstaff, June 1995 - June 1997, listed in chronological order of sighting.

Species	Location	Time	Date
1 collared peccary (Tayassu tajacu)	near US rte. 66	1830	7 Jun 1995
1 unknown deer species (Odocoileus hemionus)[1]	west lawn of observatory	2200	8 Jun 1995
1 unknown skunk species (Mephitis mephitis)[2]	next to shop	2200	13 Jun 1995
8 elk (Cervus elaphus)	just below gate to observatory	1430	27 Jun 1995
1 unknown deer species with fawn (Odocoileus hemionus)	--	0530	18 Aug 1995
1 mountain lion (Felis concolor)	--	2330	26 Aug 1995
Unknown deer species with fawn (Odocoileus hemionus)	--	1100	30 Aug 1995
Unknown deer species with fawns (Odocoileus hemionus)	entry road east of US 40	0830	18 Sep 1995
1 porcupine (Erethizon dorsatum)	entry road east of US 40	0855	25 Sep 1995
1 unknown deer species with fawns (Odocoileus hemionus)	entry road southeast of US 40	0830	25 Sep 1995
7 unknown deer species (Odocoileus hemionus)	south of US 40	1735	27 Oct 1995
1 unknown deer species fawn (Odocoileus hemionus)	below gate to observatory	1800	8 Nov 1995
2 unknown deer species fawns (Odocoileus hemionus)	on road up to observatory	1930	30 Nov 1995
1 unknown skunk species (Mephitis mephitis)	near gate to observatory	2230	26 Dec 1995
15-20 elk (Cervus elaphus)	--	0500	7 Jan 1996
1 coyote (Canis latrans)	at bottom of road up to observatory	0810	3 Mar 1996
3 unknown deer species (Odocoileus hemionus)	near gate to observatory	0630	5 Apr 1996
9 unknown deer species (Odocoileus hemionus)	near US 66	0800	1 May 1996
2 elk (Cervus elaphus)	near US 66	0800	2 May 1996

Table 5. continued.

Species	Location	Time	Date
8-10 unknown deer species (Odocoileus hemionus)	on observatory road	1930	16 May 1996
2 elk (Cervus elaphus)	on observatory road	1930	16 May 1996
2 unknown deer species (does) (Odocoileus hemionus)	on observatory road near US 66	0900	17 May 1996
2 unknown deer species (does) (Odocoileus hemionus)	near observatory buildings	1500	23 May 1996
5 elk (Cervus elaphus)	parking lot of observatory	1930	25 May 1996
2 elk (Cervus elaphus)	water tank	0600	27 May 1996
Unknown fox species (Urocyon cinereoargenteus)[3]	--	0200	22 Jun 1996
3 unknown deer species (Odocoileus hemionus)	near overpass of observatory road	0800	26 Jun 1996
3 unknown deer species (does) (Odocoileus hemionus)	near buildings	1330	10 Jul 1996
2 unknown deer species (bucks) (Odocoileus hemionus)	at bottom of observatory hill	0645	18 Jul 1996
1 unknown fox species (Urocyon cinereoargenteus)[3]	crossing observatory road	1615	18 Jul 1996
1 mule deer (Odocoileus hemionus)	near overpass of observatory road	0825	31 Jul 1996
1 porcupine (Erethizon dorsatum)	front door of observatory building	0600	30 Aug 1996
1 short-horned lizard (Phrynosoma douglassi)	in observatory road	1430	28 Aug 1996
1 juvenile bobcat (Felis rufus)	at bottom of observatory hill	0645	11 Sep 1996
1 coyote (Canis latrans)	near observatory gate	0900	27 Nov 1996
1 coyote (Canis latrans)	--	0900	8 Dec 1996
1 coyote (Canis latrans)	in parking lot	0830	10 Jan 1997
3 female mule deer (Odocoileus hemionus)	near observatory gate	0700	21 Apr 1997
2 elk (Cervus elaphus)	near lower observatory	2200	3 Jun 1997

Table 5. continued.

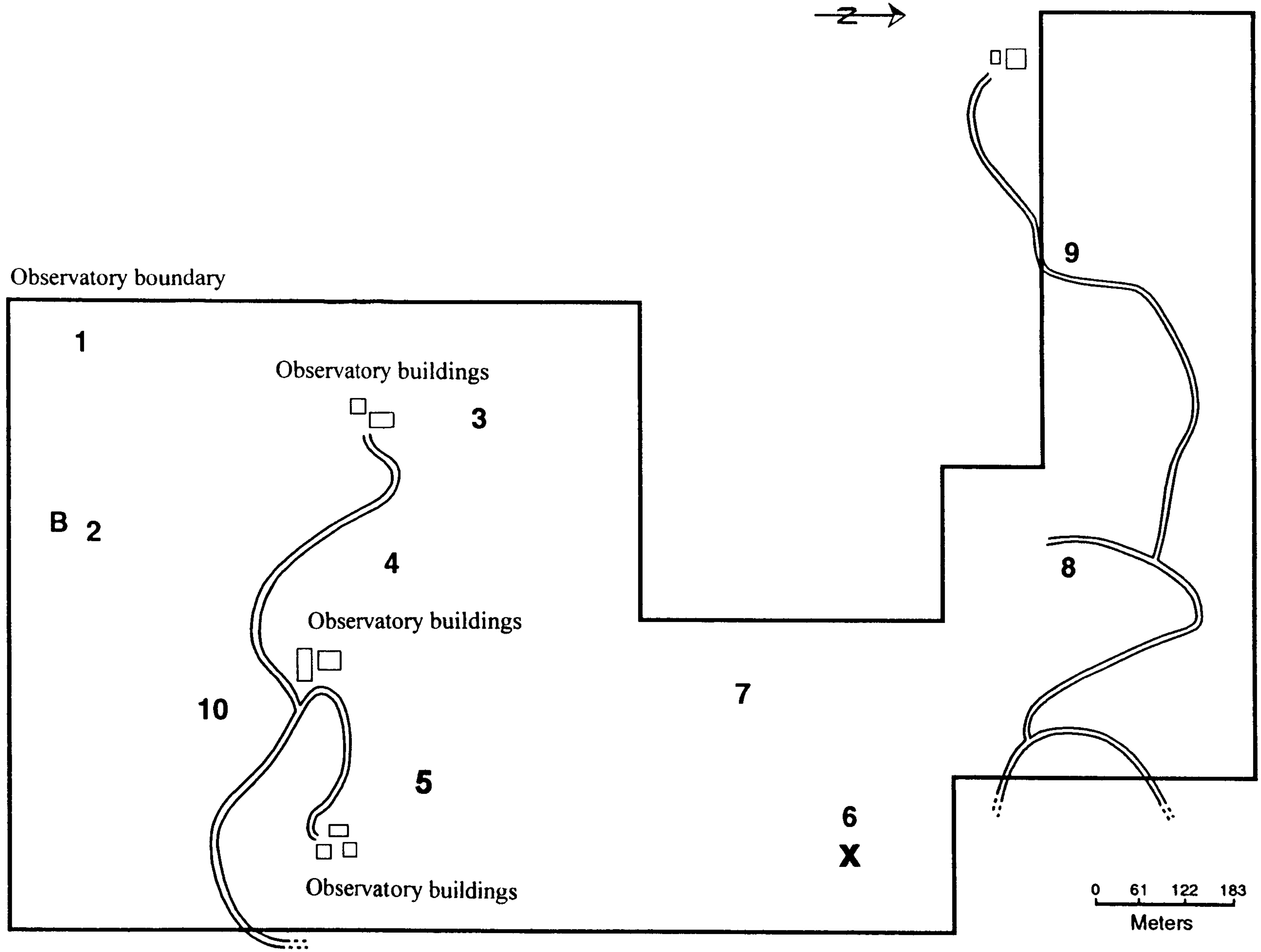
Species	Location	Time	Date
1 raccoon (Procyon lotor)	--	2330	4 Jun 1997
2 elk (Cervus elaphus)	near overpass on observatory road	0645	17 Jun 1997

[1] Probably mule deer, Odocoileus hemionus.

[2] Probably striped skunk, Mephitis mephitis.

[3] Gray fox, Urocyon cinereoargenteus, is the only fox that occurs in the San Francisco Mountain area.

Figure 1. Bird point count stations (number 1-10), reptile pit-fall arrays (X), and reptile box trap (B) at the United States Naval Observatory, Flagstaff, Arizona.



D.6 Oak and Snag Final Report

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FINAL REPORT

SNAG AND OAK RESPONSE TO FOREST THINNING ON THE U.S. NAVAL OBSERVATORY, FLAGSTAFF, ARIZONA: COLLECTION OF BASELINE DATA

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INTRODUCTION

Standing dead tre1es (snags) are an essential habitat component for cavity-nesting birds and other wildlife in the ponderosa pine (*Pinus ponderosa*) forests of the southwestern United States. The species, size, bark retention, and condition influences the value of a snag as wildlife habitat. Removal of snags has been linked to declines in both diversity and density of cavity-nesting birds and tree roosting bats in southwestern forests (Scott and Oldemeyer 1983, Rabe et al. 1998, Chambers 2002a). Healthy populations of cavity nesting birds, which are dependent on large diameter snags, may control insect outbreaks. Snags also serve as nesting and perching platforms for numerous raptor species. Forest thinning over large areas may shorten the forest rotation age, and subsequently limit the variability and diversity of snag recruitment. Although tree age and rotation age can be independent, shortening the rotation age or thinning to promote even-age management, has the potential to drastically reduce availability, recruitment and retention of snags, unless specific guidelines are included for the retention of a diverse size and age classes of trees.

Another important component of the ponderosa pine forest ecosystem is a healthy understory often comprised primarily of Gambel's oak, which provides valuable food, nesting, and denning resources for numerous wildlife species. Gambel's oak (*Quercus gambelii*) provides mast yields, on which many species within the ponderosa pine community depend. Oak understories have been correlated with increased species diversity of small mammals and breeding birds and have also been identified as a key habitat component for Mexican spotted owl *(Strix occidentalis lucida)* nest sites.

Currently the U.S. Naval Observatory in Flagstaff is treating approximately 210 acres of ponderosa pine forest using a 20 ft. tree spacing prescription. Thinning the forest to this prescription may alter the reproductive response of oaks, as well as the type, longevity and density of snags. The purpose of this project was to collect baseline measurements on oak regeneration and conduct a survey of snags (e.g., size distribution, decay condition, density, etc.) within the ponderosa pine forest on the Naval Observatory. We also permanently marked all oak regeneration plots and snags for future monitoring.

STUDY AREA

The United States Naval Observatory is located on the Coconino Plateau approximately 5 miles west of Flagstaff, Arizona. It shares boundaries with the U.S. Forest Service, state, and private lands. Most of the 116 ha (287 acre) observatory is dominated by a ponderosa pine forest with a mixed understory of Gambel's oak, and New Mexican locust (*Robinia neomexicana*). The U.S. Navy operates a year-round stellar observatory that includes several outbuildings and offices. Navy staff are concerned about protecting the historic observatory from catastrophic wildfire while maintaining airflow and canopy reflectance levels necessary to the function of the observatory. Elevations range from approximately 702 m (7,300 ft) along the northern boundary to 2304 m (7,560 ft) at the observatory in the south central portion of the installation. Cold winters (mean –9° to 6°C) and warm summers (mean 10° to 27°C) characterize the local climate with most precipitation occurring as snow from December through March (mean 53cm). A monsoon rainfall season from mid-July through September provides additional moisture (mean 251cm).

METHODS

Snag Inventory

We searched the entire installation and located every snag between January 29 and February 3, 2003. Snags were considered to be standing dead trees greater than 30.5 cm (12 inches) diameter at breast height (dbh) and greater than 2m (6.5 feet) tall, with an angle of repose greater than 45 degrees from the ground. For each snag we documented species, size (height and diameter), and decay class (Appendix II). We also noted woodpecker use, beetle infestation and bark sloughing (Appendix II). Each snag was marked with a uniquely numbered metal tag and its location was mapped using a Garmin 3+ GPS receiver for long-term monitoring.

Oak Regeneration Plots

We installed 30 plots to monitor long-term oak regeneration. Plot sites were selected by choosing a random start point and systematically spacing plots throughout the installation (Figure 1; Table 1). We documented each oak measuring less than 8 cm diameter root crown (DRC) within a 10 meter radius of the plot center and classified each oak into five size categories (1= < 0.5 cm DRC (0.20 inches), 2 = 0.5 – 2 cm DRC (0.20 – 0.78 inches), 3 = 2 - 4 cm DRC (0.78 – 1.56 inches), 4 = 4 – 6 cm DRC (1.56-2.34 inches), 5 = 6 – 8 cm DRC (2.34 – 3.12 inches)). Plots were permanently marked with ½ inch rebar and a rebar cap indicating the plot number for future monitoring.

RESULTS AND DISCUSSION

Snag Inventory

We found, measured, and permanently marked 193 standing dead trees throughout the U.S. Naval Observatory that can be used for future studies on retention and decay rates. Of these, 95 percent were ponderosa pine (183 snags) and five percent Gambel's oak (10 snags; Figure 2). Approximately 60 percent of the ponderosa snags were within the 18 to 24 inch (46-61 cm) diameter class (Figure 3) and over 30 percent of ponderosa pine snags were classified as decay class 1, i.e., recently died (Figure 4; Appendix II). When combined with decay class 2, this young cohort of ponderosa snags made up 65 percent of all the snags within the study area. In southwestern ponderosa pine forests the U.S. Forest Service recommends a minimum of 4.9 snags/ha for trees > 18 inches (46 cm) dbh regardless of decay class (USDA Forest Service 1996). The Naval Observatory falls below this recommended management standard with 1.1 ponderosa pine snags/ha. We recommend retaining all snags and coarse woody debris (fallen snags / logs) during future forest treatment projects. In addition to retaining snags in all size classes, there are several methods available to create snags within a healthy forest (e.g. girdling, fungus, or bark beetle pheromone inoculation).

When we examined wildlife use of snags, we found ponderosa pine trees supporting the majority of woodpecker foraging activity. Approximately 89 percent of ponderosa snags show some evidence of foraging, while oaks average less than 50 percent. Ponderosa pine snags showed woodpecker use throughout the bole, but oaks showed use on less than 25% of the bole (Figure 5). Although the number of trees in decay class 3, 4, and 5 made up only 35 percent of all the ponderosa snags, approximately 45 percent of all the woodpecker cavities were in these older decay classes (Figure 6). Other studies show similar results, where younger snags attract the majority of foraging activity due to higher densities of invertebrates in the bark and wood, and older softer snags show higher densities of cavities (Farris et al 2004, Zack et al. 2002). Woodpeckers and other non-migratory insectivorous cavity nesting birds play an important role in regulating insect numbers during winter and early spring months (Balda 1975, Holmes 1990) feeding on insects living within the bark and tissues of dead or declining trees. More than 70% of measured snags showed evidence of bark beetle attack (74% pitch tubes; 90% primary beetle holes) and 75% had emergent holes of secondary beetle infestations (i.e. woodborers and red turpentine beetles). The close relationship between these insectivorous birds and the snags they depend on for nest and foraging sites demonstrates clearly the necessity of retaining a suitable snag component when managing for healthy ponderosa pine forests.

Oak Regeneration Plots

Oak regeneration was tallied in 14 of the 30 survey plots measured, with most oaks located in the southeastern portion of the observatory (Figure 7). All 14 plots contained oaks <0.5 cm DRC (size class 1), five plots contained oaks from size classes 2, 3, and 4, and no plots contained oaks from size class 5 (Figure 8). There were a total of 4.8 stems per 100m^2 for size class 1 stems within all 14 plots containing oaks and four plots which measured 2.0 stems per 100m^2 for size class 2 stems. Size class 3 and 4 stems were found in only one plot each and measured 0.3 stems per 100 m^2. Oak recruitment on the observatory was considerably lower than densities measured by Chambers (2002b). In the nearby Kaibab National Forest, Chambers (2002b) documented average densities of oaks <2.5cm DRC at nearly 900 stems per hectare, and average densities of 7.5cm DRC oak stems at around 100 per hectare. For comparison, observatory average densities measured 250 (range 0-1910) and 4 (range 0–64) stems per hectare, respectively.

Future Study and Management

The opening of the forest due to current tree harvesting (i.e., 20 ft. tree spacing prescription) may reduce retention rates of snags due to increased exposure (Raphael and Morrison 1987). If trends in decreased snag abundance are observed on observatory forests several actions may be taken to mitigate their loss. Managers may want to consider creating snags through mechanical or chemical stress. When possible, we recommend snag creation by injecting the tree with bark beetle pheromones, which act as “chemical messengers between conspecifics that create a mass attack on an individual tree for the purpose of killing it” (Shea et. al. 2002). Long-term studies of artificially created ponderosa pine snags have shown that beetle-killed snags have markedly higher woodpecker feeding activity, cavity excavation, and insect diversity (Shea et. al. 2002). In fact, girdled trees showed no evidence of cavity excavation or “flaking” (a feeding behavior of woodpeckers) after 6 years post-treatment. In addition to creating snags for foraging and cavity excavation, artificial nest boxes could be installed to encourage localized nesting by flicker species that primarily prey on ants. We recommend another snag survey of the Naval

Observatory prior to creating snags to assess snag recruitment after the severe drought and pine beetle outbreak of 2003-2004.

Another by-product of an open forest may be increased oak recruitment. Oak recruitment should be re-evaluated in regular intervals (e.g. every 5 years) after forest thinning operations occur. Oaks are slow growing species, but due to their wildlife value, should be protected before, during and after any forest treatment prescription. Older oaks and oak snags can provide hollow cavities for larger species (i.e. Mexican spotted owls and squirrels). Although we did not observe any cavities suitable for Mexican spotted owls during our survey, large oaks provide ideal roosting habitat for this heat intolerant species. Young oaks begin producing mast at 6-8 cm DRC (2.34-3.12 in) and peak at 30.48-35.56 cm DRC (12-14 inches; McCulloch et al 1965). Subsequently, a small increase of oak numbers on Navy property could provide foraging opportunities for numerous species of wildlife.

Finally, we encourage utilizing prescribed fire as a tool whenever possible. To maintain snags during a ground fire, crews should rake duff and flammable debris from around the base of each dead tree. Prescribed fire, combined with maintaining snags of all age classes, will provide habitat suitable for cavity dwelling species that forage on insects (e.g. woodpeckers and bats). Cover-Bratland et. al. (*in review*) documented significantly more hairy woodpeckers foraging in burned areas than in unburned areas. They attributed this difference to a significantly higher density of bark-dwelling arthropod abundance in ponderosa pine trees between 1 and 7 years after burning. In addition to the direct wildlife benefit, occasional burning has been shown to increase oak recruitment. Harrington (1985) documented increases in oak density (100-150%) and frequency (10-40%) after one prescribed fire in southwestern pine communities. Fire will not only reduce ladder fuels for observatory wildfire protection, but will also benefit the ecology of the surrounding forest.

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Table 1. Universal Trans Mercator Coordinates (NAD 27) for oak regeneration monitoring plots on the Naval observatory outside Flagstaff, Arizona. Plots were monitored for oak regeneration between November 13 – 16, 2002.

Plot Number	Easting	Northing
1	431900	3894750
2	432100	3894750
3	432300	3894750
4	432500	3894750
5	431900	3894550
6	432100	3894550
7	432300	3894550
8	432500	3894550
9	432700	3894600
10	432700	3894400
11	432700	3894200
12	432900	3894200
13	432700	3894000
14	432900	3894000
15	432300	3893800
16	432500	3893800
17	432700	3893800
18	432900	3893800
19	432300	3893600
20	432500	3893600
21	432700	3893600
22	432900	3893600
23	432300	3893400
24	432500	3893400
25	432700	3893400
26	432900	3893400
27	432300	3893200
28	432500	3893200
29	432700	3893200
30	432900	3893200

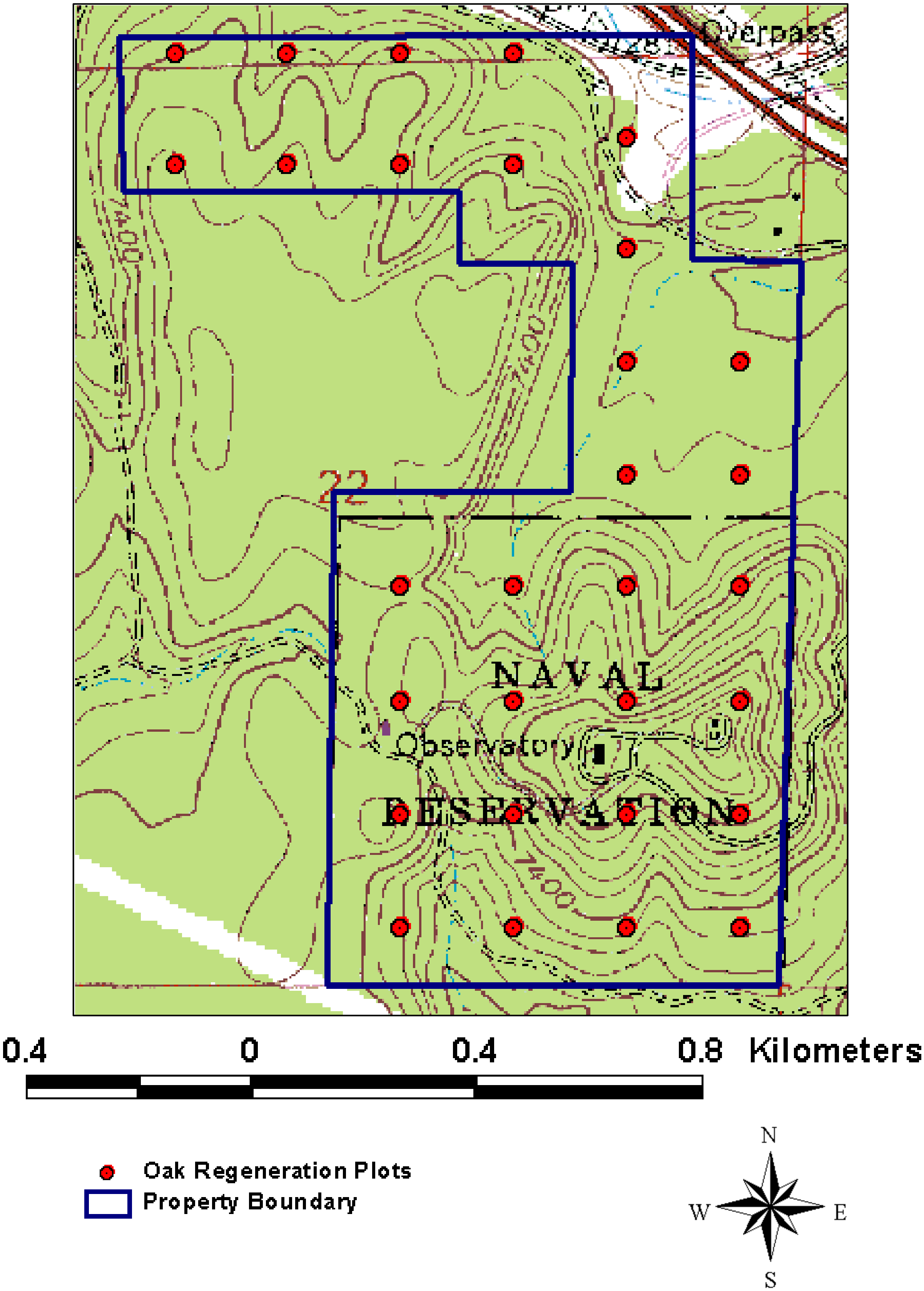

Figure 1. Location of oak regeneration plots on the U.S. Naval Observatory, Flagstaff, Arizona.

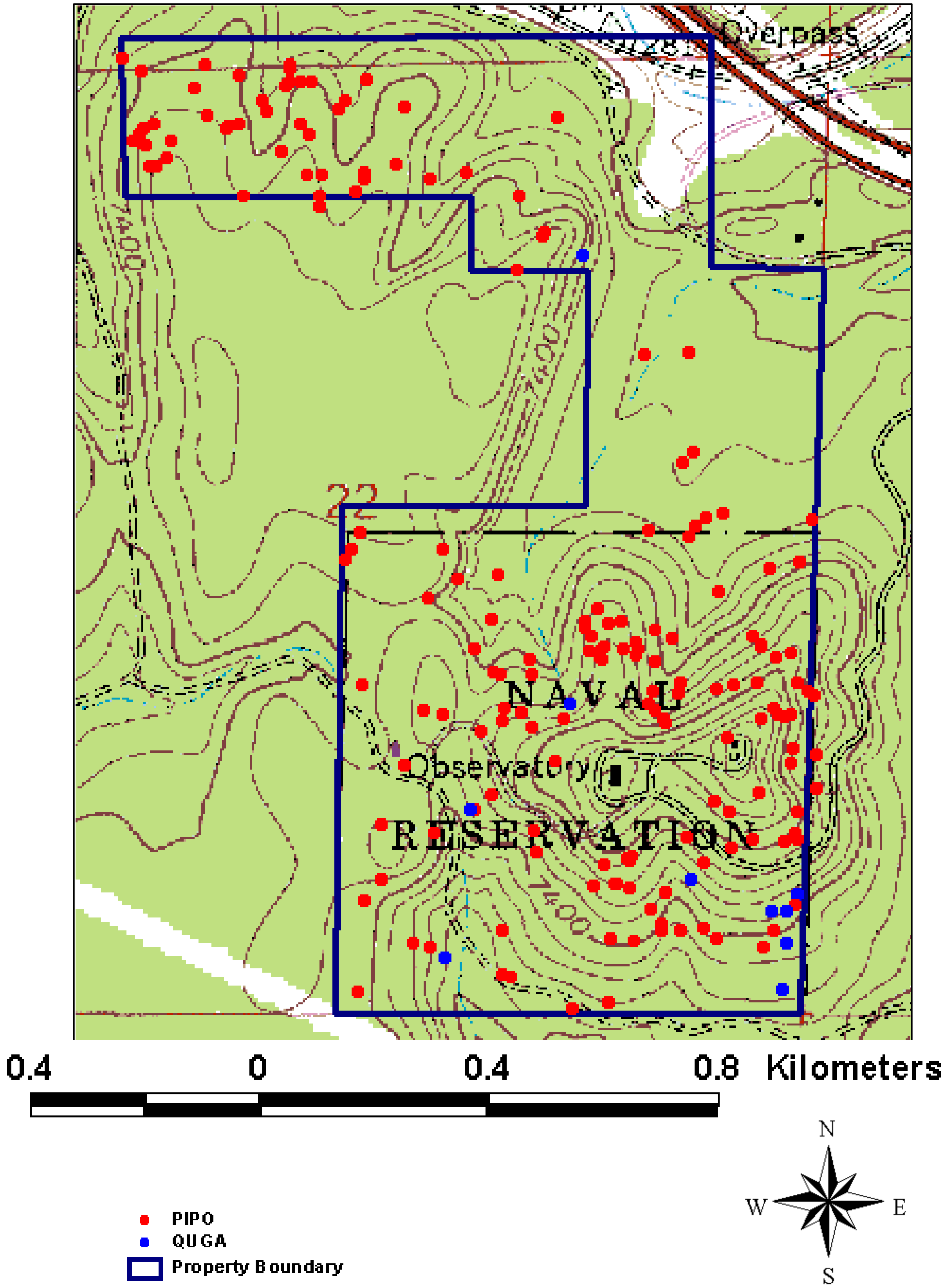

Figure 2. Distribution of Ponderosa Pine (red dots) and Gambel's Oak (blue dots) snags on the U.S. Naval Observatory, Flagstaff, Arizona.

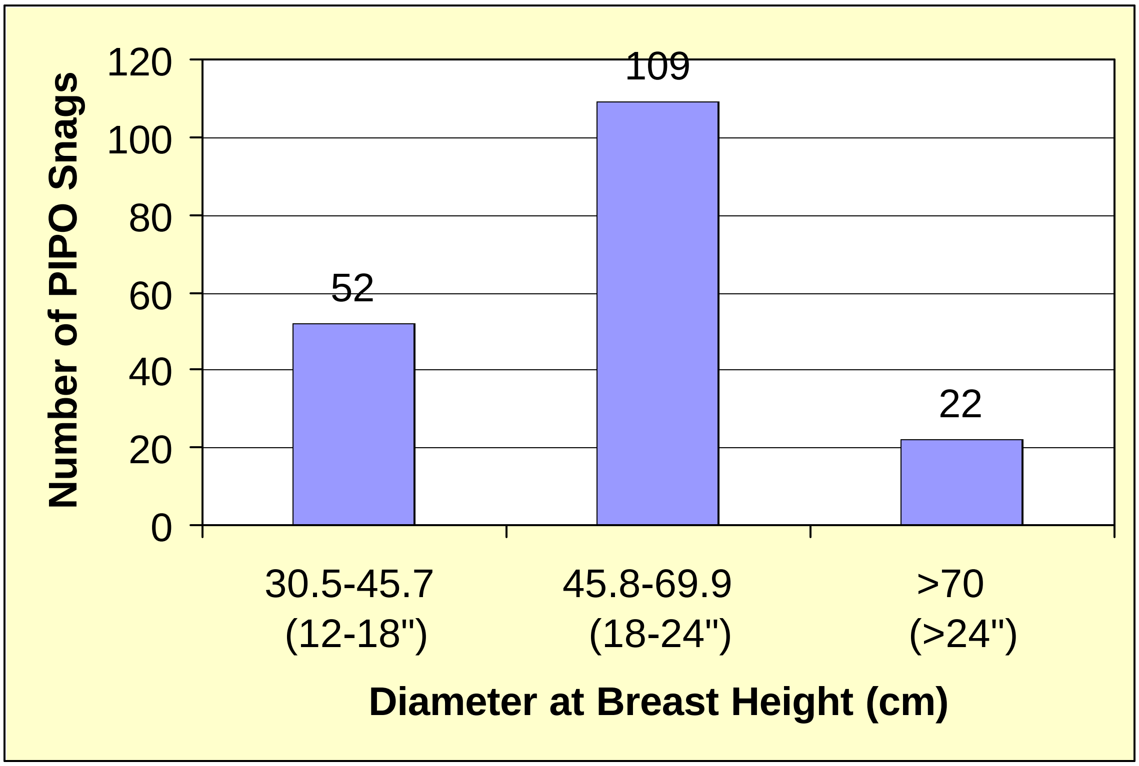

Figure 3. Number of Ponderosa pine snags per diameter size class located on the U.S. Naval Observatory, Flagstaff, Arizona.

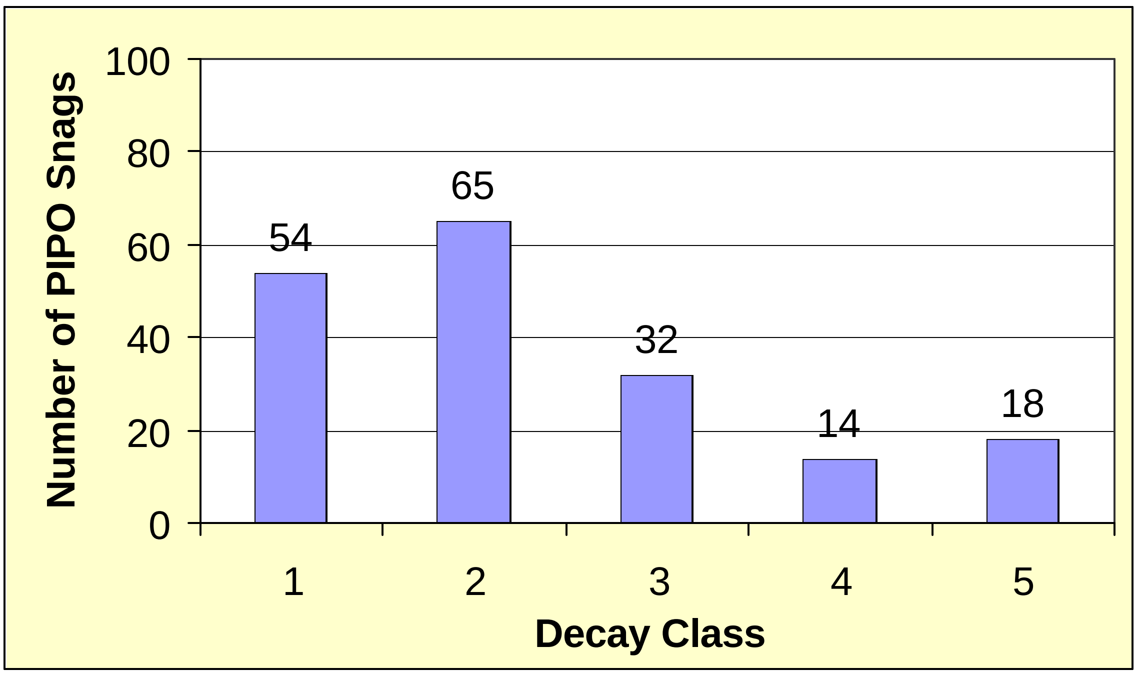

Figure 4. Number of Ponderosa pine snags per decay class (see text) located on the U.S. Naval Observatory, Flagstaff, Arizona.

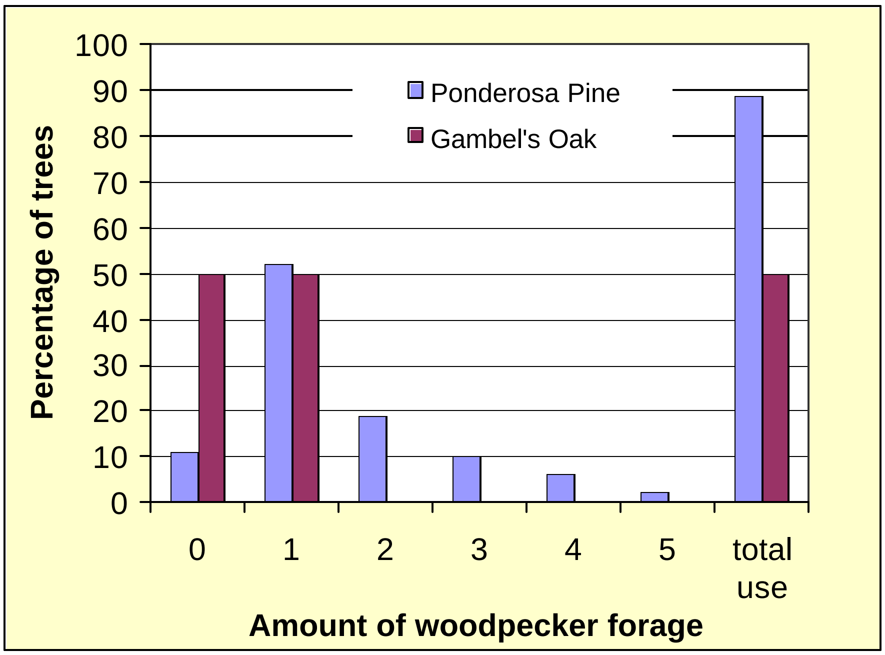

Figure 5. Percent of Ponderosa pine and Gambel's oak trees used by woodpeckers on the U.S. Naval Observatory, Flagstaff, Arizona. Amount of woodpecker forage are estimates of the amount of the tree's bole covered by woodpecker foraging sign using the following categories: **0** = 0%; **1** = 1-25%; **2** = 26 – 50%; **3** = 51-75%; **4** = 76-99; **5** = 100%. Total use describes the percentage of all snags measured showing any evidence of foraging.

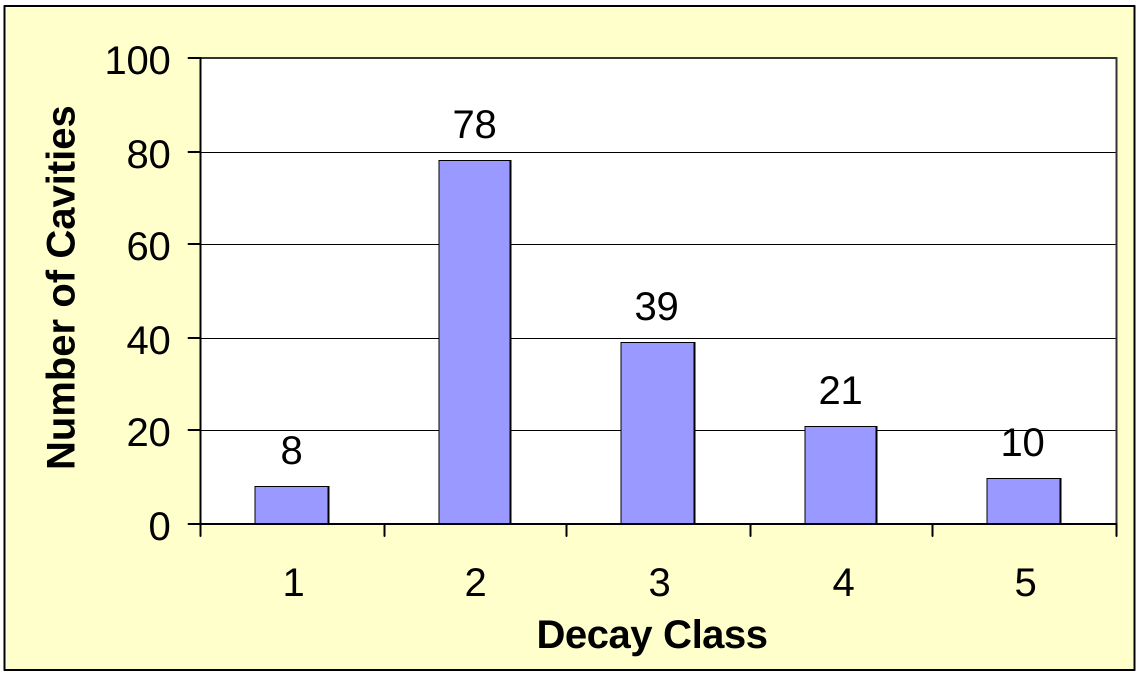

Figure 6. Number of woodpecker cavities in ponderosa pine snags depicted by decay class (see text) on the U.S. Naval Observatory, Flagstaff, Arizona.

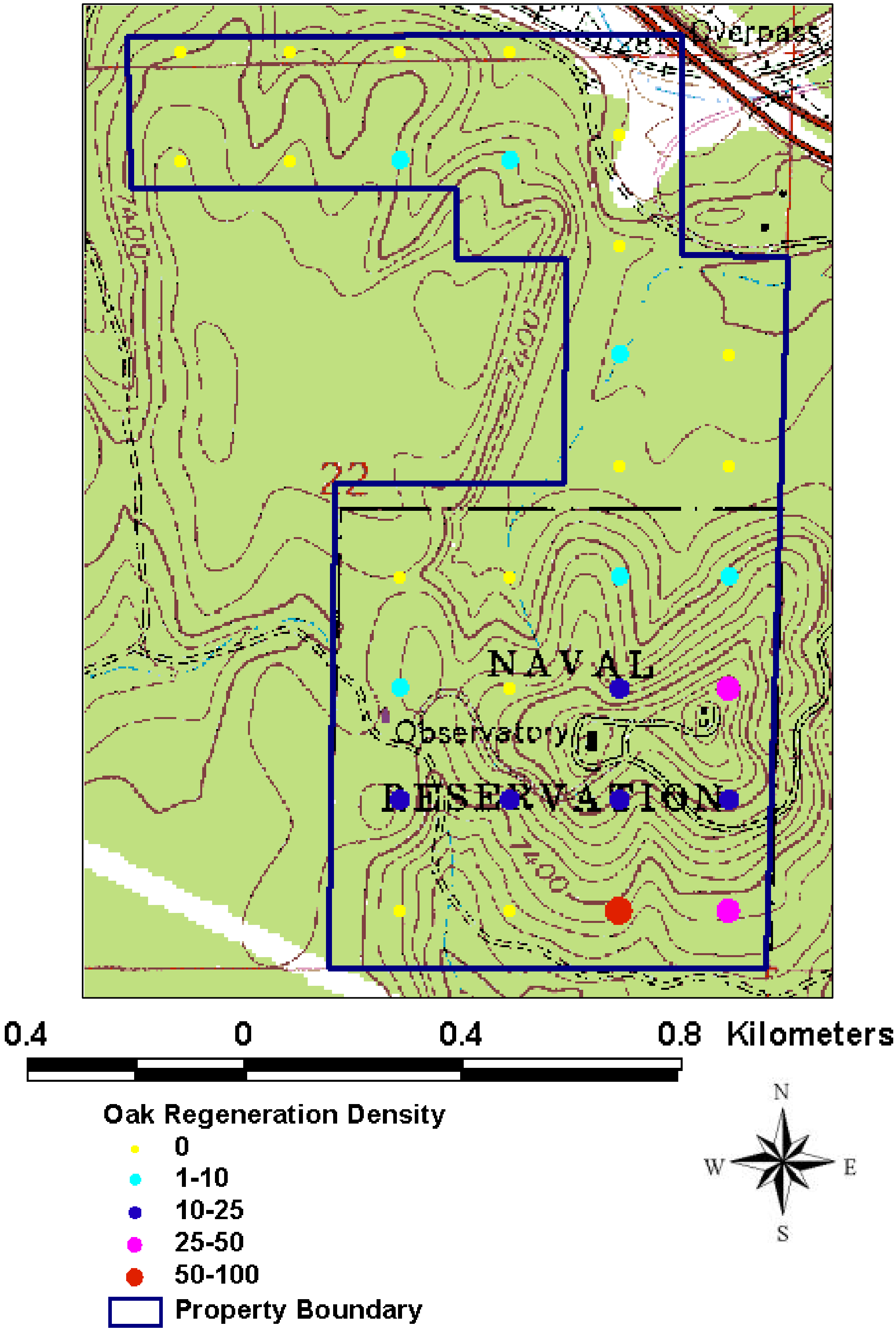

Figure 7. Number of oaks < 8 cm DRC tallied per oak regeneration plot on the U.S. Naval Observatory, Flagstaff, Arizona.

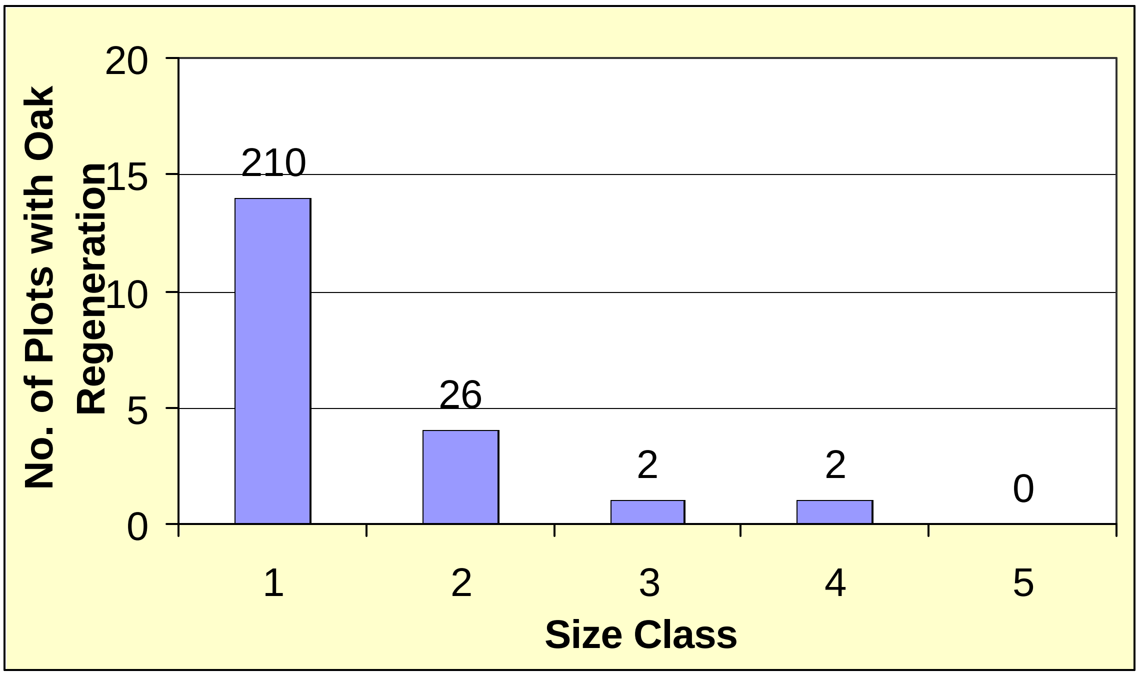

Figure 8. Number of survey plots containing oak regeneration by size class (see text); the numbers above the bars are the tallies of stems per size class.

Appendix I. – Data sheets

Example of data collection form for snag inventory.

SNAG INVENTORY - U.S. Naval Observatory

Observer(s)_________________________ Date:________ Page 1 of _____

SNAG		No. _____	No. _____	No. _____	No. _____	No. _____	No. _____	No. _____
Species								
Decay Class								
No. of Cavities	Bottom 1/3:							
	Mid 1/3:							
	Top 1/3:							
WP Foraging (1-5)								
Pitch Tubes (0 or 1)								
1B Beetles (0 or 1)								
2B Beetles (0 or 1)								
Leaf Color (G,Y,R,N/A)								
Foliage remaining (1-5)								
Bark remaining (1-5)								
Fire (1-4)								
Height (m)								
Dbh (cm)								
UTM East								
UTM North								

Example of data collection form for oak inventory.

OAK REGENERATION INVENTORY

Naval Observatory

Observer(s)____________________________

Date:______________

__

Species List:

Gambel's Oak (*Quercus gambelii*)

Turbinella Oak (*Quercus turbinella*)

Canyon Live Oak (*Quercus chrysolepis*)

AZ White Oak (*Quercus arizonica*)

Size Classes (cm): **1**) # 0.5 **2**) > 0.5 & < 2 **3**) $2 & < 4 **4**) $4 & < 6 **5**) $ 6 and < 8

NOTE: Tally all oaks within 10 m radius of UTM coordinate by size class.

Plot Number	Species	Size	Tally	UTM East	UTM North

Appendix II.

Description of variable collected during snag survey on the U.S. Naval Observatory, Flagstaff, Arizona.

SNAG DATA SHEET CODE DESCRIPTIONS

Snag number — Unique snag number; marked aluminum tag and attached to tree

Species — Four letter species code (i.e. PIPO ; Pinus ponderosa).

Decay Class
1 - Recently died, typically has little decay, and bark, branches and top are retained.
2 - Some evidence of decay; has lost some bark and branches and often a portion of the top
3 - No bark and with most branches missing.
4 - Extensive decay, missing the bark and most of the branches and has a broken top.
5 - Wood is soft and decomposing, most of tree has fallen.

No. of cavities — Count of cavities in the upper, middle, and lower 1/3 of snag.

WP Foraging — Estimate the amount of the tree's bole covered by woodpecker foraging sign in the following categories: **0** = 0%; **1** = 1-25%; **2** = 26 – 50%; **3** = 51-75%; **4** = 76-99; 5 = 100%.

Pitch Tubes — **0** = pitch tubes absent; **1** = pitch tubes present

1° Beetles — **0** = no primary beetle exit holes visible; **1** = low density of primary beetle exit holes (e.g. 1-5 per dm^2); **2** = high density of primary beetle exit holes (e.g. 10+ per dm^2). Remember that this is an "average" estimate for the entire snag.

2° Beetles — 0 = no secondary beetle exit holes visible; 1 = secondary beetle holes present.

Color — Record the snags foliage color according to the following scale: **G** = green; **Y** = yellow; **R** = red; **N/A** = the snag has no foliage.

Foliage — Estimate the amount of foliage remaining in the following categories: **0** = 0%; **1** = 1-25%; **2** = 26 – 50%; **3** = 51-75%; **4** = 76-99; **5** = 100%.

Bark — Estimate the amount of bark remaining in the following categories: **0** = 0%; **1** = 1-25%; **2** = 26 – 50%; **3** = 51-75%; **4** = 76-99; **5** = 100%.

Branching — **0** = no branching remaining on snag; **1** = primary branching; **2** = secondary branching; **3** = tertiary branching; **4** = quaternary branching. Remember that this is an "average" estimate for the entire snag.

Top Condition — **0** = intact top; **1** = top is broken.

SNAG DATA SHEET CODE DESCRIPTIONS

Fire	Record the amount of fire damage on the snag according to the following categories: **0** = no burn evidence on the snag; **1** = only the lower portion of the trunk is burned; **2** = the trunk and less than 50% of the foliage is burned; **3** = the trunk and greater than 50% of the foliage is burned; **4** = the entire snag is burned.
Height	Height of the snag measured in meters using a Hypsometer.
DBH	Diameter at breast height (4.5ft) in centimeters using a DBH tape.
UTMs	Universal Trans Mercator coordinates of the snag taken with a Garmin 3+ GPS receiver.
Lightning	Presence of lightning scar on tree. **0**= no scar; **1**=lightning scar present.
Loose Bark	Bark sloughing and loose bark still attached to tree. **0**=no loose bark; **1**=loose bark.

Appendix III.

Snag Data

Appendix IV.

Oak Regeneration Data

Appendix V.

Original Data Sheets

D.7 NOFS Mexican Spotted Owl Surveys 2006 Final Report

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Annual Report:

Mexican Spotted Owl Surveys at the U.S. Naval Observatory, Flagstaff Station and Dry Lake Protected Activity Center (PAC), 2006

Prepared by:

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EXECUTIVE SUMMARY

We conducted Mexican Spotted Owl (*Strix occidentalis lucida*) surveys at the U.S. Naval Observatory and Dry Lake Mexican Spotted Owl Protected Activity Center (PAC) in 2006. Surveys were conducted on lands administered by the Department of Defense, State of Arizona and U.S. Forest Service. Following the standardized protocol recommended by USFWS (USFWS 2002), we targeted our surveys during the Mexican Spotted Owl breeding season (1 March – 31 August). During 15 nighttime visits, we had spotted owl detections during four separate night visits, for a total of nine spotted owl detections. During one nighttime visit we visually observed three spotted owls (two adults, and possibly one juvenile) roosting in a ponderosa pine (*Pinus ponderosa)*. We conducted four day time follow up visits, and detected two spotted owls during one daytime follow-up visit. All spotted owl detections were located on Woody Mountain within or just adjacent to the Dry Lake PAC. No spotted owl detections were observed within the U.S. Naval Observatory boundary. During our spotted owl surveys we also detected five additional species of owls. These included: Great-horned Owl (*Bubo virginianus*), Long-eared Owl (*Asio otus*), Flammulated Owl (*Otus flammeolus*), Northern Pygmy Owl (*Glaucidium gnoma*), and Saw-whet Owl (*Aegolius acadicus*).

Recommended Citation: Johnson M. J., K. Etzel and R. Weber. 2007. Mexican Spotted Owl Surveys at the U.S. Naval Observatory, Flagstaff Station and Dry Lake PAC, 2006. Annual Report submitted to the U.S. Naval Observatory and Northern Arizona University. 22 pp.

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INTRODUCTION

The Mexican Spotted Owl (*Strix occidentalis lucida*) occurs in forested mountain ranges and deeply incised canyons from southern Utah and Colorado south through the mountains of Arizona, New Mexico, and west Texas into the mountains of central Mexico (Gutierrez et al. 1995). Altitudinal migration may occur in the winter to lower elevational forests and woodlands that are not normally used for breeding (Ganey et al. 1992, Willey 1993). In Arizona, the Mexican Spotted Owl is distributed widely in association with forest and steep canyon habitat (Ganey and Balda 1989, Willey 1998a).

The owl was listed as a threatened species on April 15, 1993 by the U.S. Fish and Wildlife Service (USDI 1995), and is considered threatened and a "Wildlife of Special Concern" by Arizona Game and Fish Department (AGFD 1988, AGFD, 2004.). In addition, it was placed on the Arizona Game and Fish Department's IIPAM list of sensitive species needing further study. The owl is declining in core sections of its range in Arizona (Seamans et al. 1999), and the decline may be associated with habitat loss and fragmentation (Franklin et al. 1990).

Surveys for Mexican Spotted Owls at the U.S. Naval Observatory and the Dry Lake Crater began in 1994 when State Land Department personnel first discovered a Mexican Spotted Owl immediately adjacent to the southern Naval Observatory property (Table 1). Since 1994, surveys have been conducted by the Arizona State Land Department, U.S. Forest Service and United States Geological Survey/Southwest Biological Science Center/Colorado Plateau Research Station. The number of surveys conducted at the Navy Observatory and Dry Lake PAC between 1994 and 2004 has been as low as four per season and has high as 24 (Table 1). Complete surveys during the last nine years have been inconsistent. For example, in 1995 the Naval Observatory lands were not surveyed while other areas of the Dry Lake PAC were, and in 2000 and 2002 no surveys were conducted in either site.

As part of the 1997 Naval Observatory Flagstaff Station Biological Assessment, the Department of Defense has established guidelines requiring Mexican Spotted Owl surveys every other year on Naval Observatory lands. Yet, under this contract, Mexican Spotted Owl surveys were completed in 2003 and 2004 due to the lack of complete surveys throughout the Dry Lake PAC in 2003.

Table 1. Summary of Mexican Spotted Owl surveys conducted at U.S. Naval Observatory and Dry Lake PAC, AZ, 1994-2006.

Date	**No. of visits per year.**	**No. of Mexican Spotted Owl detections and Location**	**Agency Conducting Surveys**	**Comments and Summary**
1994				
6/21/94 – 8/1/94	12	7 different MSO detections on 7 different dates, all detections in (T21N, R6E) (Identify quadrant landowner(s)	AZ State Land Dept	Single and pair MSO's detected, nesting status undetermined.
1995				
6/4/95- 7/1/95	4	Single MSO, (T21N, R6E section 25, NW1/4 nighttime visit.	U.S Forest Service	Naval Observatory not surveyed. Single MSO detected, nesting status undetermined.
1996				
Unknown	Unknown	No MSO response.	AZ State Land Dept	Details of visits unknown.

Table 1 cont.

	No. of visits	**No. of Mexican Spotted Owl detections**	**Agency Conducting**	**Comments and**

Date	per year.	and Location	Surveys	Summary
1997				
6/30/97 – 8/31/97	4	No MSO Response.	Unknown	Naval Observatory land surveyed. The protected activity center (PAC) boundary was delineated in 1997 (previously it was a Management Territory).
1998				
Unknown	Unknown	No MSO Response	AZ State Land Dept	Details of visits unknown.
1999				
6/17/99 – 8/24/99	6	No Response, visual of unknown owl.		Naval Observatory Land Surveyed.
2000				No information, area not monitored in 2000.
2001				
5/13/01-7/26/01	13	Single MSO response on 7/08/01 (T21N, R6E, Section 35, NE1/4 nighttime visit. Single MSO response on 7/10/01 same location as 7/08/01, day time visit.	U.S. Forest Service	Single MSO detected no breeding behavior or nest observed.
2002		No surveys conducted.		No information, area not monitored in 2002
2003				
3/28/03 – 7/31/03	15	No MSO's detected	USGS-SBSC-CPFS-NAU	Naval Observatory lands and Dry Lake PAC surveyed, except Woody Mountain area.
2004				
3/28/04 – 7/31/04	15	No MSO's detected	USGS-SBSC-CPFS-NAU	Naval Observatory lands and Dry Lake PAC surveyed.
2006				
4/7/06-8/17/06	15	7/6/06 - 2 MSO's detected during nighttime visit. Follow up daytime visit resulted in no detections on 7/7/06. 7/8/06 - 1 MSO response but, no response during daytime follow-up visit on 7/9/06. 8/4/06 - 2 MSO's response during nighttime visit. 8/5/06 - 2 MSO's during daytime follow up visit. 8/17/06 - 1 MSO Response at pt. 18, visually observed 3 MSO's near pt 18. No detection on 8/18/06 daytime follow up visit.	USGS-SBSC-CPFS-NAU	Naval Observatory lands and Dry Lake PAC surveyed. Ten MESO detections on Woody Mountain, no nest observed.

Mexican Spotted Owl Breeding Biology

Mexican Spotted Owls roost primarily in closed-canopy forests or rocky ledges. In these same areas they construct nests on cliff ledges, using stick nests built by other birds, or on debris platforms in trees and in tree cavities (Gutierrez et al. 1995). Forests used for roosting and nesting often contain mature or old-growth stands with a complex structure, which are typically uneven-aged, multistoried, and have high canopy closure (Gutierrez et al. 1995).

Mexican Spotted Owls nest, roost, forage, and disperse in a diverse grouping of biotic communities. Mixed-conifer forests are commonly used throughout most of the range, which may include Douglas fir (*Pseudotsuga macrocarpa)* and/or white fir *(Abies concolor)*, with species including southwestern white pine *(Pinus strobiformis)*, limber pine *(Pinus flexilis)*, and ponderosa pine (*Pinus ponderosa)*. The understory often contains the above coniferous species as well as broadleaved species such as Gambel's oak *(Quercus gambelii)*, maples (*Acer spp*.), box elder *(Acer negundo)*, and/or New Mexico locust *(Robinia neomexicana)*. In southern Arizona and Mexico, Madrean pine-oak forests are also commonly used. These forests are dominated by an overstory of Apache pine (*Pinus engelmannii)* and probably other species in Mexico, in conjunction with species such as Douglas-fir, ponderosa pine, and Arizona cypress *(Cupressus arizonica)*. Evergreen oaks are typically prominent in the understory (Brown et al. 1980). In the northern part of the range, including southern Utah, southern Colorado, and far northern Arizona and New Mexico, owls occur primarily in rocky canyons (Kertell 1977, Reynolds 1990, Rinkevich 1991, Willey 1993).

Nest placement in rocky canyons in southern Utah, Colorado, and some portions of northern New Mexico, are usually in caves or on cliff ledges. Elsewhere (Arizona, and southern New Mexico) they may also use caves and cliffs, but the majority of nests are in trees (Gutierrez et al. 1995).
Courtship begins in March and eggs are laid in late March or early April. Incubation begins shortly after the first egg is laid and is performed entirely by the female (Gutierrez et al. 1995). Female Mexican Spotted Owls generally incubate for approximately 30 days. During incubation, the female leaves the nest only to defecate, regurgitate pellets, or receive prey delivered by the male, who does most of the foraging (Gutierrez et al. 1995). The eggs usually hatch in early May (Ganey 1988, Gutierrez et al. 1995). Females leave their nests for only brief periods during the night. Nestling owls fledge four to five weeks after hatching, from early to mid-June (Ganey 1988, Gutierrez et al. 1995). The young depend on their parents for food during the summer and disperse out of the natal area in the fall (Forsman et al. 1984, Gutierrez et al. 1995).

Mexican Spotted Owl Feeding Habits

Forsman (1976) described spotted owls as "perch and pounce" predators. They typically locate prey from an elevated perch by sight or sound, then pounce on the prey and capture it with their talons. Most information on the food habits of Mexican Spotted Owls comes from analyses of regurgitated pellets (USDI 1995). Specific prey groups identified from spotted owl pellets include woodrats, mice, voles, rabbits, gophers, bats, birds, reptiles, and arthropods. The diet in most areas is heavily dominated by small, terrestrial, nocturnal mammals, but species composition varies among areas. Woodrats are generally more abundant in pellet samples collected from northern latitudes, and mice (*peromyscid spp*.) and birds are generally more abundant in southern regions of the owl's range (USDI 1995). Voles appear more common in the diet of owls dwelling at higher elevations.

OBJECTIVES

1. Conduct presence/absence protocol surveys for the Mexican Spotted Owl at the U.S. Naval Observatory, Flagstaff Station (Observatory) and throughout the Dry Lake PAC.

2. Document all Mexican Spotted Owl breeding and non-breeding activity during the breeding season (15 March – 31 August).

STUDY AREA

The survey area includes lands managed by the U.S. Naval Observatory, State of Arizona and the U.S. Forest Service. The survey area for the Naval Observatory is 287 acres. The total survey area for both the Naval Observatory and the Dry Lake PAC is 4000 acres. In addition to the core project area the survey area included a 0.5 mile buffer from the exterior boundaries. This is recommended protocol for areas that contain protected habitat and restricted habitat, as defined in the Recovery Plan (USDI 1995; Figure 1).

General estimated habitat types within the survey area include: ponderosa pine/Gambel's Oak, mixed conifer and quaking aspen (*Populus tremuloides)*. The estimated habitat type at the Naval Observatory property is dominated by ponderosa pine/Gambel's Oak, and ponderosa pine/fescue, which is also present in the Dry Lake Crater. Mixed conifer habitat is only located on the northern aspect of Dry Lake Crater. Stands of mixed conifer and Gambel's Oak are predominant along the northeastern rim of the Dry Lake Crater. Pure stands of aspen and Gambel's Oak are also located within Dry Lake Crater.

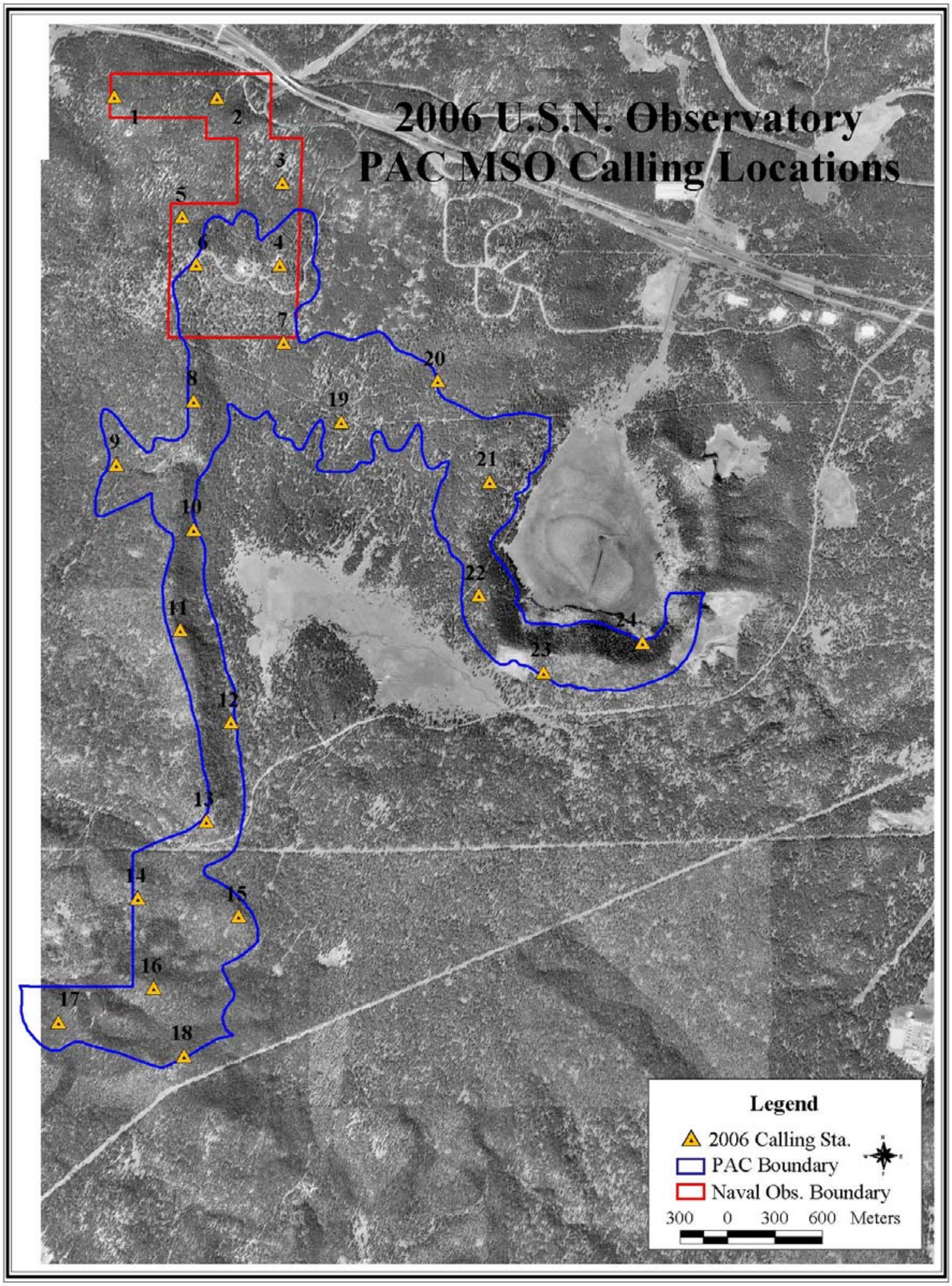
METHODS

Survey Design

The survey area at the U.S. Naval Observatory and the Dry Lake PAC included all areas where owls or their habitat may be affected by management actions. The survey area included U.S. Navy Observatory lands, and the Dry Lake PAC area and a 0.5-mile buffer from its exterior boundaries. Surveys included all areas that contain protected habitat and restricted habitat, as defined in the Recovery Plan (USDI 1995).

Calling stations and calling routes were established to ensure complete coverage of the survey area (Figure 1). Twenty-four calling stations were spaced from approximately 0.25 miles to no more than 0.5 miles apart depending upon topography and background noise levels. Nighttime calling routes and calling stations were delineated on a map and then reviewed in the field. Corrections were made in the field to improve the effectiveness of the calling stations along the route. In 2006, we surveyed all 24 points within the Naval Observatory and the MSO Dry Lake PAC.

Figure 1. Mexican Spotted Owl calling stations at U.S. Naval Observatory and Dry Lake PAC, 2006.



Mexican Spotted Owl Survey Protocol

The survey protocol used in this study followed the most recent Mexican Spotted Owl protocol released by the U.S. Fish and Wildlife Service (USFWS 2002-under review). The most efficient way to locate spotted owls is to imitate their calls (Forsman 1983). The spotted owl is territorial and responds to imitations of its common vocalizations using nocturnal calling surveys where a surveyor imitates the territorial calls of a spotted owl (Forsman 1983). Upon hearing a suspected intruder within their territories at night, most spotted owls respond by calling to and/or approaching the intruder. Spotted owl responses enable the surveyor to locate the general areas occupied by the owl. Daytime follow-up visits are used to locate roosting and/or nesting owls and to further pinpoint the activity centers of individual owls. If owls are located, mice are offered to them to locate mates, nests, and young. The information collected from nighttime calling surveys and daytime follow-up visits will assist us to determine whether areas are occupied or unoccupied by spotted owls and if they are paired, nesting, and to determine the reproductive status of the owls.

Calling

Even though most owls call during all hours of the night, our nighttime surveys concentrated around 2 hours following sunset and 2 hours prior to sunrise, which are optimal times of detection. We used nighttime surveys for all continuous or calling station routes in the survey area. All calls during each survey were imitated by the surveyor, as followed by Forsman (1983). The vocal repertoire of Mexican Spotted Owls consists of a variety of hooting, barking, and whistling calls (Ganey 1990). The four-note call of the spotted owl appears to be used most frequently by owls defending a territory. Therefore, we used all three of these calls during surveys, with the four-note call as the primary call.

Survey calling was discontinued when a potential spotted owl predator (i.e. Great-horned Owl) was detected. When predators were encountered, surveyors moved to another calling station out of earshot of the predator and resumed calling. Surveyors returned to the station skipped to complete the survey route.

Surveying during inclement weather can prevent a surveyor from hearing owl responses and reduce the quality of the overall survey effort. Negative results collected under inclement weather conditions are not adequate for evaluating spotted owl presence/absence. There is also the added risk of inducing a female owl to leave the nest during inclement weather and potentially jeopardizing nesting success. Survey calling for spotted owls did not continue during periods of rain or snow, unless there was only a light misting of rain or snow that would not affect the surveyor's ability to detect owls.

Surveys were not conducted when the wind was stronger than approximately 15 miles per hour or when the observer felt that the wind was limiting their ability to hear an owl. We used the Beaufort Wind Strength scale to record wind speed. For example a level 4 described winds 13-18 miles per hour as a moderate breeze capable of moving thin branches, raising dust, and raising paper.

We actively listened during all owl surveys. This was imperative since some owls may respond only once. In addition to active listening, we watched for owls that may be drawn in but did not respond vocally.

Mexican Spotted Owl Survey Type

In order to ensure complete coverage of the survey area, we selected a combination of methods, including: (1) calling stations and (2) continuous calling routes.

Calling Stations

We spent at least 15 minutes at each calling station: 10 minutes were devoted to calling and listening in an alternating fashion, and the last 5 minutes we listened. Owl response time varies, most likely due to individual behavior. Some owls will respond immediately, some respond following a delay, and some do not respond.

We also varied the sequence of calling stations, during subsequent visits to the area. For example, the order of visiting each calling station was reversed during each survey. Varying the order of calling stations avoids potential bias related to time of night, predator location, or other factors.

Continuous Calling

In some areas, where calling station did not adequately cover the entire area, we used the continuous calling method at the Naval Observatory and Dry Lake PAC. Continuous calling consisted of imitating owl calls at irregular intervals while walking slowly along the route (i.e. Dry Lake Rim) and stopping regularly to listen for owl responses. We walked slowly to minimize the possibility that an owl responded after we were out of hearing range. We also stopped regularly along the route to listen for owl responses.

Number and Timing of Surveys

Mexican Spotted Owl detection rates change with season and activity. Ganey (1990) found that calling activity was highest during the nesting season (March-June). Information from past survey efforts indicate that owl response may also vary with habitat type and/or reproductive chronology (Ganey 1990).

We completed five surveys and one partial survey spread out over the entire breeding season (1 March - 31 August): We conducted a minimum of two surveys during 1 March - 30 June, with no more than one survey in March. Owl response rates tend to decrease by July (Ganey 1990) and by September, juveniles have usually dispersed and adults are not necessarily on their territories. We waited at least 5 full days before beginning the next complete survey. Each survey of the Naval Observatory and the Dry Lake PAC was conducted within a period of 7 consecutive days.

During our 2006 surveys, we detected Mexican Spotted Owls on five different occasions with a conformation of three different individuals (Table 1). However, due to the late season detection and difficulty in locating birds during day-time follow up visits, we were unable to confirm breeding. It is highly recommended that surveys are continued in 2007 to monitor this potential breeding pair.

RESULTS

Survey Effort

Naval Observatory and Dry Lake PAC, 2006: During the 2006 Mexican Spotted Owl breeding season, a total of five night time visits were completed at the U.S. Navy Observatory and a six visits to the Dry Lake PAC. We conducted 24 calling station surveys during each visit from 7 – 11 April 2006; 8 - 10 May 2006 and 11 – 18 June 2006 (Table 2). When spotted owls were detected twenty calling stations were visited from 6 – 12 July 2006, and seven calling stations were visited on the 4th and 5th of August. One late visit was conducted on 17 August to follow up on the spotted owls detected earlier. During the same time periods we conducted seven continuous calling surveys within the Dry Lake PAC. One surveyor completed a total of 104 calling station surveys, 7 continuous calling surveys and four daytime follow up surveys resulting in 11 Mexican Spotted Owl detections (nine nighttime detections, two daytime detections; Table 2, Table 3).

Mexican Spotted Owl Detections

In 2006, we had a total of eleven Mexican Spotted Owl detections (Table 2, Table 3, and Figure 2). All spotted owl detections were located on Woody Mountain within or just adjacent to the Dry Lake PAC. During one nighttime visit we visually observed three spotted owls (two adults, and possibly one juvenile) roosting in a ponderosa pine (Table 2). We conducted four day time follow up visits, and detected two spotted owls during one daytime visit (Table 3). There were no Mexican Spotted Owls detected within the Naval Observatory boundary. During our spotted owl surveys we also detected five additional species of owls. These included: Great-horned Owl (*Bubo virginianus*), Long-eared Owl (*Asio otus*), Flammulated Owl (*Otus flammeolus*), Northern Pygmy Owl (*Glaucidium gnoma*), and Saw-whet Owl (*Aegolius acadicus*). Long-eared Owls were the most common species detected during these surveys. Long-eared Owl was the only species of owl detected within the Naval Observatory boundary.

Table 2. Number of Mexican Spotted Owl calling stations and continuous calling surveys completed, number of MSO's detected, other owl species detected and their location at U.S. Naval Observatory and Dry Lake PAC, 2006.

Dates Completed	# of Calling Stations Completed	# of Continuous Calling Routes Completed	MSO Detections and Locations	Other Owl Species Detected and Locations
7 April – 11 April 2006	24	2	0	NOPO pt.24 GHOW pt.21
8 May-10 May 2006	24	2	0	LEOW pts. 20,10,16 & 4 GHOW pts. 22 & 13 NSOW pt. 14
11June-18 June 2006	24	2	0	UNOW pts. 23 & 16 LEOW pt. 14
6 -12 July 2006	20	1	(3 MSO pts. 16, 15, 14.) (1 MSO pt 13)	LEOW pt. 4
4 -5 August 2006	7	0	(2 MSO's pt. 18) (1 MSO between pts. 16 and 17)	UNKN pt. 4
17 August 2006	1	0	4 MSO's, pt. 18	0
Total survey nights 15	**Total calling stations surveyed 104**	**Total continuous surveys 7**	**Total no. MSO nighttime detections 9**	**Total No. of other owl species detected 5**

*MSO = Mexican Spotted Owl, GHOW = Great-horned Owl, FLOW=Flammulated Owl, LEOW=Long-eared Owl, SWOW=Saw-whet Owl, NPOW=Northern-pygmy Owl, UNOW = Unknown Owl, UNKN= Unknown.

Table 3. Dates of Mexican Spotted Owl daytime visits, number of MSO's detected and their location at U.S. Naval Observatory and Dry Lake PAC, 2006.

Dates Completed	Location	MSO Detections
7 July 2006	Woody Mountain	0
9 July 2006	Woody Mountain	0

5 August 2006	Woody Mountain	2
18 August 2006	Woody Mountain	0
Total Survey Days **4**		**Total MSO daytime detections** **2**

Description of 2006 Mexican Spotted Owl Detections

In 2006, we had 11 Mexican Spotted Owl detections during four different nighttime surveys and one daytime follow up visit (Table 2, Table 3, and Figure 2). The following are observation descriptions of each spotted owl detection.

6 July 2006: At calling point 16 located a spotted owl initially responded with *barking* and *whining* calls. The owl then moved within 10 meters of the surveyor where it then started *four-note location* calls. The bird then proceeded to move from tree to tree calling for another ten minutes. The owl followed the surveyor to points, 15 and 14, each time responding immediately after first survey call. At this point the surveyor stopped surveying and headed back to the vehicle, the owl followed the surveyor to the vehicle giving four-note location calls the entire way. A daytime follow up visit on 7 July resulted in no spotted owl detections. **Total Mexican Spotted Owl detections = 3 nighttime detection.**

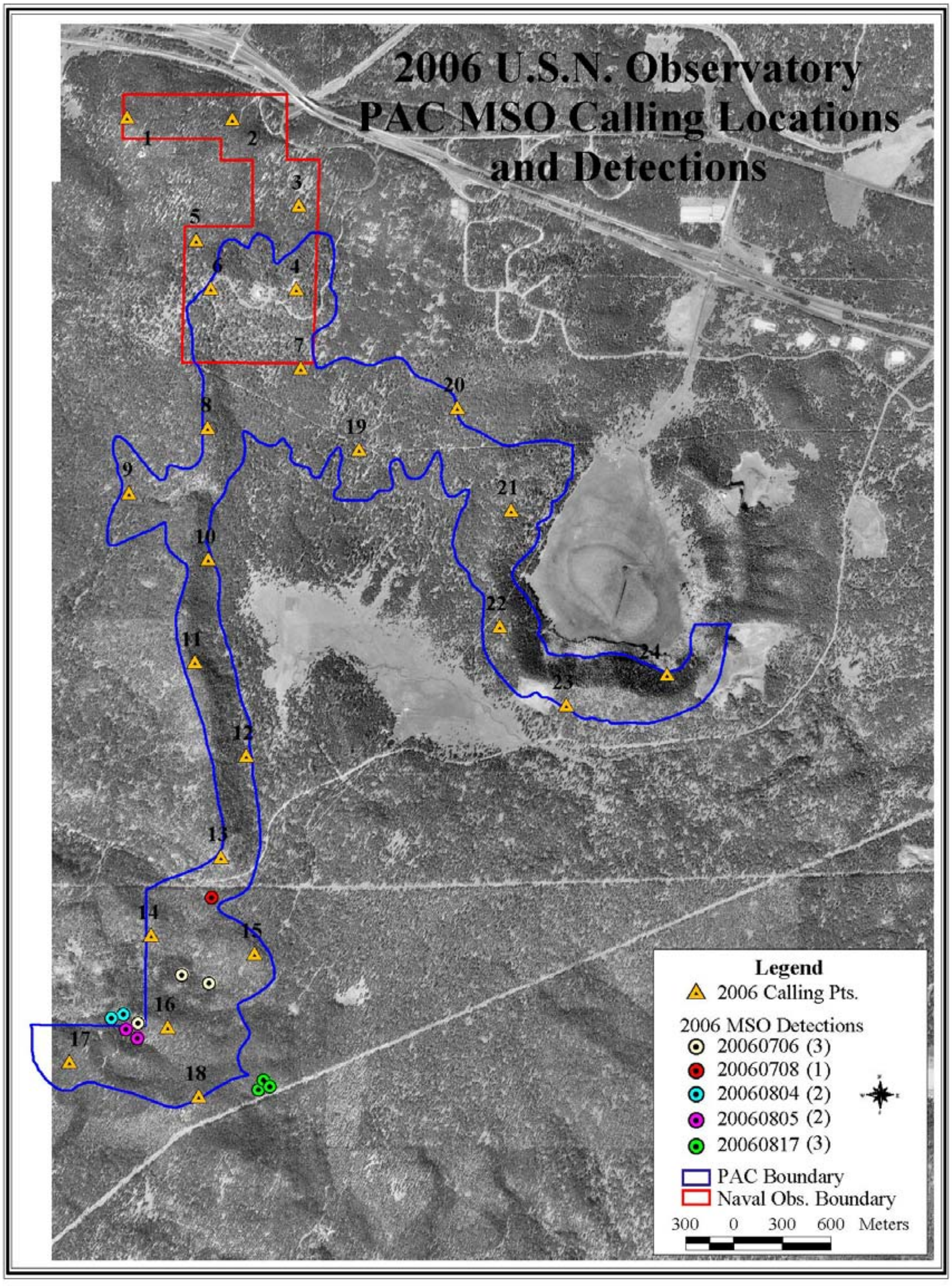
8 July 2006: Surveyor returned to point 13 to finish the survey route. After the third survey call a spotted owl responded with the four-note location call. A day time follow-up visit conducted on 9 July resulting in no detections during this visit. **Total Mexican Spotted Owl detections = 1 nighttime detection.**

4 August 2006: Two spotted owls were detected from point 18. One owl responded with four-note and barking call located between points 16 and 17. The second spotted owl vocalized *whining* calls near the first owls detected. The daytime follow-up visit on 5 August resulted in the confirmation of two adult spotted owls perched in a large ponderosa pine located in close proximity of point 18 near the previous night's detections. **Total Mexican Spotted Owl Detections = 4 (2 nighttime detections, 2 daytime detections).**

17 August 2006: Three spotted owls were detected from point 18. After seventh survey call a spotted owl responded with *barking* calls. Shortly after one male were heard giving *four-note* call and two additional spotted owls giving *whining* calls. After twenty minutes of listening, the surveyor left point 18. Upon leaving a *four-note* call was heard at point 18, the surveyor then returned to point 18 and had visual confirmation on three spotted owls in a ponderosa pine tree. A daytime follow-up visit was conducted on 18 August 2006, no spotted owls were detected, however, down feathers and white wash were observed in the area of a previous daytime detection. **Total Mexican Spotted Owl Detections = 3 nighttime detections).**

In 2006, Mexican Spotted Owl detections were concentrated in the southwestern corner of the Dry Lake PAC or just adjacent to the PAC (Figure 2). All of the detections were in the area of Woody Mountain and the majority occurred near or within one drainage on Woody Mountain. The area where most detections occurred consists of steep slopes with large Ponderosa Pines and Gambel's Oak.

Figure 2. Mexican Spotted Owl calling stations and detection locations at U.S. Naval Observatory and Dry Lake PAC, 2006. Each symbol represents the date spotted owls were detected and in parenthesis the number of owls detected on that date.



DISCUSSION

Mexican Spotted Owl Detections in 2006

During 2006, we had 11 Mexican Spotted Owl detections on Woody Mountain in the Dry Lake PAC or just adjacent to the PAC between 6 July through 18 August (Figure 2). Three surveys were conducted in this area before 6 July, yet no spotted owls were detected during these surveys. Spotted owl surveys conducted in 2006 by Arizona State Land Department at the Woody Ridge and Lebarron PAC's, just 1.5 km (1 mi) south of where these owls were detected did not detect any spotted owls. However, in 2005 a spotted owl was detected in the Woody Ridge PAC during one survey, no breeding was confirmed. The only breeding confirmation of the owls we detected on Woody Mountain may have been a possible juvenile that was observed roosting at night with two adults on 18 August.

So why were spotted owls not detected earlier when Mexican Spotted Owl calling activity is usually highest from 15 March – 30 June. It is possible that these owls could have bred adjacent to our targeted survey area, and were outside the range of our calls. After an early successful nest in that adjacent area the owls could have then dispersed to the vicinity of the Dry Lake PAC, which could have still been within the owl's home range. The mean home range of Mexican Spotted Owls in Northern Arizona can range from a size of 648 ha for individuals and 847 ha for mated pairs (Ganey and Balda 1989). Another possibility is that the owls could have also dispersed from their breeding area to the area we detected them at Woody Mountain after a failed nest. Of course these suggestions are just speculation since we do not know where these owls were earlier in the season, and very little is known about dispersal of spotted owls during this time period (USDI 1995). However, for what ever reason these owls dispersed into the Woody Mountain area, the habitat in this area is considered appropriate Mexican Spotted Owl breeding habitat (May et al. 2004). The habitat in the area where the owls were detected consists of a Ponderosa pine - Gambel's oak forest. In northern Arizona, Mexican Spotted Owls primarily use pine–oak forests and specifically roost in ponderosa pine and Gambel's oak trees (May et al. 2004). The topography of this area also consists of steep slopes which does not directly constrain home range size, but does influence location of where spotted owls activity center are located (i.e. areas that received heavy and repeated use by owls; Ganey and Balda 1989).

In 2007, we will be unable to follow up on the location or breeding status of these spotted owls since surveys are not scheduled at the Dry Lake PAC or Naval Observatory. However, surveys are scheduled in 2007 at the Woody Ridge PAC by Arizona State Land Department and NAU is scheduled in 2008 to continue surveys at the Dry Lake PAC and Naval Observatory.

Factors limiting Mexican Spotted Owls in Northern Arizona

Mexican Spotted Owl surveys at the U.S. Naval Observatory and Dry Lake PAC have previously detected owls in 1994, 1995, 2001 and now 2006. Surveys in 1994 had seven separate detections and determined that there were at least one female and possibly one pair. Nesting of these spotted owls in 1994 was undetermined. In 1995 and 2001, surveys detected unpaired Mexican Spotted Owls with no indication of breeding. The number of detections was far greater in 1994 and has dramatically declined since (Table 1). The absence of Mexican Spotted Owls within this PAC during four of the nine years of surveys is of major concern.

From 1991 through 1997, Seamans et al. (1999) studied the demographic characteristics of two Mexican Spotted Owl populations in the Upper Gila Mountains Recovery Unit. The owl populations studied were on the Coconino and Gila National Forests. The Navy Observatory and the Dry Lake PAC are in Coconino National Forest. Results of this several-year study showed a decline in the population trend of Mexican Spotted Owls within these areas. The reason for the decline is unknown. However, Seamans felt that environmental factors undoubtedly play a role in owl survival, either through weather events causing direct mortality or indirectly through reduced habitat or prey (Seamans et al. 1999). This study found that the ability of adult birds to survive successive years of poor environmental conditions might be low (Seamans et al. 1999).

The reasons why Mexican Spotted Owls are not breeding or are not consistently detected at the Naval Observatory or the Dry Lake PAC are also unknown. However, given the changes that have occurred historically in this area (logging, fire suppression and urban development), and weather events such as the ongoing drought in northern Arizona, there may be a number of factors why these owls are not consistently detected or breeding in this PAC. The following are factors considered by the Mexican Spotted Owl Recovery Plan (USDI 1995) and other spotted owl researchers that may influence Mexican Spotted Owl occupancy and breeding at the Naval Observatory and the Dry Lake PAC. These factors may support why owls are absent from this area at times even though geographically it is within their known breeding range, has adequate habitat available, and owls have historically been detected here.

Timber-harvest Practices

One of the primary factors leading to the listing of the Mexican Spotted Owl was the modification of its habitat. Habitat modification was a result of even-aged forest management, resulting in the loss of 325,000 ha of Mexican Spotted Owl habitat within Forest Service (FS) Region 3 (USDI 1995). Silviculture practices in the 1960's and 70's emphasized even-aged systems, which tended to simplify stand structure and harvest a disproportionate share of large trees. Multi-layered stands rather than even-aged stands are most often used by Mexican Spotted Owls for nesting and roosting (USDI 1995). Large trees are also an important component of spotted owl habitat and even a 20% decrease in numbers of trees >48.3 cm (19 in) diameter at breast height (dbh) removes a key habitat component of the Mexican Spotted Owl (Ganey and Dick 1995).

The forest within and surrounding the U.S. Naval Observatory and the Dry Lake PAC have been subject to various timber harvesting practices. It is unclear if silviculture practices of even-aged systems have been a regular management tool in these forests. However, it is clear that a wide variety of timber harvests have occurred here. Past timber harvest practices at the Naval Observatory, the Dry Lake PAC and the surrounding area have been the result of urban development (i.e. Flagstaff urban sprawl), fire prevention practices (e.g. tree and shrub thinning and prescribed fires) and recreational development (e.g. trails, campgrounds). The diverse timber harvests that have occurred are also a result of the large number of landowners (U.S Department of Defense, Arizona State Land Department, U.S. Forest Service and Private Land Owners) within this PAC and the surrounding area and each of the landowner's management goals. Historical timber harvest by land managers in this area may not have had the Mexican Spotted Owl in mind when management goals were initiated and did not take into account the habitat needs of the owl. Therefore, land managers have possibly had a great effect on the Mexican Spotted Owl's breeding habitat. Many of these management goals were initiated before the Mexican Spotted Owl was listed as a federally threatened species. However, it is questionable if some of these timber harvests contemplated the owls habitat needs even after the listing of this species. In the future, it is essential that both foresters and wildlife personnel work together to refine prescriptions to be compatible with maintenance of important Mexican Spotted Owl habitat elements.

Fire

Fire is a ubiquitous ecological process that influences the structure and function of conifer-dominated habitat in western North America. Humans have influenced fire regimes in northern Arizona for at least 6000-10,000 years (USDI 1995). The most recent influences range from Euro-American settlers using fire to clear land for mining and logging (Veblen and Lorenz 1991), to livestock grazing and fire suppression that have lead to structural changes in forest stands, which have further altered fire regimes (Saab et al. 1995). Recent severe fire seasons have brought fire management to the forefront of ecological restoration initiatives. One goal in Northern Arizona is to restore the natural fire regime to ponderosa pine systems, the dominant habitat type in northern Arizona, and important breeding habitat of the Mexican Spotted Owl.

With the recent fire regime changes, many forests in northern Arizona have fuel accumulations and forests overstocked with trees, placing Mexican Spotted Owls at risk with respect to stand-replacing fires. The fuel accumulation resulting from recent land management practices have initiated new management plans. Ideas have developed for more aggressive treatment of fuels using more prescribed burning and mechanical thinning to create fuel breaks in large tracks of forests where Mexican Spotted Owls breed (USDI 1995).

Fire preventive practices (i.e. mechanical thinning) are close to completion at the Naval Observatory, and currently, mechanical thinning and prescribed burning on Arizona State and U.S. Forest lands are occurring within and outside the Dry Lake PAC. These fire prevention practices are essential for maintaining the necessary characteristics of many spotted owl nest and roost sites, which in many areas are at high fire risk (USDI 1995). Yet, managers proposing tree thinning and fire prescriptions need to keep in mind the maintenance of key structural features of owl and small prey (e.g. woodrat) habitats. These include large trees (which are often fire resistant), snags, and understory hardwood trees.

To consider the owl's needs, fire prevention treatments should monitor treatment objectives and consider both short and long term goals. It is also essential that both fire and wildlife personnel work together to refine prescriptions to be compatible with maintenance of important Mexican Spotted Owl habitat elements.

Over-utilization for Commercial, Recreation, Scientific or Educational Purposes

Over-utilization through commercial, recreation, scientific or educational purposes may affect Mexican Spotted Owls directly by disturbing nests, roosts, or foraging sites. These factors may also indirectly affect Mexican Spotted Owls by altering habitat through logging, trampling of vegetation and soil damage (USDI 1995). Urban and recreational developments (e.g. campgrounds, trails and roads) may alter spotted owl habitat and habitat use and perpetuate disturbance impacts.

The forest lands surrounding the U.S. Naval Observatory and the Dry Lake MSO PAC are continuously changing due to urbanization, scientific and/or educational development (i.e. Centennial Forest, proposed Forest Health Conference Center), and recreational use (campground expansion, trails and roads). Not only does this directly affect Mexican Spotted Owl (nest and roosting disturbance) residing at the U.S. Naval Observatory and the Dry Lake PAC, but also the construction of these facilities jeopardizes the habitat these owls reside in. Again, the habitat alterations caused by this development includes the removal of large trees, snags and understory hardwood trees, all essential spotted owl structural features (USDI 1995). As mentioned previously, it is essential that both city/recreational planners and wildlife personnel work together to refine how growth and development can continue to maintain important Mexican Spotted Owl habitat elements.

Future Mexican Spotted Owl Monitoring

In order to conduct an effective Mexican Spotted Owl monitoring program, the Mexican Spotted Owl Recovery Team suggests that manager's measure changes in both habitat quantity and quality, and Mexican Spotted Owl occupancy rates (USDI 1995).

Habitat Monitoring

Ganey and Dick (1995) demonstrated that the Mexican Spotted Owl uses specific habitat characteristics. These features vary geographically, but are mainly within pine-oak and mixed-conifer forests. Spotted owls also use areas that contain large trees, snags, high log volume, multistoried stand structure, and other specific attributes. Presently, habitat trends for Mexican Spotted Owls are unknown and continue to be a subject of conflicting speculation. Yet, adequate habitat of sufficient quality must exist in the future to ensure population viability. Therefore, to support a viable population of Mexican Spotted Owls, habitat monitoring should be an essential part of the recovery process.

Habitat monitoring should address two aspects: forest types that owls prefer (macrohabitat) and specific habitat attributes within those types (microhabitat) (USDI 1995). Many studies have compared characteristics of used habitats to those of generally available habitats and have found that canopy cover, live tree basal area, snag basal area, tree density, snag density, and measures of log density or volume have differed between owl roost and/or nest sites and random sites. Seamans and Gutierrez (1995) specifically looked at basal area of large trees and found that parameter also differs between roost/nest sites and random sites. Therefore, in terms of variables related to forest structure, the MSO Recovery Plan proposes measuring/monitoring the preliminary variables listed below. It also would be desirable to include a few variables relating to shrub and herbaceous layers as surrogates of prey habitat. The MSO Recovery Plan considers the following literature in developing this list: Ganey and Balda (1994), Ganey and Dick (1995), Seamans and Gutiérrez (1995).

Mexican Spotted Owl Occupancy Monitoring

To adequately study the Mexican Spotted Owl, it is necessary to simultaneously monitor trends in both habitat quantity/quality and owl abundance (or an index thereof). Monitoring habitat as a singular effort will not reveal the true status of the owl population because numerous factors besides habitat can influence population levels (USDI 1995). Since Mexican Spotted Owls may live 16 years or more, factors unrelated to habitat quality, such as disease or competition with barred owls could result in important population changes that are not detectable through habitat monitoring (USDI 1995). Habitat quality could decline from various natural processes or anthropogenic activities, yet the territorial population could remain unchanged because of site fidelity among existing birds and recruitment of floaters.

Adequate monitoring of spotted owl populations also requires monitoring over multiple years. Long-term observational studies, such as multi-year studies of the relationships between changes in habitat quantity and/or owl abundance, contribute to an overall understanding of spotted owl population dynamics (Noon and Franklin 2002). Long-term observational studies are also required to capture sufficient environmental variation and examine hypotheses on the large-scale effects of that variation on spotted owl populations. This type of research requires substantial commitments because a period of 10–15 years is required to develop models capable of explaining effects of environmental covariates, such as climate on demographic parameters (e.g., Seamans et al. 2002).

PACs as Sampling Units for Monitoring Occupancy

PACs would seem to be a natural sampling unit to monitor occupancy. The difficulty with this scenario is that PACs are not a representative sample of available owl habitat nor do they represent the home range of an owl. PACs can only be established by the presence of an owl (USDI 1995). As a result, the occupancy rate of PACs can only decline, since each PAC is initially occupied. Additionally, PAC boundaries may change as neighboring sites are found to be occupied, creating a non-static sampling frame. In order to determine population size, the MSO Recovery Plan (USDI 1995) has recommended that the sampling unit to consist of 50-75 km plots in order to conduct population monitoring.

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Appendix 1. Protocol for when Spotted Owls are detected, determining breeding status, and locating mates and nests. Methods recommended by the USFWS (2002).

After Hearing a Spotted Owl

1. Document time the owls were first heard, the type of call heard, the owl's sex, and whether juveniles were heard.
2. Take a compass bearing from the surveyor's location to the location where the owl was heard. If possible, we will triangulate the owl's location, taking compass bearings from 2-3 locations and estimate the distance to the owl. We will record both the location where the owl responded from and the surveyor's calling location and triangulation locations on a map or photo attached to the survey form. If Mexican Spotted Owls are detected we will attempt to confirm the presence of the owl's with a daytime follow-up visit.

If the owl was heard clearly, and the call type and direction are confirmed, we will discontinue calling. If, however, there is some doubt as to whether a response was detected, or from which direction, we will listen carefully for a few minutes, as an owl may call again if given the opportunity. If the owl does not respond after a 2-5 minutes, we will continue calling in order to confirm owl presence and better assess the direction of the call. We will also record the approximate location (bearing and distance), sex, age, and species of all other raptors heard in the survey area.

Conducting Daytime Follow-up Visits

We did not detect any Mexican Spotted Owls in 2003, however, if spotted owls were detected we will complete a follow-up daytime search to assure quality of results and standardization of effort. The following are the methods that will be initiated.

A daytime follow-up visit helps locate owl roosts or nest sites by conducting an intensive search within the general vicinity of the original night response location. Owls tend to be more active in the early morning and late evening. During the day, owls are sleepy and do not always readily respond to calling. Therefore, it is critical that surveyors conduct a thorough daytime search of the response area. We will spend enough time within the response area to cover all habitats within at least a 0.5-mile radius of the response location. This will mean walking throughout the area, calling, listening, and watching for owl sign (whitewash, pellets, etc.). A minimum of 4 person-hours will be spent searching for owls. If Owls are detected at nighttime, a daytime follow-up visit will occur as soon as possible but within a maximum of 48 hours after owls are detected during nighttime surveys. If the daytime follow-up visit is performed over 48 hours from the nighttime detection, and no owls are found, the survey is considered incomplete and the nighttime surveys will continue.

If nighttime detections are observed, a daytime follow-up visit in the early morning or late afternoon/early evening will be completed. The optimal dawn period is 0.5 hour before sunrise to 2 hours after sunrise and the optimal dusk period is 2 hours prior to sunset; each daytime follow-up visit will include one of these time periods. Investing time in searching for the owl during these times will provide a more reliable inference of absence in the case where the owl cannot be located.

To conduct a thorough search for owls, we will systematically walk and call all protected and restricted habitat within the search area. We will search for signs of owls such as pellets, white wash, or molted feathers. If no owls are located during complete daytime follow-up visits, we will return to conduct nighttime surveys.

If Spotted Owls are located on a Daytime Follow-up Visit

If Mexican Spotted Owls are detected during the day time we will follow the protocol for “mousing”, which is the primary tool to locate an owl's mate, young, and/or nest. Mousing entails feeding mice to adult/subadult owls and observing the owls' subsequent behavior. We will be prepared to offer four mice (one at a time) to at least one member of the pair or to the single owl located on the daytime follow-up visit.

If an owl takes a mouse and flies away, we will follow it as closely as possible to determine where it takes the mouse. If the surveyor is unable to follow the owl, and doesn’t know if it took the mouse to a mate, nest, or fledged young, then the fate of that mouse cannot be counted toward the four-mouse minimum described above. We will be ready to rapidly pursue owls that take mice, as owls sometimes fly with mice several hundred yards to reach their nests or young. We will complete the four-mouse minimum after a mouse has unequivocally been taken to a nest.

Determining Status from Nighttime Surveys and Daytime Follow-up Visits

A. If spotted owls are detected within the Naval Observatory or the Dry Lake PAC “pair status will be established by any of the following:
1. A male and female owl are heard and/or observed in proximity (#0.25 mile apart) to each other on the same visit.
2. A male takes a mouse to a female.
3. A female is observed on a nest.
4. One or both adults are observed with young.

B. Single status is inferred from:
1. The presence or response of a single owl within the same general area on two or more occasions, with no response by an owl of the opposite sex after two complete inventories (two years of survey); <u>or</u>
2. Multiple responses over several years from a bird of the same sex (i.e., two responses in first year of surveys and one response in the second year of surveys, from the same general area).

C. Separate territories are inferred by:

Any two owl responses more than 0.5 miles apart should be considered separate territories unless daytime follow-up visits indicate otherwise. Ideally, to rule out the existence of multiple territories, surveyors on two or more crews will coordinate efforts to begin calling simultaneously near each suspected activity area. If more than one survey crew elicits responses from owls of the same sex at roughly the same time, then additional territories probably exist. However, if responses vary from those above, the results are considered inconclusive and additional attempts to determine status will continue.

<u>Determining Nesting Status and Reproductive Success</u>

Reproduction surveys are always valuable as they may provide information on nest tree locations, which provide the best data for determining 100-acre nest buffers and delineating PAC boundaries as recommended in the Recovery Plan (USDI 1995). If the exact location of the nest is not found, but juveniles are seen prior to 1 August, the area where the juveniles are seen may be referenced as the nest stand. There are two stages of reproduction surveys if spotted owls are detected at the Naval Observatory of the Dry Lake PAC: nesting status and reproductive success.
A. Determining Nesting Status:

1. Conduct nesting-status surveys between 1 April and 1 June. The start date is based on nesting initiation dates. Young identified after 1 June would still confirm that nesting occurred, but would not allow identification of the nest site.
2. Use mousing to determine nesting status. The site will be classified as nesting, non-nesting, or unknown nesting status based on the surveyor's observations.
3. Two observations at least one week apart are necessary to determine nesting status if the first observation occurs before 1 May. This is necessary because the owls may show signs of initiating nesting early in the season without actually laying eggs and their behavior could be mistaken for nesting behavior. After 1 May, a single observation of nesting behavior is sufficient.
4. The owls will be classified as nesting if, on two visits prior to 1 May, or one visit after 1 May:
   a. The female is seen on the nest.
   b. Either the male or female member of a pair carries a mouse to a nest.
   c. Young-of-the-year are detected.
5. The owls will be classified as non-nesting if any of the following behaviors are observed. Two observations, minimum three weeks apart, are required during the nest survey period (1 April - 1 June) in order to infer non-nesting status. Because nesting attempts may fail before surveys are conducted, the non-nesting status includes owls that did not attempt to nest as well as those that have failed. Non-nesting status is inferred during a daytime follow-up visit if:
   a. The female is observed roosting for a full 60 minutes (1 April - 30 April) during the time she should be on a nest. The female should not be in an agitated state and should be given every opportunity to return to the nest. Surveyors will attempt to mouse the female.
   b. The surveyor offers prey to one or both members of the pair and they cache the prey, sit with the prey for an extended period of time (30-60 minutes), or refuse to take additional prey beyond the minimum of two prey items. To be considered a valid nesting survey, one owl must take <u>at least</u> two prey items.
   c. All pairs determined to be non-nesting will receive at least one daytime follow-up visit between 15 May and 15 July to confirm that no juveniles were produced.

6. Nesting status unknown:
   a. If owls are found after 1 June, without young-of-the-year, nesting status is unknown.
   b. If no owls are found after 1 June (at those sites where owls were present prior to 1 June), nesting status is unknown.
   c. Determining Reproductive Success
      1. Once a pair is classified as nesting, conduct reproductive success surveys after the time the young-of-the-year leave the nest (fledge), usually in early to mid-June. Conduct reproductive success surveys between 15 May and 15 July for pairs for which nesting status was not established.
      2. Schedule at least two visits to the site spaced at least one week apart to locate and count fledged young, timing the visits so that the fledged young are observed as soon after leaving the nest as possible.
      3. Use visual searches and/or mousing. The mousing protocol is the same as for determining non-nesting. If young are present, the adults should take at least some of the prey to the young. The sight of an adult with prey can stimulate the young to beg, revealing their number and location.
      4. If the owls take at least two prey items and eventually cache, sit with, or refuse further prey without ever taking prey to fledged young on at least two occasions, separated by at least one week, zero young are recorded.

Appendix E: Reporting on Migratory Bird Management

Each INRMP must address the conservation of birds and their habitat to promote and support migratory birds in compliance with the MBTA, EO 13186 and any subsequent rules, and agreements. This is accomplished largely by leveraging DoD conservation efforts with appropriate State/Regional Bird Conservation Plans. Additional information on this is available on the DoDPIF Website: www.dodpif.org.

Migratory Bird Rule. In an effort to provide guidance for conflicts arising between military readiness activities and the MBTA, the USFWS issued the final rule on Migratory Bird Permits: Take of Migratory Birds by the Armed Forces (50 CFR Part 21 in the 28 February 2007 FR, pages 8931-8950). The Migratory Bird Rule authorizes the military to "take" migratory birds during military readiness exercises under the MBTA without a permit, but if the military determines that the activity will significantly affect a population of migratory birds, they must work with the USFWS to implement conservation measures to minimize and/or mitigate the effects.

Many natural resources management activities benefit migratory birds including habitat management, erosion control, managing a healthy forestry with little human activity, conservation law and trespass enforcement, invasive weed management, managing fuel loads to prevent stand-replacing wildfires, protecting Gambel oaks, snags, and dead-and-down debris, and prescribed burning.

In addition, this INRMP provides for expanded point count surveys. Conservation measures are designed around management focus species called out in regional conservation initiatives. Besides the Mexican spotted owl, management measures are designed for the migratory birds that use NOFS for stopover resting, feeding, and nesting, emphasizing snag-dependent and cavity-nesting birds.

Finally, the recently implemented thinning at NOFS was undertaken to prevent catastrophic wildfire, and to promote forest health. A twenty-foot spacing between trees was prescribed on 250 acres, while 37 acres were left untreated. This treatment created a patchwork of alternatively structured stands. This prescription should provide habitat for species that prefer more open mature forests (northern goshawk), as well as those that prefer mixed stands with higher densities (olive-sided flycatcher, and the cordilleran flycatcher). Careful monitoring of snags has begun across the entire property to track wildlife use and snag quality (Ingraldi and Bayless 2005).

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Appendix F: Critical Habitat Designation Criteria and INRMP Benefits for Endangered Species

The ESA was revised via the National Defense Authorization Act of 2004 (PL 108-136) to recognize INRMP conservation measures and species benefit that could obviate the need for critical habitat designation on Navy lands.

Section 4(a)(3) of the revised ESA states that: "The Secretary [of the Interior] shall not designate as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense, or designated for its use, that are subject to an integrated natural resources management plan prepared under Section 101 of the Sikes Act (as amended) (16 USC 670a), if the Secretary determines in writing that such plan provides a benefit to the species for which critical habitat is proposed for designation."

All Navy installations with federally listed threatened or endangered species, proposed Federally listed threatened or endangered species, candidate species, or unoccupied habitat for a listed species where critical habitat may be designated, must structure the INRMP to avoid the designation of critical habitat. The INRMP may obviate the need for critical habitat if it specifically addresses both the benefit provided to the listed species and the provisions made for the long-term conservation of the species. The species benefit must be clearly identifiable in the document and should be referenced as a specific topic in the INRMP table of contents.

The USFWS uses a three-point criteria test, to determine if an INRMP provides a benefit to the species. An installation is strongly encouraged to use these USFWS criteria, listed below, when structuring its INRMP to avoid the need for critical habitat designation.

a) The plan provides a conservation benefit to the species. The cumulative benefits of the management activities identified in a management plan, for the length of the plan, must maintain or provide for an increase in a species' population, or the enhancement or restoration of its habitat within the area covered by the plan [i.e., those areas deemed essential to the conservation of the species]. A conservation benefit may result from reducing fragmentation of habitat, maintaining or increasing populations, insuring against catastrophic events, enhancing and restoring habitats, buffering protected areas, or testing and implementing new conservation strategies.

b) The plan provides certainty that the management plan will be implemented.Persons charged with plan implementation are capable of accomplishing the objectives of the management plan and have adequate funding for the management plan. They have the authority to implement the plan and have obtained all the necessary authorizations or approvals. An implementation schedule, including completion dates, for the conservation effort is provided in the plan.

c) The plan provides certainty that the conservation effort will be effective. The following criteria will be considered when determining the effectiveness of the conservation effort. The plan includes 1) biological goals (broad guiding principles for the program) and objectives (measurable targets for achieving the goals); 2) quantifiable, scientifically valid parameters that will demonstrate achievement of objectives and standards for these parameters by which progress will be measured are identified; 3) provisions for monitoring and, where appropriate, adaptive management; 4) provisions for reporting progress on implementation (based on compliance with the implementation schedule) and effectiveness (based on evaluation of quantifiable parameters) of the conservation effort are provided; and 5) a duration sufficient to implement the plan and achieve the benefits of its goals and objectives.

In the Final Rule to designate Critical Habitat for the Mexican spotted owl published on August 31, 2004 69 FR 53181 53298, it is stated, under the Summary of Changes From the Proposed Rule, that "Fort Carson, Colorado, Fort Huachuca, Arizona, and the U.S. Naval Observatory Flagstaff Station, Arizona, are excluded because they have final INRMPs and are consistent with the 2004 National Defense Authorization Act (PL 108-136, November 2003), Section 318, Military Readiness and Conservation of Protected Species which amended section 4(a)(3) of the Act".

Concurrent with a determination to list a species as threatened or endangered, the Secretary of Interior is required to designate any habitat of the species that is considered to be critical habitat. However, the ESA was revised via the National Defense Authorization Act of 2004 (PL 108-136) to recognize INRMP conservation measures and species benefit that could obviate the need for critical habitat designation on Navy lands.

The following excerpt for this 2008 INRMP addresses the three-point criteria.

Objective: Provide a conservation benefit to the Mexican spotted owl by insuring against catastrophic loss of all habitat by uncontrolled wildfire, by maintaining a healthy forest, and by providing for the protection of oaks and growth of large pines for coming decades.

Criteria: The cumulative benefits of the management activities identified maintains or provides for an increase in a species' population, or the enhancement or restoration of its habitat within the area covered by the plan [i.e., those areas deemed essential to the conservation of the species]. A conservation benefit may result from reducing fragmentation of habitat, maintaining or increasing populations, insuring against catastrophic events, enhancing and restoring habitats, buffering protected areas, or testing and implementing new conservation strategies. Naval Observatory Flagstaff Station must provide assurances that the management plan will be implemented.

I. The recently implemented thinning at NOFS was undertaken to prevent catastrophic wildfire, and to promote forest health. A 20-foot spacing between trees was prescribed on 250 acres, while 37 acres were left untreated. This treatment created a patchwork of alternatively structured stands. This prescription should provide habitat for species that prefer more open mature forests (northern goshawk), as well as those that prefer mixed stands with higher densities (olive-sided flycatcher, and the cordilleran flycatcher). Careful monitoring of snags has begun across the entire property to track wildlife use and snag quality (Ingraldi and Bayless 2005).

- *A.* Broad guiding principles for the Mexican spotted owl program are: to protect the forestland within the PAC of the Mexican spotted owl; to conduct microhabitat monitoring; and to conduct Mexican spotted owl surveys; to enhance and treat the adjacent pine-oak forest areas (i.e., non-PAC areas) to encourage late-successional stage forest structure; to conduct forest management operations in an integrated, multi-disciplinary manner in support of the base mission and natural resources conservation. Measurable targets for achieving these goals will be the protection and integrity of the PAC area forestland to enhance structural and biological diversity.
- *B.* Quantifiable parameters for demonstrating achievement of these objectives include:
  - the number of acres of PAC forestland managed;
  - acres of forest with improved structural diversity following silvicultural treatment; the number of unoccupied but suitable habitat preserved;
  - and others as appropriate to specific resources issues.

C. Monitoring will be achieved through field and office review of protected and treated areas; treated areas will be monitored through the approved micro-habitat monitoring protocol; large organic debris will be assessed using a USFS photo guide. Treatments will be evaluated over multiple plan lifetimes to determine efficacy.

D. Progress on implementation will be documented stand by stand or by areas treated and by microhabitat plots monitored over time. This information will be added to the GIS database for evaluation and inclusion in the subsequent INRMP revision.

II. Mitigation Measures Specific to the Mexican spotted owl incorporated in the most recent BO:

A. Dirt roads will not be upgraded and will be chained off wherever practical to minimize trespassing that may result in illegal cutting of oaks for fuelwood.

B. Limiting development to the Operations Area will provide future development protection to key property areas that have the most potential for attracting the Mexican spotted owl.

C. The Navy will sponsor protocol Mexican spotted owl surveys. The most recent surveys were completed for the entire Dry Lake PAC during the 1999 breeding season.

D. Results of Mexican spotted owl surveys will be sent to the Navy monthly to keep project and construction personnel appraised of Mexican spotted owl. If an Mexican spotted owl is detected on or within 1/2 kilometer of Navy property, the Navy will, after consulting with survey personnel, notify the USFWS within 72 hours of the detection.

E. If a nest or recurring roost is located within 1/4 mile of construction, stipulations of the consultation will be renegotiated for breeding timing restrictions (March 1–August 31) on outdoor construction.

F. If prescribed burning is conducted as part of the thinning operation, large or snag oaks and pines will be protected by lining or scraping around them.

G. Steep drainages (greater than 40 percent slope) within the PAC and outside the Operations Area will incur the minimum amount of thinning required for fire control, while leaving all snag oaks and pines. Target thinning density remains 20-foot on center.

H. Naval Observatory Flagstaff Station will avoid the Mexican spotted owl breeding season when meeting any future project construction goals, or will undergo further consultation with USFWS.

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Appendix G: Lighting Ordinance

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Revised Flagstaff Arizona Outdoor Lighting Ordinance

Flagstaff Lighting Code -- Division 10-08-002 of the Land Development Code (LDC)

First Flagstaff outdoor lighting restrictions: 1958
First Flagstaff comprehensive outdoor lighting code: 1973
Major revision and update (LPS; lumens/acre): November 1989
Land Development Code revision: April 1991
Updated (Canopy caps): June 1999

DIVISION 10-08-002. DEVELOPMENT LIGHTING REGULATIONS

10-08-002-0001. INTENT AND PURPOSE

It is the intent of this Division to encourage lighting practices and systems which will: minimize light pollution, glare, light trespass; conserve energy and resources while maintaining night-time safety, utility, security and productivity; and curtail the degradation of the night time visual environment. It is recognized that since topographic and atmospheric conditions surrounding the City of Flagstaff are uniquely suited for astronomical observation and since observatories have been established in the City's vicinity, the City of Flagstaff, through the provisions herein contained, promotes the reduction of light pollution which interferes with the successful operation of such observatories. The effects of outdoor lighting on the light pollution over the observatories is strongly dependent on the distance of those lights from the observatories; therefore, three Astronomical Zones are hereby established, allowing increased flexibility in the uses of outdoor lighting farther from the observatories.

10-08-002-0002. APPLICABILITY

A. NEW USES, BUILDINGS AND ADDITIONS: All proposed new land uses, developments, buildings, structures, or building additions of twenty-five (25) percent or more in terms of additional dwelling units, gross floor area, seating capacity, or other units of measurement specified herein, either with a single addition or cumulative additions subsequent to the effective date of this provision, August 5, 1999, shall meet the requirements of this Division for the entire property. This includes additions which increase the total number of required parking spaces by twenty-five (25) percent or more. For all building additions of less than twenty-five (25) percent cumulative, the applicant shall only have to meet the requirements of this Division for any new outdoor lighting provided.

B. CHANGE OF USE/INTENSITY: Except as provided in subsection C below, whenever the use of any existing building, structure, or premises is changed to a new use, or the intensity of use is increased through the incorporation of additional dwelling units, gross floor area, seating capacity, or other units of measurement specified herein, and which change of use or intensification of use creates a need for an increase in the total number of parking spaces of twenty-five (25) percent or more, either with a single change or cumulative changes subsequent to the effective date of this provision, August 5, 1999, then all outdoor lighting facilities shall meet the requirements of this Division for the entire property, to the maximum extent possible as determined by the Planning Director. For changes of use or intensity which require an increase in parking of less than twenty-five (25) percent cumulative, the applicant shall only have to meet the requirements of this Division for any new outdoor lighting provided.

C. NONCONFORMING USES, STRUCTURES OR LOTS: Whenever a nonconforming use, structure or lot is abandoned for a period of one hundred eighty (180) consecutive days and then changed to a new use according to the requirements of Sections 10-10-005-0003 and 0004 of this Code, then any existing outdoor lighting shall be reviewed and brought into compliance as necessary for the entire building, structure or premises, to the maximum extent possible as determined by the Planning Director.

10-08-002-0003. APPROVED MATERIALS AND METHODS OF CONSTRUCTION OR INSTALLATION / OPERATION:

A. Preferred Source - Low-pressure Sodium (LPS) lamps are the preferred illumination source throughout the city; their use is to be encouraged, when not required, for outdoor illumination whenever its use would not be detrimental to the use of the property.

B. Uses that can turn off their outdoor lighting during night hours are to be encouraged in Astronomical Zone I (Section 10-08-002-0004); those which require all night illumination are to be discouraged.

C. The provisions of this Division are not intended to prevent the use of any design, material or method of installation or operation not specifically prescribed herein, provided any such alternate has been approved by the Planning Director. The Planning Director may approve any such proposed alternate provided he/she finds that it:
   1. Provides at least approximate equivalence to the applicable specific requirements of this Division; and
   2. is otherwise satisfactory and complies with the intent of this Division.

10-08-02-0004. ESTABLISHMENT OF ASTRONOMICAL ZONES:

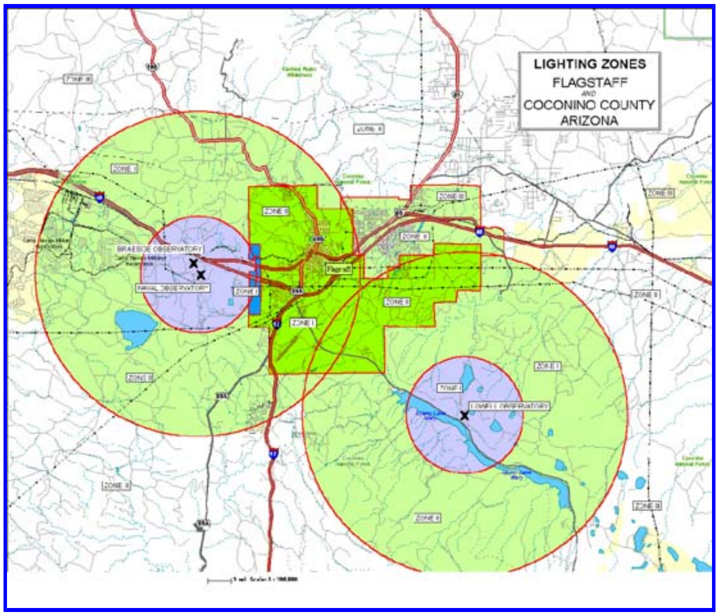

Illustration 10-08-002-0004 showing the established astronomical zones. Click for a larger view.

A. Three Astronomical Zones are hereby established: Zone I is in two parts centered at the observatories located on Anderson Mesa (Lowell Observatory) and west of Flagstaff (Naval Observatory); the outer boundary of Zone I is set at approximately two and one-half (2.5) miles from these observatories. Zone II extends from the outer boundary of Zone I to approximately seven miles from the observatories. Zone III is all remaining property within the City limits. These Zones are shown in Illustration 10-08-002-0004, the Astronomical Zone Map, and by this reference made a part hereof.

B. A parcel located in more than one of the described Zones shall be considered to be only in the more restrictive Zone.

10-08-002-0005. GENERAL REQUIREMENTS, ALL ZONES:

A. Outdoor floodlighting by flood light projection above the horizontal plane is prohibited.

B. All light fixtures that are required to be shielded shall be installed in such a manner that the shielding is effective as described in Chapter 10-14, Definitions, for fully or partially shielded fixtures.

C. All light fixtures, except street lights, shall be located, aimed or shielded so as to minimize stray light trespassing across property boundaries.

D. The installation, sale, offering for sale, lease or purchase of any mercury vapor light fixture or lamp for use as outdoor lighting is prohibited, except that until 1 January 1996, the provisions of this Subsection shall not apply to any replacement bulb.

E. Search lights, laser source lights, or any similar high-intensity light shall not be permitted, except in emergencies by police and fire personnel or at their direction; or for meteorological data gathering purposes.

F. Class 1 lighting may continue only until 9:00 pm or for as long as the area is in active use. See Table 10-08-002-0005 and Chapter 10-14, DEFINITIONS, for an explanation and use of the different classes of lighting.

G. Any lamp type that has been determined to emit substantial non-visible radiation, as determined from manufacturer's specifications or photometric test, requires a filter that blocks this non-visible radiation. Examples of such lamps include, but are not limited to, Quartz-Halogen and fluorescent. For infrared security lighting, see Section 10-08-002-0010.

H. Illumination for outdoor recreation facilities must conform to the shielding requirements of Table 10-08-002-0005 below, except when such shielding would interfere with the intended activity. For such facilities, partially-shielded luminaires are permitted. Examples of activities where partially-shielded luminaires are permitted include, but are not limited to, baseball, softball, and football. Specifically, tennis, volleyball, raquetball and handball courts and swimming pools must utilize fully-shielded luminaires. Where fully-shielded luminaires are required, the light fixtures must also conform to the requirements of Subsection C above regarding light trespass.

I. Multi-class lighting must either conform to the lamp-type and shielding requirements of the most strict class, as shown in Table 10-08-002-0005, or conform to the time limitations of the least strict class.

J. External illumination for signs shall conform to the provisions of this Division.

K. On projects where an engineer or architect is required, the developer shall verify in writing to the City that all outdoor lighting was installed in accordance with the approved plans.

L. Outdoor Light Output, Total. The maximum total amount of light, measured in lumens, from all outdoor light fixtures. For lamp types that vary in their output as they age (such as high pressure sodium), the initial output, as defined by the manufacturer, is the value to be considered. For determining compliance with sections 10-08-002-0006A, -0007A and -0008A of this Division, the light emitted from outdoor light fixtures is to be included in the total output as follows:

1. Outdoor light fixtures installed on poles (such as parking lot luminaires) and light fixtures installed on the sides of buildings or other structures, when not shielded from above by the structure itself as defined in paragraphs 2 and 3 below, are to be included in the total outdoor light output by simply adding the lumen outputs of the lamps used;
2. Outdoor light fixtures installed under canopies, building overhangs, or roof eaves where the center of the lamp or luminaire is located at least five (5) feet but less than ten (10) feet from the nearest edge of the canopy or overhang are to be included in the total outdoor light output as though they produced only one-quarter (1/4) of the lamp's rated lumen output;
3. Outdoor light fixtures located under the canopy and ten (10) or more feet from the nearest edge of a canopy, building overhang, or eave are to be included in the total outdoor light output as though they produced only one-tenth (1/10) of the lamp's rated lumen output.

M. Service Station Canopy Lighting. In addition to the calculations for paragraph L.2 and 3 above, the following requirements apply to service station canopies:

1. All luminaires mounted on the under surface of service station canopies shall be fully shielded and utilize flat glass or flat plastic (acrylic or polycarbonate) covers.
2. The total light output used for illuminating service station canopies, defined as the sum of all under-canopy initial bare-lamp outputs in lumens, shall not exceed forty (40) lumens per square foot of canopy in Zones II and III, and shall not exceed twenty (20) lumens per

square foot in Zone I. All lighting mounted under the canopy, including but not limited to luminaires mounted on the lower surface of the canopy and auxiliary lighting within signage or panels over the pumps, is to be included toward the total.

N. Neon lighting is permitted, so long as lumen calculations from such lighting are included in the total lumen calculations for the site, required by this section. Lumens are calculated on a per foot basis, rather than per "fixture." Such lighting shall also be subject to the shielding requirements of this section, unless exempted by Table 10-08-002-0005.

Table 10-08-002-0005
TABLE OF LAMP SOURCE AND SHIELDING STANDARDS

LAMP TYPE	ZONE I	ZONE II	ZONE III
Class 1 lighting (Color Rendition):			
Low-pressure Sodium above 4,050 lumens	F	F	F
Others above 4,050 lumens	X	F	F
All types below 4,050 lumens	F*	F	P
Class 2 lighting (General Illumination):			
Low-pressure Sodium above 4,050 lumens	F	F	F
Others above 4,050 lumens	X	X***	X***
All types below 4,050 lumens	F*/**	F**	F**
Class 3 Lighting (Decorative):			
Low-pressure Sodium above 4,050 lumens	F	F	F
Others above 4,050 lumens	X	F	F
All types below 4,050 lumens	F*	A	A

Use Code:

A = Unshielded lights allowed; shielding not required but highly recommended. (Unshielded and/or partially shielded lights limited to a maximum of 5,500 lumens per net acre).
F = Allowed, fully shielded
P = Partially shielded lights allowed. (Partially and/or unshielded lights limited to a maximum of 5,500 lumens per net acre).
X = Prohibited, except as noted.

* Non-LPS lights in Zone I are limited to a maximum of 5,500 lumens per net acre.

** Exception: lamps emitting no more than 4,720 lumens used for each single-family dwelling or duplex dwelling unit for residential outdoor lighting purposes are exempt from the shielding requirement. This is equivalen to four (4) 75-watt incandescent bulbs. Single-Family attached units (e.g. townhouses), and multi-family residential units are limited to 50% of this amount, or 2360 lumens of unshielded lights per unit.

*** Non-LPS lights are permitted if outdoor light fixtures are fully shielded and located under and five (5) or more feet from the

```
nearest edge of a canopy, building overhang, or eave.

Examples of lamp types of 4050 lumens and below are (the
acceptability of a particular light is decided by its lumen
output, not wattage; check manufacturer's specifications):

1. 200 Watt Standard Incandescent
2. 150 Watt Tungsten-Halogen (quartz)
3.  50 Watt High Pressure Sodium
4.  50 Watt Cool White Fluorescent
5.  30 Watt Low Pressure Sodium
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10-08-002-0006. SPECIAL REQUIREMENTS, ZONE I:

A. Total outdoor light output (excluding streetlights used for illumination of public rights-of-way) of any development project in Zone I shall not exceed 25,000 lumens per net acre, averaged over the entire project. Non-LPS lighting permitted in Table 10-08-002-0005 is limited to a total of 5,500 lumens per net acre, except that lamp(s) emitting no more than 4,720 lumens per single family dwelling unit or duplex dwelling unit for residential outdoor lighting purposes are exempt from the shielding requirements of Table 10-08-002-0005, though they must conform to all other applicable restrictions. Single-Family attached units (e.g. townhouses), and multi-family residential units are limited to 2360 lumens of unshielded lights per unit.

B. Outdoor recreational facilities are not subject to the lumens per net acre limit set in this Subsection. However, no such facility in Zone I shall be illuminated after 9:00 pm, except to conclude a scheduled recreational or sporting event in progress prior to 9:00 pm.

C. Outdoor internally illuminated advertising signs shall be constructed with an opaque background and translucent letters and symbols. (Opaque means that the material must not transmit light from an internal illumination source.) Lamps used for internal illumination of such signs shall not be included in the lumens per net acre limit set in this Section. Such signs shall be turned off at 9:00 pm or when the business closes, whichever is later.

D. Class 3 lighting must be extinguished at 9:00 pm or when the business closes, whichever is later, except that low-wattage holiday decorations may remain on all night from November 15 through January 15.

10-08-002-0007. SPECIAL REQUIREMENTS, ZONE II:

A. Total outdoor light output (excluding streetlights used for illumination of public rights-of-way) of any development project in Zone II shall not exceed 50,000 lumens per net acre, averaged over the entire project. Furthermore, no more than 5,500 lumens per net acre may be accounted for by lamps in unshielded or partially-shielded fixtures permitted in Table 10-08-002-0005, except that lamp(s) emitting no more than 4,720 lumens per single family dwelling unit or duplex dwelling unit for residential outdoor lighting purposes are exempt from the shielding requirements of Table 10-08-002-0005, though they must conform to all other applicable restrictions. Single-Family attached units (e.g. townhouses), and multi-family residential units are limited to 2360 lumens of unshielded lights per unit.

B. Outdoor recreational facilities are not subject to the lumens per net acre limit set in Subsection 10-08-002-0007.A. However, no such facility in Zone II shall be illuminated after 11:00 pm, except to conclude a scheduled recreational or sporting event in progress prior to 11:00 pm.

C. Outdoor internally illuminated advertising signs shall be constructed with an opaque background and translucent letters and symbols, or with a colored (not white, cream, off-white, or yellow) background and lighter letters and symbols. Lamps used for internal illumination of such signs shall not be included in the lumens per net acre limit set in this Section. Such signs shall be turned off at 11:00 pm or when the business closes, whichever is later.

D. Class 3 lighting must be extinguished at 11:00 pm or when the business closes, whichever is later, except that low-wattage holiday decorations may remain on all night from November 15 to January 15.

10-08-002-0008. SPECIAL REQUIREMENTS, ZONE III:

A. Total outdoor light output (excluding streetlights used for illumination of public rights-of-way) of any development project in Zone III shall not exceed 100,000 lumens per net acre, averaged over the entire project. Furthermore, no more than 5,500 lumens per net acre may be accounted for by lamps in unshielded or partially-shielded fixtures permitted in Table 10-08-002-0005, except that lamp(s) emitting no more than 4,720 lumens per single family dwelling unit or duplex dwelling unit for residential outdoor lighting purposes are exempt from the shielding requirements of Table 10-08-002-0005, though they must conform to all other applicable restrictions. Single-Family attached units (e.g. townhouses), and multi-family residential units are limited to 2360 lumens of unshielded lights per unit.

B. Outdoor recreational facilities are not subject to the lumens per net acre limit set in Subsection 10-08-002-0008.A. However, no such facility in Zone III shall be illuminated after 11:00 pm except to conclude a scheduled recreational or sporting event in progress prior to 11:00 pm.

C. Outdoor internally illuminated advertising signs shall either be constructed with an opaque background and translucent letters and symbols or with a colored (not white, cream, off-white or yellow) background and lighter letters and symbols. Lamps used for internal illumination of such signs shall not be included in the lumens per net acre limit set in thes Subsection. Such signs shall be turned off at 11:00 pm or when the business closes, whichever is later.

10-08-002-0009. AIRPORT LIGHTING:

Airport lighting which is required for the safe and efficient movement of aircraft during flight, takeoff, landing, and taxiing is exempt from the provisions of this Division. Lighting used for illumination of aircraft loading, unloading, and servicing areas is exempt from the lumens per acre limits of Subsections 10-08-002-0006.A, -0007.A, -0008.A, although it must conform to all other requirements of this Division. All other outdoor lighting at airport facilities shall comply with the provisions of this Division.

10-08-002-0010. INFRARED SECURITY LIGHTING:

Lights emitting infrared radiation used for remote security surveillance systems are exempt from the filtration requirements of Subsection 10-08-002-0005.G. Such lighting is permitted in all zones with the following restrictions:

A. Fixed lights must be fully-shielded.
B. Moveable lights, such as spot lights attached to infrared-sensitive cameras, must be mounted such that the lights cannot be directed higher than twenty degrees below the horizontal, measured from

the center of the light beam.

10-08-002-0011. APPLICATION REQUIREMENTS:

A. Whenever a person is required to obtain a building permit, electrical permit for outdoor lighting or signage, a Conditional Use Permit, subdivision approval, or development plan approval by the City, including all City projects, or whenever a person requests annexation or rezoning, the applicant shall, as a part of said application, submit sufficient information to enable the Planning Director to determine whether the proposed lighting will comply with this Division.

B. The application shall include the following:
   1. a site plan indicating the proposed location of all outdoor lighting fixtures and signs;
   2. a description of each illuminating device, fixture, lamp, support and shield. This description may include, but is not limited to, manufacturer's catalog cuts and drawings (including sections where required), lamp types and lumen outputs;
   3. photometric data, such as that furnished by manufacturers, or similar, showing the angle of cut-off of light emissions for the proposed luminaire(s);
   4. such other information as the Planning Director may determine is necessary to ensure compliance with this Division.

C. If the Planning Director determines that the proposed lighting does not comply with this Division, the permit shall not be issued or the plan approved.

10-08-002-0012. TEMPORARY LIGHTING PERMITS:

A. The Planning Director may grant a permit for temporary lighting, as defined herein, if he/she finds the following:
   1. The purpose for which the lighting is proposed is not intended to extend beyond thirty (30) days;
   2. The proposed lighting is designed in such a manner as to minimize light pollution and trespass as much as is feasible;
   3. The proposed lighting will comply with the general intent of this Division;
   4. The permit will be in the public interest.

B. The application for the Temporary Lighting Permit shall include the following information:
   1. Name and address of applicant and property owner;
   2. Location of proposed fixtures;
   3. Type, wattage and lumen output of lamp(s);
   4. Type and shielding of proposed fixtures;
   5. Intended use of the lighting;
   6. Duration of time for requested exemption;
   7. The nature of the exemption;
   8. Such other information as the Planning Director may request.

C. The Planning Director shall endeavor to rule on the application within five (5) business days from the date of submission of the request and notify the applicant in writing of his/her decision. The Planning Director may grant one (1) renewal of the permit for an additional thirty (30) days if he/she finds that, because of an unanticipated change in circumstances, a renewal would be in the public interest. The Planning Director is not authorized to grant more than one (1) temporary permit and one (1) renewal for a thirty (30) day period for the same property within one (1) calendar year.

10-08-003-0013. NONCONFORMING USES:

A. Mercury vapor lamps in use for outdoor lighting in Zones I, II and III on the effective date of this ordinance shall not be so used after 1 May 1996.

B. Any construction permit which invokes Certificate of Occupancy requirements shall specify and require that any nonconforming sign, as to lighting, located within the boundaries of the development site authorized by said permit shall be brought into conformance with the provisions of this Division.

C. No outdoor lighting fixture which was lawfully installed prior to the enactment of this ordinance shall be required to be removed or modified except as expressly provided herein; however, no modification or replacement shall be made to a nonconforming fixture unless the fixture thereafter conforms to the provisions of this Division.

D. In the event that any nonconforming sign, as to lighting, is abandoned or is damaged, and the damage exceeds fifty (50) percent of the reproduction value, exclusive of foundations, to replace it, the sign shall be brought into conformance with the provisions of this Division.

10-08-002-0014. VARIANCES:

Any person desiring to install an outdoor lighting fixture in violation of this Division may apply to the Board of Adjustment for a variance from the regulation in question, as provided for in Chapter 10 of this Code, as ammended.

10-08-002-0015. CONFLICTING REGULATIONS:

In the event of conflict between the regulations set forth in this Division and any other regulations applicable to the same area, the more stringent limitation or requirement shall govern.

10-08-002-0016. VIOLATIONS AND ENFORCEMENT:

It shall be unlawful to install or operate an outdoor light fixture in violation of this Division. Any person violating any provisions of this Division shall be guilty of a misdemeanor. Each and every day during which the illegal erection, maintenance and use continues is a separate offense.

10-08-002-0017. SEVERABILITY:

If any of the provisions of this Division or the application thereof is held invalid, such invalidity shall not affect other provisions or applications of the Division which can be given effect, and to this end, the provisions of this Division are declared to be severable.

CHAPTER 10-14. DEFINITIONS:

Abandonment. The discontinuation of use for a period of six months.

Acreage, Net. The remaining ground area after deleting all portions for proposed and existing streets within a development or subdivision.

Class 1 Lighting. All outdoor lighting used for, but not limited to, outdoor sales or eating areas, assembly or repair areas, advertising and other signs, recreational facilities and other similar applications where COLOR RENDITION IS IMPORTANT to preserve the effectiveness of the activity.

Class 2 Lighting. All outdoor lighting used for, but not limited to, illumination for walkways, roadways, equipment yards, parking lots and outdoor security where GENERAL ILLUMINATION for safety or security of the grounds is the primary concern.

Class 3 Lighting. Any outdoor lighting used for DECORATIVE effects including, but not limited to, architectural illumination, flag and monument lighting, and illumination of trees, bushes, etc.

Development Project. Any residential, commercial, industrial or mixed use subdivision plan or development plan which is submitted to the City for approval.

Direct Illumination. Illumination resulting from light emitted directly from a lamp or luminaire, not light diffused through translucent signs or reflected from other surfaces such as the ground or building faces.

Filtered Light. Light from a light source that is covered by a glass, acrylic or other cover that restricts the amount of non-visible radiation (infrared, ultraviolet) emitted by the luminaire (quartz glass does not meet this definition).

Fully Shielded Fixture. An outdoor light fixture shielded in such a manner that all light emitted by the fixture, either directly from the lamp or indirectly from the fixture, is projected below the horizontal as determined by photometric test or certified by the manufacturer.

Installed Lighting. Attached, or fixed in place, whether or not connected to a power source.

Lumen. The unit used to measure the actual amount of light which is produced by a lamp.

Luminaire. The complete lighting assembly, less the support assembly. For purposes of determining total light output from a luminaire, lighting assemblies which include multiple unshielded or partially shielded lamps on a single pole or standard shall be considered as a single unit.

Multi-class Lighting. Any outdoor lighting used for more than one purpose, such as security and decoration, such that its use falls under the definition of two or more classes as defined for Class 1, 2 and 3 Lighting.

Opaque. Opaque means that material must not transmit light from an internal illumination source.

Outdoor Light Fixtures. Outdoor electrically powered illuminating devices, outdoor lighting or reflective surfaces, lamps and similar devices, either permanently installed or portable, which are used for illumination or advertisement. Such devices shall include, but are not limited to, search, spot and flood lights for:

a. buildings and structures
b. recreational areas
c. parking lot lighting
d. landscape and architectural lighting
e. billboards and other signs (advertising or other)
f. street lighting
g. product display area lighting

Outdoor Light Output, Total. The maximum total amount of light, measured in lumens, from all outdoor light fixtures. For lamp types that vary in their output as they age (such as high pressure sodium), the initial output, as defined by the manufacturer, is the value to be considered. For determining compliance with sections 10-08-002-0006A, -0007A and -0008A of this Division, the light emitted from outdoor light fixtures is to be included in the total output as follows:

1. Outdoor light fixtures installed on poles (such as parking lot luminaires) and light fixtures installed on the sides of buildings or other structures, when not shielded from above by the structure itself as defined in paragraphs 2 and 3 below, are to be included in the total outdoor light output by simply adding the lumen outputs of the lamps used;
2. Outdoor light fixtures installed under canopies, building overhangs, or roof eaves where the center of the lamp or luminaire is located at least five (5) feet but less than ten (10) feet from the nearest edge of the canopy or overhang are to be included in the total outdoor light output as though they produced only one-quarter (1/4) of the lamp's rated lumen output;
3. Outdoor light fixtures located under the canopy and ten (10) or more feet from the nearest edge of a canopy, building overhang, or eave are to be included in the total outdoor light output as though they produced only one-tenth (1/10) of the lamp's rated lumen output.

Outdoor Recreation Facility means an area designed for active recreation, whether publicly or privately owned, including, but not limited to, baseball diamonds, soccer and football fields, golf courses, tennis courts and swimming pools.

Partially Shielded Fixture. An outdoor light fixture shielded in such a manner that more than zero (0) but less than ten (10) percent of the light emitted directly from the lamp or indirectly from the fixture is projected at angles above the horizontal, as determined by photometric test or certified by the manufacturer.

Person. Any individual, lessee, firm, partnership, association, joint venture, corporation, or agent of the aforementioned groups or the State of Arizona or any agency or political subdivision thereof.

Planning Director. The Director of the Planning Division for the City of Flagstaff.

Sign. Any medium, including its structure and component parts, which is used or intended for advertising purposes other than the painting on the surface of a building.

Sign, Indirectly Illuminated. Any sign the facing of which reflects light from a source intentionally directed upon it.

Sign, Internally Illuminated. Any sign which has the source of light entirely enclosed within the sign and not directly visible to the eye.

Temporary Lighting. Lighting which does not conform to the provisions of this ordinance and which will not be used for more than one thirty (30) day period within a calendar year, with one thirty (30) day extension. Temporary lighting is intended for uses which by their nature are of limited duration; e.g. holiday decorations, civic events, or construction projects.

Use, Abandonment of. The relinquishment of a property, or the cessation of a use or activity by the owner or tenant for a period of six months, excluding temporary or short term interruptions for the purpose of remodelling, maintaining, or otherwise improving or rearranging a facility. A use shall be deemed abandoned when such use is suspended as evidenced by the cessation of activities or conditions which constitute the principle use of the property.

Watt. The unit used to measure the electrical power consumption of a lamp.

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SECTION 17: LIGHTING

Section 17.0: Purpose and Intent

Legislative Intent

A. It is hereby found that the topography and atmospheric conditions of Coconino County, Arizona, are uniquely suited for astronomical observation, that a substantial investment has been made in observatories in the County, and that the use of certain types of outdoor lights and certain outdoor lighting practices have an adverse impact on astronomical observation. It is further recognized that naturally dark landscapes and star-filled skies are valued by many, and that poor lighting practices in outdoor lighting waste energy, hamper the reasonable use and enjoyment of property and can endanger the public welfare by producing unnecessary glare.

B. Accordingly, it is the intent of this Ordinance to encourage lighting practices and systems which will minimize light pollution, light trespass, and conserve energy while maintaining night-time safety, utility, security and productivity. Since not all areas in the County are near established observatories, four Lighting Zones are established, allowing increased flexibility in the uses of outdoor lighting further from the observatories.

C. There may be other areas that are worthy of designation where protection of the night sky is deemed to be highly important, and where the establishment of more restrictive Lighting Zones is desired.

Section 17.1: Conflicting Regulations

A. In the event of conflict between the regulations set forth in this Ordinance and any other regulations applicable to the same area, the more stringent limitation and requirement shall govern.

Section 17.2: Approved Materials and Methods of Construction or Installation/Operation

A. The provisions of this Ordinance are not intended to prevent the use of any design, material or method of installation or operation not specifically prescribed by this code, provided any such alternate has been approved by the Community Development Director. The Community Development Director may approve any such proposed alternate provided he/she finds that it:

1. Provides at least approximate equivalence to the applicable specific requirements of this Ordinance; and

2. Is otherwise satisfactory and complies with the intent of this Ordinance.

Section 17.3: Definitions

As used in this Ordinance, unless the context clearly indicates otherwise, certain words and phrases shall mean the following:

ABANDONMENT means the discontinuation of use for a period of six months.

CLASS 1 LIGHTING means all outdoor lighting used for but not limited to outdoor sales or eating areas, assembly or repair areas, advertising and other signs, recreational facilities and other similar applications where COLOR RENDITION IS IMPORTANT to preserve the effectiveness of the activity.

CLASS 2 LIGHTING means all outdoor lighting used for but not limited to illumination for walkways, roadways, equipment yards, parking lots and outdoor security where GENERAL ILLUMINATION of the grounds is the primary concern.

CLASS 3 LIGHTING means any outdoor lighting used for DECORATIVE effects, including but not limited to architectural illumination, flag and monument lighting, and illumination of trees, bushes, landscape features, etc.

COMMUNITY DEVELOPMENT DIRECTOR means the Director of Community Development for Coconino County.

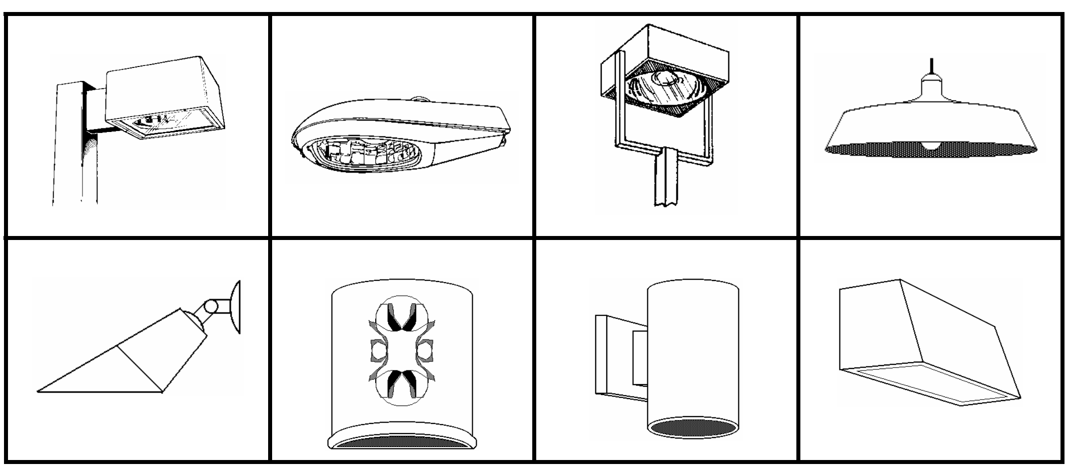
DEVELOPMENT PROJECT means any residential, commercial, industrial or mixed use subdivision plan or development plan which is submitted to the County for approval.

DIRECT ILLUMINATION means illumination resulting from light emitted directly from a lamp or luminaire, not light diffused through translucent signs or reflected from other surfaces such as the ground or building faces.

FULLY SHIELDED FIXTURE means a light fixture or luminous tube constructed and mounted such that all light emitted by the fixture or tube, either directly from the lamp, tube, or a diffusing element, or indirectly by reflection or refraction from any part of the luminaire, is projected below the horizontal.

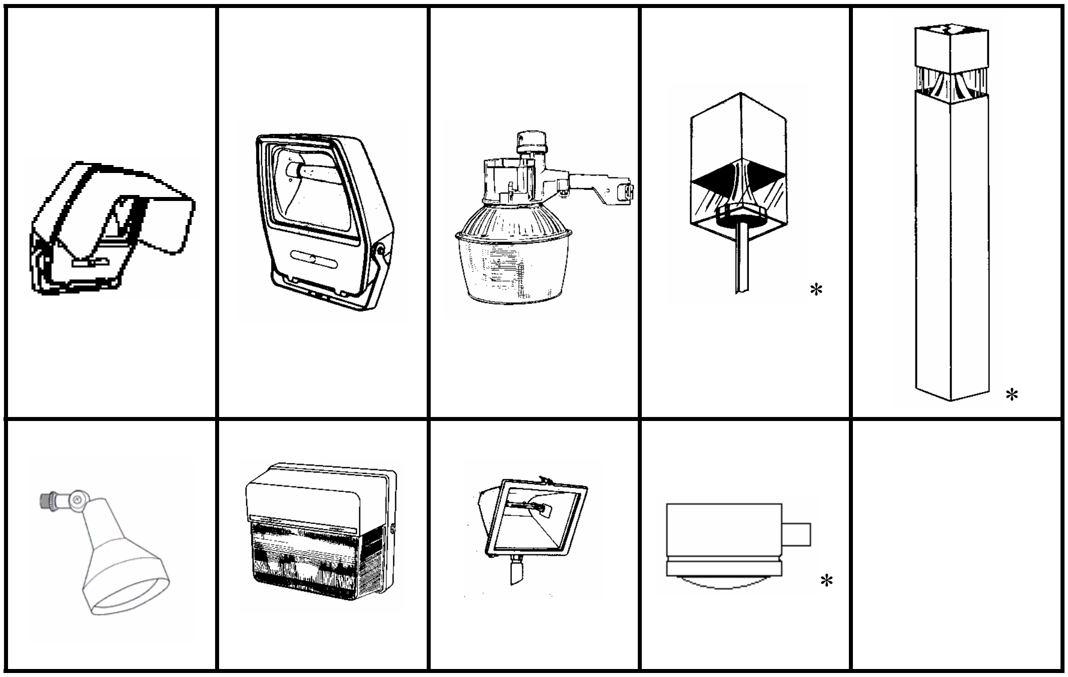
A practical working way to determine if a fixture or tube is fully shielded: if the lamp or tube, any reflective surface, or lens cover (clear or prismatic) is visible when viewed from above or directly from the side, from any angle around the fixture or tube, the fixture or tube *is not* fully shielded.

Examples of fixtures that are Fully Shielded (Note: to be fully shielded these fixtures must be closed on top and mounted such that the bottom opening is horizontal):



Revised: 3/89, 12/01

Examples of fixtures that are NOT Fully Shielded:



* Note: even though the lamp in these fixtures is shielded from direct view when viewed from the side or above, reflective surfaces and/or lens covers *are* directly visible from the side.

Note for luminous (neon) tubes: when such lighting is installed under or behind a roof overhang, if the roof-line or eave is not horizontal the tubing may be visible from above when viewed from the side and therefore be unshielded.

<u>HIGH-PRESSURE SODIUM</u> is a type of lamp using sodium and mercury vapor at high pressure to produce light.

<u>HPS</u> = high-pressure sodium.

<u>INSTALLED</u> means attached, or fixed in place, whether or not connected to a power source.

<u>LIGHT POLLUTION</u> is any adverse effect of manmade lighting; light where it is not needed or wanted; wasted light.

<u>LOW-PRESSURE SODIUM</u> is a type of lamp using sodium vapor at low pressure to produce light.

<u>LPS</u> = low-pressure sodium.

<u>LUMEN</u> is the unit used to measure the actual amount of visible light that is produced by a lamp.

<u>LUMINAIRE</u> means the complete lighting assembly, including the lamp, housing, shields, lenses and associated electronics, less the support assembly. A light fixture.

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LUMINOUS TUBE means a glass tube filled with a gas or gas mixture (including neon, argon, mercury or other gasses), usually of small diameter (10-15 millimeter), caused to emit light by the passage of an electric current, and commonly bent into various forms for use as decoration or signs. A "neon" tube. Does not include common fluorescent tubes.

METAL HALIDE is a type of lamp using mercury and metal halide(s) to produce light.

MH = metal halide.

NEON TUBE (see Luminous Tube)

OUTDOOR LIGHT FIXTURE means an outdoor electrically powered illuminating device, outdoor lighting or reflective surface, lamp, luminous tube or and similar devices, either permanently installed or portable, which is used for illumination or advertisement. Such devices shall include, but are not limited to, search, spot and flood lights for:

(a) buildings and structures
(b) recreational areas
(c) parking lot lighting
(d) landscape and architectural lighting
(e) billboards and other signs (advertising or other)
(f) street lighting
(g) product display area lighting
(h) building overhangs and open canopies
(i) pedestrian walkways or areas
(j) building or landscape decoration

OUTDOOR RECREATION FACILITY means an area designed for active recreation, whether publicly or privately owned, including, but not limited to, baseball diamonds, soccer and football fields, golf courses, tennis courts and swimming pools.

PERSON means any individual, lessee, owner, or any commercial entity including but not limited to firm, business, partnership, joint venture, or corporation.

TEMPORARY LIGHTING means lighting which does not conform to the provisions of this Ordinance and which will not be used for more than one thirty (30) day period within a calendar year. Temporary lighting is intended for uses which by their nature are of limited duration; e.g. civic events, or construction projects.

TOTAL OUTDOOR LIGHT OUTPUT means the maximum total amount of light, measured in lumens, from all outdoor light fixtures on a project site. Includes all lights and luminous tubing used for Class 1, Class 2, Class 3 lighting, and lights used for external illumination of signs, but does not include lights used to illuminate internally illuminated signs or luminous tubing used in neon signs. For lamp types that vary in their output as they age (such as high pressure sodium, metal halide, and fluorescent), the initial output, as defined by the manufacturer, is the value to be considered. For luminous tubes, output is calculated per linear foot of tubing rather than per lamp.

Revised: 3/89, 12/01

Section 17.4: Establishment of Astronomical Zones

A. Lighting Zones: Different areas, with different developed and natural conditions, and different distances from astronomical observatories, have differing levels of appropriate light usage, and different sensitivities to the various obtrusive aspects of outdoor light usage. Because of this, three Lighting Zones are hereby defined and established. These Zones are shown on the Lighting Zone Maps that are attached hereto as Map 1a and Map 1b and by this reference made a part hereof. In general, these Zones are described as follows:

1. Zone I: all area within Coconino County located within two-point-five (2.5) miles of the following locations:

    a. The Hall telescope at Lowell Observatory on Anderson Mesa
    b. The Kaj Strand telescope at the U.S. Naval Observatory
    c. Roden Crater

2. Zone II: all areas within Coconino County more than two-point-five miles yet less than seven (7) miles from the locations listed in part 17.4.A.1 above.

3. Zone III: all other areas within Coconino County.

B. Split Parcels: A parcel located in more than one of the described Lighting Zones shall be considered to be only in the more restrictive Lighting Zone.

Section 17.5: Preferred Source and Zone I Use Preference

A. Preferred Source: Low-pressure Sodium (LPS) lamps are the preferred illumination source throughout the County; their use is to be encouraged, when not required, for outdoor illumination whenever its use would not be detrimental to the use of the property.

B. Day/Night Uses: Uses which can turn off their outdoor lighting during night hours are to be encouraged in Lighting Zone I; those which require all night illumination are to be discouraged.

Section 17.6: General Requirements, all Zones

A. Upward-directed Floodlighting: Outdoor floodlighting by flood light projection above the horizontal plane is prohibited.

B. The requirements for lamp source and shielding of light emissions for outdoor light fixtures are as follows:

Use Code:
A = allowed
F = allowed, fully shielded
X = prohibited

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Table 17.6.B
Lamp Type and Shielding Standards

LAMP TYPE	ZONE I	ZONE II	ZONE III
Class 1 Lighting:			
Low-pressure Sodium	F	F	F
Others above 2500 lumens (1)	X	F	F
Others below 2500 lumens (1)	F	F	A(2,3)
Class 2 Lighting:			
Low-pressure Sodium	F	F	F
Others above 2500 lumens (1)	X	X	X
Others below 2500 lumens (1)	F	F	A(2,3)
Class 3 Lighting:			
Low-pressure Sodium	F	F	F
Others above 2500 lumens (1)	X	X	F
Others below 2500 lumens (1)	F	A(2,3)	A(2,3)
Residential Lighting (all classes):			
All types over 1000 lumens (1)	F	F	F
All types below 1000 lumens (1)	F	A(2,4)	A(2,4)

Note 1. Examples of lamp types of 2000 (1000) lumens and below (The acceptability of a particular light is decided by its lumen output, not wattage; values listed are approximate; check manufacturer's specifications):

(a) 100 (60) Watt Standard incandescent and less
(b) 100 (60) Watt Tungsten-Halogen (quartz) and less
(c) No available High-pressure Sodium of Metal Halide
(d) 25 (15) Watt Fluorescent and less
(e) 26 (13) Watt Compact Fluorescent and less

Note 2. Lights shall be shielded whenever feasible to minimize light spilled into the night sky or adjacent properties.

Note 3. Unshielded lighting is limited to a total of 3000 lumens per acre on non-residential and multi-family residential land uses; 2000 lumens per residence on single-family residential properties.

Note 4. For single-family residential uses, unshielded fixtures up to 2000 lumens output per lamp and a total of 8000 lumens per residence are permitted if used in functioning motion-sensing fixtures that remain on for short periods only.

C. Total Outdoor Light Output: Total Outdoor Light Output, excluding streetlights used to illuminate public rights-of-way, shall not exceed the following limits averaged over the entire project (values listed are total initial lamp lumens per acre and per residence):

Revised: 3/89, 12/01

Table 17.6.C
Maximum Total Outdoor Light Output Standards
(values listed are lumens per acre and lumens per residence)

Land Use	Lighting Zone		
	I	II	III
Commercial, Industrial, and Multifamily (lumens per acre)			
total (shielded + unshielded)	25,000	50,000	100,000
unshielded only	0	3,000	3,000
Non-LPS	2,500	50,000	100,000
Single-family Residential (lumens per residence)			
total (shielded + unshielded)	10,000	30,000	30,000
unshielded only	0	30,000	30,000

Note 1. Fixtures installed such that all parts of the fixture are located underneath and at least five feet from the nearest edge of a building overhang, roof eave, or balcony are to be included in the total outdoor light output as though they produced only one-quarter of the lamp's rated lumen output.

D. Effective Shielding: All light fixtures which are required to be shielded shall be installed in such a manner that the shielding is effective as defined in Section 17.3 under Fully Shielded Fixture and Partially Shielded Fixture.

E. Direct Lighting on Site: All light fixtures, except streetlamps, shall be aimed or shielded so that the direct illumination shall be confined to the property boundaries of the source as much as is feasible.

F. Direct Lighting off Roadways: All light fixtures, except streetlamps, shall be installed in such a manner that the direct illumination does not fall onto any public or private street or road as much as is feasible.

G. Curfews: Class 1 and Class 3 lighting must be extinguished at the curfew times listed in Table 17.6.G, or no later than 30 minutes after the business closes, whichever is later (for holiday decoration exemption see 17.9.B):

Table 17.6.G
Lighting Curfews
(Sports, Class 1, Class 3, Signs)

Lighting Zone		
I	II	III
9:00pm	10:00pm	11:00pm

H. High-Intensity Lights: Search lights, laser source lights, or any similar high-intensity light shall not be permitted, except in emergencies by police and fire personnel or at their direction.

I. Mercury Vapor Sales: The installation, sale, offering for sale, lease or purchase of any mercury vapor light fixture or lamp for use as outdoor lighting is prohibited, except that until 1 January 2006, the provisions of this subsection shall not apply to any replacement lamp. **Revised: 3/89, 12/01, 8/02**

Section 17.7: Special Requirements, Outdoor Advertising Signs

A. Externally Illuminated Sign Standards: External illumination for signs shall conform to all provisions of this Code. In particular, such lighting shall be treated as Class 1 lighting and shall conform to the lamp source, shielding restrictions and lumen caps of Section 17.6. All upward-directed sign lighting is prohibited.

B. Internally Illuminated Sign and Neon Sign Standards:

1. Illumination of Copy and Background; Colors: Outdoor internally-illuminated advertising signs must be constructed as follows:

    a. In Lighting Zone I: the sign face(s) must be composed of illuminated text and symbols against an opaque (unilluminated) background. The colors of these elements are not restricted.

    b. In Lighting Zones II and III: the sign face(s) must be either composed of illuminated text and symbols against an opaque background or with generally LIGHTER text and symbols against a colored (not white, off-white, light gray, cream or yellow) background.

2. Exclusion of Lamp Outputs: Lamps used for internal illumination of signs shall not be counted toward the lumen caps in Section 17.6.C.

3. Neon Signs: Neon signs shall be treated as internally illuminated signs for the purposes of this Code, and shall not have their luminous outputs counted toward the lumen caps in Section 17.6.C. Neon lighting extending beyond the area considered to be the sign area (as defined in the Sign Code of this jurisdiction) shall conform to all provisions of this Code. In particular, such lighting shall be treated as Class 3 (decorative) lighting and shall conform to the lumen caps and shielding standards of Section 17.6.

4. Non-Sign Lighting: Other internally-illuminated panels or decorations not considered to be signage according to the sign code of this jurisdiction (such as illuminated canopy margins or building faces), shall be considered decorative (Class 3) lighting, and shall be subject to the standards applicable for such lighting, including but not limited to the lamp source, shielding standards and lumens per acre caps of Section 17.6.

C. Curfews: Illumination for all advertising signs, both externally and internally illuminated, shall be turned off no later than the curfew times listed in Table 17.6.G or when the business closes, whichever is later. Signs subject to curfews are required to have functioning and properly adjusted automatic shut-off timers.

D. Curfews for Pre-Existing Signs: Light background (white, off-white, light gray, cream or yellow) internally illuminated signs, installed legally before enactment of this code [December 18, 2001], may continue to be used and illuminated but must conform to the curfews of Section 17.6.G.

Revised: 3/89, 12/01

Section 17.8: Special Requirements, Special Uses

A. Service Station Canopies:

1. Lighting Class: Lighting for service station canopies shall be considered Class 1 lighting.

2. Shielding: All luminaires mounted on or recessed into the lower surface of service station canopies shall be fully shielded and utilize flat lenses.

3. Total Under-Canopy Output: The total light output used for illuminating service station canopies, defined as the sum of all under-canopy initial bare-lamp outputs in lumens, shall not exceed sixty (60) lumens per square foot of canopy in Lighting Zone II and III, and shall not exceed twenty (20) lumens per square foot in Lighting Zone I (note: these values are *not* footcandle illuminances). All lighting mounted under the canopy, including but not limited to luminaires mounted on the lower surface or recessed into the lower surface of the canopy and any lighting within signage or illuminated panels over the pumps, is to be included toward the total at full initial lumen output.

4. Inclusion Toward Total Outdoor Light Output: The lumen output of lamps mounted on or within the lower surface of a canopy is also included toward the lumen caps in Section 17.6.C as follows:

   a. fixtures installed such that any part of the fixture is five feet or less from the nearest edge of the canopy are to be included in the total outdoor light output by simply adding the lumen outputs of the lamps used;

   b. fixtures installed such that all parts of the fixture are located at least five feet but less than 10 feet from the nearest edge of the canopy are to be included in the total outdoor light output as though they produced only one-quarter of the lamp's rated lumen output;

   c. fixtures installed such that all parts of the fixture are located ten or more feet from the nearest edge of a canopy are to be included in the total outdoor light output as though they produced only one-tenth of the lamp's rated lumen output.

B. Outdoor Recreational Facilities:

1. Lighting Class: Lighting for field/track/arena areas only shall be considered Class 1.

2. Lumen Cap Exemption: Lighting for field/track/arena areas only is not subject to the lumens per acre limit set in subsection 17.6.C.

3. Shielding: Fixtures used for field/track/arena areas must be fully shielded.

4. Curfew: No such facility shall be illuminated after the curfew times listed here except to conclude a scheduled recreational or sporting event in progress prior to the curfew, and prevented from concluding before the curfew by unforeseeable circumstances.

Revised: 3/89, 12/01

Section 17.9:

A. Airports: Airport navigation lighting systems are exempt from the provisions of this Ordinance. All other lighting at airports, including that used for loading areas, hangars, terminal aprons, parking areas, etc., shall conform to all applicable standards of this Ordinance.

B. Holiday Decorations: Low-wattage holiday decorations are exempt from the provisions of this Ordinance from 15 November through 15 January. Such lighting and all associated wiring used outdoors must be certified for outdoor use by Underwriters Laboratories.

Section 17.10: Temporary Lighting Permits

A. Findings: The Community Development Director may grant a permit for temporary lighting if he/she finds the following:

1. The purpose for which the lighting is proposed is not intended to extend beyond thirty (30) days; and
2. The proposed lighting is designed in such a manner as to minimize light pollution as much as is feasible; and
3. The proposed lighting will comply with the general intent of this Ordinance; and
4. The permit will be in the public interest.

B. Application Contents: The application for the Temporary Lighting Permit shall include the following information:

1. Name and address of applicant and property owner;
2. Location of proposed fixtures;
3. Type, wattage and lumen output of lamp(s);
4. Type, shielding and use of proposed fixtures;
5. Intended use of the lighting;
6. Duration of time for requested exemption;
7. The nature of the exemption;
8. Such other information as the Community Development Director may request.

C. The Community Development Director shall endeavor to rule on the application within five (5) business days from the date of submission of the request and notify the applicant in writing of his/her decision. The Community Development Director may grant one (1) renewal of the permit for an additional thirty (30) days if he/she finds that, because of an unanticipated change in circumstances, a renewal would be in the public interest. The Community Development Director is not authorized to grant more than one temporary permit and one renewal for the same property within one calendar year. A denial by the Director may be appealed to the Planning and Zoning Commission within 30 days.

Section 17.11: Nonconforming Uses

A. Mercury Vapor: Mercury vapor lamps in use for outdoor lighting on the effective date of this Ordinance shall not be so used after 1 May 2006.

Revised: 3/89, 12/01

B. Bottom-mounted Sign Lighting: Bottom-mounted outdoor advertising sign lighting shall not be used in Zones I, II and III after 1 May 1996.

C. Pre-existing Non-conforming Lighting: No outdoor lighting fixture which was lawfully installed prior to the enactment of this Ordinance shall be required to be removed or modified except as expressly provided herein; however, no modification or replacement shall be made to a nonconforming fixture unless the fixture thereafter conforms to the provisions of this Ordinance.

D. Conformance after Abandonment/Damage: In the event that an outdoor lighting fixture is abandoned or is damaged to the point of requiring repairs for safe operation, the repaired or replacement fixture shall comply with the provisions of this Ordinance.

Section 17.12: Variances

Any person desiring to install an outdoor lighting fixture in violation of this Ordinance may apply to the Board of Adjustment for a variance from the regulation in question. Such variances shall be allowed where a literal application or enforcement of the regulations would result in practical difficulty or unnecessary hardship and the relief granted would not be contrary to the public interest but do substantial justice and be in accordance with the spirit of the regulations and this Ordinance. Provided, that any variance may be allowed subject to any reasonable conditions that the Board may deem necessary to effectuate the purpose of this chapter.

Section 17.13: Permits and Development Plan Reviews

A. Non-Single Family Residential Lighting:

1. Permit Required: Whenever a person plans to install outdoor lighting, an outdoor lighting permit must be applied for and granted. The applicant shall, as a part of said application, submit sufficient information to enable the Community Development Director to determine whether the proposed lighting will comply with this Ordinance.

2. Application Contents: The application shall include the following:

   a. A site plan indicating any existing lighting fixtures and the proposed location of all new outdoor lighting fixtures, indicating which of the existing fixtures, if any, are to be retained and which, if any, removed;
   b. A description of each illuminating device, fixture, lamp, support and shield. This description may include, but is not limited to, manufacturer's catalog cuts and drawings (including sections where required), lamp types and lumen outputs. For existing lighting, photographs of the fixtures will be accepted if original manufacturer's information is not available;
   c. Such other information as the Community Development Director may determine is necessary to ensure compliance with this Ordinance.

3. Permit Issuance: If the Community Development Director determines that the proposed lighting does not comply with this Ordinance, the permit shall not be issued or the plan approved.

Revised: 3/89, 12/01

B. Single Family Residential Lighting:

1. Lighting Reviewed: Lighting on single family residential sites will be reviewed on-site, and compliance with this Code verified before issuance of the Certificate of Occupancy. A lighting permit separate from the building permit is not required.

Revised: 3/89, 12/01

Appendix H: Buffer Partnerships

Easements, Legal Agreements, and Resource Material

OPNAVINST 11010.40 ENCROACHMENT MANAGEMENT PROGRAM

Camp Navajo Army Depot/Naval Observatory Flagstaff Buffer Partnership Information Document

The prevention of encroachment should be a major issue detailed in the INRMP. The Nationa Defense Authorization Act for Fiscal Year 2003 includes a provision, codified as Title 10 USC 2684a, which provides us with a new tool to help control encroachment by executing agreements with public and private partners to acquire real estate interests near installations to help preclude environmental restrictions on military training and testing operations. Areas suitable for these encroachment partnering agreements should be identified during the development and revision of INRMPs and mapped as a GIS theme and reported up the chain to program needed funding.

It is important to work with installation planners to identify natural areas adjacent to your installation, that if set aside through these agreements, can protect current and future mission requirements. The CNIC N46 is the resource sponsor for encroachment partnering projects.

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DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, D.C. 20350-2000

IN REPLY REFER TO
OPNAVINST 11010.40
N46

MAR 27 2007

OPNAV INSTRUCTION 11010.40

From: Chief of Naval Operations

Subj: ENCROACHMENT MANAGEMENT PROGRAM

Ref: (a) National Defense Authorization Act for Fiscal Year 2003, Pub. L. No. 107-314, Section 2811 as amended, codified at 10 U.S.C. 2684a
(b) ASN (I&E) memo of 23 Jan 03 (NOTAL)
(c) CNO memo 11000 Ser N4/3U575979 of 14 Nov 03 (NOTAL)
(d) National Defense Authorization Act For Fiscal Year 2004, Pub. L. No. 108-12, Section 320, codified at 10 U.S.C. 113 note
(e) DOD Directive 3200.15 of 10 Jan 03

Encl: (1) CNO Encroachment Management Program Procedures and Guidelines

1. Purpose. To establish the Chief of Naval Operations (CNO) Encroachment Management program to ensure operational sustainment for all Navy installations, test and training ranges, air and water operating areas (OPAREAs), special use airspace, and military training routes (MTRs).

This Encroachment Management program also includes additional guidance for executing the Encroachment Partnering (EP) program established by reference (a), and by previous Navy guidance, references (b) and (c). The EP program provides the Navy with a tool to preserve the Navy's mission capability by preventing incompatible development and/or protecting natural habitats outside the installation.

2. Background. The Navy needs a proactive strategy to address all types of encroachment at our installations, ranges, and operating areas to preserve the ability to meet existing and future mission requirements and to provide effective test and training capabilities. Encroachment pressures (e.g., private development adjacent to an installation, range, or OPAREA, certain environmental restrictions, or growing competition for resources such as waterfront, airspace and frequency spectrum)

are increasingly impeding the ability to conduct operations, and training or testing in realistic environments. Encroachment pressures can limit low-altitude flight training, over-the-beach operations, night and all-weather training, live-fire training, and the application of new weapon technologies. Reference (d) requires DOD to report to Congress on certain types of encroachment impacts at its installations and ranges, as well as the DOD's plan to address encroachment impacts. Reference (e) establishes requirements for comprehensive and integrated planning for the sustainment of range complexes and operating areas. The Navy's Tactical Training Theater Assessment and Planning (TAP) program addresses training range sustainment challenges. As a part of TAP, the Navy is developing a proactive engagement/outreach strategy conveying the Navy's environmental stewardship initiatives in balance with the need to train at its ranges.

3. Responsibilities. Chief of Naval Operations (CNO (N4) Fleet Readiness and Logistics) plans and programs for afloat/ashore readiness and logistics programs; and ensures the effective and efficient employment of resources in meeting validated requirements. CNO (N4) is responsible for managing encroachment issues for the Navy through CNO (N43) (Fleet Readiness), CNO (N45) (Environmental Readiness) and CNO (N46) (Ashore Readiness). CNO (N46) is assigned the overall lead for Encroachment Management within OPNAV and will coordinate with all CNO codes on their respective encroachment responsibilities. CNO (N4) will execute its Encroachment Management through the Commander, Navy Installations Command (CNIC).

a. CNO (N46) establishes policy for shore installation management, planning and real estate, and facilities support. CNO (N46) plans and programs resources for an Encroachment Challenges database, Encroachment Action Plans (EAP), and the Encroachment Partnering program.

b. CNO (N43) plans and programs resources to sustain, upgrade, modernize, & transform training ranges, Major Range & Test Facility Base (MRTFB) ranges, and operating areas. CNO (N43) funds the development of Range Complex Management Plans (RCMP) that analyzes range information, including encroachment analysis and makes recommendations for encroachment prevention on training ranges. Commander, Fleet Forces Command (FFC) and Commander, United States Pacific Fleet (CPF) manage the TAP program for CNO (N43) and (N45). CNO (N43) will continue to coordinate special use airspace and MTR issues with CNO (N885) (Deputy Chief of Naval Operations Air Warfare).

c. CNO (N45) establishes policy for shipboard, ashore, and marine environmental and natural resources programs. CNO (N45) also establishes National Environmental Policy Act (NEPA) and compliance requirements for testing and training ranges, major exercises & unit level training; N45 collects marine mammal density data and sets requirements for Navy Installation Natural Resource Management Plans (INRMPs). Environmental concerns are a major focus area for encroachment management.

4. Discussion. The foundation of the Encroachment Management Program is identification and assessment by Mission Component Commands, Installation Commanding Officers (ICOs), Range Complex Commanders (RCCs), Range Commanding Officers (RCOs), and Regional Commands of all encroachment impacts to installations, ranges, OPAREAs, special use airspace, and MTRs to ensure operational sustainment. Moreover, the program requires active engagement with local, State, other Federal agencies, and community leaders to prevent encroachment impacts and promote compatible development of lands adjacent to and near our installations, ranges, special use airspace, and MTRs, and maintain unfettered access to and within our OPAREAs. The Navy is particularly susceptible to encroachment with many of its installations, ranges, special use airspace, and MTRs located in high growth areas and coastal regions. Many of the Navy's OPAREAs are located in areas subject to recreational boating, commercial fishing, and commercial shipping pressures. Additionally, Navy must balance the need to train with protection of marine resources such as marine mammals, turtles, coral reefs, etc. The Encroachment Management program envisions a multi-faceted process to include:

a. Establishment of regional teams consisting of diverse operational, planning, real estate, environmental, legal, and public affairs disciplines to become the focal point to address and resolve encroachment issues working in support of Mission Component Commands.

b. Establishment and maintenance of a Navy-wide encroachment database to identify and quantify encroachment challenges.

c. Development of installation and range Encroachment Action Plans (EAP) to provide short, mid, and long-term encroachment management strategies.

d. Development of Encroachment Partnering projects to acquire minimal real property interests in lands, adjacent to or near installations, range complexes, and airspace: (1) where local planning and zoning initiatives are insufficient to protect the long-term viability of an installation, range, MTR, and special use airspace; and (2) preserve off-base habitat to relieve current or avoid future environmental restrictions on operations.

5. Applicability. These procedures apply only to all Navy installations and training and test ranges within the United States, its territories, trusts and possessions or where Navy manages, controls or otherwise operates ranges or OPAREAs.

6. Action. Addressees shall comply with the procedures outlined herein.

M. K. LOOSE
Vice Admiral, CEC, U.S. Navy
Deputy Chief of Naval Operations
(Fleet Readiness and Logistics)

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MAR 27 2007

ENCROACHMENT MANAGEMENT

PROGRAM PROCEDURES

AND

GUIDELINES

Enclosure (1)

Table of Contents

SECTION I

DEFINITIONS, RESPONSIBILITIES, AND DISCUSSION

1. Definitions

1.1. Encroachment is primarily any non-Navy action planned or executed which inhibits, curtails, or possesses the potential to impede the performance of Navy activities. Additionally, the lack of action by the Navy to work with local communities and to monitor development plans, or to adequately manage our facilities and real property can also impact the Navy's ability to meet its mission requirements and result in encroachment. There are various DOD, Navy, and other Services documents that have identified and defined various types of encroachment challenges. These encroachment challenges are summarized and defined in Section II.

1.2. Encroachment Management is a program that focuses on systematic encroachment identification, quantification, mitigation, and prevention. Encroachment Management is a coordinated effort between Mission Component Commands with responsibility to identify test and training requirements and to assess impacts to readiness, and Installation Commanding Officers, Range Complex Commanders, Range Commanding Officers, and Navy Regions with responsibility to sustain operational assurance at installations, ranges, special use airspace (SUA), military training routes (MTRs), and operating areas (OPAREAs). Early identification and quantification of potential encroachment challenges (as defined in Section II) will enable Mission Component Commands, Navy Regions, installations and ranges to proactively assess the impacts (as defined in Section III) to training readiness and test requirements.

1.3. Enhanced Readiness Teams (ERTs) can facilitate planning, coordinating and executing a proactive Encroachment Management program. Regional Commanders, at their discretion, may designate an established or a newly created ERT as the regional entity to address encroachment challenges or create a regional entity separate from an ERT. ERT membership generally includes Mission Component Commands, Regions, installations, ranges, range users from Numbered Fleets and Type Commanders, facilities managers, planning, environmental, real estate, public affairs, security officers, and legal professionals.

1.4. An Encroachment Action Plan (EAP) is the blueprint for an installation or range's Encroachment Management program. Defined in Section IV, an EAP is organized as follows:

1.4.1. Identification of encroachment challenges that negatively impact military activities at an installation and associated land training or test areas;

1.4.2. Nature and degree of degradation to those activities;

1.4.3. Effectiveness of current Navy management, planning, or outreach activities to minimize negative mission impacts and associated additional costs;

1.4.4. Current or projected future impacts to mission and installation readiness, if applicable;

1.4.5. Regulatory and community frameworks that support or exacerbate the encroachment challenges; and

1.4.6. Short, mid, and long-term strategies to address and correct or prevent encroachment impacts.

Regional Commanders, in coordination with Installation Commanding Officers, Range Complex Commanders or Range Commanding Officers, and Mission Component Commands, are responsible for identifying the need for an EAP, developing a regional EAP IPL, and submitting a prioritized request to CNIC for those EAPs that may need additional funding.

1.5. Range Complex Management Plans (RCMPs) contain data, analysis, and project recommendations to sustain & optimize naval range complex capabilities in support of mission essential training & research, development, test and evaluation (RDT&E). The RCMP develops the operational baseline, capabilities assessment, encroachment and environmental coverage analysis, and strategic vision needed to perform subsequent environmental planning. The RCMP outlines the range complex planning and management organization, outreach strategy, and investment plan. RCMPs identify existing (short-term) encroachment challenges on the range complexes, discuss their training impacts, and recommend mitigation measures. RCMPs identify mid- and long-term encroachment challenges, particularly where introduction of new platforms, weapon systems and mission areas will exacerbate existing encroachment pressures. RCMPs do not address regional (i.e. beyond the bounds of a specific range complex) encroachment issues, nor do they quantify costs associated with encroachment.

1.6. Encroachment Partnering (EP) is a land acquisition authority specifically enacted to address encroachment challenges. In conjunction with other land acquisition authorities, EP can be used to reduce or eliminate current or potential encroachment that is likely to restrict military activities. Reference (a) authorizes the military departments to execute agreements with public and private partners to acquire real property interests from willing sellers adjacent to or near military installations and military airspace to: (1) acquire buffer zones to prevent incompatible land use from impacting military missions; and (2) preserve off-base habitat to relieve current or avoid future environmental restrictions on operations. This statute authorizes the Military Departments to enter into "encroachment partnering" agreements with states, political subdivisions thereof, and private land conservation entities. Specifically, private conservation organizations specialize in identifying and acquiring private land for conservation purposes and can respond more quickly than the Navy to purchase opportunities. Both public agencies and conservation organizations offer valuable resources to leverage Navy's encroachment prevention efforts. Navy's Encroachment Partnering program is outlined in Section V.

2. Responsibilities

2.1. CNO (N4) will coordinate the Encroachment Management Program for the Navy. CNO (N4) has tasked CNO (N46) to oversee implementation of a Navy-wide encroachment management program. CNO N46 will actively coordinate encroachment program management with CNO N43 and CNO N45 to ensure comprehensive resourcing of encroachment actions. CNO N4 executes its responsibility for overall program management and coordination through Commander, Navy Installations Command (CNIC). CNIC will coordinate the Encroachment Management program with all Mission Component Commands. CNO N4 has additionally assigned the following encroachment management and planning budget submitting office (BSO) responsibilities: CNIC - Installations, land-based ranges, MTRs, and SUAs; FFC/CPF - Littoral/OPAREAS (training ranges); and Commander, Naval Air Systems Command/Commander, Naval Sea Systems Command - Littoral/OPAREAS (T&E ranges).

2.1.1. CNIC will develop an annual Integrated Priority List for EAPs based on encroachment challenges identified by installations, ranges, Navy Regions, and Mission Component Commands. CNIC will fund high-priority EAPs where the Region may need additional funding to accomplish, subject to funds availability.

2.1.2. CNIC will manage and fund, subject to availability, the Navy's Encroachment Partnering program for Navy installations and ranges. CNIC will establish a consolidated Integrated Priority List and allocate those funds for the EP program based on the IPLs submitted from each Region. CNIC will coordinate prioritization of the list with Mission Component Commands. In addition, CNIC through ASN(I&E) will seek to obtain centrally managed DOD EP funds for projects on the IPL.

2.1.3. CNIC will coordinate development and maintenance of a Navy-wide encroachment database to include encroachment challenges identified by installations, ranges, and Regions, identified in EAPs, and identified by Commander, Fleet Forces Command (CFFC) and Commander, Pacific Fleet (CPF) through the TAP program. CNIC will work closely with CFFC, CPF, and other Mission Component Commands to establish this database and link to established repositories of information. CNO will use this repository of information to prepare reports and testimony to Congress and for encroachment program funding justification.

2.1.4. CNIC will provide guidance and training for encroachment management, EAPs, and the EP program.

2.2. CNO (N43) is responsible for the sustainability of all training and MRTFB range capabilities. CNO (N43) programs funding for Mission Component Commands to address encroachment challenges for its ranges. Specifically, as part of the overall TAP program, CNO (N43) funds the development of Range Complex Management Plans (RCMP) and Operational Range Clearance (ORC). CNO (N43) will coordinate with CNO (N885) on all matters pertaining to encroachment challenges under SUAs and MTRs. CNO (N43) delegates TAP execution responsibilities to CFFC and CPF.

2.3. CNO (N45) establishes policy for shipboard, ashore, and marine environmental and natural resources programs. Specifically, as part of the TAP program, CNO (N45) funds the Range Sustainability Environmental Program Assessments (RSEPA), environmental planning requirements for training ranges, Marine Species Density Data, and other environmental requirements.

2.4. Mission Component Commands are responsible for identifying training and test requirements and the potential readiness impacts from encroachment challenges.

2.4.1. FFC and CPF are responsible for managing encroachment challenges at fleet range complexes. RCMPs will generate specific encroachment data for fleet range complexes. The fleets will integrate the RCMP encroachment analysis into range EAPs, and implement encroachment mitigation recommendations therein.

2.4.2. FFC and CPF will maintain a database on encroachment challenges to training and will coordinate with other Mission Component Commands and CNIC on maintaining a Navy-wide database of encroachment challenges.

2.4.3. Naval Air Systems Command (NAVAIRSYSCOM) and Naval Sea Systems Command (NAVSEASYSCOM) will manage encroachment challenges at MRTFB and other T&E facilities and coordinate with CFFC/CPF, CNO (N43/N45), and CNIC.

2.4.4. Naval Education Training Command (NETC) will manage encroachment challenges at its training ranges and coordinate with CFFC/CPF, CNO (N43/N45), and CNIC.

2.5. Navy Regional Commanders will execute the Encroachment Management program within their region. The Regional Commander will designate a coordinating entity for encroachment management within the region.

2.5.1. Responsibilities of the Regions shall include: (1) coordinating with Mission Component Commands to quantify and prioritize encroachment issues; (2) cognizance and coordination of all encroachment issues impacting their Region, installation/activities, ranges, MTRs, special use airspace and OPAREAs with appropriate Mission Component Commands and CNIC; (3) working with regional/local organizations and agencies to resolve emerging encroachment issues; (4) providing annual encroachment progress reports to CNIC; and, (5) executing Encroachment Action Plans for installations and ranges within the Region, as necessary.

2.5.2. Navy Regions shall ensure that their regional encroachment entity is represented by appropriate Installation Commanding Officers (ICOs), Range Complex Commanders (RCCs), Range Commanding Officers (RCOs), Mission Component Commands, operators, planning, environmental, real estate, public affairs, security officers and legal representatives. Where appropriate, Navy Regions should also coordinate with the United States Marine Corps and other military services in addressing encroachment challenges. Navy Regions are responsible for identifying potential encroachment challenges that can affect multiple installations or ranges, MTRs, special use airspace and OPAREAs, and submitting them to Mission Component Commands and CNIC as appropriate.

2.6. Local ICOs, RCCs and RCOs shall: (1) identify potential encroachment challenges at their installation or range (including MTRs, special use airspace and OPAREAs) and forward potential encroachment issues to the Region and Mission Component Commands; (2) monitor encroachment issues and local conditions within and/or outside the installation or range; (3) execute the installation's EAP; (4) proactively maintain contact and visibility with local governments and developments to acquire a working knowledge of local land use plans, zoning and development regulations, development trends, environmental issues, and local, State, and Regional plans and programs that have the potential to impede the mission of the installation or range; (5) establish working relationships with local, State and regional governments and agencies, Non-Governmental Organizations (NGOs), and other groups engaged in any aspect of land use planning, development, conservation, and preservation that could impact operational assurance at the installation or range; and (6) ensure that the installation/range participates in the Regional encroachment entity. Installations and Ranges may require technical and management support from its Mission Component Commands, Region, and the local Naval Facilities Engineering Command to accomplish these responsibilities; hence, the ICOs and RCOs are to identify additional encroachment management program support in annual budgeting processes.

2.7. The Naval Facilities Engineering Command (NAVFACENGCOM) will provide planning, environmental, legal, and real estate support, and provide program management oversight for CNIC. NAVFACENGCOM negotiates and executes all real estate agreements and acquisitions in support of the EP program.

3. Discussion

3.1. Each Navy Regional Commander, ICO, RCC and RCO will implement an Encroachment Management program as outlined in this instruction. EAPs will be the primary tool and process in identifying encroachment challenges and recommending mitigation strategies.

3.2. While a RCMP contains many elements of an EAP, it does not specifically address the cost impact analysis of encroachment, the overarching regional view, and long-term encroachment strategy. As a result, an EAP for a Range Complex is required to supplement the RCMP encroachment analysis. Many of the same kinds of encroachment pressures that affect a Navy installation also affect its associated ranges.

3.3. Successful EAPs will require Mission Component Commands to identify training and test requirements, and may require the involvement of multiple Navy entities (Installations, Ranges, local operational commands, Regions, Facilities Engineering Commands, Mission Component Commands, CNIC, CNO, and ASN (I&E)) to develop a comprehensive EAP and implement preventative or corrective actions. The Regions, coordinating with Installations, Ranges, and Mission Component Commands, will submit plans and budget requirements for all land acquisition proposals addressing encroachment, including EP projects, to CNIC for evaluation and coordination.

3.4. CNIC will establish an annual Integrated Priority List for EAPs and request Navy Regions submit nominations for EAPs in coordination with applicable Mission Component Commands. Nominations will be required by 15 April each year and the IPL will be finalized by 1 July for the following Fiscal Year (FY).

3.5. CNIC will establish an annual Integrated Priority List for EP projects and request Navy Regions submit nominations for EP projects in coordination with applicable Mission Component Commands. Nominations will be required by 1 May each year and the IPL will be finalized by 1 July for the following FY.

SECTION II

ENCROACHMENT CHALLENGES

1. Definitions

1.1. The types of encroachment sources, described and defined in this Section, are drawn from various studies and reports of Navy and non-Navy actions that have occurred which have had an impact on training and test activities. Although not all encompassing, these potential sources of encroachment need to be examined to determine if they exist at an installation, range, MTR, special use airspace or OPAREA. Once a potential challenge is identified, it should be analyzed to determine the potential impacts and constraints imposed as described in Section III.

1.1.1. Urban Development (population growth) - As communities grow toward the boundaries of installations, ranges, OPAREAs, and beneath MTRs and SUAs, land use development could become incompatible with the Navy's mission. Incompatible development can seriously compromise the quality of the Navy's training and test mission requirements and often results in pressure to modify training and test procedures. Urban development may not surmount to an immediate threat, but continued incompatible development could present a long-range threat to the mission. Urban development may also damage habitat needed for wildlife to survive, making the installation or range the only available habitat in the area.

1.1.2. Airborne noise - The central issue of airborne noise is the impact, or perceived impact, on people, animals (both wild and domestic), structures, and land use. The magnitude of the noise problem, resulting complaints, pressure to modify or suspend air operations, and threats of litigation, is directly related to the degree to which there are people, wildlife, and other noise sensitive land uses in the vicinity of installations, ranges, OPAREAs, MTRs, and SUAs.

1.1.3. Competition for air space, land, and sea space - The Navy owns, controls, or uses resources, that need to be available to accomplish testing and training missions. These resources must be of sufficient size and quality to provide effective training and testing. Public pressure to share or relinquish some of these resources may inhibit the Navy from accomplishing its training and test objectives, or inhibit anti-terrorism/force protection programs.

1.1.4. Competition for scarce resources (oil, gas, minerals, potable and irrigated water, and ocean access) - Community pressure to gain access to valuable resources located on land or sea that Navy owns or controls may affect Navy's ability to use this land or water for training or test objectives. Access may include processing and transporting of materials. Navy cannot allow others to access these resources unless there is a statute authorizing the disposal of the resource or unless there is mandatory special legislation. There is also pressure to limit the Navy's access to the public's resources as well as pressure on the Navy to develop renewable resources.

1.1.5. Threatened and Endangered Species -- Restrictions for the purpose of protecting threatened or endangered species can reduce the value of an installation, range, or OPAREA for testing and training by limiting the types of permissible activities in terms of composition, magnitude, or timing.

1.1.6. Maritime issues (Marine Mammals, Endangered Species, Fish Habitats, Coral Reefs, Coastal Zones, Sanctuaries, and other marine protected areas) -- Regulatory or permit requirements protecting ocean resources cumulatively affects the Navy's ability to conduct training exercises or testing in the marine environment.

1.1.7. Ordnance - Unexploded Ordnance (UXO)/Munitions -- Application of various environmental laws to munitions training, demolition, disposal, or testing activities could have severe and adverse impacts on readiness. However, UXO contained within the impact area or range boundaries on an active range used for weapons delivery is not de facto encroachment.

1.1.8. Safety Arcs and footprints (Explosive Safety Quantity Distance (ESQD) Arcs, Surface Danger Zones, Weapons Safety Footprint Areas) - Land adjacent to installations and range safety zones, including land within the installation or range, may not be suitable for certain types of land use or economic development purposes.

1.1.9. Frequency Spectrum - The competition for available frequency spectrum may lead to a reduction in available spectrum for training and developmental/operational testing activities. The lack of spectrum may decrease the effectiveness of exercises by restricting the number of war-fighting systems that can participate. In addition, spectrum limitations may restrict the use of state-of-the-art instrumentation systems, resulting in less data for evaluators to use in training assessments, and may also limit development testing of new technologies. As the potential for residential and commercial encroachment increases, so does the risk of increased RF emitters and receivers, which could result in Electromagnetic Interference (EMI) problems between Navy systems and public or commercial systems.

1.1.10. Air Quality - Impacts to training and test missions in non-attainment areas, and conformance with individual State Implementation Plans (SIPs), may restrict existing mission requirements or preclude execution of new missions, as well as deployment and use of new weapon platforms.

1.1.11. Water Quality - Discharge permit requirements and timelines and/or prohibited or restricted access to wetlands and/or their buffer zones can restrict existing mission training, preclude or restrict integration of new technology/weapons systems into existing missions and training or preclude future growth and execution of new missions in amphibious, riverine, estuarine and other salt and fresh water related missions.

1.1.12. Interpretation of Historical/Environmental regulations (e.g., National Historic Preservation Act (NHPA), Coastal Zone Management Act (CZMA), Native American Graves Protection and Repatriation Act (NAGPRA), Fish and Wildlife Coordination Act (FWCA), and Migratory Bird Treaty Act (MBTA)) - Regulatory or permit requirements may affect training and testing activities. Other non-Navy actions may affect Navy's current regulatory or permit requirements under these regulations.

1.1.13. Interagency Coordination (e.g., Forest Service, Bureau of Land Management (BLM), Bureau of Reclamation (BOR), National Park Service (NPS), U.S. Fish and Wildlife Service (FWS), and State equivalents) - Navy often uses land controlled by another Federal or State agency. The types of allowable uses and restrictions are often the result of negotiations between the parties or subject to the other Federal agency's policies and regulations. These restrictive uses can limit training and testing activities.

1.1.14. Legislative initiatives that restrict training or testing activities - Congress may enact legislation that directly or indirectly limits the Navy's flexibility to conduct training or testing activities.

SECTION III

TRAINING AND TEST IMPACTS

1. Definitions

1.1. This Section summarizes the potential training and testing impacts that occur due to the encroachment challenges listed in Section II. The degradation to training and testing capability, or elimination of specific missions, may impact the overall readiness of the Navy. By identifying the costs to implement corrective actions to these impacts within EAPs and RCMPs, and consolidating such impacts in a comprehensive encroachment database, the Navy can develop defensible funding requests through future Program Objective Memoranda (POM) processes. The following encroachment impacts have been identified to help Mission Component Commands, Regional Commanders, Installation Commanding Officers, Range Complex Commanders, and Range Complex managers quantify encroachment:

1.1.1. Avoidance areas created. Areas on installations or ranges that are permanently or temporarily unavailable for training or testing activities. For example, ground troops may not be able to train in certain areas due to the presence of endangered species; or aircraft may have to avoid certain areas to limit noise. Avoiding these areas can degrade the quality of testing and training. An avoidance area might be created if development hampers the installation or range's anti-terrorism/force protection program.

1.1.2. Reduced usage days. Training or testing is restricted or prohibited for a period of time and/or in certain geographic areas. For example, ships may not be able to operate in certain areas at specified times because of migrating marine life. Aircraft training may be prohibited at certain times to reduce noise impacts, avoid migratory birds, or to avoid interfering with the mating season of certain species. Test and training range availability may be limited by recreational and commercial usage, or by fire season restrictions.

1.1.3. Prohibit certain training and testing events. Certain training and testing activities may be prohibited. For example, ground troops may be prohibited from digging into the ground to create realistic fighting positions, aircraft may be prohibited from using flares or chaff, and ships may be prohibited from using sonar equipment. In these cases, the testing or training must be conducted at other locations, or work arounds must be developed.

1.1.4. Reduced range access. Encroachment can reduce access to ranges. For example, the approaches to target areas might be limited to certain specified corridors, rather than permitting access from multiple approaches. Such limitations may degrade the realism and value of the testing or training event.

1.1.5. Segmented testing/training and reduced realism. Encroachment may result in training or testing events conducted out of preferred sequence, thus creating training segmentation. For example, aircraft might have to practice ordnance delivery and evasive maneuvers at different times, rather than together. Ground forces might have to practice ship-to-shore maneuvers at one time, and assaults on enemy positions at another. Segmentation of training or testing reduces realism and the value of those experiences.

1.1.6. Limitations on use of new technologies. Concerns about encroachment may limit training or testing with new technologies. For example, encroachment may limit the military's ability to conduct realistic training or testing with unmanned aerial vehicles (UAVs). Limitations on testing could very well translate into limited applications in combat, as forces apply technologies as they have in training, and perhaps not to the technology's full potential.

1.1.7. Restricted flight altitudes and/or airspeeds. Civilian/commercial use of airspace or development on the ground may prevent military forces from taking full advantage of special use airspace or MTRs. In testing or training, aircraft may be forced to fly at artificially low or high altitudes, or artificially low airspeeds, which reduces realism and may result in aircrews adopting practices that must be "unlearned" or "relearned" in actual combat.

1.1.8. Inhibited new tactics development. By restricting maneuver areas, approaches to targets, altitudes, airspeeds, and certain technologies, the creative development of new tactics might be limited.

1.1.9. Restricted night and all weather operations and training. Operating at night and in inclement weather is generally an overwhelming advantage when going into combat. Nighttime operations and training, therefore, are essential to force readiness. Nighttime, however, is also the time when residents near military installations are especially sensitive to noise. Nighttime is also when commercial/industrial complexes and homeowners turn on high intensity light sources, whose excessive glare and illumination impacts use of night vision devices. Voluntary restrictions on military training at night may foster better community relations, but they pose especially critical limits on militarily essential testing and training.

1.1.10. Reduced live fire proficiency. Encroachment from community development, endangered species, environmental regulations and other factors reduce opportunities for the use of live fire ordnance, thereby reducing proficiency. While the use of simulation and inert ordnance can replace some live fire training, testing or training with live ordnance remains essential for adequately preparing military forces for combat.

1.1.11. Increased costs or risks. Encroachment can increase costs in a variety of ways. Examples include transportation and other costs for units to train away from their home station when encroachment limits training there; fuel costs for aircraft training missions that must be aborted because of the occasional presence of wildlife in target areas or having to travel to ranges farther away; and the costs of natural resource conservation projects.

SECTION IV

ENCROACHMENT ACTION PLANS (EAPs)

1. Definition

1.1. An Encroachment Action Plan (EAP) is the document that captures the results of identification, quantification, and mitigation of the potential encroachment challenges to an installation or a range. The Installation Commanding Officer, Range Commanding Officer or Range Complex Commander, the Regional Commander, and the Mission Component Commands, will use the EAP to respond to encroachment challenges and to implement preventative or corrective actions identified in the Plan as appropriate. An EAP will delineate short, mid, and long-term strategies to address encroachment challenges at that installation or range. An EAP is meant to be an iterative document and should be periodically monitored and updated as necessary. An EAP is also meant to be an internal use document, although not necessarily legally protected from disclosure. The format of the document should not be that of a typical public release document, e.g., an AICUZ or NEPA document. If there is an aspect to the EAP that is to be protected, then appropriate legal methods should be used from the start to prevent disclosure. This Section outlines the process to produce an EAP.

1.1.1. Establish a comprehensive EAP team to create and evaluate an EAP - This team is not the ERT, but a team that should include members of Regional and Installation/Range facilities planning, environmental, public affairs, security officers, legal staffs, local Facilities Engineering Command planning, real estate, environmental, and the mission component command operators, with additional support as necessary. The formation of this team is an important aspect to the success of an EAP. The purpose of the team is to combine the knowledge and experience of various disciplines and perspectives in order to manage the vast array of issues involved in encroachment. The Installation Commanding Officer, Range Commanding Officer or Range Complex Commander should lead the EAP team.

1.1.2. This EAP team will decide how to proceed with the EAP. An EAP will generally be conducted by government and contractor resources to provide a comprehensive and objective view of the encroachment challenges facing Navy installations and ranges. The EAP team should generate a scope of work and assign responsibilities for the steps below.

1.1.3. Gather all existing documents -- The assessment should reflect and integrate impacts already identified in currently available planning, environmental and operational documents and studies such as the Regional Shore Infrastructure Plan (RSIP), Air Installations Compatible Use Zones (AICUZ) plan, Range Air Installations Compatible Use Zones (RAICUZ) plan, Joint Land Use Study (JLUS), Integrated Cultural Resource Management Plan (ICRMP), Integrated Natural Resource Management Plan (INRMP), NEPA Environmental Assessments or Impact Statements, local Range Complex Management Plan (RCMP), Anti-Terrorism/Force Protection plan (AT/FP), environmental agreements/permits/plans, operational plans, and any local or State development plans. These plans and studies are often generated without integration of information in other plans or studies. Often an installation or range might not be aware of the local or State development plans in the vicinity of the installation or range.

1.1.4. Conduct discussions with local/state government staffs on their proposed development plans or projects that are being contemplated in the vicinity of the installation.

1.1.5. Assess potential encroachment challenges identified in Section II for the particular installation.

1.1.6. Identify the underlying factors associated with the identified encroachment challenges. Requirements include collecting information on the encroachment challenges; the extent to which the encroachment challenges are pervasive on and off or near the installation; current Navy management, planning, or outreach activities that have been employed to minimize negative mission impacts and their effectiveness; the potential for greater impact on current and future missions; and the regulatory and community frameworks that support or exacerbate the encroachment challenges.

1.1.7. Develop short, mid, and long-term strategies to implement encroachment solutions - training and testing changes, land acquisition, rezoning requests, partnerships, outreach, environmental changes, legislative initiatives, and other means to establish mechanisms that enables/sustains the Navy's mission.

1.1.8. Encroachment data should be documented electronically to feed into the comprehensive encroachment database. Geographic Information Systems (GIS) data, maps and available satellite and/or aerial imagery should be used whenever feasible.

2. The EAP provides a comprehensive examination that identifies all encroachment challenges and potential impacts. EAPs should include the following information:

2.1. Background

2.1.1. Current and potential future mission of the installation or range

2.1.2. Current status and summary of Navy planning, environmental and operational documents

2.1.3. Current status and future plans for community development (e.g., comprehensive plans)

2.1.4. Any other potential sources of information

2.2. Challenges of encroachment

2.2.1. Examination of each encroachment challenge identified in Section II

2.2.2. Document whether the challenge exists or does not exist at the installation or range

2.3. Analysis

2.3.1. Determine if a potential encroachment source currently impacts the mission or may impact future missions (see Section III)

2.3.2. Document all mission impacts from identified encroachment challenges and any current corrective or preventative measures undertaken and/or considered. The analysis must explain the correlation between the encroachment challenge and operational assurance.

2.4. The Action Plan - Corrective and preventative strategies (short, mid, and long-term)

2.4.1. Prepare and document all corrective and preventative strategies, the responsible command, resources needed, priorities and timeline to implement

2.4.2. Identify and document costs to encroachment that cannot be corrected or prevented (for example; increased costs to obtain training due to segmenting, reduced usage or avoidance areas)

2.4.3. Develop comprehensive engagement strategies and outreach plans in order to address encroachment impacts, identify stakeholders in the process, identify Navy personnel to engage stakeholders, prepare relevant messages to stakeholders, and plans to interact with stakeholders through appropriate forums.

2.4.4. Periodically monitor and update the strategies and recommendations of the action plan.

2.5. Proposed IPL for EP projects

2.5.1. As part of the strategies, specifically identify all potential Encroachment Partnering projects, funding required, proposed programmatic plan, and priorities (See Section V)

2.5.2. Prepare conceptual approval documents/briefs for proposed projects

SECTION V

ENCROACHMENT PARTNERING (EP)

1. Introduction. The foundation of the EP program is an active local command or regional effort working with local, regional, and State land conservation organizations as well as local and State Agencies, and community leaders to identify partnering opportunities. This is necessary for two reasons: 1) local land use controls adjacent to or near Navy installations and ranges, and under MTRs and special use airspace are often inadequate to protect the mission; and 2) use of installation properties are sometimes restricted by natural resource requirements, making it necessary to acquire additional property interests to protect the regulated natural resource and/or the military mission. The Navy is particularly susceptible to a broad range of encroachment issues because many of its installations are located in ecologically important and high growth urban areas. The local installation command will coordinate its efforts closely with the Region in identifying the opportunities to address encroachment.

To identify Encroachment Partnering opportunities, the Region, installation, or range should determine what land conservation organizations, as well as government agencies, are interested in partnering for land acquisition. The Region should avoid favoritism of one or two organizations to the detriment of other willing partners. These land conservation organizations can provide additional inputs to the installation's encroachment planning process in two ways: 1) they may have knowledge of other potential mission conflicts heretofore unknown by the installation; and 2) they may be able to offer multiple, alternative buffering solutions given their extensive knowledge and expertise in working real estate and conservation issues with Federal, State, and local governments and other conservation organizations. In coordination with these partners, the Region, installation, or range can ascertain the availability of lands outside of the installation, range, or under airspace that can be used to preserve habitat or provide compatible development buffers.

Regions, coordinating with their installations and ranges, will prepare an EP portfolio composed of individual proposed projects. The Region will submit a list of the projects in priority order to CNIC that will meet the Region's needs over the Future Year Defense Plan (FYDP). Projects that will be funded regionally or locally will be so noted. The individual project nominations and the priority list will be used to allocate funding and build the program and budgets. CNIC will assess all of the Regional requests and prioritize the projects over the funding allocated in the FYDP. CNIC will, by separate cover and through regional meetings and workshops, provide additional guidance on EP funding criteria and specific project funding.

2. <u>Encroachment Partnering Responsibilities</u>

2.1. Per reference (b), the Assistant Secretary of the Navy (Installations and Environment) will retain overall policy responsibility, as well as retain approval authority for all programmatic and site specific agreements developed under the 10 U.S.C. 2684a authority. OSD has granted all EP projects a waiver from the OSD land acquisition moratorium.

2.2. Per reference (c), the Deputy Chief of Naval Operations (Fleet Readiness and Logistics) (N4) will:

2.2.1. Exercise program management responsibility for the Navy EP program through CNO (N46).

2.2.2. Coordinate EP projects for the Navy staff (N46).

2.2.3. Validate EP projects that relieve encroachment constraints to training and testing on ranges (N43).

2.2.4. Confirm that EP projects will relieve environmental constraints and that the project is consistent with Navy environmental and natural resource policy (N45).

2.2.5. Forward coordinated EP projects to ASN(I&E) for approval (N46).

2.2.6. Review POM submissions to defend EP projects (N43, N45, N46).

2.3. Per reference (c), the Commander, Naval Facilities Engineering Command (NAVFACENGCOM) will:

2.3.1. As directed by CNIC, provide oversight for the EP program and integrate the EP planning process into the Shore Infrastructure Planning effort for installations and ranges.

2.3.2. Assist in reviewing the Integrated Priority List of EP projects.

2.3.3. At the direction of CNIC or Navy Regions, provide technical expertise and develop detailed nomination packages for those EP projects identified for funding on the IPL.

2.3.4. Negotiate and execute all real estate appraisals, transactions, and title documents. Ensure all nomination packages are consistent with real estate laws, requirements, regulations, and Navy policy.

2.3.5. Ensure that Navy's financial contribution to the EP project is justified with respect to the real estate interest acquired.

2.3.6. Update real estate instructions, guidance, or training programs to support EP project execution.

2.3.7. Develop, to the extent practicable, standardized real estate land acquisition agreements and interest language to be used to obtain interests in lands under the EP program.

2.4. Per reference (c), Mission Component Commands will work with Installation Commanding Officers, Range Commanding Officers, Range Complex Commanders and Regional Commanders to identify valid encroachment constraints to training and testing activities.

2.4.1. Coordinate with the Installations, Ranges, and Regions to capture requirements and impacts. Participate in the EAP process and engage the Installations, Ranges, and Regions to begin EP project submission package.

2.4.2. Review and approve proposed changes to mission requirements that might be part of an EP project.

2.5. Commander, Navy Installations Command (CNIC) will:

2.5.1. Develop and maintain an Integrated Priority List of potential EP projects from submittals by the Regions. The Regions will prioritize projects within their cognizance. CNIC will prioritize projects across the Regions.

2.5.2. Support Program funding for prioritized EP projects. In addition, CNIC, through ASN(I&E), will seek to obtain centrally managed DOD EP funds for projects on the IPL.

2.5.3. Engage the Naval Facilities Engineering Command early in project identification and nomination package development to ensure that all planning and real estate issues are identified and considered.

2.5.4. Ensure EP project packages describe the mechanism by which the project will relieve the identified encroachment constraint.

2.6. The Regional Commander will:

2.6.1. Provide command direction, priorities, and recommendations on EP projects submitted by Installation Commanding Officers, Range Complex Commanders and Range Commanding Officers under their cognizance.

2.6.2. Establish or use a Fleet sponsored Regional Enhanced Readiness Team (ERT) to assist in identifying and prioritizing EP projects.

2.6.3. Submit EP projects to CNIC for inclusion on the IPL.

2.6.4. Ensure that the EP project process is "competitive." Regions should consider all qualified entities (State, local and NGOs) based on their geographic and programmatic areas of interest and the advantages these entities may offer, and seek the best project proposals from all eligible sources to avoid the appearance of excluding or favoring any potential partner.

2.6.5. Review and approve proposed changes to mission requirements that might be part of an EP project.

2.6.6. Engage the local Installation Commanding Officers, Range Complex Commanders and Range Commanding Officers to continually review training and test procedures to identify changes that will reduce encroachment problems within the constraints of safety, mission effectiveness and economy.

2.6.7. Engage the local FEC early in project identification and nomination package development to ensure that all planning and real estate issues are identified and considered. Regions should ensure that projects are compatible with environmental, base development and natural and cultural resources plans, regulations, and Navy policy. For habitat projects in particular, evaluate the potential for projects to directly or indirectly introduce endangered, threatened, or at-risk species onto military lands.

2.6.8. Ensure that EP related environmental documentation requirements are met. Specifically, EP actions may also require NEPA documentation, Biological Consultation, Historic Preservation Consultation, and Section 404 of the Clean Water Act permits.

2.6.9. Monitor EP project implementation efforts of subordinate commands.

2.6.10. Fund, where appropriate, EP project related NEPA and real estate transactional costs.

2.7. Installation Commanding Officers, Range Complex Commanders and Range Commanding Officers will:

2.7.1. Implement an EP program, in conjunction with the Regional command, for the installation following the concepts set forth herein.

2.7.2. Actively work with State and local planning officials and land conservation organizations to identify and implement EP projects.

2.7.3. With Regional, Mission Component Command, and local FEC support, prepare an EP submittal package for an individual project for conceptual approval by CNIC, CNO, and ASN(I&E). The advance notice should identify the facts pertaining to a potential encroachment partnering opportunity. Justify the need for using the Encroachment Partnering authority to obtain new interests in property.

2.7.4. Notify the chain of command whenever local events merit update or review of EP projects previously submitted.

2.7.5. Designate an individual to lead an integrated EP team comprised of planning, environmental, public affairs, legal, and real estate personnel who may be leveraged from other Navy commands.

3. Individual EP Project Submittal. The EP project submittal package shall include the following information in order to obtain conceptual approval. The package should have a cover letter and attachments such as a narrative description of the proposed project, power point slides, spreadsheets, and pictures or maps. Multiple projects for an installation may be submitted under one cover letter with separate justifications for each project. Other attachments, such as pictures or maps, may contain information for multiple projects or parcels.

3.1. Letter from installation or range through Region and Mission Component Command to CNIC.

3.2. Project description.

3.3. Encroachment description.

3.4. Justification - link solution to the improvement of the mission or prevention of degradation.

3.5. Coordination description (The team must plan the project with the involvement of the Region, Installation, and local FEC) - List the actual POCs.

3.6. Potential partners (these partners do not necessarily have to have been contacted at this point).

3.7. Potential costs - acquisition. Include other real estate or NEPA costs.

3.8. Potential timeframe.

3.9. Type of NEPA documentation expected.

3.10. Maps and/or pictures of project.

4. EP Project Development. Prior to moving forward on a particular project and beginning detailed negotiations with

potential partners, NEPA must be completed. An installation or range can use the NEPA process to assist in identifying partners and other Federal agency interests, etc. If there is to be no change to the land use the Navy will have a real property interest in, then Navy's new Categorical Exclusion (CATEX) for minor land acquisition may be applicable. Consult with the NEPA and legal staff.

4.1. Respond to or initiate dialog with conservation organizations, regulators, State, county, and/or city officials.

4.2. Identify the requirements, constraints and solutions being pursued.

4.3. Identify the win-win opportunities, and risks of proceeding or not proceeding.

4.4. Make NEPA decision, and obtain authorization and approval from Navy leadership, including verification that funding is available.

4.5. Once authorized, with assistance from the FEC Real Estate office conduct negotiations among parties to the partnership to achieve a tentative/draft agreement in principle.

4.6. Proceed or continue with initial real estate process (such as surveys, appraisals, title searches, etc.).

5. EP Project Execution. This section outlines the general execution process when the partner or partners have been identified and the approval to proceed has been rendered by ASN(I&E). These steps are not necessarily mutually exclusive. The execution of an EP project is functionally similar to any real estate acquisition project and the local FEC Real Estate office is the expert on acquisitions for that local area. Section 6 summarizes the acquisition process in detail.

5.1. Appoint project lead - i.e., local Facilities Engineering Command Real Estate office.

5.2. Create realistic timeline.

5.3. Finalize the necessary real estate processes.

5.4. Finalize the partnership agreement.

5.5. Finalize the easement language (CNIC to get ASN counsel approval on draft prior to execution).

5.6. CNIC/Region to provide final funding to the local FEC for acquisition.

5.7. Execute the real estate acquisition.

6. Real Property Acquisition Guidance For EP Projects. While the final phase to EP project implementation is obtaining the real estate interests, this process begins early in the encroachment planning stages when the installation is assessing its encroachment situation. As the installation begins to search for encroachment partners, real estate personnel are included in the team to help assess the competencies of the Navy's potential partners and to begin the process of integrating the partner's land acquisition processes with the Navy's land acquisition processes.

The following lists of real estate actions are a guide to developing and executing an individual EP project.

6.1. The installation or range submits an interest notification to CNIC through the Region indicating that the installation or range has identified an acquisition opportunity that had not been identified earlier. This notification keeps the chain of command aware of potential, new project submittals. This is also the time that the NEPA process should be initiated and completed. An installation or range can use the NEPA process to assist in identifying partners, other Federal agency interests, NGOs and/or others. If the project is in the execution plan for the current Fiscal Year (FY06 and beyond), this process should already be fulfilled.

6.2. The installation or range and/or the Region (in coordination with its FEC real estate staff) initiate contact with potential encroachment partners. Partners may include State, regional, and local government agencies and/or conservation organizations. The full partnership might also include Federal agencies and other community parties. During partnership development activities, the installation will identify properties in which the Navy and its partners have a common interest.

6.3. Parties develop Memorandums of Agreement (MOA) (e.g., how the partners will work together) and draft easement language if applicable. The MOA and the easement language will need final ASN(I&E) counsel approval.

6.4. The installation or range, in conjunction with the Region and the local FEC planning and real estate staff, submits a project for conceptual approval through the Region to CNIC.

6.5. The Navy's cost share in the partnership acquisition will be determined by a negotiated process. The local FEC real estate contracting officer will determine whether a fee simple and/or an easement appraisal is necessary and the appropriate appraisal procedures required.

6.6. Upon conceptual approval of the project, the local FEC real estate staff will coordinate the execution plan with the installation or range, the Region, and other FEC staff.

6.7. The FEC real estate contracting officer submits the project to ASN(I&E) for approval to execute the project.

6.8. The FEC real estate staff will execute the project according to all Federal regulations governing land acquisitions.

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Camp Navajo Army Depot/Naval Observatory Flagstaff Buffer Partnership
Information Document

Prepared by: S. Hedwall, FWS

Introduction

The Arizona Army National Guard (AZARNG), Navy, Fish and Wildlife Service (FWS), Arizona Game and Fish Department (AGFD), and other partners met on August 16, 2006, to discuss the potential for a Camp Navajo Army Depot (Camp Navajo)/Naval Observatory Flagstaff Station (NOFS) encroachment/conservation buffer partnership. Department of Defense (DoD) buffer initiatives are designed to protect the military mission from threats to the military mission (i.e., encroachment) and to work with partners to implement conservation actions within these "buffer" areas. The group discussed the current and future threats to the military mission that exist in the area and the existing support in the area to acquire lands for conservation purposes. Following this discussion, the group agreed that the military installations should move forward to engage the existing Coconino County-led partnership in developing a DoD encroachment/conservation buffer project that meets the needs of both Camp Navajo and NOFS.

This document will briefly outline both installations' military missions, describe the current threats to their missions, describe the status of the existing "open-space" partnership, and the conservation benefit to obtaining lands adjacent to and within close proximity of both Camp Navajo and NOFS. This document is not intended to be all encompassing of the information available regarding this area, but to act as a summary document to generate questions and further discussion regarding the Buffer Partnership.

Installation Missions

Camp Navajo

Camp Navajo is located in north-central Arizona, 12 miles west of Flagstaff, 17 miles east of Williams, and adjacent to the small community of Bellemont, on Interstate 40. It is owned by the U.S. Army and managed by the AZARNG. The installation is approximately 28,372 acres in size and is used for a variety of AZARNG training, munitions/missile storage, and maintenance missions. Camp Navajo is a major National Guard Bureau (NGB) training area used primarily by the Army and Air National Guard units (transportation, engineer, military police, aviation, ordnance, medical, quartermaster, and other branches) for annual and weekend training. Additionally, Camp Navajo is used as a training site by both active component and other reserve component units of all services. Headquarters at Camp Navajo is also tasked with the Command and Control of National Guard units located in northern Arizona (Flagstaff, Bellemont, Prescott, and Show Low).

A large portion of the land surrounding Camp Navajo is undeveloped and managed by the Forest Service and the Arizona State Land Department (ASLD). The Burlington Northern/Santa Fe Railroad forms the northern boundary of the installation. To the west, Camp Navajo is bounded predominately by the Kaibab National Forest, interspersed with small tracts of private property. The eastside is bounded by ASLD lands with a few privately held parcels. The southern boundary is adjacent to the Coconino National Forest with some small tracts of private land.

NOFS

The Naval Observatory Flagstaff Station is located in Coconino County, five miles west of the city of Flagstaff, on Interstate 40. NOFS is bordered by national forest, ASLD lands, and private lands. The installation is approximately 287 acres in size. The mission of the NOFS is:

- To determine the positions and motions of celestial bodies, motions of the earth, and precise time.
- Provide astronomical and timing data required by the Navy and other components of the U.S. Department of Defense for navigation, precise positioning, and command, control, and communications.
- Make these data available to the government and the general public; and, conduct relevant research, and perform other such functions as may be directed.

The NOFS is specifically charged with making, analyzing, and interpreting astrometric and photometric dark sky observations to fulfill this mission. In addition, the NOFS conducts research to improve methods and accuracy of these astronomical observations.

Current Threats to the Military Mission

Camp Navajo

As stated above, Camp Navajo is used for a variety of AZARNG training, munitions/missile storage, and maintenance missions. Camp Navajo is divided into four areas based on the facilities present and the expected use. The four operational areas are: storage of munitions, training, administration, and buffer zones around the perimeter of the installation. The Open Burn/Open Detonation Area (also known as the Demolition Areas) and surrounding buffer zone consist of approximately 5,000 acres of fenced area in the southern portion of the installation. Threats to the military mission include the development of private and ASLD lands adjacent to and nearby the installation. Training soldiers is a loud and potentially dangerous mission. It is loud due to the firing of weapons and use of helicopters. It can be dangerous if civilians, living too close to the area, challenge the marked boundary fence and enter the installation without permission. Currently, because most people using the areas surrounding Camp Navajo are hunters, trespass most likely rarely occurs. However, if adjacent ASLD lands were sold to developers to create large housing developments, we could possibly expect more trespass issues and complaints regarding the training noise.

In order to best deal with the encroachment threat, the AZARNG needs to determine the distance out from the current installation boundary that they may need protected from encroachment.

NOFS

The greatest threat to the Navy's mission is lighting pollution from development. Dark Skies are a necessity for the NOFS to conduct their mission. Though the City of Flagstaff (City) is a "Dark Skies City" and has a lighting code to aid in protecting the area's valuable observatories, there is already light pollution occurring from existing surrounding areas (City of Flagstaff, Interstate 40, etc.) and it would be beneficial if areas that could possibly be developed were maintained as "dark space" (i.e., did not produce light pollution that affects the military mission).

The City lighting code was enacted to encourage lighting practices and systems which will minimize light pollution and curtail the degradation of the night time visual environment. The effects of outdoor lighting on the light pollution over observatories is strongly dependent on the distance of those lights from the observatories; therefore, in the code adopted by the City, three Astronomical Zones were established, allowing greater flexibility in the uses of outdoor lighting as the distance from the observatories increased. Zone I is centered on the observatories located on Anderson Mesa (Lowell Observatory) and west of Flagstaff (NOFS); the outer boundary of Zone I is set at approximately 2.5 miles from these observatories. Zone II extends from the outer boundary of Zone I to approximately seven miles from the observatories. Zone III is all remaining property within the City limits. These Zones are shown on the map accompanying this document. The lands with development potential within Zones I and II (outside of existing development) should be considered for acquisition as part of the buffer identification process.

Status of the Existing Partnership in the Surrounding Area

Interest in obtaining the ASLD lands to the south and east of both Camp Navajo and NOFS to protect open space in the greater Flagstaff area, has been a goal of several agencies for many years due to the biological diversity, presence of listed and sensitive wildlife, and desire of the public to maintain the area as open space. However, with voter approval of the Coconino Parks and Open Space Program and creation of the Coconino County Comprehensive Plan, several agencies were brought together by the Coconino County to document the conservation value of these areas (see the land selection goals below). The Coconino County Parks and Open Space Program was a ballot measure passed by voters on November 5, 2002. The sales tax revenue will fund the open space program in which money is allocated toward acquisition of seven natural areas, including the wetlands and wildlife habitat in the Rogers Lake area (southeast of Camp Navajo and southwest of the Naval Observatory) and old-growth forests near NOFS west of Dry Lake. In addition, there are other Partners who may have funding opportunities to assist in acquiring pieces of the identified lands.

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A scientific advisory group comprised of members representing the County Parks and Recreation Department, FWS, AGFD, Coconino Community College, The Nature Conservancy, The Grand Canyon Trust, ASLD, and Northern Arizona University (NAU) was formed to develop acquisition recommendations. Coconino County and their partners planned to use the recommendations to determine which parcels of land should be targeted for acquisition.

Lands recommended for acquisition were required to meet one or more of the following goals:

1. Protect areas of rich biological diversity
2. Protect the habitat of threatened or endangered species, and species of concern.
3. Protect areas of significant, outstanding, or unique vegetative communities, such as wetlands and riparian areas.
4. Protect unusual, outstanding, or unique scenic viewsheds, and geologic or topographic features.
5. Protect water recharge areas, floodplains, water quality and supply, and access to water for wildlife.
6. Protect natural areas with archaeological, historical, and cultural values.
7. Protect natural areas with research, scientific, and educational values.
8. Preserve natural areas that protect and enhance connectivity to other protected lands for wildlife movement and ecological processes.
9. Protect and enhance recreational opportunities.

Identified Conservation Benefit of Lands Surrounding Camp Navajo and NOFS

The area surrounding Camp Navajo and NOFS to the south and east is predominately ponderosa pine forest with expansive meadows and a significant ephemeral wetland. For purposes of discussion in this document, we have defined several areas within the Zone I and II areas that are important from a conservation standpoint to the Partnership. Those areas are: Old-growth Area, Rogers Lake Area, Woody Ridge, Observatory Mesa, and the Fort Tuthill Expansion Area. Some information for each identified area will be described briefly below. However, if more detailed information is available, the summary will state who has the information. Please see the map generated by AGFD and FWS for further information as well (the map will be at the meeting on December 13, 2006).

Additional private land parcels that have potential encroachment and conservation benefit to the Partnership are the piece in Volunteer Canyon (SE corner of Section 33, T222N, R5E), the piece on the southwest corner of Camp Navajo (Section 6, T21N, R5E), and the piece on the west side of Camp Navajo (portions of Sections 13 and 24, T22N, R4E). The parcel we have the most information for is the parcel in Volunteer Canyon. This property is adjacent to the Volunteer Canyon Mexican spotted owl (MSO) protected activity center (PAC). Volunteer Canyon contains unique vegetation communities and species and should be protected from development. Though we do not know how developable the private property is, we do know that the landowner has recently requested access from the Forest Service and they are going to be required to build a road on public land (~200 feet) to grant him access to his property.

Old Growth Area

The "Old Growth Area" is located adjacent to NOFS and Camp Navajo. The legal description is ASLD Sections 21, 26, 27, 28, 34 and portions of 22, and 33, T22N, R6E. There is a small, private in-holding in section 27 as well that should be considered by the Partnership. A good portion of this area is Centennial Forest and is under an agreement with the ASLD for NAU to manage. However, the area has potential to be developed. This area is entirely within lighting Zone I. These lands have extremely high conservation values. A majority of the area is either part of the Dry Lake MSO PAC or is MSO restricted habitat. The area has also has high value for turkey and pronghorn. The FWS and the ASLD implemented an extensive thinning project on this acreage in 2003-2005. The slash piles are currently being burned and the agencies intend to conduct prescribed burning within the next year or so. Additional biological information on this area is located in FWS, AGFD, ASLD, and Coconino County Parks & Recreation files. A brief summary of this areas conservation value is listed below.

- Protected Activity Center for Mexican Spotted Owl
- High concentration of old growth Ponderosa pine
- Encompasses a portion of the Dry Lake caldera – a unique topographical feature, water recharge area, location of high vegetation diversity, and Bald Eagle habitat.
- Wildlife movement corridor
- Vegetation and topographical diversity along ridgeline
- Protective buffer along high priority lands
- Wildlife movement corridor

Rogers Lake

The "Rogers Lake" area is also immediately adjacent to both installations and includes portions of Sections 31 and 32, T22N, R6E and portions of Sections 4, 5, 6, T21N, R6E. A good portion of this area is Centennial Forest and is under an agreement with the ASLD for NAU to manage. The area is within lighting Zones I and II. Rogers Lake is a historically and regionally significant ephemeral wetland. It is located along the Woody Ridge wildlife movement corridor, and during the wet seasons is an important source of water for wildlife and waterfowl. While the floodplain itself cannot be developed, the surrounding uplands are attractive for development. The uplands are crucial as wildlife habitat and for unobstructed access to the floodplain. Coconino County and AGFD have done a tremendous amount of work approaching private landowners in the Rogers Lake area to discuss sale and/or conservation easements. There is the potential for a combination of these acquisition methods for a portion of the acreage. Additional biological information on this area is located in FWS, AGFD, ASLD, and Coconino County Parks & Recreation files. A brief summary of this areas conservation value is listed below.

- Diversity of wildlife and vegetation when saturated
- Important habitat for Bald Eagles and others species of concern
- Regionally significant floodplain and water recharge area.
- Significant wildlife watering area, and excellent watchable wildlife area
- Unique wetland vegetation community
- Scenic viewshed
- Historical railroad bed across the floodplain
- Outstanding community research, science, and education potential
- High biological diversity as cover for wildlife and access to the floodplain
- Wildlife movement corridor
- Surface water runoff from these lands into Rogers Lake recharges groundwater
- Potential for research, science, and education associated with Rogers Lake
- Connectivity with Forest Service and Camp Navajo lands.
- Potential for recreational opportunities outside of the floodplain.

Woody Ridge Area

The "Woody Ridge" area runs south from the NOFS down Woody Ridge and is predominately in lighting Zone II. Though this area is a few miles from Camp Navajo, there is potential for the ridge to form a topographic buffer for noise generated from Camp Navajo, so this area is worth looking at from the encroachment buffer perspective. However, the area is extremely important from a conservation perspective. The area contains MSO habitat (the Woody Mountain and LeBarron MSO PACs are completely within this area and a portion of the Dry Lake PAC is within the area), turkey habitat, and is an extremely important wildlife movement corridor for many wildlife species (see map). This is a harder area to define, but it does contain developable ASLD lands (portions of Sections 2, 4, 8, 14, 17, 22, 26 and all of Section 10, T21N, R6E). Additional biological information on this area is located in FWS, AGFD, ASLD, and Coconino County Parks & Recreation files.

Observatory Mesa

This area is located to the immediately northeast of NOFS and due east of Camp Navajo. Lowell Observatory is located on Observatory Mesa and the area has great recreational value to the people of Flagstaff. The area that could potentially be sold by ASLD for development is Section 12, T23N, R7E. This section falls within lighting Zones I and II and is important elk and pronghorn habitat, especially in terms of maintaining the movement corridor from north of Interstate 40 to south of the interstate. Additional biological information on this area is located in AGFD, ASLD, and Coconino County Parks & Recreation files.

Fort Tuthill Expansion Area

The "Fort Tuthill Expansion" Area is located to the southeast of NOFS (in lighting Zone II), east of Woody Ridge (Section 12, T21N, R6E and a portion of Section 6, T21N, R7E). This area is an important potential acquisition for the Partnership, although of all the areas described thus far it has the least conservation value to wildlife. However, it has great recreational and social value to the City and Coconino County as open space for trails and park use. This is a good example of a land parcel the Partnership may be able to purchase if they are able to partner with the military on other acquisitions. This area is extremely developable, especially based on its proximity to Interstate 17. ASLD currently owns the land. Additional information on this area is located in ASLD and Coconino County Parks & Recreation files.

Appendix I: Biological Opinion and Informal Section 7 Consultations

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2-21-97-F-110

BIOLOGICAL OPINION SUMMARY
NAVAL OBSERVATORY FLAGSTAFF STATION

Date of opinion: July 23, 1998

Action agency: Department of the Navy

Project: Naval Observatory Flagstaff Station

Location: Coconino County, Arizona

Listed species affected: Mexican spotted owl (Strix occidentalis lucida)

Biological opinion: Nonjeopardy

Reasonable and prudent alternatives (RPAs): *Implementation of one of these RPAs is necessary to remove the threat of jeopardy from the proposed action.* None.

Incidental take statement:

Anticipated take: *Exceeding this level may require reinitiation of formal consultation.* One Mexican spotted owl.

Reasonable and prudent measures: *Implementation of these measures through the terms and conditions is mandatory*. Two measures are provided to address effects due to disturbance from construction activity, forest thinning, and prescribed burning. A third measure is provided to address necessary monitoring.

Terms and conditions: *Terms and conditions implement reasonable and prudent measures and are mandatory requirements.* Three terms and conditions are provided to implement the three reasonable and prudent measures.

Conservation recommendations: *Implementation of conservation recommendations is discretionary.* None

United States Department of the Interior
Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 W. Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
(602) 640-2720 Fax (602) 640-2730

In Reply Refer To:

AESO/SE
2-21-97-F-110

July 23, 1998

Mr. Michael Stroud
Department of the Navy
Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

Dear Mr. Stroud:

The U.S. Fish and Wildlife Service (Service) has reviewed the biological assessment for the Naval Observatory Flagstaff Station located in Coconino County, Arizona. Your August 20, 1997, request for formal consultation was received on August 22, 1997. This document represents the Service's biological opinion on the effects of that action on Mexican spotted owls in accordance with section 7 of the Endangered Species Act of 1973, as amended, (16 U.S.C. 1531 et seq.).

This biological opinion is based on information provided in the August 1997 biological assessment, telephone conversations, field investigations, site visits, meetings, and other sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the species of concern, forest thinning and construction activities and their effects, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file in the Arizona Ecological Services Office.

CONSULTATION HISTORY

Informal consultation (2-21-96-I-287) on a version of this proposal began on November 27, 1995, when the Service received a November 20, 1995, request for concurrence to proceed with a forest thinning project of approximately 65 to 90 acres of land on the U.S. Naval Observatory. On June 19, 1996, the Service responded that it could not concur with a "not likely to adversely affect" determination, and recommended that formal consultation be initiated. On August 21, 1996, the Service received an August 15, 1996, request for concurrence with a finding of no effect for the installation of a 1.3 meter telescope at the Observatory. The Service responded with a September 4, 1996, letter (2-21-96-I-404) concurring with that finding, but also recommending that a long-term operating plan for the Observatory be consulted on. The Service issued a January 9, 1997, letter regarding the concept of consultation on all Observatory operations for a 10-year period. A meeting was held at the Observatory on March 11, 1997, to discuss issues and procedure for necessary consultation. At that meeting, the Service received a March 10, 1997, draft biological assessment of the proposed project. On March 24, 1997, in response to a request for comments within two weeks, the Service provided comments on the draft BA. On August 22, 1997, the Service received an August 20, 1997, request for formal consultation on the project. As requested, a draft biological opinion was provide to the Navy on December 19, 1997. A response to the draft opinion was received by the Service on March 23, 1988. A meeting to further discuss the draft opinion and the Navy's comments was conducted on April 8, 1998.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

Most of the following project description was obtained from the August 1997 biological assessment (Tierra Data Systems 1997). The mission of U.S. Naval Observatories is to: determine positions and motions of the earth and celestial bodies, determine precise time, and provide other astronomical data required by the Navy and Department of Defense (DOD) for navigation, spacecraft tracking, precise positioning and command, control and communications. The Observatory is specifically charged with making, analyzing and interpreting astrometric and photometric dark sky observations to fulfill this mission. In addition, the Observatory conducts research to improve methods and accuracy of these astronomical observations.

The Observatory is located in the Coconino National Forest in Coconino County, Arizona, five miles west of the city of Flagstaff on Interstate 40, and about 110 miles north of Phoenix on Interstate 17. It is bordered by National Forest, Arizona State Trust, and private lands. The primary land use in the region is timber harvest, recreational tourism, and human settlement. Seasonal livestock grazing is also widespread on public lands of the area.

The Observatory is located in the Upper Gila Mountain Forest Province (Bailey 1980), in the largest contiguous forest of ponderosa pines in North America, extending for 300 miles from north-central Arizona into western New Mexico. This is a physiographically transitional area between the Colorado Plateau and Basin and Range provinces (Williams 1986). The ponderosa pine forest is part of an elevation gradient of vegetation that begins with grasslands, and continues upward through pinyon-juniper, ponderosa pine, mixed conifer, and spruce-fir plant communities.

The Flagstaff area enjoys blue skies and clean fresh air for an average of 288 days of sunshine per year. The northern Arizona airshed is among the cleanest in the United States. The greater Flagstaff area easily meets all the national ambient air quality standards for nitrogen oxide, carbon monoxide, sulfur dioxide and ozone. The greatest threat to air quality is regional haze that originates from sources as distant as Los Angeles and northern Mexico. Other factors that affect the region's air quality include forest fires, dust from unpaved roads and areas with degraded vegetative cover, vehicles and electrical power generation. The City of Flagstaff passed an ordinance in July 1990 that prohibits the installation or sale of wood heaters or fireplace inserts that fail to meet EPA certification standards. The ordinance also prohibits the burning of coal within the city. City and county light ordinances may be the most restrictive in the country, mainly to reduce light interference for Lowell Observatory located within the city limits of Flagstaff, but this also benefits the Navy's night sky visibility.

The mountain peaks of the Flagstaff area provide the Observatory with a high-quality, clear, dark sky relatively free of light and particulate pollutants for astronomic observation. Continued success of this and other observatories in the area depends upon maintaining the quality local environment for low light and particulate pollution, and a healthy forest. The westward expansion of Flagstaff has become a concern. In particular, the disposition of Coconino National Forest lands to the east and north, and Arizona State Trust lands to the south and west is crucial to fulfilling the Navy mission.

The Navy operates a national space observatory at the Flagstaff site, benefiting both military and civilian causes. This fundamentally requires that the vicinity be protected from light and particulate pollution that results from encroachment of human settlement. Some protection is provided by a buffer of land ownership that the Navy controls, and a forest maintained in a healthy, fire-safe condition.

The United States Naval Observatory Flagstaff Station was originally established on October 14, 1955 because its remoteness provided the key combination of high-altitude, dark sky without urban light interference, and a comparatively pollution-free atmosphere. The Observatory in Washington D.C. had become severely limited due to the level of pollutants and light in the atmosphere. During the 1950s, Flagstaff was relatively undeveloped. Water resources seemed to guarantee slow growth at the time. One hundred and sixty acres were withdrawn from the State in 1957, after the land was leased for the first few years. In 1971 an additional forty acres, adjacent to the northeast boundary, was purchased to prevent development close to the facility that would lighten the dark sky. Another eighty-seven acres were purchased in 1988 for the same reasons, near Interstate 40 in the north half of section 22. Total area remains 287 acres. Although documentation is unavailable, it is presumed that the property was last harvested in the early 1950s when most old growth trees in the Flagstaff area were harvested and when the site was owned by the State of Arizona.

Day-to-day Activities

The nature of land use at the Observatory and its isolation make it a quiet place. Traffic levels are low and concentrated during commuting hours, with some activity during the night when the telescope is in use. Current staffing is at 22 people. The dome makes an occasional low, rumbling sound when it rotates. Proximity to I-40 and railroad tracks allows distant, fairly constant freeway noise and periodic, loud train disturbance.

Paved roads access the main facility and two smaller developed sites to the east and west. These roads are scheduled for occasional routine repairs, generally between May and September. Dirt roads are infrequently maintained and some are badly rutted. The Observatory has little incentive to repair these roads as the surrounding forest is used for no other purpose than a light and pollution buffer. Some sections may be re-worked just enough to provide access for thinning operations.

An overhead utility line links the three sites. Communication among the sites is facilitated by laser beam transmissions. Water is not available locally and is trucked in, stored in three storage tanks at each of the compounds. Due to the site's high elevation, winter temperatures are often below freezing, and construction and maintenance may be limited to the 120-day frost-free season.

Operations Area

The Observatory proposes to confine its current and all future activities and construction for at least the next 10 years to within a 38-acre Operations Area. The needs of the Observatory are not likely to extend beyond the proposed Operations Area. Future development at the Observatory is limited for multiple reasons, including: light pollution from Flagstaff and vicinity; few peaks on which to put a telescope; lack of water and high cost of developing other utility corridors; additional environmental heat and light contribution of any structure, which affects astronomic viewing conditions; budget cuts; and lack of developable sites outside the Operations Area.

Plans for Optical Interferometer Support Facility

The Observatory is planning construction of an optical interferometer support building which will be an expansion of the primary Observatory facility. The project is currently at the 35-percent design stage. Funding is anticipated in 1998 (Fiscal Year 1999). An interferometer allows for more accurate star positioning than that possible by conventional methods. The main system itself, while built by the Navy, will be located at the Lowell Observatory. The support facility at the Observatory is intended to provide office and laboratory space for additional personnel, likely transferred from Washington. This project is identified by the Navy as P-029.

The building is planned to be two stories, with the upper story adjoining the current building. The lower story will open to the east onto the existing road, with a parking lot near that entrance. Construction is anticipated to involve these components: the existing leach field will be enlarged; the existing water tank will be supplemented with a similar but larger one; the new tank is planned to be adjacent to and east of the existing one; the existing water tank will remain primarily for emergency fire control while the new one will provide water for facility daily requirements.

An electrical power entrance pad will be built outside the new addition. Existing overhead power lines will be buried to cross the road between the new addition and a new power pole just the other side of the nearby road that encircles the Observatory hill.

A construction staging area will be located on the opposite side of the road from the new addition. This will be re-seeded with appropriate indigenous ground cover after use.

Excavated material will most likely be placed next to the road at the entrance gate, where possible construction of an automobile turnaround and gatehouse have been considered. Two to three trees will be removed, including one large pine and a clump of multi-stemmed, small-diameter Gambel oak.

A generally disruptive increase in noise, traffic and other disturbance is expected during the outdoor construction period for about five to six months, gradually decreasing as excavation and the exterior shell are completed and work moves indoors. Total construction time is anticipated to be 10 to 12 months. Noise from construction traffic will peak at the beginning and ending of the work day, at approximately 0700 and 1600, with noise between these periods. This is in addition to the existing noise levels associated with train and freeway traffic.

Once construction is complete, an increase in traffic and activity within the Operations Area is anticipated with personnel being relocated to the Observatory to support the interferometer project. About 20 new staff will be added, bringing the new total to 42 persons. Additional water hauling will be required to support water needs of the increased staff. Currently this occurs about once a month for each replenishment, with two to four trips depending on the truck used. This may double. Other deliveries should not result in increased traffic, since delivery of increased liquid nitrogen supply would simply be brought in on the same truck, as more volume at one time.

All of the above activities involve the removal of a single pine tree, and trimming or removal of one clump of small-diameter Gambel oak adjacent to the planned footprint of the new addition.

Timing of construction is critical in order to control cost. In the worst case, exterior shell and site work should be completed in about six or seven months. For instance, with an April 1998 start date, the shell and site remediation could be complete by October or November, with work continuing on the interior of the building beyond that. A later start could extend the total construction period by three to five months depending on the severity of winter weather and the actual start date. Since the site is quite steep and a good deal of excavation is required, weather conditions can have a major impact on the construction period. Delay would also expose the site to erosion risk in its disturbed condition for a longer period.

Additional precautions can be taken to accelerate construction cost, such as protective shelters and temporary heat, but this will be costly and may not totally eliminate extension of the construction period. Foundation work, site grading and parking improvements can only occur in periods of dry, non-freezing weather; thus they cannot be wholly completed even with protective measures. Site access for major construction equipment may also be a problem in winter, and could cause some construction delays.

Other Construction Plans

The building of P-029 is the only construction currently planned. However, other projects may occur in the next five years, all within the Operations Area boundary. The following are presented roughly in increasingly hypothetical order: water tanks for Buildings 1 and 2 need replacement; the new tanks may be either above or below ground. No trees need be removed for this replacement.

A remote possibility is to put an underground fiber optics line along the existing utility corridor that connects the three developed sites on Naval Observatory. This would involve digging a shallow trench, with no tree removal. Communication among the three sites is currently by laser beam transmission. This normally suffices except when snow on trees bends branches and gets in the laser path. Lines would go between Buildings 4, 6, 7, and 1.

An infrared telescope at Building 1 has been considered. The project remains unfunded but is on the books for FY99. An infrared telescope can operate despite light pollution, so is one of the few telescope options still open for the Observatory. No removal of trees is currently anticipated; however, some use of heavy equipment would be required.

Future construction projects

The parking lot size at the eight-inch telescope (buildings 6 and 7) may be expanded. No plans exist for this very conceptual expansion at this time. Tree removal is currently not anticipated.

The Security Officer from Washington D. C. would like a perimeter fence around the entire Observatory property, but local staff believe the more than five-mile fence is unreasonably costly, so have not agreed to its installation. Security also wants a front gate that is always locked, with a gatehouse and a turnaround area by the gate for cars to leave if it is locked.

Maintenance

Routine and emergency maintenance occurs completely within the Operations Area, and includes: road repairs using typical hot asphalt equipment and cold patching; building maintenance and repair, including but not limited to painting and cement patching. Repainting of the Observatory dome and all other facilities is scheduled shortly. Building 4 and the dome will be first, and this will take about two weeks. It will involve mechanical abrasion of the building surface coupled with a residue vacuum. Minor erosion control is periodically required around structures, including minor vegetation manipulation where appropriate. Utility corridor maintenance includes cyclic trimming of tree branches that interfere with the laser path between buildings.

Unauthorized activities on Navy property

Despite surveyed boundary posts and "No Trespassing" signs, the Observatory continues to experience some trespass. Although the dirt road at the eight-inch telescope has a padlock and chain on it, the property lacks a boundary fence and the roads on neighboring properties have uncontrolled access. Additionally, a herd of sheep passes through the property with its owner about once a year as they migrate between pastures. The Observatory can ask the herdsman not to trespass but would have to fence out the sheep at its own expense to ensure exclusion.

Forest Fuels Reduction for Wildfire Prevention, Forest Health, Structural and Biological Diversity - Thinning Objectives

Manipulation of Navy forests through silvicultural treatments and a management system of area control is proposed with these objectives: reduce the standing fuel load and the risk of catastrophic wildfire by thinning pine stands; improve individual tree and forest stand health and vigor by decreasing the number of pines per acre; restore, enhance and perpetuate stand biological and structural diversity by protecting oaks from overtopping by pines; and by improving conditions for the survival, growth and development of oaks and pines.

Prescriptions are presented for four areas to achieve these objectives. A revision of these prescriptions would be needed when: the prescriptions have been fully implemented and the desired forest fuel load reduction, structural and biological diversities are achieved; when sufficient time has passed and, in the absence of prescription implementation, natural processes have so changed the forest conditions that the prescriptions herein no longer reflect existing conditions; protocol surveys for the Mexican spotted owl document it as inhabiting Navy lands or the species is delisted; the MSO Recovery Plan expires or is significantly revised; or when sufficient land use changes have occurred that the baseline is outdated.

The prescriptions will be contractually administered by the Navy forester. Treatment will lower the wildfire hazard to facilities, personnel, operations and forest habitat at the Observatory while providing for long-term health of the forest. The creation and retention of tree species diversity and forest structural diversity are of paramount concern. An intensive inventory of the oaks in Spring 1997 on the main portion of the station revealed that the pines pose a significant threat to the oaks by overtopping them, growing up around or through the oaks. The process is quite obvious in different stages throughout the Navy property. The effects are that the geotropic pines are shading out the heliotropic oaks; are preventing development of large primordial limbs (which, when shed, will offer access to decay cavities); and are invading the oak crowns, causing physical damage and obscuring the oaks.

Given the extremely low probability of the use of fire as a silvicultural tool on Navy lands, serious consideration must be given to reducing the number of pine stems around and in oak trees in order to protect, preserve and perpetuate the oak fraction in the forest. Without intervention through silvicultural treatments or reintroduction of fire, the pines will continue to shade out the oaks. The reintroduction of fire as an element of this effort might be considered under circumstances that could contribute to overall forest habitat management goals without jeopardizing Observatory property, functions and operations. Presently, Observatory personnel object to the use of prescribed fire because they cannot expose telescope lenses to the particulates associated with smoke, and would like to consider fire (and thus temporarily shut down night time observations) only if the thinning strategies proposed do not achieve a fire safe condition.

Forest Thinning Criteria

Treatment of up to 90 acres is proposed to reduce standing fuels by thinning dense, small-diameter "doghair" ponderosa pine thickets and other stands of ponderosa pines to 1 on 20-ft. center. More thinning (24-ft. center) is planned for the Operations Area. Treatment will require about 60 days on the ground over a 90-day period. The Navy forester is present for one week at the commencement of operations, then checks back two more times in 90 days.

Criteria for thinning balance the needs for fire hazard reduction and control with: preservation, development and perpetuation of oaks of appropriate DBH, branch and crown sizes; enhancement of MSO habitat by facilitating historical mixed species growth structure of fewer larger trees per acre; straightness of tree form; larger branch sizes in both oaks and pines; spatial evenness with a wide array of diameter sizes and ages; and avoiding excessive light (reflectance from bare ground or snow exposure), pollen, soot, and dust for the Observatory's telescope and viewing sky. Criteria closely parallel those already approved by USFWS (2-21-95-I-018) for the NOFS-Arboretum Fuels Reduction Project Biological Evaluation (October 4, 1994) conducted by the Forest Service on property adjoining that of the Observatory.

This will be accomplished through a forest management system of area control into four management zones: southern slope, Operations Area, northern slope, and northern end. Due to the small size of the Navy forest lands, it is neither advisable nor feasible to fragment the forest into a large number of stands equal to the rotation age. Rather, larger areas will be addressed in order to simplify management and MSO habitat considerations. The spacing requirement helps avoid large gaps in vegetation distribution which can result from adhering too rigidly to a size prescription. While gaps allow light into a stand which enhances regeneration, they also allow excessive light reflectance which impacts astronomic viewing conditions. Treatments are designed for spatial evenness both for development of large trees and to reduce reflectance. The following are the specifications for the fuels reduction, forest health, structural and biological diversity project thinnings.

General Silvicultural Treatment Criteria

No oaks, standing oak snags or junipers will be cut. Thinning will focus on pines.

Thinning may occur throughout the Navy property.

All snowbents will be cut.

Woody debris (slash) treatments will emphasize maximum fire safety. Limbs and tops cut from merchantable stems will be treated in accordance with slash disposal requirements. The term "slash" for the purpose of this thinning means all woody debris created on the thinning area by logging and related operations or windstorm. Slash is to be treated in one of the two following methods: lopped to no more than 6 feet in length and stacked or deposited in "haystack" or "teepee" piles no larger than 10 feet in diameter and 12 feet tall; or chipped or shredded and either broadcast strewn no deeper than 10 inches deep at any point, or placed in piles no larger than 10 feet in diameter and 10 feet tall. Dispersing untreated slash in a lop and scatter method would result in too high a risk of losing control of a fire within the Navy property if it were prescribed burned later or subject to a wildfire; or
Individual trees may be cut if they are near a powerline or fenceline.

Leave trees will be selected on the following basis and criteria:

Ponderosa pine is the only species to be considered for cutting and removal. Deciduous trees may not be selected as Leave Trees.

Selected pines are to be free of defects, disease or damage to the extent possible, consistent with spacing and Leave Tree count per acre requirements.

Fastest growth as evidenced by larger relative diameter breast high (DBH), greatest height, and light colored bark with active, buff colored crevices.
Good form and straightness of the bole.

Spacing as near as possible to 20 feet by 20 feet, on centers, for a uniform and consistent distribution of 100 trees per acre.

Dead trees and non-merchantable culls are not to be selected as Leave Trees, but are to be left uncut when possible; they may not be counted towards the requirement of 100 live Ponderosa pine Leave Trees per acre.

Trees to be cut and removed shall be selected and cut, using care and directional felling, so as to avoid damage to Leave Trees and oaks. Leave Trees and oaks damaged by the faller shall be paid for at the rate of $50 each. Excessive Damage is defined as breaking off the top, or removing bark or a limb, that leaves exposed an area greater than 28 square inches. Trees so damaged may not be felled or removed.

Standing dead trees and non-merchantable culls shall be left uncut.

Trees cut along Navy property line boundaries shall be felled into Navy land so as to contain slash and debris on the Navy property.

Stumps shall be cut as low as practicable and shall not exceed 12 inches or one tree DBH in height.

Limbs and tops are to be cut from merchantable stems and treated in accordance with slash disposal requirements. The term "slash" for the purpose of this thinning means all woody debris created on the thinning area by logging and related operations or windstorm. Slash is to be treated in one of the two following methods: lopped to no more than 6 feet in length and stacked or deposited in "haystack" or "teepee" piles no larger than 10 feet in diameter and 12 feet tall; or chipped or shredded and either broadcast strewn no deeper than 10 inches deep at any point, or placed in piles no larger than 10 feet in diameter and 10 feet tall.

Southern Slope Treatment Criteria

The Southern Slope Area has per acre basal areas of approximately 96.7 square feet/acre (SF/AC) for ponderosa pine (1992 inventory) and 18.1 SF/AC for oaks (1997 inventory).

The General Silvicultural Treatment Criteria above apply.

Live Ponderosa pines will be thinned to 20 feet on center, leaving 100 pine trees per acre. No oaks are to be cut. Leave tree selection and cutting criteria are: One hundred (100) of the best live Ponderosa pines shall be left uncut and undamaged as Leave Trees on each acre of the area. This equates to a spacing of approximately 20 feet on center between Leave Trees. Oak trees and any other deciduous or coniferous tree species do not count towards the 100 Leave trees per acre and will be additional stems left undamaged. Trees marked with yellow paint and/or signs are designated as wildlife and structural diversity trees, and are to be left uncut and undamaged. Live trees so marked are in addition to the 100 Leave Trees per acre. Dead wildlife trees may not be included in the 100 trees per acre count.

Leave trees shall be selected on the basis and criteria described above.

Operations Area Treatment Criteria

The Operations Area has per acre basal areas of approximately 85 square feet/acre (SF/AC) for ponderosa pine (1992 inventory) and 13.7 SF/AC for oaks (1997 inventory).

General Silvicultural Treatment Criteria above apply.

Live Ponderosa pines will be thinned to 24 feet on center, leaving approximately 75 pine trees per acre. No oaks are to be cut. Leave tree selection and cutting criteria are: Seventy-five of the best live Ponderosa pines shall be left uncut and undamaged as Leave Trees on each acre of the area. This equates to a spacing of approximately 24 feet on center between Leave Trees. Oak trees and any other deciduous or coniferous tree species do not count towards the 75 Leave trees per acre and will be additional stems left undamaged. Trees marked with yellow paint and/or signs are designated as wildlife and structural diversity trees, and are to be left uncut and undamaged. Live trees so marked are in addition to the 75 Leave Trees per acre. Dead wildlife trees may not be included in the 75 trees per acre count.

Leave trees shall be selected on the above basis and criteria, except for the following:

Spacing as near as possible to 24 feet by 24 feet, on centers, for a uniform and consistent distribution of 75 Ponderosa pine Leave Trees per acre.

Dead trees and non-merchantable culls are not to be selected as Leave Trees, but are to be left uncut when possible; they may not be counted towards the requirement of 75 Leave Trees per acre.

Northern Slope Area Treatment Criteria

The Northern Slope Area has per acre basal areas of approximately 103.6 square feet/acre (SF/AC) for ponderosa pine (1992 inventory) and 13.7 SF/AC for oaks (1997 inventory).

General Silvicultural Treatment Criteria above apply.

Live Ponderosa pines will be thinned to 20 feet on center, leaving 100 pine trees per acre. No oaks are to be cut. Leave tree selection and cutting criteria are: One hundred (100) of the best live Ponderosa pines shall be left uncut and undamaged as Leave Trees on each acre of the area. This equates to a spacing of approximately 20 feet on center between Leave Trees. Oak trees and any other deciduous or coniferous tree species do not count towards the 100 Leave trees per acre and will be additional stems left undamaged. Trees marked with yellow paint and/or signs are designated as wildlife and structural diversity trees, and are to be left uncut and undamaged. Live trees so marked are in addition to the 100 Leave Trees per acre. Dead wildlife trees may not be included in the 100 trees per acre count.

Leave trees shall be selected on the basis and criteria described above.

Northern End Area Treatment Criteria

The Northern End Area has per acre basal area of approximately 122.93 square feet/acre (SF/AC) for ponderosa pine (1992 inventory). Oaks were not measured in this area, since it is relatively flat, mostly doghair pine stands and had not been identified as suitable MSO habitat.

General Silvicultural Treatment Criteria above apply.

Live Ponderosa pines will be thinned to 20 feet on center, leaving 100 pine trees per acre. No oaks are to be cut. Leave tree selection and cutting criteria are: One hundred (100) of the best live Ponderosa pines shall be left uncut and undamaged as Leave Trees on each acre of the area. This equates to a spacing of approximately 20 feet on center between Leave Trees. Oak trees and any other deciduous or coniferous tree species do not count towards the 100 Leave trees per acre and will be additional stems left undamaged. Trees marked with yellow paint and/or signs are designated as wildlife and structural diversity trees, and are to be left uncut and undamaged. Live trees so marked are in addition to the 100 Leave Trees per acre. Dead wildlife trees may not be included in the 100 trees per acre count.

Leave trees shall be selected on the basis and criteria described above.

Contingency Silvicultural Treatments

If additional fuel reduction is needed beyond the thinnings, consideration will be given to hand pruning pine limbs to a specified distance above grade.
Additional pruning of lower limbs might be considered 5 to 10 years after the first pruning.

If acceptable to the Observatory, up to 20 thinning debris (slash) piles might be burned per year.

If broadcast burning can be conducted in a manner acceptable to the Observatory, duff around large or snag oaks and pines will be scraped or lined to protect the trees from fire. The burning prescription will be such that the result will be a low-intensity fire that protects the dead and down material which supports the prey base for the MSO. Such burning is valuable for increasing the probability of natural regeneration. Because natural fire was the major pre-settlement factor in shaping and maintaining southwestern ponderosa pine ecosystems, it is logical to consider applied fire in a management scheme to relieve the serious health problems that plague these forests due to many years of fire exclusion (Sackett, Husse and Harrington 1996). For broadcast burning, a permit would be sought from the Arizona Department of Environmental Quality to ensure there would be no effects on the city of Flagstaff, since prevailing winds come from the southwest.
There may be a need to improve the herbaceous understory once thinning is completed. This would address multiple objectives: decreasing snow reflectance, reducing pollen production by emphasizing grasses over pines, reducing fugitive dust, and increasing granivores (animals that eat grass seed) to improve foraging for the MSO. Suggested plants would be Arizona fescue, Penstemon barbatus, or Eriogonum sp.

Proposed Mitigation Measures

The Observatory does not intend to adopt the 10-year monitoring guidelines described in the Recovery Plan for land within PACs, which stipulate that pre- and post-treatment assessments of owl occupancy and habitat conditions be conducted. The Navy considers it lands to be outside of a PAC.

Dirt roads will not be upgraded and chained off wherever practical to minimize trespassing that may result in illegal cutting of oaks for fuelwood.

Limiting development to the Operations Area will provide future development protection to key property areas that have the most potential for attracting the MSO.

The Navy will sponsor protocol MSO surveys for 1997 (already completed with no sightings), 1998, and 1999 at a cost of $19,500. This work will be performed under a cooperative agreement between the Navy and the U.S. Forest Service.

Results of MSO surveys will be sent to the Navy monthly to keep project and construction personnel appraised of MSO. If an MSO is detected on or within 1/2 km of Navy property, the Navy will, after consulting with survey personnel, notify the FWS within 72 hours of the detection.

If a nest or recurring roost is located within 1/4 mile of proposed construction, stipulations of this consultation will be renegotiated for breeding timing restrictions (March 1 - August 31) on outdoor construction.

If prescribed burning is conducted, large or snag oaks and pines will be protected by lining or scraping around them.

Steep drainages within the PAC and outside the Operations Area will incur the minimum amount of thinning required for fire control, while preserving a clumping pattern and complex stand structure around all large or snag oaks and pines.

The Observatory will attempt to avoid the MSO breeding season wherever possible while still meeting project construction goals.

STATUS OF THE SPECIES

A detailed account of the taxonomy, biology, and reproductive characteristics of the MSO is found in the Final Rule listing the MSO as a threatened species (USDI 1993) and in the Final MSO Recovery Plan (USDI 1995). The information provided in those documents is included herein by reference. Although the MSO's entire range covers a broad area of the southwestern United States and Mexico, much remains unknown about the species' distribution and ecology. This is especially true in Mexico where much of the MSO's range has not been surveyed. The MSO currently occupies a broad geographic area but does not occur uniformly throughout its range. Instead, it occurs in disjunct localities that correspond to forested isolated mountain systems, canyons, and in some cases, steep, rocky canyon lands. The primary administrator of lands supporting MSO in the United States is the U.S. Forest Service. Most owls have been found within Forest Service Region 3 (including 11 National Forest in Arizona and New Mexico); Forest Service Regions 2 and 4 (including 2 National Forests in Colorado and 3 in Utah) support fewer owls. According to the Recovery Plan, 91% of MSO known to exist in the United States between 1990 and 1993 occurred on lands administered by the Forest Service.

Surveys have revealed that the species has an affinity for older, well-structured forest, and the species is known to inhabit a physically diverse landscape in the southwestern United States and Mexico. The range of the MSO has been divided into six Recovery Units (RUs), as discussed in the MSO Recovery Plan (USDI 1995). The Recovery Plan reports an estimate of owl sites. An owl "site" is defined as a visual sighting of at least one adult owl or a minimum of two auditory detections in the same vicinity in the same year. This information was reported for 1990-1993. The greatest known concentration of known owl sites in the United States occurs in the Upper Gila Mountains RU (55.9%), followed by the Basin and Range-East RU (16.0%), Basin and Range-West RU (13.6%), Colorado Plateau RU (8.2%), Southern Rocky Mountain-New Mexico RU (4.5%), and Southern Rocky Mountain-Colorado RU (1.8%). Owl surveys conducted from 1990 through 1993 indicate that the species persists in most locations reported prior to 1989.

A reliable estimate of the absolute numbers of MSO throughout its entire range is not available (USDI 1995) and the quality and quantity of information regarding numbers of MSO vary by source. USDI (1991) reported a total of 2,160 owls throughout the United States. Fletcher (1990) calculated that 2,074 owls existed in Arizona and New Mexico.

At the end of the 1995 field season, the Forest Service reported a total of 866 management territories (MTs) established in locations where at least a single MSO had been identified (U.S. Forest Service, *in litt.* November 9, 1995). The information provided at that time also included a summary of territories and acres of suitable habitat in each RU. Subsequently, a summary of all territory and monitoring data for the 1995 field season on Forest Service lands was provided to the Service on January 22, 1996. There were minor discrepancies in the number of MTs reported in the November and January data. For the purposes of this analysis we are using the more recent information. Table 1 displays the number of MTs and percentage of the total number of each Forest (U.S. Forest Service, *in litt.*, January 22, 1996).

The Forest Service has converted some MTs into PACs following the recommendations of the Draft MSO Recovery Plan released in March 1995. The completion of these conversions has typically been driven by project-level consultations with the Service and varies by National Forest.

Table 1. Number of management territories (MTs) as reported by the Forest Service (U.S. Forest Service, *in litt.*, January 22, 1996), percent of MTs as a proportion of the MTs in Forest Service Region 3, and the percent of suitable habitat surveyed in each Forest by National Forest (Fletcher and Hollis 1994).

National Forest	Number of MTs	Percent of MTs	Percent Suitable Habitat Surveyed
Apache-Sitgreaves	122	14.0	99
Carson	3	0.3	62
Cibola	43	5.0	41
Coconino	155	17.8	87
Coronado	108	12.4	49
Gila	197	22.7	50
Kaibab	6	0.7	96
Lincoln	126	14.5	90
Prescott	10	1.2	42
Santa Fe	33	3.8	44
Tonto	66	7.6	55
TOTAL	869	100	

The Naval Observatory project area is located at the northern edge of the Upper Gila Mountains RU as defined by the MSO Recovery Plan (USDI 1995). This RU is a relatively narrow band bounded on the north by the Colorado Plateau RU and to the south by the Basin and Range West RU. The southern boundary of this RU includes the drainages below the Mogollon Rim in central and eastern Arizona. The eastern boundary extends to the Black, Mimbres, San Mateo, and Magdalena Mountain ranges of New Mexico. The northern and western boundaries extend to the San Francisco Peaks and Bill Williams Mountain north and east of Flagstaff, Arizona. This is a topographically complex area consisting of steep foothills and high plateaus dissected by deep forested drainages. This RU can be considered a "transition zone," because it is an interface between two major biotic regions: the Colorado Plateau and Basin and Range Provinces (Wilson 1969). Habitat within this RU is administered by the Kaibab, Coconino, Apache-Sitgreaves, Tonto, Cibola, and Gila National Forests. The north half of the Fort Apache and northeast corner of the San Carlos Indian Reservations are located in the center of this RU and contain an important habitat link between owl subpopulations at the western and eastern ends of the RU and the subpopulations directly south within the Basin and Range West RU.

This RU consists of deep forested drainages on the Mogollon Plateau. Vegetation generally consists of pinyon/juniper woodland, ponderosa pine/mixed conifer forest, some spruce/fir forest, and deciduous riparian forest in mid and lower elevation canyon habitat. Climate is characterized by cold winters and over half the precipitation falls during the growing season. Much of the mature stand component on the gentle slopes surrounding the canyons has been partially or completely harvested. Most of the forest habitat on steeper ground that may serve as MSO nesting habitat is in suitable condition. MSO are widely distributed and use a variety of habitats within this RU. Owls most commonly nest and roost in mixed-conifer forests dominated by Douglas fir and/or white fir and canyons with varying degrees of forest cover (Ganey and Balda 1989; USDI 1995). Owls also nest and roost in ponderosa pine-Gambel oak forest, where they are typically found in stands containing well-developed understories of Gambel oak (USDI 1995).

This RU contains the largest known concentration of MSO with approximately 55% of known MSO territories (USDI 1995). This RU is located near the center of the MSO's range within the United States and is contiguous to four of the other five RUs within the United States. Because of its central location and its large and relatively continuous spotted owl population, the MSO Recovery Team believes that the population in this RU could be uniquely important to the overall stability and persistence of the MSO population in the United States. Specifically, this population could serve as the source population, providing immigrants to smaller, more isolated populations in other RUs. Although the Recovery Team has no data on dispersal patterns or movements between RUs, the Recovery Team believes that this population should be maintained at current levels and with at least the current level of connectivity within the RU (USDI 1995). Significant discontinuities that develop in the MSO's distribution within this RU, and the loss of habitat to support the local sub-populations, may compromise the recovery of the species.

ENVIRONMENTAL BASELINE

Most of this section was obtained from the biological assessment (Tierra Data Systems 1997). The Naval Observatory property of 287 acres is situated within the mountainous region of Coconino County, five miles west of the city of Flagstaff. It is mostly hilly, with the three telescopes on top of knolls. Elevation ranges from a low of 7,305 feet above sea level to a high of 7,575 feet at Building One. The hills have relatively steep sides with slopes generally ranging from 20 to over 40 percent, which restricts future development to the tops of the knolls or the ridgelines between the knolls. All of the soil types on Navy property are rated for a 65 percent potential canopy cover of ponderosa pine. A ponderosa pine forest dominates the Observatory property, with some meadow swales. Gambel oak is interspersed among the pines, including on the knoll that supports the primary telescope and facility. Arizona fescue (Festuca arizonica) is the most common understory species. Areas of mature pine and large oaks occur in two drainages north of the main facility.

The condition of the forest is altered from what is believed to be the natural, more open ponderosa pine structure with much less canopy closure, larger trees and much more grassland. Fire suppression and modified land use practices with the arrival of European settlement are believed to be the cause of the change. The resulting Observatory ponderosa pine forest has thickets of sapling-sized pines, duff build-up, and lacks diversity in species and stand structure. It develops a fire hazard because of excessive floor (duff) and "ladder" fuels (such as the thickets), and risk of catastrophic losses by severe fires that access the forest canopy. Trees eventually become stressed because of their excessive density, and the forest declines in overall health. The Navy property shows some sign of mistletoe and slightly higher than endemic levels of insect activity (Pajkos, pers. comm. 1997), both indicators of a stressed condition.

Portions of the forest were cruised in March 1997, with 100 percent sample of oaks within the bounds of the survey. The northern portion is cooler because of north-facing slopes, and includes some steep canyon draws, while the south-side volcanics heat up far too much to be appropriate nesting habitat. The data provide evidence of oak stress on the northern slopes. No regeneration of oaks was evident on the property. Oaks in general were found to be quite old and slow-growing, based on ring counts on stumps located at the Observatory. Many were being overtopped by pines. This phenomenon of old oaks dying without regeneration is increasingly being found in the Coconino National Forest area, especially where cattle or elk graze basal shoots (J. Ganey, pers. comm. 1997).

The BA (Tierra Data Systems 1997) provided information indicating that the entire Observatory is composed of the pine-oak vegetation type. The pine-oak vegetation type is considered to be a restricted area per the recovery plan. Portions of the pine-oak vegetation type within the Observatory boundary also exhibit slopes greater than 40%. Pine-oak vegetation with slopes greater than 40% are considered to be protected areas per the recovery plan. The BA identified four primary "types" of pine-oak vegetation: dense pine-oak with greater than 40% slope, dense pine-oak, open to moderately dense pine-oak with greater than 40% slope, and open to moderately dense pine-oak. Approximately 40.58 acres of the Observatory have slopes of greater than 40%. Dense pine-oak with greater than 40% slope covers 20.39 acres. Dense pine-oak consists of 35.35 acres. Open to moderately dense pine-oak with greater than 40% slope constitutes 20.19 acres. Open to moderately dense pine-oak covers 214.5 acres.

The BA delineated four proposed thinning management areas for the Observatory. Those four areas were referred to as the Southern Slope, Operations Area, Northern Slope, and Northern End. The Southern Slope unit is primarily open to moderately dense pine-oak, with small portions of that with slopes greater than 40%. The Operations Area is also mostly open to moderately dense pine-oak, but it also contains small portions of open to moderately dense pine-oak with greater than 40% slope, dense pine-oak, and dense pine-oak with greater than 40% slope. The Northern Slope unit contains primarily dense pine-oak and dense pine-oak with greater than 40% slope, and smaller portions of the other two types. The Northern End is primarily open to moderately dense pine-oak with small portions of the other three types.

In addition to the Observatory being completely pine-oak vegetation (restricted areas per the recovery plan) and portions of it with slopes greater than 40% (protected area), almost the entire southern half of the Observatory is within a Mexican spotted owl PAC. That PAC is known as the Dry Lake PAC and is represented in Appendix 1. PACs are also protected areas per the recovery plan. The PAC is based on several (at least 6) Mexican spotted owl responses, including a single confirmed individual (possibly a female observed in June), received during survey efforts in 1994. Four responses were obtained in the eastern part of the PAC, and two were obtained in the western part just south of the Observatory. Other possible but questionable responses were obtained either adjacent to or on the Observatory. The BA indicated that complete surveys were conducted in the vicinity of the Dry Lake PAC in 1990-92, 1993, 1994, 1995, and 1997. No nest location has been discovered for this PAC.

In a September 17, 1996, letter from the Arizona State Land Department, a boundary for the Dry Lake PAC was presented to the Service and described as being tentatively agreed upon by ASLD, the Navy, and the Forest Service. The letter stated that PAC contained all pine-oak, steep slope and mixed conifer areas within the old (Lockness) management territory. The letter stated that the design of the PAC was intended to provide for a "replacement PAC" as urban development surrounds the center of owl activity at Dry Lake. In an April 17, 1997, letter, the Forest Service stated support for the PAC delineation outlined in the Arizona State Land Department letter. In a July 2, 1997 response to the Arizona State Land Department, the Service agreed that all areas presented by the Arizona State Land Department would be in the PAC recognized by the Service. That letter also included some minor additions at the edge of those areas and stated that a connection between the two subunits should be included and asked the Arizona State Land Department to assist in identifying that addition. The ASLD has not officially responded to that request. However, a recent telephone conversation indicated that ASLD will not provide assistance in identifying an appropriate connection between the two portions of the PAC (Keith Pajkos, pers. comm., 1997). Recent conversation with a member of the Mexican spotted owl recovery team resulted in a confirmation of an earlier recommendation that the two portions of the PAC should be connected (Pat Ward, pers. comm., 1997). Thus, the Service determined a connection based on information obtained from previous management territory maps. Figure 1 represents the Dry Lake PAC.

Recent management activities that have occurred in the project area include the following that were identified in the BA. Harvest of trees less than 12 inches dbh occurred sometime in the 1990s just west of the southern portion of what is now the Dry Lake PAC. The 1992 Lebarron Timber sale harvested 122 acres in the southernmost part of what is now the Dry Lake PAC. A 1996 forest thinning project occurred on private land just east of the southern section of the Dry Lake PAC. Another 1996 thinning project involving trees less than five inches dbh occurred on private land just north of the Observatory and the Dry Lake PAC. A 1996 forest thinning project of trees less than 9 inches dbh occurred on state land in Section 26. A 1996 thinning project occurred on Forest Service land just east of the Dry Lake PAC. A 1997 thinning project occurred on Forest Service land just north and east of the northern portion of the Observatory and Dry Lake PAC.

Approximately 198 projects conducted by a variety of agencies in Arizona and New Mexico have received formal consultation since August 1993. These projects have resulted in the anticipated take of approximately 102 owls.

EFFECTS OF THE ACTION

The Navy believes (Tierra Data Systems 1997) that there are no direct effects expected on the MSO because it is not currently nesting on the Observatory property, as far as both protocol and informal surveys have shown since 1990. The Navy stated that no MSO has been observed nesting, foraging or roosting on Observatory lands. No spotted owl has been observed near the Observatory since 1994, except when a dispersing juvenile flew between south Flagstaff and the Navajo Depot, possibly close to the Observatory property, in October of 1995.

The Navy also stated the following in the BA regarding effects of the action (Tierra Data Systems 1997). Construction activity takes place in the daylight; the MSO avoids most of this disturbance by being primarily nocturnal. The rumble of the rotating Observatory dome at night as it moves is not expected to adversely affect the owl because of its routine nature and short duration. The effect of both constant or periodic noise on the MSO in this relatively quiet environment is not known. Ambient noise levels are probably less than 50 dBA, but noise from the nearby freeway and passing trains already occur, regularly loud enough to disrupt ordinary speaking communication between individuals (Burr, pers. comm. 1997).

The Navy stated that thinning operations will take place outside the breeding season so will have no adverse noise effect (Tierra Data Systems 1997). Observatory activities such as new construction may affect foraging on a short-term basis. No snags, large trees, downed logs or oak stands will be affected. Thinning will promote further recruitment of all of these habitat elements, by allowing growth of larger trees. Piling of slash may provide cover for prey species, thus enhance their population.

The Navy (Tierra Data Systems 1997) stated that although it is the strong desire of the Observatory to find means to control fuel accumulation without prescribed fire because of operational disruptions, such a technique would benefit some prey species such as Peromyscus and Neotoma by increasing food supply, but may result in concurrent declines of other species. Peromyscus and Neotoma are primarily granivores and thinning should result in more understory grasses. Ground nesting birds and burrowing animals which could be MSO prey may be affected by the prescribed fire. Downed logs which provide cover for many small mammals will be protected by only burning when fuel moisture is high. Prescribed fire may affect MSO habitat since it could get out of control and result in habitat loss. However, this is minimized by burning only when soil moisture is high.

The Service believes that effects of the action on the Mexican spotted owl could occur due to two primary means. One is disturbance of the normal behavior of owls due to construction and operations. The other is modification of restricted and protected owl habitat.

No owl nest location has been determined for the Dry Lake PAC. The known owl locations suggest that the portion of the PAC on the Observatory should not be ruled out as an area that could support owl nesting, roosting, and foraging. Because no nest or roost sites have been discovered within the PAC, and because the operations and construction areas are within habitat that could possibly be used for nesting, roosting and foraging, normal owl behavior could be adversely affected. The recovery plan calls for activities to occur within a PAC only outside of the breeding season (March 1 through August 31) to minimize any potential deleterious effects on the owl during the breeding season. At least some of the planned construction activities are being proposed to occur during the owl breeding season. Thus, these activities present an adverse effect to owls.

The recovery plan calls for no harvest of trees greater than nine inches diameter breast height in protected areas, and that harvest of trees smaller than that is only permitted as it pertains to abatement of fire risk. Thus, removal of trees within the PAC, up through nine inches dbh is allowed. The Navy stated (Tierra Data Systems 1997) that such proposed removal would be done outside of the breeding season. However, the description of the proposed removal of trees for the forest thinning did not include an upper diameter limit of nine inches within protected areas. Therefore, trees greater than nine inches dbh are proposed for removal. Thus, the proposed forest thinning presents an adverse effect to owls.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of ESA.

Cumulative effects are likely to arise from primarily two activities that can be expected to occur in the vicinity of the project area and the Dry Lake PAC. The first is anticipated development of private land immediately north of a portion of the PAC at Dry Lake Hill. It is likely that the development will occur either within or adjacent to the home range of owls(s) occupying the PAC.

The other primary cumulative effects may arise from projects that are likely to be conducted by the Arizona State Land Department on state lands that are either within or adjacent to the Dry Lake PAC. Those projects could include silvicultural treatments, and there apparently is a thinning project proposed on state land just east of the southern portion of the Dry Lake PAC. The cumulative effects from these two anticipated activities alone could result in significant impacts to the owl(s) occupying the area. The effects include loss of habitat and modification of normal owl behavior.

The BA also included mention of additional cumulative effects. There are three operating cinder pits near Sinclair Wash (and adjacent to the PAC) and a flood control dam is currently proposed for Sinclair Wash. The City of Flagstaff population doubled from 1970 to 1995. Pressure will continue for release of state and federal lands for development.

CONCLUSION

After reviewing the current status of the Mexican spotted owl, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Mexican spotted owl.

INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of ESA, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Department of the Navy has a continuing duty to regulate the activity covered by this incidental take statement. If the Department of the Navy (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

AMOUNT OR EXTENT OF TAKE

The Service anticipates that one Mexican spotted owl could be taken as a result of this proposed action. The incidental take is expected to be in the form of harm due to disturbance and loss of habitat. The Service anticipates incidental take of Mexican spotted owls will be difficult to detect for the following reasons: species numbers may be difficult to detect when the species is wide-ranging; it has small body size; finding a dead or impaired specimen is unlikely; losses may be masked by seasonal fluctuations in numbers or other causes; and the species occurs in habitat that makes detection difficult. Thus, determination of incidental take will be tied to the prescription of the proposed action. If the thinning prescription is not followed or is exceeded in any manner, then the anticipated incidental take will be considered to be exceeded. If, during the course of the action, the amount or extent of the incidental take anticipated is exceeded, the Department of the Navy must reinitiate consultation with the Service immediately to avoid violation of section 9. Operations must be stopped in the interim period between the initiation and completion of the new consultation if it is determined that the impact of the additional taking will cause an irreversible and adverse impact on the species, as required by 50 CFR 402.14(i). An explanation of the causes of the taking should be provided to the Service.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take:

1. Possible disturbance to Mexican spotted owls from activities associated with planned new construction and forest thinning at the Observatory will be minimized to the greatest extent possible. It is not necessary to consider or include normal routine maintenance and repair conducted at the Observatory under this reasonable and prudent measure.

2. Any proposed prescribed burning will be adequately addressed and planned regarding resulting effects to Mexican spotted owls.

3. All silvicultural or prescribed fire treatments will be adequately monitored.

The Federal agency (or designated applicant or contractor) as part of their action will provide a means to determine the level of incidental take that actually results from the project.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of ESA, the Department of the Navy must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. Terms and conditions for reasonable and prudent measure 1:

    a. To the greatest extent reasonably possible, outdoor construction activities associated with the planned optical interferometer support building (P-029) will be conducted outside of the Mexican spotted owl breeding season. The Mexican spotted owl breeding season is March 1-August 31. This term and condition is not intended to prohibit construction activities for this project within the breeding season, but it is intended to ensure that those activities will be minimized to the greatest extent during that time.

b. All other future major construction projects that were discussed in the biological assessment will either be conducted outside of the breeding season or they will undergo further consultation with the Service at the appropriate stage of development.

c. All thinning operations in the Dry Lake PAC will be conducted only outside of the breeding season.

2. Term and condition for reasonable and prudent measure 2:

   Any proposed prescribed fires planned for the Observatory will be conducted strictly within all of the guidelines found on pages 84-95 of the Mexican spotted owl recovery plan or they will undergo further consultation with the Service at the appropriate stage of development.

3. Term and condition for reasonable and prudent measure 3:

   Monitoring of the project area and other areas that could be affected by the proposed action shall be done to ascertain take of individuals of the species and/or of its habitat that causes harm or harassment to the species. This microhabitat monitoring will be accomplished using one of the following: a procedure developed by the Navy and acceptable to the Service, a procedure already developed as a result of consultation regarding other similar projects and adopted by the Navy, or the protocol that is being developed for Mexican spotted owl microhabitat monitoring by the Forest Service.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental take that might otherwise result from the proposed action. With implementation of these measures the Service believes that no more than one Mexican spotted owl will be incidentally taken. If, during the course of the action, this minimized level of incidental take is exceeded, such incidental take would represent new information requiring review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

The extent that this statement concludes that take of any threatened or endangered species of migratory bird will result from the agency action for which consultation is being made, the Service will not refer the incidental take of any such migratory bird for prosecution under the MBTA of 1918, as amended (16 U.S.C. Sections 703-712), or the Bald Eagle Protection Act of 1940, as amended (16 U.S.C. Sections 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of ESA directs Federal agencies to utilize their authorities to further the purposes of ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. No conservation recommendations are provided in this biological opinion.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the action outlined in the request for consultation. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Thank you for your efforts in conserving listed species. For further information please contact Bill Austin or Bruce Palmer. Please refer to consultation number 2-21-97-F-110, in future correspondence concerning this project.

Sincerely,

Thomas A. Gatz
Acting Field Supervisor

cc: Regional Director, Fish and Wildlife Service, Albuquerque NM (GMA)
District Ranger, Peaks Ranger District, Flagstaff AZ

Director, Arizona Game and Fish Department, Phoenix AZ
Commissioner, Arizona State Land Department, Phoenix AZ
Keith Pajkos, Arizona State Land Department, Flagstaff AZ

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United States Department of the Interior
U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 242-0210 Fax: (602) 242-2513

In Reply Refer to:
AESO/SE
2-21-01-I-371

February 21, 2002

Mr. Michael C. Stroud
Natural and Cultural Resources Lead
Department of the Navy
Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

Dear Mr. Stroud:

On February 14, 2002, the Fish and Wildlife Service received your February 11, 2002, request for continuing informal consultation on operations at the Naval Observatory Flagstaff Station (NOFS), Coconino County, Arizona, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). Specifically, you asked that we review the effects of the removal of 9 trees that interfere with the operation of a telescope, and requested our concurrence that the proposed project may affect, but will not likely adversely affect, the threatened Mexican spotted owl (*Strix occidentalis lucida*) (MSO).

Included in the request for consultation was a copy of the Biological Assessment and Evaluation (BAE) for the project. We have reviewed this document, and we visited the project site with NOFS staff on January 29, 2002.

The NOFS has identified 9 ponderosa pine trees for removal from the south end of the installation (T21N, R6E, Section 22, SE 1/4). The number of trees selected for removal represents the minimum number required to meet mission objectives and allow for proper operation of the telescope. All of the trees are within the Operations Area and are near the building, parking lot, or fence. The Operations Area containing this telescope and the trees marked for removal are within the Dry Lake protected activity center (PAC) (#040231).

The present mission of this telescope is to produce a catalog of northern stars that requires observations currently obscured by 6 ponderosa pine trees. The diameters at breast height of these trees are 16, 15, 13, 11, 7, and 5 inches. Three of the ponderosa pines to be removed are directly west of the telescope. These trees have diameters at breast height of 17, 15, and 11 inches. These trees touch the dome and are dropping debris directly onto the telescope when the dome is open. The NOFS proposes to remove these 9 trees prior to February 28, 2002, which precedes the MSO breeding season.

The proposed project site, the Operations Area, is an area of intensive use by Naval Observatory personnel. Vehicles and observatory staff operate in this area both day and night. In addition, the telescope dome adjacent to the trees is commonly opened and rotated at night. As a result of the intensive human presence and use in this area, MSO most likely would not nest within the Operations Area; however, there is potential nesting/roosting habitat within the NOFS boundaries (pine-oak on slopes >40% in north facing drainages) and survey evidence that MSO use the area.

We concur with the NOFS determination that the proposed action may affect, but will not likely adversely affect, the MSO. We base this determination on the following:

1) The Operations Area, where the 9 trees will be removed, is an area of intensive human activity that most likely is not used by MSO. Though the Recovery Plan for the Mexican Spotted Owl (USDI 1995) (Recovery Plan) recommends that trees >9 inches dbh not be removed from PACs, this area consists of buildings and paved surfaces. Removal of 7 trees >9 inches dbh will not violate the intent of the Recovery Plan and decrease the overall value of MSO habitat within the PAC.

2) Tree removal will not occur in the PAC during the breeding season.

We would like to clarify some points included in the BAE. The BAE states that "no MSOs have been observed using NOFS property through the 2001 survey season, with the exception of a sighting of an individual owl on Arizona state lands immediately adjacent to the southern property line on June 28, 1994." As we discussed with you during our review of the NOFS Integrated Natural Resources Management Plan, a pair of MSO, not a single individual, were located on the Observatory boundary in 1994 during the breeding season. In addition, it is difficult to observe MSO on all portions of their home range without the use of radio telemetry. Given that some MSO in ponderosa pine/Gambel oak habitat have home ranges of over 3,000 acres in size, and given that the pair of owls was located on and near the Observatory property boundary, it is likely that MSO use the property for at least foraging, and possibly for nesting and/or roosting.

No further section 7 consultation for effects on MSO is required for this project at this time. Should the proposed action change, or should new information become available that indicates the action may affect the MSO in a manner or extent not considered in our review, the NOFS may want to reconsider whether reinitiation of consultation is appropriate.

Thank you for your continuing efforts to identify and minimize any effects to federally-protected species. If you have any questions or concerns about this consultation, or the consultation process in general, please contact Shaula Hedwall (928) 226-1811 or Steve Spangle (928) 226-0250 of our Flagstaff Sub-Office.

Sincerely,

David L. Harlow

David L. Harlow
Field Supervisor

cc: Field Supervisor, Fish and Wildlife Service, Albuquerque, NM
John Kennedy, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
Robert Palmer, Southwest Division, Naval Facilities Engineering Command, San Diego, CA
Michael DiVittorio, U.S. Naval Observatory, Flagstaff Station, Flagstaff, AZ

W:\Shaula Hedwall\NOFS Removal of 9 PIPO Near Telescope.wpd:cgg

DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

11015
Ser 5GPN.RP/100
February 11, 2002

Mr. Steve Spangle
U.S. Fish and Wildlife Service
320 N. Beaver Street
Flagstaff, AZ 86001

Dear Mr. Spangle:

This transmittal continues the informal Endangered Species Act (ESA) section 7 consultation process for a proposal to remove trees that interfere with the operation of a telescope at the Naval Observatory Flagstaff Station (NOFS). The consultation for this action was initiated during a field visit to the project location on January 29, 2002 that was attended by Mr. Michael DiVittorio, NOFS Site Manager, and Ms. Shaula Hedwall, U.S. Fish and Wildlife Service (USFWS). In 1997/98, NOFS formally consulted with your agency on long-term forest management and other activities at the Station (Consultation No. AESO/SE 2-21-97-F-110). The action to be evaluated in this transmittal is much smaller in scope than the forest thinning activity evaluated in the previous consultation.

This evaluation is intended to provide the information necessary to facilitate informal consultation with the USFWS as required by 50 CFR 402.14(c). This evaluation describes the proposed action and reviews relevant biological information on Federally listed species potentially affected by the project. NOFS has determined that only one Federally listed threatened or endangered species, the Mexican spotted owl [MSO] (*Strix occidentalis lucida*), has the potential to be found within the vicinity of the project.

NOFS has identified nine ponderosa pine trees that need to be removed as they currently interfere with the operation of the 20 cm astrograph telescope that is located on the west side of Building 1 (Figure 1). The number of trees selected for removal represents the minimum number required to meet mission objectives and allow for proper operation of the telescope. All of the trees are within the operations area and are near the building, parking lot or fence. Many of the trees can be removed under the current forest thinning prescription. The tree removal effort would occur outside of the MSO breeding season extending from March 1 through August 31. The proposed telescope tree removal effort would involve the following actions:

a. Removal of three ponderosa pine trees directly west of the telescope with diameter at breast height (DBH) of 17", 15" and 11". These trees are dropping debris on the telescope when the dome is open and currently are touching the dome.

b. Removal of six ponderosa pine trees to the north of the telescope that limit the viewing of objects in the sky to the north of the dome. The present mission of this telescope is to produce a catalog of northern stars that requires observations that are currently obscured by the identified trees. The DBH of these trees are 16", 15", 13", 11", 7" and 5".

The largest concentration of known MSO sites in the United States occurs in the Upper Gila Mountain Recovery Unit, of which NOFS is a part, with apparently over half the known individuals. However, no MSOs have been observed using NOFS property through the 2001 survey season (Department of the Navy 2001), with the exception of a sighting of an individual owl on Arizona state lands immediately adjacent to the southern property line on June 28, 1994 (K. Pajkos, State of Arizona Trust Lands Department, personal communication 1997). There is no critical habitat designated at NOFS, but it does contain a limited amount of habitat suitable for foraging by the MSO, and portions of NOFS property are part of the Dry Lake Protected Activity Center (PAC)[Figure 2]. In addition, the property contains about 20 acres of dense pine-oak on slopes greater than 40 percent in two north-facing drainages which is suitable for nesting, but these drainages are problematic to the Observatory since they are the most likely place a fire would carry directly to the main Observatory dome (Building 4) and associated buildings. In general, NOFS lands are unsuitable for nesting because of the lack of dense pine-oak cover or old growth. However, directly south of NOFS, the forest becomes denser, and is probably suitable for nesting. Owls that might nest in this area in the future could potentially use Observatory habitat for foraging.

The Operations Area where the nine ponderosa pine trees would be removed is an area of intensive use by Naval Observatory personnel. Vehicles and Observatory staff are in the vicinity during both the day and night conducting operations and maintenance activities. In addition, the telescope dome adjacent to the trees is commonly opened and rotated at night. As a result of the intensive human presence and use in this area, MSO would not be expected to nest in the Operations Area; however, it is possible that they may forage in the area at night. Any foraging in the vicinity of the Operations Area, if it were to occur, would likely be limited in scope due the high level of disturbance in the area. In addition, the nine trees to be removed were examined in the field and no cavities suitable for MSO nesting were identified. Finally, the number of trees to be removed is so small that their removal would be expected to have an insignificant effect on overall wildlife habitat value in the Operations Area.

The Navy has made a "may effect – is not likely to adversely affect" determination for the MSO. We have determined that the short and long-term effects of the proposed tree removal action are believed to be so small as to be insignificant and so unlikely as to be discountable based on the above information and the following conclusions:

a. The removal of a total of nine trees from the Operations Area would be expected to have insignificant effects on the overall value of wildlife habitat in the area.

b. The tree removal effort would occur outside of the MSO breeding season that extends from March 1 through August 31.

c. The Operations Area where tree removal would occur is an area of intensive human use that would likely preclude use of the area by the MSO.

d. No owls have been located in the vicinity of NOFS since 1994.

We request your concurrence with our effect determination. You may direct any questions or concerns that you may have to the Navy point-of-contact, Mr. Robert Palmer, Fish and Wildlife Biologist, at (619) 532-3266 or by e-mail at palmerrl@efdsw.navfac.navy.mil.

Sincerely,

MICHAEL C. STROUD
Natural and Cultural Resources Lead
By direction of the Commander

Encl:
(1) Map of NOFS Operations Area
(2) Map of the Dry Lake PAC
(3) Disk with consultation document

Copy to:
Mr. David Harlow, U.S. Fish and Wildlife Service, 2321 W. Royal Palm Road, Suite 103, Phoenix, AZ 85021
Mr. Michael DiVitorrio, U.S. Naval Observatory Flagstaff Station, P.O.Box 1149, Flagstaff, AZ 86002
Ms. Christine Frego, Naval District Washington, 1014 N Street, S.E., Suite 320, Washington, D.C. 20374-5001

LITERATURE CITED

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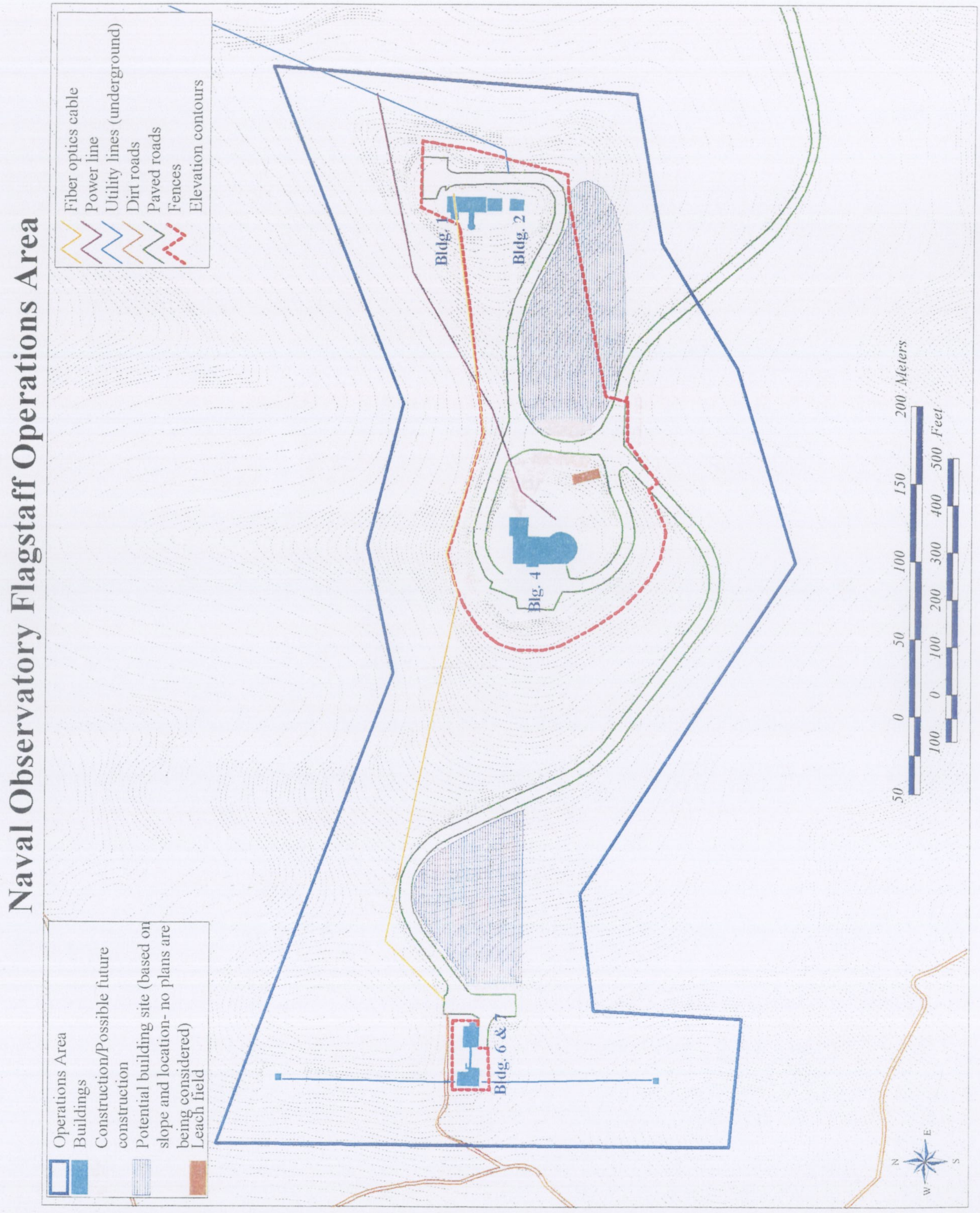
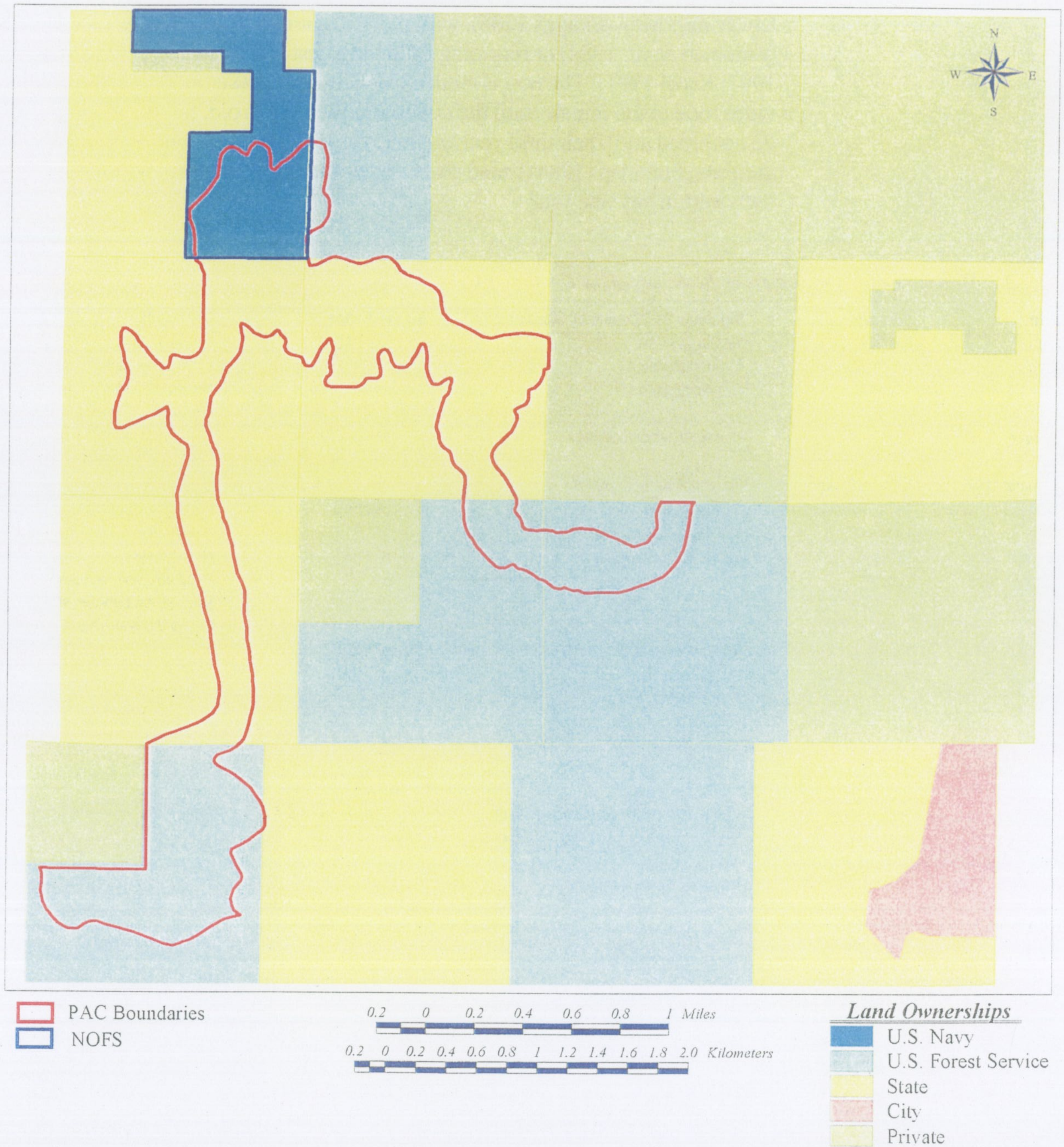


Map 1-3. NOFS Operations Area.

FIGURE 1

The Dry Lake PAC and Naval Observatory Flagstaff



Map 2-5. The Dry Lake PAC and property ownership in the vicinity of NOFS.

FIGURE 2

United States Department of the Interior

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 242-0210 Fax: (602) 242-2513

In Reply Refer to:
AESO/SE
02-21-03-I-0202

April 28, 2003

Mr. Michael C. Stroud
Natural and Cultural Resources Lead
Department of the Navy
Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

Dear Mr. Stroud:

On March 31, 2003, we received your March 27, 2003, request for informal consultation on the effects of an exotic weed species control program on the Naval Observatory Flagstaff Station (NOFS), Coconino County, Arizona, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The exotic weed control program will target noxious plant species in the Operations Area, roadways, and areas affected by the on-going forest thinning project (skid trails, landings, etc.). The Navy requests our concurrence that the proposed project may affect, but will not likely adversely affect, the threatened Mexican spotted owl (*Strix occidentalis lucida*) (MSO).

Included in the request for consultation was a copy of the Biological Assessment and Evaluation (BAE) for the project and the pesticide application plan. We have reviewed these documents and discussed the project with your staff.

The potential treatment area is approximately 290 acres in size and includes all land within the boundary of the NOFS. This area includes a portion (approximately 90 acres) of the Dry Lake MSO protected activity center (PAC) (#040231). The target exotic pest plant species are listed in the BAE. Most of the targeted plants will be treated with a 2% solution of Roundup® (a glyphosate herbicide) except for yellow star thistle (*Centaurea solstitalis*), which will be treated with a solution of Transline® (a clopyralid herbicide). A backpack sprayer will be used to apply the solution to the target plants, so application should be fairly precise. A project bio-monitor will accompany the pesticide applicator at all times to help ensure that sensitive and non-target species are avoided. The herbicides will not be applied during windy conditions and the project will comply with all State, Federal, and Department of Defense pest management regulations. Pesticide application will commence this spring (2003) in order to target actively growing plants.

Depending upon the results of effectiveness monitoring following treatment, subsequent visits to particular sites may be necessary on an annual basis for the next 20 years.

There are no known secondary effects from either Roundup® or Transline® to small mammals, birds, or reptiles. Laboratory test results indicate that both herbicides are practically non-toxic to mammal or avian species. Though Roundup® was moderately toxic to aquatic species tested, there are no waterways or stock tanks on the NOFS and we do not expect this to be an issue.

Our pesticide guidance document recommends that pesticide application should not occur inside occupied protected species habitat unless approved by the Fish and Wildlife Service and that surveys should be conducted for active nests prior to pesticide application. In addition, clopyralid (the active ingredient in Transline®) is rated as a Class 1 pesticide in the Predatory Avian toxicity group and our pesticide guidance document recommends buffering any occupied raptor nest sites by 1/8 mile. Our contaminants biologist has indicated that the buffer is primarily recommended to protect MSO from the physical disturbance that may occur from accessing the site. However, as we understand the proposed project, the Navy will be targeting disturbed sites (i.e., roads, skid trails, etc.) and will not be creating any new access points into the PAC or other MSO habitat. The Navy is currently surveying the area for MSO and will notify us immediately if any nesting owls are located. The area has been surveyed by various agencies since 1991; however, neither a roost or nest site has ever been located.

We concur with the Navy's determination that the proposed action may affect, but will not likely adversely affect, the MSO. We base this determination on the following:

1. Direct effects from the proposed herbicide application to MSO are extremely unlikely. The chemicals will be applied manually using a backpack sprayer and will only be applied to target weed species. In addition, the active ingredients of both herbicides are considered to be relatively non-toxic to avian species.

2. Indirect effects from the proposed herbicide application to MSO are extremely unlikely as the active ingredients of both Roundup® and Transline® are considered to be practically non-toxic to small mammals and reptiles. Therefore we do not expect the proposed action to adversely affect MSO prey species. We also do not expect any increased adverse effects to MSO habitat, as pesticide application will occur within currently disturbed areas.

3. The presence of a bio-monitor should greatly reduce the impacts to non-target, native vegetation. We recommend that the Navy utilize the services of either the San Francisco Weed Management Group or the local Agriculture Cooperative Extension Office in selecting a bio-monitor. If we may be of assistance in locating someone, please contact our office.

4. If current or future surveys locate MSO nesting on or directly adjacent to the NOFS, the Navy will work with our staff to protect nesting birds from any potential harm and/or harassment associated with the proposed project.

No further section 7 consultation on effects to the MSO is required for this project at this time. Should the proposed action change, or should new information become available that indicates that the action may affect the MSO in a manner or extent not considered in our review, the Navy should reconsider whether reinitiation of consultation is appropriate.

Thank you for your continued consideration of the Mexican spotted owl. In all future correspondence on this project, please refer to the consultation number 02-21-03-I-0202. If you have any questions or concerns about this consultation, or the consultation process in general, please contact Shaula Hedwall (928) 226-1811 or Brenda Smith (928) 226-0007 of our Flagstaff Suboffice.

Sincerely,

for

Steven L. Spangle
Field Supervisor

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (ARD-ES)
Field Supervisor, Fish and Wildlife Service, Albuquerque, NM
Robert Palmer, Southwest Division, Naval Facilities Engineering Command, San Diego, CA
Michael DiVittorio, U.S. Naval Observatory, Flagstaff Station, Flagstaff, AZ
John Kennedy, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ

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DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

11015
Ser 5GPN.RP/216
March 27, 2003

Mr. Steve Spangle
Field Supervisor
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, AZ 85021-4951

Dear Mr. Spangle:

This transmittal serves to initiate the informal Endangered Species Act (ESA) section 7 consultation process for a proposal to implement an exotic weed species control program at the Naval Observatory Flagstaff Station (NOFS). This action was included in the Integrated Natural Resources Management Plan (INRMP) for NOFS and was previously discussed with your agency during INRMP stakeholder and other meetings. In 1997/98, NOFS formally consulted with your agency on long-term forest management and other activities at NOFS (Consultation No. AESO/SE 2-21-97-F-110). The action to be evaluated in this transmittal is primarily mitigation for the forest thinning activity evaluated in the previous consultation.

This evaluation is intended to provide the information necessary to facilitate informal consultation with the U.S. Fish and Wildlife Service (Service) as required by 50 CFR 402.14(c). This evaluation describes the proposed action and reviews relevant biological information on Federally listed species potentially affected by the project. NOFS has determined that only one Federally listed threatened or endangered species, the Mexican spotted owl [MSO](*Strix occidentalis lucida*), has the potential to be found within the vicinity of the project. Although critical habitat has been designated for the MSO, NOFS lands were not included in that designation.

The exotic weed species control program at NOFS will target pest plant species in the Operations Area, along roadways at NOFS and in areas affected by the forest thinning project (skid trails, landings, etc). The complete pesticide application plan that includes a map of the proposed treatment area is attached (Enclosure 1). The potential treatment area is approximately 290 acres in size and includes all land within the boundary of NOFS. The target exotic pest plant species are given in Table 1. Pesticide applications will commence in Spring 2003, as glyphosate herbicide is most effective on actively growing plants during Spring. After the initial treatment in Spring 2003, treated areas will required monitoring to determine if there is any resprouting or seedling recruitment. This will determine subsequent visits to the site. Pesticide applications may be necessary on an annual basis for the next 20 years through calendar year 2023 to ensure that pest species do not become established at NOFS during this time period.

Table 1. List of exotic weeds that may occur on NOFS and will be targeted for control when found.

Common name	Scientific name	Common name	Scientific name
Bull thistle	*Cirsium vulgare*	Western sticktight	*Lappula occidentalis*
Dandelion	*Taraxacum officinalis*	Wild lettuce	*Lactuca serriola*
Cheeseweed	*Malva neglecta*	Yellow star thistle	*Centaurea solstitalis*
Cheat grass	*Bromus tectorum*	Mediterranean sage	*Salvia aetheiopis*
Curly dock	*Rumex crispus*	Camel thorn	*Alhagi pseudalhagi*
Dalmation toadflax	*Linaria genistifolia*	Redtop bentgrass	*Agrostis stolonifera*
Diffuse knapweed	*Centaurea diffusa*	Russian thistle	*Salsoa iberica*
Field bindweed	*Convolvulus arvensis*	Scotch thistle	*Onopordum acanthium*
Filaree	*Erodium cicutarium*	Smooth brome	*Bromus inermis*
Goatsbeard	*Tragopogon dubius*	Sweet clover	*Melilotus officinalis & albus*
Horseweed	*Conyza Canadensis*	Netleaf goosefoot	*Chenopodium murale*
Kentucky bluegrass	*Poa pratensis*	Prostrate knotweed	*Polygonum aviculare*
Leafy spurge	*Euphorbia esula*	Prostrate vervain	*Verbena bracteata*
Mullein	*Verbascum thapsus*	Purslane	*Portulaca oleraceae*
Tumble mustard	*Sisymbrium altissimum*		

Most of the targeted plants will be treated with a 2% solution of Roundup® (glyphosate) plus ½% of a non-ionic surfactant and color dye. Yellow star thistle will be treated with Transline® at 1 1/3 pints/acre plus ½% solution of a non-ionic surfactant and a color dye. The solutions will be foliar applied onto all above ground parts of the plant, including the trunk, stems, leaves and flowers. Foliar application involves spraying the entire plant with a herbicide solution using a backpack sprayer. No cutting of the plant is carried out prior to spraying. Plant biomass will be left on site to decompose.

Careful planning and precautions in the field will be taken to avoid and minimize any effects to sensitive habitat or endangered species. A project bio-monitor familiar with the MSO will be present to avoid and minimize the potential effects of herbicide application on native plants and prey species utilized by the MSO. Herbicide application using a backpack sprayer is precise and targeted, so overspray onto native plants or secondary species will be minimal. Herbicide application will not be carried out in windy conditions. Based on the results of laboratory tests presented in the Material Safety Data.

Sheets (MSDS) in Enclosure 1, there are no known secondary effects to other species, such as rodents or other small mammals, except at very high dosages that would not occur during this effort. For all intensive purposes, these herbicides are practically non-toxic to rodents and small mammals.

The largest concentration of known MSO sites in the United States occurs in the Upper Gila Mountain Recovery Unit, of which NOFS is a part, with apparently over half the known individuals. Approximately 124 acres of NOFS falls within the Dry Lake Protected Activity Center (PAC)[#040231]. The Dry Lake PAC was surveyed in all years between 1994 and 2002 with the exception of calendar year 2000 (Table 2). In addition, all protected and restricted habitat at NOFS was surveyed in 1997 and 1999. Based on these surveys, no MSOs have been observed using NOFS property through the 2002 survey season (Table 2, Enclosure 2), with the exception of a sighting of an individual owl on Arizona state lands immediately adjacent to the southern property line on June 28, 1994 (Mr. Keith Pajkos, Arizona State Land Department [ASLD], personal communication 1997). However, MSO surveys conducted in 1994 were not well documented and the only written record of the observation was recorded by the U.S. Forest Service (USFS). The Service questions the validity of this record and believes that a pair of owls was observed on this survey visit. In any case, the observation is nine years old. MSOs were last detected in July 2001 in the eastern portion of the PAC, approximately 1.0 mile from the NOFS boundary.

Table 2. Summary of documented Mexican spotted owl observations for the Dry Lake Protected Activity Center, 1994 to 2002*

Date	*Location*	*Observation*	*Observer*
1994			
6/28/94	T21N R6E, Section 27, NE quarter	Single MSO location; probably a dispersing juvenile (K. Pajkos 1/23/97)	ASLD
6/29/94	T21N R6E, Section 27, NW quarter	Single MSO response	ASLD
7/6/94	T21N R6E, Section 36, NW quarter	Female MSO response	USFS
7/14/94	T21N R6E, Section 35, NE quarter	Single MSO location	USFS
7/19/94	T21N R6E, Section 36, NW quarter	Single MSO response; Day and night surveys	USFS
7/31/94	T21N R6E, Section 36, NW quarter	Single MSO response	USFS
1995			
7/17/95	T21N R6E, Section 25, NW quarter	Single MSO location	USFS

1996			
		No MSO responses or locations	ASLD
1997			
		No MSO responses or locations; USN Observatory land and surrounding area surveyed	US Navy/USFS
1998			
		No MSO responses or locations	ASLD
1999			
		No MSO responses or locations; USN Observatory land and surrounding area surveyed	US Navy/USFS
2000			
		No surveys conducted	
2001			
7/8/01	T21N R6E, Section 35, NE quarter	Single MSO response	USFS
7/10/01	T21N R6E, Section 35, NE quarter	Single MSO location	USFS
2002			
		No MSO responses or locations	ASLD

*Information sources were a list (Summary of Owl observations for the Dry Lake [040231] MSO) provided by the USFS, Peaks Ranger District, an interview with Mr. Keith Pajkos, ASLD on 1/23/97, and personal communication with Mr. Keith Pajkos. The first year that the USFS had survey and monitoring data for this PAC was 1994. All surveys were conducted according to USFS Region 3 Survey Protocol. Township, Range and Section locations are provided in Enclosure 2.

There is no critical habitat designated at NOFS, but approximately 124 acres of the habitat on site is protected MSO habitat and a majority of the remaining 166 acres is restricted MSO habitat. These lands are considered to be suitable for foraging by the MSO. In general, NOFS lands are unsuitable for nesting because of the lack of dense pine-oak cover or old growth. However, the property contains about 20 acres of dense pine-oak on slopes greater than 40 percent in two north-facing drainages that could be suitable for MSO nesting. In addition, the forest floor consists almost entirely of bunch grasses that provide cover and a food source for rodents that are the primary prey species for the MSO. On lands directly south of NOFS, the forest becomes denser, and is probably suitable for nesting. Owls that might nest in the future in the area to the south could potentially use Observatory habitat for foraging.

The exotic weed species control program will primarily target areas where the habitat value of ground cover species is poor. As mentioned earlier, areas to be targeted include the Operations Area, roadways and forest thinning features such as skid trails, landings, etc. The Operations Area and roadways are lightly infested with exotic weed species and generally support poor quality ground cover communities. Forest thinning features such as skid trails and landings consist of very poor quality ground cover communities or are completely devoid of vegetation. Since these areas consist of ground cover communities of poor or lesser quality, treatment of these areas would be expected to have an insignificant effect on the cover and forage available to prey species of the owl. In addition, avoidance and minimization measures that include presence of a bio-monitor and minimization of overspray to native plants will ensure that native plant communities are unaffected by weed treatments. However, since treatment of weed species will provide opportunities for the reestablishment of native plant communities over the long-term, this project should have a beneficial effect on prey species for the owl. In addition, a future native plant seeding program for treated areas may be implemented that will provide further benefits to owl prey species.

One concern is whether the weed treatment program could result in secondary effects to owl prey species through the application of chemicals to plant species that may be used as forage by the prey species. MSDS sheets indicate that the herbicides that are to be used are practically non-toxic to species that have similar characteristics to owl prey species. The spot application of herbicides and oversight by the bio-monitor should further reduce the potential for these chemicals to enter the food chain. In addition, the concentration of herbicides used in any one area would be so small as to never approach the concentrations required to result in adverse effects to owl prey species. Based on this information, the secondary effects of herbicide application on prey species are believed to be insignificant.

The exotic weed species control program will occur in the forest during the breeding season for the owl that occurs from March 1st through August 31st. This is necessary, as weed species must be treated at a specific time of year to be effective. Since weed treatment activities will occur during the day and owl foraging generally occurs at night, any owls that may forage in the area would be expected to be unaffected. As discussed earlier, no breeding or foraging owls have ever been observed on the Observatory so the likelihood of encountering an owl is extremely small and very unlikely.

The Navy has made a "may affect – is not likely to adversely affect" determination for the MSO. We have determined that the short and long-term effects of the proposed exotic weed species control program are believed to be so small as to be insignificant and so unlikely as to be discountable based on the above information and the following conclusions:

a. Use of a project bio-monitor and spot application of herbicides will significantly minimize the potential for overspray of native plants that are used as cover and forage by rodents and small mammals that may serve as prey species for the MSO.

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b. Since the concentration of herbicides to be used in any one area are so small, the secondary effects of herbicide application on prey species is believed to be insignificant.

c. Since the treatment of weed species will provide opportunities for the reestablishment of native plant communities over the long-term, this project should have a beneficial effect on prey species for the owl.

d. The effects of the exotic weed species control program on the MSO are believed to be both discountable and insignificant since no breeding or foraging owls have ever been observed on the Observatory.

We request your concurrence with our effects determination. You may direct any questions or concerns that you may have to the Navy point-of-contact, Mr. Robert Palmer, Fish and Wildlife Biologist, at (619) 532-3266 or by e-mail at palmerrl@efdsw.navfac.navy.mil.

Sincerely,

Dan Muslin

DAN MUSLIN
Environmental Team Leader
By direction of the Commander

Encl:
(1) Pesticide Application Plan
(2) Figure 1 – Mexican Spotted Owl Observations

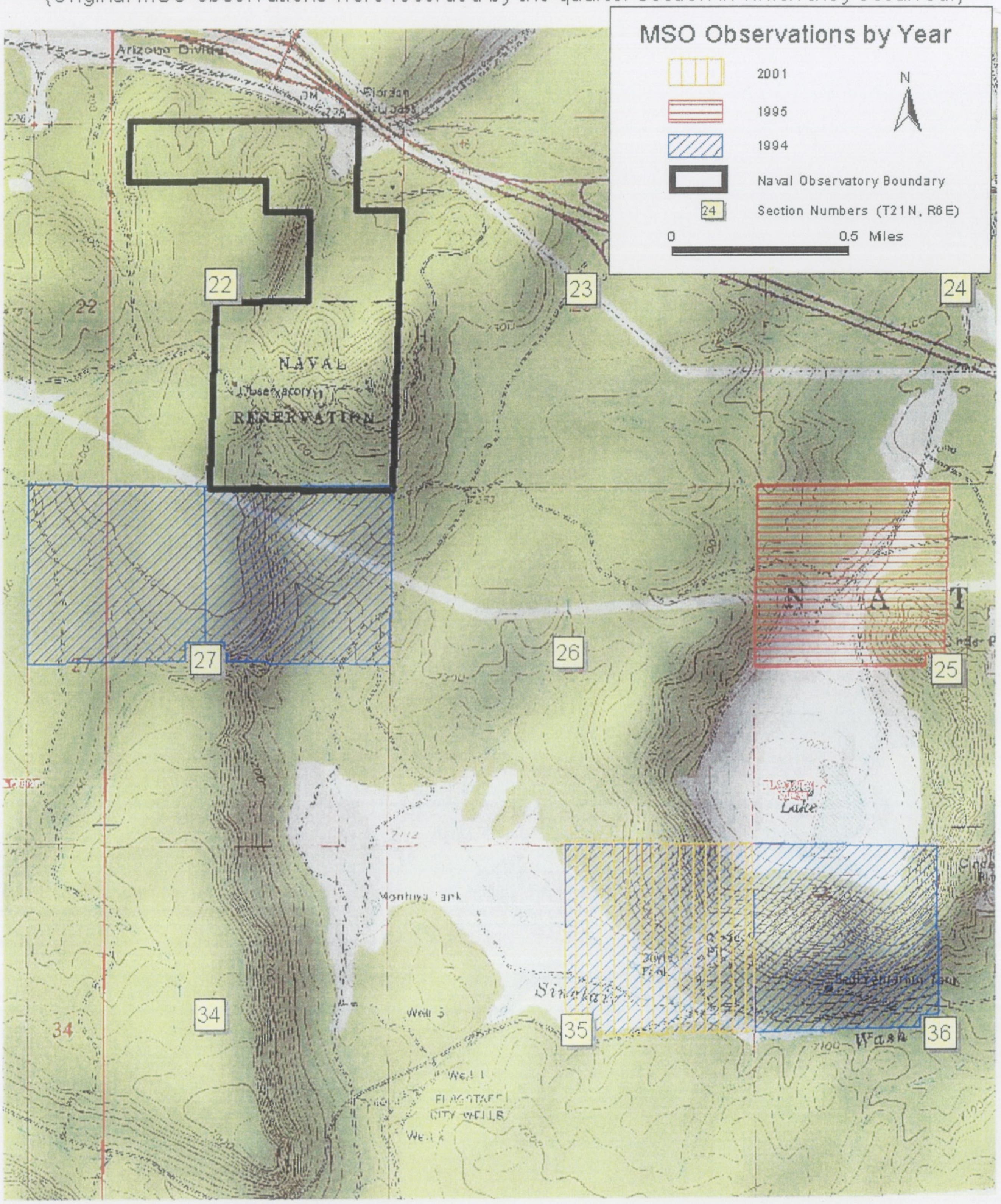
Copy to:
Mr. Michael DiVitorrio, U.S. Naval Observatory Flagstaff Station, P.O.Box 1149, Flagstaff, AZ 86002 (w/enclosures)
Ms. Christine Frego, Naval District Washington, 1014 N Street, S.E., Suite 320, Washington, D.C. 20374-5001 (w/enclosures)

Pesticide Application Plan
provided to Steve Spangle
in original letter

ENCLOSURE 1

Figure 1 - Mexican Spotted Owl Observations Near the US Naval Observatory, Flagstaff AZ 1994-2002

(Original MSO observations were recorded by the quarter section in which they occurred.)



United States Department of the Interior

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 242-0210 Fax: (602) 242-2513

In Reply Refer to:

AESO/SE
02-21-97-F-0110-R1

August 29, 2003

Mr. Robert Palmer
Southwest Division, Mail Code: 5DPR.RP
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

Dear Mr. Palmer:

Thank you for your request for reinitiation with the U.S. Fish and Wildlife Service pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended. Your request for reinitiation of formal consultation, dated July 17, 2002, was received by us on July 19, 2002. This constitutes a reinitiation of consultation regarding the July 23, 1998, biological opinion on the Naval Observatory Flagstaff Station (NOFS), Coconino County, Arizona. The non-jeopardy biological opinion (2-21-97-F-0110) considered the effects of proposed NOFS operations and forest management activities on the threatened Mexican spotted owl (*Strix occidentalis lucida*) (MSO). Critical habitat for this species has been designated; however, this action does not affect any areas of critical habitat. Therefore, the effects on critical habitat are not addressed further in this biological opinion.

This re-initation of consultation is based on information provided in the July 17, 2002, letter; the August 1997 biological assessment (BA); the May 8, 2003, change to the proposed action; correspondence and meetings with your staff and the Arizona Game and Fish Department (AGFD); telephone conversations; field investigations; and other sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the MSO, forest management and its effects, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file at this office. We have assigned log number 02-21-97-F-0110-R1 to this project. Please refer to this number in future correspondence on this consultation.

Consultation History

Details of the consultation history are summarized in Table 1.

Table 1. Summary of Consultation History

Date	*Event*
August 1, 2001	We provided comments on the draft preliminary Integrated Natural Resources Management Plan (INRMP). In our comments we noted the discrepancy between the number of acres to be thinned as analyzed in the biological opinion and what was stated in the INRMP.
January 29, 2002	Fish and Wildlife Service and NOFS staff toured the thinning operation.
May 24, 2002 June 6, 2002	We discussed the discrepancy in the number of acres analyzed for treatment in the biological opinion and what is stated in the INRMP with Navy staff.
June 7, 2002	The Navy informed us that 120 acres have been treated on the NOFS and that they plan to treat a total of 225 acres. We recommended that the Navy reinitiate formal consultation.
July 17, 2002	The Navy requested reinitiation of formal consultation.
December 11, 2002	We provided the Navy with a draft reinitiation of the July 23, 1998, biological opinion.
February 18, 2003	We received the Navy's comments on the draft biological opinion.
March 3, 2003	We met with the Navy to discuss the draft opinion and their comments.
May 16, 2003	We received the Navy's comments on a second draft biological opinion. The May 8, 2003, letter contained a change to the proposed action.
June 2003	We corresponded via e-mail with the Navy regarding our recommendations for conducting pile burning in MSO habitat.
July 25, 2003	We responded to the Navy's comments on the second draft biological opinion.
August 20, 2003	The Navy called and verbally responded with comments to the third draft biological opinion. We requested the comments in writing.

August 27, 2003	We received an electronic mail detailing the Navy's comments on the third draft biological opinion.

BIOLOGICAL OPINION RE-INITIATION

DESCRIPTION OF THE PROPOSED ACTION

The project is as described in the July 23, 1998, biological opinion except for the following changes:

A full description of the proposed thinning operation was included in the original consultation package provided by the Navy. However, the information provided in the August 1997 BA did not clearly state that the proposed action would treat more than 90 acres [the estimated protected activity center (PAC) acres]. Subsequently, the biological opinion incorrectly described the fuels reduction project as thinning up to 90 acres of forest with additional acreage to be thinned in the Operations Area. The actual acreage to be thinned across the entire 290 acre installation is 262.5 acres. This area includes approximately 90 acres within the Dry Lake MSO PAC and 172.5 acres of protected steep-slope and restricted pine-oak habitat. Thinning operations will not be conducted in accordance with recommendations from the Recovery Plan for the Mexican Spotted Owl (Recovery Plan) (USDI 1995). The action area for this consultation includes the entire Dry Lake PAC and all NOFS project area lands outside the PAC.

In addition, the NOFS requested that we analyze the effects of removing 20 ponderosa pine trees within 100 feet of buildings within the Operations Area. The Operations Area is located within the Dry Lake PAC and removal of these trees would be in addition to any trees removed during forest thinning operations. The 1998 biological opinion analyzed the effects of utility corridor maintenance (the cyclic trimming of tree branches that interfere with the laser path between buildings) and the removal of individual trees near power and fence lines. However, maintenance tree removal within the Operations Area was not included in the original proposed action. Tree removal will not occur in the PAC during the breeding season (per Term and Condition 1.c. of the July 23, 1998, biological opinion).

The NOFS has also requested (per the May 8, 2003, letter) that we analyze the effects of increasing the number of slash piles burned from 20 to 100 per year. The Navy stated in the letter that due to the increase in acres to be thinned, the project will need to burn a much larger volume of material than was originally estimated during the planning phases for this action. Slash piles will not be placed near large oaks, large live trees, yellow pines, snags, and logs in order to avoid damage during pile burning. This is especially important in protected and restricted MSO habitat. Slash will be hand-piled on steep slopes to minimize soil disturbance. Within the PAC, slash piling and pile burning will occur outside the breeding season for Mexican spotted owls (March 1-August 31).

STATUS OF THE SPECIES

The following section replaces pages 14-17 of the July 23, 1998, opinion:

The Mexican spotted owl was listed as a threatened species in 1993 (USDI 1993). The primary threats to the species were cited as even-aged timber harvest and the threat of catastrophic wildfire, although grazing, recreation, and other land uses were also mentioned as possible factors influencing the MSO population. The Service appointed the Mexican Spotted Owl Recovery Team in 1993, which produced the Recovery Plan for the Mexican Spotted Owl (Recovery Plan) in 1995 (USDI 1995).

A detailed account of the taxonomy, biology, and reproductive characteristics of the MSO is found in the Final Rule listing the MSO as a threatened species (USDI 1993) and in the Recovery Plan (USDI 1995). The information provided in those documents is included herein by reference. Although the MSO's entire range covers a broad area of the southwestern United States and Mexico, the MSO does not occur uniformly throughout its range. Instead, it occurs in disjunct localities that correspond to isolated forested mountain systems, canyons, and in some cases steep, rocky canyon lands. Surveys have revealed that the species has an affinity for older, well-structured forest, and the species is known to inhabit a physically diverse landscape in the southwestern United States and Mexico.

The U.S. range of the MSO has been divided into six recovery units (RU), as discussed in the Recovery Plan. The primary administrator of lands supporting the MSO in the United States is the Forest Service. Most owls have been found within Forest Service Region 3 (including 11 National Forests in Arizona and New Mexico). Forest Service Regions 2 and 4 (including 2 National Forests in Colorado and 3 in Utah) support fewer owls. According to the Recovery Plan, 91% of MSO known to exist in the United States between 1990 and 1993 occurred on lands administered by the Forest Service.

The Upper Gila Mountains RU, which includes NOFS, is a relatively narrow band bounded on the north by the Colorado Plateau RU and to the south by the Basin and Range-West RU. The southern boundary of this RU includes the drainages below the Mogollon Rim in central and eastern Arizona. The eastern boundary extends to the Black, Mimbres, San Mateo, and Magdalena mountain ranges of New Mexico. The northern and western boundaries extend to the San Francisco Peaks and Bill Williams Mountain north and west of Flagstaff, Arizona. This is a topographically complex area consisting of steep foothills and high plateaus dissected by deep forested drainages. This RU can be considered a "transition zone" because it is an interface between two major biotic regions: the Colorado Plateau and Basin and Range Provinces (Wilson 1969). Most habitat within this RU is administered by the Kaibab, Coconino, Apache-Sitgreaves, Tonto, Cibola, and Gila National Forests. The north half of the Fort Apache and northeast corner of the San Carlos Indian reservations are located in the center of this RU and also support MSOs.

The Upper Gila Mountains RU consists of pinyon/juniper woodland, ponderosa pine/mixed conifer forest, some spruce/fir forest, and deciduous riparian forest in mid- and lower-elevation canyon habitat. Climate is characterized by cold winters and over half the precipitation falls during the growing season. Much of the mature stand component on the gentle slopes surrounding the canyons had been partially or completely harvested prior to the species' listing as threatened in 1993, however, MSO nesting habitat remains in steeper areas. MSO are widely distributed and use a variety of habitats within this RU. Owls most commonly nest and roost in mixed-conifer forests dominated by Douglas fir and/or white fir, and canyons with varying degrees of forest cover (Ganey and Balda 1989, USDI 1995). Owls also nest and roost in ponderosa pine-Gambel oak forest, where they are typically found in stands containing well-developed understories of Gambel oak (USDI 1995).

A reliable estimate of the numbers of owls throughout its entire range is not currently available (USDI 1995) and the quality and quantity of information regarding numbers of MSO vary by source. USDI (1991) reported a total of 2,160 owls throughout the United States. Fletcher (1990) calculated that 2,074 owls existed in Arizona and New Mexico. However, Ganey *et al.* (2000) estimates approximately 2,950 ± 1,067 (SE) MSOs in the Upper Gila Mountains RU alone. The Forest Service Region 3 most recently reported a total of approximately 980 protected activity centers (PACs) established on National Forest lands in Arizona and New Mexico (USDA Forest Service, Southwestern Region, December 19, 2002). Based on this number of MSO sites, total numbers in the United States may range from 980 individuals, assuming each known site was occupied by a single MSO, to 1,960 individuals, assuming each known site was occupied by a pair of MSOs. The Forest Service Region 3 data are the most current compiled information available to us; however, survey efforts in areas other than National Forest System lands have likely resulted in additional sites being located in all Recovery Units. Currently, we estimate that there are likely 12 PACs in Colorado (not all currently designated) and 105 PACs in Utah.

Since the owl was listed, we have completed or have in draft form a total of 114 formal consultations for the MSO. These formal consultations have identified incidences of anticipated incidental take of MSO in 289 PACs. The form of this incidental take is almost entirely harm or harassment. These consultations have primarily dealt with actions proposed by the Forest Service, Region 3. However, in addition to actions proposed by the Forest Service, Region 3, we have also reviewed the impacts of actions proposed by the Bureau of Indian Affairs, Department of Defense (including Air Force, Army, and Navy), Department of Energy, National Park Service, and Federal Highway Administration. These proposals have included timber sales, road construction, fire/ecosystem management projects (including prescribed natural and management ignited fires), livestock grazing, recreation activities, utility corridors, military and sightseeing overflights, and other activities. Only one of these projects (release of site-specific owl location information) has resulted in a biological opinion that the proposed action would likely jeopardize the continued existence of the MSO.

ENVIRONMENTAL BASELINE

The following paragraphs are inserted at the beginning of this section (page 17) of the July 23, 1998, biological opinion:

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform from which to assess the effects of the action now under consultation.

A. Status of the species within the action area

Our records (based on information from the Forest Service) indicate that a pair of MSOs were observed on or near the NOFS boundary by the Arizona State Land Department (ASLD) on June 28, 1994. Nesting status was not determined and the pair has not been located on NOFS ownership since that time. However, Mexican spotted owl surveys conducted in 1994 were not well documented and the only written record of the observation was recorded by the Forest Service. The Navy questions the validity of the this record and believes that only a single owl was observed on this survey visit. Regardless of whether a pair or single bird were observed that night, an abundance of suitable habitat exists, and a PAC has been designated based on multiple MSO detections within the area.

Owl surveys have rarely been complete because in most years only discrete portions (based on ownership) of the Dry Lake PAC (#040231) have been surveyed. The ASLD, NOFS contractors, and the Coconino National Forest have all conducted surveys within and adjacent to the PAC. Mexican spotted owls were last detected in July 2001, in the eastern portion of the PAC, approximately 1.0 mile from NOFS ownership. The NOFS was surveyed in 1994, 1997, 1999, and 2001. Though portions of the NOFS were also surveyed by the ASLD in 1996 and 1998, not all protected and restricted habitat within the project area was surveyed.

Currently, of the 262.5 acres of MSO habitat to be treated on the NOFS, approximately 100 acres have been treated. This includes acreage within and outside of the Dry Lake PAC (approximately 124 acres of the NOFS are located within the Dry Lake PAC). The AGFD toured the current thinning treatments with your staff in June 2002, and observed the following impacts to MSO habitat: selective removal of large ponderosa pine trees (some in excess of 24 inches diameter at breast height); retention of small diameter ladder fuels; damage to many large standing oaks; and, soil disturbance (see AGFD letter dated August 5, 2002). The AGFD also noted that not all treated areas were cut to the prescription of 20-24 feet on center analyzed in the 1998 biological opinion. The AGFD believed that larger trees were selectively removed from much of the area, leaving a forest stand structure of smaller trees that remains vulnerable to wildfires and may no longer support MSO.

In the first set of comments on the draft biological opinion (February 10, 2003), the Navy stated that they disagree with the AGFD statements and believe that larger trees have not been selectively removed by the contractor and that issues regarding soil disturbance will be dealt with following project completion. In addition, the Navy stated that if there are more than 100 large ponderosa pine trees per acre, then some of those trees will be harvested (R. Palmer, pers. comm., March 3, 2003). The Navy concluded that this is what AGFD observed during the June 2002 field trip and further questioned the AGFD observation that many large standing oaks were damaged. However, when we toured the project area in January 2002, we also noted several damaged, large oaks and were told by NOFS staff that they intended to map the damaged oaks in an attempt to enforce the contract provisions. The Navy told the contractor, both verbally and in writing, that further damage to oaks would not be tolerated (R. Palmer, pers. comm. 2003).

B. Factors affecting species' environment within the action area

As stated earlier, the action area includes the entire Dry Lake PAC and all NOFS project area lands outside the PAC. Land ownership within and adjacent to the Dry Lake PAC includes the Forest Service, ASLD, and private property. Actions included in this analysis that may affect the MSO include astronomical and forestry research, recreation, and fuels reduction treatments. Proposed and on-going activities have the potential to reduce the quality of MSO nesting, roosting, and foraging habitat, and may cause disturbance during the breeding season. To achieve long-term research and educational goals and to provide a sustainable source of revenue, Northern Arizona University plans to construct a Centennial Forest Field Campus in the east ½ of the east ½ of Section 34, T21N, R6E. The field campus will be within and adjacent to the Dry Lake PAC and will include a forestry research station, small business development program, education camp and retreat center, and overnight guest lodging. The area is already a favorite recreation destination due to its proximity to Flagstaff, the Arboretum at Flagstaff, and the NOFS. Currently, the ASLD has conducted thinning projects adjacent to the PAC, and is planning future fuels reduction treatments within the PAC. Due to the area's proximity to urban development, treatments most likely will not comply with the Recovery Plan. In addition, the Forest Service will also be treating areas surrounding and including portions of the Dry Lake PAC as part of the Woody Ridge Wildland Urban Interface Project. The project site, the Operations Area, is an area of intensive use by Naval Observatory personnel. Vehicles and observatory staff operate in this area both day and night. In addition, the telescope dome is commonly opened and rotated at night.

EFFECTS OF THE ACTION

Insert the following paragraph at the beginning of this section (page 20) of the July 23, 1998, biological opinion:

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, that will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

Insert the following paragraphs between the third and fourth paragraphs (page 20) of the July 23, 1998, biological opinion:

The effect of the change in the action will be the modification of approximately 262.5 acres of MSO protected and restricted habitat versus the 90 acres that was analyzed in the July 23, 1998, biological opinion. In the August 1997, biological assessment the Navy stated that no snags, large trees, downed logs, or oak stands would be affected by the proposed action. However, the Navy indicated during our March 3, 2003, meeting that large trees would be harvested if there were greater than 100 large trees per acre (although the General Silvicultural Treatment Criteria in the BA states that the silvicultural goal is 100 live ponderosa pine trees per acre total).

Surveys have detected MSO over the years within the Dry Lake PAC, although no nest or roost sites have been located. The known owl locations and available habitat suggest that the portion of the PAC on the NOFS could support MSO nesting, roosting, and foraging. However, the proposed thinning prescription for protected and restricted habitat at the NOFS will not promote MSO habitat now or in the near future and will have adverse impacts to the habitat that now exists. The Recovery Plan recommends implementing appropriate fuels reduction treatments within PACs, steep slope protected habitat (outside of PACs), and within restricted habitat to abate fire risk and promote future nesting and roosting habitat. Within PACs and steep slope protected habitat, the Recovery Plan recommends no harvest of trees greater than nine inches diameter at breast height (dbh). According to the description of thinning prescriptions in the August 1997 BA, there is no nine-inch dbh limit on tree removal, and we assume that loss of large diameter pines and damage to large oaks that have occurred on the 100 acres already treated will continue to occur on the additional 162.5 acres of MSO habitat yet to be treated.

The implementation of the proposed action will likely adversely affect the MSO, ranging from short- to long-term effects. Thinning of trees greater than nine inches dbh within the Dry Lake PAC will adversely affect approximately 90 acres (as analyzed in the July 23, 1998 biological opinion). Although this action was proposed in part to reduce the risk of catastrophic wildfire, it will adversely affect the MSO by modifying the forest structure and understory plant diversity.

The proposed project is expected to change the overall stand structure within the PAC because large-diameter trees will be removed. Because there is no 100-acre core activity center identified for the Dry Lake PAC (i.e., no known nest/roost site), impacts to a nesting or roosting core area could occur and the integrity of the PAC could be compromised.

The proposed thinning will likely result in a reduction in canopy closure, a change in the forest stand structure from a wide range of uneven-age tree sizes to a more even-age structure (even spacing), and damage or disturbance of downed logs, snags, large oaks, and low-growing limbs, which may affect the prey base of the MSO.

Thinning treatments within steep-slope protected habitat and restricted habitat are also expected to have adverse effects to the MSO since these actions are not in accordance with the Recovery Plan recommendations. Trees greater than nine inches dbh will be removed from protected steep slope habitat and restricted pine-oak habitat. The removal of large trees will likely reduce the restricted habitat below the target-threshold levels recommended in the Recovery Plan..

We appreciate the Navy's willingness to minimize impacts from the increase in pile burning. Since slash piles will not be placed near large oaks, large live trees, yellow pines, snags, and logs; will be hand-piled on steep slopes to minimize soil disturbances; and within the PAC, slash piling and pile burning will occur outside the breeding season for Mexican spotted owls (March 1-August 31), we believe the navy has adequately minimized effects resulting from the aspect of the program.

The proposed removal of 20 ponderosa pine trees from the Operations Area should have a minimal impact on habitat within the PAC. As a result of the intensive human presence and use in this area, MSO most likely would not nest within the Operations Area. Though the Recovery Plan recommends that trees greater than nine inches dbh not be removed in PACs, this area consists of buildings and paved surfaces. Removal of trees adjacent to these buildings will not violate the intent of the Recovery Plan.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area to be considered in this biological opinion. Future Federal actions are subject to the consultation requirements established under section 7, and therefore, are not considered cumulative in the proposed action. Future actions within the action area that are reasonably certain to occur include urban growth and development, recreation, road construction, fuels-reduction treatments, research, livestock grazing, and other associated actions. These actions have the potential to reduce the quality of MSO nesting, roosting, and foraging habitat, cause disturbance to breeding MSO, and would contribute as cumulative effects to the proposed action.

CONCLUSION

The conclusions of this amendment to the July 23, 1998, biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document and the July 23, 1998, biological opinion, including any Conservation Measures that were incorporated into the project design.

After reviewing the current status of the Mexican spotted owl, the environmental baseline for the action area, the effects of the proposed NOFS activities and the cumulative effects, it is our biological opinion that the NOFS forest management activities, as proposed, are not likely to jeopardize the continued existence of the Mexican spotted owl because we anticipated that no more than one MSO PAC may be affected, which is essentially the same as what was anticipated in the original July 23, 1998, biological opinion.

INCIDENTAL TAKE STATEMENT

The July 23, 1998, biological opinion anticipated the incidental take of one Mexican spotted owl. The incidental take was expected to be in the form of harm due to disturbance and loss of habitat. We anticipated that the incidental take would be difficult to detect due to the wide-ranging nature of the species; its small body size; finding a dead or impaired specimen is unlikely; losses may be masked by seasonal fluctuations in numbers or other causes; and, the species occurs in habitat that makes detection difficult. Therefore, determination of incidental take would be tied to the prescription of the proposed action. The July 23, 1998, biological opinion stated that if the thinning prescription was not followed or exceeded in any manner, then the anticipated incidental take would be considered to be exceeded. Based on the information analyzed in this opinion, we believe that habitat alteration within the PAC was, and will continue to be, greater than anticipated in the original biological opinion due to the increased acreage to be harvested, removal of large diameter ponderosa pine, and increased pile burning.

AMOUNT OR EXTENT OF TAKE

The following sentences replace the first sentence beginning on page 22 of the July 23, 1998, biological opinion:

We anticipate that two MSO (one pair) and/or associated eggs/juveniles associated with the Dry Lake PAC (#040231) may be taken following full implementation of the thinning prescription. The incidental take will be in the form of harm or harassment due to long-term habitat alteration.

EFFECT OF THE TAKE

In this biological opinion, we determine that this level of anticipated take is not likely to result in jeopardy to the species.

REASONABLE AND PRUDENT MEASURES/TERMS AND CONDITIONS

All reasonable and prudent measures (RPM) and their implementing terms and conditions shall remain as stated in the July 23, 1998, biological opinion, except for the following changes to the term and condition for RPM 3:

3. Term and condition for reasonable and prudent measure 3:

   Monitoring of the project area shall be completed to ascertain harm or harassment to the species. This microhabitat monitoring will be accomplished using one of the following methods: a procedure developed by the Navy and acceptable to the Fish and Wildlife Service, or a procedure already developed as a result of consultation regarding similar projects and adopted by the Navy. The Navy shall provide the results of the monitoring to us within one year of the completion of the thinning project and any prescribed burning projects that are conducted.

Disposition of Dead or Injured Listed Species

This section of the July 23, 1998, biological opinion is amended as follows:

Upon locating a dead, injured, or sick listed species initial notification must be made to our Law Enforcement Office, Federal Building, 2450 West Broadway Suite 113, Mesa, Arizona 85202 (telephone: (480) 967-7900) within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

CONSERVATION RECOMMENDATIONS

This section of the July 23, 1998, biological opinion is amended as follows:

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. We recommend that the NOFS work with us, the AGFD, and Coconino County to acquire lands within the Dry Lake area to permanently preserve and promote MSO habitat in and adjacent to the Dry Lake PAC. There is a provision within the Sikes Act and the Defense Authorization conference report (HR 772) for the military to work with private conservation groups or state organizations to spend money off-base for protection of threatened and endangered species. Coconino County is currently attempting to purchase land from the Arizona State Land Department within the Dry Lake area to preserve as open space. This may be a good opportunity for the Navy to partner with the County to achieve multiple conservation goals.

2. We recommend that the NOFS work with us and the AGFD to minimize impacts from the proposed thinning prescription on the 162.5 acres yet to be completed. Staff from both agencies are willing to work with Naval staff and/or the contractor to promote the preservation of large pines and oaks, snags, and coarse woody debris.

In order that we be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the reinitiated action outlined in the request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

We look forward to continuing to work with the Navy and NOFS to maintain MSO habitat within and adjacent to the Dry Lake PAC. For further information please contact Shaula Hedwall at (928) 226-0614, ext. 103, or Brenda Smith at (928) 226-0614, ext. 101, of our Flagstaff Suboffice. Please refer to the consultation number, 02-21-97-F-0110-R1, in future correspondence concerning this project.

Sincerely,

Steven L. Spangle
Field Supervisor

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (ARD-ES)
Field Supervisor, Fish and Wildlife Service, Albuquerque, NM
Michael DiVittorrio, U.S. Naval Observatory Flagstaff Station, Flagstaff, AZ
Forest Supervisor, Coconino National Forest, Flagstaff, AZ (Attn: Jim Golden)
Forest Biologist, Coconino National Forest, Flagstaff, AZ (Attn: Cecelia Overby)
District Ranger, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ
District Ranger, Coconino National Forest, Mormon Lake Ranger District, Flagstaff, AZ

Commissioner, Arizona State Land Department, Phoenix, AZ
Keith Pajkos, Arizona State Land Department, Flagstaff, AZ
John Kennedy, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ

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United States Department of the Interior
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 242-0210 FAX: (602) 242-2513

In Reply Refer to:

AESO/SE
02-21-04-I-0175

June 23, 2004

E-Mail Transmission

Mr. Robert L. Palmer
Department of the Navy
Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

RE: Implementation of an Erosion Control Program at the Naval Observatory Flagstaff Station

Dear Mr. Palmer:

On April 5, 2004, we received your March 25, 2004, request for informal consultation on the effects of implementation of an erosion control program at the Naval Observatory Flagstaff Station (NOFS), Coconino County, Arizona, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The erosion control program will target areas impacted from the forest thinning project (skid trails, landings, burn piles, etc.). The Navy requests our concurrence that the proposed project may affect, but will not likely adversely affect, the threatened Mexican spotted owl (*Strix occidentalis lucida*) (MSO).

Included in the request for consultation was a copy of the Biological Assessment and Evaluation (BAE) for the project and the pesticide application plan. We have reviewed these documents and discussed the project with your staff. We met on May 12, 2004, to discuss this project with the NOFS Natural Resources Partnering Team (Team). The Team suggested potential changes to the project, such as implementing the project prior to the onset of monsoon rains. On June 8, 2004, the project start date was modified due to the availability of the Coconino County Rural Environmental Corps (CREC) to conduct the work prior to summer rains. We appreciate the Navy's willingness to incorporate the Team's recommendations into NOFS projects.

The potential treatment area includes all land within the NOFS. Preliminary field reconnaissance determined that approximately 10 acres requires erosion control work as a result of the fuels reduction harvest operations. The current plan is to address the areas of immediate need over the next one or two years and then continue an erosion control program for ten years to control possible problem areas. Proposed erosion control and site rehabilitation actions will include mulching disturbed areas with native materials, construction of water bars across steep skid roads, and seeding areas (if needed) with a native, weed-free seed mix. Work during the first year will be accomplished with a CREC crew of eight to ten people using hand-tools. The original plan was for the crews to begin work in early October, outside the MSO breeding season. However, due to the potential for summer monsoon rains to cause erosion on areas heavily impacted by logging, the Team agreed that it would be best for the area to start erosion control work as soon as possible. However, no power tools (e.g., chainsaws) will be used in the Dry Lake MSO protected activity center during the breeding season (March 1 through August 31).

Erosion control measures were developed with assistance from the Natural Resource Conservation Service (NRCS). The recommendations made by NRCS are attached to the BAE as Enclosure 1. Mulching will occur on areas where natural organic material was displaced by skidding operations and will consist of dragging slash, pine needles, and other organic litter back on to skid trails and other disturbed areas. Steep skid trails (>15% slope), especially those running parallel to the slope, will have waterbars constructed to prevent gully formation. Waterbars will be constructed by trenching across and/or by dragging larger slash across skid trails. In addition, NOFS and CREC crews will attempt to deter vehicles from using skid roads by covering roads and intersections with slash. Seeding will only occur where natural vegetation is not occurring.

Mexican spotted owl

The MSO was listed as a threatened species in 1993 (USDI 1993). The primary threats to the species were cited as even-aged timber harvest and the threat of catastrophic wildfire, although grazing, recreation, and other land uses were also mentioned as possible factors influencing the MSO population. We appointed the Mexican Spotted Owl Recovery Team in 1993, which produced the Recovery Plan for the Mexican Spotted Owl (Recovery Plan) in 1995 (USDI 1995).

A detailed account of the taxonomy, biology, and reproductive characteristics of the MSO is found in the Final Rule listing the MSO as a threatened species (USDI 1993) and in the Recovery Plan (USDI 1995). The information provided in those documents is included herein by reference. Although the MSO's entire range covers a broad area of the southwestern United States and Mexico, the MSO does not occur uniformly throughout its range. Instead, it occurs in disjunct localities that correspond to isolated forested mountain systems, canyons, and, in some cases steep, rocky canyon lands. Surveys have revealed that the species has an affinity for older, well-structured forest, and the species is known to inhabit a physically diverse landscape in the southwestern United States and Mexico.

The NOFS boundary includes approximately 124 acres of protected habitat which include a portion of the Dry Lake PAC (040231), and 166 acres of restricted habitat. Surveys conducted by the Forest Service in 2001 located owls within the Dry Lake PAC. The Dry Lake PAC was informally surveyed by the Arizona State Land Department in 2002 and the NOFS in 2003, and no MSO were located. The U.S. Geological Survey is conducting surveys on the NOFS and throughout the Dry Lake PAC in 2004. To date, no owls have been detected. If a roost or nest site is located, all work within the PAC will be re-evaluated for potential effects.

We concur with the Navy's determination that the proposed action may affect, but will not likely adversely affect, the MSO. We base this determination on the following:

1) Though crews may be present within the PAC during the MSO breeding season, they will conduct all work during daylight hours with non-mechanized hand tools and vehicles to transport crews will remain on the established road system. This will minimize impacts from disturbance to any MSO that may be present.

2) Erosion control activities will aid in revegetation and prevent further degradation of disturbed areas, which will benefit MSO prey habitat within protected and restricted habitat.

No further section 7 consultation on effects to the MSO is required for this project at this time. Should the proposed action change, or should new information become available that indicates that the action may affect the MSO in a manner or extent not considered in our review, the Navy may want to reconsider whether reinitiation of consultation is appropriate.

Thank you for your continued consideration of the Mexican spotted owl. If you have any questions or concerns about this consultation, or the consultation process in general, please contact Shaula Hedwall or Brenda Smith of our Flagstaff Suboffice at (928) 226-0614.

Sincerely,

For

Steven L. Spangle
Field Supervisor

cc: Field Supervisor, Fish and Wildlife Service, Albuquerque, NM
Bob Broscheid, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
Regional Supervisor, Arizona Game and Fish Department, Flagstaff, AZ
Michael DiVittorio, U.S. Naval Observatory, Flagstaff Station, Flagstaff, AZ

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U.S. Department of the Interior (USDI), Fish and Wildlife Service. 1995. Recovery Plan for the Mexican Spotted Owl. Albuquerque, New Mexico.

DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

11015
Ser 5DPR.RP/4027
March 25, 2004

Mr. Steve Spangle
Field Supervisor
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, AZ 85021-4951

Dear Mr. Spangle:

SUBJECT: IMPLEMENTATION OF AN EROSION CONTROL PROGRAM AT THE NAVAL OBSERVATORY FLAGSTAFF STATION (NOFS)

This transmittal serves to initiate the informal Endangered Species Act (ESA) section 7 consultation process for a proposal to implement an erosion control program at the Naval Observatory Flagstaff Station (NOFS). In 1997/98, NOFS formally consulted with your agency on long-term forest management and other activities at NOFS (Consultation No. AESO/SE 2-21-97-F-110). The actions to be evaluated in this transmittal are to address land rehabilitation needs resulting from the forest thinning activity evaluated in the 1997/98 consultation.

This evaluation is intended to provide the information necessary to facilitate informal consultation with the U.S. Fish and Wildlife Service (Service) as required by 50 CFR 402.14(c). This evaluation describes the proposed action and reviews relevant biological information on Federally listed species potentially affected by the project. NOFS has determined that only one Federally listed threatened or endangered species, the Mexican spotted owl [MSO](*Strix occidentalis lucida*), has the potential to be found within the vicinity of the project. Although critical habitat has been designated for the MSO, NOFS lands were not included in that designation.

The erosion control program at NOFS will target areas impacted from the forest thinning project (skid trails, landings, burn piles, etc). The *potential* treatment area includes all land within the boundary of NOFS. From estimates in the field it was determined that approximately 10 acres of NOFS currently require erosion control work as a result of the timber thinning operations. The current plan is to address the areas of immediate need over the next one or two years and then continue an erosion control program for ten years to control possible problem areas such as gullies or headcuts. Erosion control and site rehabilitation will be accomplished by mulching disturbed areas with native materials, construction of water bars across steep skid roads, and seeding highly disturbed areas with a native seed mix. Work for the first year will be accomplished with crews of eight to ten people using hand-tools. These crews are being provided by the Cococino County Rural Environmental Corp and are trained in erosion control work. They will work after the MSO breeding season in early October. Future work will use similar crews and methods. The use of hand tools by crews may occur in the future during the MSO breeding season. However, the use of power tools, such as chainsaws, will not be allowed in the PAC during the MSO breeding season. If chainsaws are necessary they would be used to break up slash only and would not be used for the felling of trees.

Erosion control measures were developed with input from the Natural Resource Conservation Service (NRCS). A NRCS representative conducted a site visit on June 4, 2004 to help determine treatment options to control erosion and conduct site rehabilitation on areas degraded as a result of timber thinning operations. NRCS made several recommendations for erosion control and site revegetation. Their recommendations are attached as Enclosure 1.

In general, the erosion control methods being used are low-tech and do not involve the construction of hardscape features. Mulching will occur on areas where natural organic material has been displaced by skidding of timber. Mulching will consist of dragging slash, pine needles and other organic litter displaced from timber thinning activities back onto skid trails and other disturbed areas. Steep skid trails (over 15%), especially those running parallel to the slope, will be waterbarred to prevent gully formation. Waterbars will be constructed by trenching across and/or by dragging larger slash across skid trails. In addition, slash piles will be placed where obvious skid roads meet main roads to prevent inadvertent or intentional use of skid trails by vehicles. Seeding will only occur where natural revegetation is not occurring. The seed mix recommended by NRCS (see Enclosure 1) will be used. Seeding will be done using a broadcast seeder during the recommended time of year (mid-late autumn).

Careful planning and precautions in the field will be taken to avoid and minimize any effects to sensitive habitat and threatened or endangered species. Vehicles to transport crews will remain on the established road system. Within the PAC, work will be conducted using only hand tools during the breeding season, minimizing noise in MSO habitat.

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March 25, 2004

SUBJECT: IMPLEMENTATION OF AN EROSION CONTROL PROGRAM AT THE NAVAL OBSERVATORY FLAGSTAFF STATION (NOFS)

The largest concentration of known MSO sites in the United States occurs in the Upper Gila Mountain Recovery Unit, of which NOFS is a part, with apparently over half the known individuals. Approximately 124 acres of NOFS falls within the Dry Lake Protected Activity Center (PAC)[#040231]. The Dry Lake PAC was surveyed in all years between 1994 and 2003 with the exception of calendar year 2000 (Table 1). In addition, all protected and restricted habitat at NOFS was surveyed in 1997, 1999 and 2003. Based on these surveys, no MSO's have been observed using NOFS property through the 2003 survey season (Table 1 and Figure 1), with the exception of a sighting of an individual owl on Arizona state lands immediately adjacent to the southern property line on June 28, 1994 (Mr. Keith Pajkos, Arizona State Land Department [ASLD], personal communication 1997). However, MSO surveys conducted in 1994 were not well documented and the U.S. Forest Service (USFS) recorded the only written record of the observation. The Service questions the validity of this record and believes that a pair of owls was observed on this survey visit. In any case, the observation is ten years old. MSOs were last detected in July 2001 in the eastern portion of the PAC, approximately 1.0 mile from the NOFS boundary.

Table 1. Summary of documented Mexican spotted owl observations for the Dry Lake Protected Activity Center, 1994 to 2003*

Date	*Location*	*Observation*	*Observer*
1994			
6/28/94	T21N R6E, Section 27, NE quarter	Single MSO location; probably a dispersing juvenile (K. Pajkos 1/23/97)	ASLD
6/29/94	T21N R6E, Section 27, NW quarter	Single MSO response	ASLD
7/6/94	T21N R6E, Section 36, NW quarter	Female MSO response	USFS
7/14/94	T21N R6E, Section 35, NE quarter	Single MSO location	USFS
7/19/94	T21N R6E, Section 36, NW quarter	Single MSO response; Day and night surveys	USFS
7/31/94	T21N R6E, Section 36, NW quarter	Single MSO response	USFS
1995			
7/17/95	T21N R6E, Section 25, NW quarter	Single MSO location	USFS
1996			
		No MSO responses or locations	ASLD

1997			
		No MSO responses or locations; USN Observatory land and surrounding area surveyed	US Navy/USFS
1998			
		No MSO responses or locations	ASLD
1999			
		No MSO responses or locations; USN Observatory land and surrounding area surveyed	US Navy/USFS
2000			
		No surveys conducted	
2001			
7/8/01	T21N R6E, Section 35, NE quarter	Single MSO response	USFS
7/10/01	T21N R6E, Section 35, NE quarter	Single MSO location	USFS
2002			
		No MSO responses or locations	ASLD
2003			
		No MSO responses or locations	ASLD

*Information sources were a list (Summary of Owl observations for the Dry Lake [040231] MSO) provided by the USFS, Peaks Ranger District, an interview with Mr. Keith Pajkos, ASLD on 1/23/97, and personal communication with Mr. Keith Pajkos. The first year that the USFS had survey and monitoring data for this PAC was 1994. All surveys were conducted according to USFS Region 3 Survey Protocol. Township, Range and Section locations are provided in Figure 1.

There is no critical habitat designated at NOFS, but approximately 124 acres of the habitat on site is protected MSO habitat and a majority of the remaining 166 acres is restricted MSO habitat. These lands are considered to be suitable for foraging by the MSO. In general, NOFS lands are unsuitable for nesting because of the lack of dense pine-oak cover or old growth. However, the property contains about 20 acres of dense pine-oak on slopes greater than 40 percent in two north-facing drainages that could be suitable for MSO nesting. In addition, the forest floor consists almost entirely of bunch grasses that provide cover and a food source for rodents that are the primary prey species for the MSO. On lands directly south of NOFS, the forest becomes denser, and is probably suitable for nesting. Owls that might nest in the future in the area to the south could potentially use Observatory habitat for foraging.

The erosion control program will primarily target areas where the habitat value has been degraded due to removal of the forage base for MSO prey. As mentioned earlier, areas to be targeted are forest-thinning features such as skid trails, landings, etc. Forest thinning features such as skid trails and landings consist of very poor quality ground cover communities or are completely devoid of vegetation. Since these areas consist of ground cover communities of poor or lesser quality, treatment of these areas would be expected to have a beneficial effect on the cover and forage available to prey species of the owl.

The erosion control program may occur in the forest during the breeding season for the owl that occurs from March 1st through August 31st. However, the bulk of the work is expected to take place after the breeding season in October because this is the recommended time to seed with the native seed mix. Since erosion control activities will occur during the day and owl foraging generally occurs at night, any owls that may forage in the area would be expected to be unaffected. As discussed earlier, no breeding or foraging owls have ever been observed on the Observatory so the likelihood of encountering an owl is extremely small and very unlikely.

The Navy has made a "may affect – is not likely to adversely affect" determination for the MSO. We have determined that the short and long-term effects of the proposed erosion control program on the MSO are so small as to be insignificant and so unlikely as to be discountable based on the above information. In addition, the Navy expects that the erosion control program is likely to produce beneficial effects for the MSO by increasing the forage base for MSO prey species.

11015
Ser 5DPR.RP/4027
March 25, 2004

SUBJECT: IMPLEMENTATION OF AN EROSION CONTROL PROGRAM AT THE NAVAL OBSERVATORY FLAGSTAFF STATION (NOFS)

We request your concurrence with our effects determination. You may direct any questions or concerns that you may have to the Navy point-of-contact, Mr. Robert Palmer, Fish and Wildlife Biologist, at (619) 532-1817 or by e-mail at Robert.l.Palmer@navy.mil.

Sincerely,

Robert L. Palmer

ROBERT L. PALMER
Fish and Wildlife Biologist
By direction of the Commander

Enclosures: 1. Naval Observatory Flagstaff Station Forest Thinning Understory Restoration, NRCS, Flagstaff, AZ
2. Figure 1 – Mexican Spotted Owl Observations

Copy to:
Mr. Michael DiVitorrio, U.S. Naval Observatory Flagstaff Station, P.O.Box 1149, Flagstaff, AZ 86002 (w/enclosures)
Ms. Christine Frego, Naval District Washington, 1014 N Street, S.E., Suite 320, Washington, D.C. 20374-5001 (w/enclosures)
Mr. Walter Briggs, EFA Northwest, 7th Ave NE, Poulsbo, WA 98370 (w/enclosures)
Mr. Rick Miller, Arizona Game and Fish Department, 3500 South Lake Mary Road, Flagstaff, AZ 86001 (w/enclosures)

United States Department of Agriculture

NRCS Natural Resources Conservation Service

USDA

1585 South Plaza Way, Suite 120, Flagstaff, Arizona 86001-7156

Naval Observatory Flagstaff Station
Forest Thinning Understory Restoration

Site Description:

The subject area, located west of Flagstaff, Arizona in Township 21 N., Range 6 E., is within USDA – NRCS Land Resource Unit (LRU) D39-1, Mogollon Plateau Coniferous Forest (Rocky Mountain (Petran) and Madrean Montane Conifer Forests, Brown, David E., Biotic Communities, *Southwestern United States and Northwestern Mexico*). Precipitation ranges from 17 to 25 inches in this LRU with approximately 65 percent of the precipitation occurring as snow during the months of October through April. The remaining 35 percent occurs as monsoonal thunder showers between July and September. The mean annual temperature ranges from 42 to 46 degrees Fahrenheit (F). The frost-free period (air temperature > 32 degrees F ranges from 70 to 130 days.

A dense stand of ponderosa pine, *Pinus ponderosa*, has been thinned to improve forest health and reduce the potential for catastrophic fire. A small portion of the treated area has received severe disturbance to the understory species. These areas include skid trails, landings and slash pile burn areas. The disturbance varies from moderate to severe scarification of the soil surface to extreme damage, creating mineral soil like conditions, in the area of the slash pile burns.

Soils/Ecological Sites (from General Soil Map of Coconino Co, May 1972):

Brolliar – Sponsellar Association

- Brolliar – cobbly or stony loam surface with clay loam or clay subsoil with basalt bedrock encountered at 30 to 60 inches
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Assistance Request:

The stated goal is to restore the native ground cover that was present prior to thinning. Assistance was requested to determine the necessary actions to take to minimize soil

Enclosure 1

erosion and prevent establishment of noxious weeds in the disturb areas. Specific items requested are:

1. Seed mix composition
2. Pounds of seed mix to apply
3. Best time of year to apply the seed mix
4. Application method for seed mix
5. Site preparation needs
6. Local vendors for seed mix

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On Wednesday, June 4, 2003 I met with Robert Palmer and Edie Jacobsen, Southwest Division, Naval Facilities Engineering Command and Mike McDonald, EnviroSystems Management, Inc. to observe the site, gather information, and discuss treatment options.

The extent of the subject disturbance was being mapped at the time of my visit. From this mapping the number of acres to be treated will be determined. Although most of the disturbance occurs on slope of less than 15 percent slope there are occasionally skid roads that occur on slopes greater than 15 percent. We discussed that placing a barrier, such as felled trees or limbs, across these roads would serve as water bars and inhibit vehicular traffic on these skid trails. We also observed an area where wood chippings had been originally piled and then spread. We felt the chip layer was too thick. Mr. Palmer provided me a list of plant species found on the observatory property. They requested only native species found on this list be considered for inclusion in a seeding mix.

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After the site visit I contacted Carolyn Hull Sieg, Research Plant Ecologist, USDA Forest Service Rocky Mountain Research Station, Flagstaff, Arizona. The following are highlights of that conversation.

- Seed only if deemed necessary to prevent soil erosion and/or invasion of noxious weeds.
- Ensure seed is weed free. This can be very hard to do, as she stated, most seed dealers will only certify seed to be 99 percent pure. She cautions even 1 percent weed content could prove detrimental.
- If possible, obtain seed from local source to prevent dilution of local gene pool.
- She has observed that often on skid trails incorporation and covering the soil surface with local pine needles eliminates the need to seed these areas.

- She felt it was very important that the slash pile burn areas either be treated with mulch and/or they be seeded. These areas have a high probability of invasion by weeds, with at least some of them being noxious weeds.
- She also suggested I reference a recent publication, *Ecological Restoration of Southwestern Ponderosa Pine Forests,* edited by Peter Friederici and printed by Island Press.

Recommendations:

- Establishment of vegetation on the disturb areas, skid trails, landings and slash pile burn areas, should be done as soon as practical to minimize soil erosion and prevent invasion by noxious weeds.
- Except in the most severely disturbed areas (slash pile burn areas and possibly landings) there most likely is adequate seed and/or plants that have survived to expect restoration of the natural ground cover without seeding. Carolyn Hull Sieg, as well as the publication *Ecological Restoration of Southwestern Ponderosa Pine Forests* suggests using local pine needles as a mulch to assist in the regeneration/recovery of the existing plants.
- In the slash pile burn areas and some of the landing areas it is unlikely there is adequate seed to allow these areas to recover without seeding. There also is a very high probability these areas would be invaded by weeds and noxious weeds such as Dalmatian toadflax, *Linaria genistifolia,* Mullein, *Verbascum thapsus*, Russian thistle, *Salsola iberica,* and others. These areas would also benefit from mulching with pine needles. The wood chips observed could also be used as mulch, but care should be taken to not cover the area with too much mulch. A mulch layer of less than 1 inch in depth is recommended.
- Ideally seed used should come from as locally as possible to ensure the seed is from plants that are locally adapted and to avoid potentially undesirable consequences of introducing foreign genetics. This may be impractical or impossible as collecting local seed is both difficult and expensive.
- Most likely seed will come from a commercial source. If at all possible require that the seed be certified as 100 percent weed free. This is also difficult and therefore I suggest that the seeded areas be monitored for a few years after seeding. Any weeds that may have been introduced with the seed should be removed immediately.
- The following is a suggested seeding mix. The species recommended are native species already found on the Naval Observatory property and are available commercially. I had originally also included two forb species, golden beard penstemon, *Penstemon barbatus*, and silverstem lupine, *Lupinus argenteus*, but these were not available this year due to low seed production last year. The seeding rate assumes the seed will be broadcast seeded and is double the suggested seeding rate for seeding with a drill. If a drill seeder is used this seeding rate may be reduced by one-half. Price quotes are from Granite Seed, Lehi, Utah.

Suggested Seeding Mix

Common Name	Scientific Name	Estimated Seeds/lb.	100% of Mix Seeding Rate Lbs./ac. (PLS)	Percent of Seeding Mix	Seeding Rate Lbs./ac. (PLS)	Planting Depth (in.)	Seeding Date	Approx. Cost/lb. ($)	Total Cost ($)
Arizona fescue	*Festuca arizonica*	550,000	2.0	50	**2.0**	0.5	Oct.	15 – 18	30 – 36
Prairie junegrass	*Koeleria cristata*	2,315,400	0.5	25	**.26**	0.5	Oct.	20 – 25	5.20 – 6.50
Bottlebrush squirreltail	*Elymus elymoides*	190,000	1.4	25	**.70**	0.5	Oct.	25 - 35	17.50 – 24.50
									52.70 – 67.00

Ecological Restoration of Southwestern Ponderosa Pine Forests, suggests planting one or more annual grains will aid understory recovery in severely disturb areas. The literature I referenced indicated barley, *Hordeum vulgare*, was least likely to persist for more than a year or two. To reduce any potential competition for moisture and nutrients, the following suggested seeding rate is much lighter than would be planted if it was being planted to harvest grain or for pasture.

Cover Crop

Common Name	Scientific Name	Estimated Seeds/lb.	100% of Mix Seeding Rate Lbs./ac. (PLS)	Percent of Seeding Mix	Seeding Rate Lbs./ac. (PLS)	Planting Depth (in.)	Seeding Date	Approx. Cost/lb. ($)	Total Cost ($)
Barley	*Hordeum vulgare*	12,500	7 – 10	100	7 – 10	0.5	Oct.	.30 - .35	2.10 – 3.5

Seedbed Preparation:

The soil surface should be left rough. Pits and holes of a rough surface tend to capture seeds and moisture and reduce wind velocity at the soil surface, thereby improving the environment for emerging seedlings. *Ecological Restoration of Southwestern Ponderosa Pine Forests* also states covering slash pile burn sites with a mixture of seeds and soil naturally inoculated with arbuscular mycorrhizae has been shown to promote revegetation more quickly than seeding directly on ashbeds. As stated earlier, mulching will also improve the environment for emerging seedlings.

Fertilization:

It is *not* recommended that the disturbed areas be fertilized. Fertilization appears to benefit weedy species more than the desired perennial grasses and forbs.

Treating steep sloped skid trails:

Felling trees, placing logs, scattering debris and mulching will help reduce the opportunity for soil erosion and improve the environment for emerging seedlings on the steep sloping skid trails. A copy of the contour log terrace standard drawing developed for the Rodeo-Chediski Fire rehabilitation is attached for reference.

Seed suppliers:

Granite Seed, Lehi, Utah – Ph. (801) 768-4422

Southwest Seed Inc., Dolores, Colorado – Ph. (800) 543-1279

Curtis and Curtis, Inc., Clovis, New Mexico – Ph. (505) 762-4759

Bamert Seed Company, Muleshoe, Texas – Ph. (806) 272-5506

Arkansas Valley Seeds, Inc., Rocky Ford, Colorado – Ph. (303) 254-7469

Horizon Seeds, Inc., Hereford, Texas – Ph. (806) 258-7288

Anderson Seed and Grain, Greeley, Colorado – Ph. (303) 356-7400

Additional sources of information:

Ecological Restoration of Southwestern Ponderosa Pine Forests edited by Peter Friederici and printed by Island Press.

Carolyn Hull Sieg, USDA Forest Service Rocky Mountain Research Station, Flagstaff Arizona, 2500 South Pine Knoll Drive, Flagstaff, Arizona 86001-6381. Ph. (928) 556-2151

Granite Seed catalog – http://www.graniteseed.com

Prepared by:

Steve Cassady
Rangeland Management Specialist
USDA – NRCS
Flagstaff Resource Support Team
1585 South Plaza Way, Suite 120
Flagstaff, Arizona 86001
Ph. (928) 774-2401x227
Email – steve.cassady@az.usda.gov

Attachment:

Figure 1 - Mexican Spotted Owl Observations Near the US Naval Observatory, Flagstaff AZ 1994-2003

(Original MSO observations were recorded by the quarter section in which they occurred.)

FIGURE 1

Appendix J: Arizona Game and Fish Department Standard Game Fence Specifications

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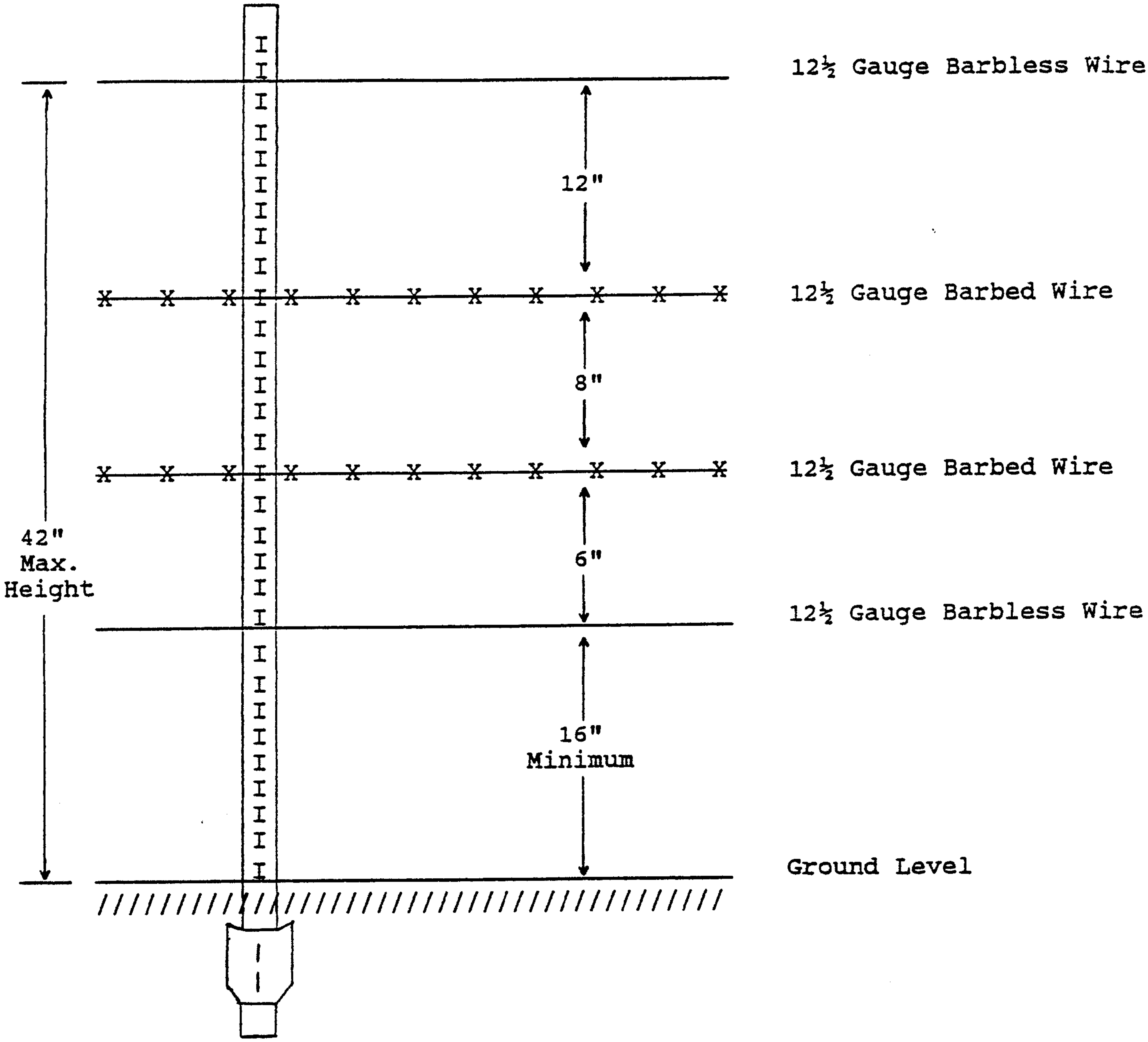
ARIZONA GAME AND FISH DEPARTMENT
STANDARD GAME FENCE SPECIFICATIONS



Additional Specifications:

- 20 - 25 feet between T-posts.
- At least 3 equally spaced stays between each post.
- Modifications to this design may be requested for fencing anticipated to be routinely encountered by elk, bighorn sheep or pronghorn.

Revised 11/93
Habitat Branch
DLW:RAC:rc

ARIZONA GAME AND FISH DEPARTMENT
STANDARD GAME FENCE SPECIFICATIONS

The following are fence specifications on cattle allotments intended to facilitate safe movements by wildlife.

Standard AGFD Recommended Fence Specifications.

Wire	Type	Position
1st	smooth	16" above ground
2nd	barbed	6" above bottom wire
3rd	barbed	8" above second wire
4th	smooth	12" above third wire

Total Fence Height - 42"

Additional Specifications: 20-25 feet between T-posts, with at least three equally spaced stays in between each post.

Most Important Specifications:
- total fence height
- height of bottom wire
- space between 3rd and 4th wire
- fence stays and spacing between posts
- smooth bottom wire

Negotiable Points:
- smooth top wire
- space between 2nd and 3rd wire
- space between 1st and 2nd wire
- total height up to 44"

Fence Specifications in Bighorn Sheep Range

Wire	Type	Position
1st	smooth	20" above ground
2nd	barbed	15" above bottom wire
3rd	smooth or barbed	4" above second wire

Total Fence Height - 39"

Burro Exclusion Fence Specifications in Bighorn Sheep Range

Wire	Type	Position
1st	rail	20" above ground
2nd	rail	16" above bottom rail
3rd	barbed	8" above second rail
4th	barbed	4" above third wire

- OR -

1st	rail	20" above ground
2nd	rail	16" above bottom rail
3rd	rail	6" above second rail

Total Fence Height - 42 - 48"

Fence Specifications for Pronghorn Habitat

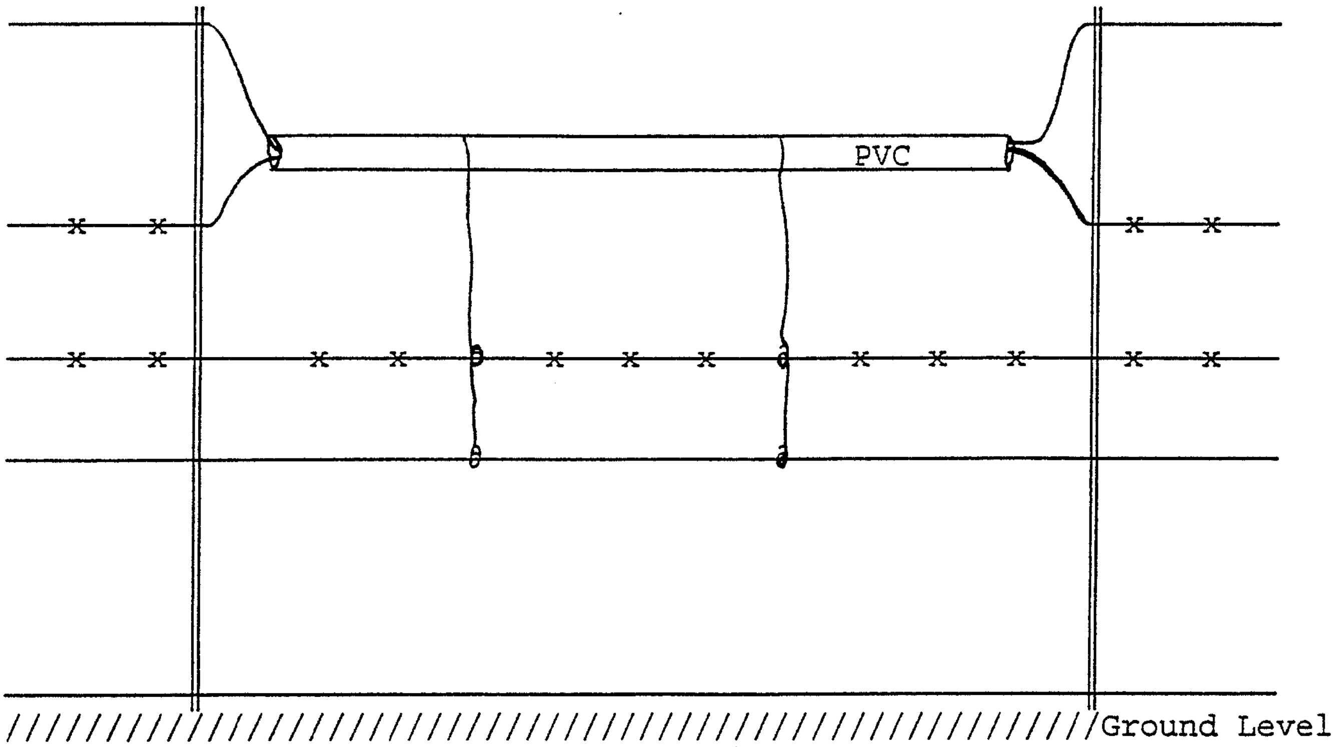
Wire	Type	Position
1st	smooth	16" above ground
2nd	barbed	14" above bottom wire
3rd	barbed	12" above second wire

Total Fence Height - 42"

Additional Specification: Sixteen to thirty feet between posts; no fence stays between posts that are less than 20 feet apart, only one stay between posts greater than 20 feet apart.

Note: The AGFD standard recommended fence is an adequate alternative. However, stays should be omitted, or reduced in number if deer are generally absent from the area.

ARIZONA GAME AND FISH DEPARTMENT
PVC FENCE CROSSING FOR ELK
April 11, 1994



Materials: 10' Length 1¼" or 1½" PVC
Boundary Fence
Wire Cutters
Leather Gloves

Instructions:

1. Remove fence stays between two primary fence posts.

2. Cut the top two wires approximately 18-24 inches from one of the primary posts.

3. Run both wires through the PVC. Then re-stretch and re-tie both wires.

4. Use smooth wire to form wire stays that hold down the PVC to the bottom two wires.

Notes: Time to install ≈ 10-15 minutes.
Cost ≈ $2.50-$5.00 for PVC.

Revised 4/11/94
Habitat Branch
BV:no

Appendix K: NOFS Forest Thinning Understory Restoration

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United States Department of Agriculture

NRCS Natural Resources Conservation Service

1585 South Plaza Way, Suite 120, Flagstaff, Arizona 86001-7156

Naval Observatory Flagstaff Station
Forest Thinning Understory Restoration

Site Description:

The subject area, located west of Flagstaff, Arizona in Township 21 N., Range 6 E., is within USDA – NRCS Land Resource Unit (LRU) D39-1, Mogollon Plateau Coniferous Forest (Rocky Mountain (Petran) and Madrean Montane Conifer Forests, Brown, David E., Biotic Communities, *Southwestern United States and Northwestern Mexico*). Precipitation ranges from 17 to 25 inches in this LRU with approximately 65 percent of the precipitation occurring as snow during the months of October through April. The remaining 35 percent occurs as monsoonal thunder showers between July and September. The mean annual temperature ranges from 42 to 46 degrees Fahrenheit (F). The frost-free period (air temperature > 32 degrees F ranges from 70 to 130 days.

A dense stand of ponderosa pine, *Pinus ponderosa*, has been thinned to improve forest health and reduce the potential for catastrophic fire. A small portion of the treated area has received severe disturbance to the understory species. These areas include skid trails, landings and slash pile burn areas. The disturbance varies from moderate to severe scarification of the soil surface to extreme damage, creating mineral soil like conditions, in the area of the slash pile burns.

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The stated goal is to restore the native ground cover that was present prior to thinning. Assistance was requested to determine the necessary actions to take to minimize soil erosion and prevent establishment of noxious weeds in the disturb areas. Specific items requested are:

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Fertilization:

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Treating steep sloped skid trails:

Felling trees, placing logs, scattering debris and mulching will help reduce the opportunity for soil erosion and improve the environment for emerging seedlings on the steep sloping skid trails. A copy of the contour log terrace standard drawing developed for the Rodeo-Chediski Fire rehabilitation is attached for reference.

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Granite Seed catalog – http://www.graniteseed.com

Prepared by:

Steve Cassady
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Flagstaff Resource Support Team
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Flagstaff, Arizona 86001
Ph. (928) 774-2401x227
Email – steve.cassady@az.usda.gov

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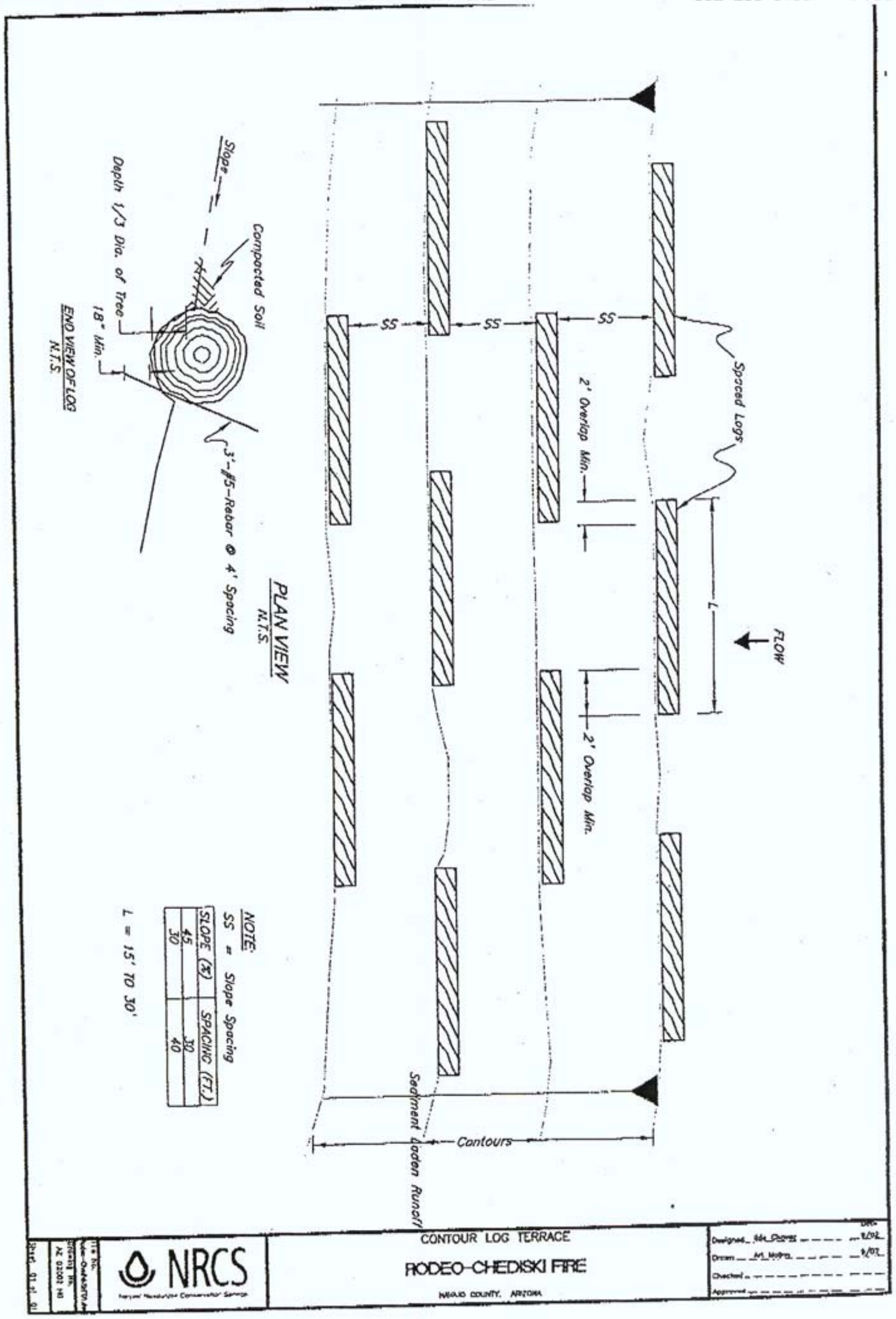
PLAN VIEW
N.T.S.
Spaced Logs
SS
2' Overlap Min.
FLOW
L
Slope
Compacted Soil
Depth 1/3 Dia. of Tree
18" Min.
END VIEW OF LOG
N.T.S.
3'-#5-Rebar @ 4' Spacing
NOTE:
SS = Slope Spacing
SLOPE (%) SPACING (FT.)
45 30
30 40
L = 15' TO 30'
Sediment Laden Runoff
Contours
NRCS
CONTOUR LOG TERRACE
RODEO-CHEDISKI FIRE
NAVAJO COUNTY, ARIZONA

Appendix L: Bat Management Information

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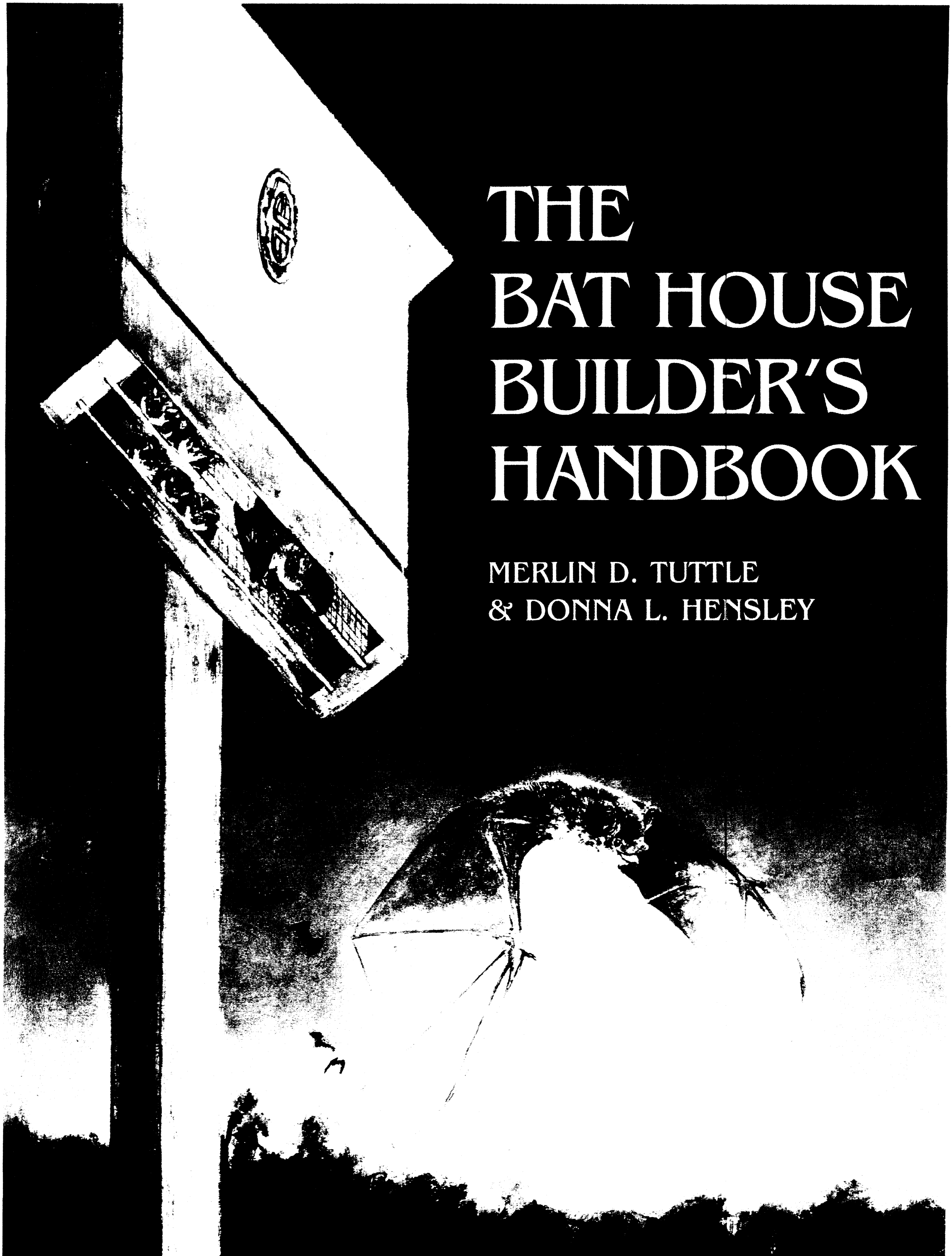


THE BAT HOUSE BUILDER'S HANDBOOK

MERLIN D. TUTTLE
& DONNA L. HENSLEY

Bat Conservation International
P.O. Box 162603, Austin, Texas 78716
www.batcon.org

Dear Friend:

Thank you for your interest in helping bats. By building even one bat house, you can make a difference for bats and help promote a healthy environment. And you can greatly multiply this accomplishment by participating either as a member of Bat Conservation International or as a volunteer Research Associate in the North American Bat House Research Project.

In addition to funding critical conservation efforts, BCI membership brings you our quarterly magazine, *BATS*, our catalog of educational and gift products, and opportunities to join workshops, field projects, and ecotours. Research Associates additionally share experiences with other bat house owners, receive special spring and fall updates on new discoveries, compete for small grants and awards, and help their own backyard bats.

Details and a convenient application form are provided in this handbook. We hope to hear from you soon.

Sincerely,

Merlin D. Tuttle
Founder

Cover artwork by Andrea Peyton

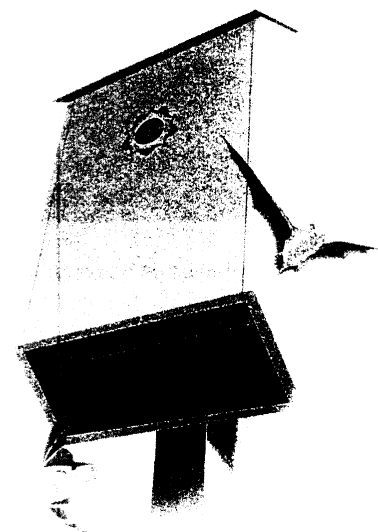
Back cover:
The spectacular sight of vast numbers of bats in flight across the evening skies used to be far more common. Many North American bats have lost key roosting habitat, from caves and abandoned mines to old growth forests. Erecting bat houses, and carefully observing the results, gives us a unique opportunity to help these magnificent animals. PHOTO BY MERLIN D. TUTTLE

A publication of Bat Conservation International, Inc. Printed on recycled paper.

ISBN 0-9638248-6-4 2001 Revision

The Bat House Builder's Handbook

CONTENTS



You can purchase copies of this handbook, the new *Building Homes for Bats* video, or sign up for the North American Bat House Research Project through the BCI catalog. Call 1-800-538-BATS (2287) or (512) 327-9721, or order online at www.batcon.org.

MARK AND SELENA KISER

Putting up a bat house is one of the more rewarding ways to help wildlife. A maternity colony of several hundred little brown myotis raised young in this back-to-back pair (one side shown) of nursery houses in British Columbia. Bat houses like these are now providing shelter for thousands of displaced bats in North America each year.

Why Build a Bat House?

AMERICA'S BATS ARE an invaluable natural resource. Yet, due to decades of unwarranted human fear and persecution, bats are in alarming decline. You can help by putting up a bat house. You will benefit from having fewer lawn and garden pests, and you will enjoy learning about bats and sharing your knowledge with friends and neighbors. Few efforts on behalf of wildlife are more fun or rewarding than helping bats.

As primary predators of night-flying insects, bats play a vital role in maintaining the balance of nature. As consumers of vast numbers of pests, they rank among humanity's most valuable allies. A single little brown myotis can catch hundreds of mosquitoes in an hour, and a typical colony of 150 big brown bats can protect local farmers from the costly attacks of 33 million rootworms each summer. Cucumber and June beetles, stink bugs, leafhoppers, and cutworm and corn earworm moths—all well-known pests—are just a few of the many insects known to be consumed by these frequent users of bat houses.

Although bat house building may someday contribute greatly even to saving endangered species, our first goal is to preserve America's most abundant bats in sufficient numbers to maintain nature's balance. Their loss contributes to growing demands for toxic pesticides that increasingly threaten our personal and environmental health.

Recent BCI research on bat houses documents substantial success and exciting potential for helping rebuild healthy populations of some of America's most valuable species. More importantly, it shows how slight modifications, often as simple as moving a house only a few feet higher or into slightly more or less sun, can substantially improve the odds of successful occupation by bats.

These results, combined with new knowledge of bat preferences, are very encouraging. However, there is still much we need to learn to consistently attract nursery colonies in a variety of climates. We also have much to learn about how best to meet the needs of individual species.

Participate in the North American Bat House Research Project

INSTALLING BAT HOUSES and making careful observations offers an excellent opportunity to learn more about bat roosting requirements. To encourage experimentation, BCI has established the North American Bat House Research Project. We invite bat house enthusiasts to make an important contribution to our understanding of bat roosting behavior by participating as active volunteer Research Associates in this long-term project.

Volunteer Research Associates Needed . . .

Even the most abundant bats of North America are rapidly losing roosting habitat. Although we know that at least 12 species are using bat houses, we need more information before we can consistently accommodate even these bats' needs. High priorities include learning more about preferred roost chamber dimensions for individual species and the effects of insulation and solar heating under various climactic conditions.

The amount of time each volunteer needs to commit will range from minimal to as much as you care to devote to the project. From spring to fall, depending on your area, you will be asked to make regular monthly inspections of your bat houses. In addition, it will be critical that you complete and return a simple data report to BCI the first year for each house erected and then a status follow-up at the end of each subsequent year.

Participants will receive complete instructions on how to begin conducting the experiments most needed in their areas along with report forms. The most important data on temperature preferences will result from erecting groups of at least two or three houses, but those who can erect only one house can also contribute valuable information about the incidence of occupancy when single versus multiple roost choices are available. Individuals unable to build their own bat houses may still participate by purchasing them from the BCI catalog. We strongly encourage those who have unoccupied bat houses to participate by moving them or making other appropriate changes and reporting the results.

Research Associates will receive *The Bat House Researcher*, a special biannual newsletter on bat house research progress. Also, participants will be able to use the project as a forum to share their experiences and exchange ideas with other Research Associates. Those who successfully attract bats (or who already have done so) and complete and return the data forms, will be eligible to compete for grants to conduct further experiments. In addition, special achievement awards will be made to those who contribute most to new knowledge.

The resources required to mount a national species-specific study of bat roosting needs are truly formidable. Establishing a special project fund by enlisting the participation of contributing volunteers will enable this important work to continue. The project fund supports the costs of phone and mail consultation with participants, data gathering, analysis, and reporting. It will also support small grants and awards to encourage successful participants to expand their research. The North American Bat House Research Project is open to current BCI members and to nonmembers.

Participation as a Research Associate in BCI's North American Bat House Research Project offers a unique opportunity to help your own backyard bats while sharing in the excitement and satisfaction of scientific discovery.

Your participation can yield important information. Please fill out the application included in this handbook and return it to BCI, North American Bat House Research Project, P.O. Box 162603, Austin, Texas 78716.

Designing Better Bat Houses

New research discoveries have greatly enhanced our ability to attract bats . . .

THROUGH THE North American Bat House Research Project, hundreds of new bat houses are tested each year. The designs illustrated on the following pages incorporate the most successful features thus far discovered. The correct bat house for you will depend on available tools and lumber, your skill as a carpenter, your budget, and your expectations. There are also many modifications you can make to your house(s) to adjust for location-specific factors such as climate and the preferences of local species.

Key Criteria for Successful Bat Houses

Design

The most successful bat houses are at least two feet tall, at least 14 or more inches wide, and have 3- to 6-inch landing areas extending below the entrances or recessed partitions with landing space inside. The number of roosting chambers is not critical. Single-chambered houses are often successful when mounted on wooden or stone buildings, which help to buffer temperature fluctuations. Houses with three or more chambers are more likely to provide appropriate ranges of temperature and better accommodate the larger numbers of bats typical of nursery colonies.

Our house sizes are a compromise between bat needs and builder convenience. For example, 17 1/2-inch widths for nursery houses enable builders to make two houses from a half sheet each of 3/8-inch and 1/2-inch plywood. This is the minimum amount stores will sell of either of the two required thicknesses and results in the least waste. Widths of up to 24 inches or more would likely be preferred by many bats. Greater heights are not typically necessary, but might be appreciated for their greater thermal gradients.

Roost partitions should be carefully spaced 3/4-inch to 1 inch apart—mostly 3/4-inch. Some small myotis and pipistrelle bats may prefer roosting crevices between 1/2-inch and 3/4-inch wide, while larger bats, such as big brown and pallid bats, may prefer 1-inch to 1 1/4-inch widths. Partitions and landing areas must be roughened. Wood surfaces can be scratched or grooved horizontally, at approximately 1/2-inch intervals, or covered with durable UV-resistant plastic mesh (1/8-inch or 1/4-inch mesh). We especially recommend plastic mesh of the type sold by Internet, Inc. (1-800-328-8456, product numbers XV-1670 or XV-1170). Mesh must be securely stapled down along all exposed edges and should not cover ventilation slots. It is attached to one side of each roost partition as well as to the landing area.

Ventilation slots are critically important in all houses to be used where average high temperatures in July are 85°F or above. They should be 1/2-inch wide to reduce entry of light and unwanted guests, such as birds. The front vent should extend from side to side about six inches above the bottom (for houses three feet or taller, approximately one-third the distance from the bottom). A vertical vent, 1/2-inch wide by six inches long, should be included at each end of the rear chamber of multiple-chamber houses. The vents greatly reduce the odds of overheating on extra hot days and especially contribute to success in moderate or hot climates. They may be unnecessary in exceptionally cool areas.

When nursery houses are mounted in back-to-back pairs (see Figure 2), an additional horizontal vent slot should be provided in the rear—just like the one in front, but 3/4-inch rather than 1/2-inch wide. This slot allows bats to move from one house to the other without exiting. Such an arrangement provides ideal temperature ranges for nursery colonies.

Construction

Half-inch plywood is ideal for fronts, backs, and roofs, while 1-inch board lumber is best for the sides. Use of 3/8-inch plywood for roosting partitions reduces overall bat house weight and enables more roosting space for a given house size. Do not use pressure-treated wood, as it contains chemicals which may be toxic to bats. Staples used to attach plastic mesh should not protrude from the far sides of panels and will last longer if they are exterior grade or galvanized. All seams must be caulked, especially around the roof, prior to painting. Latex caulk is easiest to use.

Wood treatment

Bats apparently like dry, non-drafty homes as much as we do, hence the need to carefully caulk and paint bat houses. Providing sufficient warmth without overheating is a key element in attracting bats. All outer surfaces, landing, and entry areas of bat houses should be painted or stained with one coat of primer followed by two coats of flat exterior, water-based paint or stain to protect against moisture, air leaks, and wood deterioration. Do not use oil-based products. Application of two coats of dark paint or stain to interior surfaces prior to assembly greatly extends the life span of the bat house and provides a darker interior. Available observations demonstrate that bat houses in cool climates need to absorb much more solar heat than those in hot climates. They should be black where average high temperatures in July are 85°F or less; dark (such as dark brown, gray, or green) where they are 85-95°F; medium where they are 95-100°F; and light or white where they exceed 100°F (see Figure 7 on page 17 for a map of recommended paint colors). Much depends upon the amount of sun exposure. Darker colors help absorb more heat from less sun.

Sun exposure

When choosing a bat house location, both sun exposure and heat absorption (according to house color) must be carefully considered. Too little sun exposure is the most important known cause of bat house failure, even in relatively hot climates as far south as Florida and Texas. Overheating, though a possibility, can be greatly reduced by use of ventilation slots (see "Design" section) that allow heat to build up above but not below. Ventilated houses allow bats to move vertically to find their preferred temperatures through daily and seasonal cycles, providing a wider margin for error in selecting appropriate sun exposure and color. Bats in nursery colonies like warm houses, ideally where temperature gradients cover at least a 10-15°F range, predominantly between 80° and 100°F, meaning that their roosts require solar heating in all but the hottest climates. The graph in Figure 1 illustrates the impact of solar heating on a black bat house by comparing internal bat house temperature with ambient outside temperature in a house occupied by a nursery colony of little brown myotis.

In areas where high temperatures in July average 80°F or less, houses should be black and receive at least 10 hours of daily sun; more hours may be better. Even in areas where high temperatures in July average less than 100°F, houses of appropriate color (see "Wood treatment" section) should receive at least six hours of direct daily sun.

When two houses are mounted back to back in pairs, attached at the sides, and covered by a tin roof

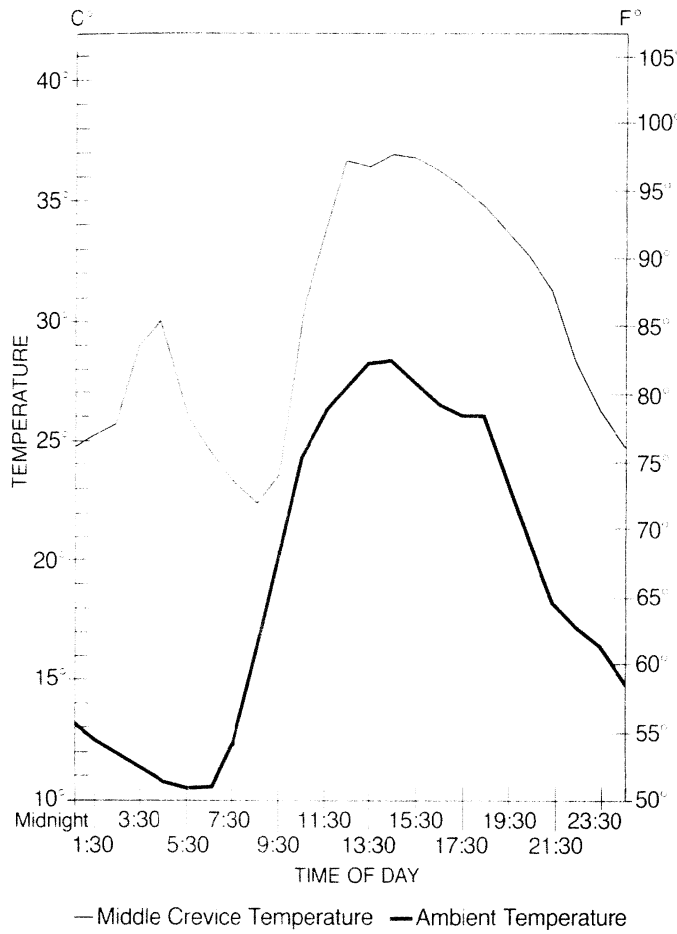


FIGURE 1

***This graph compares internal versus external temperatures over a 24-hour cycle at a bat house occupied by a nursery colony of little brown myotis in Pennsylvania. Temperatures in roosting crevices remained in the 80-100°F range for 16 hours of the daily cycle, falling below 80° only for eight hours in the morning. The house is similar to our nursery design and is vented, covered with black tar paper, and exposed to approximately seven hours of full sun each day.* (Courtesy, Lisa Williams, Pennsylvania Game Commission)**

(see Figure 2), solar heat gain is high early and late, but reduced by midday when overheating is most likely. A wide range of temperatures is provided between the house exposed to full sun and the one which is largely shaded by the other, in part because heat transfer is minimized by the fully ventilated area that remains between.

By roughening the backs of both houses and providing a 3/4-inch-wide horizontal ventilation slot in the rear of each, another roosting chamber is added, with access from either house or the sides. An exceptional temperature range is provided for bats to choose from, with

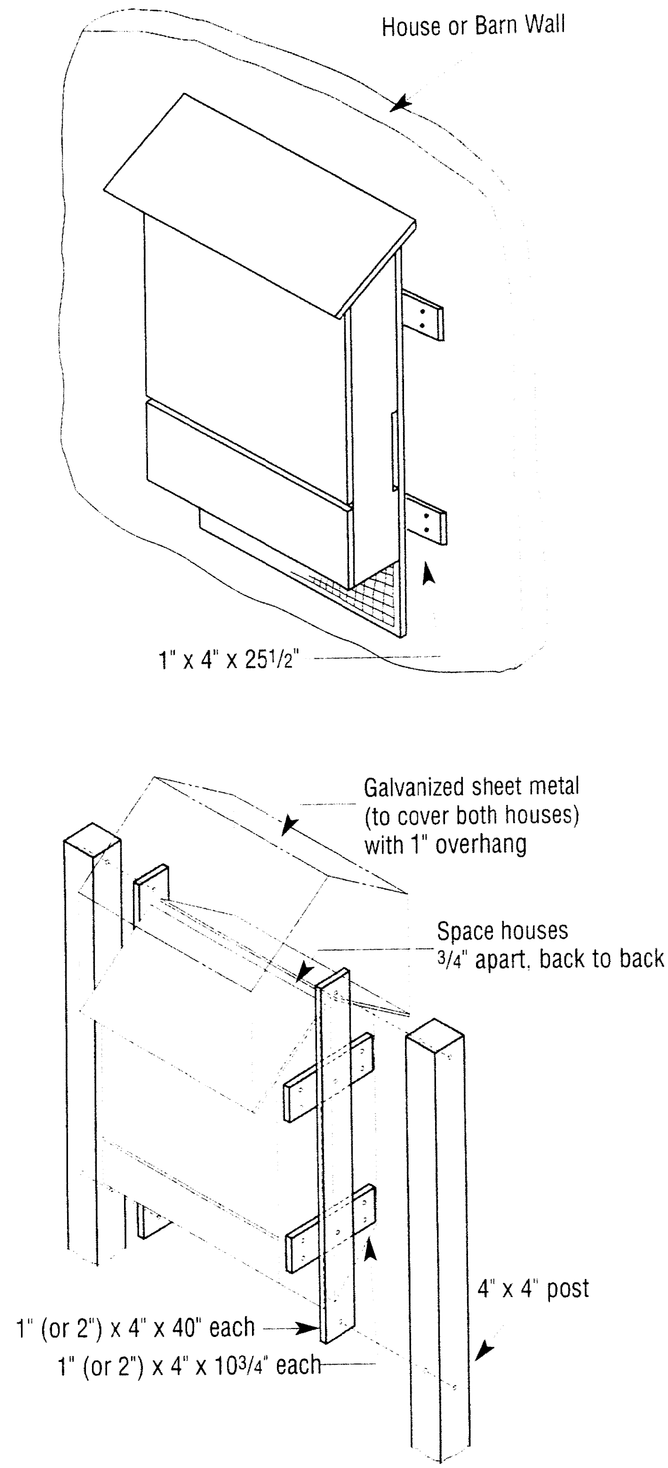


FIGURE 2

Nursery houses can be mounted independently on the side of a building or on a pole. However, when houses are mounted back to back in pairs, the space between can accommodate more bats and provides an especially well-ventilated area for use on hot days. The tin roof is optional, but aids greatly in protecting the houses from midday sun.

reduced danger of overheating. In climates where high temperatures in July average 100°F or more, extra protection can be provided by extending the overhang of the metal roof to lengthen the period of midday shade.

Habitat

Most nursery colonies of bats choose roosts within 1/4 mile of permanent fresh water, preferably a stream, river, or lake. Greatest bat house success has been achieved in areas of diverse habitat, especially where there is a mixture of differing agricultural use and natural vegetation.

Little brown and other myotis bats are most likely to use bat houses that are located nearest caves or abandoned mines that provide suitable overwintering habitat. In contrast, big brown bats can hibernate in buildings, cliff-face crevices, and other non-cave locations; Mexican free-tailed and evening bats migrate south for winter. Bat houses are also more likely to succeed in areas where bats are most frequently found in buildings, particularly where bats have been excluded from buildings.

Mounting

Bats find houses mounted on poles or buildings more than twice as fast as those on trees. Trees may be less preferable, in part, because tree-mounted houses tend to receive less sun and may be more vulnerable to predators. Houses mounted under the eaves on wood or stone buildings, but still exposed to the sun, tend to be better protected from rain and predators and have been especially successful.

Nursery colonies of up to 600 bats have been attracted to pairs of nursery houses mounted back to back, 3/4-inch apart on poles, both covered by a tin roof (see Figure 2). Generally, bat houses should be mounted 12-20 feet above ground, though 10-12 feet may suffice. The best locations are along the borders of streams, rivers, or lakes or along a forest edge, because these are natural bat flyways.

Protection from predators

Safety from predators appears to be a key factor in bat choice, and houses mounted on sides of buildings or high up on poles provide the best protection. The largest colonies attract the most predators and therefore require the greatest height. Locations at least 20-25 feet from trees reduce obstructions and predation and may receive more necessary sunlight.

In areas where climbing snakes or raccoons occur, it may be necessary to purchase predator guards from a supplier of purple martin house products. You may make your own guards by tightly covering the upper end of a 2-foot section of 10-inch-diameter galvanized stove pipe with 1/4-inch hardware cloth, allowing a hole in the middle for a bat house pole. Place one such predator guard around each pole about four feet above the ground. You may further thwart climbing invaders by occasionally oiling the exterior metal. Snakes typically attempt to climb the inner pole to the screen and give up. If bats suddenly disappear at a time when they traditionally have been present, the most likely culprits are rat snakes, though other predators can have the same effect.

Avoiding uninvited guests

Houses with open bottoms are far less likely to be occupied by birds, mice, squirrels, or parasites, and they do not require removal of accumulated droppings. Wasps do not normally cause problems once bat colonies move into bat houses. Paper wasps, the ones with painful stings, rarely build nests in 3/4-inch spaces. If they begin to build a nest at a house entrance, they can be discouraged with blasts of water from a high pressure hose before their workers emerge. Mud daubers are seldom aggressive and have weak stings. If their nests accumulate prior to bat occupancy, just scrape or hose them out in the fall or winter.

Importance of local experimentation

We have much to learn about the needs of individual bat species in differing climates. It is important to test for local needs before putting up more than a few houses, especially comparing different sun exposures and shades of a color for heat absorption.

To determine the temperature needs of local bats, check to see what colors and sun exposures are recommended. Then try mounting two houses side by side on a building where they receive similar sun, but paint one darker than the other to see which one the bats prefer. Alternatively, paint one pair of pole-mounted houses darker than another pair, or extend the roof to provide more shade. Finally, when bats move in, observe their behavior to see which house or pair of houses they prefer during temperature extremes through a daily or seasonal cycle. Their choices will provide important clues to their needs, enabling you to enjoy improved success with future houses.

Ideas for the future

NUMEROUS IDEAS REMAIN to be tried. If you're an inventor, don't let our design suggestions interfere with your imagination. Do remember that temperature, a secure gripping surface, and safety from predators are all important for bats, as well as proximity to ample food and water.

So far, we have attempted to accommodate only crevice-roosting species with the three designs shown in this handbook. Other bats may prefer different designs altogether, such as long narrow tubes or much larger roost chamber dimensions. Endangered Indiana bats, and many other species, roost under exfoliating tree bark in the summer. Success in attracting such bats may be as simple as encircling a tree trunk with a 24- to 36-inch piece of sheet metal, plastic, fiberglass, or tar paper. Attach it as tightly as possible at the top, allowing it to flare out an inch or two at the bottom. Corrugated sheet metal, wrapped around trees to protect wood duck nesting boxes from predators, has proved highly successful in attracting nursery colonies of little brown myotis. Bats apparently move around the trunk to find the needed amount of solar heating.

In lowland desert areas, where bats have difficulty finding roosts that are cool enough, you might try making bat houses out of lightweight mixtures of concrete. Such houses, thus far used only in Europe, may be especially well adapted to meet the needs of bats that roost in desert rock crevices. Concrete houses can be formed to provide a central crevice with an open bottom. Successful houses have even been constructed from 1/4-inch plastic conduit material. One nursery house design, made entirely of plastic, with 1/4-inch plastic mesh roosting partitions, has attracted up to 500 Mexican free-tailed bats in Texas. Provision of 3/4-inch vent holes, covered with plastic shields to block light, were essential to success. When using any white or light-colored material in construction, the interior should be painted or stained black to ensure the darkness that bats prefer.

Most European bat houses are built with bottoms; however, these require regular cleaning and harbor more parasites than those with open bottoms. An average painted bat house may last for 10 years or more, considerably longer than most people today remain in one place. By using open-bottom designs, even bat houses abandoned by their builders will remain available to bats for a long time.

Although much remains to be learned, it is encouraging that even the less sophisticated bat houses, mounted singly and without plastic mesh on the partitions, already are averaging more than 80 percent occupancy when ideally located relative to solar exposure and habitat. We strongly encourage you to experiment and become an active participant in BCI's North American Bat House Research Project.

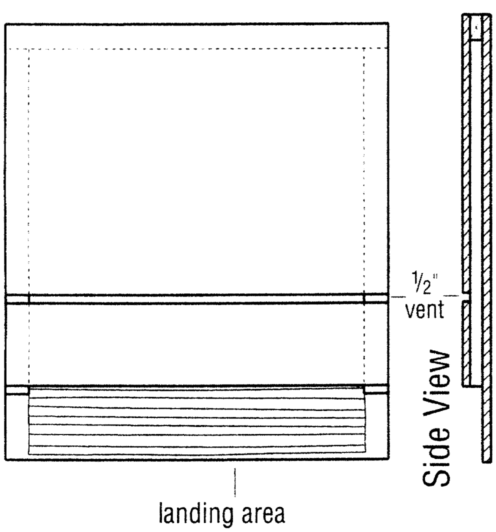
SMALL ECONOMY BAT HOUSE

Materials Needed (makes 1)

1/4 sheet (2' x 4') 1/2" cdx (outdoor grade) plywood
One piece 1" x 2" (3/4" x 1 3/4" finished) x 8' pine (furring strip)
20-30 1 1/4" coated deck or exterior-grade Phillips screws
One pint black, water-based stain, exterior-grade
One pint water-based primer, exterior-grade
One quart flat water-based paint or stain, exterior-grade
One tube paintable latex caulk
1" x 3" x 28" board for roof (optional, but highly recommended)
Black asphalt shingles or galvanized metal (optional)
6-10 7/8" roofing nails (optional)

Recommended tools

table saw or handsaw	caulking gun
variable speed reversing drill	paintbrushes
Phillips bit for drill	scissors (optional)
tape measure or yardstick	staple gun (optional)



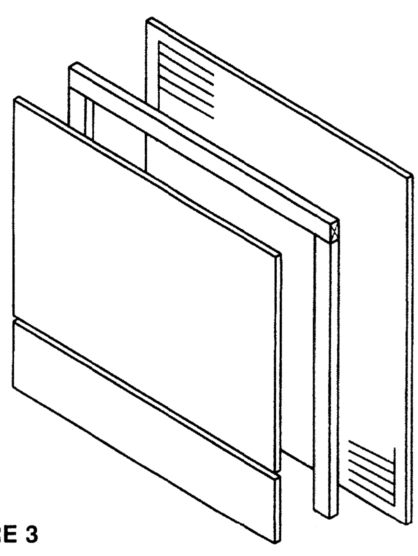


FIGURE 3

Construction procedure

1. Measure and cut plywood into three pieces:
   26 1/2" x 24"   16 1/2" x 24"   5" x 24"
2. Roughen inside of backboard and landing area by cutting horizontal grooves with sharp object or saw. Space grooves about 1/2" apart, cutting 1/16" to 1/32" deep.
3. Apply two coats of black, water-based stain to interior surfaces. Do not use paint, as it will fill grooves, making them unusable.
4. Measure and cut furring into one 24" and two 20 1/4" pieces.
5. Attach furring strips to back, caulking first. Start with 24" piece at top. Roosting chamber will be 3/4" wide (front to back).
6. Attach front to furring strips, top piece first (don't forget to caulk). Leave 1/2" vent space between top and bottom front pieces.
7. Caulk around all outside joints to further seal roosting chamber.
8. Attach a 1" x 3" x 28" board to the top as a roof (optional, but highly recommended).
9. Paint or stain exterior three times (use primer for first coat).
10. Cover roof with shingles or galvanized metal (optional).

Optional Modifications to the Small Economy Bat House

1. Wider bat houses can be built for larger colonies. Be sure to adjust dimensions for back and front pieces and ceiling strip. A 3/4" support spacer may be required in the center of the roosting chamber for bat houses over 24" wide to prevent warping.
2. Two bat houses can be placed back to back, mounted on poles. Before assembly, a horizontal 3/4" slot should be cut in the back of each house about 9" from the bottom edge of the back piece to permit movement of bats between houses. Two pieces of wood, 1" x 4" x 4 1/4', screwed horizontally to each side, will join the two boxes. To provide additional roosting space, leave a 3/4" space between the two houses, and roughen the wood surfaces or cover the back of each with plastic mesh. (Do not cover the rear exit slots; see item 4 below). One 1" x 4" x 34" vertical piece, attached to each side over the horizontal pieces, blocks light but allows bats and air to enter. A galvanized metal roof, covering both houses, protects the center roosting area from rain. Eaves should be about 3" in southern areas and about 1 1/2" in the north.
3. Ventilation may not be necessary in cold climates. In this case, the front should be a single piece 23" long. Smaller bat houses will be less successful in cool climates. However, those mounted on buildings gain heat faster, maintain thermal stability better, and are more likely to attract bats.
4. Durable plastic mesh can be substituted for roughening to provide footholds for bats. Attach one 20" x 22 1/2" piece to backboard after staining interior, but prior to assembly. See page 13 for details.

LARGE ECONOMY BAT HOUSE

Materials Needed (makes 1)

1/2 sheet (2' x 8') 1/2" cdx (outdoor grade) plywood
Two pieces 1" x 2" (3/4" x 1 3/4" finished) x 8' pine (furring strips)
40-50 1 1/4" coated deck or exterior-grade Phillips screws
One pint black, water-based stain, exterior-grade
One quart water-based primer, exterior-grade
One quart flat water-based paint or stain, exterior-grade
One tube paintable latex caulk
1" x 3" x 28" board for roof (optional, but highly recommended)
Black asphalt shingles or galvanized metal (optional)
6-10 7/8" roofing nails (optional)

Recommended tools

table saw or handsaw	caulking gun
variable speed reversing drill	paintbrushes
Phillips bit for drill	scissors (optional)
tape measure or yardstick	staple gun (optional)

Construction procedure

1. Measure and cut plywood into three pieces:
   51" x 24" 33" x 24" 12" x 24"
2. Roughen inside of backboard and landing area by cutting horizontal grooves with sharp object or saw. Space grooves about 1/2" apart, cutting 1/16" to 1/32" deep.
3. Apply two coats of black, water-based stain to interior surfaces. Do not use paint, as it will fill grooves, making them unusable.
4. Measure and cut furring into one 24" and two 43 3/4" pieces.
5. Attach furring strips to back, caulking first. Start with 24" piece at top. Roosting chamber will be 3/4" wide (front to back).
6. Attach front to furring strips, top piece first (don't forget to caulk). Leave 1/2" vent space between top and bottom front pieces.
7. Caulk around all outside joints to further seal roosting chamber.
8. Attach a 1" x 3" x 28" board to the top as a roof (optional, but highly recommended).
9. Paint or stain exterior three times (use primer for first coat).
10. Cover roof with shingles or galvanized metal (optional).

Optional Modifications to the Large Economy Bat House

1. Wider bat houses can be built for larger colonies. Be sure to adjust dimensions for back and front pieces and ceiling strip. A 3/4" support spacer may be required in the center of the roosting chamber for bat houses over 24" wide to prevent warping.
2. Two bat houses can be placed back to back, mounted on poles. Before assembly, a horizontal 3/4" slot should be cut in the back of each house about 16" from the bottom edge of the back piece to permit movement of bats between houses. Two pieces of wood, 1" x 4" x 4 1/4", screwed horizontally to each side will join the two boxes. To provide additional roosting space, leave a 3/4" space between the two houses, and roughen the wood surfaces or cover the back of each with plastic mesh. (Do not cover the rear exit slots. See item 4 below). One 1" x 4" x 57" vertical piece, attached to each side over the horizontal pieces, blocks light but allows bats and air to enter. A galvanized metal roof, covering both houses, protects the center roosting area from rain. Eaves should be about 3" in southern areas and about 1 1/2" in the north.
3. Ventilation may not be necessary in colder climates. In this case, the front should be a single piece 45" long. *Smaller* bat houses will be less successful in cool climates. However, those mounted on buildings gain heat faster, maintain thermal stability better, and are more likely to attract bats.
4. Durable plastic mesh can be substituted for roughening to provide footholds for bats. Attach one 20" x 49" piece to backboard after staining interior, but prior to assembly. See page 13 for details.

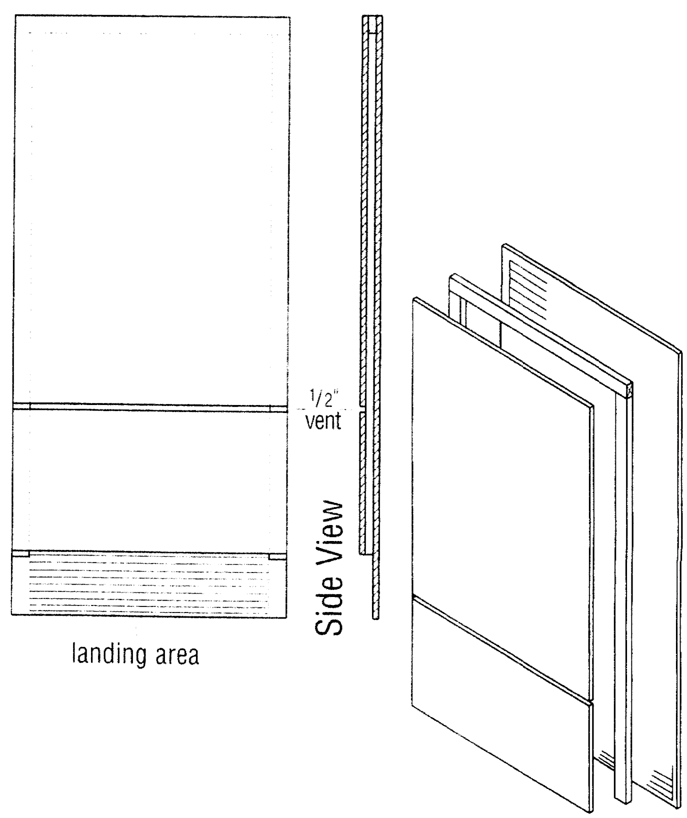


FIGURE 4

NURSERY HOUSE

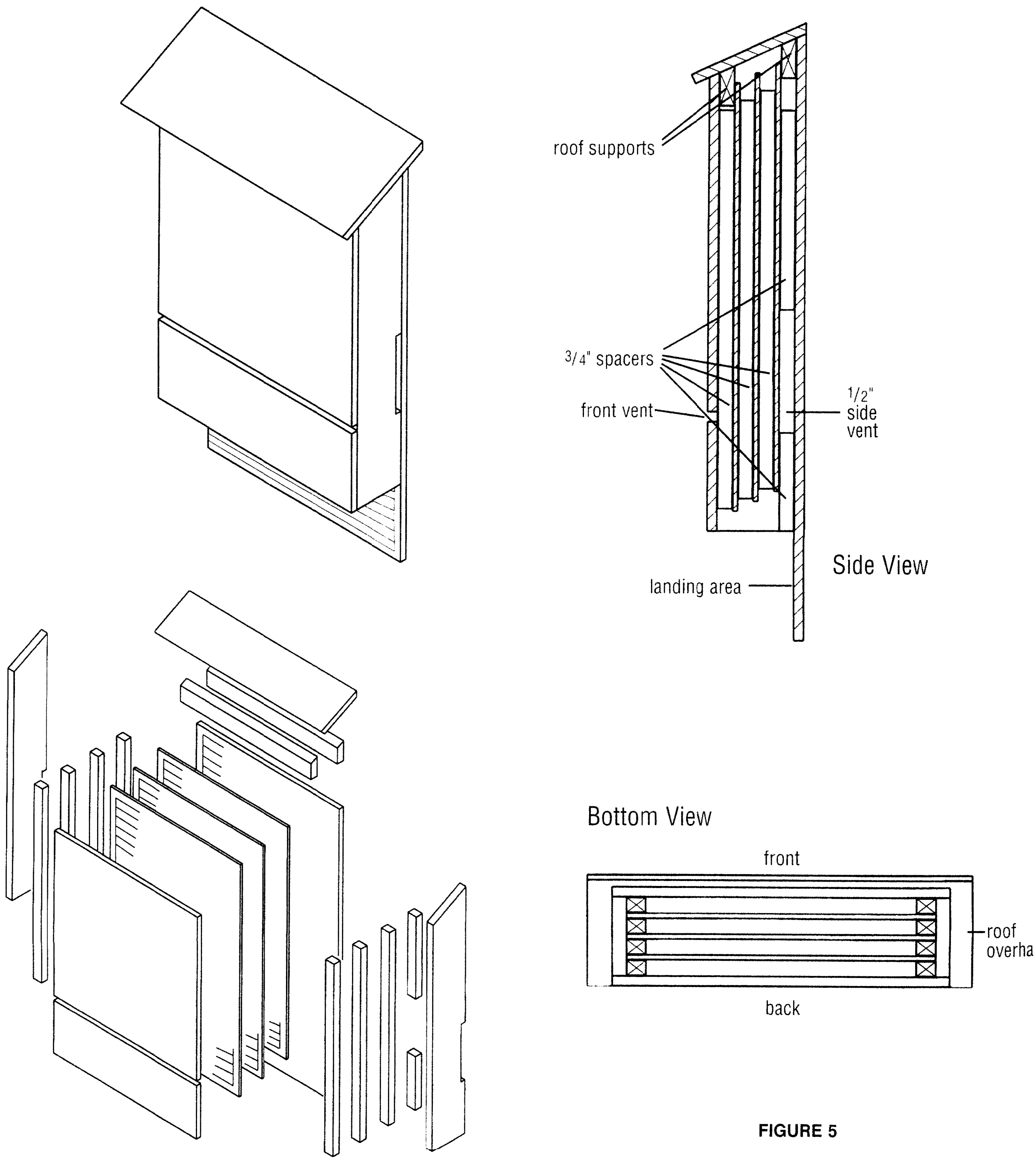


FIGURE 5

NURSERY HOUSE

Materials Needed (makes 2)
See diagrams on pages 14 & 15

1/2 sheet (4' x 4') 1/2" cdx (outdoor grade) plywood
1/2 sheet (4' x 4') 3/8" cdx (outdoor grade) plywood
Two pieces 1" x 6" (3/4" x 5 1/2" finished) x 8' pine or cedar
One lb. 1 5/8" coated deck or exterior-grade Phillips screws
20-25 1 1/4" coated deck or exterior-grade screws
One quart black, water-based stain, exterior-grade
One quart water-based primer, exterior-grade
Two quarts flat water-based paint or stain, exterior-grade
One tube paintable latex caulk
Black asphalt shingles or galvanized metal
12-20 7/8" roofing nails

Recommended Tools

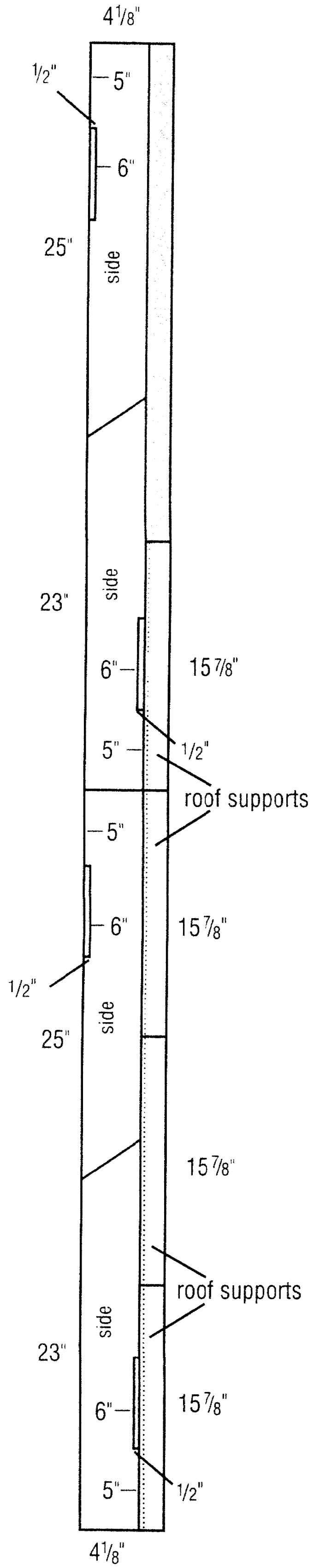
table saw	paintbrushes
variable speed reversing drill	scissors (optional)
Phillips bit for drill	staple gun (optional)
tape measure or yardstick	bar clamp (optional)
caulking gun	sander (optional)

Construction Procedure

1. Measure, mark and cut out all wood per sawing diagrams on page 14 & 15.
2. Roughen interior and landing surfaces by cutting horizontal grooves with sharp object or saw. Space grooves approximately 1/2" apart, cutting 1/16" to 1/32" deep.
3. Apply two coats of black, water-based stain to interior surfaces. Do not use paint, as it will fill grooves, making them unusable.
4. Attach side pieces to back, caulking first. Make sure top angles match.
5. Attach 5" and 10" spacers to inside corners per drawings on page 12. Roosting chambers will be 3/4" wide (front to back). Do not block side vents.
6. Place 1st roosting partition on spacers within 1/2" of roof. Place 20" spacers on partition, screw to first spacers (through partition).
7. Repeat step 6 for remaining spacers and partitions.
8. Attach front to sides, top piece first (caulk seams). Be sure top angles match (sand if necessary). Leave 1/2" vent space between top and bottom front pieces. A bar clamp may be useful if sides have flared out during construction.
9. Attach roof supports to the top inside of front and back pieces. Be careful that screws do not protrude into roosting chambers.
10. Caulk around all top surfaces, sanding first if necessary to ensure good fit with roof.
11. Attach roof to sides and roof supports. Caulk around roof and side joints to further guard against leaks and drafts.
12. Paint or stain exterior three times (use primer for first coat).
13. Cover roof with shingles or galvanized metal.

Optional Modifications to the Nursery House

1. Nursery house dimensions provided here were chosen to permit construction of two bat houses per half-sheet of plywood. Increasing house width to 24" or more, or adding partitions, benefits bats and attracts larger colonies. Additional spacers may be required to prevent warping of roost partitions for houses over 24" wide.
2. Taller bat houses provide improved temperature gradients and may be especially useful in climates where daily temperatures fluctuate widely. Bat houses 3' or taller should have the horizontal vent slot 12" from the bottom of the roosting chambers
3. Longer landing areas (up to 12") can be substituted, but they should still be roughened (or covered with plastic mesh. see item 6 below).
4. Two bat houses can be placed back to back mounted on poles. Before assembly, a horizontal 3/4" slot should be cut in the back of each house about 10" from the bottom edge of the back piece to permit movement of bats between houses. Two pieces of wood, 1" x 4" x 10 3/4", screwed horizontally to each side, will join the two boxes. Leave a 3/4" space between the two houses, and roughen the wood surfaces, or cover the back of each with plastic mesh. One 2" x 4" x 40" vertical piece, attached to each side, over the horizontal pieces, blocks light but allows bats and air to enter. Use a 2" x 6" vertical piece if securing houses with U-bolts to metal poles. A galvanized metal roof, covering both houses protects them and helps prevent overheating. Eaves should extend about 3" in front in southern areas and about 1 1/2" in the north.
5. Ventilation may not be necessary in cold climates. In this case, the front of the bat house should be a single piece, 23" long. Far northern bat houses may also benefit from a partial bottom to help retain heat. Slope sides and bottom at a 45° or greater angle to reduce guano build-up. Leave a 3/4" entry gap at the back, and be sure the bottom does not interfere with access to the front crevices. A hinged bottom and regular cleaning are required.
6. Durable plastic mesh can be substituted for roughening. Attach mesh to backboard, landing area, and one side of each partition after staining interior, but prior to assembly. Use 1/8"- or 1/4"-inch HDPE plastic mesh [such as Internet product #XV-1670 (call 1-800-328-8456)] and attach every two inches with 5/16" Monel® or stainless steel staples.



1" x 6" x 8' board

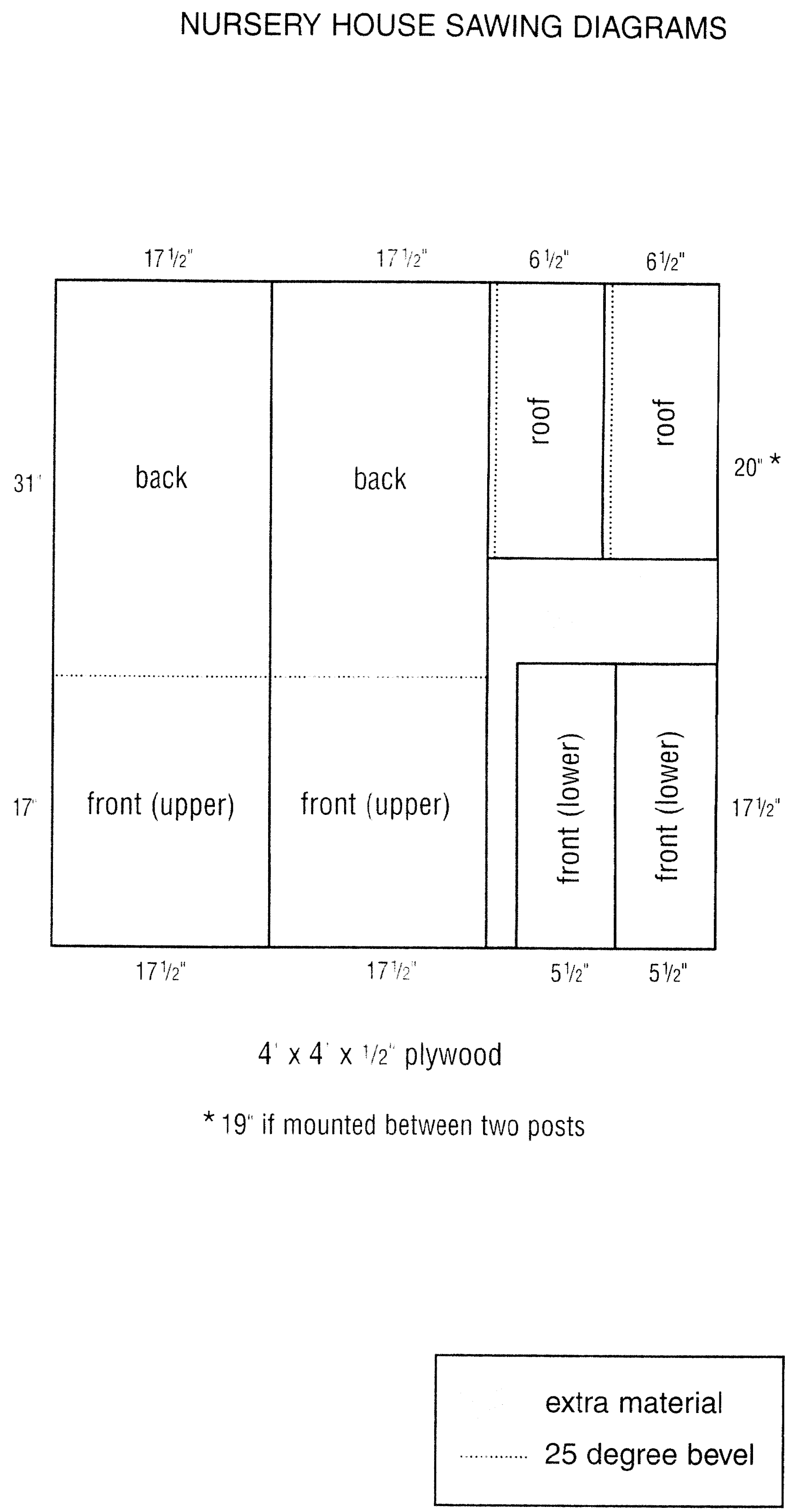
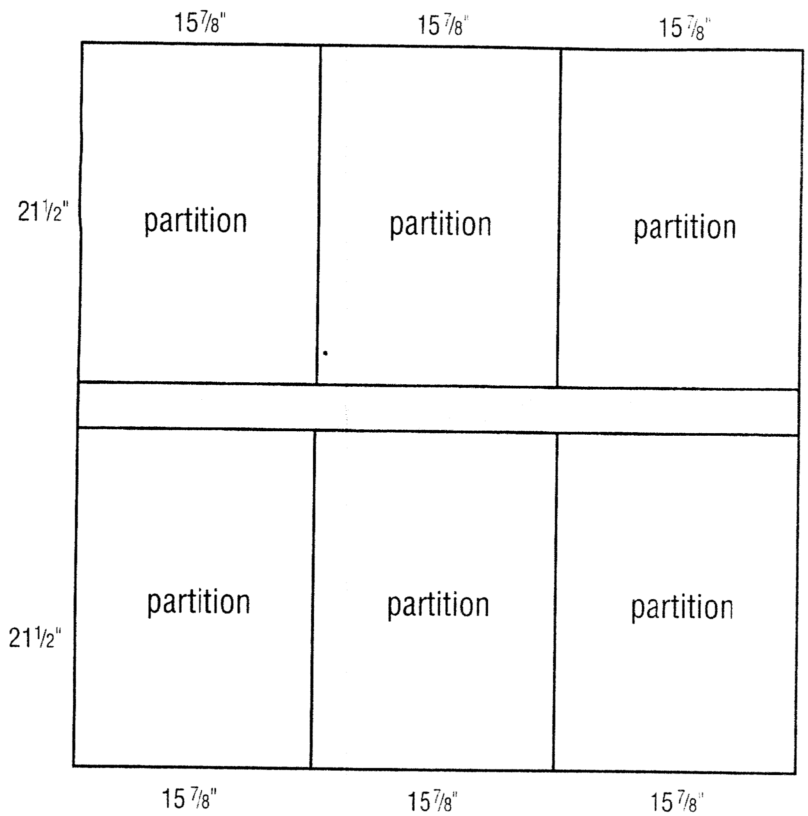
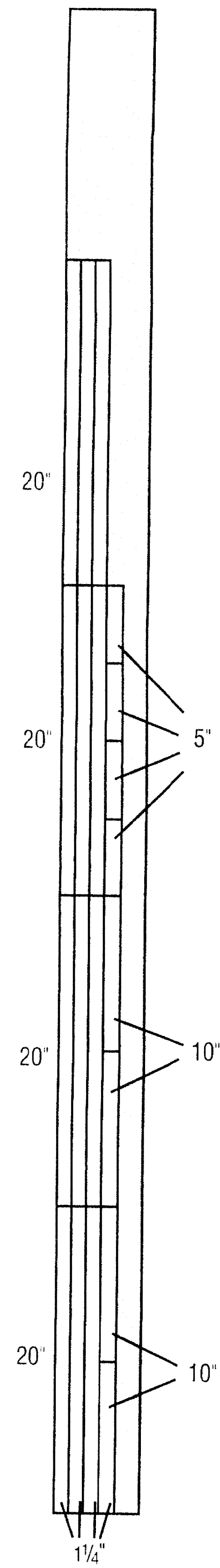


FIGURE 6



4' x 4' x 3/8" plywood



spacers:
5" spacers = back bottom
10" spacers = back top
20" spacers = others

1" x 6" x 8' board

A Few Pointers for Bat House Experimenters

Attention to seemingly small details can make a big difference to bat house success . . .

• *Bat house success* is dramatically enhanced when houses are: 1) caulked and painted to be airtight and watertight; 2) colored and hung to best meet local needs for solar heating; 3) mounted 12-20 feet or higher on buildings or poles at least 20-25 feet from the nearest trees; 4) located near rivers, lakes, or ponds, especially along water or forest edges or in areas where varied agriculture is mixed with natural habitat. Small commercial houses are often poorly designed for bats and sold without instructions, greatly reducing overall success. However, people who build their own houses and carefully locate them according to the instructions provided here are achieving high levels of success (see "The Secrets of Bat House Success," page 18).

• *Local testing* is required before putting up large numbers of bat houses in any new area. Temperature is a critical consideration. First tests can be accomplished by: 1) mounting houses in pairs on buildings, one darker, the other lighter; 2) varying the amount or timing of exposure to heating from the sun; 3) comparing pole-mounted back-to-back pairs in darker versus lighter shades of a color or with longer and shorter roof overhangs to vary solar heating; 4) orienting pairs on poles to increase temperature ranges by facing them north/south or to facilitate greater stability by facing them east/west.

• *First occupancy*, in the majority of successful bat houses, occurs in the first new summer season after placement, meaning that houses put up in fall or winter are most likely to be used during the next summer. Recently, about 63% of all reported houses that were up for one year or more have attracted bats. Nursery colonies often begin with just one or a few individuals the first season, greatly expanding over the next several seasons.

• *Cleaning* of open-bottomed houses is unnecessary unless mud dauber nests accumulate.

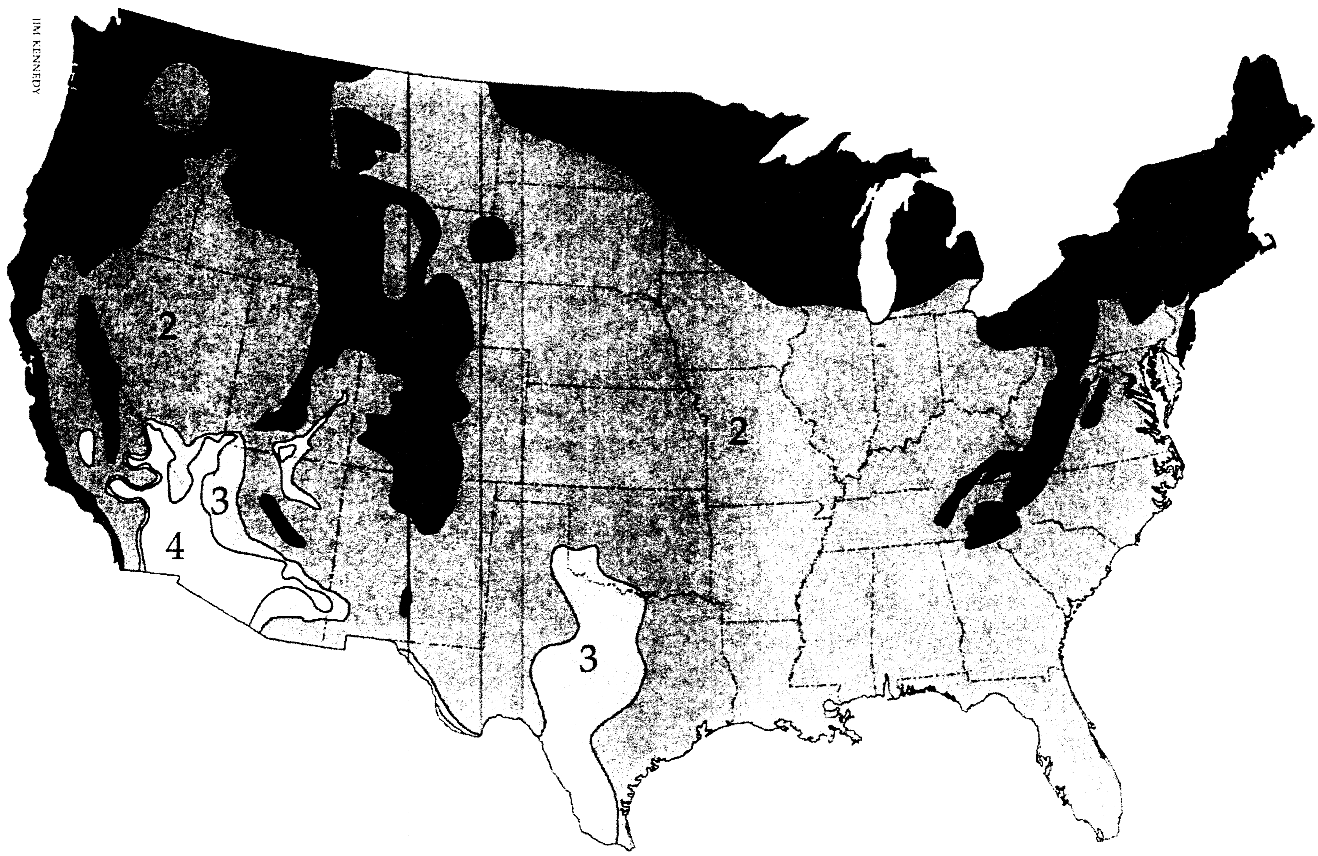
• *Maintenance* should not be needed for the first several years for houses that have been carefully caulked and painted before being put up. However, eventual recaulking and painting may be necessary and should be done during the off-season when bats are not present. Drafty houses may be abandoned if not repaired.

• *Annual use cycles* may range from just a few weeks to entire summers in cool climates. In warmer southern areas, such as Florida and Texas, bats may use houses from February to November or even year-round. In all but the warmest climates, bats probably will begin arriving in April or May, sometimes not until early June, and may depart anytime from July to October. Use patterns are typically repeated from year to year. Sometimes annual use periods can be greatly extended by providing better temperature ranges, warmer or cooler houses, or several houses close together.

• *Observing roosting bats* is quite simple if you shine a bright light up into the open bottom. For houses mounted high up, you may need to have someone shine a light while you look with binoculars. Make observations as brief as possible at first to avoid disturbance. Once a colony is established, bats typically are quite tolerant of people looking at them as long as you do not touch the mounting poles or houses and do not shine bright lights for more than 10 seconds.

• *Counting bats* may be relatively easy by simply looking inside if there are just a few, but when larger colonies become established the only reasonably accurate method is to count them emerging at dusk. To determine if you have a nursery colony, briefly look inside after the adults emerge. Young are always left behind over a roughly 3-week period until they learn to fly, normally in June in moderate climates, May in the warmest, and July in the coolest.

Bat House Color Recommendations and Average Daily High Temperatures in July



1) Dark areas: less than 85° F. Recommend black paint.

2) Medium areas: 85°-95° F. Recommend dark shade of paint.

3) Light areas: 95°-100° F. Recommend medium shade of paint.

4) Lightest areas: 100° F or greater. Recommend light shade of paint.

FIGURE 7

Years of research have shown that bat houses are far more successful at attracting bats if they are painted or stained. Painting helps provide the proper internal temperature for bats and also increases the life span of the bat house. Appropriate color depends upon geographic location and amount of sun exposure. At least six hours of direct daily sun are recommended for all bat houses where daily high temperatures in July average less than 100° F. Houses where high temperatures in July average 80° F, or less, should receive 10 hours of sun. Adjust to darker colors for less sun. Use exterior-quality, water-based stain or latex paint, and choose flat paint rather than gloss or semi-gloss paint for best solar absorption.

• *Testing bat needs* is relatively easy once even a few move into one of your houses. Provide them nearby houses with more or less sun, darker or lighter color, improved landing areas, rougher climbing surfaces, paired houses with greater temperature ranges, etc. Careful observations of daily and seasonal movements within and between houses during cool versus hot periods can provide vital knowledge about how best to help your local bats, and by sharing such information, you can contribute greatly to progress.

The Secrets of Bat House Success

MERLIN D. TUTTLE

MERLIN D. TUTTLE

SINCE BAT CONSERVATION INTERNATIONAL first popularized bat houses in the early 1980s, thousands have been erected in backyards, parks, and forests all across America. Yet nothing in the history of bat conservation efforts has generated more controversy. Claims and counterclaims over whether bat houses work too often have been based only on limited local observations. As a result, many erroneous conclusions have been reached about the overall success or failure of bat houses. We now know a great deal more, thanks to the many BCI members and Research Associates who are testing and reporting bat house use under a wide variety of conditions and geographical locations.

To evaluate the rate of bat house occupancy and why bats prefer some houses over others, in 1992 BCI conducted a comprehensive survey of 420 people in 26 states in the United States and one province in Canada who had built or purchased one or more bat houses. Some of the results were surprising, opening the door for further experimentation. But the most encouraging news is how successful bat houses really are: 52 percent of the houses in our survey attracted bats (study details begin on page 24). The survey also enabled us to quantify roosting preferences over broad geographical areas for the first time.

It is clear from this study that when bat houses are placed to meet bat needs, occupancy success is high. Taking the survey results for the northern third of the United States, where we found bat houses are most used and are now best understood, we checked to see what the success rate was for houses that met just two of the most important criteria. We looked at all houses located a quarter of a mile or less from a stream or river, or a lake larger than three acres, and receiving at least four or more hours of sun daily. The occupancy rate for these houses, without consideration

Above: Tony Koch put up nine special bat houses in the loft of his barn to create a more hospitable environment for nursing mother bats. These unusual houses have open sides because of the warmth of the loft. Mother bats routinely move their pups from house to house, perhaps to escape parasites.

Left: In bat houses where the species could be positively identified, little brown myotis were the most common.

MERLIN D. TUTTLE

Pallid bats were among those found in bat houses in the Southwest. Although bat houses in lowland desert regions may become too hot for most bats, those placed against shaded buildings, especially stone, have had some success.

of other factors, was 83 percent. When we further limited the sample by adding houses stained or painted dark, occupancy rose to 92 percent (this proved important for heat gain in northern latitudes). When we added another condition—houses located in areas of mixed agriculture (mostly orchards)—100 percent of the 13 houses meeting all four criteria were occupied. For reasons as yet unknown, bats seemed to be especially attracted to such areas.

Two bat house builders from different parts of the country illustrate the high occupancy rates that can be expected when bat needs are met. Both locations are near rivers and are surrounded by a mixture of orchards, other agriculture, and woodlands. Tony Koch, an organic farmer in Oregon, has had 23 of 24 bat houses occupied by a growing colony of more than 2,000 little brown myotis. Koch's houses are stained or painted dark brown or black and are exposed to six or more hours of daily sun. His only failure was a shaded house on a tree, illustrating the importance of solar heating in the North. In the South, Baxter and Carol Adams of Texas have attracted approximately 700 Mexican free-tailed bats, which occupy all 12 of their bat houses.

Innovations and new discoveries

MOST BAT HOUSES SURVEYED were either purchased from BCI or patterned after BCI designs, but several innovative people developed modifications that will substantially improve our ability to attract larger colonies. The fact that bat houses only 24 inches tall and wide, and 5 or 6 inches deep, can attract nursery colonies of as many as 200 to 300 bats is very good news. Since such houses require far less time and expense to build, and on the average attract more bats than the much larger

A BCI study of bat house use in the United States reveals that bats are occupying bat houses season after season in record numbers . . .

MERLIN D. TUTTLE

Big brown bats were found hibernating in bat houses as far north as New York. Such use may be increased with the addition of insulation in bat houses.

Missouri-style houses,* it is no longer necessary to build these costly houses to provide for large colonies.

The Adamses of Texas experimented with screening, a material bats find especially easy to cling to, and this may explain why two of their houses, with interior dimensions of only about 16 inches by 7 1/2 inches by 5 1/2 inches and two vertical partitions, each sheltered up to 150 Mexican free-tailed bats. They lined the vertical partitions with fiberglass insect (or window) screening, which was still intact after five years. (Because fiberglass window screening is highly variable in quality, and often wears out rapidly or sags to obstruct roosting spaces, we now recommend 1/8-inch or 1/4-inch heavy-duty plastic mesh of the kind sold by Internet, Inc., 1-800-328-8456.)

Quarter-inch hardware cloth has been used successfully by Dr. Stephen Frantz, a research scientist for the New York Department of Health. He noticed that nursery colonies in attics showed a distinct preference for roosting on hardware cloth. Frantz believes that, in some bat houses, it could be used instead of wood partitions to increase roosting space and permit a colony to remain in closer contact. He attracted over 300 little brown myotis to a house of this design that he constructed. Frantz also built another successful house by covering wooden partitions with tar paper held in place by hardware cloth. The tar paper was added to help absorb and retain heat. Heavy-duty plastic mesh of the type sold by Internet, Inc., will last longer, is nontoxic, and has been successfully used in place of wooden partitions.

All available evidence suggests that most of America's crevice-roosting bats prefer crevice widths of 3/4-inch to 1 inch when using open-bottomed houses. However, they also routinely use bat houses with a single 2-inch chamber and a 3/4-inch entry. Koch reported that wasps were less attracted to 3/4-inch roosting crevices, which he now uses exclusively. Lisa Williams, of State College, Pennsylvania, conducted research on bat houses in collaboration with Cal Butchkoski of the Pennsylvania Game Commission. They added ventilation slots that provided wider temperature ranges, thereby increasing use.

In an attempt to attract bats faster, some people painted new bat houses with a mixture of bat guano and water, but there is no clear documentation that this

* A very large free-standing bat house developed by the Missouri Department of Conservation in the early 1980s. Because of its size and cost, it has been built mostly by parks and nature centers.

increased success. Koch used guano from the same species and vicinity and consistently attracted bats the first season, while houses made of new, untreated wood were twice ignored until the second season. But other builders, who did not treat with guano, also attracted bats the first season, some immediately. To treat their houses, people sometimes buy bat guano or obtain it from caves. This, however, could prove counterproductive because droppings from one species may not attract, and might even repel, another species. Since bats in this study were shown to prefer aged wood, it is possible that merely filling the inside of a house with slightly damp earth or a rich humus and then pouring it out after a few days would work just as well.

The study also revealed that the higher a bat house is located, the greater the occupancy success. Mounting houses on poles can help accommodate bat preferences for roosts 15 to 20 feet or higher and offers ideal opportunities to take advantage of solar heating, especially in northern areas. A further advantage of poles is protection from predators. Predation at bat houses was not included in the scope of this study, but instinctual fear of predators may explain bat preferences for higher roosting sites. Dr. Frantz notes that, where raccoons are a problem, poles can be wrapped with a 24-inch piece of sheet metal three feet above the ground. Even in the wild, bats often have difficulty finding safe roosts. We recently checked thousands of desert rock crevices for roosting bats and found that despite an abundance of cliff-face crevices, bats often found very few they could use. Their consistent preference was for places unreachable by snakes or small mammal predators.

DAVE MCGILL

Owners of multiple bat houses reported that their bats often switched roosts when temperatures became extreme. In Lisa Williams' well-documented study, bats moved their young into the coolest houses on hot days and into the warmest houses on cool days among these three different designs.

The advantages of multiple bat houses

THE MOST SUCCESSFUL bat house builders we surveyed erected their houses in groups of three or more. Some observed nursery colonies move their young among the different houses. This was especially well documented by Williams and Butchkoski. They placed bat houses in groups of three, just a few feet apart on the sides of buildings, and carefully monitored internal temperatures. The bats moved their young into the coolest houses on hot days and into the warmest houses on cool days. In addition, mothers sometimes moved young back and forth even when temperature seemed not to be a factor, a phenomenon also observed by Tony Koch in his nine nursery roosts. Occasional moves may additionally help bats evade parasites.

Robert Ginn places his Georgia bat houses in groups of three on trees, one facing south and one each facing northwest and northeast. Twenty-six of his 29 houses are occupied. The three that remain empty are mounted just one to a tree. Close placement of two or three houses painted different colors or positioned to absorb varying amounts of solar heat appears to help attract nursery colonies and also provides excellent opportunities for studying bat temperature needs. Such groupings may prove ideal in areas where temperature requirements are poorly understood.

In the hottest climates bats typically roost in rock or concrete crevices, which act as heat sinks to help keep them from overheating. Bat biologist Dr. Patricia Brown reports that lowland desert bats seldom roost in buildings, meaning that they also may not occupy bat houses in areas of intense heat. Careful experimen-

By putting up bat houses and carefully observing the results, we have an excellent opportunity to help bats and to learn more about their needs.

tation with insulation, reflective paints, and heat sinks will be essential to success in these areas. Both pallid and free-tailed bats have used bat houses mounted on the shaded sides of stone buildings in extra-hot climates. However, at least in central Texas, free-tails and cave myotis appear to prefer houses exposed to at least six hours of daily sun.

The considerable success that some people in our survey had with bat houses was not without patient observation and experimentation before they put up large numbers of them. Much of the controversy over whether bat houses work is stimulated by well-intentioned but premature large-scale projects. Many of these have a high probability of failure largely because of poor placement and lack of prior testing to evaluate bat roosting needs in a particular area.

Many people experiment with bat houses out of a desire to find a natural means of reducing local populations of mosquitoes and other insect pests. Nevertheless, simply erecting large numbers of bat houses to solve a town's mosquito problems is unlikely to succeed. No mosquito control is 100 percent effective, and a pesticide-free approach most often requires a broad range of treatments, including elimination of artificial breeding sites, and use of a variety of natural predators, from small fish and aquatic insects to bats.

Bat biologist Dr. Elizabeth Pierson voiced concern that large-scale bat house projects might be considered by forestry personnel as adequate mitigation for proposed destruction of natural habitats. While there is certainly great potential in developing artificial roosts for more bats, we currently know little about the needs of most American species and cannot yet assume that existing houses meet the needs of more than a relative few.

In some circumstances, you may be able to provide unique roosting habitat for bats. These guards were put up to protect nesting wood ducks from predators and have housed nursery colonies of little brown myotis for more than 25 years.

R.L. CLAWSON

The value of bat houses to conservation

SINCE BCI FIRST MARKETED bat houses in 1986, many other vendors have followed suit.** While some have done much to increase public interest in bat conservation, others pay far more attention to competitive pricing than to bat needs. Such vendors rarely provide mounting instructions or other accurate information and often market poorly constructed houses, which are unlikely to be used even under the best of circumstances. As a result, genuine bat conservation efforts suffer.

By putting up bat houses and carefully observing the results, we have an excellent opportunity to help bats and to learn more about their needs. If your bat house is unoccupied, experiment! Based on what we now know, unoccupied houses often become successful if they are moved only a few feet to receive more or less sun, are stained or painted to absorb or reflect heat, or are merely raised. Occupancy of previously unsuccessful houses, after modification, provides especially enlightening insights into bat needs.

If, despite providing ideal conditions, a bat house remains unoccupied, there could be other reasons why. Most properly built and placed houses in our survey were occupied. However some likely fail because local bats already have all the roosts they need. Distances to undisturbed hibernating sites, local pollution levels, and food base are also important factors. With the possible exception of lowland desert areas, we know of no evidence suggesting that any geographic region is unsuitable for successful bat house use.

The value of building artificial roosts is already well documented for birds. The U.S. population of purple martins grew by more than 25 percent from 1966 to 1986, while almost all other insectivorous songbirds suffered significant declines. Bluebirds, for which a major nest box program was also established, were also an exception. The largest songbird losses were among cavity nesters, especially those that, like bats, do not make their own nest holes.

Some of our most endangered bats, such as the tree-roosting Indiana bat, may be helped by simple use of metal, tar paper, or even fiberglass or plastic collars around tree trunks. In addition, we now know that the big brown bat, one of North America's most agriculturally valuable species, can live year-round in some bat houses. With experimentation, such as using insulation, we may be able to increase the odds of providing year-round roosts for this and other species.

Bat Conservation International's North American Bat House Research Project, begun in 1993, has provided invaluable observations and stimulated experiments required to better understand bat roosting preferences. As bats increasingly lose their traditional roosts, such studies become all the more critical.

Some species that would not ordinarily roost in a bat house, such as this endangered Indiana bat, may be helped by the use of metal or other collars wrapped around tree trunks. Corrugated metal imitates the exfoliating bark that these bats prefer for their summer roosts, but metal is far more durable. Other materials, from plastic or fiberglass to tar paper, may also be used.

MERLIN D. TUTTLE

** The only commercial bat houses on the U.S. market today that directly benefit BCI's bat conservation efforts are sold through the BCI catalog. These houses are continually improved to incorporate new discoveries.

How Research Findings Reveal Bat Preferences

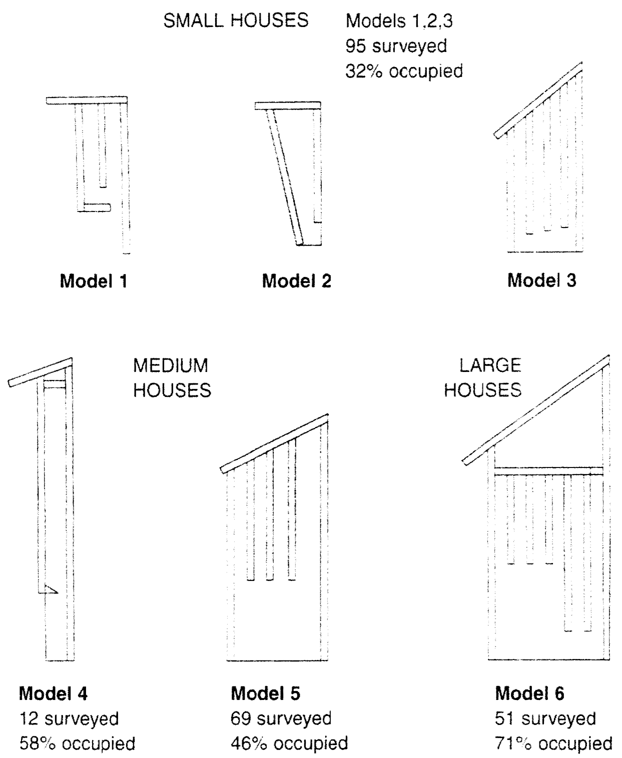
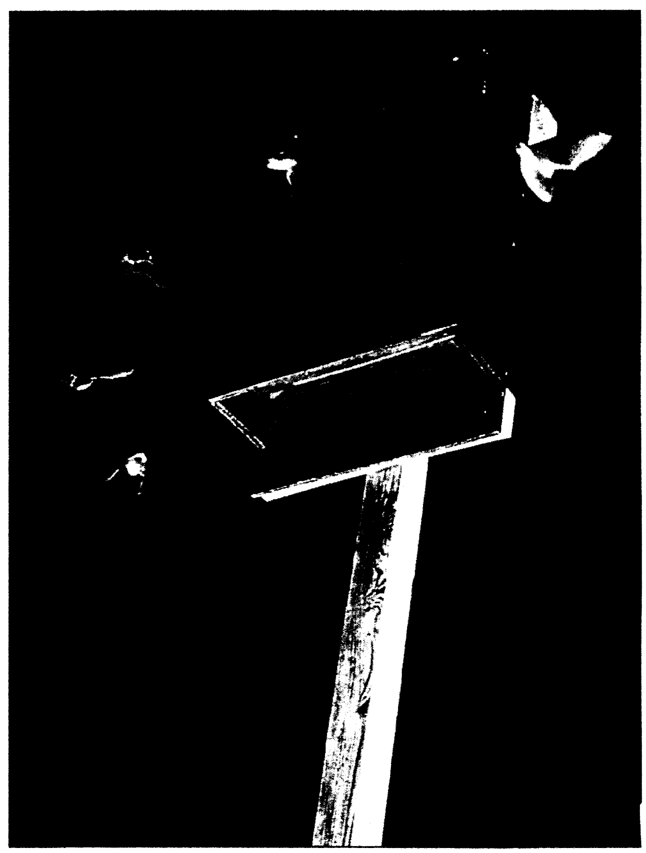


FIGURE 8

Above: The majority of bat houses in the survey were patterned after these six basic designs, which appeared in various BCI publications prior to 1993. To determine the effect of size on occupancy success, they were further grouped into four basic size categories, each of which had many variations. As shown, certain designs were more successful in attracting bats than others, but larger size, providing longer and taller roosting chambers, appeared to be an important factor. Development of better houses has made these models used in the 1992 study largely obsolete.

Right: Current nursery-style houses, like the one shown, are achieving 75 percent occupancy across the U.S. and Canada when recommended installation criteria are met.

New knowledge of bat preferences opens many opportunities to improve bat house occupancy success . . .



MARK AND SELENA KISER

CAREFUL READING OF the detailed findings of BCI's 1992 bat house survey before you begin your own bat house project will greatly increase your chances of success.

Occupancy rates—BCI members achieved significantly higher success rates (64 percent) than the generally less informed nonmembers (44 percent). Nonmembers had often built or purchased bat houses without adequate instructions, and they were 10 percent more likely to use the smallest, least successful sizes. The average occupancy rate was 52 percent. However, as bat house users become better informed, higher success can be expected.

Use rates varied among the six basic bat house models (Figure 8), larger houses tending to be chosen over smaller ones. Bats preferred the tallest houses with the longest crevices, oriented side to side, within the size range investigated.

Eleven bat houses that relied on basically the same designs as Models 3, 5, and 6, but that provided longer roosting chambers, had the highest occupancy rate at 73 percent. These houses averaged 24 to 36 inches tall x 16 to 24 inches wide x 4 to 5 inches deep or 12 inches tall x 32 inches wide x 5 1/2 inches deep.

Missouri-style bat houses, approximately 7 1/2 feet long, 4 feet wide, and 2 1/2 feet tall, with entry through an open bottom, were only 39 percent occupied when built according to instructions. The use rate was surprisingly low for such a large house. This design apparently fails to meet several key needs. In northern areas, the sun probably does not sufficiently warm the roosting crevices, because the design calls for a spacious attic that shades the chambers from the sun's warmth. Equally important, each of its 3/4-inch wide roosting chambers is only 12 inches tall and long, meaning that bat colonies are forced to divide into many small groups, unable to share body heat. This gives them little or no advantage over the smallest houses illustrated. Furthermore, in southern areas where some shading from solar heating might be advantageous, Missouri-style houses are generally too heavy and cumbersome to be placed high enough on poles to attract free-tailed bats, one of the most common species in the South.

Colony sizes—Ninety-four percent of colony size estimates were based on visual inspection through open bat house bottoms. Comparison of counts made of roosting, versus emerging, bats showed that the former and predominantly used method underestimated real numbers by approximately 38 percent—because bats cluster toward the top where observers often cannot see the innermost individuals.

Colony sizes for small bat house Models 1 to 3 averaged 28 bats and ranged from one to 150, though the most frequently reported numbers were just one to five. Colony sizes for the medium-sized Model 4 houses averaged 21 bats and were used most frequently by colonies of 21 to 30 bats; the largest colony sizes reported for this model were between 31 and 50 individuals. Model 5 houses averaged 14 bats per house and were used by from one to 150 bats. Colonies attracted to Model 6 houses averaged 29 bats and ranged from one to 250.

Eleven wider houses of the Model 3, 5, and 6 designs (see "Occupancy Rates" section) held average colonies of 100 bats, ranging from 13 to 250. The much larger Missouri-style house, as originally designed, averaged colonies of only 65 bats, ranging from eight to 250 per house.

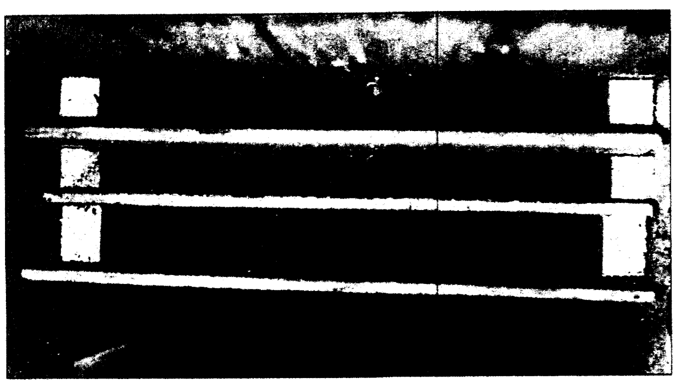
Use patterns—Occupancy rates for bat houses built and put up by different people varied greatly with placement, especially when erected in areas of differing bat habitat and needs. These uneven patterns clearly explain much of the controversy over whether bat houses work and emphasize the need for broad-based sampling.

Among the eight largest samples reported by individual people who had erected multiple bat houses, use rates varied from 0 to 96 percent. For example, at one Oregon location, none of 18 houses placed on trees in dense forest were occupied, while 23 of 24 at another Oregon site attracted bats when placed both outside and inside a barn and on poles at the edge of woodlots. The only one not used was mounted on a shaded tree trunk.

Time until first occupancy—Most houses used by bats in the 1992 study were occupied in the first season. The proportion of occupancy versus time from installment was as follows:

Time Lapsed	*Occupancy Rate*
<1 month	24%
1 to 6 months (through 1st summer)	46%
1 year (through 2nd summer)	15%
2 years	11%
3 years	2%
4 years	1%
5 years	1%

Species occupying bat houses—Most houses studied were erected by laypeople who could only guess at a bat's identity. However, bats from 37 percent of the occupied houses were positively identified by biologists or were photographed well enough to permit identification by BCI staff. Of these, 82 percent were used by little brown myotis *(Myotis lucifugus)*, sharing at least 7 percent with big brown bats *(Eptesicus fuscus)* and 3 percent with northern myotis *(M. septentrionalis)*. Texas houses were mostly occupied by Mexican free-tailed bats *(Tadarida brasiliensis)* or cave myotis (*Myotis velifer*), including as many as 150 in a single small house. A colony of between 30 and 50 pallid bats *(Antrozous pallidus)* occupied a small house in Arizona.



A surprising number of houses shelter nursery colonies, some of them 200 or more bats in a single house. This one is shared by both little brown myotis and northern myotis.

It is highly probable that additional species occupied bat houses without being positively identified. For example, many of the bats reported from Georgia, Florida, and coastal Texas may be southeastern myotis *(Myotis austroriparius)*. Since the 1992 study, several colonies of up to 150 evening bats *(Nycticeius humeralis)* from Florida and Texas have been identified, Yuma myotis *(Myotis yumanensis)* have been confirmed in bat houses from Arizona to western Canada, western long-eared myotis (*Myotis evotis*) have been found in bat houses in Washington, and Pallas' mastiff bats (*Molossus molossus*) have been documented in Puerto Rico and the Cayman Islands.

How bats use bat houses—Where inspection was adequate to determine the kind of use, 33 percent of houses were used by nursery colonies, 60 percent by bachelor colonies, and 7 percent for hibernation. Most houses were not checked in winter.

Only big brown bats and little brown and northern myotis were confirmed to be rearing young in bat houses, though others undoubtedly were, without being identified. Since the 1992 study, nursery colonies of Mexican free-tailed bats, evening bats, Yuma myotis, western long-eared myotis, and Pallas' mastiff bats also have been documented.

Big brown bats, the only bats likely to hibernate in bat houses over the northern two-thirds of North America, overwintered in bat houses in Texas, Kentucky, and New York.

Effect of wood type—There is no evidence that any kind of untreated wood yet tried is objectionable to bats. Occupancy rates from the 1992 study based on the kind of wood used were as follows (types of wood used in fewer than 10 houses are excluded from this comparison):

# Houses	*Wood Used*	*Occupancy Rate*
142	Cedar	54%
77	Pine	53%
21	Cypress	29%
19	Exterior plywood	74%

The apparent preference for plywood results from its availability in large sheets, enabling construction of the longer and taller houses that bats prefer.

Effect of age of wood and treating bat houses with guano—Occupied houses made of old versus new wood were compared for timing of first use. Bats were significantly more likely to move into houses during the first season if they were made of old wood. The age of wood, however, affected only the timing of first use, not the probability of use.

One bat house builder reported that his well-established and growing colony typically expands quickly into new houses made of old wood or new wood treated with a solution of bat guano diluted with water. His bats have twice waited until the second season to occupy houses made of new, untreated wood. Droppings were collected from the same species living in the immediate vicinity. This is the only strong evidence to support the idea of earlier occupancy for guano-treated houses. Other builders report that houses made of new, untreated wood have been occupied as soon as the first night.

Effect of urbanization and agriculture—Only 21 houses included in our sample were put up in an urban environment. Of these, 48 percent were used, a figure surprisingly close to the overall average.

Bats exhibited a significant preference for houses

MERLIN D. TUTTLE

Mexican free-tailed bats are the most common bat house occupants in the South. They like to roost as high as possible above ground, though houses at heights of 12 to 15 feet have been quite successful.

located in agricultural areas. Such houses had an occupancy rate of 88 percent, compared with the average of 52 percent for all areas combined. These areas were mainly orchards interspersed with a variety of other land uses. Samples did not include any houses placed where large areas were planted in single crops.

Effect of lakes, rivers, and streams—Bat houses located within a quarter-mile of streams or rivers had an occupancy rate of 78 percent. The size of the river was not a significant factor. The results indicate a significant preference for houses located near streams or rivers, even when compared with large lakes. (Very large lakes, such as Lakes Michigan or Superior, were not compared.)

Where lakes were the dominant water source, bats significantly preferred houses near those of three acres or more. These houses were 62 percent occupied versus 28 percent near ponds covering less than three acres. Bats using artificial roosts in arid areas of the Southwest likely would be less influenced by the size of water sources.

Four houses located more than a mile from a lake, *Exposure to sun is one of the most important criteria identified for determining use of bat houses.*

CAL HUTCHINSON

After a night of feeding, little brown myotis circle and re-enter a bat house. The outside of this Pennsylvania house is covered with tar paper to absorb heat. In northern climates, dark houses proved to be significantly more successful than others.

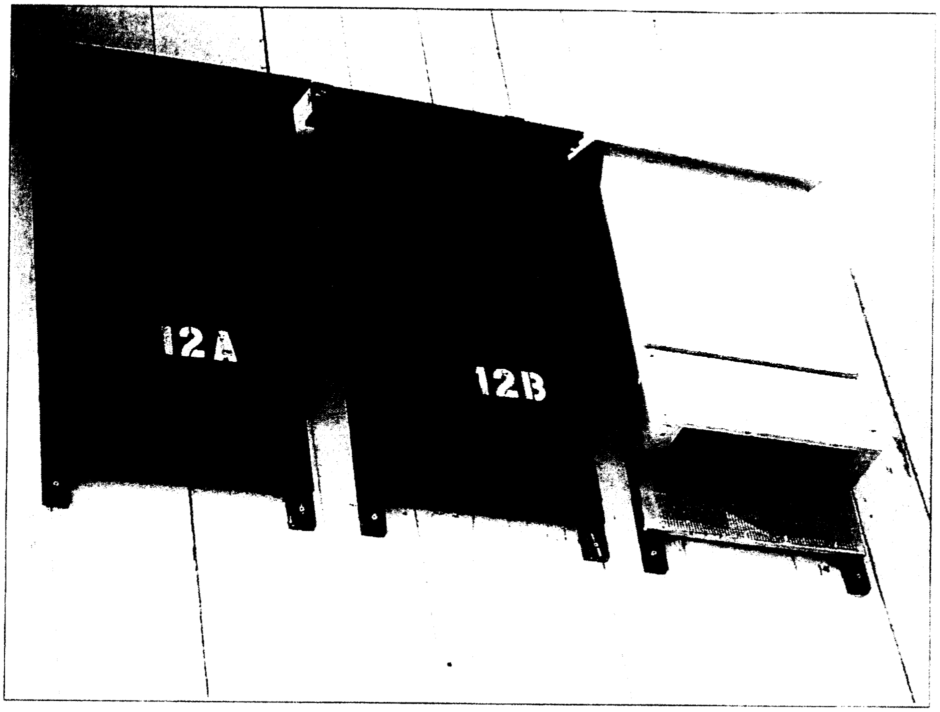
river, or stream were occupied, demonstrating that success is sometimes possible even when water is not near.

Effect of paint or stain—Although bat researchers have long believed that painting or staining a bat house might repel bats, no evidence was found to support this assumption. In fact, bats living in cool areas (for purposes of comparison, at latitudes north of 40 degrees) showed a significant preference for houses with exteriors either stained dark or painted black.

Sixty-seven percent of dark-colored northern houses were occupied, compared with an occupancy rate of 44 percent for those left plain. Covering houses with tar paper achieved similarly positive results. Subsequent research shows painted houses are two and a half times more successful than unpainted houses. The appropriate shade of color for heat absorption varies with climate—see "Wood treatment" section under "Designing Better Bat Houses," on page 6.

Effect of solar radiation—Exposure to sun is one of the most important criteria identified for determining use of bat houses. Bat needs are known to vary according to geographically differing ambient temperatures, but temperature cannot be accurately predicted based on mere knowledge of latitude and altitude. For purposes of this investigation, North America was divided into three zones: 1) all localities at latitudes north of 40 degrees; 2) all localities between 35 and 40 degrees; and 3) all localities south of 35 degrees.

Houses, with or without dark stain or tar paper covering, were significantly more likely to be used north of 40 degrees if they were exposed to four or more hours of sun. Those receiving more than four hours of sun were 83 percent occupied, compared to 26 percent for those with less than four hours. No amount of sun appeared to be too much for northern houses, but in interpreting results, one must consider that they mostly reflect the preferences of little brown myotis. Big brown bats may prefer less.



JIM KENNEDY

Bat preferences are determined through controlled testing. All aspects of the test houses are identical except the attribute being tested. These differently colored houses will test local temperature preferences.

Since the 1992 study, highly successful bat houses have been reported from both shaded and full sun locations from central Texas to Florida, perhaps reflecting differing needs among species or among nursery versus bachelor colonies. One bat house, located on the shaded side of a building in central Texas, remained unoccupied for five years, but attracted hundreds of Mexican free-tailed bats soon after being moved to a location on the same building where it received more than five hours of morning sun. In central Florida, a nursery colony of 125 evening bats abandoned its shaded house when offered a pair of dark brown houses attached back to back on poles in full sun (see Figure 2). The colony then expanded to become a mixed nursery colony for some 400 evening bats and Mexican free-tailed bats. Further tests are in progress to determine if these bats would prefer a lighter color in the sun.

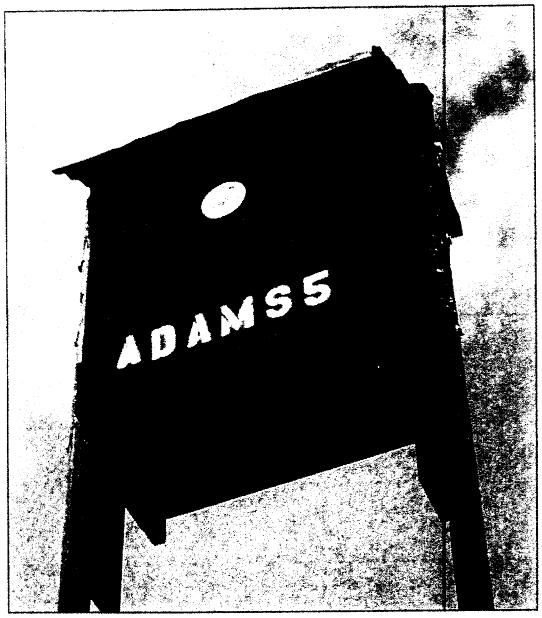
Most southern bat houses seem to be more successful if exposed to sun for at least six hours per day, and early experiments with houses mounted in pairs in full sun, as illustrated in Figure 2 (page 8), are encouraging. When first using houses in a new area, it is a good idea to provide options until local preferences are established.

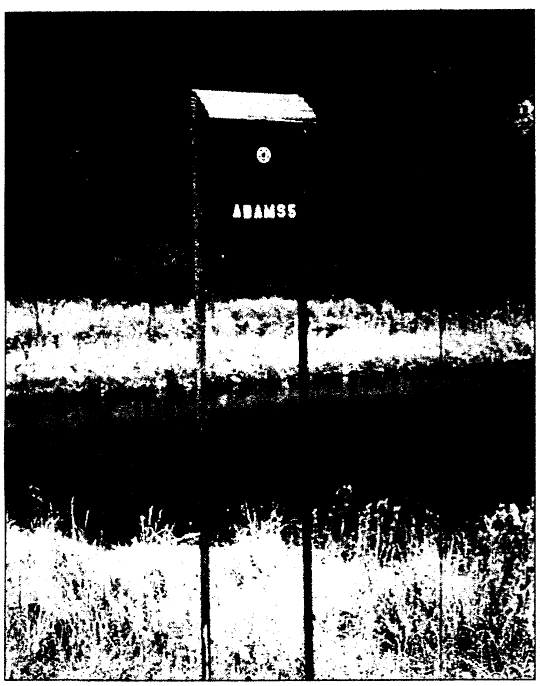
Effect of height above ground—Bats clearly preferred houses that were highest above ground, but this factor may not be entirely independent of exposure to sun.

# Houses	*Height*	*Occupancy Rate*
25	<10′	40%
214	11′-15′	50%
27	16′-20′	63%
10	21′-30′	70%

Effects of dense forest and distance to nearest obstacles—The 28 bat houses located in dense forest had occupancy rates significantly below average. These were only 18 percent occupied compared to 52 percent for the study at large.

The distance of a bat house to the nearest potential flight obstacles, usually tree branches, was significantly related to occupancy. Those less than five feet from obstacles were only 24 percent used, compared to 76 percent for those 20 feet or more from obstacles. As will be discussed, factors such as forest density, distance to nearest obstacles, and exposure to solar heating are not independent of one another.





Two bat houses mounted back to back with an additional roosting chamber in between creates space for more than 500 bats. The brown color, vent slots, and north-south orientation provide a maximum temperature gradient. The houses are mounted 15 feet high on poles to protect the bats from climbing predators and to increase solar exposure. The location—near water and in an area of known bat activity greatly enhances success. (Note that the tongue-and-groove lumber used on these houses gives them the appearance of having more vents.)

Effect of mounting substrate—Occupancy rates differed significantly among houses mounted on buildings, poles, or trees. Houses located on poles were 81 percent occupied and those on buildings were 73 percent used, while those placed on trees (whether isolated or in a forest) achieved only 34 percent success. Sixty percent of the sample was northern, 6 percent mid-latitude, and 34 percent southern. Mounting substrate and exposure to solar heating are closely related, and bats appeared not to be actually choosing a particular substrate, but rather exposure to sun.

Relevance of solar radiation to dense forest, obstacles, and mounting substrate—Looking at the data showing highest occupancy rates on poles and least in dense forest, we hypothesized that exposure to sun might explain these differences. Indeed, houses mounted on poles received an average of nine hours of daily sun, compared to seven for those mounted on buildings and only two hours on trees. Furthermore, it was found that nearby obstacles, usually tree branches, significantly reduced the amount of sun reaching houses.

To test our hypothesis, we predicted that if reduced solar heating were the primary determinant of low use rates for houses on trees, tree-mounted houses receiving more than four hours of daily sun would have use rates comparable to those mounted on buildings or poles. Knowing that bat needs for solar warming may differ between northern and southern localities, this test was limited to houses located at latitudes north of 40 degrees.

Northern houses mounted on trees, but still receiving four or more hours of sun daily, were significantly more likely to be occupied than those receiving less. In fact, such houses achieved occupancy rates of 82 percent, compared to 81 percent for poles and 73 percent for buildings. It seems clear that the mounting substrate is not as important as hours of exposure to sun.

Assuming too little sun to be the reason for poor occupancy rates on trees, it was postulated that houses on southern trees should be better used than their northern counterparts. Indeed, occupancy rates for houses on southern trees proved to be significantly higher than for those on northern trees. The 17 percent improvement likely would have been even greater except that little brown myotis are uncommon in the South, while Mexican free-tailed bats are among the most frequent users of southern houses. Free-tails are high-speed flyers that may not choose to risk flying into the increased obstacles around many tree-mounted houses. Thus far, their only known use has been limited to houses mounted on buildings or poles.

Answers to Common Bat House Questions

Will attracting bats to bat houses in my yard increase the likelihood that they will move into my attic or wall spaces?
No. If bats liked your attic or wall spaces, they probably would already be living there.

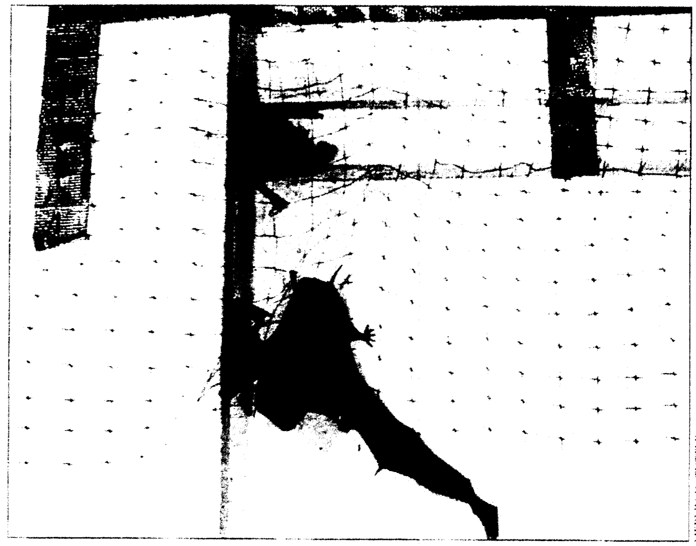
If I have bats living in my attic, but would prefer that they occupy a bat house instead, what should I do?
Attics and other parts of buildings often provide ideal bat roosting sites. This is especially true for nursery colonies, which prefer stable high temperatures and the ability to move up and down to select from a range of available temperatures under varied weather conditions. Sometimes an attic is only marginally suited to bat needs, and a good bat house large enough to shelter the whole colony may tempt them to move without other encouragement. This is especially true when a group of several houses ensures a range of available temperatures at a nearby location.

In most cases, however, bats will not voluntarily move from an attic. In such cases, alternative roosts ideally should be provided several weeks or months before the desired move. The bats should be evicted from the attic at a time in early spring or fall when flightless young are not present.

Eviction is often easily accomplished. Watch to see where the bats emerge at dusk. Then cut a piece of 1/4" polypropylene bird netting (available at yard and garden stores) large enough to hang over the emergence point, extending at least a foot below and to each side of each exit. Tape it in place so that it hangs free an inch or two from the building at the bottom. It will then serve as a one-way valve, permitting emergence, but closing when bats land on it to return. There are many documented cases of successful relocations to bat houses that have been carried out in this manner.

Can bats be introduced into areas where they do not already live?
If appropriate bat species pass through your general area, you may, by putting up a bat house, attract a colony, but there is nothing you can do to introduce them artificially. They have strong homing instincts and likely would return to their original roost. Thus, catching or purchasing bats (which is illegal) for introduction into a new bat house should not be attempted.

How can I determine the likelihood of attracting bats?
Most North American bats prefer to live within a few hundred yards of fresh water, especially streams, rivers, or lakes. However, some bat houses up to two miles from water have attracted bachelor colonies. In some western areas, even small cattle tanks that provide open water may be sufficient. All bats, especially nursery colonies, require good feeding habitat; riparian areas are typically best. Exceptionally high bat house success has been achieved in areas that support a mixture of varied agriculture, especially orchards and natural woodlots or other vegetation near water. Areas where bats already have attempted to live in buildings are a good bet, and the nearer they are to potential hibernating sites in caves or abandoned mines the better.


MERLIN D. TUTTLE

Many people who have bats in their attic, and who erected a bat house before they made repairs to evict the bats, have been successful in persuading the bats to move into the alternate roost. Putting up bird netting over the bats' entry holes allows them to leave but not to return.

Why might bats not be attracted to my bat house?
It may not be well built, most frequently meaning failure to: 1) provide 3/4-inch-wide roosting crevices that are at least 20 inches tall; 2) carefully caulk and paint; or 3) include ventilation slots. Also, even well-built houses must be positioned and painted an appropriate shade of color to provide adequate solar heating, and they should be as safe as possible from climbing predators.

If your bat house meets construction, mounting, and habitat criteria and still has not attracted bats by the

MERLIN D. TUTTLE

With their voracious appetite for beetles, bugs, and leafhoppers, big brown bats are among a farmer's best allies in reducing agricultural pests.

end of its second full spring-summer season of availability, try moving it to a location with more or less sun. Many bat house owners have achieved dramatically improved success by simply moving their houses, typically to receive more sun.

Some areas simply do not provide bats with adequate food, water, or hibernation sites. These areas will not support bats in buildings either.

Alternatively, in a few places, bats may simply have all the roosts they need and are unlikely to move until they lose an existing roost or until you provide a better home than they already have. This is where patient testing comes into play! So far, we are unaware of any large areas in North America (with the possible exception of some unusually hot desert lowlands) where bats have not been attracted.

How effective are bats in controlling insects?
As primary predators of night-flying insects, bats play a key role in the balance of nature. They consume vast quantities of insects, including many agricultural and yard pests. Little brown myotis often feed on mosquitoes when they are abundant, and just one bat can catch hundreds in a single hour. They also are excellent predators of moths, which produce such costly pests as cutworms, corn earworms, and army worms. Organic farmer Tony Koch reports a reduction of corn earworms from an average of several per ear of corn to none since he successfully attracted approximately 2,000 little brown myotis that live in 24 bat houses on his Oregon farm. Many pests avoid areas where they hear bats.

Bat biologist Dr. John Whitaker recently documented that a single colony of 150 big brown bats, a number that could easily live in one bat house, can eliminate 38,000 cucumber beetles, 16,000 June bugs, 19,000 stink bugs, and 50,000 leafhoppers in a summer. This is a conservative number that does not consider the many other unidentified insects these bats eat. Cucumber beetles are among America's most costly agricultural pests. Adults attack corn, spinach, and various vine plants, but the greatest harm comes from their larvae, known as corn rootworms. Whitaker concluded that by eating 38,000 cucumber beetles, the bats protected local farmers from approximately 33 million rootworms that the beetles would have produced.

Illustrative of the incredible impact bats can have, the 20 million Mexican free-tailed bats living in Bracken Cave, Texas, consume up to 250 tons of insects in a single night over surrounding towns and croplands. Loss of such bats leaves us increasingly dependent on toxic chemical alternatives that already seriously threaten our personal and environmental health.

Will having bat houses in my yard interfere with attracting birds?
No. They will not compete, either for food or space.

Will bat droppings pose a health threat to my family?
No more so than bird or cat droppings would. Inhalation of dust associated with animal feces of any kind should be avoided.

What are the odds that a sick bat will endanger my family with rabies?
Like all mammals, bats can contract rabies, though very few (less than half of one percent) do. Unlike many other animals, even rabid bats rarely become aggressive. They quickly die from the disease, and outbreaks in their colonies are extremely rare. The odds of being harmed by a rabid bat are remote if you simply do not attempt to handle bats. Any bat that appears easy to catch should be assumed sick and left alone.

Fewer than 40 Americans are believed to have contracted rabies from bats in the past five decades. Nearly as many people die annually from contact with household pets. With or without bats in your yard, the most important action you can take to protect your family from rabies is to vaccinate your family dogs and cats.

Bats Most Likely to Occupy Bat Houses

THROUGHOUT THE NORTHERN two-thirds of the United States and southern Canada, the little brown myotis and the big brown bat are the most likely species to be encountered in bat houses. In the South, Mexican free-tailed and evening bats are the most common. In general, any species that naturally roosts in buildings or under bridges is a candidate for a bat house. The following species are confirmed bat house users. Several additional species likely will be found using bat houses.

802-3408

Pallid bat, *Antrozous pallidus*
WESTERN AND SOUTHWESTERN U.S., mostly in arid areas. Found in rock crevices, buildings, under bridges, and in bat houses. Winter habitat unknown, presumed to hibernate locally in deep rock crevices.

800-1517

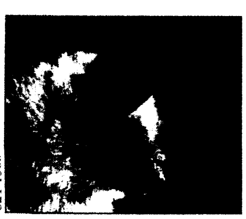
Big brown bat, *Eptesicus fuscus*
MOST OF THE U.S. and Canada, except for extreme southern Florida, and south/central Texas. Rears young in tree hollows, buildings, and bat houses. Hibernates in caves, abandoned mines, and buildings. Frequent bat house users that have also overwintered in bat houses from Texas to New York.

710-1501

Pallas' mastiff bat, *Molossus molossus*
IN THE U.S., found in buildings in the Florida Keys only. Throughout the Carribean, northern Mexico, Central America and northern South America, roosts include hollow trees, palm fronds, rock crevices, caves, bridges, culverts, and buildings. Uses bat houses year-round in Cayman Islands and Puerto Rico.

822-3100

Southeastern myotis, *Myotis austroriparius*
MOSTLY RESTRICTED to Gulf States. Rears young in caves, tree hollows, and buildings. Mostly non-migratory, hibernates in caves in northern range and often in tree hollows or buildings farther south. Confirmed bat house use in Florida; believed to use bat houses in other Gulf States.



824-1508

Western long-eared myotis, *Myotis evotis*
PRIMARILY in forests of southwestern Canada and the western U.S. Often lives alone or in small groups; females form maternity colonies of 12 to 50 individuals in summer. Roosts in hollow trees, under bark, in cliff crevices, sinkholes, caves, mines, and abandoned buildings. Confirmed bat house use in Washington. Winter habitat unknown.

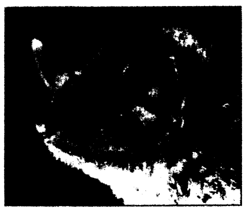
828-1301

PHOTOS BY MERLIN D. TUTTLE

Little brown myotis, *Myotis lucifugus*
WOODED AREAS throughout most of Canada and the northern half of the U.S., except desert and arid areas. A few isolated populations farther south. Rears young in tree hollows, buildings, rock crevices, and bat houses. Travels to nearest suitable cave or abandoned mine for hibernation. This is the species that most commonly occupies bat houses.


828-6218

Northern myotis, *Myotis septentrionalis*
UPPER MIDWEST and East into Canada, also ranging south into northern Arkansas, Tennessee, eastern Alabama, and western Georgia. Summer roosts are varied, and these bats have been found beneath tree bark, in buildings, and at night in caves. Little is known about their nursery colonies, but small numbers have been found rearing young beneath tree bark, in buildings, and in bat houses. Hibernates in rock crevices, caves, and mines.


830-4106

Cave myotis, *Myotis velifer*
SOUTHERN ARIZONA and New Mexico into West Texas and Oklahoma, and extreme south-central Kansas. Forms large nursery colonies in caves. Also rears young in smaller groups in buildings, often in crevices. The eastern subspecies hibernates in caves, but the winter habitat of the western subspecies is unknown. Shares bat houses with Mexican free-tailed bats in Texas.


000-1106

Yuma myotis, *Myotis yumanensis*
ALL OF WESTERN Canada, Washington, Idaho, Oregon, California, Arizona, extreme western Nevada, eastern Utah, southern Colorado to western New Mexico. Restricted to areas near water. Rears young in caves, in buildings, under bridges, and in bat houses. Winter habitat unknown. Lives in bat houses from Arizona to southwestern Canada.


831-1201

Evening bat, *Nycticeius humeralis*
EAST OF THE Appalachians, ranges from southern Pennsylvania to Florida. West of these mountains, it occurs from extreme southern Michigan and Wisconsin, west to southeastern Nebraska, and south through eastern and southern Texas. Abundant in southern coastal states. Rears young in buildings, tree cavities, and bat houses. Forms nursery colonies numbering in the hundreds, often sharing roosts with Mexican free-tailed bats. Winter habitat unknown.


832-1502

Eastern pipistrelle, *Pipistrellus subflavus*
EASTERN NORTH AMERICA into Canada, except northern New England. Most of the Midwest, except Michigan, northern Indiana, and western Wisconsin. South from eastern Minnesota to eastern Texas and central Florida. Abundant over much of the Southeast. Little known about summer roosts; sometimes rears young in buildings. Several pipistrelles twice reported in bat houses. Hibernates in caves.


803-3401

PHOTOS BY MERLIN D. TUTTLE

Mexican free-tailed bat, *Tadarida brasiliensis*
COMMON IN southern and southwestern U.S., and north to Nebraska, Colorado, Utah, Nevada, and Oregon. Rears young in caves, in buildings, under bridges, and in bat houses. A frequent bat house user. Migrates to overwinter in caves of Mexico and Central America. Non-migratory in the southeastern U.S. and west coast. Remains active year-round.

For further information:
If you are interested in learning more about bats, particularly those that might occupy your bat house, Merlin Tuttle's book, *America's Neighborhood Bats*, can help. Numerous color photographs and identification keys will assist you in understanding and identifying the most common American bats. It is available at bookstores or through BCI's free catalog.

MERLIN D. TUTTLE

The Importance of Bat Conservation

Because of their multifaceted ecological roles, bats rank among the world's most important animals . . .

BATS PLAY A KEY ROLE in maintaining the diversity of life on earth. Nearly a thousand kinds of bats comprise almost a quarter of all mammal species, and their presence in large numbers is essential to the balance of nature.

Mexican free-tailed bats from just three caves near San Antonio, Texas, consume up to a million pounds of insects nightly over local towns and farms. Giant cacti and agaves of the American Southwest rely on bats as important pollinators. And in tropical rain forests, bats play an essential role as the primary pollinators or seed dispersers for countless trees and shrubs, including many, such as bananas, dates, figs, and avocados, that are of great economic value. More than 450 products derived from bat-dependent plants sell for hundreds of millions of dollars annually.

Despite their many values, bats are widely misunderstood, feared, and persecuted. Their populations are in alarming decline in many parts of the world. More than half of America's 45 species are already listed as endangered or are official candidates for such designation.

Bats Need Your Help

Join Bat Conservation International . . .

BAT CONSERVATION INTERNATIONAL was founded in 1982, as scientists around the world became alarmed about severe declines in bat populations. Most conservation groups have neglected bats, while animals of greater public appeal—but often of less ecological importance—are represented by a variety of organizations.

Today, BCI is recognized as the international leader in conservation initiatives that protect bats and their habitats. BCI is the only resource center providing a broad range of expertise about bats to conservation planners, environmental educators, government agencies, and many other people and organizations.

Although bat conservation remains one of the greatest challenges in conservation history, much progress is being made. As a result of BCI's educational efforts, millions of people worldwide are beginning to understand and appreciate bats. Key nursery and hibernation caves containing millions of American bats are becoming protected as sanctuaries, and international research is being funded to document bat values and needs.

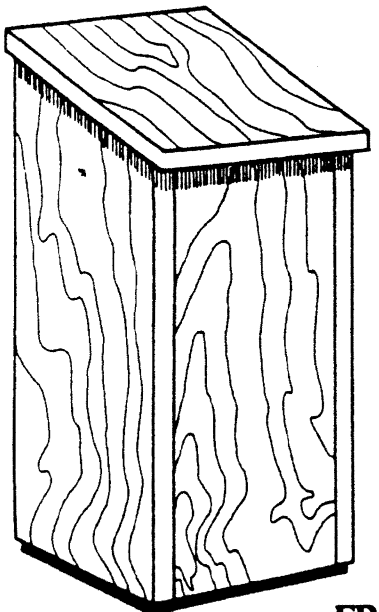
Please join us! BCI members have the satisfaction of knowing that their conservation dollars are making a real difference. Members receive our quarterly magazine, *BATS*, with spectacular photography and informative articles by the world's leading bat biologists and others about bat behavior, conservation progress, and projects your contributions are funding. Members also have opportunities to become active participants by attending our workshops and using our educational materials, available through the BCI catalog. In addition, members receive invitations to join us on unique ecotours that emphasize bats and their fascinating habitats.

Through your extra participation as a volunteer Research Associate in BCI's North American Bat House Research Project, you can directly help your own backyard bats and make an important contribution to our understanding of bat needs, while sharing in the excitement of scientific discovery.

Bats—and the habitats that rely on them—urgently need your assistance. Please join us and help save these remarkable and vulnerable animals.

BAT CONSERVATION INTERNATIONAL'S
Official Bat-House Builder's Guide

Read instructions and recommendations completely through before beginning



Bat houses have been used for more than 60 years in Europe, and they have become increasingly popular in the U.S. We have compiled the following recommendations crucial to bat house placement and use based on studies done in the U.S. and Canada on bats roosting in man-made structures. The following bat house plans are designed according to the most up-to-date information available on the preferences of North American crevice-roosting bats. The varied crevice widths accommodate several of North America's most abundant and widespread species.

LOCATION

Bat houses located near a permanent source of water, especially a marsh, lake or river, are by far the most likely to attract bats. They should be hung roughly 12–15 feet above the ground in a location where entry is unobstructed and bats have easy access. A bat house can be placed on a tree or pole, although those attached to the side of a building have had the most success (possibly because of increased temperature stability and protection from predators).

(continued inside)

FREQUENTLY ASKED BAT HOUSE QUESTIONS

How can I attract bats to my bat house?

Bats find bat houses just as birds find bird houses. If roosts are needed in your area, and your bat house is appropriately located and meets bat requirements, they eventually will find it and move in on their own. Some people have painted the inside of bat houses with moistened bat droppings to establish a bat odor, but no one is certain that this makes houses any more attractive to bats.

How can I determine the likelihood of attracting bats to my bat house?

Most North American bats prefer to live within a few hundred yards of water, especially streams, marshes or lakes, although colonies are sometimes found up to a mile or more from such places. In some western areas, they may travel several miles, utilizing only a cattle trough or other similarly small water source. Wherever bats live, they must find enough insects to eat, largely explaining their preference for aquatic habitat. In urban areas the oldest neighborhoods, with their larger trees and more established yards, are most likely to meet bat needs.

Why might bats not be attracted to my bat house?

Too great a distance to feeding or drinking sites may be a factor, or heavy use of agricultural or other pesticides that may poison bats or their insect prey. Another reason may be that bats sometimes are prevented from using otherwise ideal summer habitat because potential winter hibernating sites in nearby caves or mines have been eliminated through human disturbance. Finally, bats are unlikely to move into a bat house unless it is needed. Bats are most likely to need alternative roosts, such as bat houses, in areas where roosting sites are insufficient to house as many bats as the local insect population can support.

Can bats be introduced into areas where they do not already live?

If appropriate bat species pass through your general area, you may, by putting up a bat house, attract a colony, but there is nothing you can do to artificially introduce them. They have strong homing instincts and likely would return to their original roost. Thus, catching or purchasing bats (which is illegal) for introduction into a new bat house should not be attempted.

If I have bats living in my attic, but would prefer that they occupy bat houses instead, what should I do?

Attics or other parts of buildings often provide ideal bat roosting sites. This is especially true for nursery colonies. Bats raising young require stable high temperatures and the space to move up and down to select from a range of temperatures under varied outside weather conditions. Neither natural tree roosts nor bat houses are likely to lure bats out of a good attic! Only excluding them, by plugging their means of entry, is likely to make them move, and even then, they may move to a neighbor's attic instead of living in your bat house. Some excluded bats, however, do move into bat houses, especially if they have few options.

Do you guarantee that my bat house will be used?

The only real guarantee is that, used or not, it will make an excellent conversation piece and give you an opportunity to tell your neighbors about the importance of bats! As just outlined, there are several reasons beyond our control why bats might not occupy a bat house.

What kinds of bats are most likely to use bat houses?

Throughout the northern two-thirds of the United States and Canada, the little brown bat (*Myotis lucifugus*) and the big brown bat (*Eptesicus fuscus*) are the most likely. These species also occur in the southeastern U.S., but in the Gulf States the southeastern bat (*Myotis austroriparius*) and the Mexican free-tailed bat (*Tadarida brasiliensis*) are the most abundant. In the southwest and western U.S., the Mexican free-tailed bat and a variety of small bat species (often loosely referred to as mouse-eared

(continued on back)

(continued from front)

TEMPERATURE CONSIDERATIONS

Since appropriate temperature may determine whether or not a bat house is used, you may wish to consider several factors before choosing a location. Lower temperatures, due to higher altitude or latitude, require that bat houses intended for use by nursery colonies be oriented to receive maximum sun, especially in the morning (southeast exposure). In warm climates, bat houses also should be positioned to receive morning sun, but in hot climates they will require shade by mid-day.

Nursery colonies normally prefer stable temperatures from 80–100° Fahrenheit. Bachelor colonies frequently select cooler roosts, so even if your bat house is too cool for a nursery colony, you may still attract bachelors.

WHEN TO EXPECT GUESTS

Although there have been reports of bats moving into houses almost immediately, a year to a year and a half is a more common waiting period. Some highly successful bat houses were not occupied until the third year. Reasons for the delay are unknown. Bats may be more likely to discover houses during spring or fall migratory movements, odors may need to dissipate, or the bats may simply require time to get used to a new structure. Hanging houses in the fall or winter may help. If a house is not occupied by the end of the second year, you might try moving it to a new location.

GETTING STARTED

MATERIALS:

One 10′ piece of 1″ X 8″ untreated, rough-sided lumber
One 11″ piece of 1″ X 10″ untreated, rough-sided lumber
—this will be the top, (A)
Approximately 30 six-penny galvanized nails
Silicone caulk

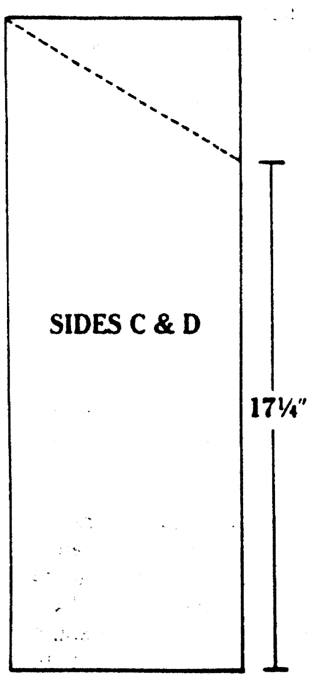
TOOLS:

Skil saw with crosscut blade
Hammer
Ruler
Tape measure
Pencil
Drill

NOTES:

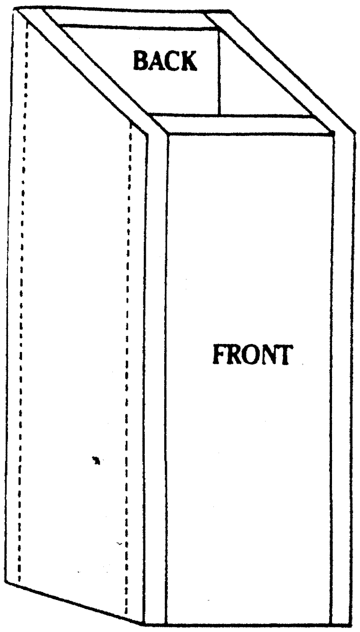
1. Do not use paint, as the odor may repel bats.
2. Bats need a rough surface to secure a foothold. If rough-sawn lumber is unavailable, you can roughen all interior surfaces manually by cutting 1/16″ horizontal grooves at about ½″ intervals.
3. Some types of lumber split easily. Drilling small holes for the nails will reduce this possibility.
4. Lumber will vary in thickness and width. Most 1″ thick lumber is actually only ¾″ thick, and the width of an 8″ board can vary from 7″ to 8″. These plans can be modified for slight variation, but you should try to select lumber that is as close to ¾″ thick and 8″ wide as possible.

ASSEMBLY



STEPS 2-3-4

1. Cut the 10′ piece of lumber into seven (7) pieces of the following sizes:
   —3 pieces that are 22″ long
   these will be the back (B), and the two sides, (C) and (D)
   —1 piece that is 17¾″ long
   this will be the front (E)
   —1 piece that is 11″ long
   this will be the first partition (F)
   —1 piece that is 12″ long
   this will be the second partition (G)
   —1 piece that is 13″ long
   this will be the third partition (H)
2. Take the two sides, (C) and (D), and measure off 17¼″ along one edge. Make a pencil mark at this point.
3. Draw a diagonal line across the face of each piece from the 22″ end to the pencil mark at 17¼″.
4. Using a skil saw, cut along the diagonal lines. Set these pieces aside.



STEP 7

5. Now you need to cross-cut the angle off the *top end* of each of the following pieces: the top (A), the back (B), the front (E), and the three partitions, (F),(G), and (H). The easiest way to set this angle is to place the skil saw *guide* on the angled cut of one of the side pieces from Step 4, and place the *blade* firmly against the 17¼" edge of the side piece; then lock the guide in place. The angle should be roughly 33°, but will vary depending on the exact width of your lumber.

   NOTE: When you angle off the top end of the front piece (E), the *outside* surface of this piece should measure 17¼" in length.

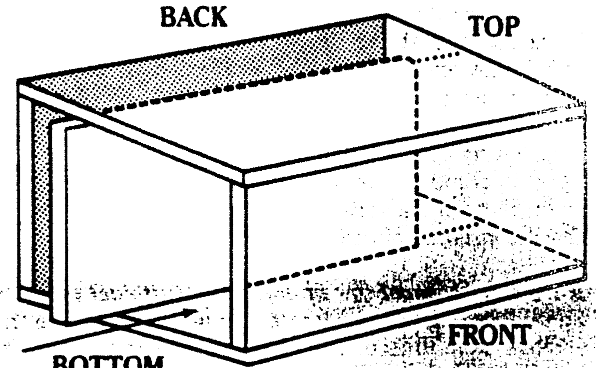
6. Take the two side pieces, (C) and (D), from Step 4. Using a ruler and a pencil, mark the pieces *on both sides* to allow the following crevice widths between the three partitions from front to back in the bat house: ¾", ¾", 1", and 1¾". Be sure to allow for the thickness of each partition and that of the front and back pieces as you mark the crevice widths along each side piece.

   NOTE: The width of the final crevice can vary from ¾" to 1¾" depending on the exact width and thickness of your lumber.

7. Now, you are ready to start building. Take the two sides, (C), and (D), the back (B), and the front (E), and nail them together, angled ends up. *Remember that the side pieces fit over the ends of the front and back pieces.*

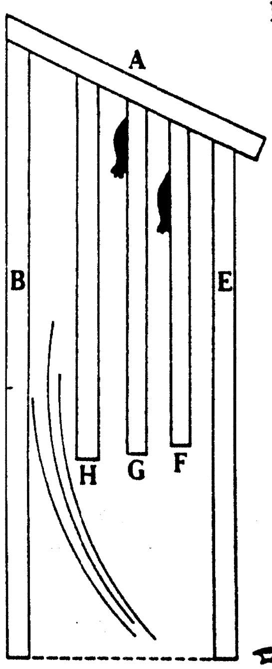
8. Now you can insert the partitions. Lay the partially completed house on its side. Take the longest partition and slide it into the box, using the lines closest to the back of the box as a guide for placement. Position the partition so that it is flush with the tops of the sides.

9. Secure the partition in place by nailing along the outside lines you drew in Step 6.



STEPS 8-9-10

10. Follow the same procedure for securing the other two partitions along the remaining lines. The shortest partition should be nearest to the front of the box.



DIMENSIONS:
A—Roof, 11" X 10"
B—Back, 8" X 22"
C & D—Sides 8" wide X 22" at back, 17¼" at front
E—Front, 8" X 17¼"
F—First partition, 8" X 11"
G—Second partition, 8" X 12"
H—Third partition, 8" X 13"

SPACING BETWEEN PARTITIONS, FRONT TO BACK:
¾", ¾", 1", 1¾"

11. Now you can affix the roof. To ensure a tight, weatherproof seam along the top, apply a line of silicone caulk along the perimeter of the main frame. Place the top piece (A) on the frame so that the back edge of the board is flush with the back of the box and creates an overhang in the front and on the sides. Hold firmly and nail the top to the main frame. The completed house should look like the drawing on the front of these plans.

HANGING YOUR BAT HOUSE

Your house can be hung in a variety of ways depending upon where you choose to hang it. A wide selection of nails, screws, hooks, and brackets can be found at your local hardware store. Be inventive, but following installation, we recommend that you check the house periodically to ensure that it is safely anchored in place.

If bats do occupy your house, write and tell us about it!

bats) may occupy bat houses. Pallid bats (*Antrozous pallidus*) may also roost in bat houses, especially in arid areas. In general, any species that naturally roosts in crevices under bridges or in buildings is a likely candidate for a bat house.

How do I know if my bat house is occupied?
Bats that regularly live in a bat house can be seen with a flashlight. Another way to tell if bats are using your house is to put a piece of plastic below to see if droppings collect. Keep in mind that a bat house may not be used every day; some bats may use a particular site as a night roost, staying for only a few hours at a time. Bats may also use a house seasonally, occupying it for only a few weeks during migration.

How can I observe bats in a bat house without disturbing them?
The longer a colony has occupied your bat house, the more tolerant they will be of disturbance. After several months, they may tolerate having a flashlight shone on them occasionally. However, any attempt to handle them or touch the house while they are inside may cause abandonment. If you want to know if you have a nursery colony, shine a light inside soon after the bats leave at dusk (in June or early July). Young are left behind in the roost for the first three to four weeks after birth. Do this only briefly and do not repeat more than once a week, or you could cause them to abandon the house.

How many bats can live in a bat house?
Up to 50 or more have been reported, though some are occupied by only one or a few. Bachelor groups tend to be smaller, sometimes consisting of half a dozen or fewer bats.

If I put up several bat houses, can I attract more bats?
Europeans often put up four at a time around a tree trunk. They arrange them to face each direction, providing a variety of temperatures that might better meet the bats' seasonal needs. In some cases, people who put up two or more houses at once report that all are occupied. In one case, however, one of two houses mounted side by side was used by 30 bats, while the other was ignored over a period of two years. Although it is difficult to anticipate how many bat houses might be needed in a given area, one might reasonably assume that more might attract more bats. Use of more than two to four is not recommended until at least one has been occupied, confirming a local need.

Can bats live in a bat house year-round, or do they leave for winter?
In Canada and the northern two-thirds of the U.S., all bats migrate south or find safe hibernating sites for winter. Very few species can long survive subfreezing temperatures. Tree-roosting species travel south, while those that would occupy bat houses generally move to an undisturbed cave or abandoned mine. The big brown bat is so hardy that it sometimes overwinters in the outer walls of buildings, but in most northern climates, even big brown bats require greater protection than a bat house could provide. Bats might overwinter in bat houses only in southern or coastal areas where winters are mild.

How many insects do bats really eat?
While birds, such as purple martins, play a major role in keeping day-flying insects in check, bats are by far the most important predators of night-flying species, consuming half their weight or more in insects each night. The amount a bat eats varies with season and reproductive condition. Nursing mothers may eat more than their body weight. The actual numbers of insects caught varies, ranging from less than a hundred moths or beetles to thousands of smaller insects, such as mosquitoes. The Mexican free-tailed bat colony from Bracken Cave, Texas, catches nearly a half million pounds of insects nightly! It takes 20 million bats to do that, but even 30 little brown bats from one bat house easily could catch more than 30,000 insects in an evening's feeding. No control is perfect, but when it comes to insects, no bug zapper is a match for bats.

Will other animals or insects occupy my bat house?
The lack of a bottom prevents competition from animals such as birds, mice or squirrels, but paper wasps and mud daubers can cause problems. Once a house is occupied by bats, wasps are unlikely to displace them.

Mud dauber nests can be easily removed by spraying them with a hose and then scraping the nests out. Mud daubers are seldom aggressive and have a weak sting, but you must be very careful with paper wasps. They are much more aggressive and have a painful sting. *Never* spray insecticides into your bat house, as this may be toxic to bats.

If you use great caution, you can kill the wasps with chloroform (or some other lethal liquid), using a saturated cotton ball placed in a plastic bag. Tape the bag to a wire hoop and attach it to the end of a pole. Slip the open bag over the bottom of the house and hold it in place until the wasps have died—usually several minutes. You can then destroy the nest with the other end of the pole.

Experts do not know a sure method to prevent wasps from building nests in bat houses. If you discover one, please write and let us know!

Is there anything I can do to protect my bats from predators, such as dogs, cats, or raccoons?
Take the same precautions as for protecting nesting birds. The mere presence of dogs or cats in the yard is unlikely to disturb bats. If you have mounted your bat house in a tree, a metal band at least two feet wide placed around the tree below the bat house will keep other animals from reaching the house. Houses hung on the sides of buildings are probably the safest from predators and seem to be preferred by bats.

Will bat droppings pose a health threat to my family?
No more so than bird droppings would. It is not a good idea, however, to unnecessarily stir up and breath dust associated with any animal feces.

What are the odds that a sick bat will endanger my family or pets with rabies?
Like all mammals, bats can contract rabies, though very few (less than half of one percent) do. Unlike many other animals, even rabid bats rarely become aggressive. They quickly die, and outbreaks in their colonies are extremely rare. The odds of being harmed by a rabid bat is remote if you simply do not attempt to handle bats. Any bat that is easily caught should be assumed to be sick and left alone.

It is helpful to put danger in perspective. In more than four decades of record keeping in the U.S., only 16 people are believed to have died of bat-borne rabies. More people die *annually* from contact with household pets. With or without bats in your yard, the most important action you can take to protect your family from rabies is to vaccinate your family dogs and cats.

Bat Conservation International
P.O. Box 162603
Austin, TX 78716
512/327-9721

Bat House Report Form

Each kind of bat has specific preferences for where it roosts: size shape, temperature, relative humidity, degree of darkness, protection form predators, etc. Because such characteristics are difficult to reproduce there is no guarantee bats will move into your new bat box. Even when they do occupy a bat box they may not move in until after it has been up a year or more.

Nevertheless, it is helpful to know what kinds of boxes are being tryed, how and where they are being put up. Completed copies of this form can help us identify the most successful house types and installation conditions. Please complete a separate form for each bat box and mail to: Education Branch, Arizona Game and Fish Department,
2221 W. Greenway Rd., Phoenix, AZ 85023

Locality: ______________________________

State County Town

Dominate character of surrounding area: (circle one)

Residential Business School Forest Woodland

Desertscrub Riparian Meadow Other ____________

Type of bat house: (circle one)

GEORGIA BCI 91 TUTTLE 88 Small Woodworker CWF 90

BCI 87 BCI MICROBAT 88 Big Woodworker Other ____________

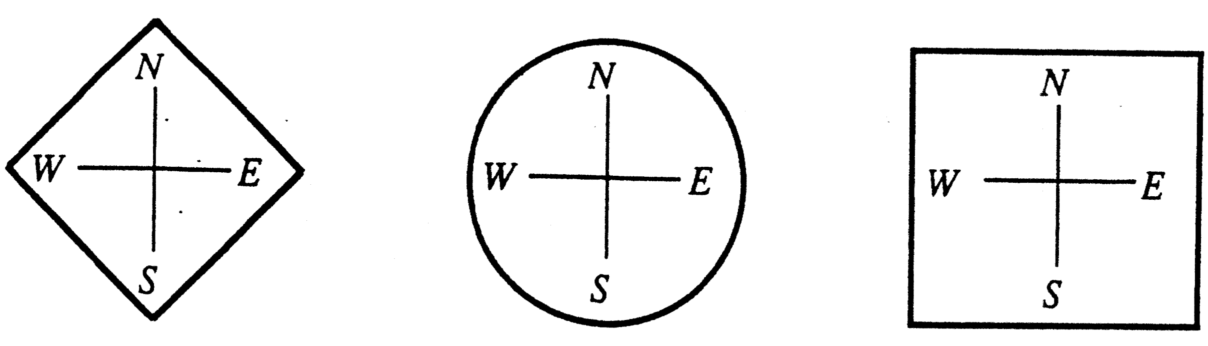
Installation data: Date erected ______________________________

Distance to permanent water: ______________________________

Type of permanent water: (circle one)

Stream Lake Pond Swimming pool Stock tank Other ____________

Exposure: (Choose or draw the shape of support structure that best approximates where the bat house is located. mark with "X" location of bat house. Assume north is top of page)



SUPPORT STRUCTURE: (circle one)

Tree Pole Side of building Other ______________________

HEIGHT OF ENTRANCE TO THE GROUND: ______________________

PROTECTION FROM ABOVE: (circle one)

Limbs Eves Porch Other ______________________

SUN (Does it get sun rays):

No Yes

IF YES WHEN? (circle one) All day Early Morn Mid Morn Noon Mid Afternoon Late Afternoon

TREATMENT: (was anything special done to encourage bat occupation?) (circle one)

No Yes (what?) ______________________

OCCUPATION HISTORY:

Date first noticed use? ______ Dates of use (from) ______ (to) ______ unknown ______

TYPE OF USE: (circle one)

Day Night Nursery Hibernation other ______________________

EVIDENCE OF USE: (circle one)

Seen exiting seen entering guano at site seen in box other ______

EXIT TIME: ______________ **ENTRY TIME:** ______________

SPECIES USING BOX: ______________________

HOW IDENTIFIED: ______________________

NAME OF PERSON IDENTIFYING BAT SPEICES: ______________________

Name

____

Address

____

Phone Number

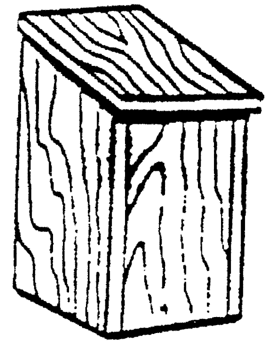
NAME OF PERSON COMPLETING FORM: ______________________

Name

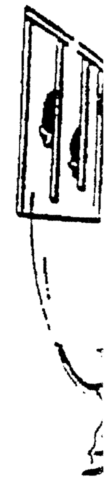
____

Address

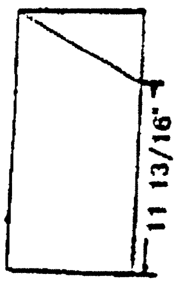
____



(Step

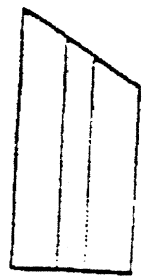


Befriend Bats --
Build Your Own Bat Box!

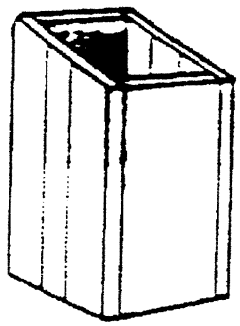


(Step 2)

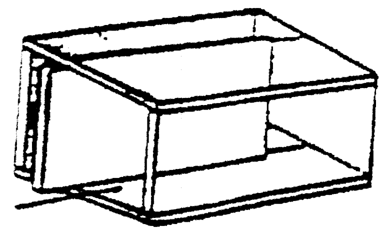
(Step 6)



(Step 7)



(Step 8)



(Step 9)

SIMILAR TO BIRDHOUSES, bat houses are easily constructed. A bat house can be put out at any time of the year, but it is preferable to hang them in fall or winter, since this is when bats seek shelter. Bats may not move into a bat box for up to a year and a half. This is thought to be the time needed for dissipation of wood odors in the box. Therefore, weathered is best. However, some bat boxes attract bats within hours. Boxes should not be painted. Holes should be drilled to prevent wood splitting. Wood should be rough to give bats a foothold.

MATERIALS: One 8' piece of 1"x8" untreated, rough-sided lumber.
One 10" piece of 1"x10" untreated, rough-sided lumber for top
About 20 six-penny galvanized nails
Saw, hammer, ruler, tape measure, pencil

Step 1: Cut the 8' piece of rough lumber into six pieces --
a) three pieces each 16" long (sides and back)
b) one piece 11 and 3/16" long (front)
c) one piece 13" (for partition c)
d) one piece 11" (partition d)

Step 2: Take two of the 16" pieces and measure off 11 and 3/16" on one side of each. Make a pencil mark at this point.

Step 3: Draw diagonal line from mark to closest corner on opposite side of board.

Step 4: Repeat step 3 on the other piece.

Step 5: Saw along diagonal lines. Set these pieces aside.

Step 6: Adjust saw to a 30 degree angle. Take the third 16" board, unmarked, and angle off one end for box back. Repeat procedure for front piece: the two partitions (c and d); and the top (10"x10"x1" piece).

Step 7: Take two side pieces from step 5, mark both according to measurements in diagram.

Step 8: Begin building. Take the two sides, the 16" back, the 11 and 13/16" front and nail together as shown, angled ends up. Make top surface even for complete seal.

Step 9: Insert partitions. Lay partially completed house on side and take 13" partition (c) and slide it into box, centering it along the pencil lines closest to box back. Position partition piece (c) so that it is flush with side tops.

Step 10: Secure partition with nails from outside. Use outside line to guide nail placement.

Step 11: Follow same procedure for securing shorter partition (d) along frontal pencil lines.

Step 12: Place 10"x10"x1" board on top so that the back edge of board is flush with box back and creates an overhang in front and on sides. Hold firmly and nail the top tightly onto main frame. Completed house should resemble final drawing.

HANGING: The easiest way to hang box is to drill two 1/4" holes in back and center these about 4" from top and bottom. Drive two stout nails into desired tree or wall and hang house by placing holes over nails.

GIVE WILDLIFE A CHANCE! Help support wildlife by contributing to the Nongame Wildlife Conservation Fund. To find out what else you can do for

BAT HOUSE REPORT FORM

Each kind of bat has specific preferences for where it roosts: size shape, temperature, relative humidity, degree of darkness, protection form predators, etc. Because such characteristics are difficult to reproduce there is no guarantee bats will move into your new bat box. Even when they do occupy a bat box they may not move in until after it has been up a year or more.

Neverthleless, it is helpful to know what kinds of boxes are being tryed, how and where they are being put up. Completed copies of this form can help us identify the most successful house types and installation conditions. Please complete a separate form for each bat box and mail

to: Education Branch, Arizona Game and Fish Department,
2221 W. Greenway Rd., Phoenix, AZ 85023

LOCALITY: ____
State County Town

DOMINATE CHARACTER OF SURROUNDING AREA: (circle one)

Residential Business School Forest Woodland

Desertscrub Riparian Meadow Other ______________

TYPE OF BAT HOUSE: (circle one)

GEORGIA BCI 91 TUTTLE 88 Small Woodworker CWF 90

BCI 87 BCI MICROBAT 88 Big Woodworker Other ______________

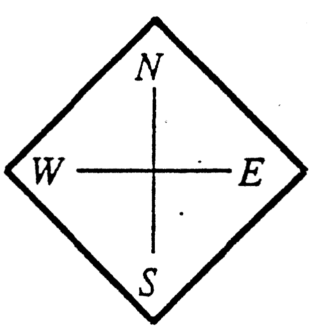
INSTALLATION DATA: Date erected ______________________________

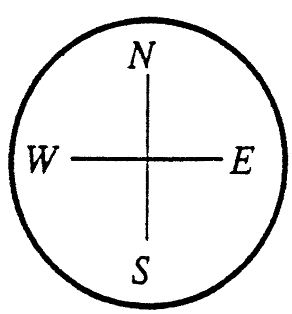
DISTANCE TO PERMANENT WATER: ______________________________

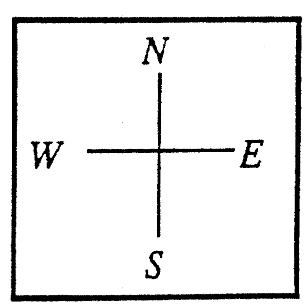
TYPE OF PERMANENT WATER: (circle one)

Stream Lake Pond Swimming pool Stock tank Other ______________

EXPOSURE: (Choose or draw the shape of support structure that best approximates where the bat house is located. mark with "X" location of bat house. Assume north is top of page)







SUPPORT STRUCTURE: (circle one)

Tree Pole Side of building Other________________

HEIGHT OF ENTRANCE TO THE GROUND: ________________

PROTECTION FROM ABOVE: (circle one)

Limbs Eves Porch Other________________

SUN (Does it get sun rays):

No Yes

IF YES WHEN? (circle one) All day Early Morn Mid Morn Noon Mid Afternoon Late Afternoon

TREATMENT: (was anything special done to encourage bat occupation?) (circle one)

No Yes (what?)________________

OCCUPATION HISTORY:

Date first noticed use?______ Dates of use (from)______(to)______unknown______

TYPE OF USE: (circle one)

Day Night Nursery Hibernation other________________

EVIDENCE OF USE: (circle one)

Seen exiting seen entering guano at site seen in box other__________

EXIT TIME:________________ ENTRY TIME:________________

SPECIES USING BOX:________________

HOW IDENTIFIED: ________________

NAME OF PERSON IDENTIFYING BAT SPEICES:________________

Name

____

Address

____

Phone Number

NAME OF PERSON COMPLETING FORM: ________________

Name

____

Address

____

The Impact of Bats on Public Health in Maricopa County

A Health Care Assessment

March 1990

Daniel P. McCartan, RN
Jimmy J. Wallace, Jr.

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Office of Epidemiology and Vital Statistics
Division of Public Health
Maricopa County Department of Health Services

Acknowledgement

We are indebted to Barry Spicer, Nongame Mammologist, with the Arizona Game and Fish Department for sharing his knowledge and expertise with us. Without his assistance, this project could not have been completed.

INTRODUCTION

Bats have aroused the curiosity and interest of man throughout our history. As members of the order Chiroptera, bats are the only mammals that can truly fly. It is this ability to fly, combined with their secretive nature and nocturnal activities that has generated suspicion, folklore and fear among many people. It is this fear that has resulted in sensationalized reporting by the media when dealing with bats. There are a number of cases where the inaccurate reporting of situations involving bats has only worsened such situations thereby causing a public uproar.

There are approximately 40 different species of bats in the United States, of which 28 are found in the state of Arizona with at least 6-9, but probably more, found in the Phoenix metropolitan area. Of this large number of bats, only a few may cause problems. The two major diseases believed to be of consequence to public health that are associated with bats are histoplasmosis and rabies. We will focus our discussion on these two areas.

IDENTIFICATION

There are three species of bats that are considered to be the most common in the Phoenix metropolitan area, the Mexican Free-tailed Bat, the Big Brown Bat, and the Pallid Bat.

The Mexican (or American or Brazilian) Free-tailed Bat (Tadarida brasiliensis) has a wingspan of 11 1/2 to 13 inches. Its body and leathery flight membranes are dark brown with some individuals being dark grey or pale brown due to bleaching by ammonia fumes emitted from the bat guano. Its tail is 'free' in that it extends beyond the interfemoral membrane that connects the hind legs. It is the smallest of the free-tailed bats in the United States.

The Big Brown Bat (*Eptesicus fuscus*) has a 13 to 14 inch wingspan and weighs about 0.7 ounces. They are copper colored with each hair being bi-colored from black to brown on the outer most portion. With the exception of the Pallid Bat, the Big Brown Bat is the largest bat found in buildings.

Although the Pallid Bat (*Antrozous pallid~~o~~us*) weighs only 0.7 ounces, they are still a relatively large appearing bat because of their 14 - 15 1/2 inch wingspan. This cream to straw colored bat has large ears, over an inch in length, and a plain nose without flaps or leaves.

Bats live in two basic styles, colonial and solitary. Bats that congregate in groups are referred to as colonial bats and include the Big Brown Bat, Mexican free-tailed Bat, and Pallid Bat.

The Big Brown Bat is the species that is probably most familiar to humans. These bats often raise their young, and may also hibernate, in buildings since they often present an ideal environment. Colonies of the Big Brown Bat are relatively small, ranging up to 40 individuals in Arizona, and as many as 200-300 individuals elsewhere.

The most colonial of all the bats is the Mexican Free-tailed Bat. Although it is primarily a cavedweller in the Southwest, it also roosts in buildings and sometimes in palm trees in urban areas. Most of the population migrates south and spends the winter in

Mexico, while a few of the species may occupy a house or other structure year round. Colonies of this species can number in the millions as evidenced by the great number of bats found in the Carlsbad Caverns. More commonly, however, they are found in groups of several hundred.

The attractively colored Pallid Bat, like the Big Brown Bat, usually occurs in small colonies in such places as under bridges and in little used buildings. In the Southwest, they may on occasion become a nuisance when they roost in a barn, garage, or porch and foul hay, cars, or picnic tables with their droppings. Their feeding habits, which include taking scorpions and crickets from the ground, make them especially interesting denizens of the desert country.

Solitary bats, such as Red Bats, Hoary Bats, and Silver-haired Bats, live alone in trees or under the bark of the tree, but never in caves. Individual members of these species may enter buildings during spring and fall migrations as transients, but do not permanently roost in the building.

HABITAT and BEHAVIOR

Caves, rocky crevices, and trees constitute the natural habitat of most bats. Some species are found in buildings and many can be found in mines. Some kinds of bats also roost in palm trees and others may occasionally be found roosting in such places as abandoned woodpecker holes or the mudnests of swallows. During the day bats roost in dark and secluded places. Toward evening they become restless and after nightfall they leave the roost to forage around water, forests, fields, buildings, street lights, and ravines for food. They may stop for an hour or so at a temporary roost to digest their food and groom themselves and each other, but around dawn they will return to their day roost.

In Arizona, 26 of the 28 bat species are insectivorous, feeding primarily on small to medium sized flying insects, which in many cases are harmful to man. The two remaining species feed on nectar and pollen. It is common for a bat to consume up to one-half its total weight in insects every night.

Bats use sound both to communicate and to locate their flying food. Low frequency sound waves, that are also audible to humans, are used for social interactions with each other. High frequency waves, which are inaudible to humans, function much like sonar enabling the bats to navigate and avoid obstacles and to capture insects.

Most bats mate during the fall, prior to hibernation, or during the winter months. The female stores the sperm in her uterus until she emerges from hibernation in the spring when ovulation and fertilization occur. Once the female is pregnant she joins other females in maternity colonies that are usually traditional sites in caves, mines, buildings, or other warm, dark places. The new bats are born between May and mid-July and grow very rapidly, being able to fly within three weeks. Most species have only one offspring, although some have twins and a few have three or four offspring in the litter. Maternity colonies disperse in July and August after weaning the newborn bats.

Around the time of the first frost the bats begin to prepare for winter. Some species migrate a relatively short distance to caves, mines, and sometimes buildings, while others, like the Mexican Free-tailed Bat, may travel up to 1000 miles. In the southern part of the country the bats may hibernate for a shorter period than the September through May cycle that is the typical pattern of bats in the northern U.S. and Canada. Their hibernation pattern may also be sporadic and some may even leave their roosts during a warm spell in the winter.

The life span of the bat is longer than most small mammals, with some living for 10 years or longer. Two Little Brown Bats that had been banded were recaptured 29 and 30 years later.

HEALTH CARE CONCERNS

As previously stated, there are two major diseases that are associated with bats, histoplasmosis and rabies. Although these are the two principal ones, there are also a number of other concerns. Bats are mammals and as such are distantly related to man, thereby making them susceptible to some of the diseases that affect humans. As a result, bats may become inadvertent vectors for transmitting human illness.

The disease-causing organisms that have been found in bats themselves, or in their guano, include bacterial agents, fungal or mycotic agents, and viral agents. Additionally, bats may harbour a variety of endoparasitic and ectoparasitic organisms that may cause disease or can carry one or more of the previously listed microbial agents.

A number of bacteria have been found in bats that cause disease in humans and animals. Since very little investigation into the bacterial community of bats has been done, the extent to which they may pose a threat to public health is not known. There are eight serious to moderately serious human pathogenic bacterial agents that have been isolated in some bats. The rate of incidence of these organisms is random and sporadic. The only bacterial organism that would be of interest to those residing in the Phoenix Metropolitan area is a mycobacterium, the causative agent in tuberculosis, recently discovered in some wild-caught Mexican Free-tailed bats from a cave in Arizona.

The most common fungal disease associated with bats is histoplasmosis, also referred to as Darling's Disease. Histoplasmosis is caused by the inhalation of spores that contain the fungus Histoplasma capsulatum (Emmonsiella capsulata). These spores are frequently found in common dust. It is estimated that up to 80% of the human population has been exposed to histoplasmosis at one time or another. The primary source of the infection is bird droppings, especially from pigeons and chickens, as well as bat guano found in hot, dry attics. Histoplasmosis is endemic in the Ohio and Mississippi River Valley area of the eastern U.S. where 90% of the cases have been reported. Outbreaks have occurred in families and groups of workers with common exposure to bird and/or bat droppings.

Infection associated with histoplasmosis is of varying severity. While infection is common, overt clinical symptomatology is not. There are five recognized clinical forms of histoplasmosis beginning with asymptomatic which presents itself as only a mild hypersensitivity reaction. The second form is acute benign respiratory which varies from mild respiratory illness to temporary incapacity with general malaise, weakness, fever, chest pains, and a dry or productive cough. Occasionally, erythema multiforme and erythema nodosum may be present, and sometimes multiple, small scattered calcifications in the lungs, hilar lymph nodes, and spleen may be seen.

The third form is acute disseminated which is characterized by hepatosplenomegaly, accompanied by septic-type fever, prostration, and a rapid course often resembling military tuberculosis. It is most frequent in infants and small children and is usually fatal without treatment. The fourth form is chronic disseminated which has variable symptoms including unexplained fever, anemia, patchy pneumonia, hepatitis, endocarditis, meningitis, mucosal ulcers in the mouth, larynx, stomach or bowel. Adrenal infection is common but is usually asymptomatic in nature. This form is more common in adult males and may follow cytotoxic or corticosteroid therapy. In this case, the disease will progress over the course of a few years and will be fatal without treatment.

The final form is chronic pulmonary which clinically and radiologically resembles chronic pulmonary tuberculosis. It is more common in males over age 40, and is progressive over a number of months and years with periods of flair-ups and occasional spontaneous cures.

Clinical diagnosis is confirmed by culture or by visualizing the fungus in Giema or Wright stained smears of ulcer exudate, bone marrow, sputum or blood. Special stains are necessary to demonstrate the fungus in biopsies of ulcers, liver, lymph nodes, or lungs. Several serologic tests are available for the serum antibodies, but they are not specific enough to be reliable for diagnostic purposes. False negative tests are common enough that negative serological tests should not exclude the diagnosis.

There are also a number of other disease-causing fungal organisms associated with bats and bat guano, although none is unique to bats alone. These organisms are currently limited to bat species that are not native to our area.

Bats are infected by a wide variety of viruses. Virology of bats is a new and growing science that is complicated by the small size of some bats and the difficulty in obtaining a large enough serum sample from bats to enable extensive testing. The colonial habits of bats make the transmission of a viral agent very easy. Everyday, humans encounter numerous viruses from a multitude of sources. Many of these are often not pathogenic at all and many others are not pathogenic in man. However, it is important to note that some viruses, such as those that use the bat as a vector for transmission, may cause death in man and animals. An example of this is Western equine encephalitis and Yellow fever virus. Also of importance is the fact that most viral agents associated with bats occur only in very localized areas of the world and often do not affect humans. An example of this is the Rio Bravo virus that is limited to the southwestern area of the United States. This virus is harmless to bats and humans, but is fatal to mice.

The greatest threat to man caused by a viral agent transmitted by bats is rabies. The disease is most frequently associated with wild and domestic cats and dogs, although any warm blooded animal is susceptible to rabies. The rabies virus can be found almost everywhere in the world with the exception of Great Britain, Australia, Hawaii, and other Pacific islands. Rabies has been reported in about 30 of the 40 species of bats in the U.S., and in all 48 lower states. In the U.S. there have only been 15 reported cases of rabies in humans from bats since 1953.

Rabies in bats is very similar to rabies in other animals with the difference that the bat can fly and is rarely aggressive. The data that states that rabies in bats is high is incorrect because the data reflect figures of the number of sick animals examined in the lab and not a random sample. Actual infection rates in bats are too low to be calculated. In North America, as an example, the actual infection rate is very low, being estimated at less than one half of one percent. Rabies outbreaks in bats, other than the vampire bat which regularly attacks livestock, either do not occur or must be rare. It is important to note that Vampire Bats do not occur in the United States.

As stated earlier, rabies is almost exclusively an animal disease, proving fatal in man if left untreated. The disease affects the nervous system with initial symptoms of apprehension, headache, fever, malaise, and sensory changes at the wound site. The disease progresses to paralysis, hydrophobia, and death, usually after 2-6 days. Diagnosis is confirmed by specific fluorescent antibody staining of brain tissue or by virus isolation.

There are a number of a protozoal and helminthic and arthropod parasites that use the bat as a host, and are usually host specific. The only concern humans might have with these parasites would be with the arachnids, including ticks and mites. On occasion, bat mites may find their way onto a human host. This usually occurs when the bats occupy a dwelling which is primarily used by man. The mites may bite their human host and there are records of reactions to these bites ranging from mild dermatitis and, very rarely, to rather serious but undiagnosed diseases.

Also of concern are ticks that can be found on many species of bats. These ticks rarely attack humans and inflict painful bites. Such attacks may occur when bats occupy human dwellings.

MANAGEMENT CONCERNS

In handling any situations that involve bats there are a number of concerns that must be addressed. The only time that health care personnel are sought for a bat problem is usually when the bat is ill or dead. The chances of being bitten or coming in contact with some pathogen is significantly increased when the bat is ill. Bites, or other contact, can be effectively prevented by not directly handling the bat, i.e. by the use of forceps, containers, and leather gloves. As far as rabies is concerned, researchers and others at high risk for exposure to rabies should be inoculated. The modern rabies vaccine is relatively painless, very effective, and one of the safest inoculations we have. The human diploid cell rabies vaccine is the preferred choice because of its effectiveness and lack of adverse reactions.

A second area of concern involves entry into an area believed to be infested with bats. Since the possibility of infection with histoplasmosis increases with the amount of spores that are inhaled, anyone entering an area with suspected bats or bat guano must be wearing a 2-micron fine respirator or a self contained breathing apparatus. If guano samples are to be taken the guano must be wetted down with water and then scrapped very carefully into a plastic bag or petri dish. This will prevent a large number of spores from entering the atmosphere.

The final area of concern centers around the public. The amount of exposure given a bat-related incident in the press will do nothing but increase the public's concerns. Many situations have been worsened by the careless reporting of bat related problems. Public education is needed to correct the persistent misinformation and ease the fears associated with bats. We, as health care professionals, have the responsibility to insure that only accurate information is given and that the media refrains from sensationalizing information on bats.

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Bat Watcher's Etiquette

- **Strive at all times to disturb as little as possible roosting, foraging or other activities of bats.**

- **At roosts sites stay as far away from the bats as possible.** Keep lights, flash photography, noise, and other activities in the vicinity of a roost to a minimum. Although some bats sometimes persist in using a roost site despite attempts to discourage them, many others abandon their roosts after minimal disturbance.

  If you are observing roosting bats do it from a distance, using your binoculars when possible. If you must approach or pass close by them try to do it in small, quiet groups, each with just one light. Groups talking or laughing loudly, banging equipment, shining a dozen bobbing lights and all snapping several dozen photographs will be serious disturbances to almost any group of roosting bats.

  Keep in mind that you are 10-15 times taller and at least 800 times bigger by weight than even the largest bats in Arizona.

- **Refrain from visiting maternity roosts during the nursery season (May through July).** This is one of a bat population's most vulnerable periods because such disturbance is likely to cause young bats to lose their grip and fall to the floor, thus increasing injuries and deaths. It may also cause roost abandonment. Observation of exits, entries, etc. can be made from outside the roost site.

- **Do not disturb, much less awaken, hibernating bats.** Lights, noise, flashbulbs, etc. will arouse hibernating bats. Arousal from hibernation increases use of stored energy reserves and may thus decrease the time a bat can stay in hibernation. This depletion of energy reserves and shortened hibernation may result in the bat awakening too early in spring, reducing its chances for survival.

Arizona Game and Fish Department, Education Branch, 8/91

Appendix M: Landscape

Naval Observatory Flagstaff Station

APPROVED PLANT LIST, 2007 NOV 13

CONDITIONS OF USE

1. Landscape designs and plant lists shall be reviewed and approved by the Installation Biologist and NAVFAC Landscape Architect (Bruce Rudd, phone: 619-532-4079, e-mail: bruce.rudd@navy.mil) in the planning stages of project design.

2. For each project, native species from the approved plant list shall constitute a minimum of 80 percent of the plant material within each stratum (herb, shrub, and tree). Other drought tolerant species from this list shall constitute the remainder of the plant material (a maximum of 20 percent in each stratum) for each project. A higher proportion of natives may be required for projects within or adjacent to natural areas. The determination of whether cultivars are considered native or exotic will be made on a project-by-project basis by the Navy points of contact listed above.

3. It is vital that coordination with the Navy points of contact occur early in the planning process to determine site-specific needs and constraints. Please note that not all species on this list are appropriate for all settings. For example, in some areas trees may not be approved due to Bird/Animal Strike Hazard risks and/or the presence of federally listed species.

4. Additional native species may be included in the landscape design contingent upon the approval of the Navy points of contact listed above.

5. All plants shall be verified for availability in size and quantities needed for each project prior to specifying on plans or scopes of work.

6. This list is updated periodically. Prior to initiating a project, please obtain the most recent list from either of the Navy points of contact listed above.

PLANTS UNACCEPTABLE FOR LANDSCAPING UNDER ANY CIRCUMSTANCES

Scientific name	Common Name
Aptenia spp.	Red apple ice plant
Asphodelus fistulosus	Onion weed
Carpobrotus spp.	Hottentot fig ice plant
Cephallophyllum spp.	Red spike ice plant
Chyrsanthemum spp.	Chrysanthemum
Cortaderia spp.	Pampas grass
Delosperma spp.	Disneyland ice plant
Dorotheanthus spp.	Livingstone daisy ice plant
Gazania spp.	Gazania, treasure flower
Hypericum canariense	St. John's wort
Lampranthus (Oscularia) spp.	Ice plant
Malephora spp.	Ice plant
Mesembryanthemum spp.	Ice plant
Myoporum laetum	Ngaio tree
Pennisetum spp.	Fountain grass
Schinus terebinthifolius	Brazilian pepper-tree
Tragopogon spp.	Goat's beard

A copy of the Invasive Non-Native Plants that Threaten Wildlands in Arizona (August 2005) is at the end of this Appendix.

APPROVED PLANT LIST

	Common Name	*Species name*	Prevents Erosion	Drought Tolerance	Description	Attracts birds/insects
TREES						
TREES	White fir	*Abies concolor*		Medium		
	Amur maple	*Acer ginnala*		Low	Hardy, best in partial sun	
	Bigtooth maple	*Acer grandidentatum*		Low		
	Curl-leaf mahogany	*Cercocarpus ledifolius*		High		
	Utah juniper	*Juniperus osteosperma*		High		
	Rocky mountain juniper	*Juniperus scopulorum*		High	Native evergreen	
	Colorado blue spruce	*Picea pungens*		Medium	Evergreen; pyramid shaped	
	Twoneedle pinyon	*Pinus edulis*		High	Bushy evergreen with edible seeds	
	Black locust	*Robinia pseudoacacia*		High	Shade tree; drought and wind tolerant	
SHRUBS/VINES						
SHRUBS/VINES	Utah serviceberry	*Amelanchier utahensis*		High		
	Desert false indigo	*Amorpha fruticosa*		Medium		
	Prairie sagewort	*Artemisia frigida*		High		
	White sage brush	*Artemisia ludoviciana*		High	Silvery-white, aromatic foliage	
	Yellow bird of paradise	*Caesalpinia gilliesii*		High	Green berries	
	Netleas hackberry	*Celtis reticulata*		High		
	Mountain mahogany	*Cercocarpus spp.*		High	Semi-evergreen	
	Desert sweet	*Chamaebatiaria millefolium*		High		butterflies
	Western white clematis	*Clematis ligusticifolia*		Medium		
	Rubber rabbitbush	*Ericameria nauseosa*		High	Evergreen with plumes of yellow flowers; drought tolerant	
	Apache plume	*Fallugia paradoxa*		High	Pink seed heads in summer	
	Velvet ash	*Fraxinus velutina*		Medium		
	Rockspirea	*Holodiscus dumosus*		High		
	Creeping barberry	*Mahonia repens*		High		
	Sacahuista	*Nolina microcarpa*		High		
	Virginia creeper	*Parthenocissus inserta*			scrabbles instead of climbs; good groundcover	
	Littleleaf mock orange	*Philadelphus microphyllus*		High		
	Shrubby cinquefoil	*Potentilla fruticosa*				
	American plum	*Prunus americana*		None		
	Chokecherry	*Prunus virginiana*		Medium	Red to black berries	
	Common hoptree	*Ptelea trifoliata*		Low		
	Smooth sumac	*Rhus glabra*		Medium		
	Skunkbush sumac	*Rhus trilobata*		Medium		
	Currant (golden/wax)	*Ribes spp.*			Spring flowers	
	New Mexico locust	*Robinia neomexicana*		Medium	Pink, pea-like flowers	
	Wood's rose	*Rosa woodsii*			Fragrant pink flowers in spring and summer; red fruit	
	Silver Buffaloberry	*Shepherdia argentea*		Medium		
GRASSES						
GRASSES	Blue grama	*Bouteloua gracilis*	X	High	Low traffic turf alternative	
	Arizona fescue	*Festuca arizonica*	X	Medium	Bunch grass with dense, thin blades	
	Bluejoint	*Calamagrostis canadensis*	X	Low	Upright grass with tawny, fluffy flower heads	
	Little bluestem	*Schizachyrium scoparium*	X	High	Reddish fall and winter color	

	Common Name	*Species name*	Prevents Erosion	Drought Tolerance	Description	Attracts birds/insects
FLOWERS/GROUNDCOVERS						
FLOWERS/GROUNDCOVERS	Fragrant white sand verbena	*Abronia fragrans*				
	Western yarrow	*Achillea millefolium* var. *occidentalis*		Medium	Fern-like foliage with white blooms; many colored cultivars	
	Bill Williams mountain giant hyssop	*Agastache pallidiflora*				
	Threadleaf giant hyssop	*Agastache rupestris*			Licorice scented, light orange flowers in summer	hummingbirds
	Nodding onion	*Allium cernuum*				
	Pussytoes	*Antennaria* spp.				
	Colorado blue columbine	*Aquilegia caerulea*		Low		
	Golden columbine	*Aquilegia chrysantha*				
	Southwestern prickly poppy	*Argemone pleiacantha*				
	Spider milkweed	*Asclepias asperula*			Green and purple petals	
	Showy milkweed	*Asclepias speciosa*		Low		butterflies
	Butterfly milkweed	*Asclepias tuberosa*		High	Yellow to orange flowers in summer	hummingbirds
	Purple aster	*Aster bigelovii*				
	Heath aster	*Aster falcatus* var. *commutatus*				
	Tahoka daisy	*Aster tanacetifolius*		Medium		
	Ragleaf bahia	*Bahia dissecta*				
	Hartweg's sundrops	*Calylophus hartwegii*				
	Bluebell bellflower	*Campanula rotundifolia*				
	Whole leaf Indian paintbrush	*Castilleja integra*				
	White-felted paintbrush	*Castilleja lanata*				
	Plains paintbrush	*Castilleja sessiliflora*				
	Baby white aster	*Chaetopappa ericoides*				
	Fireweed	*Chamerion angustifolium* ssp. *circumvagum*				
	Rocky clematis	*Clematis pseudoalpina*				
	Rocky Mountian beeplant	*Cleome serrulata*		Low		
	Birdbill dayflower	*Commelina dianthifolia*				
	Scrambled eggs	*Corydalis aurea*				
	Blue dicks	*Dichelostemma pulchellum*				
	Spectacle pod	*Dimorphocarpa Rollins*				
	Showy daisy or mountain aster	*Erigeron formosissimus*				
	Sanddune wallflower	*Erysimum asperum* var. *capitatum*				
	Red dome blanketflower	*Gaillardia pinnatifida*			Red disk flowers surrounded by yellow ray flowers	
	Pineywoods geranium	*Geranium caespitosum*				
	Old man's whiskers	*Geum triflorum*				
	Showy goldeneye	*Heliomeris multiflora*			Yellow sunflowers summer through fall	
	Hairy false goldenaster	*Heterotheca villosa*		Medium		
	Owl's-claws	*Hymenoxys hoopesii*			Bright yellow flowers	
	Arizona ipomopsis	*Ipomopsis arizonica*			Red flowers	
	Rocky Mountain Iris	*Iris missouriensis*		Low		
	Medium pepperweed	*Lepidium virginicum medium*				
	Moutain pepperweed	*Lepidium montanum*		Medium		
	Cardinalflower	*Lobelia cardinalis*		Medium		
	Silver lupine	*Lupinus argenteus*		Medium		
	Roving soldier	*Maurandya antirrhiniflora*		Medium		
	Plains blackfoot	*Melampodium leucanthum*				
	Rough mendora	*Menodora scabra*		High		
	Seep monkey flower	*Mimulus guttatus*		None		
	Colorado four o'clock	*Mirabilis multiflora*		High	Large magenta flowers	
	Primrose	*Oenothera* spp.				butterflies

	Common Name	*Species name*	Prevents Erosion	Drought Tolerance	Description	Attracts birds/insects
FLOWERS/GROUNDCOVERS	Limoncillo or lemonweed	*Pectis angustifolia*		High		
	Giant lousewort	*Pedicularis grayi*				
	Penstemon	*Penstemon* spp.				
	Gypsum phacelia	*Phacelia integrifolia*				
	Towering Jacob's ladder	*Polemonium foliosissimum*				
	Wolly cinquefoil	*Potentilla hippiana*			Silver foliage with yellow, rose like flowers	
	Scarlet cinquefoli	*Potentilla thurberi*			Deep red flowers	bees
	Parry's primrose	*Primula parryi*				
	Wolly paperflower	*Psilostrophe tagetina*				
	Upright prairie coneflower	*Ratibida columnifera*		Medium		
	Cutleaf coneflower	*Rudbeckia laciniata*		High		
	Cockerell's stonecrop	*Sedum cockerelli*				
	Broomlike ragwort	*Senecio spartioides*			Showy yellow flowers	
	Cardinal catchfly	*Silene laciniata*				
	Canada goldenrod	*Solidago canadensis*		Medium		
	Scarlett globemallow	*Sphaeralcea coccinea*		High		butterflies, bees and hummingbirds
	Desert prince's plume	*Stanleya pinnata*				
	Montain golden banner	*Thermopsis montana*				
	Alpine pennycress	*Thlaspi alpestre*				
	Western spiderwort	*Tradescantia occidentalis*				
	Dakota mock vervain	*Verbena bipinnatifida*				
	Secnted verbena	*Verbena goodingii*				
	Spike verbena	*Verbena macdougalii*				
	Purple verbena	*Verbena wrightii*				
	Golden crownbeard	*Verbesina encelioides*				
	Joe Pye weed or ironweed	*Vernonia missurica*				
	Showy golden eye	*Viguiera multiflora*				
	Rough mule's eyes	*Wyethia scabra*				
	Hummingbird trumpet	*Zauschneria latifolia*				

Invasive Non-Native Plants That Threaten Wildlands in Arizona

A categorized list developed by the Arizona Wildlands Invasive Plant Working Group

August 2005

Supporting Organizations

Arizona Association of Environmental Professionals
Arizona Department of Agriculture
Arizona Department of Environmental Quality
Arizona Department of Transportation
Arizona Department of Water Resources
Arizona Game and Fish Department
Arizona Native Plant Society
Arizona-Sonora Desert Museum
Arizona State Land Department
Arizona State Parks
Bureau of Indian Affairs
Bureau of Land Management
Bureau of Reclamation
National Park Service
Sonoran Institute
Southwest Vegetation Management Association
The Nature Conservancy in Arizona
University of Arizona Cooperative Extension
US Army Corps of Engineers
US Department of Defense
US Environmental Protection Agency
US Fish and Wildlife Service
USDA Forest Service
US Geological Survey

The appearance of an organization's name above indicates that it: (1) recognizes that the list was developed in a transparent, unbiased, and scientific manner; (2) supports the conclusions reached during the Arizona Wildlands Invasive Plant Working Group's (AZ-WIPWG) listing and oversight process as reflected by the plants contained in the resultant list and their categorization; and (3) intends to use and internally promote the list to guide day-to-day management activities in accordance with its particular organizational mission and responsibilities.

Purpose

Invasive non-native plants, especially those that alter ecological processes such as fire and hydrologic regimes, are a significant threat to Arizona's wildlands. Federal and state noxious weed lists, however, are concerned primarily with agricultural pests that in some cases are not yet in the state. As a result, these regulatory lists do not provide land managers and other stakeholders with a complete picture of those non-native plants that can impact native species, plant and animal communities, and ecosystems. What is needed is objective information that identifies and distinguishes those non-native plants that can invade an area and cause adverse ecological impacts from those non-native plants that, at least based on current knowledge, are relatively innocuous.

Approach

To address the above need, over 20 federal and state agencies, academic institutions, and private conservation, professional, and commercial interests from across Arizona joined together to form the Arizona Wildlands Invasive Plant Working Group (AZ-WIPWG). The AZ-WIPWG was truly an example of multiple organizations partnering and sharing resources to accomplish a mutual goal. Over a two and a half-year period, the AZ-WIPWG developed the enclosed categorized list of invasive non-native plants that threaten Arizona's wildlands. This non-regulatory list was constructed through the application of a regionally developed assessment protocol, *Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands*, released in February of 2003 (the ***Criteria***). The AZ-WIPWG implemented a comprehensive review and oversight process that ensured a consistent and objective evaluation of each non-native plant considered. To be evaluated a non-native plant species had to be established in Arizona's wildlands (that is, outside of human cultivation and management).

Categorized List

High: These species have severe ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate to high rates of dispersal and establishment; and species are usually widely distributed, both among and within ecosystems /communities. See page 9 for annotations.

Plants Ranked High (19)

- ***Acroptilon repens*** (Russian knapweed)
- ***Arundo donax*** (Giant reed)
- ***Bromus rubens*** (Red brome)
- ***Bromus tectorum*** (Cheatgrass)
- ***Centaurea solstitialis*** (Yellow starthistle)
- ***Eichhornia crassipes*** (Water hyacinth)
- ***Elaeagnus angustifolia*** (Russian olive)
- ***Eragrostis lehmanniana*** (Lehmann lovegrass)
- ***Euphorbia esula*** (Leafy spurge)
- ***Euryops multifidus*** (Sweet resinbush)
- ***Lepidium latifolium*** (Perennial pepperweed)
- ***Myriophyllum aquaticum*** (Parrot's feather)
- ***Myriophyllum spicatum*** (Eurasian watermilfoil)
- ***Pennisetum ciliare*** (Buffelgrass)
- ***Pennisetum setaceum*** (Fountain grass)
- ***Salvina molesta*** (Giant salvinia)
- ***Tamarix chinensis*** (Fivestamen tamarisk)
- ***Tamarix parviflora*** (Smallflower tamarisk)
- ***Tamarix ramosissima*** (Saltcedar)

Elaeagnus angustifolia **(Russian olive). Photo by John M. Randall, The Nature Conservancy**

Medium: These species have substantial and apparent ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate to high rates of dispersal, often enhanced by disturbance; and ecological amplitude (diversity of ecosystems/communities) and distribution (within an ecosystem/community) range from limited to widespread.

Plants Ranked Medium (40)

- ***Alhagi maurorum*** (Camelthorn)
- ***Avena fatua*** (Wild oat)
- ***Brassica tournefortii*** (Sahara mustard)
- ***Bromus diandrus*** (Ripgut brome)
- ***Bromus inermis*** (Smooth brome)
- ***Cardaria chalapensis*** (Lenspod whitetop)
- ***Cardaria draba*** (Whitetop)
- ***Cardaria pubescens*** (Hairy whitetop)
- ***Carduus nutans*** (Musk thistle)
- ***Centaurea biebersteinii*** (Spotted knapweed)
- ***Centaurea diffusa*** (Diffuse knapweed)
- ***Centaurea melitensis*** (Malta starthistle)
- ***Chondrilla juncea*** (Rush skeletonweed)
- ***Cirsium arvense*** (Canada thistle)
- ***Conium maculatum*** (Poison hemlock)
- ***Convolvulus arvensis*** (Field bindweed)
- ***Cortaderia selloana*** (Pampas grass)
- ***Cynodon dactylon*** (Bermudagrass)
- ***Erodium cicutarium*** (Redstem filaree)
- ***Hordeum murinum*** (Mouse barley)
- ***Linaria dalmatica*** (Dalmatian toadflax)
- ***Linaria vulgaris*** (Yellow toadflax)
- ***Lolium perenne*** (Perennial ryegrass)
- ***Melilotus alba*** (White sweetclover)
- ***Melilotus officinalis*** (Yellow sweetclover)
- ***Mesembryanthemum nodiflorum*** (Slenderleaf iceplant)
- ***Rhus lancea*** (African sumac)
- ***Rubus armeniacus*** (Himalayan blackberry)
- ***Rubus discolor*** (Himalayan blackberry)
- ***Saccharum ravennae*** (Ravennagrass)

- ***Salsola collina*** (Slender Russian thistle)
- ***Salsola paulsenii*** (Barbwire Russian thistle)
- ***Salsola tragus*** (Prickly Russian thistle)
- ***Schismus arabicus*** (Arabian schismus)
- ***Schismus barbatus*** (Common Mediterranean grass)
- ***Sonchus asper*** (Spiny sowthistle)
- ***Sonchus oleraceus*** (Annual sowthistle)
- ***Sorghum halepense*** (Johnsongrass)
- ***Ulmus pumila*** (Siberian elm)
- ***Vinca major*** (Bigleaf periwinkle)

Cardaria draba **(Whitetop). Photo by John M. Randall, The Nature Conservancy**

Brassica tournefortii **(Sahara mustard). Provided by U.S. Fish and Wildlife Service**

Centaurea melitensis **(Malta starthistle). Photo by John M. Randall, The Nature Conservancy**

Low: These species have minor yet detectable ecological impacts; invasiveness attributes result in low to moderate rates of invasion; ecological amplitude and distribution are generally limited, but the species can be problematic locally.

Plants Ranked Low (12)

- ***Aegilops cylindrica*** (Jointed goatgrass)
- ***Asphodelus fistulosus*** (Onionweed)
- ***Cirsium vulgare*** (Bull thistle)
- ***Cynoglossum officinale*** (Houndstongue)
- ***Echinochloa crus-galli*** (Barnyardgrass)
- ***Elymus repens*** (Quackgrass)
- ***Eragrostis curvula*** (Weeping lovegrass)
- ***Leucanthemum vulgare*** (Oxeye daisy)
- ***Mesembryanthemum crystallinum*** (Common iceplant)
- ***Onopordum acanthium*** (Scotch thistle)
- ***Panicum antidotale*** (Blue panicum)
- ***Tamarix aphylla*** (Athel tamarisk)

***Asphodelus fistulosus* (Onionweed). Photo by John M. Randall, The Nature Conservancy**

Evaluated but not listed: Designation when current information is inadequate to respond to the ***Criteria*** questions or sum effects of ecological impacts, invasiveness, and ecological amplitude and distribution are below the threshold for listing.

Plants Evaluated but not listed (3)

- ***Hydrilla verticillata*** (Hydrilla)
- ***Tribulus terrestris*** (Puncturevine)
- ***Verbascum thapsus*** (Common mullein)

Alert: Additional designation for some species in either the high or medium category, but whose current ecological amplitude and distribution are limited. This designation alerts site managers to species capable of invading unexploited natural communities, based on initial, localized observations or behavior in similar ecosystems/communities elsewhere.

Plants with an Alert Designation (19)

- ***Bromus diandrus*** (Ripgut brome)
- ***Cardaria chalapensis*** (Lenspod whitetop)
- ***Cardaria draba*** (Whitetop)
- ***Cardaria pubescens*** (Hairy whitetop)
- ***Chondrilla juncea*** (Rush skeletonweed)
- ***Conium maculatum*** (Poison hemlock)
- ***Eichhornia crassipes*** (Water hyacinth)
- ***Euphorbia esula*** (Leafy spurge)
- ***Lepidum latifolium*** (Perennial pepperweed)
- ***Linaria vulgaris*** (Yellow toadflax)
- ***Mesembryanthemum nodiflorum*** (Slenderleaf iceplant)
- ***Myriophyllum aquaticum*** (Parrot's feather)
- ***Myriophyllum spicatum*** (Eurasian watermilfoil)
- ***Rhus lancea*** (African sumac)
- ***Rubus armeniacus*** (Himalayan blackberry)
- ***Rubus discolor*** (Himalayan blackberry)
- ***Saccharum ravennae*** (Ravennagrass)
- ***Salvina molesta*** (Giant salvinia)
- ***Vinca major*** (Bigleaf periwinkle)

Red Flag : Additional designation assigned by the AZWIPWG to identify and document a critical piece of information not evident in the overall ranking.

Red Flag Annotations (21)

Aegilops cylindrica—Above 1,220 meters (4,000 feet) elevation, *Aegilops cylindrica* can replace native herbaceous and shrub vegetation subsequent to its removal on highly disturbed soil surfaces. *Aegilops cylindrica* infestations alter natural fire regimes during the summer months when wildfires are most likely to occur by increasing fine-fuel loads relative to native vegetation. Roadside populations of *A. cylindrica* connect rights-of way that serve as fire corridors to wildlands and, as a result, increase the risk of wildfires in the wildland-urban interface. Because *A. cylindrica* can occur as a contaminant in revegetation seed lots, seed mixes should be checked for the presence of this species.

Brassica tournefortii—Abundant rainfall during the latter part of 2004 and early 2005 resulted in an undocumented response by *Brassica tournefortii* in terms of number of individuals and total biomass. These increases potentially contributed to the altered fire regimes (that is, increased number and areal extent of fires) that occurred in Arizona at lower elevations during 2005. Should these trends persist in future years, then the scores and rank reported here for *B. tournefortii* should be revisited.

Bromus inermis—*Bromus inermis* should not be used for reclamation purposes in wildlands because of its persistence and invasive potential.

Centaurea biebersteinii—*Centaurea biebersteinii* likely has not yet reached its full invasive potential in Arizona. Its ecological impacts and reproductive capacity are well documented in other states, especially in Montana. *Centaurea biebersteinii* has great potential to increase its abundance and areal extent in Arizona on sites that are subjected to fire suppression, mechanical fuel treatment (that is, thinning), or timber harvest activities on public lands.

Cirsium arvense—*Cirsium arvense* has been observed in a variety of ecosystems/plant communities across Arizona and in even more ecological types in other states, but it currently has few occurrences within any specific ecological type in Arizona. Above elevations of 1,525 meters (5,000 feet), *C. arvense* has a high potential to invade many ecological types. It may not have had, however, enough time or opportunity to exploit these types. Because this plant is extremely difficult to control, land managers currently without infestations may want to consider this plant as a priority for early detection and monitor accordingly.

Cortaderia selloana—*Cortaderia selloana* is widely sold as both a live plant or seed in Arizona and on the internet. It also is promoted as a low water-use plant in Arizona. As a relatively new plant to Arizona, *C. selloana* has only started to appear in wildlands. Based on the species' broad ecological amplitude, it potentially can become as problematic in Arizona as it now is in California and other places. At present *C. selloana* exists only in small patches in the state; however, plenty of unoccupied niches, such as riparian corridors, are available to this species to invade.

Eichhornia crassipes—At present no wildland aquatic ecosystems within Arizona are known to be infested with *Eichhornia crassipes*. Records at the Arizona Department of Agriculture, however, indicate several small (< 0.4 hectares [1 acre]) populations have been discovered and eradicated from Arizona wildland streams, park ponds, and irrigation tail-water pits during the past 20 years. *Eichhornia crassipes* is listed as a regulated and restricted noxious weed in Arizona.

Eragrostis curvula—This assessment does not pertain to *Eragrostis curvula* var. *conferta* (Boer lovegrass). This taxon has different moisture and temperature limits relative to the species as whole and likely behaves differently in regard to its ecological impacts, invasiveness, and ecological amplitude. *Eragrostis curvula* var. *conferta* as a valid taxon is ambiguous as the U.S. Department of Agriculture Plants Database regards it as a synonym of *E. curvula*. Because of the differences in environmental tolerances and ploidy between *E. c.* var. *con-*

ferta and the species as a whole, for the purposes of this list *E. c.* var. *conferta* is considered a separate taxon and is not evaluated as part of *E. curvula*.

Euryops multifidus—Only about 10 known populations of *Euryops multifidus* occur in Arizona. Those populations have been mapped and most locations have active control efforts. Vegetation survey projects should be aware that undocumented populations may exist on historic Civilian Conservation Corps project sites.

Hordeum murinum—Some authorities recognize *Hordeum glaucum*, *H. leporinum*, and *H. murinum* as separate species; however, based on the use of the U.S. Department of Agriculture Plants Database as the authority for reconciling taxonomic questions, *H. murinum* is recognized herein as the valid species taxon and *H. m. glaucum*, *H. m. leporinum*, and *H. m. murinum* are recogized as subspecies.

Hydrilla verticillata—Although based on its question and section scores related to Impact and Invasiveness *Hydrilla verticillata* potentially could have been ranked as a **High**, **Alert** taxon, it was assigned an Evaluated but not listed designation to reflect its current distribution status: present in the state but only in human-constructed water bodies. If inadvertently introduced into natural, low-elevation water bodies in Arizona, *H. verticillata* easily could establish and flourish in Arizona's wildlands.

Lepidium latifolium—*Lepidium latifolium* is not widely distributed in Arizona. Established populations occur mostly near the northern borders of the state. Land managers should be on the alert for isolated plants or small nascent populations that can be eradicated before they can spread. *Lepidium latifolium* is a difficult species to eradicate so addressing infestations while they are small is critical.

Linaria dalmatica—*Linaria dalmatica* occurs within a variety of ecosystems/plant communities that experience different natural fire regimes. *Linaria dalmatica*, however, established in these various ecological types after the onset of habitat alteration and fire exclusion that characterizes these types today. Because *L. dalmatica* was not present when historic (natural) fire regimes were functioning, it is unclear how the presence of *L. dalmatica* might affect the ability to restore a natural fire regime. Little empirical evidence exists to enable anticipating these potential effects. The expanding wildland-urban interface and projected increases in the intensity of forest restoration/fuel treatments may provide new opportunities for *L. dalmatica* to spread into forested areas. Only a portion of *L. dalmatica* seeds may germinate in any given year. As a result, dormant seeds may germinate at sites following herbicide applications or other site disturbances that reduce native plant competition.

***Melilotus* spp.** (*M. alba, M. officinalis*)—*Melilotus* spp. is invasive in a number of ecosystems/plant communities in Arizona. *Melilotus* spp. also may be used, however, in semi-arid habitats in northern Arizona for reclamation purposes where it has been difficult to reestablish native species after disturbances such as fire. Once suitable native alternatives can be identified and successfully restored in these areas, use of *Melilotus* spp. for reclamation purposes should be discontinued.

Pennisetum ciliare—At present *Pennisetum ciliare* is only occasionally observed in semi-desert grasslands and Chihuahuan desertscrub and has not been observed in southwestern interior chaparral scrub, and Madrean evergreen woodland. Invasion into these "cooler" ecological types could increase or begin if the new cold-tolerant cultivar "Frio" is released into Arizona. Continued development of cold tolerance or drought tolerance in *P. ciliare* cultivars poses a significant ecological threat if such cultivars are released into Arizona wildlands.

Pennisetum setaceum—Although *Pennisetum setaceum* is established in a number of ecosystems/plant communities, it is not yet present in many individual occurrences of these types. Large areas of suitable wildland habitat still remain for this species to colonize. The misnamed *Pennisetum setaceum* "Rubrum" (with dark purplish foliage and purplish crimson spikes) or *P. setaceum* purple-type is actually a distinct species, *P. advena*. *Pennisetum advena* is sold commercially in Arizona as an ornamental but reportedly does not reproduce reliably from seed and, as a result, was not evaluated.

Tamarix aphylla—*Tamarix aphylla* currently has a limited distribution within Arizona wildlands even though many thousands of populations are present in agricultural and urban areas of southwestern Arizona. The species was introduced to provide windbreaks for homesteads. Until recently seeds were thought to be sterile and the only means of spread into wildlands was via vegetative reproduction. It is now known that *T. aphylla* can hybridize with other *Tamarix* spp. One documented occurrence of this is along the Gila River in western Maricopa County. It is unclear at this point what the morphology, physiology, reproduction by seed, and invasiveness of the hybrids will be, as well as the attributes of any subsequent backcross progeny.

***Tamarix* spp.** (*T. chinensis*, *T. parviflora*, *T. ramosissima*)—The ecological impacts associated with invasion by *Tamarix* spp. should be considered within the context of the specific riparian community invaded. In addition, such impacts may be mediated by previous changes to a variety of ecological processes associated with the particular riparian community. Land managers planning riparian restoration projects involving the control of *Tamarix* spp. should consider and address, as appropriate, other factors, such as existing hydrologic regimes, fluvial processes, and whether *Tamarix* spp. stands are providing habitat for southwestern willow flycatchers (*Empidonax traillii extimus*) before proceeding with such projects.

Applications

Some of the intended uses of the list are to: (1) be a tool for land managers to assist in setting priorities, allocating resources, and developing and justifying management strategies; (2) educate a variety of stakeholders about the ecological impacts and distribution of specific non-native plants; and (3) modify public and industry behavior regarding particular plants that adversely impact wildlands and may be sold commercially. The AZ-WIPWG recognizes that the list should be updated periodically as new information is acquired about a currently listed species' behavior in wildlands or as additional non-native plants become established in Arizona's wildlands.

Usage

Based on the use of the ***Criteria*** as currently conceived, the ranking categories are designed to reflect the degree of ecological impact a particular plant species is having on a statewide basis. Some species, however, potentially threaten wildlands in only a portion of Arizona. In other geographic locales, they may not be able to establish and survive outside human cultivation. The answers to the ***Criteria*** question regarding ecological amplitude indicate those ecosystems/plant communities occurring within Arizona within which a species likely will have an ecological impact based on current information. These ecosystems/plant communities often have a close correspondence with geographic location. Although a lack of information on impacts does not rule out that a particular plant may be problematic in other locales in the state, it might suggest geographic areas where such a plant may not be of ecological concern.

Plants sold commercially and on the list may behave in the manner described above. Two approaches are possible relative to the use of the list in these situations. First, plant taxa presumed to be non-invasive in particular geographic areas of Arizona might still be used. Because, however, the ***Criteria*** and its application for Arizona were not designed to provide positive recommendations on where (or within which ecosystems/plant communities) particular plants might be non-invasive, each commercially sold plant should be assessed on a case-by-case basis and used with caution. Future modifications to the ***Criteria*** that enable plant assessments on a bioregional basis may improve the above determination. Second, ecosystems/plant communities within which invasion does not occur by a particular plant may occur in close proximity to ecosystems/plant communities that are invaded and impacted by the same plant. Moreover, plant materials sold in one location may be used in another inappropriate location. It would be difficult to manage all the potential pathways for moving a plant within the state to inappropriate locations. As a result, a conservative approach to this situation would be to err on the side of caution and not sell the plant within Arizona. Because the categorized list of *Invasive Non-Native Plants that Threaten Wildlands in Arizona* is a non-regulatory list, the AZ-WIPWG cannot dictate which of the two preceding approaches should be followed. To the extent that non-invasive plant alternatives can be identified and promoted for any of the commercially sold plants on the list that may fit under this situation, the ideal situation is that industry itself will eventually have sufficient incentive and motive not to sell listed plants anywhere within the state.

Linaria vulgaris **(Yellow toadflax). Photo by John M. Randall, The Nature Conservancy**

INVASIVE NON-NATIVE PLANTS THAT THREATEN WILDLANDS IN ARIZONA						
Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag
01. *Acroptilon repens* (L.) DC. (Russian knapweed)	A	A	B	High		
02. *Aegilops cylindrica* Host (Jointed goatgrass)	C	B	B	Low		X
03. *Alhagi maurorum* Medik. (Camelthorn)	B	A	A	Medium		
04. *Arundo donax* L. (Giant reed)	A	B	B	High		
05. *Asphodelus fistulosus* L. (Onionweed)	C	B	D	Low		
06. *Avena fatua* L. (Wild oat)	C	B	A	Medium		
07. *Brassica tournefortii* Gouan (Sahara mustard)	B	B	A	Medium		X
08. *Bromus diandrus* Roth (Ripgut brome)	B	B	C	Medium	X	
09. *Bromus inermis* Leyss. (Smooth brome)	B	B	B	Medium		X
10. *Bromus rubens* L. (Red brome)	A	B	A	High		
11. *Bromus tectorum* L. (Cheatgrass)	A	A	A	High		
12. *Cardaria chalapensis* (L.) Hand.-Maz. (Lenspod whitetop)	B	B	C	Medium	X	
13. *Cardaria draba* (L.) Desv. (Whitetop)	B	B	C	Medium	X	

INVASIVE NON-NATIVE PLANTS THAT THREATEN WILDLANDS IN ARIZONA						
Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag
14. *Cardaria pubescens* (C.A. Mey.) Jamolenko (Hairy whitetop)	B	B	C	Medium	X	
15. *Carduus nutans* L. (Musk thistle)	B	B	B	Medium		
16. *Centaurea biebersteinii* DC. (Spotted knapweed)	B	B	B	Medium		X
17. *Centaurea diffusa* Lam. (Diffuse knapweed)	B	A	B	Medium		
18. *Centaurea melitensis* L. (Malta starthistle)	B	B	B	Medium		
19. *Centaurea solstitialis* L. (Yellow starthistle)	A	B	B	High		
20. *Chondrilla juncea* L. (Rush skeletonweed)	B	A	C	Medium	X	
21. *Cirsium arvense* (L.) Scop. (Canada thistle)	B	B	B	Medium		X
22. *Cirsium vulgare* (Savi) Ten. (Bull thistle)	C	B	B	Low		
23. *Conium maculatum* L. (Poison hemlock)	B	B	C	Medium	X	
24. *Convolvulus arvensis* L. (Field bindweed)	B	B	A	Medium		
25. *Cortaderia selloana* (J.A. & J.H. Schultes) Aschers. & Graebn. (Pampas grass)	B	B	B	Medium		X
26. *Cynodon dactylon* (L.) Pers. (Bermudagrass)	B	B	A	Medium		

INVASIVE NON-NATIVE PLANTS THAT THREATEN WILDLANDS IN ARIZONA						
Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag
27. *Cynoglossum officinale* L. (Houndstongue)	C	B	D	Low		
28. *Echinochloa crus-galli* (L.) Beauv. (Barnyardgrass)	C	C	B	Low		
29. *Eichhornia crassipes* (Mart.) Solms (Water hyacinth)	A	B	D	High	X	X
30. *Elaeagnus angustifolia* L. (Russian olive)	A	A	B	High		
31. *Elymus repens* (L.) Gould (Quackgrass)	C	C	C	Low		
32. *Eragrostis curvula* (Schrad.) Nees (Weeping lovegrass)	C	B	B	Low		X
33. *Eragrostis lehmanniana* Nees (Lehmann lovegrass)	A	B	A	High		
34. *Erodium cicutarium* (L.) L'Her. ex Ait. (Redstem filaree)	C	B	A	Medium		
35. *Euphorbia esula L.* (Leafy spurge)	A	A	C	High	X	
36. *Euryops multifidus* (Thunb.) DC. (Sweet resinbush)	A	B	B	High		X
37. *Hordeum murinum* L. (Mouse barley)	B	B	A	Medium		X
38. *Hydrilla verticillata* (L.f.) Royle (Hydrilla)	A	B	U	Evaluated but not listed		X
39. *Lepidum latifolium* L. (Perennial pepperweed)	A	B	C	High	X	X

INVASIVE NON-NATIVE PLANTS THAT THREATEN WILDLANDS IN ARIZONA

Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag
40. *Leucanthemum vulgare* Lam. (Oxeye daisy)	C	B	B	Low		
41. *Linaria dalmatica* (L.) P. Mill. (Dalmatian toadflax)	B	B	A	Medium		X
42. *Linaria vulgaris* P. Mill. (Yellow toadflax)	B	B	C	Medium	X	
43. *Lolium perenne* L. (Perennial ryegrass)	B	B	B	Medium		
44. *Melilotus alba* Medikus (White sweetclover)	C	B	A	Medium		X
45. *Melilotus officinalis* (L.) Lam. (Yellow sweetclover)	C	B	A	Medium		X
46. *Mesembryanthemum crystallinum* L. (Common iceplant)	C	B	D	Low		
47. *Mesembryanthemum nodiflorum* L. (Slenderleaf iceplant)	B	B	C	Medium	X	
48. *Myriophyllum aquaticum* (Vell.) Verdc. (Parrot's feather)	A	B	C	High	X	
49. *Myriophyllum spicatum* L. (Eurasian watermilfoil)	A	B	C	High	X	
50. *Onopordum acanthium* L. (Scotch thistle)	C	B	B	Low		
51. *Panicum antidotale* Retz. (Blue panicum)	C	C	C	Low		
52. *Pennisetum ciliare* (L.) Link (Buffelgrass)	A	A	A	High		X

INVASIVE NON-NATIVE PLANTS THAT THREATEN WILDLANDS IN ARIZONA						
Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag
53. *Pennisetum setaceum* (Forsk.) Chiov. (Fountain grass)	A	B	B	High		X
54. *Rhus lancea* L. f. (African sumac)	B	B	C	Medium	X	
55. *Rubus armeniacus* Focke (Himalayan blackberry)	B	B	C	Medium	X	
56. *Rubus discolor* Weihe & Nees (Himalayan blackberry)	B	B	C	Medium	X	
57. *Saccharum ravennae* (L.) L. (Ravennagrass)	B	B	D	Medium	X	
58. *Salsola collina* Pallas (Slender Russian thistle)	B	B	A	Medium		
59. *Salsola paulsenii* Litv. (Barbwire Russian thistle)	B	B	A	Medium		
60. *Salsola tragus* L. (Prickly Russian thistle)	B	B	A	Medium		
61. *Salvina molesta* Mitchell (Giant salvinia)	A	B	C	High	X	
62. *Schismus arabicus* Nees (Arabian schismus)	B	B	A	Medium		
63. *Schismus barbatus* (Loefl. ex L.) Thellung (Common Mediterranean grass)	B	B	A	Medium		
64. *Sonchus asper* (L.) Hill (Spiny sowthistle)	C	B	A	Medium		
65. *Sonchus oleraceus* L. (Annual sowthistle)	C	B	A	Medium		

INVASIVE NON-NATIVE PLANTS THAT THREATEN WILDLANDS IN ARIZONA

Scientific Name/Authority (Common Name)	Ecological Impacts	Invasiveness	Distribution	Overall Score	Alert	Red Flag
66. *Sorghum halepense* (L.) Pers. (Johnsongrass)	B	B	A	Medium		
67. *Tamarix aphylla* (L.) Karst. (Athel tamarisk)	B	C	D	Low		X
68. *Tamarix chinensis* Lour. (Fivestamen tamarisk)	A	A	A	High		X
69. *Tamarix parviflora* DC. (Smallflower tamarisk)	A	A	A	High		X
70. *Tamarix ramosissima* Ledeb. (Saltcedar)	A	A	A	High		X
71. *Tribulus terrestris* L. (Puncturevine)	D	C	U	Evaluated but not listed		
72. *Ulmus pumila* L. (Siberian elm)	B	B	B	Medium		
73. *Verbascum thapsus* L. (Common mullein)	D	C	A	Evaluated but not listed		
74. *Vinca major* L. (Bigleaf periwinkle)	B	B	C	Medium	X	

Definitions

Section Scores (Ecological Impacts, Invasiveness, Distribution)

Section scores can range from **A** to **D**. In some cases **U** or Unknown is used when insufficient information is available to assign a score. Section scores are based on scores (**A** to **D**, or **U**) assigned to individual questions within each section. For Ecological Impacts, the scores represent a range of severity with **A** assigned for the most severe impacts and **D** assigned for a negligible impact. For Invasiveness, **A** represents the greatest potential to invade an ecosystem/community, whereas **D** would indicate a low potential. For Distribution, **A** indicates that the species has a wide ecological amplitude, is widespread within particular ecosystems/communities, or both. A **D** score would indicate the converse.

Other Useful Definitions

Invasive non-native plants that threaten wildlands: Plants that: (1) are not native to, yet can spread into, the wildland ecosystems under consideration; and that also (2) do any of the following within wildland ecosystems—displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes.

Non-native plants: Species introduced to the ecosystems under consideration [here in reference to Arizona] after European contact and as a direct or indirect result of human activity.

Wildlands: Public and private lands [and waters] that support native ecosystems, including national, state, and local parks and forests, ecological reserves, wildlife areas, Bureau of Land Management lands, and so on. Working landscapes—such as grazed rangeland and active timberlands—that support native ecosystems are included in the definition.

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For More Information

Additional pdf copies of this booklet are available at the Southwest Vegetation Management Association website (**http://www.swvma.org/**) and U.S. Geological Survey's Southwest Exotic Plant Information Clearinghouse (**SWEPIC**) website (**http://www.usgs.nau.edu/swepic)**. Go to the "**AZ-WIP**" link. Individual plant assessment information, as well as additional information about the **AZ-WIPWG** and the ***Criteria***, also are posted at the **SWEPIC** website.

Cover Photos: *Sorghum halepense* (Johnsongrass) by John M. Randall, The Nature Conservancy.
Pennisetum ciliare (Buffelgrass) by John M. Randall, The Nature Conservancy.
Salvinia molesta + *Tamarix* spp. by Theresa Olson, Bureau of Reclamation.
Mesembryanthemum nodiflorum (Slenderleaf ice plant) by Barry A. Rice, The Nature Conservancy.

Appendix N: Legislation, Executive Orders, Regulations and Instructions

N.1 Federal Regulations and Department of Defense Manuals and Instructions

7 USC 4201 et seq. Farm Land Protection Policy.

15 CFR 923. Coastal Zone management Program Regulations.

15 CFR 930. Federal Consistency with Approved Coastal Management Programs.

32 CFR 190. Natural Resources Management Program.

33 CFR 330. Clean Water Act Section 404 and Rivers and Harbors Act Section 10 Regulatory Programs.

50 CFR 10.13. List of Migratory Birds.

50 CFR 10, 18, 216, & 228. Regulations Concerning Marine Mammals.

50 CFR 17. Endangered and Threatened Wildlife and Plants.

ASN (I&E) memo of 12 August 1998, DoN Policy Memo 98-06; Review of INRMPs under NEPA.

Conserving Biodiversity on Military Lands - A Handbook for Natural Resources Managers, 1996.

CNO Letter of 30 November 1998, Guidance on Preparing NEPA Documents for INRMPs.

DoD 3210.6-R, DoD Grant and Cooperative Agreement Regulations of April 1998.

DoD Financial Management Regulation 7000. 14-R, Vol. 11A, Chapter 16. Accounting for Production and Sale of Forest Products.

DoD Instruction 4150.07, DoD Pest Management Program (29 May 2008)

DoD Instruction 4715.03, Natural Resources Conservation Program (18 March 2011)

NAVCOMPT Manual Volume 3.

NAVFAC Letter of 2 July 1996, guidelines for establishment of Ecological Areas.

NAVFAC Natural Resources Management Procedural Manual, P-73, Vol. II.

NAVFAC Real Estate Procedure Manual P-73, Vol.1.

Magnuson-Stevens Fishery Conservation and Management Act, 16 USC 1801-1883.

OPNAVINST 5090.1C. CH 1 of 18 July 2011. DoN Environment and Natural Resources Procedural Manual. CH-1 Natural Resources Management, describes requirements, guidelines, and standards for conserving natural resources on Navy lands. Summarizes the natural resources management program to include management of waters, forests, fish and wildlife, and outdoor recreation.

SECNAVINST 6401.1A of 16 August 94, Veterinary Health Services.

SECNAVINST 11011.47 Acquisition, Use by Others and Disposal of DoN Real Property.

N.2 Legislation Related To Natural Resources

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC 668) provides for protection of the bald eagle and the golden eagle by prohibiting taking, possession, and commerce of the birds.

Conservation Programs on Military Installations (Sikes Act)

Conservation Programs on Military Installations (Sikes Act), 16 USC 670 requires each military department to manage natural resources and to ensure that services are provided which are necessary for management of fish and wildlife resources on each installation; to provide their personnel with professional training in fish and wildlife management; and, to give priority to contracting work with Federal and State agencies that have responsibility for conservation or management of fish and wildlife. Authorizes cooperative agreements (with States, local governments, non-governmental organizations, and individuals) which call for each party to provide matching funds or services to carry out natural resources projects/initiatives.

Defense Appropriations Act of 1991 Legacy Program, P.L. 101-511

The Defense Appropriations Act of 1991 Legacy Program (10 USC § 2701) provides for the stewardship of biological, geophysical, cultural and historic resources on Department of Defense lands.

Endangered Species Act

The ESA (PL 93-205; 16 USC §§ 1531 et seq.) of 1973 requires that all Federal agencies undertake programs for the conservation of endangered and threatened species. These agencies are prohibited from authorizing, funding, or carrying out any action that would jeopardize a listed species or destroy or modify its “critical habitat” (Section 7). Coordination regarding threatened and endangered species is addressed in Section 7 of this Act. In particular, Section 7(a) requires a federal agency to consult with USFWS on any proposed action if the agency has reason to believe that an endangered or threatened species could be directly or indirectly affected by the action. Species under review and those of “special concern” are also included. A Biological Assessment by the lead agency is required under Section 7(c) if listed species or critical habitat may be affected by a major construction activity. The purpose of a Biological Assessment is to evaluate potential effects of the action on listed species and/or critical habitat, and to assist USFWS in rendering a Biological Opinion.

The ESA of 1973 (1978 Amendments), (PL 95-632; 16 USC §§1531 et seq.) provides for the conservation and protection of endangered and threatened species of fish, wildlife, and plants and expands the consultation process.

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), (7 USC 136) provides the principal means for preventing environmental pollution from pesticides through product registration and applicator certification. The registration of all pesticide products by EPA results in label instructions on each container for use, storage, and disposal. Label instructions are legally applicable to all users. Under FIFRA, EPA is required to accept certain pesticides under recall for safe disposal. It is unlawful to purchase, distribute, or use any pesticide that does not have an EPA registration number or for which registration has been canceled or suspended, or to apply, store, or dispose of any pesticide or container in any manner inconsistent with applicable regulations.

Federal Noxious Weed Act of 1974

The Federal Noxious Weed Act of 1974 (PL 93-629; 7 USC § 2801) provides for the control and eradication of noxious weeds and their regulation in interstate and foreign commerce. Beyond establishing a Federal program to control the spread of noxious weeds, the Federal Noxious Weed Act defines the term noxious weed and gives authority to the Secretary of Agriculture to oversee the issues regarding their management. Once the Secretary has designated a species as a noxious weed, they have the right to seize, treat, and destroy the plants, ban the importation and transportation of them as well as conduct inspections and quarantine areas. The Secretary is also authorized to cooperate with State and local agencies and individuals in measures to manage these species. Essentially, this Act developed a means of delegating control efforts, defining species that are to be considered noxious at the Federal level, and assigned the Secretary of Agriculture as the official executive in these matters.

Federal Water Pollution Control Act as amended by the Clean Water Act of 1977, 33 USC1251

The Federal Water Pollution Control Act Amendments of 1972 (CWA; 33 USC 1251) sets up a Federal permit and license system to carry out certain pollution discharge activities in navigable waters. Section 314 of this act established the Clean Lakes Program.

Fish and Wildlife Conservation Act of 1980

The Fish and Wildlife Conservation Act of 1980 (16 USC 2901) provides for conservation, protection, restoration and propagation of certain species, including migratory birds threatened with extinction.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 USC 661) mandates that wildlife conservation receive equal consideration and be coordinated with other features of water resource development. The intent is to prevent loss or damage of wildlife and provide for development and improvement of wildlife in conjunction with water development projects. Federal agencies proposing to impound, divert or control surface waters are required to consult with the USFWS and CDFG, to include and give full consideration to the recommendations of these agencies, and to provide justifiable means and measures for benefiting wildlife in project plans. The USACE must coordinate permit applications with USFWS and CDFG. Like NEPA, implementation of this Act is essentially procedural in that no particular outcome is mandated. The Act authorizes project modification, land acquisition, and other measures necessary to protect wildlife.

Forest Resources Conservation and Shortage Relief Act, 16 USC 620

The purpose of the Forest Resources Conservation and Shortage Relief Act (16 USC 620) is to promote the conservation of forest resources in conjunction with State and Federal resources management plans, and other actions or decisions, affecting the use of forest resources; to take action essential for the acquisition and distribution of forest resources or products in short supply in the western United States; to take action necessary, to meet the goals of Article XI 2.(a) of the GATT 1994 (as defined in section 3501 (1)(B) of title 19), to ensure sufficient supplies of certain forest resources or products which are essential to the United States; to continue and refine the existing Federal policy of restricting the export of unprocessed timber harvested from Federal lands in the western United States; and to effect measures aimed at meeting these objectives in conformity with the obligations of the United States under the World Trade Organization Agreement and the multilateral trade agreements.

Magnuson-Stevens Fishery Conservation and Management Act, 16 USC 1801-1883

The purpose of the Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801-1883) is to provide for the conservation and management of the fisheries, and for other purposes. The Act requires Federal agencies undertaking permitting or funding activities that may adversely affect essential fish habitat to consult with the National Marine Fisheries Service. The Act also requires Fishery Management Councils to amend all of their fishery management plans to describe and identify essential fish habitat for the fishery based on guidelines established by the National Marine Fisheries Service, to minimize to the extent practicable adverse effects on such habitat caused by fishing, and to identify other actions to encourage the conservation and enhancement of essential fish habitat.

Marine Mammal Protection Act, 16 USC 1361

The Marine Mammal Protection Act of 1972 as Amended was established to protect marine mammals; to establish a Marine Mammal Commission and for other purposes.

Marine Protection, Research and Sanctuaries Act of 1972, 16 USC 1431

The purposes and policies of the Marine Protection, Research and Sanctuaries Act of 1972 (16 USC 1431) are to identify and designate as national marine sanctuaries areas of the marine environment which are of special national significance and to manage these areas as the National Marine Sanctuary System; to provide authority for comprehensive and coordinated conservation and management of these marine areas, and activities affecting them, in a manner which complements existing regulatory authorities; to maintain the natural biological communities in the national marine sanctuaries, and to protect, and, where appropriate, restore and enhance natural habitats, populations, and ecological processes; to enhance public awareness, understanding, appreciation, and wise and sustainable use of the marine environment, and the natural, historical, cultural, and archeological resources of the National Marine Sanctuary System; to support, promote, and coordinate scientific research on, and long-term monitoring of, the resources of these marine areas; to facilitate to the extent compatible with the primary objective of resource protection, all public and private uses of the resources of these marine areas not prohibited pursuant to other authorities; to develop and implement coordinated plans for the protection and management of these areas with appropriate Federal agencies, State and local governments, Native American tribes and organizations, international organizations, and other public and private interests concerned with the continuing health and resilience of these marine areas; to create models of, and incentives for, ways to conserve and manage these areas, including the application of innovative management techniques; and to cooperate with global programs encouraging conservation of marine resources.

Migratory Bird Treaty Act

The MBTA (16 USC 703) protects most birds, whether or not they migrate. Birds, their nests, eggs, parts or products may not be killed or possessed. Game birds are listed and protected except where specific seasons, bag limits, and other features govern their hunting. Exceptions are also made for some agricultural pests, which require a USFWS permit (yellow-headed, red-winged, bi-colored red-winged, tri-colored red-winged, Rusty and Brewer’s blackbirds, cowbirds, all grackles, crows and magpies). Some other birds that injure crops in California may be taken under the authority of the County Agricultural Commissioner (meadowlarks, horned larks, golden-crowned sparrows, white- and other crowned sparrows, goldfinches, house finches, acorn woodpeckers, Lewis woodpeckers, and flickers). Permits may be granted for various non-commercial activities involving migratory birds and some commercial activities involving captive-bred migratory birds.

Military Construction Authorization Act- Leases; Non-excess property

The Military Construction Authorization Act- Leases; Non-excess property (10 USC 2667) provides for the outleasing of public lands.

Military Construction Authorization Act - Military Reservation and Facilities-Hunting, Fishing and Trapping

The Military Construction Authorization Act - Military Reservation and Facilities-Hunting, Fishing and Trapping (10 USC 2671) requires that all hunting, fishing, and trapping on military installations follow Fish and Game laws of the state in which it is located, and be issued appropriate state licenses for these activities.

Military Construction Authorization Act - Sale of Certain Interests in Lands; Logs, 10 USC 2665

Military Construction Authorization Act—Sale of Certain Interest in Lands; Logs (PL 97-321, 10 USC 2665) provides for the production and sale of forest products on military lands.

National Defense Authorization Act of 2004 - Critical Habitat for Endangered Species PL 108-136

The National Defense Authorization Act of 2004 established a documentation system that provides the DoD an alternative means of natural resource responsibility in fulfillment of the Sikes Act. Under this Authorization Act, the Secretary shall not designate any lands or other geographical areas owned or controlled by the DoD, or designated for its use as critical habitat if they are subject to an integrated natural resources management plan prepared under section 101 of the Sikes Act (16 USC 670a). That is, if the Secretary determines in writing that such a plan provides a benefit to the species for which critical habitat is proposed for designation. This Act does not affect the requirement to consult under section 7(a)(2) with respect to an agency action. Furthermore, this Act does not affect the obligation of the DoD to comply with section 9, including the prohibition preventing extinction and taking of endangered species and threatened species. This Act resulted in the amendment of Section 4(b)(2) of the Endangered Species Act of 1973, adding ''the impact on national security,'' after ''the economic impact,''.

National Environmental Policy Act of 1969

The NEPA of 1969 (42 USC 4321) evolved over a period of ten years from the desire of Congress to have a cohesive statement of the national environmental policy. Agencies must assess, in detail, the potential environmental impact of any proposal for legislation or other major Federal action that has the potential for significantly affecting the quality of the human environment. The Act is intended to help public officials and citizens make decisions that are based on understanding of environmental consequences and take action that protects, restores and enhances the environment.

National Invasion Species Act of 1996, 16 USC 4701

The National Invasion Species Act of 1996 reauthorizes and amends the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. This Act intends to prevent unintentional introduction and dispersal of nonindigenous species into waters of the United States through ballast water management and other requirements; to coordinate federally conducted, funded or authorized research, prevention control, information dissemination and other activities regarding the zebra mussel and other aquatic nuisance species; to develop and carry out environmentally sound control methods to prevent, monitor and control unintentional introductions of nonindigenous species from pathways other than ballast water exchange; to understand and minimize economic and ecological impacts of nonindigenous aquatic nuisance species that become established, including the zebra mussel; and to establish a program of research and technology development and assistance to States in the management and removal of zebra mussels.

Oil Pollution Act of 1990, 33 USC 2701

The Oil Pollution Act of 1990 (33 USC 2701) establishes limitations on liability for damages resulting from oil pollution, to establish a fund for the payment of compensation for such damages, and for other purposes.

Outdoor Recreation-Federal/State Program Act, 16 USC 460 P-3

The Outdoor Recreation-Federal/State Program Act (16 USC 460) provides for the management of lands used for outdoor recreation. Requires consultations with U.S. National Park Service regarding management.

Soil Conservation Act

The Soil Conservation Act (16 USC 3B) provides for application of soil conservation practices on Federal lands. Requires Federal agencies to control and prevent soil erosion and preserve natural resources in managing Federal lands.

N.3 Executive Orders Relevant To Natural Resources

11644 as amended by 11989, Use of Off-Road Vehicles on Public Lands of 24 May 1977

The Off-Road Vehicles on Public Lands Executive Order (EO 11989) provides for closing areas to use where soil, wildlife, or other resources are adversely affected.

11988 Floodplain Management

The Floodplain Management Executive Order (EO 11988) specifies that “Agencies shall encourage and provide appropriate guidance to applicants to evaluate the effects of their proposals in floodplains prior to submitting applications”. This order includes wetlands that are within the 100-year floodplain and especially discourages filling.

11990 Protection of Wetlands

The Protection of Wetlands Executive Order (EO 11990) directs all federal agencies to “take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands”. This applies to the acquisition, management, and disposal of federal lands and facilities; to construction of improvements undertaken, financed, or assisted by the federal government; and to the conduct of federal activities and programs which affect land use. Section 4 of the EO requires that when federally owned lands are leased and easement is assigned, or when disposed of to a non-federal party, a reference be included in the conveyance to identify any wetlands and indicate those uses which are restricted in such areas.

12962 Recreational Fisheries of 7 June 1995

Recreational Fisheries Executive Order (EO 12962) orders Federal agencies to improve the quantity, function, sustainable productivity and distribution of U.S. aquatic resources for increased recreation fishing opportunities where practicable and in cooperation with States and Tribes. Purpose is to conserve, restore and enhance aquatic systems to provide nationwide fishing.

13089 Coral Reef Protection of 11 June 1998

Coral Reef Protection Executive Order (EO 13089) aids in preserving and protecting the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment.

13112 Invasive Species, 3 February 1999

Invasive Species Executive Order (EO 12112) is to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

13148 Greening the Government Through Leadership in Environmental Management

Greening the Government through Leadership in Environmental Management Executive Order (EO 13148) orders environmental management considerations to be a fundamental and integral component of Federal Government policies, operations, planning, and management.

13158 Marine Protected Areas

Marine Protected Areas Executive Order (EO 13158) helps to protect the significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation’s system of marine protected areas.

13186 Responsibilities of Federal Agencies to Protect Migratory Birds

Responsibilities of Federal Agencies to Protect Migratory Birds Executive Order (EO 13186) directs Executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act.

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Appendix O: Natural Resources Data Call Support Information

NAVFAC will post copies of all INRMPs and associated NEPA documents on the Natural Resources Data Call Station. The installation natural resources manager is encouraged to study other INRMPs to learn more about management techniques. Posting the INRMP will also contribute to a library of INRMP information that facilitates information exchange among INRMP stakeholders. The Data Call Station INRMP Library will also serve as a source for baseline data to fuel the production of NEPA and other planning documents, Biological Assessments, and outreach materials.

All INRMP projects must be accounted for in the EPR-web system. If all INRMP projects are entered in EPR-web, all INRMP conservation project requirements will automatically be submitted for consideration and tracked during the development of the Shore Environmental Quality (Shore EQ) program Baseline Assessment Memorandum and annual review process. It is mandatory that all conservation, compliance, and stewardship projects be entered into the EPR-web process in order to receive proper chain of command review and to report total conservation requirements to DoD.

All readiness levels will be reported to DoD; however, projects earmarked for separate stewardship funding will not be considered within the Environmental O&MN funding program. The process of entering projects has been automated through the INRMP Builder. This electronic template for developing and updating an INRMP will guide the installation natural resource manager through the INRMP-building process, allowing the manager to simultaneously build an INRMP project table and enter each project into EPR-web (https://eprportal.cnrnw.navy.mil/logon.aspx), the Navy's system for submitting environmental funding requests. The INRMP Builder may be accessed at the NAVFAC Natural Resources Data Call Station, available at: https://clients.emainc.com/navfac/index.html.

It is important to maintain current project information in the Natural Resources Data Call Station, which will be used to monitor/measure INRMP implementation and other measures of merit. Project information should be updated a minimum of two times per year.

In addition to the measures of merit described above, installations shall use the web-based Metrics Builder tool on the Natural Resources Data Call Station to provide Deputy Assistant Secretary of the Navy (Environment) (DASN[E]) with data on installation performance.

Natural Resources Data Call Station Information

1. T/E Species

- Profile [see below]
- Biological Assessments [Appendix I]
- Biological Opinions [Appendix I]
- Mitigation Requirements & Costs
- Description of Mission Impacts
- Work around Costs
- Problems/Issues
- Successes
- Additional Information
- Special Management Provisions

Common Name: Mexican spotted owl

Scientific Name: *Strix occidentalis lucida*

Picture(s): http://www.fws.gov/ifw2es/mso/

Species Description: The spotted owl is mottled in appearance with irregular white and brown spots on its abdomen, back and head. The spots of the Mexican spotted owl are larger and more numerous than in the other two subspecies, giving it a lighter appearance. Strix occidentalis translates as "owl of the west"; lucida means "light" or "bright." Unlike most owls, spotted owls have dark eyes. Several thin white bands mark an otherwise brown tail.

Based on plumage characteristics, adult male and female spotted owls similar (i.e., monochromatic). However, the sexes can be readily identified by voice (see below). Juveniles, subadults, and adults can be distinguished by plumage characteristics, however (Forsman 1981; Moen et al. 1991). Juvenile spotted owls (hatchling to approximately five months) have a downy appearance. Subadults (5 to 26 months) possess adult plumage but have pointed rectrices with white tips (Forsman 1981; Moen et al. 1991). The rectrices of adults (>27 months) have rounded and mottled tips.

Although the spotted owl is often referred to as a medium-sized owl, it ranks among the largest owls in North America. Of the 19 species of owls that occur in North America, only 4 are larger than the spotted owl (Johnsgard 1988). As a full species, the spotted owl averages 41-48 cm (16-19 inches) long (Earhart and Johnson 1970), 107-114 cm (42-45 inches) across the spread wings (Walker 1974), and weighs 547-647 grams (19.5-23 ounces). These measures are expressed as ranges because, similar to other owl species, spotted owls exhibit reversed sexual dimorphism (i.e., females are larger than males). Adult female Mexican spotted owls in Arizona and New Mexico averaged 647 grams (23 oz) (SE = 9.6, n = 11), whereas males averaged 547 grams (19.5 oz) (SE = 18.7, n = 12; Ganey and Ward, unpublished data).

Life History: Feeding Habits - Forsman (1976) described spotted owls as "perch and pounce" predators. They typically locate prey from an elevated perch by sight or sound, then pounce on the prey and capture it with their talons. Most information on the food habits of Mexican spotted owls comes from analyses of regurgitated pellets. Specific prey groups identified from spotted owl pellets included woodrats, mice, voles, rabbits, gophers, bats, birds, reptiles, and arthropods. The diet in most areas was heavily dominated by small, terrestrial, nocturnal mammals, but species composition varied among areas. Woodrats were generally more abundant in pellet samples collected from northern latitudes, and peromyscid mice and birds were generally more abundant in southern regions of the owl's range. Voles appear more common in the diet of owls dwelling at higher elevations.

Reproductive Biology - Courtship begins in March and eggs are laid in late March or, more typically, early April. Incubation begins shortly after the first egg is laid, and is performed entirely by the female. Female spotted owls generally incubate for approximately 30 days. During incubation, the female leaves the nest only to defecate, regurgitate pellets, or receive prey delivered by the male, who does most or all of the foraging The eggs usually hatch in early May (Ganey 1988). Females brood their young almost constantly, leaving their nests for only brief periods during the night. Nestling owls fledge from four to five weeks after hatching, from early to mid-June in most cases (Ganey 1988). Owlets often leave the nest before they can fly, simply jumping from the nest onto surrounding tree branches or the ground. Within a week after leaving the nest, most owlets can make short, clumsy flights between trees. Three weeks after leaving the nest owlets can hold and tear up prey on their own, and by late July most have become proficient at pouncing on crawling insects (Forsman et al. 1984). The young depend on their parents for food during the summer and will eventually disperse out of the natal area in the fall.

Listing Info:

31-AUG-04 Final Critical Habitat Designation
18-NOV-03 Proposed Critical Habitat
16-MAR-93 Final Listing Threatened
Final Rule to List the Mexican Spotted Owl as a Threatened Species
04-NOV-91 Proposed Listing Mexican Spotted Owl as Threatened

Hotlink to full FR Notice: www.fws.gov/ifw2es/mso/

Critical Habitat Status: Final Critical Habitat designated on August 31, 2004
69 FR 53181 53298

Hotlink to GIS critical habitat layer:
www.fws.gov/ifw2es/mso/critical_habitat/critical_habitat.htm

Recovery Plan Status: The Mexican spotted owl was listed as a threatened species on 15 April 1993. Two primary reasons were cited for the listing: historical alteration of its habitat as the result of timber management practices, specifically the use of even-aged silviculture, plus the threat of these practices continuing, as provided in National Forest Plans.

The danger of catastrophic wildfire was also cited as a potential threat for additional habitat loss. Concomitant with the listing of the Mexican spotted owl, a Recovery Team was appointed by FWS Southwestern Regional Director John Rogers to develop a Recovery Plan.

The Recovery Plan provides a basis for management actions to be undertaken by land-management agencies and Indian Tribes to remove recognized threats and recover the spotted owl. Primary actions will be taken by the USFS, Bureau of Land Management, USFWS, Bureau of Indian Affairs, and sovereign American Indian Tribes. The USFWS will oversee implementation of the Recovery Plan through its authorities under the ESA.

The Recovery Plan contains five basic elements:

1. A recovery goal and a set of delisting criteria that, when met, will allow the Mexican spotted owl to be removed from the list of threatened species.
2. Provision of three general strategies for management that provide varying levels of habitat protection depending on the owl's needs and habitat use.
3. Recommendations for population and habitat monitoring.
4. A research program to address critical information needs to better understand the biology of the Mexican spotted owl and the effects of anthropogenic activities on the owl and its habitat.
5. Implementation procedures that specify oversight and coordination responsibilities.

Hotlink to full text of recovery plan: www.fws.gov/ifw2es/mso/recovery_plan.htm

2. Wetlands

- Total Wetland Acres
- Acres Impacted
- Acres Mitigated
- Acres Created
- Acres Restored
- Acres Banked
- Acres Delineated

3. Agricultural Outlease Report

- Lease Number

- Last Updated
- Contact Information
- Receipts ($)
- Value of Services ($)
- Outlease Expenses ($)
- Cost Savings ($)

4. BASH

- Information Flying Activity?
- Installation Name
- BASH Plan?
- Annual Cost

5. Forestry

- Forested Acres
- Commercial Program (Y/N)
- Gross Receipts
- Expenditures

6. INRMP

- How much was spent on implementation for FY2007? ($)
- When do you plan to start using the Metrics Builder to perform your annual review?
- Have you added new projects as a result of your annual review?
- Did you update your plan during the annual review using the Metrics Builder?
- Do the FWS and State partners consider the INRMP current and satisfactory?

7. Invasive Species

- Fiscal Year
- Common Name
- Approximate Acreage Affected
- Location
- T&E Species that are jeopardized by invasive species, if any
- Estimated Annual Cost to Control
- Amount Spent This Fiscal Year

8. Outdoor Recreation

- Sikes Act Fees Hunting & Fishing
- Wildlife Program Expenses
- Shoreline Habitat Miles*
- Aquatic Habitat Acres*

9. Success Stories and Outreach Photography [a database of reports on jobs well done with regard to natural resources work, tone is like a newspaper feature. E.g. beneficial partnerships, Earth Day, fun species work, environmental awards, prescribed burn successes, and many other examples]

10. References and Hot Link Catalog (INRMP Guidance; Instructions; Technical Assessments and Surveys]

11. GIS Catalog

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Appendix P: U.S. Navy Metrics Support Information

The Secretary of Defense is required by the Sikes Act (as amended) to submit a report to Congress by 01 March annually, detailing the number of INRMPs in effect, the amounts expended on conservation activities pursuant to the INRMPs, and an assessment of the extent to which the INRMPs comply with the Sikes Act (as amended). DoD has established the following formal measures of merit to produce the end-of-year Interim Progress Review and annual Environmental Quality Report to Congress to meet both internal and Congressional requirements.

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FY11 Defense Environmental Programs Annual Report to Congress (DEPARC) – Natural Resources Data Summary

Introduction

In accordance with DoDI 4715.03, *Natural Resources Conservation Program*, and the Sikes Act Improvement Act, the Deputy Under Secretary of Defense (Installations and Environment) requires environmental management information to support Congressional reporting and ensure DoD is on track to meet its environmental management goals. Consequently, the Navy Natural Resources (NR) Metrics were developed to support the annual Natural Resources Program reviews between the Navy and its Sikes Act partners, the USFWS and State Fish and Wildlife agencies. These NR Metrics can be used to gather and report essential information required by Congress, Executive Orders, existing U.S. laws, and the Department of Defense. There are seven Focus Areas that comprise the NR Metrics to be evaluated during the annual review of the Natural Resources Program/INRMP.

1. Ecosystem Integrity
2. Listed Species and Critical Habitat
3. Fish and Wildlife Management for Public Use
4. Partnership Effectiveness
5. Team Adequacy
6. INRMP Project Implementation
7. INRMP Impact on the Installation Mission

Each of the seven Focus Areas contains questions that can be evaluated. Questions are weighted, with responses to questions having different values, ranging from 0.0 to 1.0. Each Focus Area is scored, using a rating scheme of Green (1.0-0.67), Yellow (0.66-0.34), and Red (0.33-0.0), resulting in a comprehensive scorecard for the entire NR Metrics for each Navy installation (Figure 1).

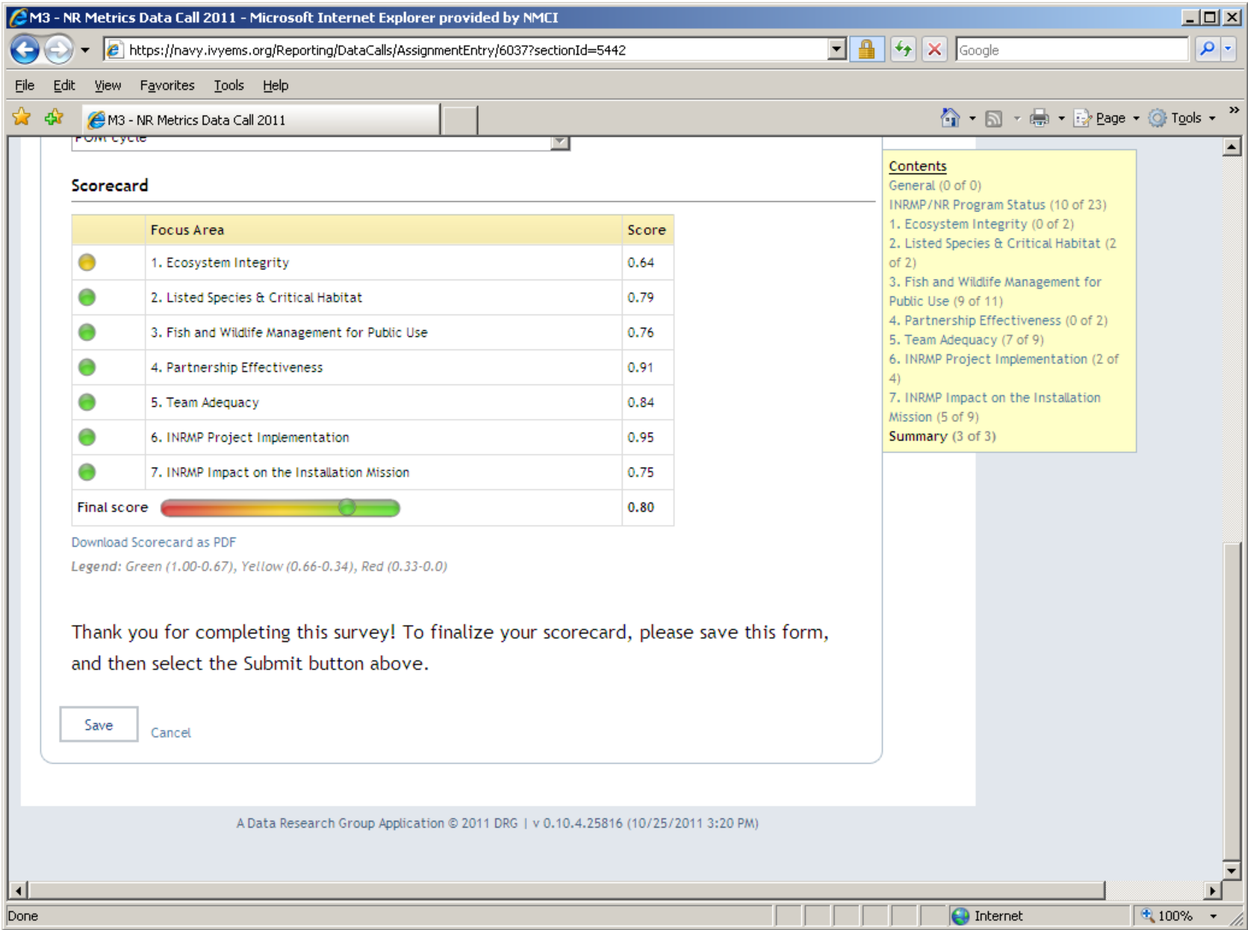

Figure 1. Example of NR Metrics Scorecard.

The questions asked in each Focus Area of the NR Metrics are intended to measure how well the Navy managed natural resources at each installation during any given year as well as the status of project implementation. In FY11, the Navy revised the questions to reflect the updated DoDI 4715.03 and draft OPNAVINST 5090, currently under revision. In addition, the field was asked to respond for all Navy-owned sites, which includes installations and special areas, in the Navy's real property database, iNFADS. Of the approximately 829 sites within iNFADS, 314 sites were found to have significant natural resources. These sites were then rolled up based on main installations, e.g. all special areas associated with an installation and covered under the same INRMP. Unique special areas having their own INRMP were counted separately. This list of sites was then correlated to the CNIC Base Command list.

Summary of NR Metrics by Focus Area

Per FY11 NR Metrics, many of the installations appear to have healthy NR programs (as indicated by the numerous green scores for the various Focus Areas), which reflects their ability to successfully implement projects identified in their existing INRMPS. Further, responses to questions in the Ecosystem Integrity and Listed Species & Critical Habitat Focus Areas indicate that existing INRMPs are sufficient in accomplishing ecosystem based management and protection of listed species. The questions *scored* in the NR Metrics that were used to evaluate the health of the NR program and effectiveness of the INRMP at each installation are listed below by Focus Area.

Focus Area 1: Ecosystem Integrity –

According to the DoDI 4715.3, the goal of ecosystem management is to ensure that military lands support present and future training and testing requirements while preserving, improving, and enhancing ecosystem integrity. Over the long term, that approach shall maintain and improve the sustainability and biological diversity of terrestrial and aquatic (including marine) ecosystems while supporting sustainable economies, human use, and the environment required for realistic military training operations. This Focus Area is intended to define the ecosystems that occur on the installation and assess the integrity of these ecosystems. The term, integrity, refers to the quality of state of being complete, unbroken condition, wholeness, entirety, unimpaired, without significant damage, good condition, or general soundness. Terrestrial ecosystems, as defined by Nature Serve's "Ecological Systems of the United States: A Working Classification of US Terrestrial Systems" and marine ecosystems, as defined by NOAA's "Coastal and Marine Ecological Classification Standard" (including only the Benthic Biotic Component, Surface Geology Component, and Water Column Component of the classification scheme) were selected from a list and assigned to each installation. Locally-defined ecosystems were added, if necessary. Once the ecosystems were assigned to the installation, the following questions [4 out of 5 new in FY11] were asked for each of the ecosystems identified as being present on the installation.

1. To what extent is the ecological system on the installation fragmented due to land conversion? (0-5)

   Answers:
   0 = Ecosystem fragmentation is the result of five (5) of the phenomena (0)
   1 = Ecosystem fragmentation is the result of four (4) of the phenomena (0.20)
   2 = Ecosystem fragmentation is the result of three (3) of the phenomena (0.40)
   3 = Ecosystem fragmentation is the result of two (2) of the phenomena (0.60)
   4 = Ecosystem fragmentation is the result of one (1) of the phenomena (0.80)
   5 = No fragmentation (1.00)

2. Is the ecosystem effectively managed to sustain viable populations of species? (0-3)

   Answers:
   0 = Not effectively managed (0)
   1 = Minimally effective management (0.33)
   2 = Moderately effective management (0.67)
   3 = Effectively managed (1.00)

3. To what degree is the ecological system vulnerable to stressors? (0-5)

   Answers:
   0 = Completely Vulnerable (0)
   1 = Severely Vulnerable to Stress (0.20)
   2 = Highly Vulnerable to Stress (0.40)

3 = Moderately Vulnerable to Stress (0.60)
4 = Slightly Vulnerable to Stress (0.80)
5 = Not Vulnerable to Stress (1.00)

4. To what degree has the installation's INRMP/Natural Resources Program provided an overall benefit to ecological integrity? (0-3)

   Answers:
   0 = No Benefit (0)
   1 = Minor Benefit (0.33)
   2 = Moderate Benefit (0.67)
   3 = Significant Benefit (1.00)

Each of these questions in the Ecosystem Integrity Focus Area is equally weighted by a value of 1. This means that no one question contributes more to the overall score of the Focus Area than any other question. However, question #4 is the most relevant in terms of assessing the importance of the INRMP on Ecosystem Integrity. The score of each question, as well as the overall score of the Focus Area, can't exceed 1.00. This means that the score calculated for each question is the product of the numerical value associated with the answer provided and the weight (=1). For example, if the answer provided for question #4 is "No Benefit", then the score for that question is [0 x 1 = 0]. But, if the answer provided for question #4 is "Significant Benefit", then the score for that question is [1.00 x 1 = 1.00]. Therefore, if the INRMP has a significant benefit to ecological integrity, then the response of "Significant Benefit" to this question increases the potential for a higher overall score for this Focus Area, which may contribute to the Focus Area being coded as green.

Note: The numerical value associated with each answer is the result of the total potential score for the question (1.00) divided by the number of possible answers, except for zero. If NA is chosen, the question drops out of the calculation. For example, for question #4, there are three possible answers (other than "No Benefit", which is zero) so [1.00/3 = 0.33]. The answers are ranked according to importance, e.g. an INRMP with a "Significant Benefit" has more importance on the overall benefit to ecological integrity than an INRMP with a "minor benefit". Therefore, an answer of "Significant Benefit" to question #4 is weighted by 3, resulting in a score of 1.00 for the question.

Focus Area 2: Listed Species & Critical Habitat -

This Focus Area is intended to identify the federally listed species that occur on a Navy installation and/or special area, as well as determine if conservation efforts are effective and if the INRMP provides the conservation benefits necessary to preclude designation of critical habitat for particular species. Federally listed species were selected from the USFWS list of federally threatened and endangered species and assigned to each installation. Once the listed species were assigned to the installation, the following questions [1 out of 6 new in FY11] were asked for each of the federally listed species identified as being present on the installation.

1. To what extent do INRMP projects & programs provide a benefit to this species? (0-4, NA)

   Answers:
   0 = No benefit (0)
   1 = Minor benefits (0.25)
   2 = Moderate benefit (0.50)
   3 = Major benefit (0.75)
   4 = Significant benefit (1.00)
   NA

2. To what degree have projects been funded in support of this species? (0-4, NA)

   Answers:
   0 = No funding (0)
   1 = 1% to 25% funded (0.25)
   2 = 26% to 50% funded (0.50)
   3 = 51% to 75% funded (0.75)
   4 = 76% to100% funded (1.00)
   NA

3. To what extent are quantifiable goals, parameters, and monitoring requirements in place to assess conservation effectiveness? (0-4, NA)

   Answers:
   0= None (0)
   1= Minimal (0.25)
   2= Moderate (0.50)
   3= Good (0.75)
   4= Excellent (1.00)
   NA

4. Do existing surveys provide adequate data on habitat conditions? (Y/N)

   Answers:
   N (0)
   Y (1.00)

5. Do existing surveys provide adequate data on population presence and numbers? (Y/N)

   Answers:
   N (0)
   Y (1.00)

The questions in the Listed Species & Critical Habitat Focus Area are not equally weighted. Questions #1 and #3 are weighted the most at 1.1; question #2 is weighted 1.0; and questions #4 and #5 are weighted the least at 0.9. In particular, question #1 speaks directly to the effect of the INRMP on listed species. Therefore, if the answer provided for question #1 is “Significant Benefit”, then the score for that question is [1.00 x 1.1 = 1.1]. Therefore, if the INRMP has a significant conservation benefit to a listed species, then the response to this question increases the potential for a higher overall score for this Focus Area, which may contribute to the Focus Area being coded as green.

Focus Area 3: Fish and Wildlife Management for Public Use –

The purpose of this Focus Area is to evaluate the availability of public recreational opportunities, such as fishing and hunting, given the existing security requirements for the installation. While recreational opportunities may be available at an installation, they may be restricted for security reasons. The following questions [6 out of 9 new in FY11] were asked.

1. Are recreational opportunities available on the installation? (Y/N)

   Answers:
   N (0)
   Y (1.00)
   NA (landscape doesn't support recreational opportunities)

2. If recreational opportunities are available, are they limited/restricted for security reasons? (Y/N/NA)

   Answers:
   Y (0)
   N (1.00)
   NA (recreational opportunities are not available)

3. If recreational opportunities are available, are they offered to the public?

   Answers:
   N (0)
   Y (1.00)
   NA (recreational opportunities are not available)

4. If recreational opportunities are available, are they offered to DoD personnel?

   Answers:
   N (0)
   Y (1.00)
   NA (recreational opportunities are not available)

5. If recreational opportunities are available, are they accessible by disabled veterans/Americans?

   Answers:
   N (0)
   Y (1.00)

NA (recreational opportunities are not available)

6. Are Sikes Act fees collected for outdoor recreational opportunities? (Y/N/NA)

   Answers:
   N (0)
   Y (1.00)
   NA (recreational opportunities do not include hunting and fishing)

7. Is there an active natural resources law enforcement program on the installation? (Y/N/NA)

   Answers:
   N (0)
   Y (1.00)
   NA (recreational opportunities do not include hunting and fishing)

8. Are sustainable harvest goals addressed in the INRMP and effective for the management of the species' population? (0-4, NA)

   Answers:
   0 = Not effective (0)
   1 = Minimal effectiveness (0.25)
   2 = Moderate effectiveness (0.50)
   3= Effective (0.75)
   4 = Highly effective (1.00)
   NA (recreational opportunities do not include hunting and fishing)

9. Is public outreach/educational awareness provided? (0-4, NA)

   Answers:
   0 = No public outreach provided (0)
   1 = Low outreach (0.25)
   2 = Moderate outreach (0.50)
   3 = Good outreach (0.75)
   4 = Excellent outreach (1.00)
   NA

The questions in the Fish and Wildlife Management for Public Use Focus Area are not equally weighted. Question #1 is weighted the most at 1.2; questions #2-5, #8, and #9 are weighted 1.0; and questions #6 and #7 are weighted the least at 0.9. Overall the questions in this Focus Area are relatively evenly weighted due to the fact that there are many contributing factors to whether or not recreational opportunities are available at an installation. Specifically, security restrictions often limit access to recreational opportunities. However, question #1 speaks to whether recreational opportunities are available on the installation. Therefore, if the answer provided for question #1 is "Yes", then the score for that question is [1.00 x 1.2 = 1.2]. Therefore, if the installation offers recreational opportunities, as prescribed by the Sikes Act, then the response to this question increases the potential for a higher overall score for this Focus Area, which may contribute to the Focus Area being coded as green. Similarly, question #2 asks if available recreational opportunities are limited or restricted for security reasons. Therefore, if the answer provide for question #2 is “Yes”, then the score for that question is [0 x 1 = 0]. This will reduce the overall score for this Focus Area, which may contribute to the Focus Area being coded yellow or red.

Focus Area 4: Partnership Effectiveness –

The purpose of this Focus Area is to determine to what degree partnerships are cooperative and result in effective implementation of the INRMP. Partnerships and/or initiatives actively participated in by installation NR staff were identified. Once they were identified, the following questions [4 out 10 new in FY11] were asked for each of the partnerships and/or initiatives identified as relevant to the installation.

1. Does your Natural Resources program support the regional conservation efforts of the USFWS? (Y/N)

   Answers:
   N (0)
   Y (1.00)

2. Does your Natural Resources program support State conservation goals identified in State Wildlife Action Plans (SWAPs)? (Y/N)

   Answers:
   N (0)
   Y (1.00)

3. Does your Natural Resources program support regional NOAA/NMFS conservation objectives/efforts? (Y/N/NA)

   Answers:
   N (0)
   Y (1.00)
   NA

4. Does your Natural Resources program support other Conservation Initiatives? (Y/N)

   Answers:
   N (0)
   Y (1.00)

5. Is there adequate collaboration/cooperation between partners? (0-4)

   Answers:
   0 = None (0)
   1 = Minimal cooperation (0.25)
   2 = Satisfactory cooperation (0.50)
   3 = Effective cooperation (0.75)
   4 = Highly effective cooperative (1.00)

6. Are NR program executions meeting USFWS & State expectations? (0-4)

   Answers:
   0 = Dissatisfied (0)
   1 = Minimally satisfied (0.25)
   2 = Somewhat satisfied (0.50)
   3 = Completely satisfied (0.75)
   4 = More than satisfied (1.00)

7. Did the USFWS participate in the INRMP/Natural Resources Program annual review? (Y/N)

   Answers:
   N (0)
   Y (1.00)

8. Did the State participate in the INRMP/Natural Resources Program annual review? (Y/N)

   Answers:
   N (0)
   Y (1.00)

9. Did the NOAA/NMFS participate in the INRMP/Natural Resources Program annual review, if applicable? (Y/N/NA)

   Answers:
   N (0)
   Y (1.00)
   NA

10. To what extent has the INRMP/Natural Resources Program successfully supported other mission areas? (e.g. encroachment, BASH, range support, port operations, air operations, facilities management, etc.) (0-4)

    Answers:
    0 = Not supported (0)
    1 = Minimally supported (0.25)
    2 = Satisfactorily supported (0.50)

3 = Well supported (0.75)
4 = Very well supported (1.00)

The questions in the Partnership Effectiveness Focus Area are not equally weighted. Questions #5 and #7-9 are weighted the most at 1.1; questions #1-3 and #6 are weighted 1.0; and questions #4 and #10 are weighted the least at 0.8. In particular, questions #7-9 speak directly to stakeholder participation in the annual Sikes Act review of the INRMP and NR Program at each of the installations. Specifically, question #7 asks if the USFWS participated in the INRMP/Natural Resources Program annual review. Therefore, if the answer provided for question #7 is "Yes", then the score for that question is [1.00 x 1.1 = 1.1]. Likewise, if the answers to question #8 (regarding State Fish and Wildlife agency participation in the review) is "Yes" and question #9 (regarding NOAA/NMFS participation in the review, when applicable) is "Yes", then the score for each of these questions is [1.00 x 1.1 = 1.1]. Therefore, if our Sikes Act partners are actively engaged in the annual review of our INRMPs, then the response to these questions increases the potential for a higher overall score for this Focus Area, which may contribute to the Focus Area being coded as green.

Focus Area 5: Team Adequacy –

The purpose of this Focus Area is to assess the effectiveness and adequacy of the Navy natural resources team in accomplishing the goals and objectives of the INRMP and Natural Resources Program at each installation. Team refers to the Navy staff only. The following questions [1out of 7 new in FY11] were asked.

1. Is there a Navy professional Natural Resources Manager assigned by the Installation Commanding Officer? (Y/N)

   Answers:
   N (0)
   Y (1.00)

2. Is there an on-site Navy professional Natural Resources Manager? (Y/N)

   Answers:
   N (0)
   Y (1.00)

3. Is HQ and Regional support adequate, e.g. reach back support for execution, policy support, etc.)? (0-4)

   Answers:
   0 = No support (0)
   1 = Minimal support (0.25)
   2 = Satisfactory support (0.50)
   3 = Well supported (0.75)
   4 = Very well supported (1.00)

4. Is there adequate Natural Resources staff to properly implement the INRMP goals and objectives? (Y/N)

   Answers:
   N (0)
   Y (1.00)

5. The team is enhanced by the use of contractors. (0-4)

   Answers:
   0 = Disagree (0)
   1 = Somewhat agree (0.25)
   2 = Neutral (0.50)
   3 = Agree (0.75)
   4 = Strongly Agree (1.00)

6. The team is enhanced by the use of volunteers. (0-4, NA)

   Answers:
   0 = Disagree (0)
   1 = Somewhat agree (0.25)
   2 = Neutral (0.50)
   3 = Agree (0.75)
   4 = Strongly Agree (1.00)
   NA

7. The Natural Resources team is adequately trained to accomplish its duties to ensure compliance. (0-4)

   Answers:
   0 = Disagree (0)
   1 = Somewhat agree (0.25)
   2 = Neutral (0.50)
   3 = Agree (0.75)
   4 = Strongly Agree (1.00)

The questions in the Team Adequacy Focus Area are not equally weighted by a value of 1. Questions #4 and #7 are weighted the most at 1.1; questions #1-3 are weighted 1.0; and questions # and #6 are weighted the least at 0.9. In particular, questions #4 and #7 speak directly to having sufficient NR staff and adequately trained NR staff to properly implement the INRMP goals and objectives at each of the installations. Therefore, if the answers to question #4 (regarding sufficient NR staff) is "Yes" and question #7 (regarding adequately trained NR staff) is "Yes", then the score for each of these questions is [1.00 x 1.1 = 1.1]. Therefore, the likelihood of getting a higher overall score for this Focus Area increases if there is sufficient NR staff that is adequately trained at the installation, which may contribute to the Focus Area being coded as green.

Focus Area 6: INRMP Project Implementation –

The purpose of this Focus Area is to assess how the goals and objectives of the INRMP have been met through the projects implemented during the previous fiscal year. Projects were selected from a list of EPRWeb projects and evaluated based on the type of funding received, the status of the project, and whether projects realized their intended goals. In addition, benefits to ecosystem integrity or a listed species, previously identified as a part of the installation, were noted for each project, if applicable. The following questions [9 out of 10 new in FY11] were asked for each project identified as being implemented during FY11 at each installation.

1. Is project accomplishment on schedule? (Y/N)

   Answers:
   N (0)
   Y (1.00)

2. What is the Project Status? (0,1)

   Answers:
   0= On-Hold; Funds Not Yet Received (0)
   1= In EPRWeb; In POM; Emergent; Funding Received; SOW Prepared; Awarded/Executed; Now In-Progress; Completed (1.00)

3. Which Natural Resources Program Area was most benefitted from the project? (0,1)

   Answers:
   0=None (0)
   1= Flora; Fauna; Habitat; At Sea; INRMP; Listed Species; Wetlands; Invasives; Soil; Forestry; Outdoor Recreation; Training; Other NR Requirements (Misc) (1.00)

4. The project design met the goals and objectives of the INRMP. (0-4)

   Answers:
   0 = Disagree (0)
   1 = Neither agree nor disagree (0.25)
   2 = Somewhat Agree (0.50)
   3 = Fully Agree (0.75)
   4 = Strongly Agree (1.00)

The questions in the INRMP Project Implementation Focus Area are equally weighted by a value of 1. In general, these questions are intended to evaluate the status of INRMP project implementation. Because there are some many factors outside the control of the NR program manager, it is difficult to score this Focus Area. It wouldn't be fair to penalize the NR program manager because many times the implementation status is due to a lack of funding or delays in execution. As long as the NR program manager has done their part in getting projects POMed and designed to meet the goals and objectives of the INRMP, then this should be reflected in the score for this Focus Area. For example, if the answer to question #2 (regarding status of the project) is "In EPRWeb; In POM; Emergent; Funding Received; SOW Prepared; Awarded/Executed; Now In-Progress; or Completed" and question #4 (regarding project design) is "Strongly Agree", then the score for each of these questions is [1.00 x 1 = 1.00]. Therefore, the likelihood of getting a higher overall score for this Focus Area increases, which may contribute to the Focus Area being coded as green.

Focus Area 7: INRMP Impact on Installation Mission –

This Focus Area is designed to measure the level to which existing natural resource compliance requirements and associated actions support the installation's ability to sustain the current operational mission. Per the Sikes Act, the goals and objectives of an INRMP should achieve no net loss of the mission at an installation. The following questions [0 are new in FY11] were asked.

1. Has Coordination between natural resources staff and other installation departments and military staff been successful/effective? (0-4)

   Answers:
   0 = No coordination (0)
   1 = Minimal coordination (0.25)
   2 = Satisfactory coordination (0.50)
   3 = Effective coordination (0.75)
   4 = Highly effective coordination (1.00)

2. To what extent has the INRMP successfully supported other mission areas? (e.g. encroachment, BASH, range support, port operations, air operations, facilities management, etc.) (0-4)

   Answers:
   0 = Not supported (0)
   1 = Minimally supported (0.25)
   2 = Satisfactorily supported (0.50)
   3 = Well supported (0.75)
   4 = Very well supported (1.00)

3. To what extent has there been a net loss of training lands or mission-related operational/training activities? (0-4)

   Answers:
   0 = Mission is fully impeded; training activities cannot be conducted (0)
   1 = Mission/Training activities are somewhat impeded with workarounds (0.25)
   2 = Neutral (0.50)
   3 = No loss occurred (0.75)
   4 = Mission has seen benefits (1.00)

4. Does the Natural Resource program effectively consider current mission requirements? (0-4)

   Answers:
   0: Strongly disagree
   1: Disagree
   2: Neutral
   3: Agree
   4: Strongly Agree

The questions in the INRMP Impact on Installation Mission Focus Area are equally weighted by a value of 1. In general, these questions are intended to evaluate the effectiveness of the installation's NR program on mitigating and/or avoiding natural resource impacts on the installation's military mission. For example, if the answer to question #3 is "Mission has seen benefits, then the score for this question is [0.75 x 1 = 0.75]. Therefore, the INRMP satisfies a fundamental requirement of the Sikes Act, no net loss of the mission, contributing to a higher overall score for this Focus Area, which may contribute to the Focus Area being coded as green.

Summary of INRMP and Sikes Act Questions

In addition to the NR Metrics questions, some additional questions were asked to assess the status of INRMPs at installations. In general, if an installation is reported as having significant natural resources, then it was counted as an installation requiring an INRMP. Per the DoDI 4715.03, significant natural resources are defined as resources identified as having special importance to an installation and/or its ecosystem. Natural resources may be significant on a local, regional, national, or international scale. All threatened, endangered and at-risk species are significant natural resources that normally require an INRMP. Installations that actively manage fish and wildlife, forestry, vegetation and erosion control, agricultural outleasing or grazing, or wetlands protection should be evaluated for significance, but normally will require an INRMP. An evaluation for significance should also consider the degree of active management, special natural features, aesthetics, outdoor recreational opportunities, and the ecological context of the installation. There are 73 Navy installations requiring INRMPs, all of which currently have an INRMP.

However, not all Navy installations with an INRMP have a compliant INRMP. A compliant INRMP is defined as "a complete plan that meets the purposes of the Sikes Act (§101(a)(3)(A-C)), contains the required plan elements (§101(b)(1)(A-J)), and has been reviewed for operation and effect within the past 5 years (§101(2)(b)(2))." Therefore, a compliant INRMP must be Sikes Act compliant and less than 5 years old. If the INRMP is greater than 5 years old, then it must have undergone a review for operation and effect within the past 5 years. A review for operation and effect is defined as "a comprehensive review by the Parties, at least once every 5 years, to evaluate the extent to which the goals and objectives of the INRMP continue to meet the purpose of the Sikes Act, which is to carry out a program that provides for the conservation and rehabilitation of natural resources on military installations. The outcome of this review will assist in determining if the INRMP requires a revision (§101(f)(1)(A)). (CNO-N45) The annual review can qualify for the 5-year review for operation and effect, which is legally required by the Sikes Act, if mutually agreed upon by both partners (i.e. USFWS and State)." According to this definition, there are 41 compliant INRMPs and 32 noncompliant INRMPs. But, if you qualify the annual review of the Natural Resource Program/INRMP with the USFWS and State Fish and Wildlife agencies as a sufficient review for operation and effect, then the total number of noncompliant INRMPs decreases to only 4. Therefore, the remaining 28 INRMPs could be considered partially compliant because they meet the condition of a noncompliant INRMP, but the USFWS participated in the annual NR Metrics review during the last reporting period (FY11).

INRMP implementation refers to projects that meet the goals and objectives of the INRMP. In FY11, total funds expensed toward implementing all 73 INRMPs equal $29,475,223. These funds include O&MN, MIS, Ag-Outlease, Forestry Reserve Account, Legacy, and Special Projects funds. Of this, $4,502,462 was spent on federally listed species, which accounts for approximately 15% of the total INRMP implementation costs. There are 75 critical habitat designations across all Navy installations, with 37 of these granted critical habitat designation exclusion under the ESA (Sec. 4. (a)), per NDA 2004. Further, 31 of those critical habitat designation exclusions were granted due to an INRMP.

Further Consideration

Given the results of the FY11 NR Metrics, it appears that there may be a discrepancy between the health of the NR programs across the Navy and the POM-14 budget request. It is important to consider that the NR Metrics were designed to be subjective. So, it is difficult to try and interpret the answers provided to the NR Metrics in a way that will help justify something objective, like the budget. The two are not directly correlated. The POM-14 budget request is forward looking, e.g. what is needed to execute projects associated with INRMPs in the out-years. On the other hand, the NR Metrics reflect the past execution and implementation of INRMPs.

However, the increased request for funds may reflect the fact that many of the INRMPs need to be revised. According to this year's DEPARC data, there are 28 partially compliant INRMPs and 4 noncompliant INRMPs. Many of these may require a revision. There are likely many new projects associated with these noncompliant and partially compliant INRMPs that need to be implemented; hence, the increased request for funds.

Therefore, INRMP project tables should really be compared to projects in POM-14. This will highlight if there are still projects in INRMPs that need to be implemented, hence the INRMPs are not being successfully implemented and the goals and objectives of the INRMP may not be met. In the future, consideration should be given to framing questions in the INRMP Project Implementation Focus Area in a manner that asks about INRMP Implementation tables, instead of EPR Execution Reports. If the objective is to evaluate how well the current INRMP is being implemented and meeting the goals of the NR Program, then this is what should be driving requests for funds. The annual funds expensed will continue to be pulled from the EPR Execution Report.

Appendix Q: Pertinent Sections of the Arizona Game and Fish Department Comprehensive Wildlife Conservation Strategy Plan

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Tree-Roosting Bat
Photo by AGFD

Forest Bats of Northern Arizona

Class: Mammalia
Order: Chiroptera
Family: Vespertilionidae

Arizona Game and Fish Department

ALLEN'S BIG-EARED BAT *(IDIONYCTERIS PHYLLOTIS*)

Species Description: Allen's big-eared bat is a rather large bat weighing 8-16 g with a wingspan of 31-35 cm and a forearm length of 46 mm. This bat is distinguished by its large ears (40 mm long, tragus 16 mm) and a unique pair of lappets or small lobes on the inner edge near the base of ear. A membrane going across the forehead joins the ears. When at rest, the ears are often protected by folding and coiling them into "ram's horns" which lie along the sides of their necks. This species has glandular enlargements on the muzzle and a keeled calcar. Allen's big-eared bat is typically tawny above with hairs dark brown at the base and underparts slightly lighter with no fur on wings or membranes. Dorsal fur is long and soft, and there is a patch of white fur behind each ear.

The presence of forward-projecting lappets at the base of the ears distinguish Allen's big-eared bat from the other 4 big-eared bats with which it may be confused: *Euderma maculatum* (Spotted bat), *Antrozous pallidus* (Pallid bat), *Macrotus californicus* (California leaf-nosed bat), and *Corynorhinus townsendii* (Townsend's big-eared bat) (Hoffmeister 1986). Call is a loud, distinctive "peep" at about 1 second intervals, similar to the spotted bat but has a slightly higher frequency and faster cadence. It also emits a "rapid clicking" or "low, barely audible cheeping" much like Townsend's big-eared bat (AGFD 2001).

Allen's big-eared bat
Photo by Bruce Talbert, AGFD

Habitat Requirements and Life History: Allen's big-eared bat usually inhabits forested areas of the mountainous Southwest. It is relatively common in pine-oak forested canyons and coniferous forests, but it may also occur in non-forested, arid habitats. In Arizona this species is found most often in lower elevation ponderosa pine forests, pinon-juniper woodlands, and riparian areas of sycamores, cottonwoods, and willows. It has been trapped on occasion in higher-elevation white-fir forests and in Mojave desertscrub. At most sites where this species occurs, cliffs, outcroppings, boulder piles, or lava flows are nearby. Day roosts may include rock shelters, caves and mines, and exfoliating bark. Their roosts are often loosely associated with roosts of Townsend's big-eared bat, *M. californicus* (California myotis), and fringed myotis (AGFD 2001). Allen's big-eared bat leaves the roost only after complete darkness, and usually flies about 10 m above the ground. Flights are characterized by swift, direct flights from one place to another (Barbour and Davis 1969). In close quarters, this species flies slowly, is highly maneuverable, able to hover, and can fly vertically (Czaplewski 1983).

Diet studies have found that Allen's big-eared bats feed primarily on small moths (Microlepidoptera, 6-12 mm in size). Soldier beetles (Cantharidae), dung beetles (Scarabeidae), leaf beetles (Chrysomelidae), roaches (Blattidae) and flying ants (Formicidae) have also been found in the diet. Food is gleaned from surfaces or pursued and taken in flight (AGFD 2001).

Reproduction in this species is very poorly understood. The sexes segregate geographically during summer months, with females gathering into maternity colonies and males possibly remaining solitary, roosting elsewhere. Maternity roosts can occur in pine snags, on boulders beneath rock shelters, and in mine entrances. A single young is born mid to late June in Arizona and become volant by late July. Arizona maternity roosts are known from the Kingman area and across the Mogollon Rim from Flagstaff to the Aravaipa Canyon area at the north end of the Galiuro Mountians. Lactating females have been captured in the vicinity of Flagstaff (AGFD 2001).

Distribution and Abundance: Allen's big-eared bat is distributed throughout the southwestern United States to central Mexico. It occurs in the central highlands of Mexico from the Distrito Federal, San Luis Potosi, Tamaulipas and Durango northward into west-central New Mexico to the Colorado River Valley, Arizona. It is found mostly at higher elevations (Barbour and Davis, 1969) and typically in mountainous regions. Seasonal movements, and winter whereabouts and activities are unknown. Specimen locations range across most of Arizona, but are not known from the southwestern deserts of Arizona (Figure 1). Most Arizona specimens have been taken from the southern Colorado Plateau, the Mogollon Rim and adjacent mountain ranges. They are fairly common in tree roosts on the Coconino and Apache-Sitgreaves National Forests, in Arizona (AGFD 1996). It has also been known to inhabit Mojave desertscrub with *Opuntia spp.*, catclaw, *Yucca spp.*, and Joshua trees (*Yucca brevifolia*) (Commissaris 1961, Findley and Jones 1961). Allen's big-eared bat has been observed at few locations on Camp Navajo and the surrounding area (Figure 2).

Species Status: Allen's big-eared bat is listed as a Sensitive species by BLM (Table 1, Appendix B). This species has a global (G) ranking of G3G4 indicating a vulnerable to apparently secure status throughout its range (NatureServe 2006). A state (S) ranking of S2S3 indicates that populations in Arizona range from imperiled to vulnerable. Insufficient information currently exists to assess the vulnerability status of the species in Arizona; however, scientific experts suspect that this species may be declining. Allen's big-eared bat was therefore identified as a high priority species of unknown status in Arizona's Comprehensive Wildlife Conservation Strategy (CWCS) (Table 2, Appendix C).

LONG-EARED MYOTIS (*MYOTIS EVOTIS*)

Species Description: Long-eared myotis is a large bat among the *Myotis spp.* It has a head and body length of 75-100 mm and weighs 5-8 g. It is distinguished from all other species of myotis by its long blackish ears (18-23 mm) which extend 5-10 mm beyond the tip of the nose when laid flat forward. The tragus is long and slender. The forearm length is 35.5-41mm and has a wingspan of 25-30 cm. General coloration is pale brown. Pelage on upper parts is generally light to medium brown and pale brown to straw-colored overall. Fur is full, soft, and glossy with individual hairs black at base (AGFD 2003a).

Long-eared myotis can be distinguished from other myotis by its unkeeled calcar and lack of conspicuous fringe of hairs on the trailing border of the tail membrane. The cranium rises gradually from rostrum to braincase and the skull is fairly narrow. Long-eared myotis has long tooth rows with robust molars and relatively large auditory bullae when compared to other long-eared species. It is easily confused with *M. auriculus* (Southwestern myotis), which is similar in size, ear length, and color, but tends to have brownish ears and membranes with a more dull, brownish pelage overall (AGFD 2003a).


Long-eared myotis
Photo by Bruce Talbert, AGFD

Habitat Requirements and Life History: Long-eared myotis occur in a variety of habitats over its range in North America, but occupies mostly forested areas. This species is found at elevations from sea level to 3,058 m. In the Pacific Northwest and British Columbia it occurs from dry forest to subalpine forest, especially where broken rock outcroppings prevail. In Arizona this species inhabits ponderosa pine or spruce-fir forests. When suitable roosting sites are available, this species is also found in semi-arid shrublands, sage, chaparral, and agricultural areas. The availability of appropriate roost sites may more strongly influence local distribution and abundance than plant community composition. In Oregon, areas where long-eared myotis forage and roost seem to be strongly influenced by the availability of water sources as well. Foraging areas and day roosts were more likely to be found close to a water source and were less influenced by forest composition (Waldien and Hayes 2001).

During the summer months these bats roost in small groups of 12 to 30 individuals in rock outcroppings, tree cavities, under peeling bark, in stumps, caves, mines, sink holes, lava tubes, or in abandoned buildings. Large diameter trees and snags seem to be the preferred tree roost sites (Rabe 1998, Waldien et al. 2000). These bats probably migrate short distances between summer haunts and winter retreats, although very little is known about these migration patterns and almost nothing is known about hibernacula. During winter it is likely that they use caves and abandoned mines as hibernacula. The only known hibernation site is an abandoned mine in Montana (AGFD 2003a). Records indicate that this species emerges at dusk and also late into the evening. Its flight is typically fast and maneuverable.

Long-eared myotis is adapted for foraging in vegetatively dense habitats. This species forages low (1.2-1.8 m above ground), and between and within treetops, and over woodland ponds. They are categorized as "hovering gleaners" which feed by taking prey from the surface of foliage, tree trunks, rocks, or ground. Long-eared myotis feeds on moths (Lepidoptera), beetles (Coleoptera), flies (Diptera), lacewings (Neuroptera), wasps (Hymenoptera), and a variety of other insects. The majority of prey taken are moths. Males eat significantly more moths and females feed more on beetles. Where long-eared myotis occurs sympatrically with Southwestern myotis, there is evidence that long-eared myotis of both sexes prey mainly on beetles, while Southwestern myotis individuals prey mainly on moths. Long-eared myotis varies the echolocation frequencies and patterns used in response to different foraging situations. They typically use lower frequency calls and passive listening to detect prey, making them particularly adept at capturing tympanate moths which are sensitive to the typical echolocation frequencies used by insectivorous bats. This species seem particularly efficient at foraging in high elevation habitats and when ambient temperatures are low (AGFD 2003a).

Mating occurs in the fall, and ovulation and fertilization occur in the following spring. Females form small maternity colonies in the summer, while males and barren females live singly or in small groups, occasionally occupying the same roost as the maternity colony but roosting apart from it. Females give birth to one young per year in late June or July. This species has a recorded lifespan of 22 years, but most individuals probably have a much shorter lifespan (AGFD 2003a).

Distribution and Abundance: Long-eared myotis occurs in temperate western North America from central British Columbia, and southern Saskatchewan and Alberta, Canada southward along the Pacific Coast to Baja California, eastwardly through Montana and Idaho to the western Dakotas, and from Nevada, Utah, Wyoming, and Colorado to New Mexico and Arizona. In Arizona this species occurs mostly along the Kaibab Plateau, Mogollon Plateau, and Chiricahua Mountains (AGFD 2003a) (Figure 3). Long-eared myotis has been observed at numerous locations on Camp Navajo and the surrounding area (Figure 4). Populations of the long-eared myotis are stable in Arizona, though populations inhabiting relatively isolated mountain ranges may be threatened.

Species Status: Long-eared myotis is currently listed as a Sensitive species by BLM (Table 1, Appendix B). This species has a global (G) ranking of G5 indicating a secure status with common and widespread populations throughout its range (NatureServe 2006). Populations in Arizona are vulnerable as indicated by the state (S) ranking of S3. Insufficient information currently exists to assess the vulnerability status of this species in Arizona, however, scientific experts suspect that this species may be declining. Long-eared myotis was therefore identified as a high priority species of unknown status in Arizona's CWCS (Table 2, Appendix C).

ARIZONA MYOTIS (*MYOTIS OCCULTUS*)

Species Description: Arizona myotis was once considered a subspecies of *M. lucifugus* (little brown myotis), but genetic evidence now supports its status as a separate species (Piaggio et al. 2002). It is a medium-sized myotis (total length = 80-97 mm and forearm length = 36-41 mm).

Small ears (11-16 mm) and large feet (8-11 mm) are characteristic of this species. Long hairs occur on the toes and extend beyond the tips of the claws. The pelage of Arizona myotis is often bright, sleek, and glossy, and generally tan, or reddish-brown to dark brown in color. It is the only long-footed (i.e., hind foot length >8.0 mm) myotis in Arizona with a gradually sloping forehead and only 1 small upper premolar behind the canine. In the rare individual with two premolars, it is only on one side or is crowded out of alignment (AGFD 2003b).

Arizona myotis can be distinguished from some myotis species by its lack of a keeled calcar. Shorter ears (11-16 mm) distinguish this species from long-eared myotis (20-24 mm), Southwestern myotis (19-21 mm) and usually from fringed myotis (12-19 mm). Arizona myotis may also be distinguished from fringed myotis by having no macroscopic fringe of hairs on the trailing edge of the tail membrane. The lack of a bare spot between the scapulae and lack of a grayish back distinguish Arizona myotis from *M. velife*r (Cave myotis). Darker ears, longer forearms (36-41 mm), and a glossier coat distinguish Arizona myotis from *M. yumanensis* (Yuma myotis) (AGFD 2003b).


Arizona myotis
Photo by Bruce Talbert, AGFD

Habitat Requirements and Life History: During summer months in Arizona, Arizona myotis is usually found in ponderosa pine and oak-pine woodland near water. This species has also been found along permanent water or in riparian forest in some desert areas such as along the lower Colorado and Verde rivers. This bat is most common at higher elevations between 1,830 and 2,806 m. There are also some records from much lower elevations: between 46 and 305 m along the lower Colorado, approximately 732 m at Tucson, and around 1,068 m in the vicinity of the Verde River. They are primarily found over or near water (AGFD 2003b).

Day roosts are located in buildings, trees, under rocks or wood, or occasionally in caves. Night roosts are located in similar sites, but usually in more confined spaces. This species emerges from day roosts at dusk and activity peaks about 2.5 hours after dusk. Few winter roosts are known, but one each was located in California and Sonora (AGFD 2003b). There are no known hibernacula in Arizona or New Mexico; however, Findley et al. (1975) suggests that in New Mexico they hibernate within the area of their summer range. Mines seem to be rarely used in summer although both winter records are from mines. Arizona myotis has been found roosting with Yuma myotis, cave myotis, and Mexican free-tailed bats (AGFD 2003b).

The Arizona myotis feeds on small (3-10mm) flying insects located by echolocation. This species generally hunts low over water for flying insects, including mosquitoes and midges (Diptera). Its flight is maneuverable, and it has the ability to detect prey at a short distance. It returns to regularly used feeding areas. The Arizona myotis has been observed foraging under large cottonwoods and in an orchard at low elevations. At higher elevations they usually forage at low levels over and around water (AGFD 2003b). A single Arizona myotis can consume 600 mosquitoes in an hour (Davis 2003).

Reproduction of the Arizona myotis is poorly understood. It is believed that the sexes roost separately in summer, since males have not been found at the 3 or 4 maternity colonies that have been reported. Maternity colonies in the Southwest range from about 60 to 800 females. The Arizona and New Mexico maternity colonies all occur in buildings near permanent water (AGFD 2003b). In California, mating occurs in fall and fertilization is delayed to the following spring. One young is born after a gestation of 50-60 days with births occurring between May and August. In southern, or lower elevation populations, births peak in May-June, and at higher elevations, peak in July. Females breed in the first year, while males do not breed until the second year. This species has a maximum lifespan of 20 years, although the average lifespan is 1-2 years.

<u>Distribution and Abundance</u>: Arizona myotis occupies extreme southeastern California through central and eastern Arizona into New Mexico, and southward through extreme western Texas into Chihuahua, Mexico. There is an isolated record from the Distrito Federal of central Mexico and Barbour and Davis (1969) state Colorado as part of their range. Winter range is unknown. In Arizona, most records are from the Mogollon Rim from Alpine northwest to near Flagstaff, including Mingus Mountain, Verde Valley, Sierra Ancha Mountains, and the Pinal Mountains (Figure 5). Numerous observations of Arizona myotis have been reported on Camp Navajo and within the surrounding area (Figure 6). The Arizona myotis likely occurs along the lower Colorado River Valley since it is known from at least 4 localities in the California portion of that area from the southernmost tip of Nevada south to near Yuma and 1 unmappable locality in the "Mojave Desert" of Arizona (AGFD 2003b). There is also a record of 12 specimens collected in 1894 by W. Price from the then abandoned Fort Lowell near Tucson (Howell 1989). According to the California Department of Fish and Game, populations have drastically declined in many parts of its range.

<u>Species Status</u>: Arizona myotis is currently a BLM Sensitive species (Table 1, Appendix B). This species has a global (G) ranking of G3G4 indicating a vulnerable to secure status throughout its range (NatureServe 2006). A state (S) ranking of S3 indicates that populations are vulnerable in Arizona. Insufficient information currently exists to assess the vulnerability status of this species in Arizona; however, scientific experts suspect that this species may be declining. Arizona myotis was therefore identified as a high priority species of unknown status in Arizona's CWCS (Table 2, Appendix C). Due to the relatively small range of Arizona myotis, with a large portion occurring in Arizona, this species was also ranked as a high priority species under the responsibility category of the CWCS.

FRINGED MYOTIS (*MYOTIS THYSANODES*)

<u>Species Description</u>: Fringed myotis has the shortest ears in the long-eared myotis group (16-19 mm). Their ears project 3-5 mm beyond the muzzle when laid forward. Fringed myotis weigh 5-7 g with a head and body length of 80-99 mm, forearm length of 40-47 mm, wingspread of 265-300 mm, and tail length of 34-45 mm. Pelage ranges in color from yellowish brown to darker olivaceous tones, with little difference between ventral and dorsal surfaces. Color varies geographically with tendency toward darker colors in the northwestern populations. Sexual dimorphism exists with females exhibiting a significantly larger head and body as well as forearm length. The robust calcar is not distinctly keeled (AGFD 2003c).

The most distinctive characteristic of this species is a conspicuous fringe of stiff hairs that protrude along the trailing edge of the tail membrane (uropatagium). This feature distinguishes fringed myotis from all other North American myotis, though some long-eared myotis individuals have a relatively inconspicuous fringe. Although similar to long-eared myotis in overall appearance, this bat is larger, except in ear size. Forearm length is generally larger than 40 mm, while forearm length of long-eared myotis is typically shorter than 40 mm. The metaloph, protoconule, and paraloph are usually absent on the first and second molars. This dental simplification is not observed in other North American species of *Myotis* (AGFD 2003c).

Fringed myotis
Photo by Bruce Talbert, AGFD

Habitat Requirements and Life History: The fringed myotis occurs at middle elevations (1,220 - 2,571 m) within a variety of habitats from desert scrub to fir-pine associations. These bats seem to occupy the lowest elevational range of all of the long-eared *Myotis* species (Southwestern myotis, long-eared myotis, *M. keenii* (Keen's myotis), *M. milleri* (Miller's myotis), and *M. septentrionalis* (Northern myotis)). Oak and pinyon woodlands appear to be the most commonly used vegetative associations. Coastal populations occur in low-elevation woodlands and some records indicate forays into high-elevation forests (AGFD 2003c). In southern Arizona, the fringed myotis occurs mostly in oak woodlands but also uses habitat ranging from lowland chaparral to ponderosa pine (Jones 1965, Hoffmeister 1986). This is one of the most abundant species in oak-woodland habitat between 1,524 and 1,829 m in the Chiricahua Mountains (Barbour and Davis 1969).

Fringed myotis tend to roost in the open in tightly packed groups. They have been recorded roosting in rock crevices, caves, mines, large snags, and in buildings. In buildings, the sides of ceiling joints are preferred, although cracks between beams may also be used. Roost trees used were large diameter snags in early to medium stages of decay and were more likely to be near water sources than random trees. Thermoregulation of fringed myotis in roosts is highly variable, with individuals shifting between regulating body temperatures and conforming to ambient temperatures. Lactating females tend to maintain lower body temperatures in day roosts than do post-lactating and pregnant females. Clusters of individuals tend to shift sites within the roost periodically in response to temperature changes or disturbance. Human disturbance can cause abandonment of the roost site (AGFD 2003c). In Mohave County, Arizona males are found at higher elevations than females during the spring and summer. Sex differences in roost distribution have been documented throughout Arizona (Hoffmeister 1970).

The fringed myotis eats a variety of insects although small beetles (Coleoptera) are taken more than 70 percent of the time. These bats forage close to the vegetative canopy and have relatively slow and highly maneuverable flight, which is consistent with their wing morphology. This bat may land to pick up prey from the ground. Most foraging activity occurs between one and two hours after sunset, but some activity may continue until 4.5 hours after sunset (AGFD 2003c).

Females do not copulate until after leaving the maternity roost in the fall (O'Farrell and Studier, 1973). Copulation may occur at hibernacula, as in most other temperate vespertilionids. Ovulation, fertilization, and implantation begins in late April. Pregnancy lasts between 50 and 60 days, and a single young is born between late June and early July. Females deposit newborns in a separate roost site and only visit them to nurse or to assist young in distress. During lactation two to ten adults are always present in the roost to care for the young. Young have open eyes and erect pinnae shortly after birth and are pink in color for approximately one week, after which the skin pigmentation process commences, followed by hair growth in the pigmented areas. The neonate is huge in proportion to the mother, at 22% of her body mass and 54% of her total length. Young are capable of limited flight after 16.5 days and are indistinguishable from adults in both flight and form after 21 days.

Distribution and Abundance: The distribution of fringed myotis encompasses most of western North America from British Columbia to southern Mexico. A disjunct population occurs in the Black Hills of Wyoming and South Dakota. In Arizona, this species occurs throughout much of the state, although it is not known from the northeast or southwest corners. The lack of records from the northeast corner of Arizona is probably due to the lack of knowledge from the Navajo reservation lands and not the absence of this species in the area. Records of fringed myotis exist for the northwest corner of New Mexico adjacent to the Navajo land. Their winter range in Arizona shifts to the southernmost counties and Mohave County (AGFD 2003c) (Figure 7). Fringed myotis has been observed at several locations on Camp Navajo and the surrounding area (Figure 8). Populations of fringed myotis appear to be stable in Arizona, though they are rare in other areas.

Species Status: Fringed myotis is listed as a Sensitive species by BLM (Table 1, Appendix B). This species has a global (G) ranking of G4G5 indicating that populations are apparently secure to demonstrably secure in status throughout its range (NatureServe 2006). Populations in Arizona range from vulnerable to apparently secure, indicated by the state (S) ranking of S3S4.

LONG-LEGGED MYOTIS (*MYOTIS VOLANS*)

Species Description: Long-legged myotis is one of the larger species of myotis weighing 5-10 g with an overall length of 9.4-10.7 cm, wingspan of 25.0-30.0 cm, forearm of 3.8-4.1 cm, tail 4.3-4.9 cm, and hind foot 8.0-11.0 mm. It has a keeled calcar, short rounded ears (11.0-15.0 mm), and a long pointed tragus (6.0-8.0 mm). Fur is long and soft with color varying geographically. The dorsal fur ranges from ochraceous to dark reddish or blackish brown and the ventral pelage ranges from pale buff to cinnamon or smokey brown. Its belly fur extends out onto the underside of the wing to a line joining the elbow and the knee. Characteristics of the skull include a short rostrum, steep forehead, broad interorbital region and a globose brain case. Ears and flight membranes are blackish. Sexual dimorphism occurs with the female having a slightly larger forearm length (AGFD 2003d).

Long-legged myotis is distinguished from other myotis by its short, rounded ears that barely reach the nostril when laid forward, small hind feet, distinctly keeled calcar, and comparatively long, dense fur on the underside of the wing membrane extending from the body to a line joining the elbow and the knee (AGFD 2003d). Several other myotis have hair on the underwing, but it is usually not as long, dense, or extensive as in the long-legged myotis.


Long-legged myotis
Photo by Bruce Talbert, AGFD

Habitat Requirements and Life History: Long-legged myotis typically occupies mountainous or relatively rugged areas. They occur across an elevational range from 60 to 3,770 m, most often between 2,000 and 3,000 m. Although primarily a coniferous forest bat, it may also be found in riparian and desert habitats. In Arizona, this species is common in ponderosa pine and coniferous forest, although it does occur in pinon-juniper and oak woodlands.

This species utilizes a variety of roosts including abandoned buildings, cracks in the ground, crevices in cliff faces and spaces behind exfoliating tree bark. Caves and mine tunnels are used as hibernacula, and typically more males inhabit a hibernaculum than females. In the summer, they apparently do not use caves as a daytime roost site. Long-legged myotis tend to be active over long periods of the night, but their peak activity is within the first three to four hours after sunset (AGFD 2003d).

The timing of reproductive activity in this species seems to vary extensively, probably partly in relation to climatic factors. Copulation begins in late August and sperm is stored over winter in the female's reproductive tract. Ovulation occurs between March and May, and young may be born from May through August. Long-legged myotis form large nursery colonies, often numbering in the hundreds. Rock crevices, trees, stream banks, or buildings serve as maternity roost sites. In the Southwest, they give birth to single young earlier in the season than most other bats (AGFD 2003d). Lifespan may be up to 21 years (Warner and Czaplewski 1984).

Long-legged myotis commonly forages 3.1-4.6 m high over water and in openings in woods. These bats are strong direct fliers, capable of speeds up to 15-17 km per hour and can be recognized in flight when feeding. This species consumes primarily moths but has also been observed taking flies, lacewings, wasps, beetles, and other insects. It pursues prey over fairly long distances around, under, and over the forest canopy. There is some evidence that an individual bat will follow a similar foraging route night after night. Long-legged myotis is an opportunistic forager, taking appropriate prey in approximate proportion to their availability in the environment (AGFD 2003d).

Distribution and Abundance: Long-legged myotis occurs in southern Alaska and western Canada southward into northern Mexico and throughout the western United States from the Pacific coast to western North Dakota and extreme western Texas. In Arizona, this species occupies forested mountains in Apache, Cochise, Coconino, Gila, Mohave, and Yavapai counties, and is absent from the desert and mountains of the southwestern part of the state (AGFD 2003d) (Figure 9). Long-legged myotis has been observed at several locations on Camp Navajo and the surrounding area (Figure 10).

Species Status: Long-legged myotis is currently a BLM Sensitive species (Table 1, Appendix B). This species has a global (G) ranking of G5 indicating a secure status with common and widespread populations throughout its range (NatureServe 2006). Populations in Arizona range from vulnerable to apparently secure as indicated by the state (S) ranking of S3S4.

THREATS

In general, the long term persistence of North American bat species is threatened by the loss of clean, open water; modification or destruction of roosting and foraging habitat; and, for hibernating species, disturbance or destruction of hibernacula (Keinath 2003). Because of low fecundity, high juvenile mortality, and long generational turnover, many bat populations may be vulnerable to human-induced pressures. Entering roosts at sensitive times of the year, camping in or near caves, releasing environmental toxins (O'Shea et al. 2001), and destroying roost sites are all human-induced pressures known to be threats to bats. In addition, accidental midair collisions with wind turbines (Osborn et al. 1998), trees, and barbed-wire fences, or accidental groundings during extreme weather may cause bat fatalities. Midair predation by raptors and roost predation by snakes, raccoons, and skunks also contribute to bat mortality.

Forestry practices that selectively remove older, larger trees or snags constitute the greatest threat to tree-roosting bats, as these trees are most likely to possess cavities and loose bark that bats need for roosting. Both prescribed fire and wildfires may also threaten forest bats and their roosts, although they may also create new snags for roosting. As urbanization and recreational use of existing forests increase, resulting disturbance and fragmentation of tree stands may reduce their suitability for bat roosting.

Military missions on Camp Navajo and the Naval Observatory can impact habitat, thereby placing tree-roosting bat species at risk. Habitat on Camp Navajo is predominately ponderosa pine (*Pinus ponderosa*) forest with a Gambel oak (*Quercus gambelli*) understory (Camp Navajo 2007). Large open grasslands in the forest exist naturally and from past logging operations. The highest elevations contain mixed-conifer forest dominated by Douglas-fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*). The lowest elevations occur in Volunteer Canyon, a mesic steep-walled canyon with pockets of Engelmann spruce (*Picea engelmannii*) on the south boundary of the installation. Forestlands on the eastern and northern portions of the facility consist primarily of second-growth ponderosa with limited understory vegetation. Grasses and shrubs dominate Camp Navajo's central area, which was heavily developed to facilitate munitions storage. Ponderosa pine forests also dominate the Naval Observatory property, with some grassland meadows (USNOFS 2001). Gambel oak is interspersed among the pines, most notably on the knoll that supports the primary telescope and facility.

Mission impacts to installation natural resources include the reduction of ground vegetation. Affected areas are often localized; occurring in areas used as bivouac, camping, training, and construction areas. Vehicular traffic can also modify habitat areas by disturbing and compacting soils. Severe soil damage, a result of repeated use, can occur resulting in a loss of native vegetation cover that may lead to increased soil erosion and establishment of invasive species. This loss also represents a loss of graze, browse, growing medium, cover, or other important ecological attributes. Noise disturbance and vehicular traffic also represent mission impacts, potentially affecting movement and activity patterns of wildlife species. Military activities, such as range and training activities, may cause local wildlife displacement, which may lead to reduced survival and reproductive success. Activities peripheral to military objectives, such as logging and firewood gathering, can reduce habitat value through ground disturbance and the loss of important habitat features (e.g. snags, downed dead wood, large mature trees) (USNOFS 2001, Camp Navajo 2007).

MANAGEMENT RECOMMENDATIONS

Habitat use and selection by bats is influenced by the availability of suitable roosts in proximity to water and foraging resources. In general forest-dwelling bat species use tall snags in intermediate stages of decay for day roosting and occupy multiple day roosts within a stand. Bats tend to select snags that are >30 cm dbh (diameter at breast height) and in beginning to intermediate decay classes (2 and 3) due to the greater amount of loose bark available for roosting (Weller and Zabel 2001). Although snags in decay class 1 are usually not selected due to their intact bark, they will serve as the next generation of snags and so must be considered in management schemes. Decay classes 4 and 5 usually do not have enough bark to be suitable roost snags. Large diameter snags may be used more frequently because they remain on the landscape longer and provide more permanent roost structures. Bats may be selecting roost trees above canopy cover and in areas with less canopy cover because they receive greater solar radiation, which can then increase the diurnal temperature of roosts. Forest management prescriptions should specifically aim to preserve and promote growth of larger ponderosa pine and Gambel oak. Rabe et al. (1998) reported that clumps of large diameter ponderosa pine snags with peeling bark were the primary habitat components selected by pregnant and lactating bats. A recent study on Camp Navajo indicated that the majority of non-reproductive bat day roosts were located in medium sized Gambel oaks and large diameter ponderosa pine snags (AGFD unpub. data 2006). Chambers (2002) also reported that both female and male southwestern myotis used Gambel oak trees with cavities. Maternity roosts for southwestern myotis were located in live Gambel oak trees with cavities (Bernardos et al. 2004). Both ponderosa pine snags and live Gambel oaks with cavities >30 cm dbh or drc (diameter at root crown) should be protected. Retaining snags and the oldest live trees within green-tree retention zones is essential to providing future bat roost habitat (Waldien et al. 2000).

Recent research suggests that bats show fidelity to small areas rather than specific roost trees. This fidelity underscores the importance of understanding habitat selection at a larger scale than at the roost. Roost trees are found in stands with significantly more snags per hectare and cavity roosts tend to be closer to water. Therefore, management prescriptions aimed at conserving bat-roosting habitat should set aside a greater number of suitable snags (>30 cm dbh) than currently thought to be sufficient habitat for cavity-nesting forest birds (Rabe et al. 1998, Baker and Lacki 2006). Forest management prescriptions should also provide for large snags with exfoliating bark across all landscape positions and in perpetuity (Baker and Lacki 2006). To sustain roosting habitat for bats, xeric ponderosa pine forest management prescriptions should include thinning of young stands to expedite recruitment of large trees that are then allowed to die in place and all existing large snags should be preserved (Rabe et al. 1998). While bats will roost in a younger forest and even in logged forests, multi-age forest is essential if they are to stay and reproduce (Murphy 1994). If multi-age stands, including old growth, are not left, the dead and dying trees that the bats depend on will not become available on a continuing basis.

Foraging habitat should also be considered when managing habitat for forest-dwelling bats. Several studies suggest that bats primarily day-roost in upland forests and use riparian corridors for their nightly foraging activity. Other species of bats, such as long-eared myotis often forage near dense tangled vegetation or in forested areas (Faure and Barclay 1992, Manning and Jones 1989). Buffers should be established around riparian corridors and around other water sources. Additionally, some areas of dense understory vegetation should be maintained to help sustain insect and prey abundance. Overall, ideal areas for many species of bats will contain a mosaic of foraging habitat, still water sources, and roost structures that are proximate to each other over a large enough area to accommodate shifts in local prey abundance.

Special management considerations should be taken during the peak of maternity roosting in June. Because bats have low reproductive rates, intensive forest management practices in ponderosa pine habitats during summer months when bats are reproductively active may negatively affect their reproductive success (Morrell et al. 1999). In addition, buffer zones should be created around snags known to house large colonies of bats, which would protect the main maternity colony and the surrounding snags. In areas where snags are scarce or absent, artificial roosts could be constructed and installed to help support the local bat population (Smith and Agnew 2002, AGFD unpub. data 2006).

There are several possible management strategies that could help maintain current snag populations as well as promote the recruitment of future snags and other habitat components important to bats on Department of Defense lands in Northern Arizona.

- Preserve and promote growth of larger ponderosa pines.
- Maintain and protect Gambel oaks.
- Retain all snags and trees with cavities over 30 cm dbh across all landscape positions.
- Establish a multi-age forest.
- Buffers should be established around riparian corridors and other water sources.
- Maintain some areas of dense understory vegetation for foraging habitat.
- Identify and map areas of high snag value (i.e. location and density of existing snags).
- Identify and map areas of high snag recruitment value (i.e. location and density of live trees of the appropriate size and density).
- Continue to support snag monitoring (i.e. determine dynamics of snag recruitment and retention on military lands).
- Maintain integrity of mature pine-oak forests.
- Encourage understory growth by opening dense forest stands (remove young small seedlings).
- Locate infrastructure expansions or improvements in areas with lower habitat value (e.g. areas with low snag density, areas of younger forests).
- Educate logging operators on the importance of snags.

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Table 1. Species status[1] according to the Endangered Species Act (ESA), Bureau of Land Management (BLM), Arizona Game and Fish Department Wildlife of Special Concern (STATE), and NatureServe Explorer Global (G) and State (S) Conservation Status Rankings.

SPECIES	ESA	BLM	STATE	GRANK	SRANK
Allen's big-eared bat	--	S	--	G3G4	S2S3
Long-eared myotis	--	S	--	G5	S3
Arizona myotis	--	S	--	G3G4	S3
Fringed myotis	--	S	--	G4G5	S3S4
Long-legged myotis	--	S	--	G5	S3S4

[1]See Appendix B for status and ranking definitions.

Table 2. Species status[1] according to rating categories in Arizona's Comprehensive Wildlife Conservation Strategy (CWCS) (AGFD 2006).

	CWCS Rating Categories			
SPECIES	Responsibility[1]	Community Focal[1]	Vulnerability[1]	Unknown Status[1]
Allen's big-eared bat	3	2	2	1
Long-eared myotis	3	2	2	1
Arizona myotis	1	2	2	1
Fringed myotis	3	2	2	3
Long-legged myotis	3	2	2	3

[1]See Appendix C for summary of Arizona's CWCS rating categories and component criteria.

Figure 1.

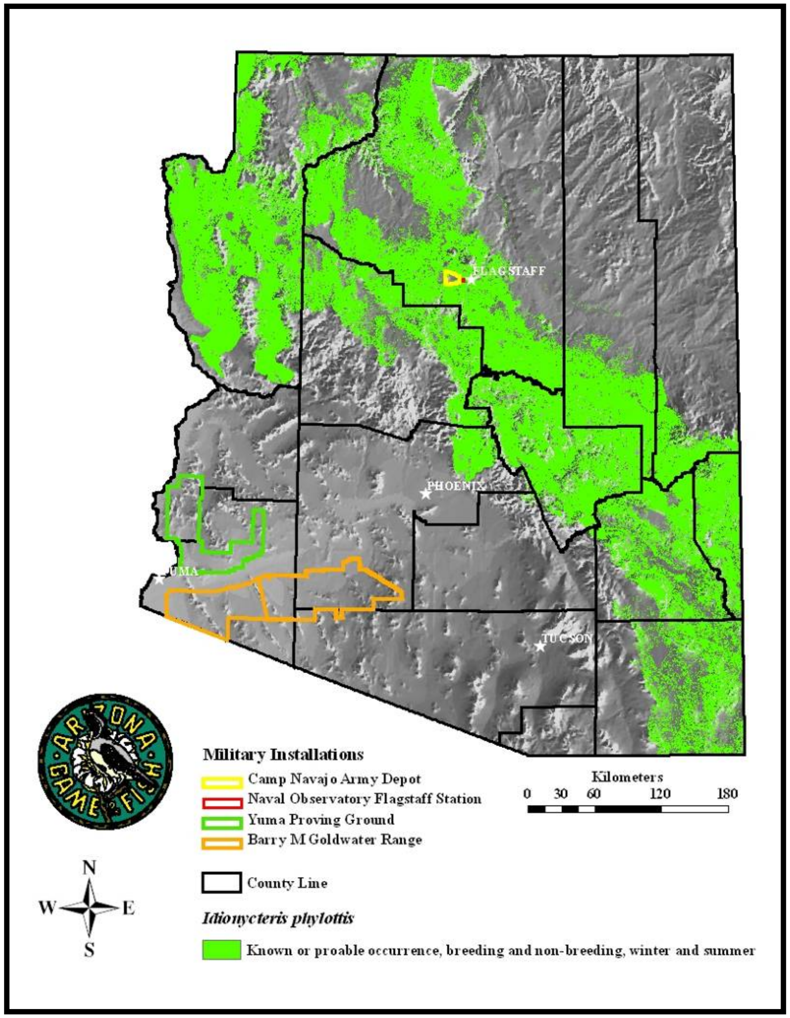
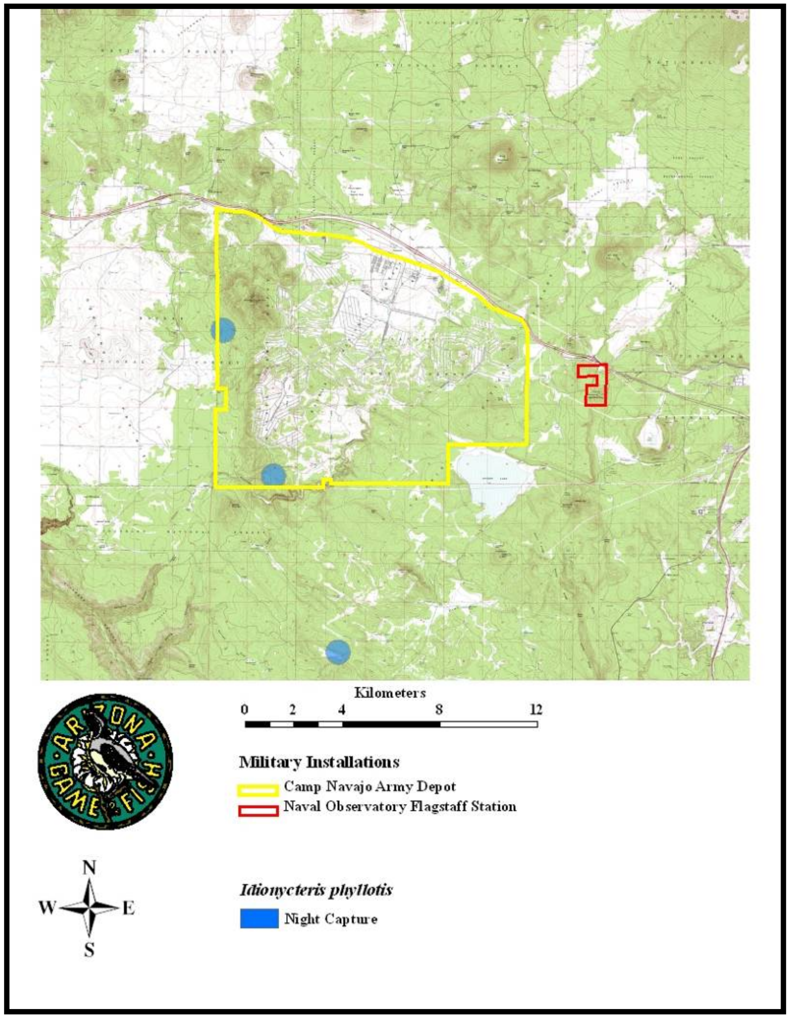


Figure 2.



Figures 1 and 2. Potential range (Figure 1) and known occurrences (Figure 2) of the Allen's big-eared bat (*Idionycteris phylottis*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Occurrence data were compiled from Arizona's Heritage Data Management System; Arizona Game and Fish Department (AGFD) BATS database; and from forest bat research conducted on Camp Navajo by AGFD (*pers. comm.*, Valerie Horncastle). See Appendix A for further information on data sources.

Figure 3.

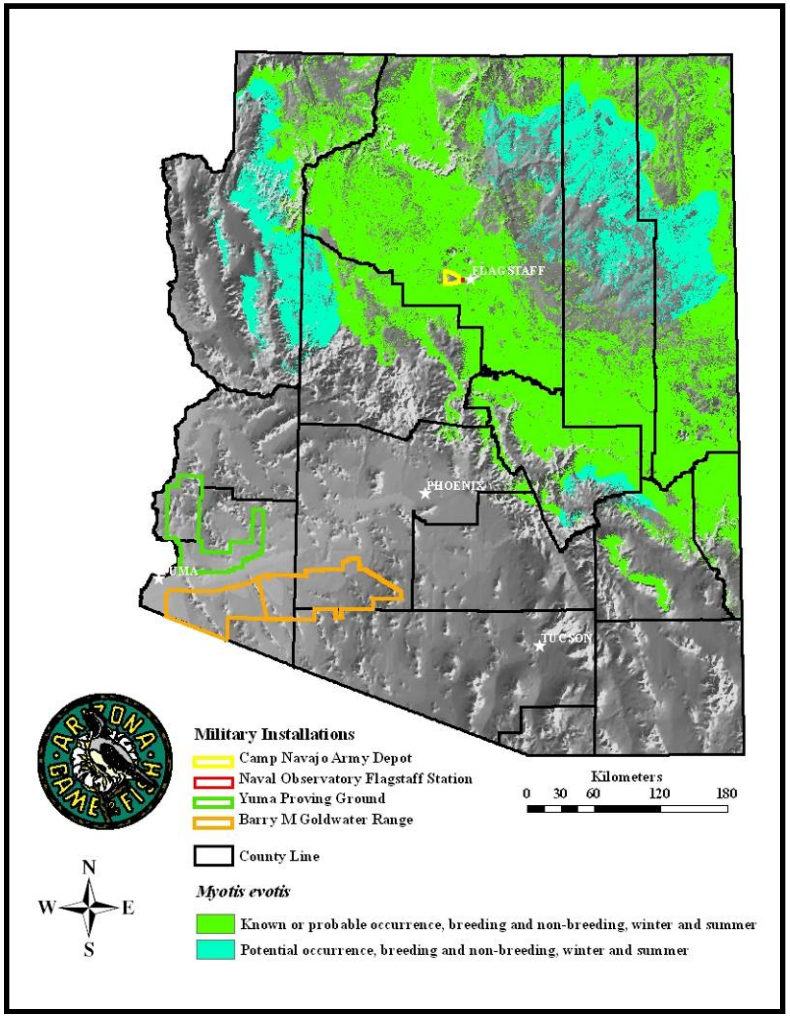
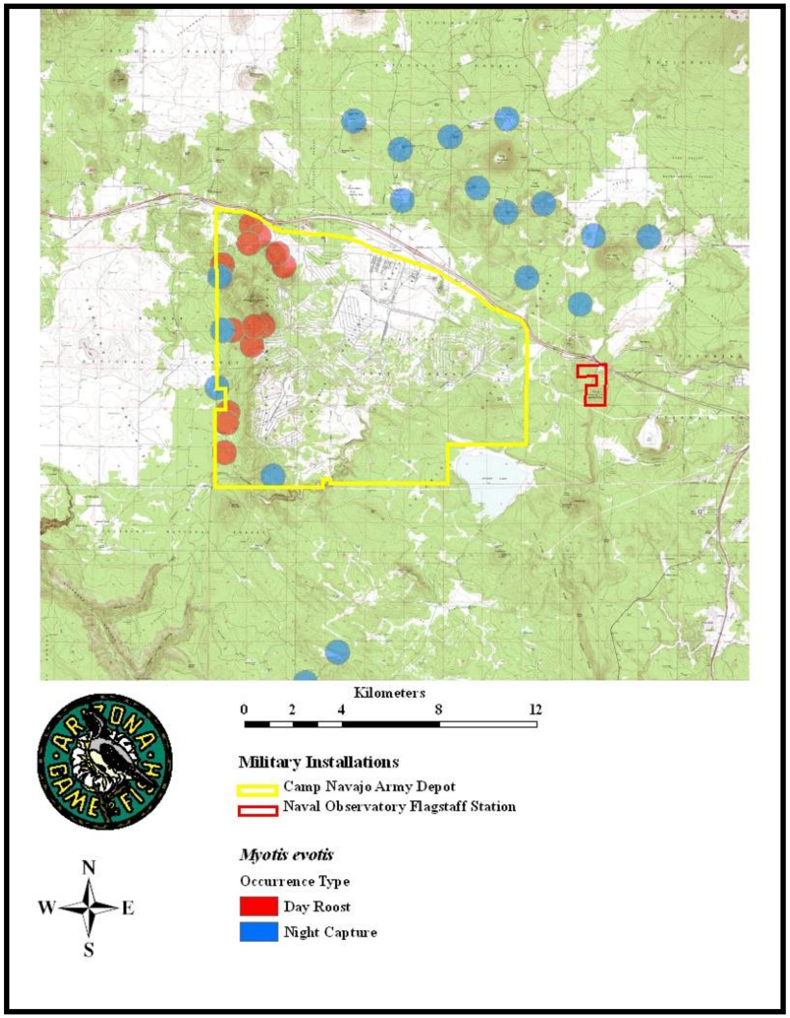


Figure 4.



Figures 3 and 4. Potential range (Figure 3) and known occurrences (Figure 4) for the long-eared myotis (*Myotis evotis*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Occurrence data were compiled from Arizona's Heritage Data Management System; Arizona Game and Fish Department (AGFD) BATS database; and from forest bat research conducted on Camp Navajo by AGFD (*pers. comm.*, Valerie Horncastle). See Appendix A for further information on data sources.

Figure 5.

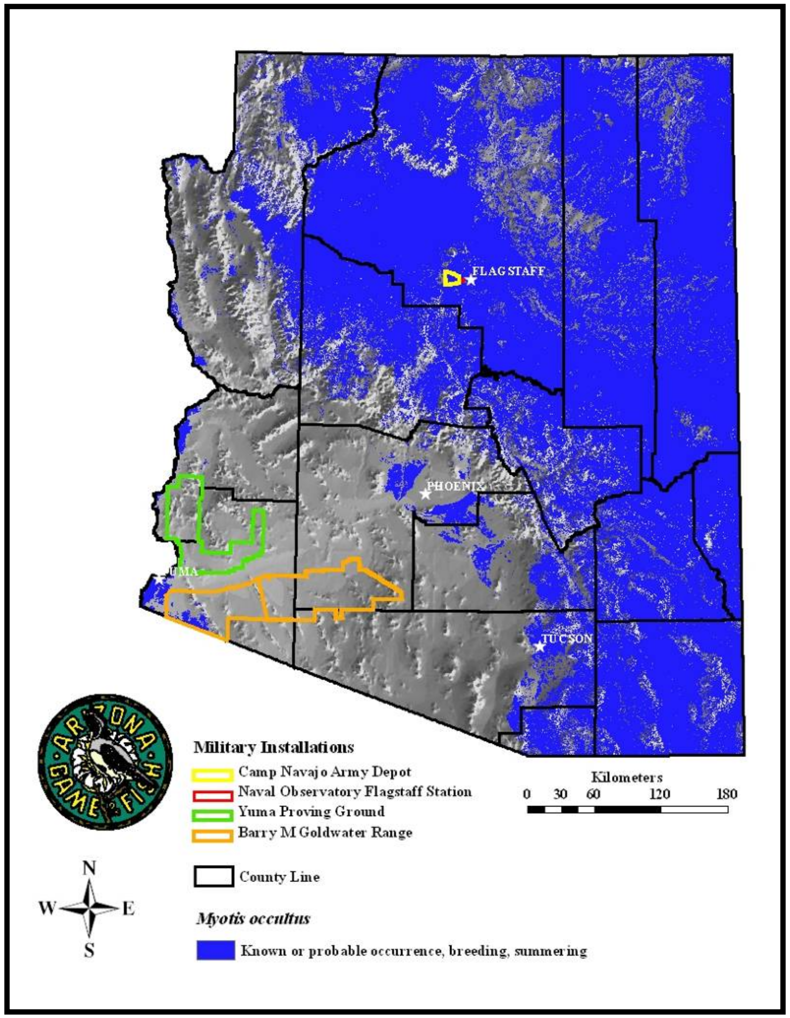
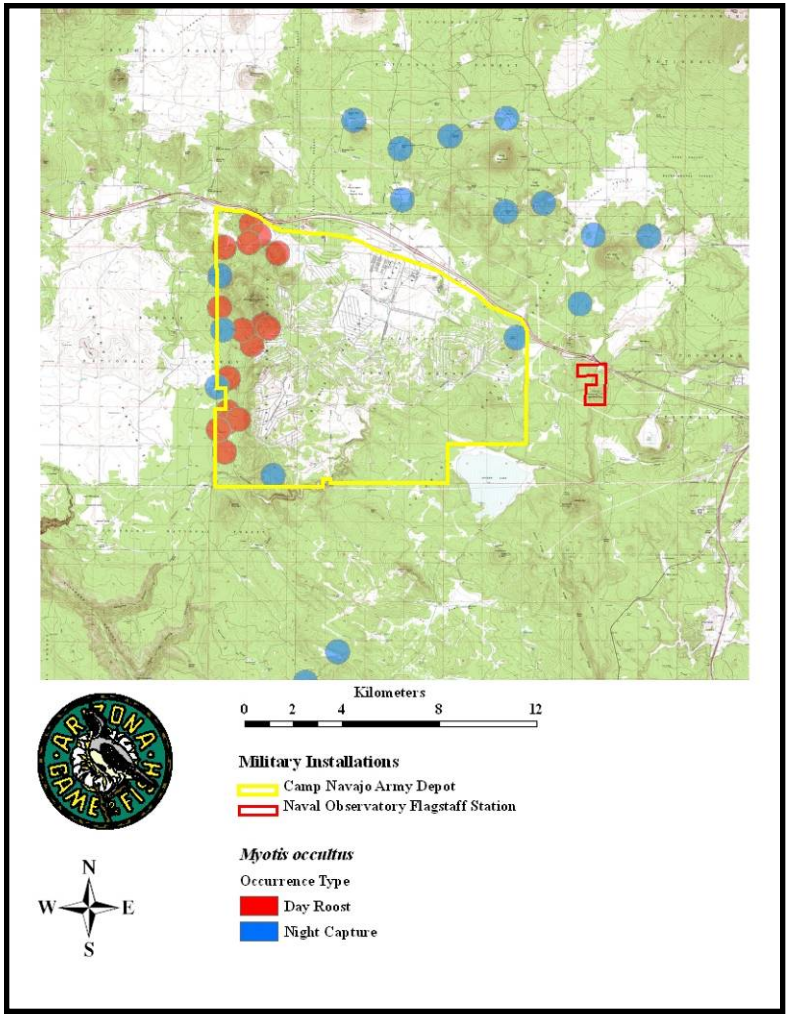
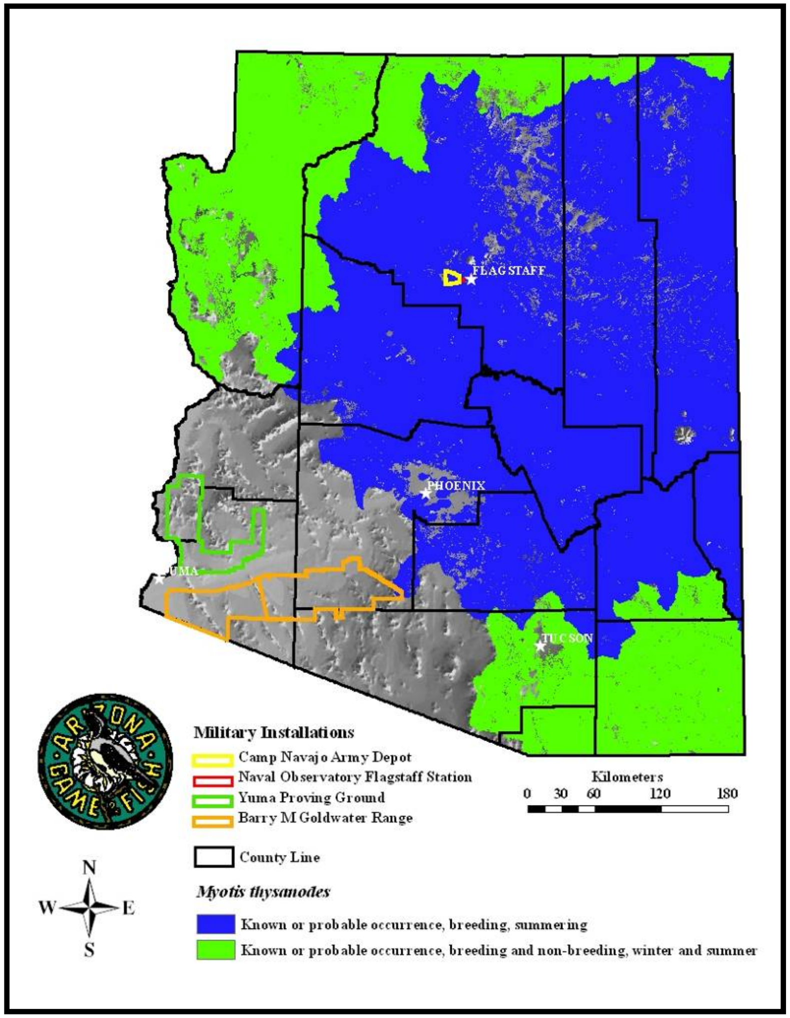


Figure 6.



Figures 5 and 6. Potential range (Figure 5) and known occurrences (Figure 6) for the Arizona myotis (*Myotis occultus*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Occurrence data were compiled from Arizona's Heritage Data Management System; Arizona Game and Fish Department (AGFD) BATS database; and from forest bat research conducted on Camp Navajo by AGFD (*pers. comm.*, Valerie Horncastle). See Appendix A for further information on data sources.

Figure 7.



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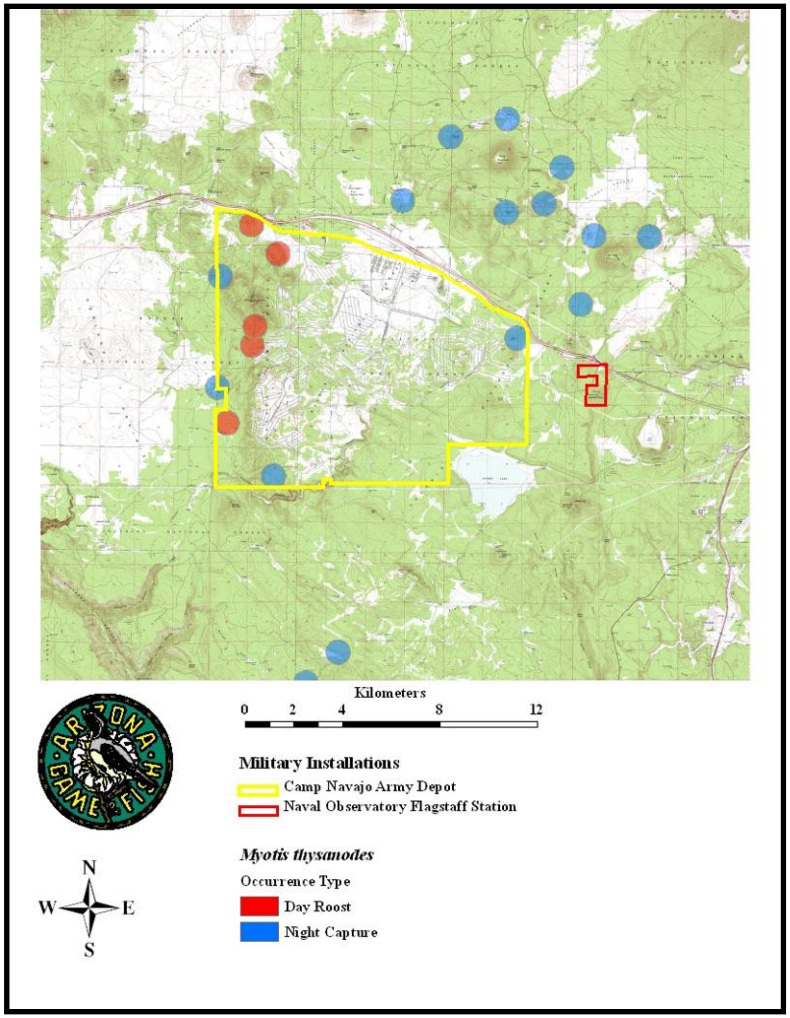


Figures 7 and 8. Potential range (Figure 7) and known occurrences (Figure 8) for the fringed myotis (*Myotis thysanodes*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Occurrence data were compiled from Arizona's Heritage Data Management System; Arizona Game and Fish Department (AGFD) BATS database; and from forest bat research conducted on Camp Navajo by AGFD (*pers. comm.*, Valerie Horncastle). See Appendix A for further information on data sources.

Figure 9.

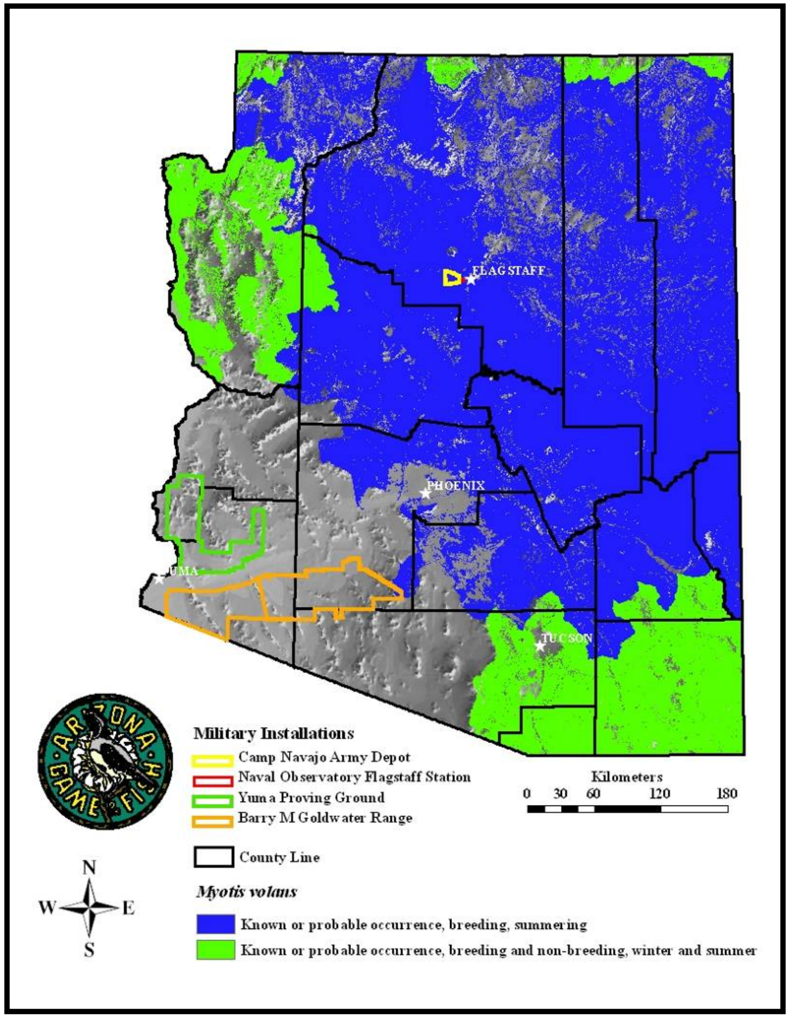
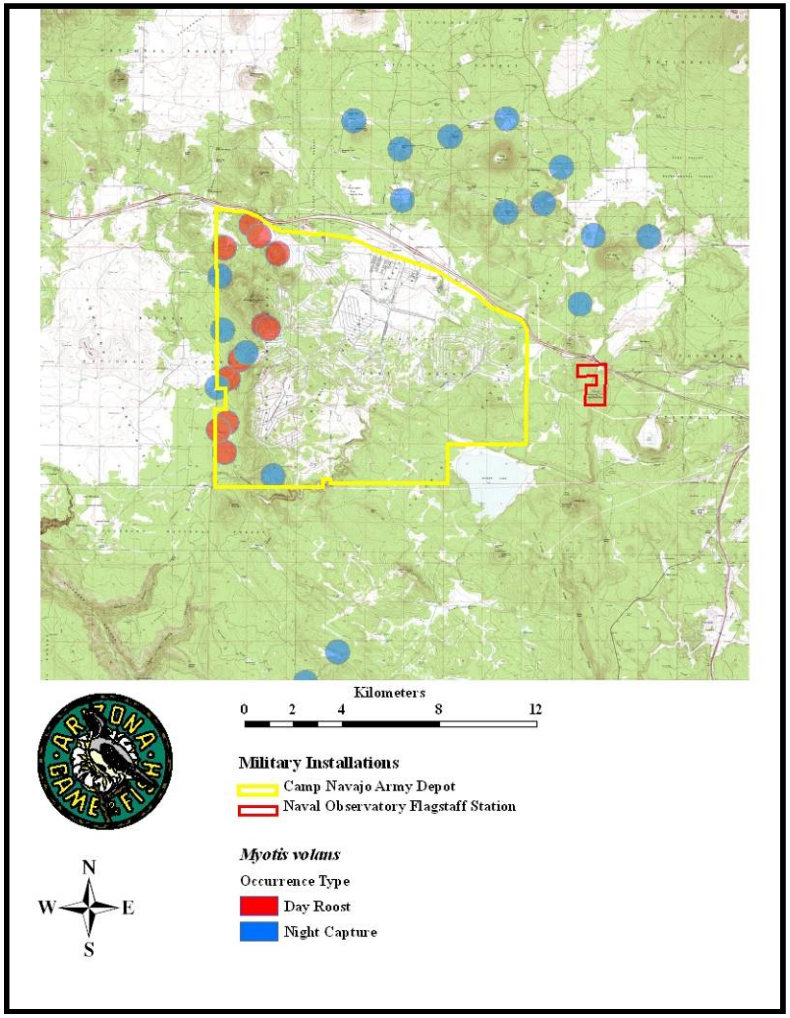


Figure 10.



Figures 9 and 10. Potential range (Figure 9) and known occurrences (Figure 10) for the long-legged myotis (*Myotis volans*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Occurrence data were compiled from Arizona's Heritage Data Management System; Arizona Game and Fish Department (AGFD) BATS database; and from forest bat research conducted on Camp Navajo by AGFD (*pers. comm.*, Valerie Horncastle). See Appendix A for further information on data sources.

Forest Woodpeckers of Northern Arizona

Class: Aves
Order: Piciformes
Family: Picidae

Arizona Game and Fish Department

DOWNY WOODPECKER (*PICOIDES PUBESCENS*)

Species Description: The downy woodpecker is the smallest woodpecker in North America, attaining 14-17 cm (6-7 in) in length and 21-28 g (0.74-0.99 oz) in weight. Adults have primarily black upperparts and white to grayish underparts. The center of the back is white and white spotting occurs on the wings. White stripes are present on the face above and below the eye. The tail is black in the center with white outer tail feathers. The outermost tail feathers are barred with black on each side. Adult males have a red patch at the back of the head whereas juvenile males have red foreheads and no red patch on the rear of the crown. Females have a black patch at the rear of the head. The bill is small and pointed. Call note is a flat "pik" or a rapid descending whinny or rattle. Drumming is long and very fast (Cornell Lab of Ornithology 2003a).


Downy woodpecker, female
Photo by George Andrejko, AGFD

Downy woodpecker size and coloration varies gradually across its ranges. Birds tend to be larger in the north and at higher elevations, whereas smaller birds occur in the south and at lower elevations. Western downy woodpeckers tend to have less white spotting on the wings and less black on the outer tail feathers (Cornell Lab of Ornithology 2003a).

The downy woodpecker is very similar in plumage to the hairy woodpecker (*Picoides villosus*) but is smaller in size (average length 17 cm versus 24 cm), has a proportionately smaller bill (obviously shorter than head), black spots or bars on the white outer tail feathers, and a flatter call note (pik versus peek!). Despite similar plumage patterns, DNA-sequence-based phylogenetic analyses revealed that the downy and hairy woodpeckers are not closely related and the large genus *Picoides* is in need of systematic revision (Weibel and Moore 2002a, Weibel and Moore 2002b). Further analyses by Weibel and Moore (2005) indicated that convergence, as opposed to parallel evolution or shared ancestry, underlies the similarity in plumage patterns between these two species. Mimicry and interspecific territoriality were proposed as possible causal explanations for convergence in the woodpecker plumage patterns (Weibel and Moore, 2005).

Habitat Requirements and Life History: Downy woodpeckers are found in deciduous and mixed woodlands, second growth forests, parks, swamps, and riparian woodlands. In the northern parts of their range, downy woodpeckers favor open deciduous forests and woodlands. They are less common in conifer-dominated forests unless there is a deciduous understory. Although occasionally seen in foraging groups, downy woodpeckers are generally solitary. Both males and females defend territories against same sex conspecifics. When encountering an intruder, the resident woodpecker uses threat displays (e.g., wing flicking, tail fanning) to try to drive the intruder away. If displays are unsuccessful the resident may attack the intruder, grappling in mid-air (Jackson and Ouellet 2002). A percentage of birds in northern populations of downy woodpeckers are migratory, moving southward during winter months (Jackson and Ouellet 2002). Other populations are non-migratory, remaining in their summer range during winter months, although often restricting movements when compared to summer breeding ranges. Both individual and pair territories have been reported in downy woodpeckers (Kilham 1983). Nesting territories reported in deciduous forest in Illinois averaged 4.4 ha (n = 5 pairs) in 1934, and 5.5 ha (n = 4 pairs) in the same forest in 1935 (Twomey 1945). These territories were non-overlapping and did not include all available forest. Larger territories with fewer pairs suggests some link between population density and territory size. Territory size is affected by life history stage. Territories are generally smaller during the nesting period when adults need to remain near young (Jackson and Ouellet 2002).

Downy woodpeckers roost and nest in cavities dug into dead and live trees 1 to 15 m above the ground. Each individual normally roosts in its own cavity each night, and new roost cavities are generally excavated in the fall, independent of sexual behavior. Females typically select nest cavity sites, while both the male and female excavate the cavity together. They prefer nest sites in more open forests, excavating cavities in a dead limb of a living or dead tree ranging in size from 20 to 40 cm dbh (diameter at breast height) and in wood with an advanced stage of heart rot (Conner et al. 1975, Li and Martin 1991). Tree species used for nesting vary regionally, although not always with availability. Typical species selected for nest cavities include pine, maple, oak, willow, and aspen. Nest-cavity entrance is characteristically on the underside of a stub or limb attached to the tree (Conner 1975, Petit et al. 1985). The total excavation takes from 7 to 20 days and usually commences 1 to 10 days prior to egg-laying.

Downy woodpeckers are monogamous, forming breeding pairs in late winter and early spring (January to March). Once formed, breeding pairs remain together to forage until incubation begins and stay together for the length of the summer. These pairs may also mate together for more than one breeding season (Jackson and Ouellet 2002). Downy woodpeckers produce 1 brood per year, although 2 broods may be possible in southern populations. Incubation periods last approximately 12 days, with clutch sizes ranging from 3 to 7 eggs. Both parents share incubation duties, the male incubates at night and both parents incubate during the day. Chicks fledge in 18 to 21 days, although they remain largely dependent on the parents for food for approximately 3 additional weeks. Most young downy woodpeckers are able to breed the next season.

Downy woodpeckers are omnivorous, foraging primarily on the larvae, pupae, and eggs of insects and other arthropods obtained from the bark of trees or weed stems, although they may also eat berries, nuts, sap, and cambium tissues (Terres 1980). Foraging microhabitats include surfaces and shallow subsurfaces of live and dead trees, and tall vegetation in open woods, suburban yards, and parks, fencerows, and similar habitats. Downy woodpeckers drink water by scooping it up with their bill. They drink from water that collects on horizontal limb surfaces, in epiphytes, puddles, streams, ponds and bird baths (Jackson and Ouellet, 2002)

Distribution and Abundance: The downy woodpecker is a common woodpecker, occurring throughout most of North America from Alaska to Florida. Depending on the particular location, trend analysis for populations of downy woodpeckers indicate slightly increasing, stable, or slightly decreasing numbers (Sauer et al. 2005). Although this is a widespread species, the downy woodpecker is considered to be more abundant in the deciduous woodlands of the eastern United States when compared to the western coniferous forests. In Arizona, these woodpeckers are patchily distributed in forests above 6,200 ft including the Mogollon Rim to the White Mountains and the North Rim of the Grand Canyon and Chuska Mountains on Navajo Tribal lands (Corman 2005) (Figures 1 and 2). Few observations of the downy woodpecker have been reported on Camp Navajo (Figure 3).

Species Status: The downy woodpecker has a global (G) ranking of 5, indicating a secure population with more than 100 occurrences throughout its entire range (Table 1, Appendix B). A G5 ranking was given to this species due to its extensive range, commonness in many areas, and lack of large-scale declines (NatureServe 2006). A state (S) ranking of 4 indicates that the population in Arizona is secure with more than 100 occurrences in the State, though it could be quite rare in some areas. The downy woodpecker was identified as a Species of Greatest Conservation Need (SGCN) (rated a "1" in the Vulnerability category) in Arizona's Comprehensive Wildlife Conservation Strategy (AGFD 2006) (Table 2, Appendix C). Compared to the subset of SGCN in need of immediate attention (tiers 1a and 1b), conservation priority is lower for the downy woodpecker in Arizona (tier 1c).

HAIRY WOODPECKER (*PICOIDES VILLOSUS*)

Species Description: The hairy woodpecker is a medium-sized woodpecker ranging from 18-26 cm (7-10 in) in length and 40-95 g (1.4-3.4 oz) in weight. Adults have mostly black upperparts and white to grayish underparts. The center of the back is white and white spotting occurs on the wings. White stripes are present on the face above and below the eye. The tail is black centrally with white outer tail feathers. Outermost tail feathers are white on each side. Adult males have a red patch at the back of the head whereas juvenile males have red foreheads and no red patch on the rear of the crown. Females have a black patch at the rear of the head. The bill is thick and nearly as long as the head. Call note is a sharp "peek" or a loud, woody rattle. Drumming is very fast, with an abrupt beginning and end (Cornell Lab of Ornithology 2003b).

The hairy woodpecker shows a great deal of morphological variation across its broad range, with more than 17 recognized subspecies. Northern birds tend to be larger than those occurring farther south. Western birds often have darker undersides and fewer wing spots compared to eastern birds which tend to be white underneath and have extensive spotting on the wings. Hairy woodpeckers in the Rocky Mountains are white below, but have few spots on their wings (Cornell Lab of Ornithology 2003b).

Hairy woodpecker, female
© Larry Master

Habitat Requirements and Life History: Hairy woodpeckers are found in forested areas, especially in conjunction with standing dead trees. They are most abundant in mature woods with large old trees suitable for cavity nesting. While this species occupies both deciduous- and coniferous-forest habitats, habitat preferences may vary geographically. For example, in the Southeast (Jackson 1971a), Southwest (Winkler 1979), and California (Roberson 1993) there is preference for open pine forest; in the West and Northwest there is preference for Douglas fir/Western hemlock forests, open juniper woodlands, and riparian forests; in the East all types of forests are suitable. In the tropics, hairy woodpeckers occur in mountainous regions up to 3,400 m in elevation (Winkler et al. 1995). Hairy woodpeckers also respond positively to post-fire conditions found one to three years after moderate to high intensity fires (Hobson and Shieck 1999, Covert-Bratland et al. 2006), due in part to increased populations of wood-boring insects and increased snag recruitment post-fire. Northernmost breeding populations are considered partially migratory, moving south during winter months (Farrand Jr. 1988). In mountainous regions, hairy woodpeckers may also migrate between higher and lower elevations. Territory size varies widely, ranging from 0.65 to 2.6 ha.

Both adults and juveniles characteristically roost in cavities that are excavated by the occupants. However, in the absence of a cavity a bird will roost in a sheltered location on a tree trunk or under a limb. Cavities are excavated primarily by males 1.5 to 18 m above the ground, preferentially located in dead or dying portions of live trees, especially where fungal heart rot has softened the heartwood. A snag ($\geq$ 25 cm dbh) density of 5/ha is assumed to be optimal for reproduction, although this may not be adequate for foraging (Sousa 1987). The minimal dbh for hairy woodpecker nest trees is 20 cm; averaging 27-28 cm in New England, 38 cm in Colorado, 41 cm in Virginia, 44 cm in California, and 92 cm in Oregon (Sousa 1987). The species of trees selected for cavities include pine, fir, and aspen.

Hairy woodpeckers are monogamous, forming year-round and possible lifetime pair bonds. Breeding occurs two to three months before nesting in February through June, depending on location within this species' geographic range. In some locations, females maintain territories and will advertise for a male by drumming. Once the pair-bond is formed, both male and female drum (Bent 1992). Females may spend the entire year on the breeding territory, joined in late winter by the male (Harrison 1979). Nesting occurs once annually, with a clutch size of 2 to 5 white eggs (Palmer and Fowler 1975, Winkler et al. 1995). Incubation periods average 14 days, with both males and females sharing incubation duties (Winkler et al. 1995). Chicks fledge after 28 to 30 days, although they may depend on the adults for food for 2 additional weeks.

Hairy woodpeckers forage primarily on insects, especially hairy caterpillars and their chrysalids. Other insects include ants, grasshoppers, wood-boring beetles, crickets, and flies. They will also consume nuts, seeds, and some fruits (Palmer and Fowler 1975, Terres 1980, Winkler et al. 1995). Foraging sites include trees, bushes, stumps, vines, rotting branches and other ground debris.

Distribution and Abundance: The hairy woodpecker is a primarily resident woodpecker throughout North America, ranging from Alaska to Newfoundland south from Panama to Florida (Palmer and Fowler 1975). Northern residents may also migrate south during the winter (Farrand Jr. 1988), being found in Central America and the Bahamas (Winkler et al. 1995). Hairy woodpeckers are common and widespread, with populations stable or slightly increasing in most of its range (Sauer et al. 2005). In Arizona, these woodpeckers are widespread throughout forested elevations above 4,800 ft including pinyon-juniper, ponderosa pine-oak, and mixed coniferous and fir forests of the White Mountains, particularly in association with early post-fire successional forests (Grossi and Corman 2005, Covert-Bratland et al. 2006) (Figures 4 and 5). Hairy woodpeckers have been observed at numerous locations on Camp Navajo and the Naval Observatory Flagstaff Station (Figure 6).

Species Status: The hairy woodpecker has a global (G) ranking of 5, indicating a secure population with more than 100 occurrences throughout its entire range (NatureServe 2006) (Table 1, Appendix B). The global short term trend is indicated as stable (unchanged or within +/- 10% fluctuation in population, range, area occupied, and/or number or condition of occurrences) although local declines were reported in several parts of the range in the 1980s (Ehrlich et al. 1992). A state (S) ranking of 5 indicates that the population in Arizona is secure with more than 100 occurrences in the State.

NORTHERN FLICKER (*COLAPTES AURATUS*)

Species Description: The Northern flicker is a medium to large woodpecker that is 28-31 cm (11-12 in) in length and 110-160 g (3.9-5.7 oz) in weight. Adults are grayish-brown with black barring on the back and wings. Underparts are off-white or buffy with numerous small black spots. A black crescent is present on the chest and the tail is black above. The rump is white and is conspicuous in flight (Cornell Lab of Ornithology 2003c).

The Northern flicker has two color forms that are found in different regions. The yellow-shafted form is common across the eastern and northern parts of North America, while the red-shafted form resides in the West. Red-shafted flickers are orange-red under the tail and wings, and have orange-red central shafts on their primary feathers. The face and throat are gray, and the crown is brown. Males are distinguished from females by a red moustache mark. Females have a brown moustache mark. Juveniles are similar to adults, but duller in color. Yellow shafted Northern flickers have a tan throat and face, gray crown, and a red crescent on the nape of the neck. The central shaft and undersides of the wing are bright yellow, in addition to the tail feathers. Males have a black mustache mark. Call consists of a long series of loud “wik-wik-wik” notes, or softer “wik-a-wik-a-wik-a” and a strong singe-note “peah” (Cornell Lab of Ornithology 2003c).

The red-shafted and yellow-shafted forms of the Northern flicker formerly were considered different species (red-shafted flicker, *Colaptes cafer*; yellow-shafted flicker, *Colaptes auratus*). The two forms hybridize extensively in a wide zone from Alaska to the panhandle of Texas. Hybrid birds often have traits from each of the two forms and some traits that are intermediate between them. The red-shafted form of the Northern flicker also hybridizes locally with the gilded flicker (*Colaptes chrysoides*) of the Southwest but less frequently. The gilded flicker is considered a similar, but separate species, and is distinguished by its yellow wing and tail feathers (Cornell Lab of Ornithology 2003c).


Northern flicker, red-shafted, male
© Robert Shantz

Habitat Requirements and Life History: Northern flickers are found in open woodlands and forest edges, both in deciduous and coniferous forests, particularly those with standing dead trees (Palmer and Fowler 1975, AOU 1983). They can also be found in clear-cut and burnt areas, agricultural lands, and residential areas (Winkler et al. 1995). Specific woodland types include riparian woodlands, especially on Great Plains (Sedgwick and Knopf 1990); swamps or recently flooded areas with numerous snags and shelter belts; and settled areas (Aldrich and Coffin 1980). The abundance of both yellow-shafted and red-shafted flickers is relatively higher in burnt forests and clear-cuts (Conner et al. 1975, Conner and Adkisson 1977), provided scattered stubs remain standing. Although southern populations are year round residents, breeding populations north of the United States-Canadian border move south for the winter.

This species nests in holes excavated in dead trees, stumps, or dead portions of live trees 2 to 8 m above the ground (Harrison 1978). Both sexes participate in cavity excavation, although the male appears to take the dominant role. They may also re-use old cavities which may also be found in wooden poles, buildings, and earthen banks (Palmer and Fowler 1975). The tree species selected for nests are highly variable. Northern flickers generally inhabit trees that are 30 to 47 cm dbh. Nest placement is opportunistic, with the presence of suitably soft wood being the major determinant.

Northern flickers are monogamous. Pairs nest from February to July and have 1 or 2 broods annually, with typical clutch sizes of 3 to 12 (Palmer and Fowler 1975, Winkler et al. 1995). Both parents share incubation duties, which last from 11 to 16 days. The chicks fledge in 25 to 28 days, remaining with the parents who continue to feed them for some time (Winkler et al. 1995).

The primary food source for Northern flickers is ants, although they also consume other insects (e.g., grasshoppers, crickets, termites, wasps, aphids, beetles, caterpillars). Fruit such as cherries and the berries of dogwood, poison ivy, sumac, hackberry, and blackgum are also consumed, particularly in winter months (Palmer and Fowler 1975). Acorns, seeds, and other nut kernels can also be locally important (Palmer and Fowler 1975, Terres 1980, Winkler 1995).

Distribution and Abundance: The breeding range of Northern flickers is from Alaska eastward to Quebec, Canada and south throughout the entire United States. In winter, northern migrants can also be found as far south to Nicaragua (Palmer and Fowler 1975, Farrand Jr. 1988, Winkler et al. 1995). Populations of Northern flickers are common and widespread, although showing significant declines throughout their range (Sauer et al. 2005). In Arizona, these woodpeckers primarily occur in forests above 4,000 ft, however, this species does nest locally in lower elevations in riparian gallery forests (Spence 2005) (Figures 7 and 8). Numerous observations of Northern flickers have been reported on Camp Navajo and the Naval Observatory Flagstaff Station (Figure 9).

Species Status: The Northern flicker has a global (G) ranking of 5, indicating a secure population with more than 100 occurrences throughout its entire range (NatureServe 2006) (Table 1, Appendix B). A state (S) ranking of 5 indicates that the population in Arizona is secure with more than 100 occurrences in the State. The Northern flicker was identified as a high priority Community/Focal species (rated a “1” in the Community/Focal category) in Arizona’s Comprehensive Wildlife Conservation Strategy (AGFD 2006) (Table 2, Appendix C).

ACORN WOODPECKER (*MELANERPES FORMICIVORUS)*

Species Description: The acorn woodpecker is a medium-sized, black and white woodpecker with a red crown, glossy black and white head, and white rump and wing patches. The back, chest, nape, wings, and tail are black. Black streaks extend from the chest into the belly. The eye is white surrounded by black and the throat is pale yellow. Adult males have a solid red crown whereas females have a black band separating the red crown from the white forehead. Juveniles are similar to adult males, but with dark eyes. The most common call is a loud“waka-waka-waka”. Acorn woodpeckers range from 19-23 cm (7-9 in) in length and 65-90 g (2.3-3.2 oz) in weight (Cornell Lab of Ornithology 2003d).

The acorn woodpecker shows some morphological variation across its range (Benitez-Diaz 1993). Coastal and interior birds differ slightly in size, bill length, and plumage (Sibley 2000). More study is needed to check for differences in voice and other characteristics. More subspecies occur in Mexico.

Acorn woodpecker, female
Photo by George Andrejko, AGFD

Habitat Requirements and Life History: The occurrence of acorn woodpeckers is primarily associated with the presence of oaks, either in unmixed open woodland or mixed with conifers (AOU 1983). They are also found in riparian corridors and mixed conifer forests in combination with nearby oaks, and in urban and suburban areas that possess numerous oak trees. Acorn woodpeckers are non-migrants, using the same summer and winter ranges, although winter, non-breeding ranges may be smaller than summer ranges.

Acorn woodpeckers excavate and nest within cavities 3 to 21 m above the ground in live or dead trees. This species will often roost communally in tree cavities throughout the year (du Plessis et al. 1994). Cavities are dug into large dead or living limbs in trees or snags. Tree species used for nesting and roosting are highly variable and include oak, pine, and cottonwood. The cavity is often lined with wood chips and may be re-used for several seasons.

Mating strategies in populations of acorn woodpeckers range from monogamy to polygynandry (i.e., two or more males have an exclusive relationship with two or more females). Cooperative nest groups are not uncommon, with 1 to 4 breeding males competing for matings with 1 to 3 breeding females. Competition between males usually manifests as attempts by co-breeders to disrupt copulations between other pairs. The nest group may also include 0 to 10 non-breeding offspring from past reproductive seasons (Koenig and Mumme 1987). Acorn woodpeckers may produce 2 to 3 broods annually, with a clutch size of 4 to 5 for a single breeding female. The white, elliptical eggs are laid at 24 hour intervals. Typical incubation periods are approximately 14 days, with both male and female breeders sharing incubation duties. Once the chicks have hatched all group members provide care. Nestlings generally fledge after 30 to 32 days. Acorn woodpeckers may nest as late as September or October.

Acorn woodpeckers primarily forage on insects during summer months (e.g., grasshoppers, ants, beetles, flies). They may also eat tree sap and some fruit, and rarely small lizards, bird eggs, and nestlings. During the winter months they are primarily dependent on acorns and other nuts. Insects are stored in cracks or crevices, while acorns and other nuts are stored in individually drilled holes in granaries. A single granary tree may hold up to 50,000 holes, which are usually drilled into dead limbs and thick bark. Almost any dead or living tree with deep, dry bark may be used as a granary, even parts of trees such as pine cones. Widespread mast-crop failure can lead to permanent disappearance of a large proportion of the acorn woodpecker population from an area. During food-shortage periods, these woodpeckers will wander, with small numbers appearing in lower than normal elevations, even into desert regions.

Distribution and Abundance: In the United States, populations of acorn woodpeckers occur in western Oregon, California, Arizona, New Mexico and western Texas. Worldwide distributions extend southward through Mexico and Central America (Howell and Webb 1995), and isolated populations occur in Colombia (Kattan 1988). Throughout its range, populations of acorn woodpeckers are considered to be stable or increasing (Sauer et al. 2005). This species is common in Arizona where mast-producing oak woodlands occur throughout the Mogollon Rim, White Mountains and highlands of southeastern Arizona (Wise-Gervais 2005) (Figures 10 and 11). Acorn woodpeckers have been observed at several locations on Camp Navajo (Figure 12).

Species Status: The acorn woodpecker has a global (G) ranking of 5, indicating a secure population with more than 100 occurrences throughout its entire range (NatureServe 2006) (Table 1, Appendix B). A state (S) ranking of 5 indicates that the population in Arizona is secure with more than 100 occurrences in the State.

LEWIS'S WOODPECKER (*MELANERPES LEWIS)*

Species Description: Named after famed explorer Meriwether Lewis, this woodpecker has a distinct coloration that makes it easily differentiated from other woodpeckers in the field. Lewis's woodpeckers are medium in size, attaining a length of 26-28 cm (10-11 in) and weight of 88-138 g (3.1-4.9 oz). Adults have dark iridescent greenish-black backs, pink or salmon red bellies, gray breasts and collars, and red faces rimmed with black. The wings and tail are dark with no white spots or patches. Adult males and females are similar in plumage. Juveniles are similar to adults but are mottled brown beneath, with dark brown heads and no gray collars or red faces (Cornell Lab of Ornithology 2003e).

Lewis's woodpecker is often mistaken for a crow due to its dark coloring, long tail and wings, and overall flight pattern consisting of slow-wing beats and gliding. Males have a "churr" call that is repeated rapidly 3-8 times, usually during courtship. Males also produce an aggressive chatter call that consists of a series of squeaks. Drumming is done only in courtship and is described as a weak roll followed by several taps (Cornell Lab of Ornithology 2003e).

Lewis's woodpecker, male
Photo by George Andrejko, AGFD

Habitat Requirements and Life History: During the breeding season Lewis's woodpeckers prefer open pine, aspen, or riparian forests and logged or burned areas, particularly in old growth woodlands as opposed to dense forest. They will often use burned pine forests, depending on post-fire conditions such as the age, size, density of remaining snags, and the intensity of the burn (Diem and Zeveloff 1980, Tobalske 1997). Lewis's woodpeckers have generally been considered a species of older burns, moving in several years post-fire once dead trees begin to fall and brush develops, which generally occurs five to thirty years post-fire (Bock 1970, Block and Brennan 1987, Caton 1996, Linder and Anderson 1998). As post-fire succession progresses, however, habitat suitability may decline, with a concurrent decline in woodpecker numbers (Linder and Anderson 1998). Overall, conditions considered suitable include an open canopy, availability of nest cavities and perches, abundant prey items, and a shrubby understory (Linder and Anderson 1998, Saab and Dudley 1998). In winter, this species chooses oak woodland or commercial orchards such as almond, walnut, and pecan trees (Bent 1964, Winkler et al. 1995). Although Lewis's woodpeckers are sometimes semi-gregarious when several nest cavities are in close proximity, typically this species aggressively defends immediate areas around nest sites. Migration characteristics range from non-migrant to local and long range migrants. Bird populations in the northern half of the breeding range move southward during the winter months, while those occupying southern regions are generally present year round. Movements may vary from year to year, likely in response to food availability. Breeding season territories vary between 1 and 6 acres (Thomas et al. 1979).

Lewis's woodpeckers nest in excavated cavities in burned or dead trees from 1 to 52 m above the ground, and may re-use the same cavity for many years. Tree species vary and include cottonwood, pine, fir, willow, and paper birch in advanced stages of decay. The size of the nest tree ranges from 47 to 67 cm dbh or higher. Unlike other woodpeckers, Lewis's woodpeckers are not morphologically well-adapted to excavate cavities in hard wood, instead preferring to use natural cavities or previously used cavities of other species (e.g., Northern flicker). If available these woodpeckers will sometime excavate a new cavity in a soft snag, dead branch of a tree, or utility pole (Harrison 1979, Tobalske 1997). In Arizona, nesting activity begins in mid-April and continues through mid-August (Wise-Gervais 2005).

Lewis's woodpeckers form life-long pair bonds. Clutch sizes range from 5 to 9 eggs, which are incubated by both parents from 13 to 14 days. Chicks fledge in 28 to 34 days (Terres 1980, Ehrlich et al. 1988). After fledging each parent takes part of the brood, staying close to the nest area for up to 10 days before departing. Mated pairs may return to the same nest site in successive years.

Approximately 1/3 of the diet of Lewis's woodpeckers consists of acorns, which are stored in cracks and loose bark. In addition, they consume many different types of insects (e.g., ants, crickets, grasshoppers) as well as pine nuts, juniper berries, huckleberry, chokecherries, twinberry, and apricots (Bock 1970, Tobalske 1997). Unlike other woodpecker species, Lewis's woodpeckers do not bore for insects, instead flycatching and gleaning insects from tree branches or trunks.

<u>Distribution and Abundance</u>: The range of Lewis's woodpeckers in North America spans from British Colombia south through California to the mountains of Colorado, New Mexico and northern Arizona (Bent 1964, Winkler et al. 1995). Local areas of higher abundance occur in northern Arizona, Washington, Oregon and northern California in summer and California, Arizona and northern New Mexico in winter (Sauer et al. 1995). Populations of Lewis's woodpeckers are considered to be stable to slightly decreasing throughout its range (Sauer et al. 1995). This species is very local in Arizona; local populations exist around the San Francisco Mountains near Flagstaff to the Happy Jack region; around urban areas along the Mogollon Rim; and in the White Mountains south to Hannagan Meadow; and in the Chuska Mountains and Defiance Plateau region of Navajo Tribal lands (Wise-Gervais 2005) (Figures 13 and 14).

<u>Species Status</u>: The Lewis's woodpecker has a global (G) ranking of 4, indicating a population that is apparently secure with more than 100 occurrences throughout its entire range, though it could be quite rare in some parts (Table 1, Appendix B). A G4 ranking was given to this species due to its large range in the western United States and southern Canada, but spotty distribution and apparent decline in abundance (NatureServe 2006). The global short term trend is indicated as declining. Based on data collected through the Breeding Bird Survey (BBS) and the Christmas Bird Count (CBC), the Lewis's woodpecker population may have declined by 60% since the 1960's (Tobalske 1997). BBS data showed a significant decline in the United States for the period 1966-1969 and a non-significant declining trend between 1980 and 1996 (Sauer et al. 2000). CBC data showed non-significant declining trends in California, Colorado, and Oregon, and a non-significant increase in Arizona from 1959 to 1998 (Sauer et al. 1996). Ehrlich et al. (1992) suggest that populations appeared to have stabilized recently, although those occurring in riparian habitats in arid regions continue to be vulnerable to drought, overgrazing, and habitat degradation. A state (S) ranking of 4 indicates that the overall population in Arizona is apparently secure with more than 100 occurrences in the State although it could be quite rare in

some areas. The Lewis's woodpecker was identified as a Species of Greatest Conservation Need (SGCN) (rated a "1" in the Vulnerability category) in Arizona's Comprehensive Wildlife Conservation Strategy (AGFD 2006) (Table 2, Appendix C). Compared to the subset of SGCN in need of immediate attention (tiers 1a and 1b), conservation priority is lower for the Lewis's woodpecker in Arizona (tier 1c).

WILLIAMSON'S SAPSUCKER (*SPHYRAPICUS THYROIDEUS*)

Species Description: The Williamson's sapsucker is a medium-sized woodpecker that is 21-25 cm (8-10 in) in length and 44-55 g (1.6-1.9 oz) in weight. The male and female differ drastically in appearance making the Williamson's sapsucker an unusual woodpecker species. Adult males have a red throat patch, white rump, and black head, breast, back, wings, and tail. The belly is yellow and flanks are barred black-and-white. White facial stripes are present above and below the eye, extending from the black bill to the nape. Large white patches occur on the wings. Adult females are pale brown in color and heavily barred with white, brown, and black on the upperparts, wings, and flanks. The rump is white, belly is yellow, and breast is black. The tail is black with black-and-white barring in the center. Juveniles are similar to adults, but males have a white throat and nape, and females lack black on the breast. Call is a scratchy "quee-ah" or "churr". Drumming consists of slow, regular tapping (Cornell Lab of Ornithology 2003f). The dramatic difference in appearance between the male and female Williamson's sapsucker caused confusion with early naturalists who considered the two birds as separate species. The male was called the Williamson's sapsucker, while the female was called a black-breasted woodpecker. This sapsucker is named after Robert Williamson, a topographical engineer who led surveying expeditions throughout the western United States.


Williamson's sapsucker, female
© Robert Shantz

Habitat Requirements and Life History: Williamson's sapsuckers inhabit open coniferous and mixed coniferous-deciduous forests of western North America. Williamson's tends to select nest sites in areas close to conifer-dominated forests, preferring drainage bottoms over ridge tops and areas with a higher percentage of green ground cover and lower basal area (Conway and Martin 1993). During the breeding season, Williamson's sapsuckers are found in middle to high elevation montane coniferous forests, including spruce-fir, Douglas fir, lodgepole pine, and ponderosa pine forests, although they can also be found in mixed deciduous-coniferous forests, particularly those containing aspen. During migration and winter months, this species prefers southern lowland forests (AOU 1983). Home range sizes range from 4 to 7 ha (Crockett 1975, Thomas et al. 1979, Short 1982). Although permanent residents in some parts of their range, Williamson's sapsuckers are complete migrants in areas where sap freezes, traveling as far south as Mexico.

Nest cavities are excavated in dead or decaying pine, fir, or aspen 28 to 70 cm dbh or more in size. Cavities are typically 2 to 18 m above the ground, in aspen when present but also in ponderosa pine and Douglas fir (Terres 1980, Conway and Martin 1993). Males appear to do the majority of the excavation, taking from 3 to 4 weeks to complete a cavity. New cavities are excavated each year, although they may occur in the same tree as in previous years.

Williamson's sapsuckers form monogamous pairs during the breeding season, often with its mate from a previous year. A single brood is produced annually, with typical clutch sizes of 4 to 6 eggs. Incubation takes 12 to 14 days and duties are shared by both parents. After hatching, caring for the brood is also shared with adults alternating between brooding and foraging for the first 2 weeks. Fledging occurs after 21 to 32 days (Terres 1980) with fledglings leaving the nest area after 2 to 3 days.

Williamson's sapsuckers are omnivorous, feeding on conifer sap, insects (e.g., ants, beetles, flies, aphids), and berries. They exhibit strong seasonal specialization, feeding exclusively on conifer sap during the pre-nesting period but shifting primarily to ants after the young hatch.

Distribution and Abundance: Williamson's sapsuckers are found from the mountains of southern British Columbia southward through California and northern Arizona to Mexico during the breeding season, while their winter range is restricted to Oregon southward to Mexico. Overall, populations of Williamson's sapsuckers appear to be stable or increasing, although local populations, particularly in the northern portion of its range, may be declining (Sauer et al. 2005). In Arizona, this species occurs in pine and mixed-conifer forests containing at least some aspen above 7,000 ft from the Mogollon Rim north (Latta and Corman 2005) (Figures 15 and 16). The Williamson's sapsucker has been observed at only 1 location in the northwest corner of Camp Navajo (Figure 17).

Species Status: The Williamson's sapsucker has a global (G) ranking of 5, indicating a secure population with more than 100 occurrences throughout its entire range (NatureServe 2006) (Table 1, Appendix B). The global short term trend is indicated as stable (unchanged or within +/- 10% fluctuation in population, range, area occupied, and/or number or condition of occurrences). Breeding Bird Survey data for North America indicate a non-significant increase averaging 4.68% per year for the period 1966-1993 (Peterjohn et al. 1994). A state (S) ranking of 4 indicates that the overall population in Arizona is apparently secure with more than 100 occurrences in the State although it could be quite rare in some areas.

THREATS

The main threats impacting the demography of woodpecker populations are habitat destruction and forest fragmentation. Practices resulting in dense, even-aged, isolated forest stands lacking large snags in advanced decay classes and coarse woody debris have proven limiting to most populations of woodpeckers. The single largest threat is the lack of suitable nesting and foraging sites. All species included in this report are primary cavity nesters, excavating cavities in large snags, the dead portions of live trees, or lightning scars for nesting, foraging, and security cover.

In addition, snags and other coarse woody debris provide microhabitats for invertebrates used as food by most species of woodpeckers.

Several forest activities have the potential to reduce the diversity and density of forest stands and snags. Forestry practices aimed at reducing the risks of high-severity wildfire or accomplishing forest restoration treatments (i.e., thinning and burning) can cause direct snag loss by mechanical removal or injury to snags (i.e., removing snags to increase area infrastructure or safety concerns, logging equipment knocking over snags), as well as the loss of snags to fire. Other activities, such as firewood gathering and military activities, can also impact snag populations dynamics by removing dead wood from forest ecosystems. Logging strategies that selectively remove larger size classes, live green trees or encourage dense, even-aged forest stands can affect the future recruitment of large snags in addition to impacting important habitat parameters. Salvage logging of moderate to intense burned areas almost always negatively impacts populations of woodpeckers by removing snags used for nesting and foraging (Covert-Bratland et al. 2006, Hutto 2006). Another important consideration is the retention of old "yellow" pines, which have loose bark and desiccation cracks used by mast collecting species as granary trees.

Grazing and other surface disturbing activities (e.g., mining, OHV use, military maneuvers, and road building) can impact forest stand structure and understory plant communities used by woodpecker species (e.g., berry producing shrubs) as well as impacting ground dwelling insect communities. The recruitment of mast producing trees (i.e., oak trees), which is important for several woodpecker species (i.e., acorn woodpeckers and Lewis's woodpeckers), can also be impacted by surface disturbance and local firewood cutting.

Habitat on Camp Navajo is predominately ponderosa pine (*Pinus ponderosa*) forest with a Gambel oak (*Quercus gambelli*) understory (Camp Navajo 2007). Large open grasslands in the forest exist naturally and from heavy logging. The highest elevations contain mixed-conifer forest dominated by Douglas-fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*). The lowest elevations occur in Volunteer Canyon, a mesic steep-walled canyon with pockets of Engelmann spruce (*Picea engelmannii*) on the south boundary of the installation. Forestlands on the eastern and northern portions of the facility consist primarily of second-growth ponderosa with limited understory vegetation. Grasses and shrubs dominate Camp Navajo's central area. Ponderosa pine forests also dominate the Naval Observatory property, with some grassland meadows (USNOFS 2001). Gambel oak is interspersed among the pines, most notably on the knoll that supports the primary telescope and facility.

Mission impacts to installation natural resources include the reduction of ground vegetation. Affected areas are often localized, occurring in areas used as bivouac, camping, training, and construction areas. Vehicular traffic can also modify habitat areas by disturbing and compacting soils. Severe soil damage, a result of repeated use, can occur resulting in a loss of native vegetation cover that may lead to increased soil erosion and establishment of invasive species. This loss also represents a loss of graze, browse, growing medium, cover, or other important ecological attributes. Noise disturbance and vehicular traffic also represent mission impacts, potentially affecting movement and activity patterns of wildlife species. Military activities, such as range and training activities, may cause local wildlife displacement, which may lead to reduced survival and reproductive success. Activities peripheral to military objectives, such as logging and firewood gathering, can reduce habitat value through ground disturbance and the loss of important habitat features (e.g., snags, downed dead wood, large mature trees) (USNOFS 2001, Camp Navajo 2007).

MANAGEMENT RECOMMENDATIONS

Retention and recruitment of large snags and other suitable nest trees is one of the most important aspects in preserving healthy, natural populations of cavity nesting birds, including woodpeckers. It is widely recognized that all snags and other nesting sites are not equal and different cavity nesting birds select certain characteristics for nesting and foraging. Although the exact selection mechanisms are not entirely understood and may differ for individual species and sites, there are several general characteristics that can be used to guide snag management in forests. Characteristics of snags selected for nesting include: large size (≥ 35 cm dbh), advanced decay class (2 through 4), and broken tops. Forage snags also tend to exhibit these characteristics, as well as retaining a high percentage of bark and having high levels of insect activity. Although young snags (i.e., decay class 1) are not selected for, their importance rests with the fact that they will serve as the next generation of snags and so must also be considered in management schemes. Old snags (i.e., decay class 5), while not typically selected by cavity nesters, add downed woody material to the forest floor, promoting animal and fungal populations that are crucial to healthy forest ecosystems. In addition to snag dynamics, live trees of the appropriate age and size must be left in the forest to provide future generations of snags. Of particular interest may be live trees with dead tops, which could have increased value because they provide habitat alternatives to completely dead snags, survive on the landscape for a long period of time, and allow natural processes (i.e., heart rot) to create high quality snags for future generations. Some woodpecker species (i.e., hairy woodpeckers) even prefer to nest in living trees infected with fungal rot, while others (i.e., acorn woodpeckers, Lewis's woodpeckers) use similar trees for the storage of mast crops (e.g., acorns). Maintaining snag densities ranging from 4 to 6 large (> 33 cm dbh) snags/ha have been suggested as a way to promote forest health in relation to cavity nesters and other communities that depend on dead wood (Ganey and Votja 2005, Rosenstock 1996). Hutto (2006) suggests retaining or creating areas containing snag densities of 200 to 300 snags/ha, similar to conditions found after a moderate to intense burn in a dense ponderosa pine forest. Practices such as salvage logging prevent the formation of these high density areas, which negatively affects several species of woodpeckers (e.g. hairy and Lewis's woodpecker).

Due to relatively low use and public access, military lands in Northern Arizona may represent areas of unique value to wildlife. The lack of substantial recreational activities (e.g., OHV use, firewood cutting, camping) has allowed large tracts of land to remain relatively undisturbed when compared with surrounding private and public lands. To protect and enhance populations of woodpeckers it is important to maintain forest stand diversity, provide corridors between habitat patches, and protect existing roosting, nesting, and foraging sites. To ensure that appropriate snags are available for woodpeckers now and in the future, snags and green recruitment trees should be retained in the larger diameter classes, and in all age and decay classes. While general guidelines can be helpful, it is important to recognize that any single approach will disadvantage some group of species, so a range of practices is preferable if a range of species is to be sustained in an area. Creating and maintaining a healthy forest with a mosaic of forest structures, densities, and successional stages is the best way to provide a variety of habitat conditions that will favor the highest number of species and represent the most natural forest condition.

There are several possible management strategies that could help maintain current snag populations as well as to promote the recruitment of future snags and other habitat components important to woodpeckers on Department of Defense lands in Northern Arizona:

- Identify and map areas of high snag value (i.e., location and density of existing snags).
- Identify and map areas of high snag recruitment value (i.e., location and density of live trees of the appropriate size and density).
- Continue to support snag monitoring (i.e., determine dynamics of snag recruitment and retention on military lands).
- Maintain integrity of mature pine-oak forests.
- Encourage understory growth by opening dense forest stands.
- Use a variety of treatment types and prescriptions to create a mosaic of forested habitat to benefit the maximum number of species.
- Perform burning operations in times of favorable weather conditions (e.g., rainy or snowy periods).
- Rake duff and loose materials from the base of valuable snags prior to burning activities.
- Locate infrastructure expansions or improvements in areas with lower habitat value (e.g., areas with low snag density, areas of younger forests).
- Educate contractors (e.g., logging and construction contractors) on the importance of protecting snags and large trees.
- Impose management treatments that may be near breeding areas during times when birds are not breeding.
- Preserve existing snags and live trees of the appropriate size and age to provide future generations of snags.

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Table 1. Species status[1] according to the Endangered Species Act (ESA), Bureau of Land Management (BLM), Arizona Game and Fish Department Wildlife of Special Concern (STATE), and NatureServe Explorer Global (G) and State (S) Conservation Status Rankings.

SPECIES	ESA	BLM	STATE	GRANK	SRANK
Downy woodpecker	--	--	--	G5	S4
Hairy woodpecker	--	--	--	G5	S5
Northern flicker	--	--	--	G5	S5
Acorn woodpecker	--	--	--	G5	S5
Lewis's woodpecker	--	--	--	G4	S4
Williamson's sapsucker	--	--	--	G5	S4

[1]See Appendix B for status and ranking definitions.

Table 2. Species status[1] according to rating categories in Arizona's Comprehensive Wildlife Conservation Strategy (CWCS) (AGFD 2006).

	CWCS Rating Categories			
SPECIES	Responsibility[1]	Community Focal[1]	Vulnerability[1]	Unknown Status[1]
Downy woodpecker	3	2	1c	3
Hairy woodpecker	3	2	3	3
Northern flicker	3	1	3	3
Acorn woodpecker	3	2	3	3
Lewis's woodpecker	3	2	1c	3
Williamson's sapsucker	3	2	2	3

[1]See Appendix C for summary of Arizona's CWCS rating categories and component criteria.

Figure 1.

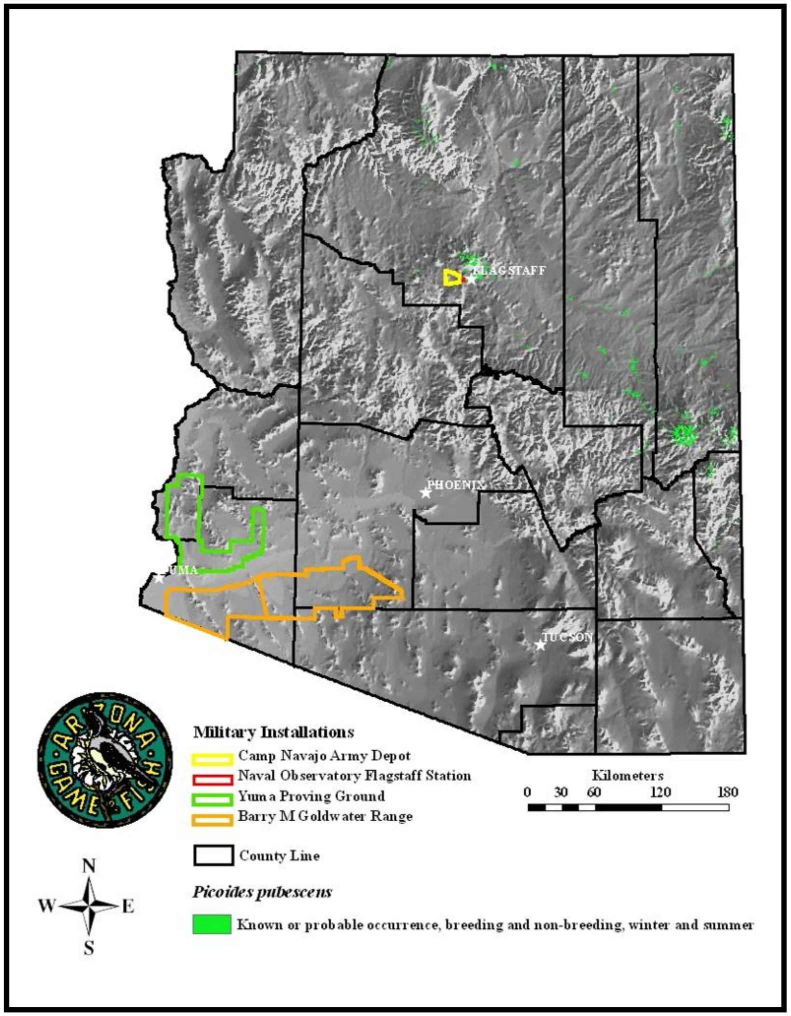
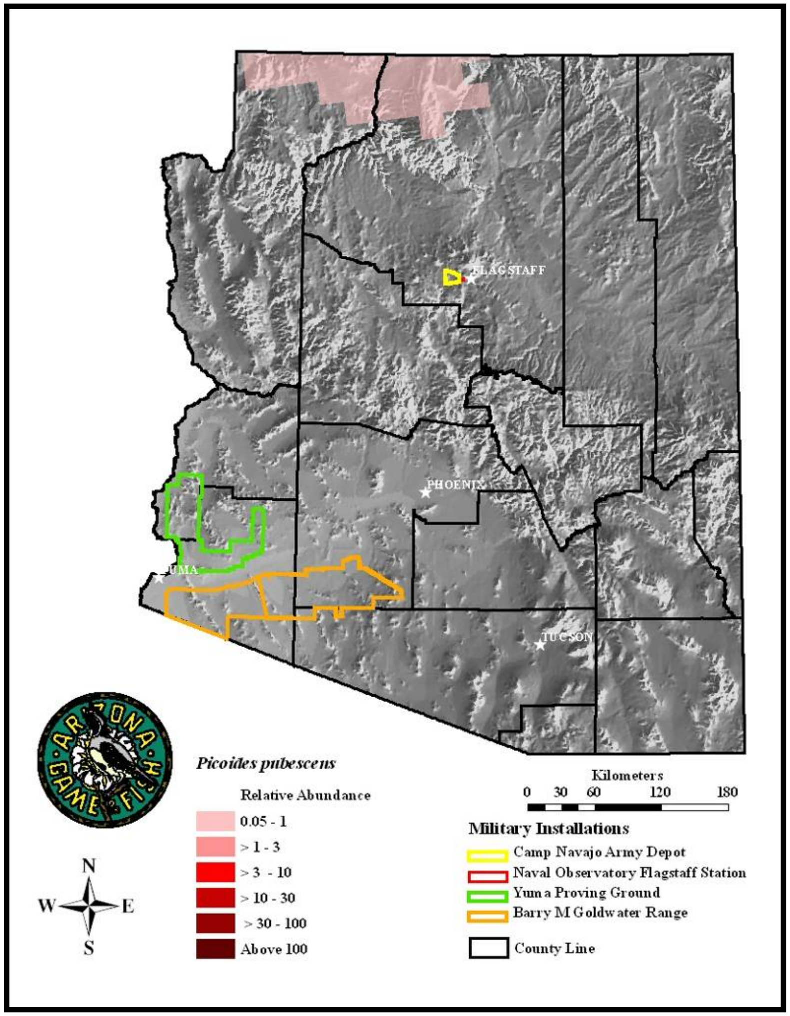


Figure 2.



Figures 1 and 2. Potential range (Figure 1) and relative abundance (Figure 2) of the downy woodpecker (*Picoides pubescens*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Relative abundance data were downloaded from The North American Breeding Bird Survey, Results and Analysis, 1966-2005 webpage (http://www.mbr-pwrc.usgs.gov/bbs/) (Sauer et al. 2005). See Appendix A for further information on data sources.

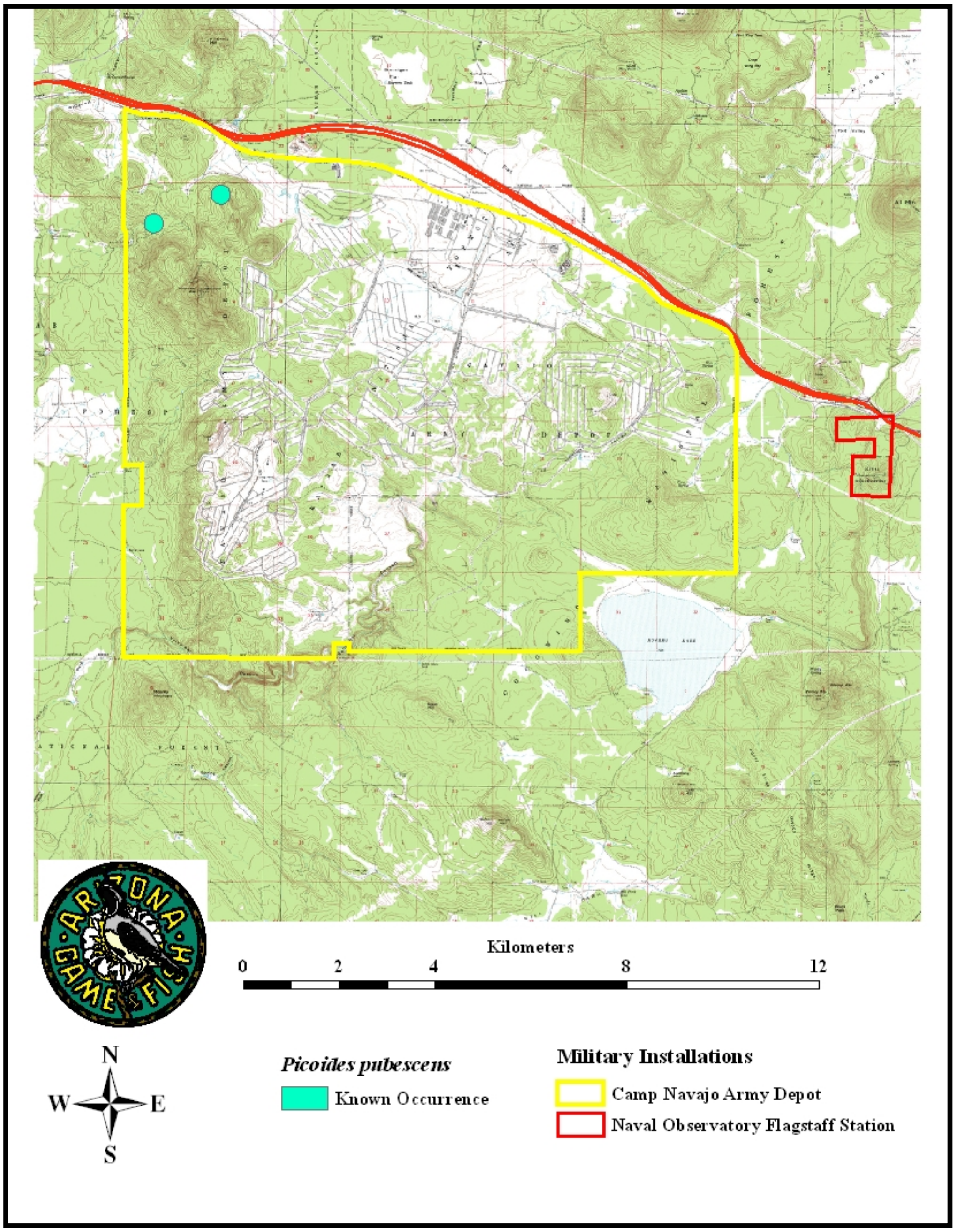
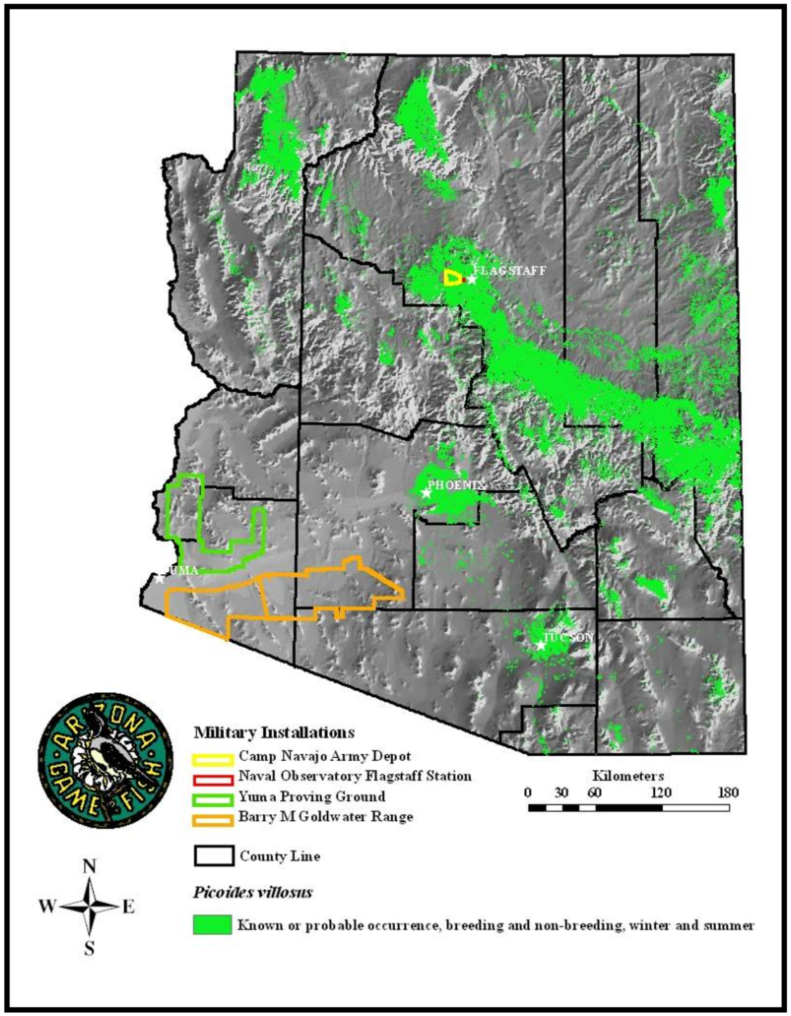


Figure 3. Known occurrences of the downy woodpecker (*Picoides pubescens*) on Camp Navajo and Naval Observatory Flagstaff Station (NOFS). Occurrence data were compiled from NOFS 2005 breeding bird survey data (Shepherd and Burr 2005). See Appendix A for further information on data sources.

Figure 4.



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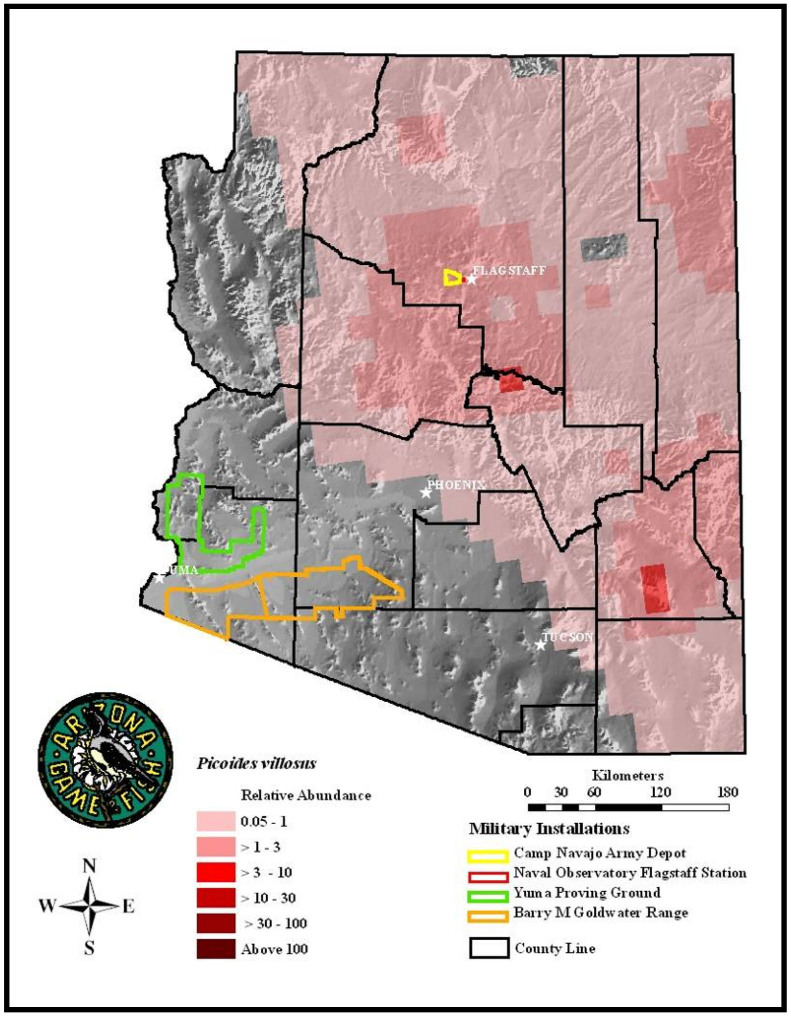


Figures 4 and 5. Potential range (Figure 4) and relative abundance (Figure 5) of the hairy woodpecker (*Picoides villosus*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Relative abundance data were downloaded from The North American Breeding Bird Survey, Results and Analysis, 1966-2005 webpage (http://www.mbr-pwrc.usgs.gov/bbs/) (Sauer et al. 2005). See Appendix A for further information on data sources.

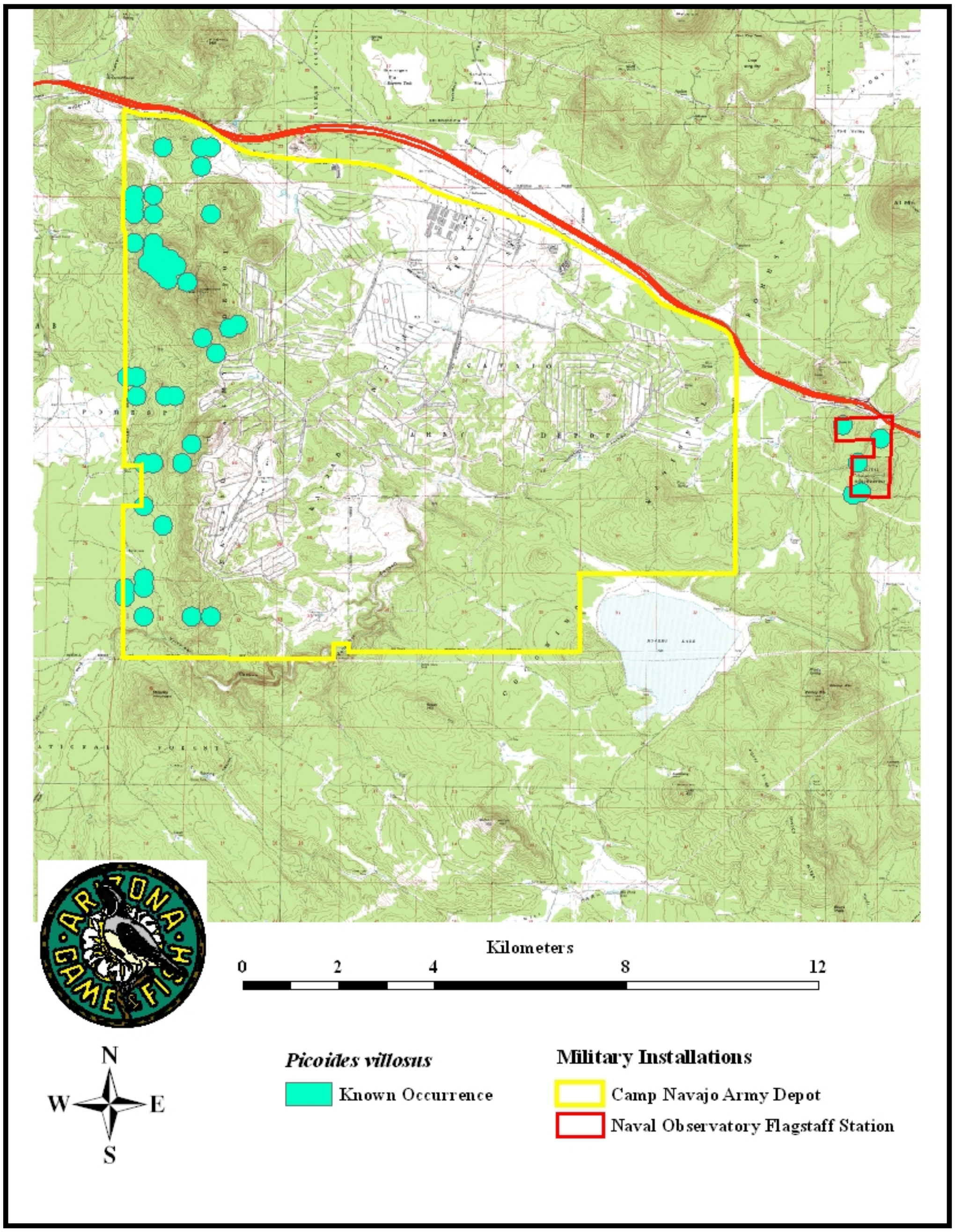
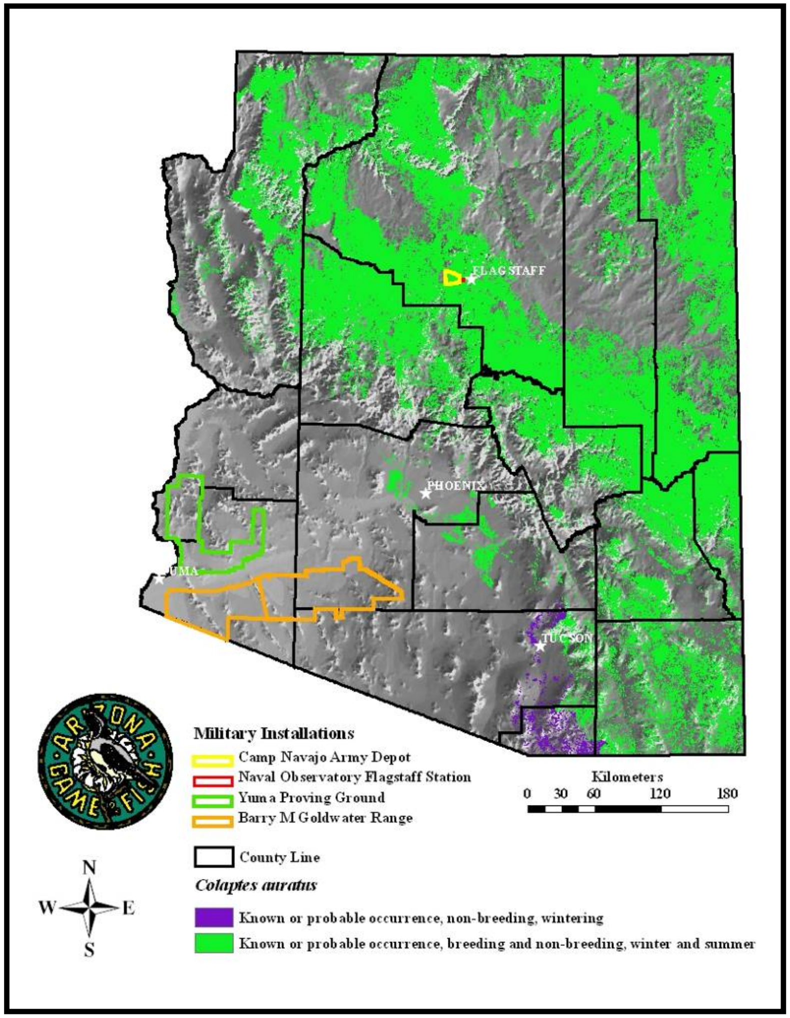


Figure 6. Known occurrences of the hairy woodpecker (*Picoides villosus*) on Camp Navajo and Naval Observatory Flagstaff Station (NOFS). Occurrence data were compiled from NOFS 2005 breeding bird survey data (Shepherd and Burr 2005). See Appendix A for further information on data sources.

Figure 7.



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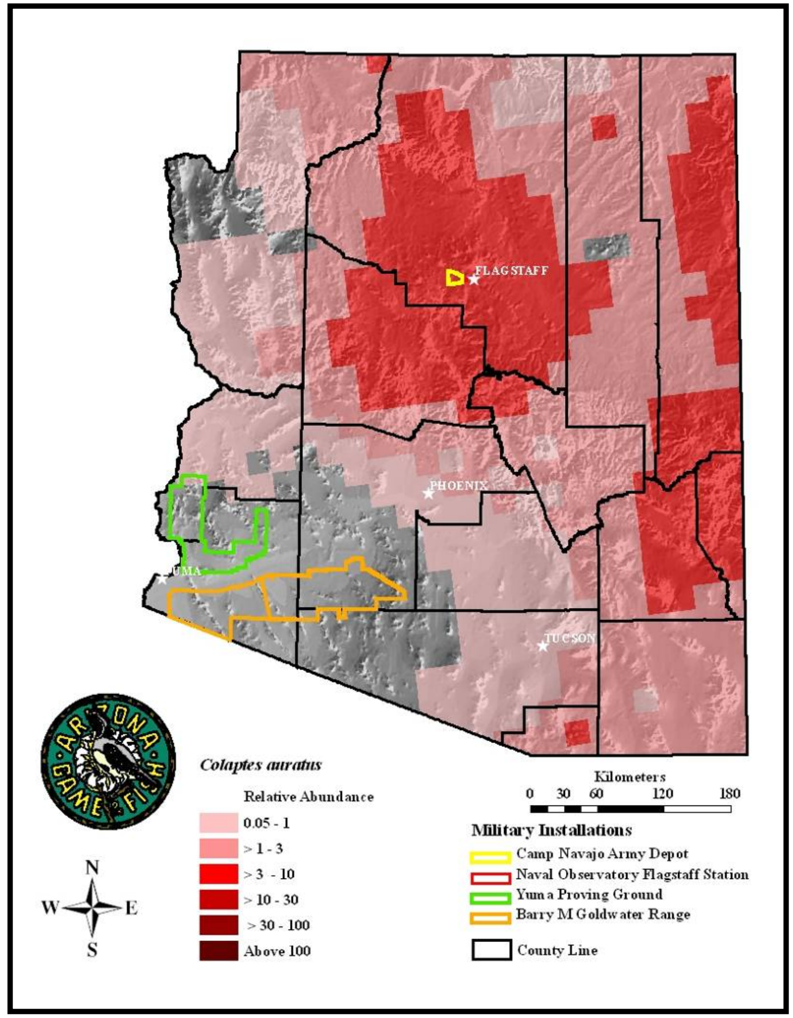


Figures 7 and 8. Potential range (Figure 7) and relative abundance (Figure 8) of the Northern flicker (*Colaptes auratus*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Relative abundance data were downloaded from The North American Breeding Bird Survey, Results and Analysis, 1966-2005 webpage (http://www.mbr-pwrc.usgs.gov/bbs/) (Sauer et al. 2005). See Appendix A for further information on data sources.

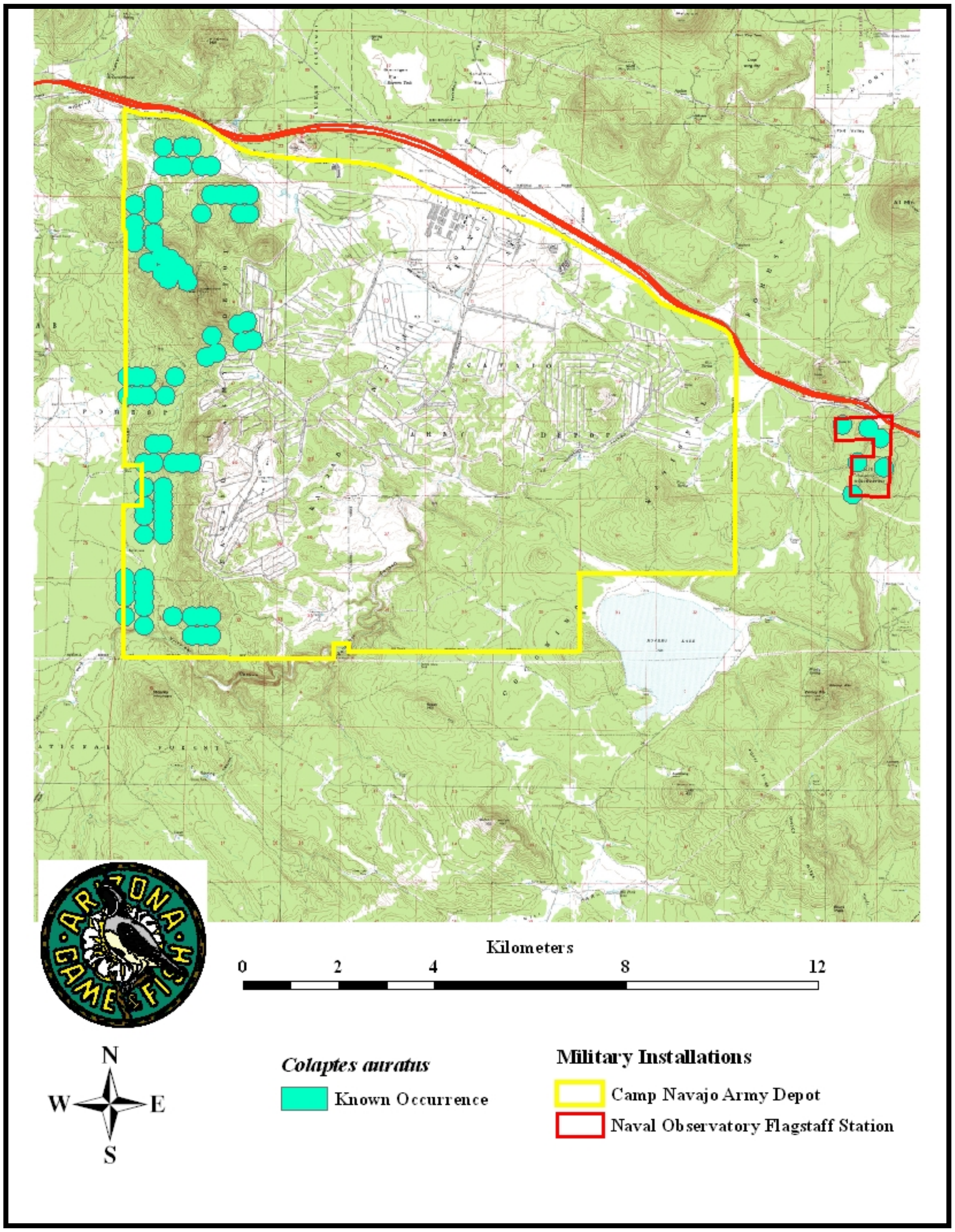
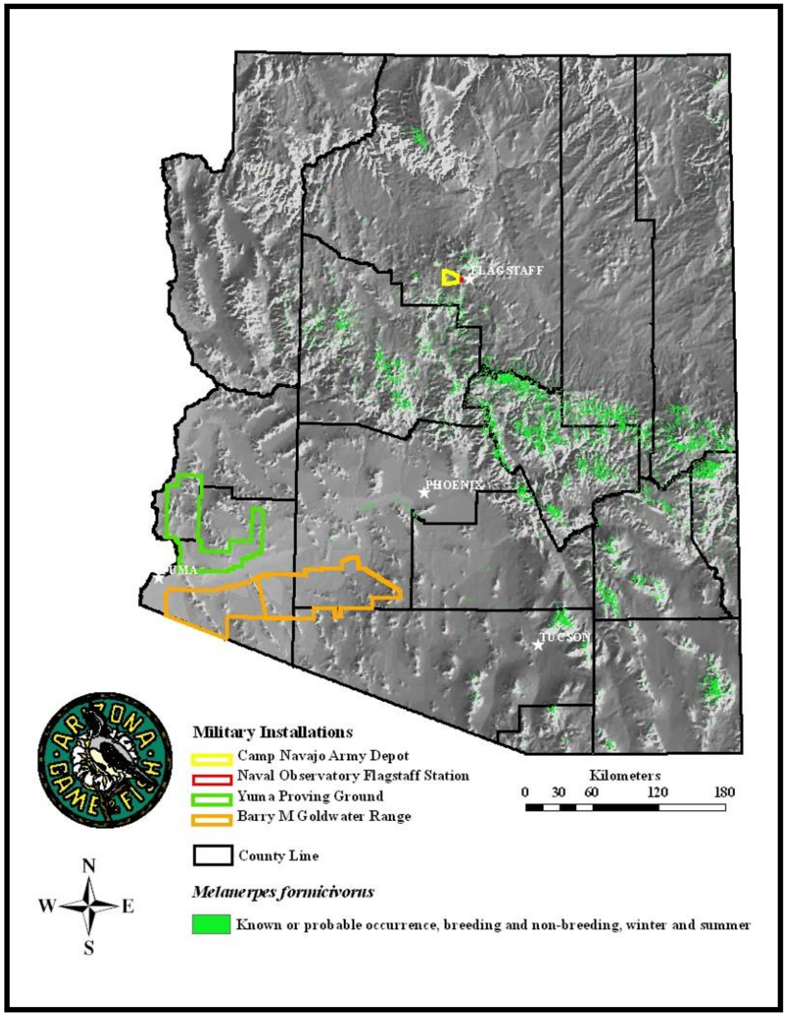


Figure 9. Known occurrences of the Northern flicker (*Colaptes auratus*) on Camp Navajo and Naval Observatory Flagstaff Station (NOFS). Occurrence data were compiled from NOFS 2005 breeding bird survey data (Shepherd and Burr 2005). See Appendix A for further information on data sources.

Figure 10.



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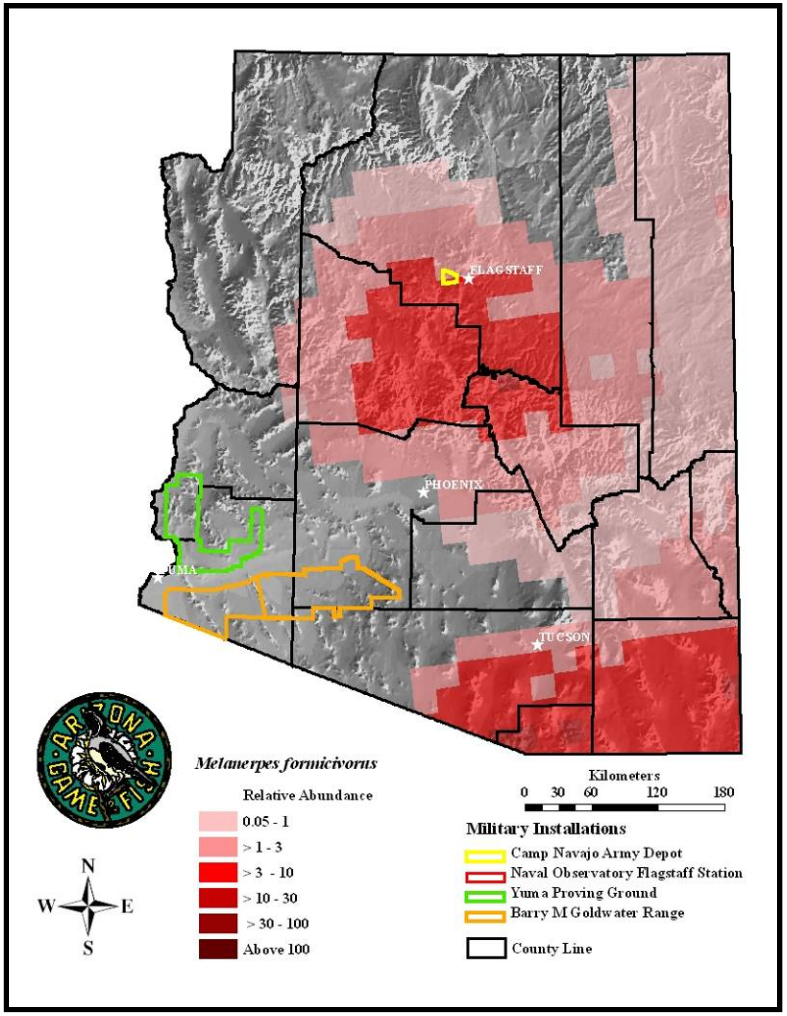


Figures 10 and 11. Potential range (Figure 10) and relative abundance (Figure 11) of the acorn woodpecker (*Melanerpes formicivorus*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Relative abundance data were downloaded from The North American Breeding Bird Survey, Results and Analysis, 1966-2005 webpage (http://www.mbr-pwrc.usgs.gov/bbs/) (Sauer et al. 2005). See Appendix A for further information on data sources.

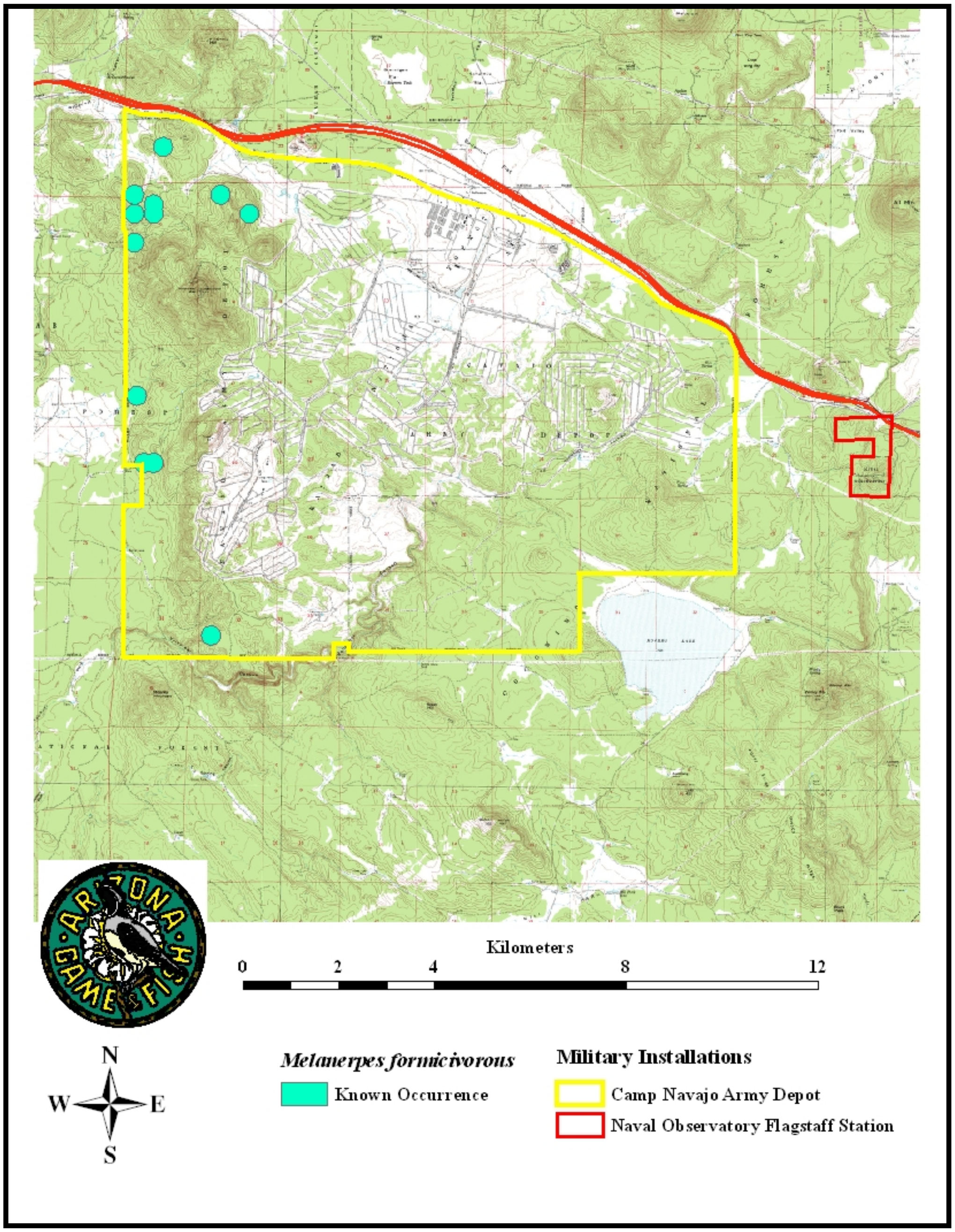


Figure 12. Known occurrences of the acorn woodpecker (*Melanerpes formicivorus*) on Camp Navajo and Naval Observatory Flagstaff Station (NOFS). Occurrence data were compiled from NOFS 2005 breeding bird survey data (Shepherd and Burr 2005). See Appendix A for further information on data sources.

Figure 13.

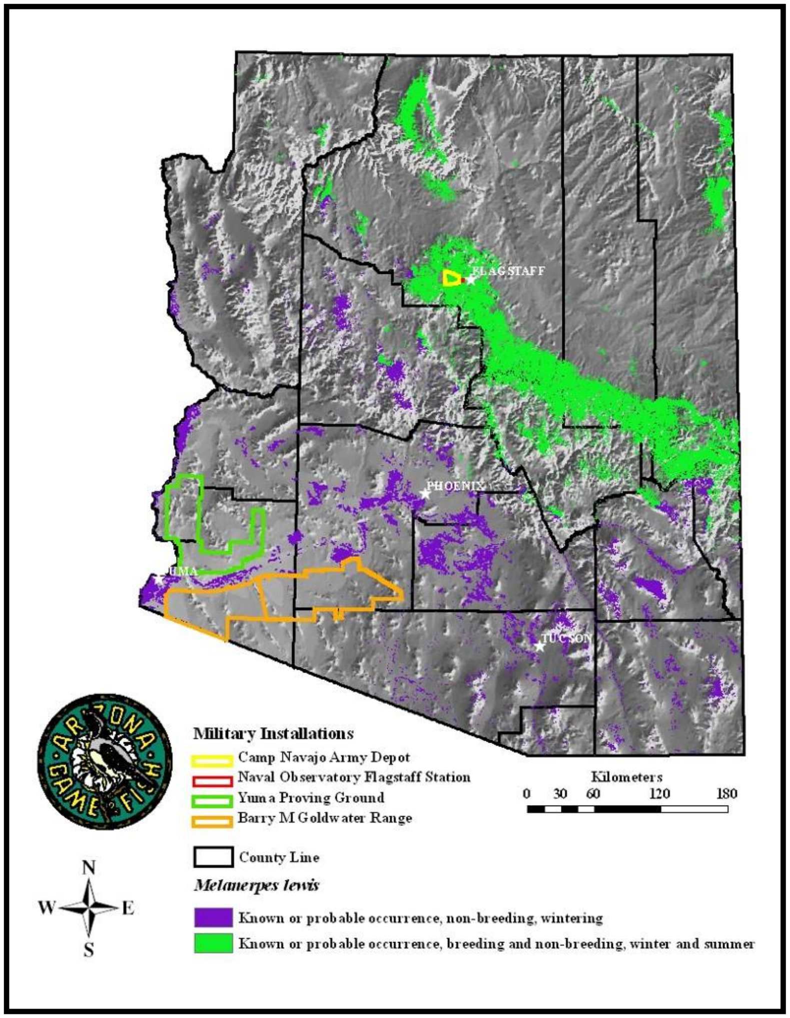
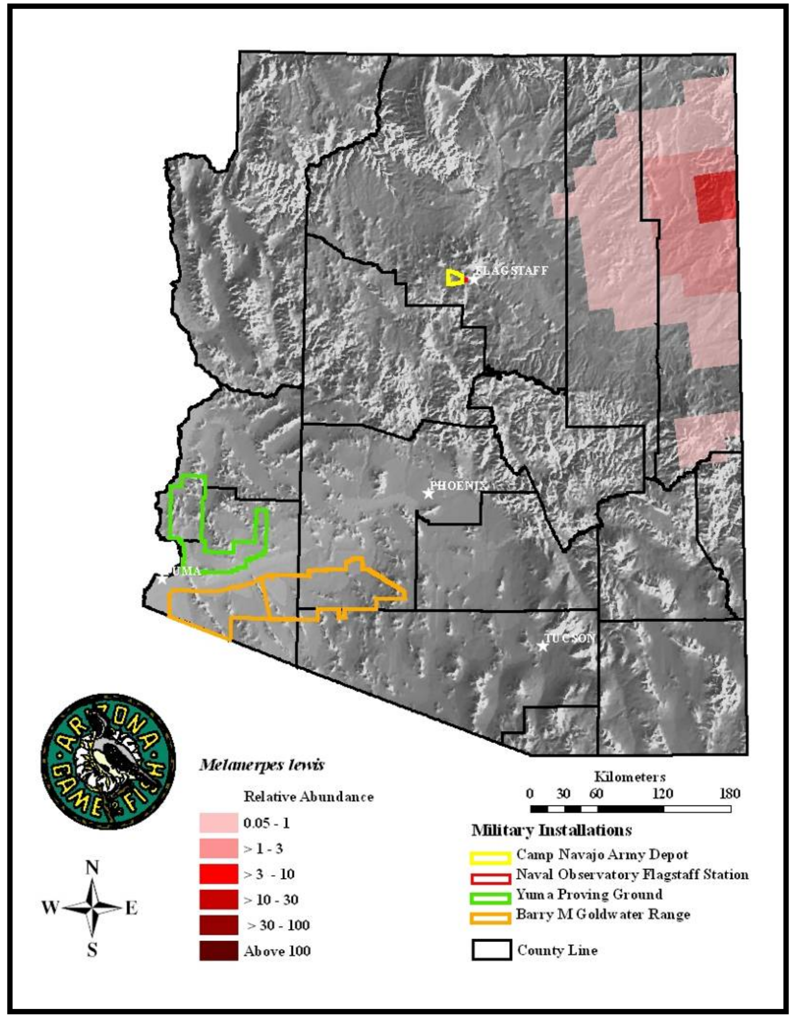
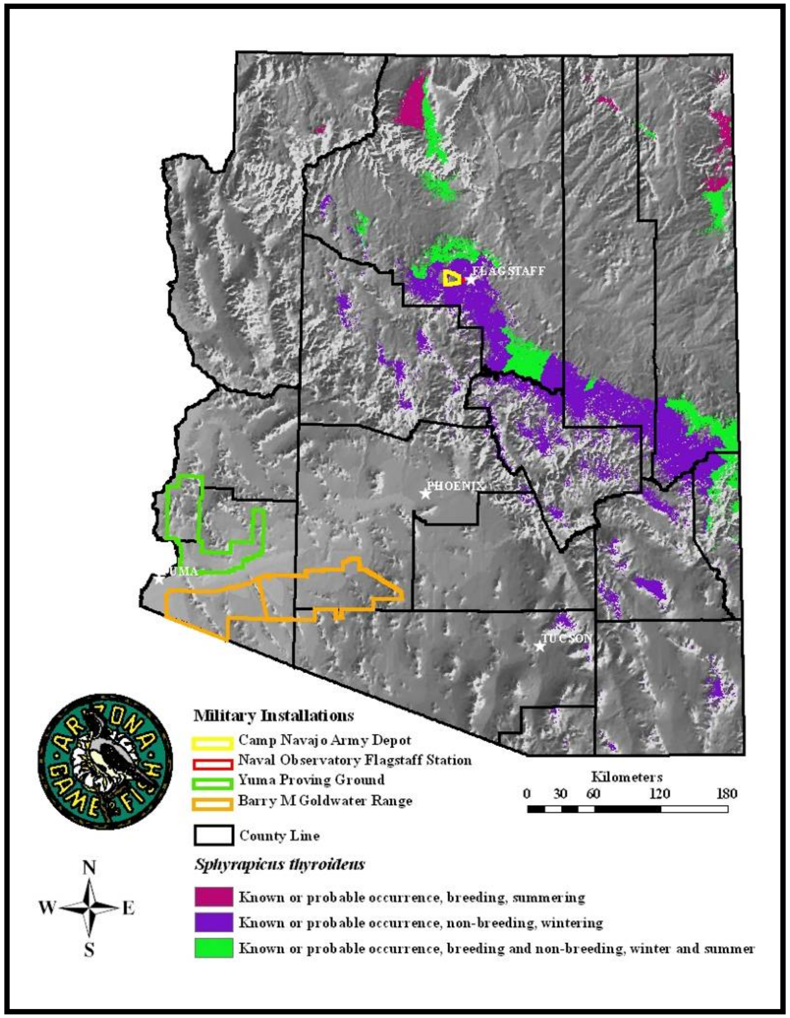


Figure 14.



Figures 13 and 14. Potential range (Figure 13) and relative abundance (Figure 14) of the Lewis's woodpecker (*Melanerpes lewis*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/default.htm). Relative abundance data were downloaded from The North American Breeding Bird Survey, Results and Analysis, 1966-2005 webpage (http://www.mbr-pwrc.usgs.gov/bbs/) (Sauer et al. 2005). See Appendix A for further information on data sources.

Figure 15.



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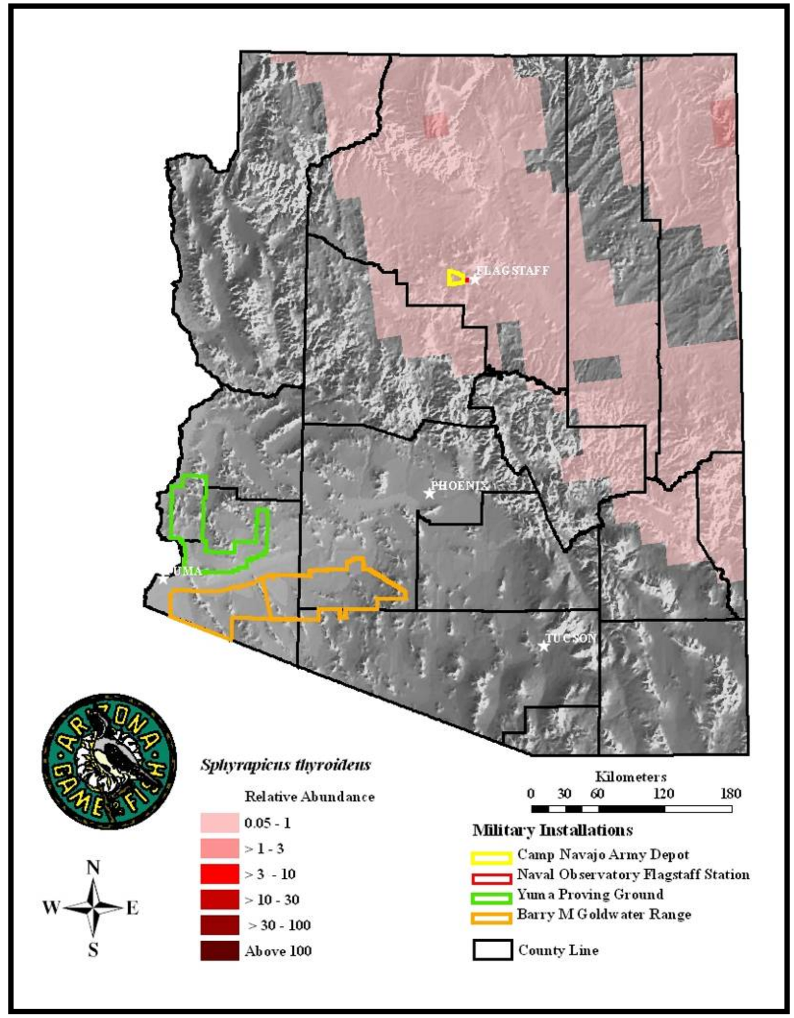

Figures 15 and 16. Potential range (Figure 15) and relative abundance (Figure 16) of the Williamson's sapsucker (*Sphyrapicus thyroideus*) in Arizona and on focal Department of Defense military installations in Arizona. Potential range data were downloaded from the United States Geological Survey National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project webpage (http://fws-nmcfwru.nmsu.edu/swregap/ default.htm). Relative abundance data were downloaded from The North American Breeding Bird Survey, Results and Analysis, 1966-2005 webpage (http://www.mbr-pwrc.usgs.gov/bbs/) (Sauer et al. 2005). See Appendix A for further information on data sources.

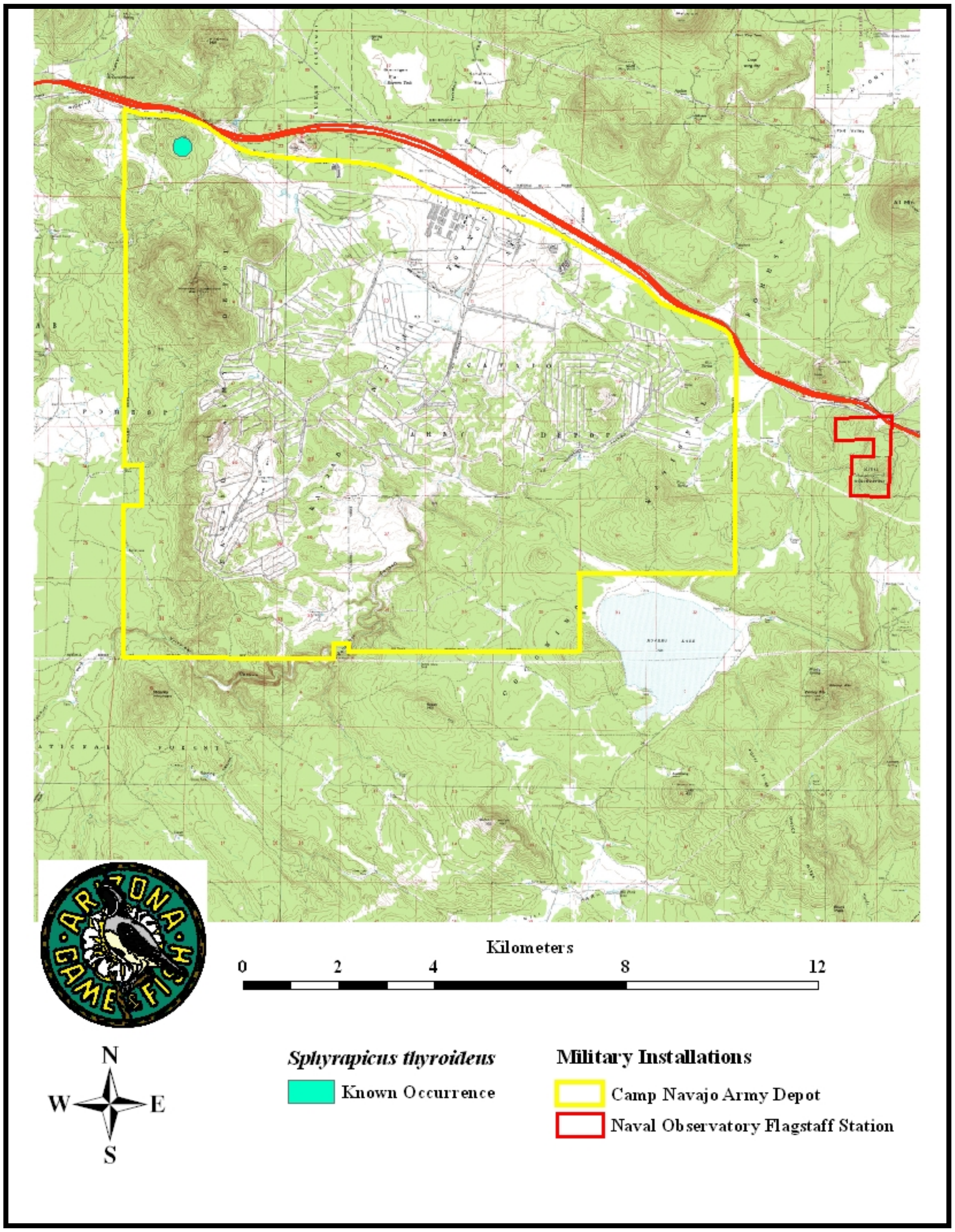

Figure 17. Known occurrences of the Williamson's sapsucker (*Sphyrapicus thyroideus*) on Camp Navajo and Naval Observatory Flagstaff Station (NOFS). Occurrence data were compiled from NOFS 2005 breeding bird survey data (Shepherd and Burr 2005). See Appendix A for further information on data sources.

Appendix A. Information Sources

The following data sources were used to construct potential range and known occurrence maps for identified species at risk within Arizona and selected Department of Defense (DoD) installations: (1) United States Geological Survey (USGS) National Gap Analysis Program (2005), Southwest Regional Gap Analysis Project (SWReGAP); (2) Arizona's Natural Heritage Program, Heritage Data Management System; (3) Arizona Game and Fish Department BATS Database; and (4) The North American Breeding Bird Survey.

The SWReGAP project predicted habitat for 820 vertebrate species that reside, breed, or use habitat in the Southwestern states of Nevada, Utah, Colorado, New Mexico, and Arizona for a significant portion of their life history. These models are based on the concept of Wildlife Habitat Relationships which are statements describing resources and conditions present in areas where a species persists, reproduces or otherwise occurs. For each species, these relationships were identified by reviewing available literature and then generating a spatial representation of habitat within the species known range. Assumptions associated with SWReGAP vertebrate habitat models can be found on the website: http://fws-nmcfwru.nmsu.edu/swregap/ default.htm. Digital habitat models (240-m resolution) were downloaded for each vertebrate species at risk from the aforementioned website and projected in ArcGIS 9.0 to show potential range both state-wide and within selected DoD installations.

Managed by the Arizona Game and Fish Department (AGFD), Arizona's Heritage Data Management System (HDMS) collects, synthesizes, and catalogs information concerning the distribution and occurrence of species and habitats in need of conservation attention. Information included in the HDMS comes from published and unpublished reports, data collected by cooperating agencies, museum and herbarium collections, scientific and academic communities, and many other sources. Known occurrence data for each identified species at risk were requested from Arizona's Natural Heritage Program and mapped within selected DoD installation boundaries using ArcGIS 9.0. Due to the sensitivity of the data (e.g., locations of sensitive species, mine locations, roost sites), known occurrence data points were buffered to an area of 1 square mile. Additional roost and capture locations were compiled from Castner et al. 1993, Castner et al. 1995, and the AGFD BATS Database (Nancy Renison, Arizona Bat Project Biologist) to supplement HDMS occurrence data for identified forest and desert bat species at risk.

HDMS occurrence data were not available (i.e., species not tracked in HDMS) for all identified species at risk, specifically the Le Conte's thrasher and woodpecker species. As an alternative to HDMS occurrence data, shapefiles containing relative abundance information were downloaded for each avian species at risk from The North American Breeding Bird Survey (BBS), Results and Analysis, 1966-2005 website (http://www.mbr-pwrc.usgs.gov/bbs/) (Sauer et al. 2005) and mapped in ArcGIS 9.0. These maps indicate the number of birds seen on BBS routes, grouped into categories of relative abundance. The maps predict the average number of individuals of the species that could be seen in approximately 2.5 hours of observation along roadsides. Relative abundance maps are based on mean counts on BBS routes over the interval 1994 – 2003 (i.e., 10-year mean) (Sauer et al. 2005).

Citations:

Arizona Game and Fish Department. 2007. Heritage Data Management System. Arizona Game and Fish Department, Phoenix, Arizona (Accessed March, 2007).

Arizona Game and Fish Department. 2007. BATS Database. Phoenix, Arizona (Accessed April, 2007).

Castner, S.V., T.K. Snow, and D.C. Noel. 1993. Bat inventory of U.S. Army Yuma Proving Ground, Arizona: 1993. Nongame and Endangered Wildlife Program Final Report. Arizona Game and Fish Department, Phoenix, Arizona.

Castner, S.V., T.K. Snow, and D.C. Noel. 1995. Bat inventory of the U.S. Army Yuma Proving Ground, Arizona: 1995. Nongame and Endangered Wildlife Program Technical Report 90. Arizona Game and Fish Department, Phoenix, Arizona.

Sauer, J. R., J. E. Hines, and J. Fallon. 2005. The North American Breeding Bird Survey, Results and Analysis 1966 - 2005. Version 6.2. 2006. USGS Patuxent Wildlife Research Center, Laurel, MD. Available at: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html.

USGS National Gap Analysis Program, 2005. Provisional Digital Animal-Habitat Models for the Southwestern United States. Version 1.0. Center for Applied Spatial Ecology, New Mexico Cooperative Fish and Wildlife Research Unit, New Mexico State University.

Appendix B. Species Status and Ranking Definitions

Status designations and conservation rankings for identified species at risk were compiled using information provided by Arizona's Heritage Data Management System, managed by the Arizona Game and Fish Department, and NatureServe Explorer. Definitions of Federal and State status designations and conservation rankings are provided below.

Status Definitions, Federal:

Endangered Species Act (ESA, 1973 as amended) U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS)	
Listed	
LE	Listed Endangered: imminent jeopardy of extinction
LT	Listed Threatened: imminent jeopardy of becoming Endangered.
XN	Experimental Nonessential population.
Proposed for Listing	
PE	Proposed Endangered
PT	Proposed Threatened
Candidate	
C	Candidate: species for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list as Endangered or Threatened under ESA.

U.S. Department of the Interior, U.S. Bureau of Land Management (BLM) Arizona State Office (2000)	
S	Sensitive: taxa occurring on BLM Field Office Lands in Arizona which are considered sensitive by the Arizona State Office.

Status Definitions, State of Arizona:

Arizona Native Plant Law (1993) Arizona Department of Agriculture	
HS	Highly Safeguarded: no collection allowed.
SR	Salvage Restricted: collection only with permit.
ER	Export Restricted: transport out of State prohibited.
SA	Salvage Assessed: permits required to remove live trees.
HR	Harvest Restricted: permits required to remove plant by-products.

Wildlife of Special Concern in Arizona (WSC, 1996 in prep) Arizona Game and Fish Department	
WSC	Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona.

Ranking Definitions (NatureServe 2006):

Conservation status ranks are based on a one to five scale, ranging from critically imperiled to demonstrably secure. Status is assessed and documented at the global (G) and state/province (S) geographic scales. These status assessments are based on the best available information, and consider a variety of factors such as abundance, distribution, population trends, and threats.

Global and State Ranks:

Rank	**Definition**
G1/S1	Critically imperiled - Critically imperiled because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation.
G2/S2	Imperiled - Imperiled because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation.
G3/S3	Vulnerable - Vulnerable due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
G4/S4	Apparently Secure - Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5/S6	Secure - Common; widespread and abundant
G#G#_S#S#	Range Rank - A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community. A G2G3 rank would indicate that there is a roughly equal chance of G2 or G3 and other ranks are much less likely.

Citations:

Arizona Department of Agriculture. 1993. Arizona Revised Statutes, Chapter 3, Title 7: Arizona Native Plants. Phoenix, Arizona.

Arizona Game and Fish Department. In prep. 1996. Wildlife of special concern in Arizona. Arizona Game and Fish Department Publication. Phoenix, Arizona. 32pp.

Arizona Game and Fish Department. 2007. Heritage Data Management System. Arizona Game and Fish Department, Phoenix, Arizona (Accessed March, 2007).

Endangered Species Act of 1973, As Amended through the 108th Congress. 1973. U.S. Department of the Interior, U.S. Fish and Wildlife Service. Washington D.C., 20240.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe. Arlington, Virginia. Available http://www.natureserve.org /explorer. (Accessed: April, 18 2007).

U.S. Department of the Interior, Bureau of Land Management. 2000. Arizona BLM Sensitive Species List.

Appendix C: Summary of Arizona's Comprehensive Wildlife Conservation Strategy Rating Categories and Component Criteria

In addition to compiling species status and conservation ranks provided by Arizona's Heritage Data Management System and NatureServe Explorer, Arizona's Comprehensive Wildlife Conservation Strategy (CWCS) was evaluated (AGFD 2006). Arizona's CWCS addresses the full array of wildlife, but focuses on identifying and managing the "wildlife and biotic communities of greatest conservation need". Ratings within 4 conservation categories (i.e., Community Focal, Responsibility, Vulnerability, and Unknown Status) were summarized for identified species at risk. Ratings were compiled from Appendices I (Master Species List for the Colorado Plateau Ecoregion) and K (Master Species List for the Sonoran Desert Ecoregion) of the CWCS, respectively for the northern military installation cluster of Camp Navajo Army Depot and Naval Observatory Flagstaff Station, and the southern military installation cluster of Yuma Proving Ground and Barry M. Goldwater Range. The rating categories and component criteria used to rank species is summarized from Arizona's CWCS below (AGFD 2006).

1) Community Focal

The rank in this category would be the lowest score for species in any of the following criteria since all these criteria indicate ties between the species and the larger landscape and/or ecosystem – defined as "community focal species." Rating of 1 = high priority species; 2 = medium priority species; 3 = low priority species.

- Keystone and strongly interactive species
- Home range size
- Habitat quality indicators

2) Responsibility

These criteria rank species for their value because their global status is largely a function of their status in Arizona, because they contribute to the unique character of wildlife in Arizona compared to other parts of the United States, or because of their unique value to sovereign nations that interact with Arizona to conserve wildlife. The 'Responsibility' category was designed to give importance to species that are uniquely represented in the United States by their Arizona populations. This may be desirable if the criteria identify species where Arizona makes agreements with Mexico or tribes concerning these species, but the species are not otherwise eligible for funding. Rating of 1 = high priority species; 2 = medium priority species; 3 = low priority species.

- Responsibility status
- Administrative protection status on tribal lands in Arizona
- Administrative protection status in Mexico

3) Vulnerability

Species may arrive at a point of vulnerability in different ways, according to the stressors involved and the biology of each species in Arizona. Accordingly, the Department developed a set a criteria to capture these different types of vulnerability. Any one criterion can flag a species as vulnerable, so it does not matter whether a species ranks as 'vulnerable' on 1,3, on all 9 criteria. Ranks are not additive. Rating of 1 = high priority species; 2 = medium priority species; 3 = low priority species.

The rank is based on the following criteria:

- Endangered, threatened, candidate status or *Wildlife of Special Concern in Arizona*
- Extirpated status
- Declining status
- Disjunct status
- Demographic status
- Concentration status
- Element occurrences (includes endemics)
- Fragmentation status

Species that rated “1” for any criteria under the Vulnerability category are Species of Greatest Conservation Need (SGCN) and were designated to have the highest priority for directed conservation management. Vulnerable species require conservation actions aimed at improving conditions for those species through intervention at the population or habitat level. Species that rated “1” for Vulnerability were further separated into 3 tiers of priorities (1a, 1b, and 1c).

Tier 1a. Scored “1” for vulnerability and match at least one of the following:

- Federally listed species
- Candidate species
- Existence of a signed conservation agreement
- Require monitoring following delisting

Tier 1b. Scored “1” for vulnerability, do not match the above criteria, but do match at least one of the following:

- Is petitioned for listing
- Is high priority in the Arizona Partners in Flight Bird Conservation Plan or occurs on any of the following special concerns lists:
    - BLM Sensitive Species
    - USFS Sensitive Species
    - NPS Sensitive Species
    - Pima County Priority Vulnerable Species
    - Trilateral Committee Species of Common Concern
    - Federal Species of Concern
    - WSCA

Tier 1c. Scored “1” for vulnerability, but match none of the above criteria

4) Unknown Status (criterion same as category; based on the criteria scores for ‘Vulnerability’) Species would rank high in this category if they do not have a ‘1’ for ‘Vulnerability’, but any of the ‘Vulnerability’ criteria was scored ‘0’, indicating that there was insufficient information to consider whether this species is vulnerable. Rating of 1 = high priority species; 2 = medium priority species; 3 = low priority species.

Citations:

Arizona Game and Fish Department. 2006. DRAFT. Arizona’s Comprehensive Wildlife Conservation Strategy: 2005-2015. Arizona Game and Fish Department, Phoenix, Arizona.

Appendix R: Public Comments

The Public Draft of the *Integrated Natural Resources Management Plan for Naval Observatory Flagstaff Station* was sent out for public review 20 August 2009. The review period ended 24 September 2009, and no public comments were received.

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Appendix S: Environmental Assessment

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Environmental Assessment

for
The 2011 Revised Integrated Natural Resources Management Plan

U.S. Naval Observatory Flagstaff Station

Flagstaff, Arizona

July 2012

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DEPARTMENT OF DEFENSE
DEPARTMENT OF THE NAVY

FINDING OF NO SIGNIFICANT IMPACT (FONSI) FOR THE ENVIRONMENTAL ASSESSMENT (EA) FOR THE 2011 REVISED INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN (INRMP) AT THE NAVAL OBSERVATORY FLAGSTAFF STATION (NOFS), FLAGSTAFF, COCONINO COUNTY, ARIZONA

Pursuant to the Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508) implementing the National Environmental Policy Act (NEPA) and Navy NEPA regulations (32 CFR Part 775) and Chief of Naval Operations Instruction 5090.1C, the Department of the Navy (Navy) gives notice that an EA has been prepared and an Environmental Impact Statement (EIS) is not required for the 2011 Revised INRMP at NOFS, Flagstaff, Coconino County, Arizona.

The Draft EA was released for public review from 26 August 2011 to 24 September 2011. The Navy published a Notice of Availability of the Draft EA for three consecutive days in the Arizona Daily Sun newspaper which described the Proposed Action, solicited public input, and announced the locations the Draft EA was available for public review. The Draft EA was made available for public review at the Flagstaff City-Coconino County Public Library, 300 West Aspen Ave., Flagstaff, AZ 86001. Copies of the Draft EA in CD-ROM format were also made available to interested parties, upon request. No comments were received on the Draft EA.

Proposed Action: The Proposed Action is the adoption of the NOFS 2011 Revised INRMP. The Proposed Action, through the use of management focus areas, will balance natural resource management with the military mission of NOFS. Many of the natural resource management objectives established in the 2001 INRMP are carried forward in the 2011 Revised INRMP. In addition, eight new strategies have been added to the Revised INRMP. These strategies address the collection of new data, encroachment planning, invasive species control, environmental sustainability, partnerships, and erosion and water quality control. In addition, forest management will be adapted to permit the use of prescribed fires on 40-acres or less (16 hectares [ha]) per year.

The purpose and need for the Proposed Action is to meet statutory requirements under the Sikes Act Improvement Act (SAIA) of 1997 (16 United States Code § 670a *et seq.*), as well as the requirements of various Department of Defense (DoD) and Navy Instructions. The SAIA requires the Secretaries of the respective military departments to prepare and implement an INRMP for each military installation in the United States. The current INRMP for NOFS (implemented in 2001) needs to be revised to reevaluate management concerns and practices (particularly with regard to forest fuels management), address recent Navy guidelines and consider recent scientific studies and monitoring results.

Existing Conditions: The NOFS, consisting of 287 acres (116 ha), is located in Coconino County, Arizona. It is five miles (8 kilometers [km]) west of the city of Flagstaff on Route 66 and is bordered by Coconino National Forest lands, Arizona State Trust lands and private lands.

NOFS is a Navy-owned asset used as an observing station of the United States Naval Observatory (USNO) based in Washington, D.C. The USNO provides local administrative and logistical support to NOFS. NOFS needs to have a dark-sky to enable optical and near-infrared astronomy activities to occur there. Infrastructure on NOFS includes: nine buildings; facilities to support astronomy equipment, satellite research and the development of navigational programs; paved and unpaved roads; parking lots; potable water tanks; and, supporting utilities. The infrastructure itself only occupies approximately two acres of NOFS, which is less than one percent of the total acreage.

The remaining 99 percent of NOFS land is primarily composed of forested lands. Within the NOFS boundaries are a number of important natural resources, including small areas of jurisdictional wetlands and several stream segments classified as Jurisdictional Waters of the U.S. The southern portion of the property lies within the Dry Lake Protected Activity Center for the federally-endangered Mexican spotted owl (*Strix occidentalis lucida*), however, no Mexican spotted owls have been observed on NOFS property. No other federal threatened or endangered species are known to occur on NOFS. Other special status species observed, or with the potential to occur, on NOFS include: bald eagle (*Haliaeetus leucocephalus);* northern goshawk (*Accipiter gentilis*); Allen's big-eared bat (*Idionycteris phyllotis*); fringed myotis (*Myotis thysanodes*); long-eared myotis (*Myotis evotis*;, long-legged myotis (*Myotis volans*); occult little brown bat (*Myotis lucifugus occultus*); flammulated owl (*Otus* *flammeolus*); Arizona leatherflower *(Clematis hirsutissima var. hirsutissima); and,* Flagstaff pennyroyal (*Hedeoma diffusum*).

Alternatives Analyzed: The EA analyzed the potential environmental effects of the Proposed Action and two additional alternatives, including the No Action Alternative. The Proposed Action is the selected alternative because it best meets the purpose and need for the project and presents the most comprehensive approach to effectively manage the natural resources on NOFS. Of the alternatives considered, the Proposed Action also offers the most effective approach towards reducing potential conflicts between natural resources and the military uses of the area.

Alternative 2 - Implementation of the 2011 Revised INRMP using mechanical methods only for forest fuels management. All management strategies in this alternative would be the same as in the Proposed Action, with the exception that prescribed fires would not be conducted. Instead of prescribed fire, brush and fuel material on the forest floor would be cut down, collected, and removed from the area using mechanized equipment such as chainsaws. Non-mechanized hand tools would also be used and no more than 40 acres would be treated annually for forest fuel management.

Alternative 3 - No Action Alternative. Continued implementation of the 2001 INRMP. This alternative would continue current management objectives, using mechanical clearing, thinning and pile burning as the management tool for forest fuel reduction.

Environmental Effects: The following is a summary of the environmental consequences of the Proposed Action:

<u>Geology and Soils:</u> The Proposed Action will benefit geologic and soil resources overall because prescribed fires will reduce the potential for large wildfires on NOFS. The reduced potential for large wildfires will result in decreased damage to soils and soil erosion potential. Minor and temporary negative impacts to soil and geologic resources will result during and immediately after the prescribed fires as soil surfaces are exposed and soil structure is broken down from the heat of the fire. However, effects to soil resources will be minimized with the implementation of Best Management Practices (BMPs) during prescribed fires. Therefore, there will be no significant impact to geologic and soil resources from implementation of the Proposed Action.

Water and Hydrology: Overall, the Proposed Action will have beneficial effects to water resources. It will reduce the potential for large wildfires on NOFS, thus protecting surface waters from the detrimental effects (such as large quantities of soil sediment, ash, and debris entering surface waters) that would occur after a large wildfire. The Proposed Action may result in minor and temporary indirect effects to water quality from flame retardants and flame accelerants (that have not dissipated), soil sediment, ash, and debris filtering into surface waters. However, the implementation of BMPs during prescribed fires will greatly reduce the amount of soil sediment and pollutants entering the waters. Therefore, there will be no significant impact to water and hydrology under the Proposed Action.

Biological Resources: The overall effects of the Proposed Action to biological resources will be beneficial, as the potential for large wildfires will be reduced. This will then reduce the direct impacts to wildlife and vegetation that would occur from large wildfires. During prescribed fires and other Proposed Action activities, avoidance and minimization measures, as prescribed by the U.S. Fish and Wildlife Service, will be implemented to avoid impacts to Mexican spotted owls. Although minor and temporary negative impacts will occur to non-federally listed biological resources living within, or dependent upon, the area of the burn patches, these impacts will be reduced as NOFS will only burn a maximum of 40-acres of understory vegetation per year. Also, the majority of wildlife species will be able to escape impacts from a prescribed fire by temporarily leaving the area to adjacent forest lands. Therefore, there will be no significant impact to biological resources from the Proposed Action.

Air Quality and Climate Change: Overall, the Proposed Action will result in beneficial effects to air quality and climate change, as it will reduce the potential for large wildfires at NOFS. This will, in turn, reduce the large amount of smoke, heat and air pollutants that would result from wildfires of that size. Small amounts of air emissions and greenhouse gases from the prescribed fires will be released over the course of the Proposed Action. These emissions will be small, however, as no more than 40-acres per year will be burned at NOFS. Per Arizona Department of Environmental Quality (ADEQ) regulations, an annual "Prescribed Burn Plan", as well as a burn request for each prescribed fire, will be submitted to, and approved by, ADEQ. This requirement will result in further reductions in air quality impacts as ADEQ will only approve prescribed fires in safe conditions when there would be no potential for air quality impacts to human health. Therefore, implementation of the Proposed Action will have no significant impacts on air quality or climate change.

Safety and Environmental Health: Implementation of the Proposed Action will reduce long-term threats to public safety by minimizing the potential for large wildfires on NOFS. Personnel involved in prescribed fire activities will follow all safety procedures per the annual "Prescribed Burn Plan". Therefore, there would be no significant impact to public health and safety under the Proposed Action.

Finding: Based on the analysis presented in the EA and in coordination with the U.S. Fish and Wildlife Service and the Arizona Department of Game and Fish, the Navy finds that implementation of the Proposed Action will not significantly impact the quality of the human or natural environment or generate significant controversy.

The EA prepared by the Navy addressing this action is on file, and interested parties may obtain a copy from: Gene Beale, Environmental Planner, NAVFAC Southwest, 1220 Pacific Highway, San Diego, CA 92132, (619) 532-1027 or gene.beale@navy.mil.

7/10/12
Date

RADM Dixon R. Smith, USN
Commander, Navy Region Southwest

Environmental Assessment

for
The 2011 Revised Integrated Natural Resources Management Plan

U.S. Naval Observatory Flagstaff Station
Flagstaff, Arizona

Abstract

This Environmental Assessment (EA) has been prepared for the U.S. Department of the Navy (DoN) to determine if an Environmental Impact Statement or Finding of No Significant Impact should be prepared on the strategies proposed in the final 2011 Revised Integrated Natural Resources Management Plan (INRMP) for the U.S. Naval Observatory Flagstaff Station (NOFS) located in Flagstaff, Arizona. NOFS is assigned as a Class I Special Area to the Commanding Officer of Naval Air Facility El Centro. The purpose of the revised INRMP is to meet statutory requirements under the Sikes Act Improvement Act, Public Law 105-85, Div. B Title XXIX, 18 November 1997, 111 Stat 2017-2019, 2020-2022, as well as the requirements of various U.S. Department of Defense and DoN Instructions. The 2011 Revised INRMP is designed to provide for the continuation of military activities while preserving, protecting, and enhancing the natural resources and biodiversity of NOFS. This EA describes three alternatives: the Proposed Action, Alternative 2, and the No Action Alternative. The Proposed Action is to implement the 2011 Revised INRMP for NOFS. The Proposed Action would continue many of the natural resources management strategies outlined in the 2001 INRMP with the addition of prescribed fire as a management tool for forest fuels on the NOFS property. Alternative 2 is the same as the Proposed Action in implementing the 2011 Revised INRMP but without the addition of prescribed fire; instead, mechanical methods would be used as the tool for forest fuels management. The No Action Alternative would continue implementation of the existing INRMP completed in 2001. The Navy would implement recommendations in the 2011 Revised INRMP within the framework of regulatory compliance, national Navy mission obligations, force protection limitations, and funding constraints. Any requirement for the obligation of funds for projects in this 2011 Revised INRMP shall be subject to the availability of funds appropriated by Congress, and none of the proposed projects shall be interpreted to require obligation or payment of funds in violation of any applicable federal law including the Anti-Deficiency Act, 31 U.S. Code § 341, *et seq*.

For further information, contact:

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October 2011

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List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
4FRI	Four Forests Restoration Initiative
ADEQ	Arizona Department of Environmental Quality
APE	area of potential effect
API	Arizona Preserve Initiative
ASLD	Arizona State Lands Department
AZGFD	Arizona Game and Fish Department
BMP	Best Management Practice
BO	Biological Opinion
C	carbon
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	Methane
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPOS	Coconino Parks and Open Space Program
CPRS	Colorado Plateau Research Station
CWA	Clean Water Act
DBH	Diameter at Breast Height
DoD	U.S. Department of Defense
DoN	U.S. Department of the Navy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FMU	Fire Management Unit
FONSI	Finding of No Significant Impact
g	gram
GHG	greenhouse gas
ha	hectare
HDMS	Arizona Heritage Data Management System
HFI	Healthy Forests Initiative
I-40	Interstate 40
INRMP	Integrated Natural Resources Management Plan
km	kilometer
m	meter
m^2	square meter
MBTA	Migratory Bird Treaty Act
MSO	Mexican spotted owl
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAFEC	Naval Air Facility El Centro
NAU	Northern Arizona University
NEPA	National Environmental Policy Act

Acronym/Abbreviation	Definition
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOFS	U.S. Naval Observatory Flagstaff Station
NRHP	National Register of Historic Places
OPNAVINST	Chief of Naval Operations Instruction
PAC	Protected Activity Center
PM_{10}	Particulate matter 10 microns in diameter
$PM_{2.5}$	Particulate matter 2.5 microns in diameter
ROC	Reactive Organic Compounds
SAIA	Sikes Act Improvement Act
SBSC	Southwest Biological Science Center
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
Tg	teragram
USC	U.S. Code
USDoDINST	U.S. Department of the Navy Instruction
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNO	United States Naval Observatory
WUI	Wildland Urban Interface

Executive Summary

The purpose of this Environmental Assessment (EA) is to analyze the impacts of the 2011 Revised Integrated Natural Resources Management Plan (INRMP) for the Naval Observatory Flagstaff Station (NOFS) located in Flagstaff, Arizona. NOFS is assigned as a Class I Special Area to the Commanding Officer of Naval Air Facility El Centro. This assessment will determine if an Environmental Impact Statement or Finding of No Significant Impact should be prepared for the final draft of the revised INRMP.

The purpose of the INRMP is to meet statutory requirements under the Sikes Act Improvement Act (SAIA), Public Law 105-85, Div. B Title XXIX, 18 November 1997, 111 Stat 2017-2019, 2020-2022. The current INRMP, implemented in 2001, needs to be updated to address recent changes in U.S. Department of Defense (DoD) and U.S. Department of the Navy (DoN) guidelines, to consider recent scientific studies and monitoring results, and to reevaluate current natural resource management practices. As a result of ongoing forest thinning practices commenced under the 2001 INRMP, it is now appropriate to reconsider natural resources management, particularly with respect to understory management, and designate prescribed burning as a potential management tool.

The range of reasonable alternatives in this EA was identified by evaluating their ability to meet the purpose and need for action and certain other criteria (Chief of Naval Operations Instruction [OPNAVINST] 5090.1C) including:

- Compatibility with the mission of NOFS – NOFS serves as an observing station for the U.S. Naval Observatory based in Washington, D.C., and the mission of NOFS is to analyze and interpret astrometric and photometric dark sky observations. An alternative must be compatible with telescope operations and must sustain a dark sky and maintain low levels of smoke, pollen, and dust;
- Low risk of harm – An alternative must have a low risk of harm to human health and safety and the overall ecological health of the forest; and,
- Demonstrate biological soundness for forest health and species management – An alternative must be considered biologically sound with respect to addressing key concerns identified in the INRMP, as well as protecting soil, water, cultural, and other resources.

The alternatives considered in this EA are:

- Alternative 1 – Proposed Action/Preferred Alternative. Implementation of the 2011 Revised INRMP with the optional use of prescribed fire in landscape patches as the management tool for forest fuels;
- Alternative 2 – Implementation of the 2011 Revised INRMP using mechanical methods only for forest fuels management; and,
- Alternative 3 – No Action Alternative. Continued implementation of the 2001 INRMP. This alternative would continue current management objectives, using mechanical clearing, thinning, and pile burning as the management tool for forest fuels.

Each alternative has potential resource impacts associated with its implementation (Table ES-1). The EA for the 2001 INRMP assessed the impacts of management strategies based on current (2001) conditions at NOFS. Other than from activities associated with forest thinning, there have been no significant changes in the state of resources at NOFS since that time. Therefore, the conditions that existed prior to the 2001 INRMP adoption serve as the baseline for this EA.

Table ES-1. Potential resource impacts by alternative.

Resources Potentially Affected	**Alternative 1: Proposed Action – Implement 2011 Revised INRMP with Prescribed Fire in Landscape Patches**	**Alternative 2: - Implement 2011 Revised INRMP using Mechanical Methods Only**	**Alternative 3: No Action Alternative – Retain 2001 INRMP**
Air Quality	Short-term emissions from smoke and ash. Decreased potential in emissions from stand-replacing wildfire.	Short-term emissions from mechanical equipment and dust from clearing. Decreased short-term potential in emissions from stand-replacing wildfire. Long-term increased potential for pollutant emissions from organic matter and debris during a stand-replacing wildfire.	Continued short-term emissions from mechanical equipment, dust from clearing, and smoke and ash from pile burns. Increased potential for emissions from forest fuels in a stand-replacing wildfire.
Biological Resources	Short-term disturbance and loss of habitat. Decreased potential for severe disturbance during breeding and nesting season from stand-replacing wildfire. Long-term improvement of habitat. Decreased potential habitat loss from stand-replacing wildfire.	Short-term disturbance and loss of habitat. Decreased potential for severe disturbance during breeding and nesting season from stand-replacing wildfire. Long-term benefits from improved habitat. Decreased short-term potential habitat loss from stand-replacing wildfire. Long-term increased potential habitat loss from stand-replacing wildfire.	Same as Alternative 2.
Climate Change	Short-term release of carbon and greenhouse gas (GHG) emissions. Long-term resiliency to climate change. Decreased potential for GHGs release from stand-replacing wildfire.	Short-term release of carbon and GHGs. Potentially improves long-term resiliency to climate change. Reduces short-term potential for a stand-replacing wildfire that would release significantly more GHGs and carbon and would take decades to replace. Remaining organic matter and debris increases long-term potential for stand-replacing wildfire, thus contributing to GHG release and climate change.	Same as Alternative 2.

Resources Potentially Affected	Alternative 1: Proposed Action – Implement 2011 Revised INRMP with Prescribed Fire in Landscape Patches	Alternative 2: - Implement 2011 Revised INRMP using Mechanical Methods Only	Alternative 3: No Action Alternative – Retain 2001 INRMP
Topography, Geology and Soil Resources	Short-term mobilization of nutrients. Increased erosion potential before new growth stabilizes. Decreased potential for burning and severe erosion from stand-replacing wildfire.	Compaction, ruts and potential erosion from foot traffic and equipment. Decreased short-term potential for burning and severe erosion from stand-replacing wildfire. Increased long-term potential for burning and severe erosion from stand-replacing wildfire due to remaining forest fuels.	Continued compaction and ruts from foot traffic and equipment. Continued localized disturbance from burn piles. Continued increased erosion potential before new growth stabilizes. Continued decreased short-term potential for burning and severe erosion from stand-replacing wildfire. Increased long-term potential for burning and severe erosion from stand-replacing wildfire due to remaining forest fuels.
Hydrology and Water Quality	Short-term small sediment load from ash, soil, debris and fire retardants/accelerators. Long-term protection from riparian buffers. Decreased potential for sediment load and loss of riparian buffers from stand-replacing wildfire.	Short-term small sediment load from soil and debris and fire retardants. Decreased short-term potential for high sediment load and loss of riparian buffers from stand-replacing wildfire. Increased long-term potential for high sediment load and loss of riparian buffers from stand-replacing wildfire.	Same as Alternative 2.
Safety and Environmental Health	Short-term potential for injuries or fatalities of firefighters, buildings, and NOFS staff. Reduced threats to public safety from stand-replacing wildfire.	Short-term potential for injury to work crews. Reduced short-term threats to public safety from stand-replacing wildfire. Increased long-term threats for potential injury to clearing crews from stand-replacing wildfire.	Continued short-term potential for injury to clearing crews. Continued short-term reduced threats to public safety from stand-replacing wildfire. Increased long-term threats for potential injury to clearing crews from stand-replacing wildfire.

Interagency cooperation contributed to the development of the 2011 Revised INRMP. As required by the SAIA, participation by the DoD, DoN, U.S. Fish and Wildlife Service, and Arizona Game and Fish Department ensures the mutual agreement among these parties concerning conservation, protection, and management of resources on NOFS.

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1.0 Introduction

This Environmental Assessment (EA) has been prepared by the U.S. Department of the Navy (DoN) in accordance with the National Environmental Policy Act (NEPA) to evaluate the potential impacts that may be associated with the implementation of the natural resources management strategies outlined in the 2011 Revised Integrated Natural Resources Management Plan (INRMP) for the Naval Observatory Flagstaff Station (NOFS). The overall natural resources management objectives include forest management, fish and wildlife management, land management, and outdoor recreation. The DoN is the action proponent, the land owner, and the lead federal agency for NEPA compliance and preparation of this EA. NOFS is assigned as a Class I Special Area to the Commanding Officer of Naval Air Facility El Centro (NAFEC).

1.1 Project Location

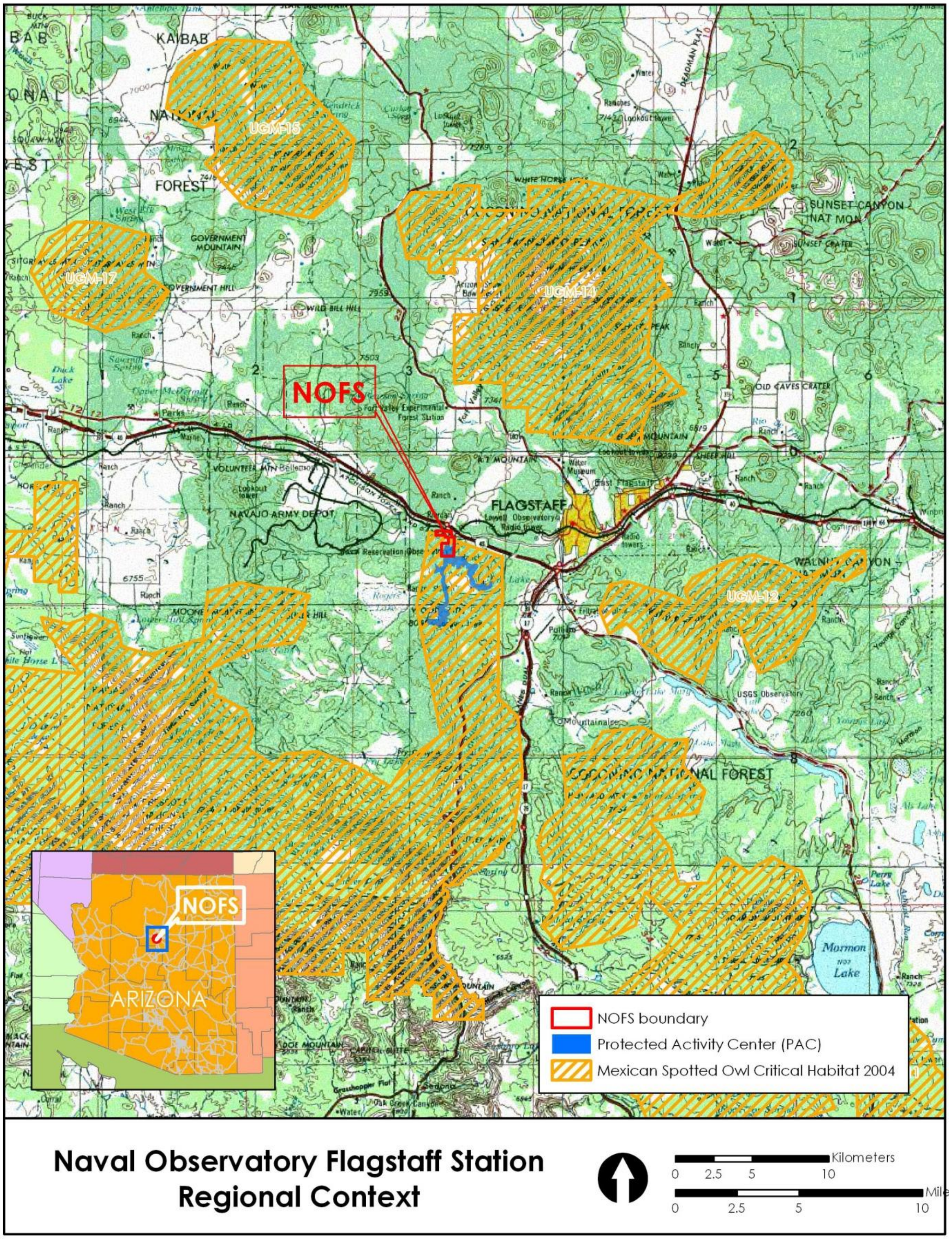
The NOFS, consisting of 287 acres (116 hectares [ha]), is located in Coconino County Arizona, five miles (eight kilometers [km]) west of the city of Flagstaff on Route 66 (Map 1-1). It is bordered by the Coconino National Forest, Arizona State Trust lands, and private lands. The primary land use in the region is timber harvest, recreational tourism, and human settlement. Seasonal livestock grazing is also widespread on public lands of the area. Map 1-2 shows NOFS and the ownership patterns of neighboring lands.

NOFS functions as an observing station of the United States Naval Observatory (USNO) based in Washington, D.C. The USNO provides local administrative and logistical support to NOFS. The mission of NOFS is to:

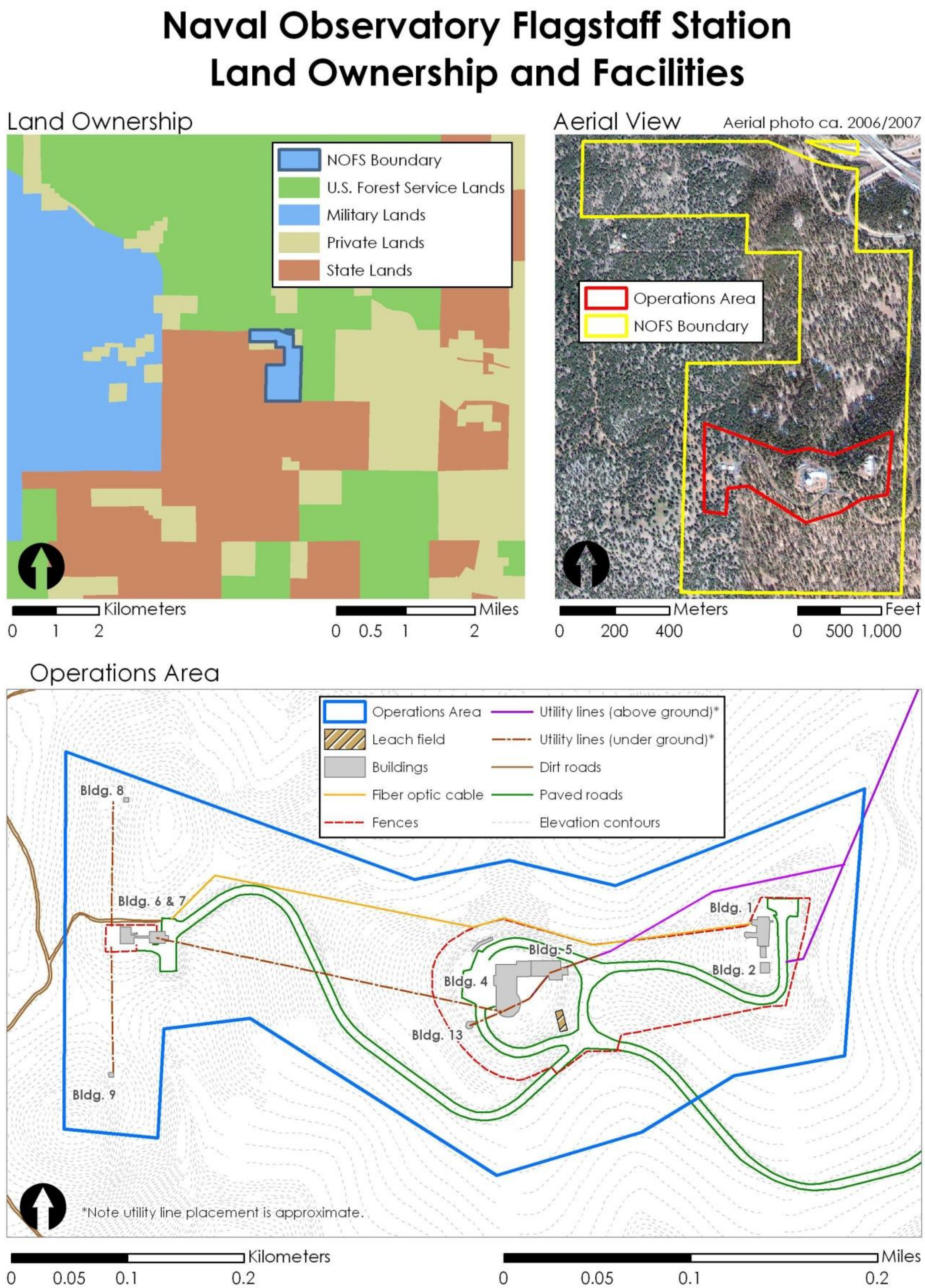
- Make, analyze, and interpret such astrometry and photometric dark sky observations as are required to fulfill the mission of the USNO;
- Conduct a research program to improve the observational methods and the accuracy of astronomical data required by the DoN and other components of the U.S. Department of Defense (DoD); and,
- Perform such other functions or tasks as may be directed by higher authority.

1.2 Purpose and Need of Proposed Action

The purpose and need for the INRMP (revision) is to meet statutory requirements imposed by the Sikes Act Improvement Act (SAIA), as well as the requirements of various DoD and DoN Instructions. The 2011 Revised INRMP is designed to implement an ecosystem-based conservation program that would provide for the conservation and rehabilitation of natural resources in a manner consistent with the military mission. The 2011 Revised INRMP would integrate and coordinate all natural resources management activities, provide for sustainable multipurpose uses of natural resources, and provide for public access for the use of natural resources subject to safety and military security considerations. The NOFS 2011 Revised INRMP management objectives are to integrate forest management, fish and wildlife management, land management, and outdoor recreation as practical and consistent with the military mission and established land uses.



Map 1-1. Location of the Naval Observatory Flagstaff Station in the Arizona region.



Map 1-2. Naval Observatory Flagstaff Station facilities and local land ownership.

The current INRMP (implemented in 2001) for NOFS needs to be updated to address recent management concerns and Navy guidelines, consider recent scientific studies and monitoring results, and reevaluate current natural resources management practices. One of the management strategies implemented in 2001 was forest thinning for wildfire prevention. As a result of this action, which had been ongoing since 2001 and was completed in 2010, the forest canopy is more open, thus changing natural resources conditions at NOFS. As a result, it is now appropriate to re-consider natural resource management, particularly with respect to forest health into the future, and understory management for ecosystem food chain support and biodiversity. Prescribed burning is a potential management approach. Prescribed burning could consist of: broadcast burning, understory burning, and slash pile burning. The Navy would use prescribed burning primarily to: (1) manage the fuel load for wildfire protection of Observatory structures; (2) improve understory structure and habitat condition that supports prey base (small mammals, reptiles and insects) of wildlife that are the focus of management; and, (3) enhance the amount, distribution, and nutritional value of wildlife forage plants. Understory management at NOFS is needed to reduce fuel buildup, thus protecting the Observatory's facilities as well as providing for overall forest health and ecosystem diversity.

Overall, there is a need to:

- Manage the risk of large, high severity wildfires by maintaining an open stand structure that prevents crown fires and by minimizing fuel loads, especially ladder fuels;
- Maintain a healthy forest that supports diverse plants and wildlife that may be resident on the property, may migrate through seasonally, or may use the property in concert with the surrounding forest lands;
- Establish a process and standards for avoiding wildfire ignition and effectively suppressing wildfire threatening the life, property, and facilities of NOFS and its neighbors; and,
- Participate in prescribed burning with neighbors to maintain a low risk of high-severity wildfire if consistent with protecting mission-related operations.

1.3 Decision to be Made

The decision to be made as a result of the analysis in this EA is to decide if an Environmental Impact Statement (EIS) is needed. An EIS will need to be prepared if it is anticipated that the Proposed Action would have significant impacts on the human or natural environment. Should an EIS be deemed unnecessary, an alternative action from this EA would be selected for implementation. The selection of this alternative would be documented in a Finding of No Significant Impact (FONSI).

1.4 Environmental Issues of the Proposed Action

Environmental resources potentially affected by the alternatives and evaluated in detail in this EA include: topography geology, and soil resources; hydrology and water quality; air quality; climate change; biological resources; and safety and environmental health. See Chapter 3 for analysis of the alternatives' impacts on these resources.

1.5 Resource Areas not Carried Forward for Detailed Analysis

The following resource areas do not warrant detailed analysis in this EA. It is anticipated that there would be no effects, or only minor effects, to these resource areas upon implementation of the alternatives.

Land Use. Current land use at NOFS is restricted primarily to the developed areas. The primary functions of the facilities at NOFS are to make astronomical observations required by DoN for navigation and communication purposes. On-the-ground activity does not occur in the undeveloped portions of NOFS. Emphasis is on maintaining a sufficient buffer of minimally-disturbed forested land around the main operations area to minimize light reflectance and pollution (“dark sky” conditions) needed for maximum effectiveness of the telescopes. However, specific management prescriptions within the forested areas are important for the Observatory’s proper functioning. Consequently, timber stands directly surrounding the Observatory are kept denser than the surrounding forest. The undeveloped area around NOFS is also essential for providing a buffer from encroaching development, which may produce excessive light and reduce visibility. Alternatively, a forest thinning plan is currently being implemented to address forest health issues and reduce fire hazard.

Land adjacent to NOFS is owned by the state of Arizona, the U.S. Department of Agriculture (managed by the United States Forest Service [USFS]), or is privately owned (See Map 1-1). Northern Arizona University (NAU) manages an experimental forest, Centennial Forest, adjacent to NOFS. General zoning in the area is one residence for every 10 acres (four ha).

Implementation of the Proposed Action, Alternative 2, or No Action Alternative would not change any land use patterns or land ownership in the area. Observatory land would remain in the DoN inventory; therefore, there would be no impact to land use on the NOFS.

Public Facilities and Access Recreation. NOFS does not currently have a public access and recreation program or the facilities and personnel to support one. The capability for a program is limited for several reasons: the lack of dedicated security to monitor public use; the sensitivity of telescope instrumentation to disturbance that could increase from public access; and the lack of freshwater available for onsite use. The Observatory is located on DoN property, and access is restricted to government employees and NOFS staff.

Although NOFS is not open to general public use, school field trips may be arranged and conducted onsite. There are also numerous dirt roads that allow access to the property, and periodically NOFS staff finds evidence of a camp. The site manager believes it is important to maintaining the property’s astronomical mission to close all dirt roads by blocking or fencing.

Because public access to the facilities is strictly limited, no impacts to public facilities or public access to recreation would occur under the alternatives.

Socioeconomics and Environmental Justice. Over the past decades, the population growth in northern Arizona, including Coconino County and the city of Flagstaff, has increased at a relatively rapid rate. The population figures and estimates show that growth in the city of Flagstaff has grown parallel to that of Coconino County. The availability of less expensive land on the outskirts of Flagstaff tends to attract population growth in the unincorporated area.

Offsetting this is the difficulty in obtaining services, especially water, which attracts growth within the urban service boundary.

Population – The total population of the city of Flagstaff is 63,505 according to 2008 census data estimates. Approximately 26 percent of the population is of a minority race and approximately 8.7 percent of families in Flagstaff live below the poverty level (U.S. Census Bureau webpage, accessed 02 November 2010).

Housing patterns – Multifamily units have been increasing in Flagstaff for some time. Recently, gated communities have arisen on Flagstaff's outskirts. In general, there is an adequate supply of housing in the area, with the city experiencing about a 12.6 percent housing vacancy rate (U.S. Census Bureau 2008).

Employment – Flagstaff is the center of both the regional northern Arizona and the local economy, with about 100,000 people doing business in the city. Leading sectors of the economy are government, education, tourism, services, and wholesale/retail trade. Government alone accounts for about 9,000 jobs, including NAU, USFS, National Park Service, the state of Arizona, and local government. A substantial proportion of employment is attributable to the tourist industry. Approximately 22 persons are employed by NOFS.

Implementation of the alternatives would have minimal to no effects on socioeconomic resources. The actions would occur entirely on NOFS lands. Because no low-income or minority communities exist at the project location, these communities would not be disproportionately affected with implementation of any alternative.

Aesthetics. As with any question involving beauty, that of forest aesthetics may be viewed from several perspectives. The common, but very limited, public view of DoN property is from a distance. From a distance this affords a vista of evergreen and deciduous trees and light to moderate topographic relief. Overall, it presents a rather "natural" scene. The handful of drop-in tours conducted each year is to visit the telescope, not to view the forest.

Adjustments to the viewshed from any of the alternatives include landscaping, invasive species control, and treatment of forest fuels. The treated areas for forest fuels would be away from public viewsheds and, ultimately, would result in an improved viewshed as timber is thinned and cleared, resulting in a healthier forest. Landscaping and invasive species control would also result in improved aesthetics in the developed areas. Therefore, the effect on aesthetics is anticipated to be minor, yet positive, for any alternative.

Utilities

Water – There are no groundwater sources at NOFS and the property lies outside of Flagstaff's municipal water boundary. Consequently, the facility's water is trucked onto NOFS by a private contractor and stored in tanks. The water trucked in usually originates from groundwater collected in pipes from within the local watershed. At each of two storage sites, there are two tanks; one tank is for domestic supply and the other is for fire protection.

Sewage and solid waste – Sanitary sewage produced by the restrooms is managed by a septic tank with a subsoil drainage system. Sewage is transported via two sewer lines. All solid waste is collected and taken offsite.

Electricity – Electricity is obtained from Arizona Public Service. Above- and underground distribution lines carry the electricity across NOFS. Emergency power lights and the 61-inch (155-centimeter [cm]) telescope, and its associated equipment in Building 4, are powered by a 40-kilovolt propane generator. Propane is used for heating Building 1. An aboveground power line cuts through part of the property on the north slope. A cleared right-of-way runs along this power line.

Telephone – Telephone service is provided to all buildings by U.S. West via overhead lines. Equipment is rented from AT&T. A low power, line-of-sight laser system provides computer network communications between the three main building complexes.

The areas impacted by forest fuels treatment would not take place near aboveground utility lines, water tanks, or sewer lines (which are contained within the developed area of NOFS), so there is no threat of damage. Any forest fuels treatment would be completed within the accepted distance from the power line and safety measures would be taken to remain out of the right-of-way. Potable water onsite would not be used for safety measures or project activity.

Transportation. Only one access road leads onto NOFS from adjacent USFS land. This paved road runs from Interstate 40 (I-40), and access onto NOFS is by a Special Use Permit from the USFS. The access road runs approximately 4/5 of a mile from I-40 and enters NOFS on the east boundary. From there it branches off to buildings to the north, east, and west. Prior to reaching NOFS, the road is maintained by the county of Coconino, with DoN maintaining the road on NOFS. The county of Coconino plows the snow on NOFS in exchange for use of the NOFS turnaround area. Black cinders, not salt or chemicals, are dropped by the county for traction during the winter.

There are no circulation problems and there is adequate parking for each building on NOFS. However, there is concern about the numerous dirt roads that allow access to the property from lands managed by the USFS or state of Arizona. These roads are not maintained as that would encourage trespass onto NOFS lands.

The treated areas would be conducted in forested lands away from public roads and highways or would involve very minor use of roads; therefore, there would be no impacts to transportation and circulation with implementation of either alternative.

Cultural Resources. Compliance with Section 106 of the National Historic Preservation Act (NHPA) for the NOFS INRMP is accomplished through conformance with the 36 Code of Federal Regulations (CFR) § 800 process and is the responsibility of NAFEC. The potential for effects to historic properties for the NOFS INRMP and any future and emergent implementation projects are to be considered on an individual basis as separate undertakings and require review by authorized NAFEC Cultural Resources personnel. Pursuant to 36 CFR § 800, such efforts include determining: (1) the area of potential effect (APE); (2) the identification of historic properties within the APE; and, (3) the effect to historic properties within the APE. Each determination requires consultation with the Arizona State Historic Preservation Office (SHPO) and all relevant Native American tribes.

In 2001, NOFS completed an intensive archaeological survey of its entire property and funded an evaluation of its older buildings and telescopes. Archeological surveys did not identify any eligible historic properties within the APE. However, the telescopes within the Observatory have been designated in the National Register of Historic Places (NRHP). Although cultural resources that are sacred or possess religious and cultural significance are not on NOFS property, many tribes do consider various peaks in the surrounding region to be sacred and of religious/cultural significance.

In compliance with Section 106 of the NHPA, consultation was initiated on August 22, 2011 with the Arizona SHPO and all relevant Native American tribes on a Finding of No Historic Properties Affected.

Implementation of the alternatives would not result in any impact to cultural resources; therefore, this category is not carried forward for detailed analysis.

Noise. The nature of land use and the isolated location of NOFS make it a relatively quiet place. Traffic levels are low and concentrated during commuting hours of the staff, with some activity at night when the telescope is in use. The dome occasionally makes a low rumbling sound when it rotates. Proximity to I-40 and railroad tracks allows distant, fairly constant freeway noise and periodic loud train disturbance.

Noise-sensitive receptors include those persons who occupy areas where noise is an important element of the environment. Such areas include residential dwellings, mobile homes, hotels, hospitals, nursing homes, education facilities, and libraries. In addition, noise-sensitive receptors may also include wildlife species, such as migratory birds, that rely on vocalizations for communication. Although exposure to high noise levels has been demonstrated to cause hearing loss, the principal human responses to environmental noise are annoyance and stress.

The noises associated with the Proposed Action, Alternative 2, and No Action Alternative are from fire management activities and small construction projects. Noises from these activities would be generated from mechanical equipment, motor vehicles, human traffic, and combustion of fuels materials. Machinery used and the amount of noise produced while performing specific fire or fuel management activities varies by the location of the activity (e.g. different equipment is used in wilderness than along road corridors).

Human noise receptors are few on NOFS; however, wildlife species may be present that are sensitive to noise. Any noises are anticipated to be short-term and only during daylight hours. Fire management activities conducted inside the Protected Activity Center (PAC) would be conducted outside Mexican spotted owl (*Strix occidentalis lucida*) (MSO) breeding season to avoid disturbance; all other fire management activities are also recommended to occur outside wildlife breeding seasons.

Any noise impacts to resources are expected to be minor and have no significant impacts; therefore, this category is not carried forward for analysis.

1.6 Intergovernmental Coordination

Interagency cooperation contributed to the development of the revised INRMP. As required by the SAIA, participation by the DoD, DoN, U.S. Fish and Wildlife Service (USFWS), and Arizona Game and Fish Department (AZGFD) ensures the mutual agreement among these parties concerning conservation, protection, and management of resources on NOFS. Signatures from the representative agencies are solicited on the INRMP; in addition, the INRMP and EA were provided for public comment.

This EA has been prepared pursuant to the following:

- NEPA of 1969 (42 U.S. Code [USC] §§ 4321-4370);
- Council on Environmental Quality (CEQ) Regulations (40 CFR 1500-1508); and,
- U.S. Department of the Navy Procedures for Implementing NEPA (32 CFR § 775), as described in the Chief of Naval Operations Instructions (OPNAVINST) 5090.1C.

The NEPA requires consideration of potential impacts to the environment in the decision-making process for federal actions. Council on Environmental Quality regulations implement the "action forcing" provisions of NEPA to ensure that federal agencies comply with NEPA. The OPNAVINST 5090.1C provides specific guidance for the DoN in preparing environmental documentation for proposed actions subject to NEPA.

In preparing this EA, the DoN has taken the following legal authorities into account:

- Archeological Resources Protection Act of 1979, 16 USC §§ 470aa-470mm;
- Clean Air Act (CAA), as amended, 2 USC §§ 7401-7671p, including 1990 General Conformity Rule;
- Clean Water Act (CWA), 33 USC §§ 1251-1387;
- Endangered Species Act (ESA), 16 USC §§ 1531-1544;
- Magnuson-Stevens Fishery Conservation and Management Act, 16 USC §§ 1801-1882;
- Migratory Bird Treaty Act (MBTA), 16 USC §§ 703-712;
- NHPA, 16 USC §§ 470-470x-6;
- SAIA (16 USC §§ 670a-670o, 74 Stat. 1052), as amended;
- Executive Order (EO) 11990 - Protection of Wetlands, 24 May 1977;
- EO 11988 – Floodplain Management, 24 May 1977;
- EO 12148 – Federal Emergency Management, 20 July 1979;
- EO 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, 11 February 1994;
- EO 13045 – Protection of Children from Environmental Health Risks and Safety Risks, 23 April 1997;

- EO 13112 – Invasive Species, 03 February 1999;
- EO 13101 – Greening the Government through Waste Prevention, Recycling, and Federal Acquisition, 14 September 1998;
- EO 13123 – Greening the Government through Energy Efficient Management, 03 June 1999;
- EO 13148 – Greening the Government through Leadership in Environmental Management, 21 April 2000;
- EO 13186 – Responsibility of Federal Agencies to Protect Migratory Birds, 11 January 2001; and,
- EO 13514 – Federal Leadership in Environmental, Energy and Economic Performance, 05 October 2009.

1.7 Organization of the Document

This EA is organized as follows: Chapter 1 defines the purpose and need for the Proposed Action. Chapter 2 describes the three alternatives. Chapter 3 describes the affected environment and presents the potential environmental effects of the three alternatives. Chapter 4 examines the cumulative impacts of the three alternatives. Chapter 5 addresses various other considerations required by NEPA. This is followed by chapters on the list of preparers and their qualifications, persons and agencies contacted, and references.

1.8 Public Involvement

The Navy published a Notice of Availability (NOA) of the Draft EA for three consecutive days (August 26-28, 2011) in the Arizona Daily Sun newspaper that described the Proposed Action, solicited public input, and announced that the Draft EA was made available for public review at the Flagstaff City-Coconino County Public Library for 30 days. The EA was made available in for review in the Flagstaff City-Coconino County Public Library for 30 days from August 26, 2011-September 24, 2011. No public comments were received during the 30-day comment period. A NOA of the Final EA and FONSI will also be published in the Arizona Daily Sun newspaper and be available for public review at the Flagstaff City-Coconino County Public Library. Copies of the EA in CD-ROM format were made available to any interested parties upon request.

2.0 Proposed Action and Alternatives

The *CEQ Regulations for Implementing the Procedural Provisions of NEPA* establishes a number of policies for federal agencies, including "using the NEPA process to identify and assess the reasonable alternatives to the proposed action that will avoid or minimize negative effects of these actions on the quality of the human environment" (40 CFR 1500.2 [e]). This chapter describes the three alternatives and their potential impacts on the human and natural environment.

The range of reasonable alternatives for this EA was identified by evaluating the ability to meet the purpose and need for action and the ability to meet certain criteria (OPNAVINST 5090.1C). To be considered reasonable, an alternative must be consistent with these criteria:

- Compatibility with the mission of NOFS. The NOFS serves as an observing station for the USNO based in Washington, D.C., and the mission of NOFS is to analyze and interpret astrometric and photometric dark sky observations. To be considered reasonable, an alternative must be compatible with telescope operations, must sustain a dark sky, and maintain low levels of smoke, pollen, and dust;
- Low risk of harm. To be considered reasonable, an alternative must have a low risk of harm to human health and safety and the overall ecological health of the forest; and,
- Demonstrate biological soundness for forest health and species management. An alternative must be considered biologically sound with respect to addressing key concerns identified in the INRMP, such as maintaining habitat conditions to support the MSO and other species that are the focus of management, as well as protecting soil, water, cultural, and other resources.

2.1 Alternatives

2.1.1 Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with the Optional Use of Prescribed Fire in Landscape Patches

The Proposed Action would implement the 2011 Revised INRMP. This INRMP revision would continue to be consistent with the military use of the property and the goals and objectives established in the SAIA, while providing further improvement in natural resources management. Within the Proposed Action the four management objectives for NOFS laid out in the 2001 original INRMP (forest management, fish and wildlife management, land management, and outdoor recreation) would be carried forward. The objectives from the original INRMP, as described in Section 2.1.3, would remain the same, except for particular aspects of the forest management strategies. A new Biological Opinion (BO) is currently being drawn up by the USFWS in consultation with NAFEC that will cover operations, including thinning and clearing criteria for forest management, maintenance, and natural resources management actions described in the INRMP. The Proposed Action would add prescribed fire as the primary forest fuel management tool, as well as add the following eight resource management strategies:

1. Conduct new studies and surveys;
2. Rearrange encroachment planning priorities to set a higher priority on lighting and other issues that affect the dark, clear sky needed for nighttime astronomic observation;

3. Develop and implement measures to reduce the carbon footprint of routine operations and maintenance;
4. Develop and implement measures to control invasive species;
5. Implement erosion control measures;
6. Develop and implement measures to control point and non-point sources of water pollution;
7. Develop and implement new monitoring priorities for forest health; and,
8. Encourage participation in regional and interagency partnerships.

Specific activities related to the four resource management objectives that are different from or in addition to the 2001 original INRMP include:

1. Forest Management

a) Restoration

- Utilize prescribed fire rather than herbicides as part of the pre-planting site treatment in areas where reforestation might occur. Prescribed fire could be used to clear areas of heavy grass and/or brush that compete with reforested seedlings.

2. Fish and Wildlife Management

- Support a big game corridor study with agency partners; and,
- Support an oak/snag study with agency partners.

3. Land Management

a) Fire Management

Preventing catastrophic, stand-replacing wildfires that threaten facilities and existing forest cover is of paramount concern to NOFS. This is because of the threat that accumulated fuels and catastrophic wildfires could pose to the integrity of the property and astrometric equipment. The recently completed timber thinning program addressed this fire risk and forest health, but this relatively fire-safe condition needs to be maintained. To address the situation, this alternative proposes to:

- Ensure the necessary assets are available to suppress wildfires that start or are threatening the NOFS property or their neighbors;
- Ensure that all management tools, including prescribed burning in patches collectively totaling as much as 40 acres (16 ha) per year, are available to NOFS to achieve forest health and other INRMP objectives;
- Reduce the fuel load; improve understory structure and condition; and enhance the amount, distribution, and nutritional value of wildlife forage plants with prescribed fire, as necessary;
- Create a mosaic of understory/litter ages across the DoN property in order to maintain a healthy forest that supports diverse plants and wildlife that may be resident on the

property, may migrate through seasonally, or may use the property in concert with the surrounding forest lands; and,

- Conduct vegetation thinning using mechanical means, as outlined in the 2011 Revised INRMP and the new BO, when conditions are not appropriate for prescribed fire.

Consistent with the forest management objective, the most significant component of the Proposed Action would be to implement prescribed burning at NOFS. Prescribed burning would be used only as necessary, primarily to reduce the fuel load for wildfire protection. It would also be used to improve understory structure and condition and to enhance the amount, distribution, and nutritional value of wildlife forage plants. Under the Proposed Action, the Navy would burn up to 40 acres (16 ha) per year, which may consist of up to five separate burn plots (Map 2-1) consisting of “like stand-types.” The burn plots would be identified, selected, and ignited depending on weather, topography, fuel loading, fuel condition, and other criteria such as base operations, budgets, and logistical constraints within the Navy and its cooperating entities. Burning may not be conducted every year, but possibly every other year, creating a 14-year cycle; or on an as needed basis depending upon the amount, condition, and location of fuel concerns.

One criterion for prescribed burning in the presence of oaks in the forest surrounding NOFS would be to prevent scorching oak root crowns and boles. Prior to any prescribed burn, particular care would be given to assure that oak stems/boles/canopies are protected to the extent practicable and consistent with the use of prescribed burning. Because the oaks are an essential species of forest composition, the conditions for their survival, growth, and canopy development would be enhanced. Protection for oaks may involve active measures such as pulling leaf litter away from close proximity to the oaks; initiating burns when moisture conditions would preclude ignition of oak leaf litter near the stem; or scraping fuel breaks around clumps of oaks. Burning would occur when there is sufficient understory vegetation (grasses and forbs) to carry a wildfire in an efficient and effective manner without deleterious intensity or duration.

Prescribed burning always carries some degree of risk for a fire escape, typically resulting from unforeseen factors such as adverse changes in weather. Federal and land management agencies conduct 4,000-5,000 prescribed fires annually, only one percent of which escape or are near misses (Dether 2005). (A near-miss event is defined as an unintentional unsafe occurrence that could have resulted in an injury, fatality, or property damage. Only a fortunate break in the chain of events prevented an injury, fatality, or damage.) Escaped fires have occurred in the vicinity of NOFS, such as a recently reported fire that burned onto NOFS land (Section 4.2). Once escaped, these prescribed burns are referred to as wildland fires and may have the same beneficial or adverse effects as an unintentional wildland fire.

To minimize the risk of fire escape, all prescribed burning requires that a burn plan be developed and approved by the state of Arizona Department of Environmental Quality (ADEQ) prior to ignition. All prescribed burn plans contain measurable objectives, a predetermined prescription, and a contingency plan to be implemented in the event the fire escapes. All appropriate safety and control mechanisms are factored in to every burn plan. A prescribed fire is then approved only under specific conditions, depending upon available resources, time of year, weather, and desired results. Only an experienced leader and crew should be used for implementing prescribed fires.

b) Wetlands/Riparian Areas

- Establish and maintain appropriate buffering of jurisdictional waters and wetlands of the U.S. that occur on the property. No tree cutting in drainages is anticipated;
- Control point and non-point sources of water pollution on the property; and,
- Avoid the use of pesticides or herbicides in a manner that contributes to water pollution.

4. Outdoor Recreation

Recommendations for additional recreation opportunities for the 22 people currently staffed at NOFS include:

- Develop a natural resources interpretive kiosk and display adjacent to the main parking lot; and,
- Provide interpretive material about local habitats, plants, and wildlife with brochures and a field guide for wildlife viewing.

2.1.2 Alternative 2 – Implement the 2011 Revised INRMP using Mechanical Methods Only

All management strategies in this alternative would be the same as in the Proposed Action with the exception that prescribed fires would not be conducted (Map 2-2). The overall goal is to manage forest health, achieve INRMP goals and objectives, and protect NOFS facilities from the threat of wildfire. Instead of prescribed fire, brush and fuel material on the forest floor would be cut down, collected and removed from the area using mechanized equipment such as chain saws. Non-mechanized hand tools would also be used and no more than 40 acres would be treated annually.

2.1.3 Alternative 3: No Action Alternative – Continued Implementation of the 2001 INRMP

The most important natural resources issues addressed in the 2001 INRMP are: sensitive wildlife management, erosion control, sustainable timber management, and forest fuels management to reduce the risk of stand-replacing wildfire. Erosion is a concern on NOFS because of its steep topography. Timber management must balance fire hazard control and the density of timber preferred by the MSO and other sensitive wildlife species.

The No Action Alternative would continue implementation of the objectives and practices outlined in the 2001 INRMP and EA (Map 2-3). The No Action Alternative would retain all elements of the 2001 INRMP that address the four resource management objectives that guide planning. These elements include:

1. Forest Management

The continued forest management objectives at NOFS would be to: (1) support the military mission by thinning pine stands and maintaining continuous forest cover that minimizes fuel loading, risk of stand-replacing wildfire, and reflectivity of light that interferes with telescope operation; (2) maintain the timber stands in a healthy, productive condition with a reduced number of pines per acre, increase tree and stand vigor, and enhance structural diversity of both pines and oaks; (3) support the military mission by maintaining land availability, use options, and soil stability along access roads; (4) preserve the stands with particular attention to those seeming to have the greatest future potential for MSO habitat; and, (5) integrate forest management with other natural resource disciplines and programs to protect natural resources attributes associated with the forested acreage on NOFS.

Thinning criteria would follow guidelines laid out in the existing 2001 INRMP. A balance between fire hazard reduction and control with habitat enhancement for MSO is achieved through these guidelines, which specify size, spatial distance, diameter at breast height (DBH), species, and ages of trees to be thinned. Forest management objectives outlined in the No Action Alternative include:

a) Timber Management Program

- Promote structural diversity, protect endangered species habitat, and ensure water quality;
- Monitor microhabitat plots, update forest inventory, survey for disease and insect infestation, and prepare management plan revisions;
- Utilize sanitation or salvage logging if conditions warrant, such as natural wind throw, deadfall, pest infestation/outbreak, landslide, or wildfire;
- Leave large pines and oaks that succumb to natural causes on the forest floor as large organic debris to the maximum practicable extent;
- Protect snags and downed large organic debris. In addition, trees deemed unique or of special interest for wildlife, such as advanced second growth specimens, isolated relict old growth, trees with large limbs or cavities, or less prevalent species, would be protected in any service contracts and field marked with signs or paint prior to advertisement of the contract;
- Place crushed rock on existing roads to stabilize or develop temporary haul spurs, if necessary, to implement silviculture treatments. Develop haul spurs using old grades where possible. Where these do not exist or present unacceptable risks, new spurs would be created by meandering between leave trees;
- Treat logging slash, the residual scrap tops, limbs, and non-merchantable logs after thinning by lopping and scattering or piling or windrowing. Concentrations of slash will be removed to a minimum of 25 feet (eight meters [m]) from roads and structures;
- Allow spot treatments involving herbicide, hand grubbing around leave trees, and burning slash piles associated with timber thinning and mechanical clearing;
- Allow forest or understory treatment to respond to the change in the forest conditions that have resulted from thinning activities since the 2001 INRMP;
- Evaluate and protect cultural sites or artifacts if discovered;
- Periodically remove or trim trees naturally encroaching on the roads; and,
- Remove or trim individual trees to remove obstructions to the telescopes.

b) Restoration

- Provide for reforestation as necessary in open areas apparently unforested since the 1950s. In areas of heavy grass and/or brush competition, spot application of herbicides could be used as part of the pre-planting site treatment. All herbicide applications would comply with DoD requirements, as described in DoD Instruction (USDoDINST) 4150.7, which establishes the DoD Pest Management Program;
- Reforest cleared areas or fully stock deficient stands with hand-planted conifer seedlings planted on 16-foot (five-m) centers. Hand planting is more expensive than seeding, but affords more rapid and dependable stand establishment and may provide a positive influence on stand species composition and structure. Some planting areas could involve site preparation at each planting spot; and,
- Evaluate the desirability of planting natives for understory enhancement and, if desirable, revegetate the understory to reduce light reflectance and enhance the prey base for the MSO by providing habitat for prey and control erosion.

2. Fish and Wildlife Management

- Focus the fish and wildlife management under the 2001 INRMP on baseline inventories and ongoing trend monitoring in relation to the timber management program. Integrate with results of botanical surveys and weather effects. Management-focus species include cavity-nesting birds and other species identified in the Arizona Wildlife Action Plan;
- Continue bird surveys at point count stations and monitor the Breeding Bird Survey route for the property;
- Trap feral cats and submit them to the local animal control officer;
- Periodically conduct small mammal surveys to track trends in the prey base of MSO and other raptors;
- Compare the results of microhabitat monitoring for the MSO with other plant and animal surveys; and,
- Leave some naturally downed logs undisturbed on the forest floor, unless inadvertently moved as part of the logging process, to provide habitat for wildlife, including small mammals, salamanders, insects, and other arthropods.

a) Mexican Spotted Owl

No changes are proposed to the timber management/removal program that might be inconsistent with prior evaluations for MSO recovery. The objectives include:

- Manage the NOFS forest that lies within the Dry Lake PAC in accordance with federal law, regulation, and EOs in order to provide a direct benefit to the species and to recovery efforts;
- Conduct selective cut thinning consistent with the conditions in the existing 2001 INRMP; thinning is aimed at actively promoting more desirable native forest structure and composition; and,

- Conduct pre- and post-thinning microhabitat monitoring to ascertain effects on the owl and its habitat.

3. Land Management

- Conduct a botanical inventory for potential existence of rare plants (currently none are known on the property) and invasive weeds;
- Track weather data and relate to results of resource monitoring;
- Use aerial photography of the property at 1:12,000 scale every three to five years in conjunction with ground-based plant surveys to characterize forest densities and habitat characteristics and monitor other management issues such as erosion; and,
- Keep a cumulative map and record of surveys and findings on sensitive species in order to enhance understanding of their needs and status.

a) Erosion Control

- Evaluate the area south of the transit telescope for remedial treatments to restore and stabilize the soil surface, profile, and vegetative cover. Treatment may include straw mulch incorporated into the soil with fertilizer (and gypsum if the pH needs adjustment), broadcast grass seed, and cover with jute netting;
- Minimize trees cut in drainages, selectively thinning for only necessary fire control or sanitation and salvage logging;
- Establish buffer strips to protect drainages from damage by forestry operations;
- Use logging slash in some cases to reduce, trap, or repair historic erosion;
- If needed, create small detention swales in areas of high runoff to capture water on roads or skid trails in order to keep runoff onsite; and,
- Develop or use proven Best Management Practices (BMPs) for controlling soil erosion from construction and landscaping sites.

b) Landscaping

- Use drought-tolerant native plants in all landscaping. Construction contracts would include, as appropriate, specifications for these plants and proper invasive species control in disturbed soil; and,
- Monitor and control invasives in and around the buildings and other areas of the property.

c) Invasives

- Implement dedicated monitoring and eradication programs for invasives beginning with surveys to identify and map all infestations on the property;
- Prioritize treatment areas based on known aggressiveness of invasives, the extent of infestation, and the threat risk to native plants and animals;
- Target bindweed (*Convolvulus arvensis*) and other invasives for control in the disturbed soil around the new construction site at the main building and mullein (*Verbascum thapsus*) around other buildings;

- Coordinate timing of invasive control near the property boundary with adjacent landowners and managers to achieve maximum control and minimize cross-boundary reinvasions;
- Include contingencies for removing invasives as they appear and for implementing new control measures as they become available in restoration, construction, and mitigation plans;
- Conduct programs in order to provide the least possible disturbance to native species and communities; and,
- Monitor invasive weeds and those that have the potential to become noxious by remapping every three to five years.

d) Fire Management

- Prevent catastrophic, stand-replacing wildfires that threaten facilities and existing forest cover. This is of paramount concern to NOFS because of the threat accumulated fuels and catastrophic wildfires would pose to the integrity of the property and astrometric equipment;
- Ensure the necessary assets are available to suppress wildfires that start or threaten the NOFS property or their neighbors;
- Formalize a Mutual Assistance Agreement between and the city of Flagstaff, USFS, and other partners as appropriate for fire suppression activities; and,
- Utilize spot application of herbicides in areas of heavy grass and/or brush competition as part of the pre-planting site treatment. Duff around large or snag oaks and pines would be scraped or lined to protect the trees from fire.

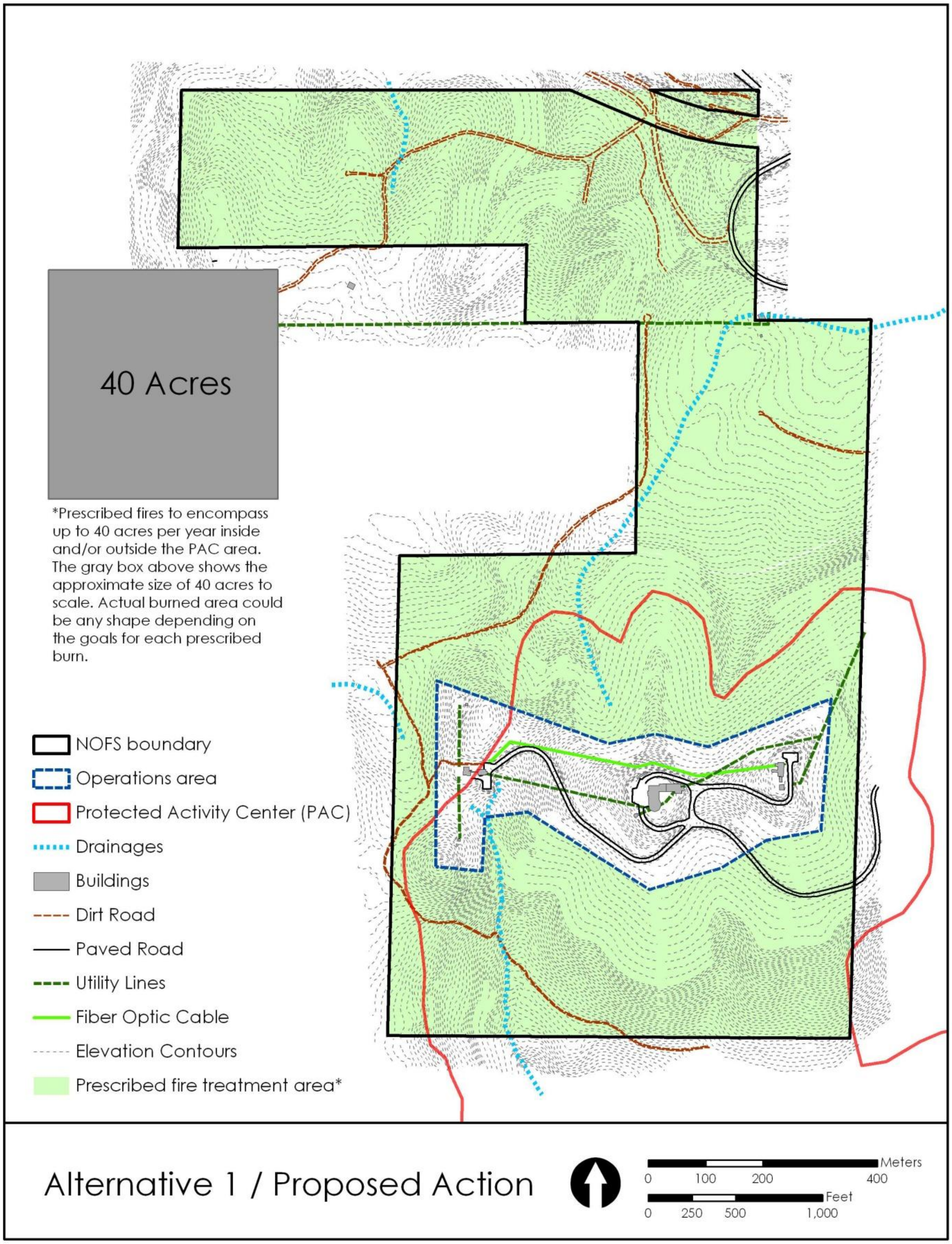
e) Wetlands/Riparian Areas

- Selectively log and buffer with leave trees around wetlands and drainages in areas of severe slopes. (At the time of the 2001 INRMP, jurisdictional waters or wetlands of the U.S. were not known on the property. A 2003 wetland delineation determined that jurisdictional waters are located on NOFS [see Section 3.1.2 for more information]; therefore, management needs to be updated to reflect this.)

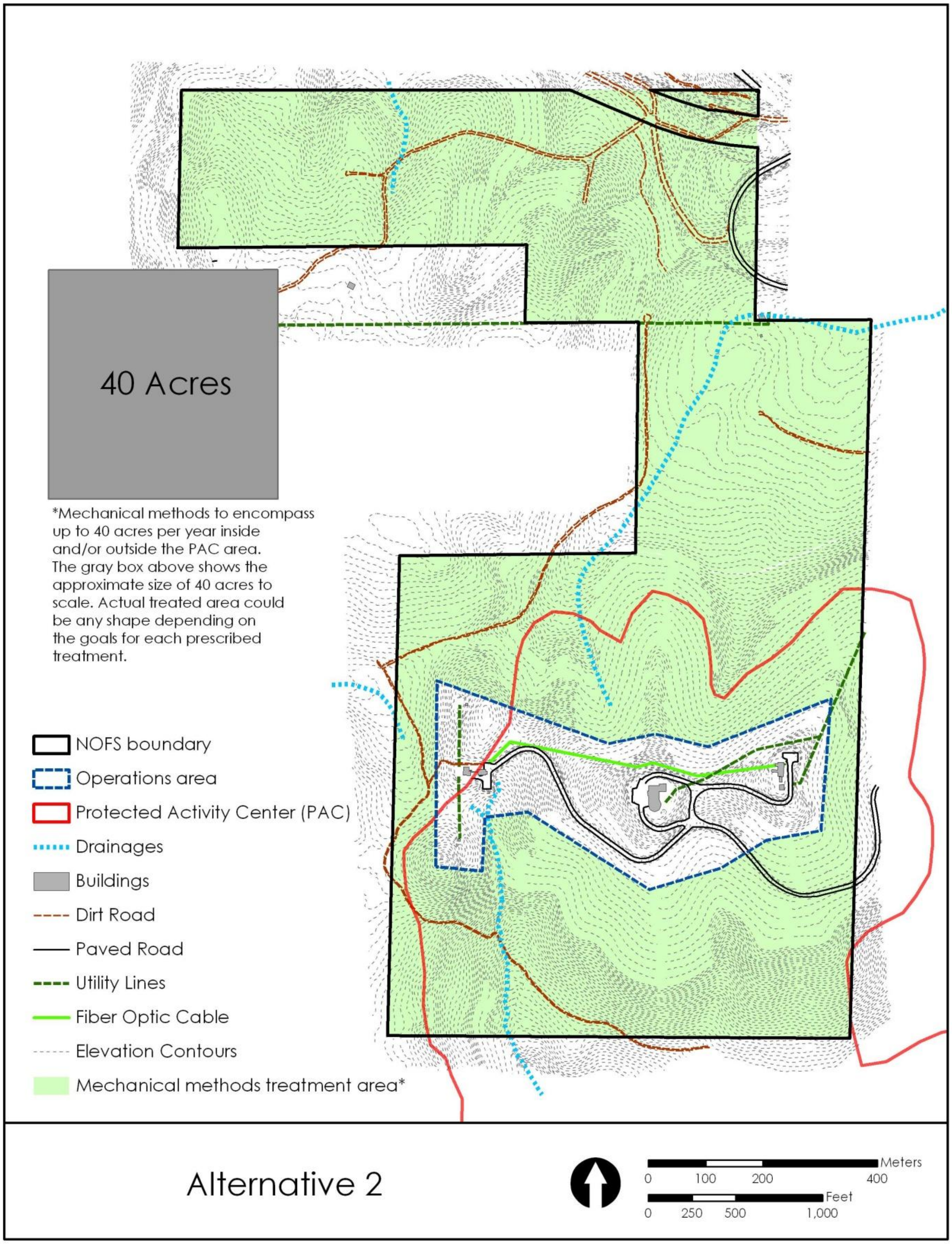
4. Outdoor Recreation

Staff recreation is an encouraged component of all INRMPs as described in OPNAVINST 5090.1C. Recommendations in the 2001 INRMP for additional recreation opportunities for the 22 people currently staffed at NOFS include:

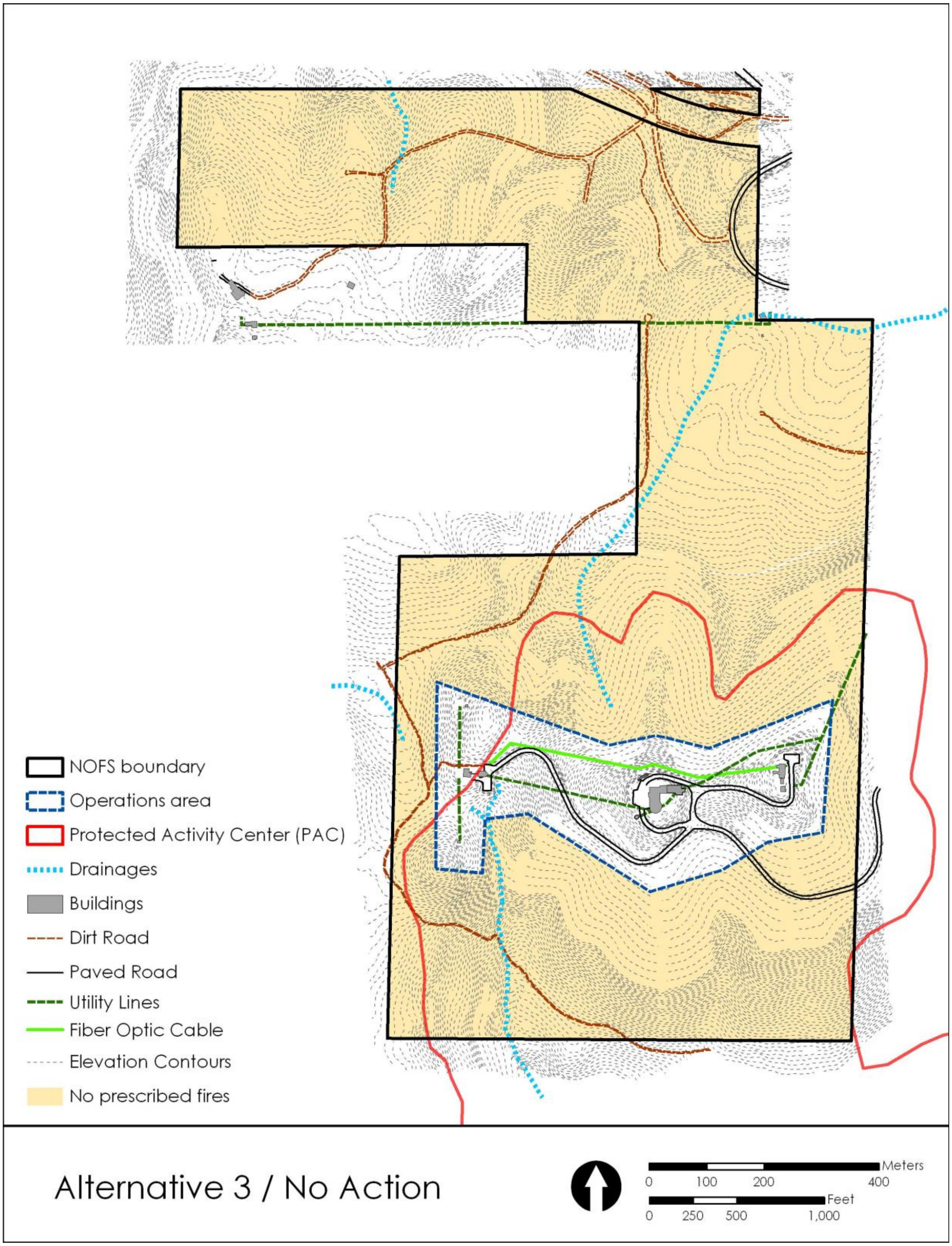
- Construct a volleyball court on the south side of the interferometer building near the new patio, adjacent to the old telescope building; and,
- Provide interpretive material about local habitats, plants, and wildlife with brochures and a field guide for wildlife viewing.



Map 2-1. Locations of management actions at Naval Observatory Flagstaff Station under the Proposed Action to implement the 2011 Revised Integrated Natural Resources Management Plan.



Map 2-2 Locations of management actions at Naval Observatory Flagstaff Station under Alternative 2 to implement the 2011 Revised Integrated Natural Resources Management Plan.



Map 2-3. Locations of management actions at Naval Observatory Flagstaff Station under the No Action Alternative (2001 INRMP).

2.1.4 Environmental Protection Measures

Table 2-1. Description of the protection measures for potentially impacted resources for the alternatives.

Resource	Alternative 1 – Proposed Action	Alternative 2	Alternative 3 – No Action Alternative
Air Quality	File annual Burn Plan and submit Burn Request to Arizona Department of Environmental Quality. Obtain necessary permits and approval. File post-burn Accomplishment Report.	Check wind direction and speed. Avoid clearing during windy conditions.	Check wind direction and speed. Avoid thinning activities on windy days. Follow thinning procedures as appropriate. Same as Proposed Action for pile burns.
Biological Resources	Follow guidelines from 2011 Revised INRMP, 2011 informal USFWS consultation letter and new BO. Avoid burning during breeding season. Avoid burning on steep slopes. Minimize size/heat of prescribed fire. Roll mulch away from oaks. Utilize drought-tolerant and native species in landscaping.	Avoid clearing during breeding season. Minimize patch size. Roll mulch away from oaks. Utilize drought-tolerant and native species in landscaping.	Follow guidelines from existing 2001 INRMP.
Topography, Geology and Soil Resources	Minimize patch size and heat of fire. Avoid removing all groundcover. Avoid heavy equipment for firebreaks and clearing. Minimize traffic on wet ground. Maintain vehicles/equipment and fuel in developed areas.	Minimize patch size for treatment. Limit treatment on steep slopes. Avoid removing all groundcover. Avoid heavy equipment for clearing. Maintain equipment and fuel use away from project site.	Same as Proposed Action.
Hydrology and Water Quality	Buffer streams. Avoid burning in steeper draws. Limited and careful use of fire retardants. Minimize pesticide and herbicide use. Follow Pesticide Management Plan.	Buffer streams. Avoid thinning in steeper draws. Minimize pesticide and herbicide use. Follow Pesticide Management Plan.	Follow guidelines from existing 2001 INRMP.
Safety and Environmental Health	Follow Prescribed Burn Plan, Accident Prevention Plan and Pesticide Management Plan.	Follow Accident Prevention Plan and Pesticide Management Plan.	Same as Proposed Action.

2.2 Alternatives Considered but Not Carried Forward for Detailed Analysis

2.2.1 Outdoor Recreation Emphasis Alternative

Although exploring expanded recreational opportunities is an integral part of the legislation and direction for INRMPs, an outdoor recreation emphasis alternative was not carried forward for detailed analysis because there was no recognizable demand due to many acres of similar forested lands adjacent to the project area. The Observatory offers nothing unique compared to adjacent lands. There are also substantial security and liability concerns with enhanced public access for recreation. Public access is restricted because there are no dedicated security personnel for the property and because the telescope instrumentation is sensitive to radio interference, smoke, and light that could arise from greater public use of the property.

2.2.2 Mexican Spotted Owl Emphasis Alternative

Another alternative considered but not carried forward in this EA was to manage the property for the MSO alone. Tree spacing considered desirable for the MSO is a mosaic of different densities. The MSO requires areas of high density for nesting and lower density for foraging. The variable tree densities pose particular problems for the Observatory in terms of lighting and potential wildfire. While the MSO might find suitable habitat at NOFS, emphasizing management for MSO alone is incompatible with the military mission at NOFS.

The Observatory has many encroachment concerns within a five-mile radius of its property related to night lighting that affect telescope viewing. NOFS staff vigilantly monitor local and regional land use proposals due to this concern. Within a mosaic of diverse tree densities, some areas would also be more open (which the owl might use for foraging) and result in tree spacing that is too great to control reflectance. Additionally, some areas (especially those used for nesting) have a high density of trees that could result in hazardous forest fuel conditions and greater potential for catastrophic wildfires. Dense pine areas on NOFS are in steep drainages that lead directly to structures and are considered a primary path for wildfire toward NOFS structures. Stand-replacing wildfire is the primary threat to the MSO (USFWS 1995), as well as to the Observatory and its neighbors. With increased habitat loss and fragmentation, owls have fewer choices of relocation areas after a stand-replacing wildfire. This alternative was not carried forward because of its impact on the military mission and on fire control objectives. A reasonable alternative allows for forest management that controls light reflectance and potential wildfire, while continuing to maintain habitat conditions for MSO and other dependent species.

2.2.3 Forest Openings Alternative

This alternative proposed creating patch cuts of one-quarter to one-half acre in size in order to enhance habitat value for MSO, elk (*Cervus elaphus nelsoni*), and Merriam’s turkey (*Meleagris gallopavo merriami*). This alternative was not carried forward for several reasons:

- Forest openings could create light reflectance, which may affect operation of the telescopes;
- Forest thinning for fuels management would take place consistent with the current guidelines, and post-thinning habitat values should be evaluated before any new tree cutting takes place. The microhabitat monitoring for MSO habitat values currently occurring in compliance with the guidelines could be used to assess enhancement potential for the MSO and for other species before any patch cuts could be created;
- Elk and Merriam’s turkey, neither federally-listed species, already occur on the property, and it is believed there are sufficient openings for their benefit. For instance, there are seven acres of grassland openings on the property; and,
- The next revision of the INRMP would be a more appropriate opportunity to consider habitat enhancement because, at that time, the results of the thinning with respect to wildlife values would be better understood.

2.3 Summary of Potential Resource Impacts

Table 2-2. Potential resource impacts by alternative.

Resources Potentially Affected	Alternative 1: Proposed Action – Implement 2011 Revised INRMP with Prescribed Fire in Landscape Patches	Alternative 2: Implement 2011 Revised INRMP using Mechanical Methods Only	Alternative 3: No Action Alternative – Retain 2001 INRMP
Air Quality	Short-term emissions from smoke and ash. Decreased potential in emissions from stand-replacing wildfire.	Short-term emissions from mechanical equipment and dust from clearing. Decreased short-term potential in emissions from stand-replacing wildfire. Long-term increased potential for pollutant emissions from organic matter and debris during a stand-replacing wildfire.	Continued short-term emissions from mechanical equipment, dust from clearing, and smoke and ash from pile burns. Increased potential for emissions from forest fuels in a stand-replacing wildfire.
Biological Resources	Short-term disturbance and loss of habitat. Decreased potential for severe disturbance during breeding and nesting season from stand-replacing wildfire. Long-term improvement of habitat. Decreased potential habitat loss from stand-replacing wildfire.	Short-term disturbance and loss of habitat. Decreased potential for severe disturbance during breeding and nesting season from stand-replacing wildfire. Long-term benefits from improved habitat. Decreased short-term potential habitat loss from stand-replacing wildfire. Long-term increased potential habitat loss from stand-replacing wildfire.	Same as Alternative 2.
Climate Change	Short-term release of carbon and greenhouse gas (GHG) emissions. Long-term resiliency to climate change. Decreased potential for GHGs release from stand-replacing wildfire.	Short-term release of carbon and GHGs. Potentially improves long-term resiliency to climate change. Reduces short-term potential for a stand-replacing wildfire that would release significantly more GHGs and carbon and would take decades to replace. Remaining organic matter and debris increases long-term potential for stand-replacing wildfire, thus contributing to GHG release and climate change.	Same as Alternative 2.

Resources Potentially Affected	Alternative 1: Proposed Action – Implement 2011 Revised INRMP with Prescribed Fire in Landscape Patches	Alternative 2: Implement 2011 Revised INRMP using Mechanical Methods Only	Alternative 3: No Action Alternative – Retain 2001 INRMP
Topography, Geology and Soil Resources	Short-term mobilization of nutrients. Increased erosion potential before new growth stabilizes. Decreased potential for burning and severe erosion from stand-replacing wildfire.	Compaction, ruts and potential erosion from foot traffic and equipment. Decreased short-term potential for burning and severe erosion from stand-replacing wildfire. Increased long-term potential for burning and severe erosion from stand-replacing wildfire due to remaining forest fuels.	Continued compaction and ruts from foot traffic and equipment. Continued localized disturbance from burn piles. Continued increased erosion potential before new growth stabilizes. Continued decreased short-term potential for burning and severe erosion from stand-replacing wildfire. Increased long-term potential for burning and severe erosion from stand-replacing wildfire due to remaining forest fuels.
Hydrology and Water Quality	Short-term small sediment load from ash, soil, debris and fire retardants/accelerators. Long-term protection from riparian buffers. Decreased potential for sediment load and loss of riparian buffers from stand-replacing wildfire.	Short-term small sediment load from soil and debris and fire retardants. Decreased short-term potential for high sediment load and loss of riparian buffers from stand-replacing wildfire. Increased long-term potential for high sediment load and loss of riparian buffers from stand-replacing wildfire.	Same as Alternative 2.
Safety and Environmental Health	Short-term potential for injuries or fatalities of firefighters, buildings, and NOFS staff. Reduced threats to public safety from stand-replacing wildfire.	Short-term potential for injury to work crews. Reduced short-term threats to public safety from stand-replacing wildfire. Increased long-term threats for potential injury to clearing crews from stand-replacing wildfire.	Continued short-term potential for injury to clearing crews. Continued short-term reduced threats to public safety from stand-replacing wildfire. Increased long-term threats for potential injury to clearing crews from stand-replacing wildfire.

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3.0 Affected Environment and Environmental Effects

This chapter presents the existing environment of NOFS and potential environmental effects of the Proposed Action, Alternative 2, and the No Action Alternative on resources. Table 3-1 presents the human and natural environmental elements that have the potential to be impacted by the alternatives. Only those resources that may be affected are carried forth in the impacts analysis. This chapter is broken down by affected resource areas with the direct and indirect impacts of each of the three alternatives described. The type of impact describes a relative measure of beneficial or negative effects on biological or physical systems.

Table 3-1. Critical elements of the affected environment and potential effects.

Resource	Rationale
Air Quality	Smoke and particles would be created from prescribed, pile, and broadcast fires; dust and debris would be created from mechanical clearing.
Biological Resources	Prescribed burns would be in MSO habitat and PAC, and non-listed wildlife habitat would be disturbed/altered by fires and clearing.
Climate Change	Prescribed, pile, and broadcast fires and mechanical clearing would release small amounts of carbon and emit greenhouse gases into the atmosphere and would alter the forests resiliency and carbon contribution to potential climate change.
Topography, Geology and Soil Resources	Burning and mechanical clearing could cause soil disturbance. High heat, large patches, or fire in steep terrain could cause water repellent layers and/or erosion. Work crews would create paths and trample soil surface.
Hydrology and Water Quality	Sedimentation from soil run-off could increase turbidity; fire retardants/accelerants could contaminate waters.
Public Services	Local police and firefighters could be utilized as crews and safety measures for implementing prescribed burns.
Safety and Environmental Health	Crews would be using fire, hand, and mechanical tools. No hazardous materials exist in the wildland area. Anti-terrorism/force protection would not be required.

3.1 Physical/Natural Environment

3.1.1 Topography, Geology, and Soils

The NOFS is located at 7,305 feet to 7,575 feet (2,226 m to 2,309 m) above sea level on the Colorado Plateau. The Colorado Plateau extends from northern Arizona into western Colorado, northwestern New Mexico, and southern and eastern Utah. The Mogollon Rim is a rugged escarpment that forms the southern limit of the Colorado Plateau. This escarpment was formed by the uniform erosion back from a monocline that formed over a fault running through the region approximately 15 to 20 million years ago. Since then, the layers of rock have been eroded fairly uniformly northeastward, intensifying the escarpment.

This region is intersected by a considerable network of minor faults. The Oak Creek Fault is located less than a quarter mile from NOFS, about 700 feet (213 m) west of the western boundary. It has been classified as inactive; however, any future development should be located at a minimum of 50–100 feet (15–30 m) on either side of the fault line.

The soils of the site are mostly basaltic, cinders, benmorite residuum, or alluvium due to the volcanic history of the area. Brolliar-Sponsellar is the primary soil type, which is typically found on the high basaltic and volcanic plateaus of the area (DoN 1987). The soils are reddish brown, moderately deep, and fine textured clays mixed with stony clays. There is a severe erosion hazard on the steeper slopes. Most of the site is limited by low soil strength, which affects movement across it and risks soil damage when wet. Some areas are limited by shrink-swell clays or excessive stones or cobbles. All of the soil types on DoN property are rated for a 65 percent potential canopy cover of ponderosa pine (*Pinus ponderosa*).

The NOFS property is mostly hilly with various telescopes perched atop the highest ridge. Elevation ranges from 7,305 feet to 7,575 feet (2,226 m to 2,309 m) at Building 1. The hills have relatively steep sides with slopes generally ranging from 20 percent to over 40 percent, which restricts future development to the tops of the knolls or the ridgelines between the knolls.

3.1.1.1 Impacts on Topography, Geology, and Soil Resources

Impacts can manifest themselves in changes in a soil's physical, chemical, and biological properties. These impacts may alter soil structure, thus changing moisture retention and holding capacity; as a result, soils may develop water repellency and the potential for erosion losses. Biological effects include changes in nutrient pools and cycling rates; atmospheric loss of or retention of elements; reduction or increase of soil organic matter; alteration of microbial species, invertebrates, and population dynamics; and partial elimination (through decomposition) of plant roots. On a steeply-sloped area, altered soils, such as those from severe fires or vegetation removal, present a severe erosion hazard. In addition, most of the area has low soil strength, which limits traffic and risks soil damage when wet.

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) Effects of prescribed burning on topography, geology, and soil resources – Prescribed burning can affect soil resources through the reduction of coarse woody debris, damage to soil physical structure, and damage to soil biological features. The effects from fire are directly related to fire intensity. The general rule of thumb is that the greater the burn intensity, the greater the amount of damage to forest soils (Neary *et al*. 2005). Severe fire-damaged slopes present a severe erosion hazard.

   Yet prescribed fire can also provide positive effects through nutrient flushes from the burn (Covington and Debano 1990). This increase in nutrients is short-lived due to rapid biological and chemical immobilization of released nutrients.

   The Proposed Action would offer an overall benefit to soils because it allows for burns under more controlled conditions and places management controls on fire size, severity, and return interval. These controls also directly limit soil erosion potential. Prescribed fire provides alternatives for minimizing damage to soils. Cool-burning fire impacts are considered minor and short-term (Neary *et al.* 2005). Burning of concentrated or dense fuels can result in soil damage that is long-term and moderate because of localized, intense heat. To protect soils, such fires need to be small and the sites isolated from water sources. The Proposed Action also would result in better fire management that would limit fire size and severity, the effect of which would vary by soil and fuel moisture regimes and fuels distribution. Duff/litter portions of the prescribed burn would have the least negative effect on soil properties while allowing for nutrient release over a one to two year period.

The majority of the prescribed burning activity would be in the duff/litter portion, creating a short-term positive affect from soil nutrient increases. Burning larger material would increase the risk of negative effects to soil properties as the size of material burned increases, which increases fire intensity. Prescribed burning fuel treatments on acres that have been thinned, as well as maintenance burning on previously un-thinned sites, would be expected to produce a varying intensity of burns with a majority of the burned area having a low to moderate burn intensity. A small percentage of the prescribed burns would be expected to have a high intensity burn due to fuel arrangements.

Effects to soil resources from burning would be minimized with the implementation of the following BMPs:

- Design prescribed burns to minimize soil temperatures, thus maintaining soil health and productivity;
- Implement low-fuel fuel break zones to prevent soil degradation or changing hydrologic processes so that these areas remain sufficiently vegetated to provide protective soil cover;
- Use retardants to restrict the ability of fires to burn across large areas to reduce erosion and sedimentation that often results from wildfires so that its use is beneficial in the long term; and,
- Implement Minimum Impact Suppression Tactics. Suppression tactics involving off-road vehicles that impact soils should be generally avoided to avoid soil compaction.

Impacts to topography, geology, and soil resources under the Proposed Action from the use of prescribed fire would be both negative (in the short-term) and positive (in the short- and long-term), yet minimal. The use of prescribed burning allows for greater control of forest fuels, and in the long term minimizes possibility of damage to soils from a high intensity wildfire. With the implementation of soil management BMPs within the Proposed Action, impacts from prescribed fire would not be significant.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the original 2001 INRMP EA and FONSI. The effects and finding of no significant impact on topography, geology, and soil resources would remain the same (See 4.1.1 of 2001 INRMP EA).

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

There would be some soil disturbance from brush cutting activities and the treatment of vegetation during the brush and fuel removal work. Increased soil compaction and possibly erosion could result from heavy equipment and foot traffic during treatments. However, BMPs would be implemented to minimize impacts on soil resources. The accumulation of ground cover and forest litter as a result of this alternative would continue to allow for greater possibility of long-term damage to soils from a high intensity wildfire.

All other elements in this alternative have only been slightly modified from those previously analyzed in the original 2001 INRMP EA and FONSI (See 4.1.1 of 2001 INRMP EA).

Therefore, implementation of this alternative would not result in significant impacts to topography, geology, and soil resources.

Alternative 3: No Action Alternative – Continued Implementation of 2001 INRMP

The No Action Alternative would continue to have a long-term positive effect on the soils of NOFS. The 2001 original INRMP establishes objectives that would help to protect and restore soil productivity and nutrient functioning through the use of BMPs to prevent and control soil erosion. Soil erosion and compaction caused by thinning activities would continue to be minimized through:

- Requiring the continued use of BMPs during management activities;
- Continued restriction of forestry procedures using rubber-tired vehicles or draft horses or mules;
- Allowing slash piles and scattered slash to continue to decay naturally in the soil; and,
- Continued maintenance of slope stability by requiring future salvage patch cuts on slopes over 15 percent to be less than five acres in size with some individual trees left and no adjacent parcels patch cut until regeneration has reached an average height of 14 feet (4 m). (However, patch cutting is a worst case scenario and is not anticipated during the life of this plan.)

The accumulation of ground cover and forest litter as a result of this alternative would continue to allow for greater possibility of long-term damage to soils from a high intensity wildfire.

The use of pile burning would have short-term negative and positive impacts on soil. Pile burns typically burn with high intensity, removing organic cover and breaking down soil structure, thus exposing the soil to erosion. At the same time, fire releases nutrients locked up into soil, thus increasing soil productivity for the short-term. However, these affects are very localized, occurring just beneath and along the perimeter of the pile. The use of BMPs would continue to minimize impacts to soil resources. These include:

- Continue to minimize the use of pile burning throughout NOFS forest; avoid on steeper slopes;
- Continue to form hand piles rather than machine piles;
- Continued pile burning when large diameter fuels, duff, and soil moisture is higher; and,
- Continue to ensure that some groundcover remains post-burn.

The No Action Alternative is anticipated to have some direct negative impacts and largely direct and indirect positive impacts to soil resources; however, with the use of BMPs and erosion control practices, these impacts would not be significant.

3.1.2 Hydrology and Water Quality

The area around Flagstaff receives a relatively large amount of precipitation for the state of Arizona. Annual precipitation averages 22 inches (56 cm), most of it in the form of snow. Although the amount of precipitation in Flagstaff is high, the ample porosity of the surface rocks allows the precipitation to seep into the soil and minimizes the amount of runoff.

NOFS lies within the Verde River watershed, containing primarily ephemeral streams. Oak Creek is the only perennial stream nearby, located several miles to the southeast of the property. A 2003 wetland delineation (Tierra Data Inc. 2004) identified one jurisdictional wetland, located in the northeast corner of the property, and several stream segments that are classified as jurisdictional waters of the U.S. because they drain into the Verde River via Oak Creek and eventually into the Colorado River.

3.1.2.1 Impacts on Hydrology and Water Resources

The protection of wetlands is facilitated through CWA, Section 401; EO 11990, Protection of Wetlands; and the "no net loss" goal outlined by the White House Office on Environmental Policy in 1993. Executive Order 11990 requires that leadership be provided by involved agencies to minimize the destruction, loss, or degradation of wetlands. Directors Order 77-1 and Procedural Manual 77-1 provide the procedural structure in which EO 11990 may be implemented.

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) Effects of prescribed fire on hydrology and water quality – Direct effects to water quality under the Proposed Action could include soil, sediment, ash, and debris produced through ground disturbance and high intensity burns filtering into waterways. Any flame retardants or flame accelerants not fully dissipated may also enter waterways. Ground disturbance from foot and vehicular traffic or burn areas has the potential to produce detached sediments (soil particles that become separated from the soil surface) or ash that could filter into waterways. The disturbance would occur on a maximum of 40 acres (16 ha), in smaller patch sizes, annually. Detached sediments or pollutants from an even smaller number of the maximum of treated acres have the potential to filter into waterways. However, the implementation of these BMPs would greatly reduce the amount of sediment or pollutants entering waters:

- Fire retardant or Class A foams should not be applied within 100 feet (30 m) of a centerline of a watercourse. Since effects of retardants are short-term, they are considered unlikely to negatively affect species. Keep retardant and herbicide lines from canyons and from water sources of any kind;
- Designate buffer strips to minimize sediment entering waterways;
- Identify wetlands for avoidance by vehicles and equipment;
- Follow erosion control methods (3.1.1.1) to minimize creating sediment;
- Limit the patch sizes of prescribed burns on slopes with greater than 25 percent slopes; and,
- Buffer vegetated slopes that drain into jurisdictional waters.

The potential of high intensity wildfire would be decreased through the Proposed Action, therefore, indirectly decreasing the risks of a larger amount of sediments and pollutants from a wildfire entering watercourses.

With the use of BMPs, the extent of sediments entering waterways would be minimal, especially due to the small size of fires and on sloped areas. Impacts to water and hydrologic resources under the Proposed Action would not be significant.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the original 2001 INRMP EA and FONSI. The effects and finding of no significant impact on hydrology and water quality would remain the same (See 4.1.2 of 2001 INRMP EA).

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

Implementation of this alternative would result in a small amount of soil disturbance from the brush cutting activities and the treatment of vegetation during the brush and fuel removal work. This soil disturbance would occur on a maximum of 40 acres (16 ha) annually, in small patches, and has the potential to produce detached soil sediments. These detached soil sediments, however, would be relatively small in volume and would not be likely to pollute waterways. To avoid the potential of detached sediments filtering into waterways, thinning in drainages is not anticipated and erosion control practices would be required during thinning (Chapter 4). The build-up of debris and organic matter on the forest floor after mechanical treatment would increase the long-term potential of a stand-replacing wildfire, thus increasing the potential for negative impacts to waterways from sediment, ash, and debris. All other elements in this alternative have only been slightly modified from those previously analyzed in the original 2001 INRMP EA and FONSI (See 4.1.2 of 2001 INRMP); therefore, there would be no significant impacts from this alternative to water and hydrological resources.

Alternative 3: No Action Alternative – Continued Implementation of 2001 INRMP

Continued implementation of the No Action Alternative would have potentially short-term negative effects and possible overall long-term positive effects on the water resources on NOFS. The 2001 original INRMP recommends water conservation practices and erosion control procedures to protect the drainages of NOFS from sedimentation, which could alter hydrological functioning and potentially affect downstream water users. The presence of roads, especially dirt roads that are not properly graded or drained, can affect hydrologic functioning. Consequently, water quality could be impacted by forest thinning activities if sediment from haul roads, from areas cleared of vegetation by forestry practices, and from pile burns is allowed to erode into nearby water bodies. However, erosion control practices are required during thinning as described (Section 3.1.1.1) and would minimize any impacts on water quality. In addition, restricting access to dirt roads leading onto the property would control some erosion that results from their illegal use and would reduce the proliferation of new roads and trails. Finally, DoN policy on the use of natives and drought tolerant species in landscaping provides for both water conservation and minimal use of fertilizers that may leave the site in runoff water. Besides strategies mentioned above, the 2001 original INRMP recommends to:

- Reduce use of water for landscaping while continuing to provide a quality working environment to NOFS personnel;
- Reduce water waste and use drought-tolerant plants as appropriate;
- Investigate the possibility of using reclaimed water or collected natural rainfall for irrigation; and,
- Use selective cutting and buffers in riparian areas and treat erosion problems before they become problematic.

While forest management activities could have short-term direct impacts on water resources at NOFS, the use of BMPs and additional water management practices outlined in the No Action Alternative would not result in significant impacts to water resources.

3.1.3 Air Quality and Climate Change

The location of the Observatory was originally chosen for its clean air and high visibility for the telescopes. Smoke from forest fires, both prescribed and wildfires, and dust from unpaved forest roads are the primary air pollution concerns around NOFS. Rapid growth in the region also increases air and light pollution, smoke from fireplaces, and auto emissions, all of which individually and collectively threaten the integrity of the telescopes and mission at NOFS. Working with the local community and landowners/managers to minimize encroachment and maintain high standards locally of air quality and reduced lighting are of paramount interest and concern to NOFS.

The U.S. Environmental Protection Agency (EPA) has established primary and secondary National Ambient Air Quality Standards (NAAQS) for six “criteria” pollutants (carbon monoxide [CO], nitrogen dioxide [NO_2], particulate matter, ozone, sulfur dioxide [SO_2], and lead). Primary standards are adopted to protect public health, and secondary standards are adopted to protect public welfare. States are required to adopt ambient air quality standards that are at least as stringent as the federal NAAQS; however, the state standards may be more stringent. The ADEQ has adopted the federal NAAQS as shown in Table 3-2 (http://www.azdeq.gov/environ/air/index.html accessed 13 January 2011).

Naval Observatory Flagstaff Station is located within the Verde River airshed and is on the border with the Little Colorado River airshed. The closest air monitoring station to NOFS is in the city of Flagstaff. The Flagstaff area is in attainment for all NAAQS as measured by the ADEQ. Prevailing winds are predominately south-southwest and southwest in all months but November and December when the winds shift east-northeast (Western Regional Climate Center accessed 03 November 2010).

Because air quality still remains relatively good in the area, currently only the level of particulates less than ten microns in diameter (PM_{10}) is monitored in Flagstaff. No violations of the PM_{10} standards have been recorded at the monitoring station in Flagstaff.

Table 3-2. Summary of Arizona and Federal Ambient Air Quality Standards. Standards are not to be exceeded more than once per year with three exceptions – ozone, PM_{10}, $PM_{2.5}$. See footnote for details.

Pollutant	**Average Time**	**Primary**[a]	**Secondary**[b]
Carbon monoxide (CO)	1-hour 8-hour	35 ppm 9 ppm	None
Nitrogen dioxide (NO_2)	Quarterly average	1.5 µg/m^3	Same as primary
Ozone[c]	8-hour	0.075 ppm	Same as primary
PM_{10} [d]	24-hour	150 µg/m^3	Same as primary
Particulate matter 2.5 microns in diameters ($PM_{2.5}$) [e]	24-hour Annual	35 µg/m^3 15 µg/m^3	Same as primary
Sulfur Dioxide (SO_2)	1-hour 24-hour Annual	75 ppb 0.14 ppm 0.03 ppm	None 0.5 ppm 3-hour 0.5 ppm 3-hour
Lead	Quarterly average	0.15 µg/m^3	0.15 µg/m^3

[a] Primary standards are adopted to protect public health. [b] Secondary standards are adopted to protect public welfare. [C] Three-year average of the fourth highest daily maximum eight-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. [d] PM_{10} must not be exceeded greater than once per year on a three-year average. [e] To remain below exceedence for $PM_{2.5}$, the three-year average from one or more community monitors must not exceed this level. Source: http://www.epa.gov/air/criteria.html (01/13/11)

3.1.3.1 Impacts on Air Quality

The smoke and ash created from fires can impact air quality within a region, especially if burning is frequent and intense. The federal CAA stipulates that federal land managers have a responsibility to protect air quality values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from negative air pollution impacts. Air quality would be affected in the short-term during any type of fire. Section 176 of the CAA requires any action on the part of a federal agency in an area considered in nonattainment for air quality standards to conform to the state's efforts to attain and maintain these standards. However, NOFS is located within an attainment area for all air quality standards and, consequently, is exempt from the general conformity analysis.

Fire management activities could potentially affect air quality in either airshed on which NOFS sits from smoke emissions from wildland and prescribed fires. A negative impact would be one that increases emissions or raises pollutant concentrations. It would be considered short-term if it is associated with the duration of a specific fire event and long-term if it continues to occur when threshold natural resource conditions are met.

Criteria pollutants from wildfire include ozone, NO_2, CO, and particulate matter ($PM_{2.5}$ and PM_{10}) (National Wildfire Coordinating Group 2001). The amount of emissions produced during a fire varies widely and is dependent upon fuel type, fire line intensity, fuel moisture, and fire temperature.

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) Effects of prescribed burning on air quality resources – Prescribed burning would generate smoke and airborne particles, thus decreasing air quality on a short-term basis. Impacts may result from two sources: (1) initial entry broadcast burning of the forest floor, and (2) maintenance broadcast burning of the forest floor. Smoke decreases each day after initial burning, but can last for several weeks after ignitions based on fuel moistures and precipitation events. Much of the smoke generated by broadcast burning in the area would move north and east in months with predominant southwest wind direction (January-November).

Quantitative data on the emissions caused by forest burning are not available and instead are analyzed in terms of the potential smoke trajectories. The ADEQ requires minimization of smoke impacts in Class I Areas, roads or highways, airports, areas that are in non-attainment for particulate matter, carbon monoxide non-attainment areas, or other smoke-sensitive areas. Smoke from a fire at NOFS could potentially move into the Sycamore Canyon Wilderness (a Class I Area), the Flagstaff Airport, and across Interstates 40 and 17.

Air quality standards would not be exceeded due to NOFS' procedural adherence to the ADEQ's Smoke Management Plan. All prescribed burns would be approved in advance by the ADEQ to ensure air quality standards are maintained[1], and ADEQ regulates burned acreage per day, per airshed, to comply with current air quality forecasts. Standard smoke management practices, smoke reduction techniques, and Emission Reduction Techniques would be implemented. The burns would be small and localized (<40 acres [16 ha] spread over up to five patches). Per ADEQ regulations, an annual Prescribed Burn Plan would be submitted, and burn requests for each burn would be submitted to and approved by ADEQ.

Although the prescribed burning would create short-term direct negative impacts to air quality, standard smoke management practices, smoke reduction techniques, and ADEQ regulations would be followed to prevent long-term negative impacts. In addition, the Proposed Action would reduce the possibility of negative impacts to air quality due to stand-replacing wildfires. Therefore, the Proposed Action would not result in any significant impacts to air quality.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI. The effects and finding of no significant impact on air quality resources would remain the same (see 4.1.3 of 2001 INRMP EA).

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

The cutting of brush and removal of some fuel from the forest floor would generate a very small amount of air born dust, the impacts of which would be short-term. While mechanical clearing would reduce some potential for a stand-replacing wildfire, this alternative would not clear all organic matter and debris from the forest floor. The remaining fuels, left over the long-term, would increase the potential for pollutant emissions from smoke and ash in a stand-replacing wildfire, which would have negative impacts on air quality. All of the other elements in this alternative have only been slightly modified from those previously analyzed in the 2001 EA (see 4.1.3 of 2001 INRMP EA); therefore, there would be no significant impacts from this alternative to air quality.

[1] The ADEQ models emissions/pollutants from all prescribed burning within the state. Any prescribed burn planned by NOFS must be approved by ADEQ on a daily basis. ADEQ will not allow more acres burned per day, per airshed, than is acceptable with current air quality forecasts.

Alternative 3: No Action Alternative – Continued Implementation of 2001 INRMP

The No Action Alternative outlines routine maintenance activities and small construction projects that would result in minor and insignificant emission increases. The small construction projects, such as construction of gates, water bars, retaining walls, or diversion culverts, are recommended in the INRMP, and project details are not yet defined. The assessment of air quality impacts from small construction projects would be verified once specific designs are proposed. Spot application of herbicides, if determined necessary, would be performed using hand pump and backpack sprayers and would occur in accordance with label instructions. These activities would be minor, temporary, and thus, insignificant to air emissions levels.

Thinning activities would include the use of chainsaws, five days/week for ten weeks over multiple years to cut trees. Daily usage actually amounts to eight hours of operation. This would probably be a sum of two men running chainsaws for four hours each per day to fell, limb, and buck timber. A log skidder (the machine with diesel engine that "yards" or drags logs from the stump to the landing) could be used approximately eight hours each day five days/week for ten weeks to yard logs and pile them on the landing. A log loader would be used for about 30 minutes per truckload of logs.

Existing forest roads would be used for the thinning. Not all roads that would be used are on Navy property, i.e. haul routes will traverse existing roads on contiguous state, federal, and perhaps private lands adjoining the Navy property. This would be done to minimize haul road construction. This would involve about three truckloads per day, four days per week for ten weeks (120 loads total). Each truck haul is expected to last about 30 minutes. The haul roads to be used are located in the southwest corner and southern edge, the western edge, the north-central, and northwestern portions of the Navy property.

The overall emissions of criteria pollutants for forest thinning are estimated in Table 3-3 and represent the most liberal (maximum) estimates. These numbers are relatively small when compared to various relevant (though not applicable) measures. The total emissions of criteria pollutants are below federal major source thresholds and below CAA General Conformity Rule thresholds, which demonstrates that project emissions are insignificant.

Table 3-3. Total estimated emissions for forest thinning activities. Estimates are based upon exhaust emission factors provided by South Coast Air Quality Management District (1993).

Activity	Carbon Monoxide (CO)	Nitrous Oxides (NO_x)	Sulfur Oxides (SO_x)	Particulate Matter (PM_{10})	Reactive Organic Compounds (ROC)
Chainsaw equivalent (8 hrs/day, 5 days/wk, 10 wks)	0.43 tons	0.0004 tons	0.00016 tons	0.00029 tons	0.137 tons
Log skidder equivalent (8 hrs/day, 5 days/wk, 10 wks)	0.00022 tons	0.005 tons	0.0004 tons	0.0003 tons	0.0004 tons
Diesel Wheeled loader equivalent (120 loads, 0.5 hr/load)	0.017 tons	0.057 tons	0.0055 tons	0.0051 tons	0.0069 tons
Trucks: off-highway equivalent (120 loads, 0.5 hr/load)	0.054 tons	0.13 tons	0.014 tons	0.0078 tons	0.0057 tons

In addition to mechanical thinning, pile burning would contribute negative short-term impacts to air quality. Pile burning is a more efficient combustion process that produces fewer emissions than wildfires and initial-entry prescribed burning. Piles can be burned during precipitation events, creating better smoke dispersion and less daytime smoke flowing into the canyons or basins that are prevalent on NOFS. Done properly, pile burning consumes a majority of the fuel before atmospheric cooling begins, thus producing less nocturnal smoke and less residual smoke on the succeeding day (USFS February 2010; USFS September 2010).

The 2003 BO Amendment approved up to 100 slash pile burns per year (USFWS 2003). From 2005-2010 pile burns were used in only two of those years (G. Beale, personal communication [*pers. comm*.], 2011). Pile burns contribute the same pollutants as prescribed fires (see Section 3.1.3.1) with as much variability depending on conditions. However, to minimize impacts, the procedures for conducting the burns as outlined in the Proposed Action would be replicated.

If a stand-reducing wildfire were to occur, which is more likely under this alternative, smoke and other emissions from burnt organic matter and debris would have negative impacts on air quality and human health, and could exceed air quality standards in both volume and duration.

Continued implementation of the No Action Alternative would result in small, direct, short-term impacts to air quality through emissions from mechanical equipment and pile burning. Projects would be small and short-term and ADEQ regulations for burning would be followed; therefore, there would be no significant impacts to air quality.

3.1.3.2 Climate Change

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere. Emissions of these gases occur from human activities and naturally occurring processes. The earth's temperature is affected by the accumulated of GHGs in the atmosphere, and scientific evidence indicates that the trend of increasing global temperatures over the past century is due to human actions that emit GHGs.

The most common GHGs produced from natural and human activities include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Every GHG has an associated global warming potential rating, which is derived from its ability to trap heat in the atmosphere. The rating system is standardized and every GHG is assigned a value against CO_2, which has a value of 1. Total GHG emissions from a source are often expressed as a CO_2 equivalent (CO_2e). The CO_2e is calculated by multiplying the emissions of each GHG by its Global Warming Potential rating and adding the results together to produce a single, combined emissions quantity representing all GHGs.

Federal agencies and states have begun addressing emissions of GHGs through laws and regulations that account for and reduce GHG emissions mandated in federal laws and EOs, including EO 13423 and EO 13514. The DoN is also implementing EO 13123 (Greening the Government through Energy Efficiency) and the Energy Policy Act of 2005, with renewable energy projects being implemented on various installations.

The climate change associated with this global warming is predicted to produce negative environmental, economic, and social consequences across the globe. Predictions of long-term negative environmental impacts due to global warming include: rising sea levels; changing weather patterns with increases in severity of storms and droughts; changes to local and regional ecosystems, including the potential loss and shift of species; and a substantial reduction in winter snow pack. With future climate change in the southwestern U.S., forest structure, health, and species ranges are also expected to change. Increased drying and more extreme drought may become standard. A warmer, dryer climate will lead to more frequent wildfires, possibly more severe wildfires, and a longer fire season in the west (Westerling *et al.* 2006). Changes in species distribution are also anticipated with many forest types predicted to move further north or to higher elevations than their current range.

The potential effects of GHG emissions are large-scale and cumulative as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. Therefore, the impact of the three alternatives on climate change is discussed in Chapter 4, Cumulative Effects, of this EA. The types of emissions expected from prescribed fire are identified in the Air Quality section.

3.1.4 Biological Resources

3.1.4.1 Vegetation

Ponderosa pine forest dominates NOFS property with some meadow swales. Debate continues about the pre-European condition of ponderosa pine forests of the U.S. southwest. This condition likely included a range of natural variability and a mosaic of forest conditions including open, park-like areas such as that shown below (Photo 3-1) and dense clumps of trees. In any case, the condition and structure of the NOFS forest is altered from its natural and pre-European state.

Ponderosa pine accounts for 65 percent of the canopy cover on NOFS (Grinder and Krausman 1998). Gambel oak (*Quercus gambelii*) is interspersed among the pines, most notably on the knoll that supports the primary telescope and facility. Arizona fescue (*Festuca arizonica*) is the most common understory species. Areas of mature pine and larger oaks occur in two drainages north of the main facility.

Fire suppression and modified land use practices with the arrival of European settlement are believed to be the cause of the vegetation change. The resulting NOFS ponderosa pine forest has thickets of sapling-sized pines and duff build-up and lacks diversity in species and stand structure. This develops into a fire hazard because of excessive duff and "ladder" fuels (such as the thickets) and risk of catastrophic losses by severe wildfires that access the forest canopy. Trees eventually become stressed because of their excessive density, and the forest declines in overall health. NOFS property shows some sign of dwarf mistletoe (*Arceuthobium vaginatum*). Dwarf mistletoe is a parasitic plant that can weaken a tree, especially one that is already stressed from drought or other causes. Insects similarly can weaken or kill trees.

The recent history of forest management on NOFS can be surmised from the existing timber stands. The majority of existing trees are about 50 to 180 years old indicating that most of the acreage was harvested prior to Navy acquisition of the property. The subsequent reforestation resulted from natural seeding and coincided with favorable environmental conditions for the establishment of new stands of timber, primarily from ponderosa pine stands on adjacent property. In the absence of periodic fires, naturally established stands of ponderosa pine tend to be very dense, often containing more than 2,000 stems per acre at an early age.

Photo 3-1. Example of open parkland structure of historic southwestern ponderosa pine forest (U.S. Forest Service).

Since the Navy acquired the NOFS property in 1955 until about 2000, there was little active forest management. Ongoing thinning operations in 2001-2010 have resulted in a changed forest structure, with seven categories of prescriptions for the property's forest. This thinning program is analyzed in detail in the 1998 BO along with all Observatory operations for a 10-year period. The 2003 BO Amendment was initiated to increase the number of slash piles burned and to modify forest thinning.

Approximately seven acres (three ha) of NOFS are predominately grassland, presumably formed during timbering operations in the 1930s. Grasses include Arizona fescue (*Festuca* sp.), mountain muhly (*Muhlenbergia montana*), screwleaf muhly (*Muhlenbergia* sp.), pine dropseed (*Sporobulus* sp.), black dropseed (*Sporobulus interruptus*), bottlebrush squirreltail (*Sitanion* sp.), and blue grama (*Bouteloua gracilis*). Other common species are western yarrow (*Achillea lanulosa*), American vetch (*Vicia* sp.), Arizona pea (*Dalea* sp.), and silverstem lupine (*Lupinus* sp.) (Grinder and Krausman 1998).

No protected or special status plants have been identified on the NOFS property although updated botanical surveys specifically for rare plants would confirm this. The Arizona leather flower (*Clematis hirsutissima arizonica*), a federal species of concern, and the Flagstaff pennyroyal (*Hedeoma diffusum*), a USFS sensitive species, are known to occur within five miles of NOFS according to the Arizona Heritage Data Management System (HDMS).

Invasive plants are not well-documented on NOFS. During the 1996–1997 surveys, Grinder and Krausman (1998) did not record invasive weeds for the NOFS property. Ornamental non-natives were confined to the landscaped areas around the facilities. However, subsequent anecdotal observations of invasives as recently as May 2001 indicate they are encroaching on the property, especially along the roadways and in disturbed soil around buildings. Bindweed has established around the newer construction and is of particular concern for its ability to persist and spread, thus out-compete native plants. Mullein was also seen near structures in other areas of the property. Dalmation toadflax (*Linaria dalmatica*) persists along the roadway edges, and Russian olive trees

(*Elaeagnus angustifolia*) are located adjacent to the parking lot or along the access road to two buildings. While a native plant, southwestern dwarf mistletoe can infest ponderosa pine forests and increase the risk of insect outbreaks and wildfire depending on the history of fire suppression and timber cutting practices. Dwarf mistletoe currently has not been identified as a problem in the forest on the property. Other invasives may be discovered during dedicated surveys.

Some plantings take place around buildings as part of post-construction landscaping. Native plants should be used in these plantings per EO 13112.

3.1.4.2 Wildlife

The wildlife found on NOFS is typical of species common to a ponderosa pine vegetation association, especially birds and mammals that use Gambel oak and ponderosa pine snags. Grinder and Krausman (1998) observed four reptile species and 17 bird species. They also trapped five small species of mammals during faunal surveys in 1996 and early 1997. Larger game species that inhabit the local forest and may use the NOFS property in some limited or transitory capacity include black bear (*Ursus americanus*), elk, mule deer (*Odocoileus hemionus*), and Merriam's turkey.

No federally threatened or endangered species have been observed on NOFS. However, a single MSO was identified, probably female, about 328 feet (100 m) south of the southern property line on 28 June 1994. Several Federal Species of Concern or sensitive species recognized by the USFS are known to use the forests in and around Flagstaff but have never been confirmed on the NOFS property. Based on the HDMS, there are four wildlife species of varying degrees of special status known to occur within five miles of NOFS including Northern goshawk (*Accipiter gentilis atricapillus*), Allen's big-eared bat (*Idionycteris phyllotis*), occult little brown bat (*Myotis lucifugus occultus*), and greater western mastiff bat (*Eumops perotis californicus*). In addition, the flammulated owl (*Otus flammeolus*), considered sensitive by the USFS, was observed during the 1996-97 bird surveys on NOFS, and Randall-Parker (1997) reported that this species may breed on the property.

As a result of documented population declines, migratory birds are the subject of an international conservation effort. The MBTA of 1918 protects most species of birds and prohibits the taking or pursuing of migratory birds, their eggs, feathers, or nests. Game birds are listed and protected except where specific seasons, bag limits, and other factors govern their hunting. Exceptions are also made for some nuisance pests, which require a federal depredation permit (e.g. yellow-headed, red-winged, tri-colored, rusty and Brewer's blackbirds, cowbirds, all grackles, crows, magpies, rock doves, European starlings, and house sparrows). The USFWS has overall authority for coordinating and supervising all federal migratory bird management activities, including enforcement of federal migratory bird statutes regulating the taking of protected species (game and nongame) by individuals and federal agencies. All birds identified in Appendix F of the INRMP as confirmed on NOFS are protected under the MBTA.

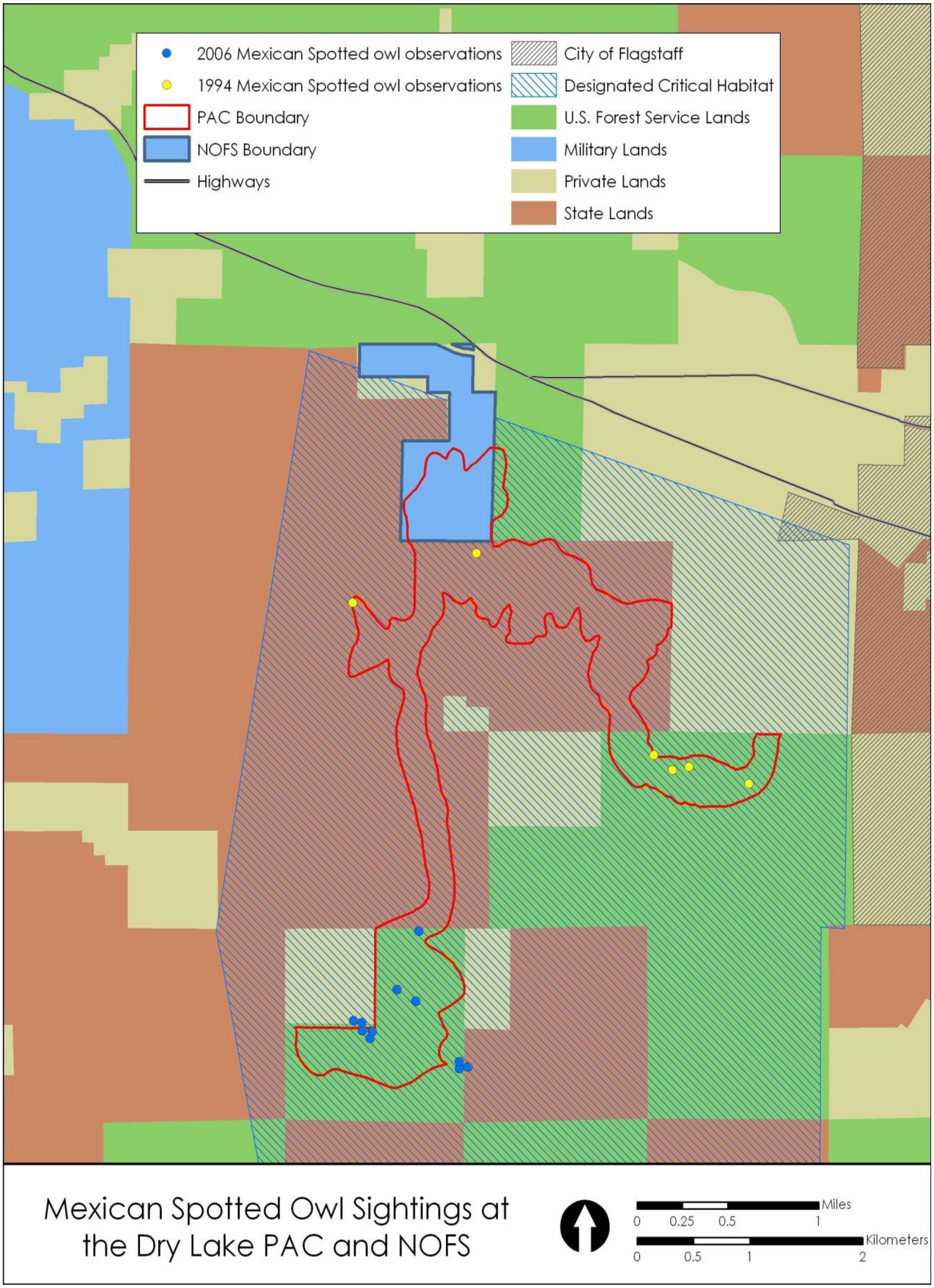
3.1.4.3 Mexican Spotted Owl

NOFS occurs within the Upper Gila Mountain Recovery Unit containing what is believed to be the largest concentration of MSO recorded sightings in the United States. The MSO was federally listed as threatened in 1993 (USFWS 1993) and is considered threatened and a "Wildlife of Special Concern" by the AZGFD. In addition, it was placed on the AZGFD's Identification, Investigation, Acquisition, Protection, and Management list of sensitive species needing further study. The owl is declining in core sections of its range in Arizona (Seamans *et al.* 1999), and the decline may be associated with habitat loss and fragmentation (Franklin *et al.* 1990).

The recovery plan for the MSO provided for three levels of habitat management: protected areas, restricted areas, and other forest or woodland types meeting certain criteria. Protected Activity Centers were designated around known owl sites encompassing an area of at least 600 acres (243 ha) or on average 75% of the foraging area of an owl. Protected habitat for MSOs includes PACs and all areas within mixed conifer or pine-oak types with slopes greater than 40% where timber thinning has not occurred within the past 20 years. Restricted habitat includes mixed conifer forest, pine-oak forest and riparian areas outside of protected habitat (Map 3-1). Other forest and woodland types (ponderosa pine, spruce-fir, pinyon-juniper and aspen) are not expected to provide nesting or roosting habitat for the MSO (except when associated with rock canyons). Although the recovery plan does not provide owl-specific guidelines to manage these areas, the designated areas may provide important foraging and dispersal habitat. They should be managed for landscape diversity, mimicking natural disturbance patterns, incorporating natural variation in stands, and retaining special features such as snags and large trees (USFWS 1995).

All protected and restricted habitat at NOFS was surveyed in 1997, 1999, 2003, 2004, 2006, 2008, 2009, and 2010 (Table 3-4). Since 1994, surveys have been conducted by the Arizona State Lands Department (ASLD), USFS, and the U.S. Geological Survey (USGS)/Southwest Biological Science Center (SBSC) and Colorado Plateau Research Station (CPRS) of NAU. The number of surveys conducted at NOFS and Dry Lake PAC between 1994 and 2010 has been as low as four per season and as high as 24 (Table 3-4). Seasonal (or annual) surveys during the last 15 years have been inconsistent. For example, in 1995 Observatory lands were not surveyed while other areas of the Dry Lake PAC were; in 2000, 2002, 2005 and 2007 no surveys were conducted at either site. As part of NOFS's INRMP and the 1998 NOFS BO, the DoN established guidelines requiring MSO surveys every other year on NOFS lands. See Map 3-1 for MSO observations in the vicinity of NOFS.

Based on these surveys, no MSOs have been observed using NOFS property through the 2010 survey season, with the exception of a sighting of an individual owl on Arizona State Lands immediately adjacent to the southern property line on 28 June 1994 (Pajkos, *pers. comm.*, 1997). However, MSO surveys conducted in 1994 were not well documented and the USFS recorded the only written record of the observation. The USFWS questions the validity of this record and believes that a pair of owls was observed on this visit. Map 3-1 indicates positions of recently recorded observations of MSOs in the vicinity of NOFS; none have been observed since 2006. This and other evidence of owls in the vicinity over time (Table 3-4) led to the designation of the Dry Lake PAC. Portions of the PAC on NOFS property contain some of the densest tree cover and severest slopes (Map 3-2). The Observatory does contain some habitat that is likely suitable for use by the MSO, especially in portions of the PAC with severe slopes. The Final Rule was published on 31 August 2004 designating critical habitat for the MSO. No critical habitat was designated on NOFS lands.



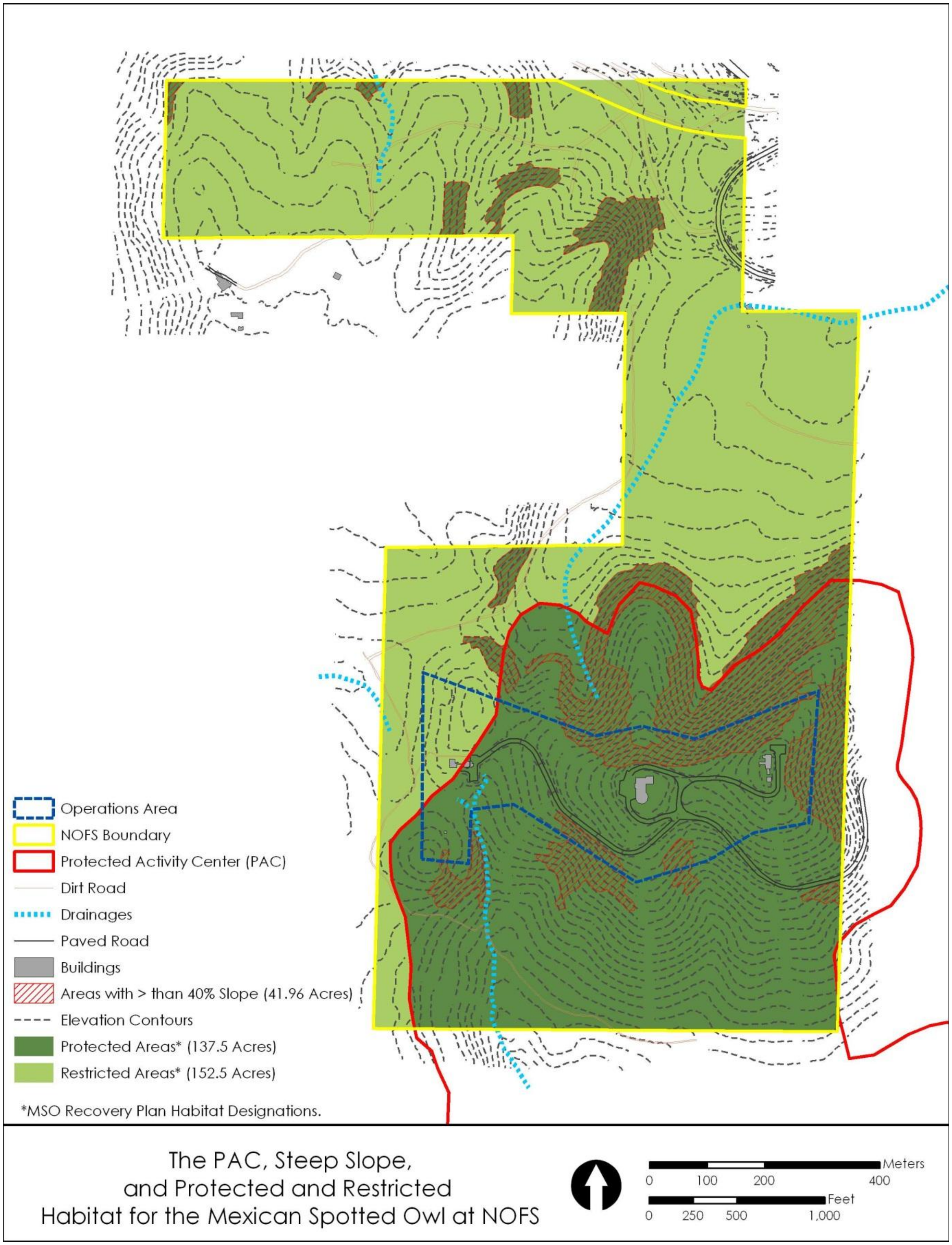
Map 3-1. The Dry Lake Protected Activity Center Mexican spotted owl observations 1990-2010 and property ownership in the vicinity of Naval Observatory Flagstaff Station.

Table 3-4. Mexican spotted owl surveys in the vicinity of the Dry Lake Protected Activity Center.

Year	Surveyor	Sightings by Occupancy Classification	Survey Range	Comments
2010	CPRS-NAU	6/4/10 – Possible detection, very quiet. Follow up daytime visit on 6/8/10 resulted in no detections. 7/1/10 – One MSO response during nighttime visit; MSO did continuous contact whistles. Daytime follow visit resulted in no detections on 7/2/10.	Naval Observatory lands and Dry Lake PAC	14 visits 4/8/10-7/13/10. One MSO detection on Woody Mountain; no nest observed
2009	CPRS-NAU	No MSO detected	Naval Observatory lands and Dry Lake PAC	18 visits 4/20/09-8/30/09
2008	CPRS-NAU	No MSO detected	Dry Lake PAC and NOFS	
2006	U.S. Geological Survey	7/6 - Two MSOs detected during nighttime visit. Follow up daytime visit resulted in no detections on 7/7. 7/8 - Single MSO response, but no response during daytime follow-up visit on 7/9. 8/4 - Two MSOs response during nighttime visit. 8/5 - Two MSOs during daytime follow up visit. 8/17 - Single MSO Response, visually observed three MSOs. No detection on 8/18 daytime follow up visit.	Dry Lake PAC and NOFS	15 nights between 1 March - 31 August. All sightings concentrated on the southern end of the Dry Lake PAC. No detections on NOFS.
2004	USGS	No responses or locations	Dry Lake PAC	March 28 - July 31
2003	USGS	No responses or locations	Dry Lake PAC	March 28 - July 31
2002	Arizona State Lands Department	No responses or locations	Dry Lake PAC	
2001	McGuinn	7/8 Single audio 7/10 Single visual 7/11 No response	Dry Lake PAC	Eastern portion of PAC on USFS and Arizona State Lands. No responses during three 2001 surveys prior to 7/8 response.
Summer 1999	Nagiller[a]	No responses or locations	Dry Lake PAC, with emphasis on Naval Observatory lands	Complete protocol surveys.
Summer 1997	Randall-Parker[b]	No responses or locations		
September 1996	Randall-Parker Grinder[c]	No responses or locations	Dry Lake PAC	Survey late and not a complete season.
Summer 1996	Pajkos[d]	No responses or locations	Dry Lake PAC	Not protocol.

Year	Surveyor	Sightings by Occupancy Classification	Survey Range	Comments
October 1995	Ganey[e]			Radio-telemetered dispersing juvenile flew between south Flagstaff and Navajo Depot.
Summer 1995	Pajkos	No responses or locations	Dry Lake PAC	
Summer 1994	Randall-Parker	Single confirmed: 6/29 Single visual 7/06 Single audio, female 7/14 Single visual 7/19 Single audio, daytime 7/31 Single audio	Dry Lake PAC	
June 1994	Pajkos	6/28 Single confirmed (visual, probably female); probable several other audios same night.	Dry Lake PAC	
Summer 1993	Pajkos Randall-Parker	No responses or locations	Dry Lake PAC	
Summer 1990-1992	Pajkos	No responses or locations	Woody Mountain	

[a] Nagiller, S.J. 2000. 1999 surveys for the Mexican spotted owl in the vicinity of the U.S. Naval Observatory, Flagstaff, Arizona. Prepared under Contract for the U.S. Navy, San Diego, CA.
[b] Randall-Parker, Tammy; U.S. Forest Service. Flagstaff, AZ.
[c] Grinder, Martha; University of Arizona at Tucson, surveyor under contract to U.S. Navy.
[d] Pajkos, Keith; Timber Suspense Program Manager, Arizona State Land Department. Flagstaff, AZ.
[e] Ganey, Joe; U.S. Forest Service Research Station. Flagstaff, AZ.
*Only general information regarding specific survey sites/transects monitored was available. Specific sites/transects monitored on NOFS were not recorded.



Map 3-2. Slopes and Mexican Spotted Owl Recovery Plan Habitat Designations on Naval Observatory Flagstaff Station.

Because of some habitat potential and the fact that NOFS property is part of the Dry Lake PAC, DoN and USFWS have formally consulted under Section 7 of the ESA. The initial 1998 consultation and subsequent 2003 Amendment were initiated for particular proposed construction work and forest thinning to reduce wildfire risk on the property. Measures for operations and forest management specific to the MSO were integrated into the 1998 BO and 2003 BO Amendment. The Terms and Conditions of those two documents mandated that outdoor construction activities be conducted outside of the MSO breeding season (March 1-August 31) to the greatest extent reasonably possible or undergo further consultation with USFWS at the appropriate stage of development. In addition, all thinning operations in the Dry Lake PAC should only be conducted outside the breeding season. An informal consultation for prescribed fires was initiated in 2011. From this, it was determined that prescribed fire may affect, but is not likely to adversely affect any owls. In addition, any prescribed fires planned for the Observatory should follow all of the guidelines specified in the MSO Recovery Plan, specifically burning outside of breeding season and protecting MSO habitat during prescribed burns (USFWS 2011). Monitoring of the project area shall be completed to ascertain harm or harassment to the species. Although it was established in the informal consultation that no additional consultation was required for prescribed burning, additional guidelines for monitoring or forest management relevant to the MSO may be established pursuant to the upcoming BO.

3.1.4.4 Impacts on Biological Resources

The effects of activities on wildlife populations on NOFS could be direct or indirect. Direct effects include injury and mortality due to direct exposure to disturbance. Indirect effects are caused by the alteration, improvement or destruction of habitat utilized by wildlife. Most animals are able to escape the lethal effects of disturbance by selecting an insulated microenvironment (burrows and riparian areas) or by rapidly emigrating from the area of the disturbance. Therefore the majority of the effects are indirect, a result of alterations in the vegetation structure, and temporary loss of habitat. These alterations include the removal of favorable nesting sites, disappearance of host and forage plants, and loss of protective vegetation cover. Additionally, the loss of vegetation may result in changes to biophysical conditions; thus altering temperature, wind, incident radiation, and soil moisture among other parameters that make up a microhabitat.

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) Effects of prescribed burning on biological resources - Fire suppression and prescribed burning activities can inadvertently and negatively affect wildlife through direct disturbance of animals and habitats even though both activities are designed to benefit habitat conditions in the long run. Fire or its absence affects the structure, distribution, and diversity of wildlife and wildlife habitats. As there are successions of species and age classes of plants that occur between fires, there are successions of animal species that are favored or disfavored as habitats change.

   Broadly speaking, examples of fire regime vulnerability for wildlife species include: short-lived species with sedentary life histories that depend on understory or herbaceous plants, such as some butterflies; species that depend on an open vegetation condition; canopy-dependent species; interior versus edge species; others that have narrow requirements; understory plants versus tall canopy dominants.

In negative fire regimes, wildlife persistence and recovery could be substantially altered by the combined effects of fragmented habitats and fire due to: 1) the local disappearance (extinction) of some species in burned habitat fragments; 2) the inability of some species to respond to and recover from fire because escape routes are blocked and there is reduced chance of recolonization; and 3) frequent fire or short fire return intervals in fragmented areas may facilitate the movement of invasive species into natural systems, thus impacting native biota. Each of these effects is exacerbated by large, intense fires and by short fire return intervals. Although there is virtually no quantitative data on the interactive effects of habitat fragmentation and wildfire on wildlife populations, wildfire suppression is interpreted as generally beneficial to the degree that it limits the amount of area burned at short intervals, which would have the greatest potential to make habitat unsuitable for wildlife.

Fire plays a role in the management of many plant species at NOFS by maintaining open habitat, encouraging reproduction, and affecting competing species. Soil fertility is enhanced by low-intensity fires, thus encouraging understory plant growth. Fire may injure or kill individual plants while the effect on the species as a whole may be beneficial because competition has been reduced or openings created; and some seeds or re-sprouts germinate by fire activation. Fire suppression activities can negatively affect these same species because of ground disturbance. Prescribed fires can also be detrimental, especially when timing, frequency, and intensity of fire are outside of the fire regime to which a species is resilient.

Impacts to wildlife from prescribed burns would be negative, short-term, and minor due to mortality in a small number of individuals; and beneficial, moderate, and long-term with regard to habitat. Smaller fires are expected to improve habitat diversity by spatially diversifying the fire regime. Smaller fires would also reduce the potential for wildfires to replace threatened and endangered species habitat. Extending the time between fires would allow understory and tree recovery.

Areas on NOFS to be treated with prescribed fire may occur within the MSO PAC and may benefit owl habitat. In addition to reducing vulnerability for a stand-replacing wildfire, it could enhance forest cover favorable to owls and their prey base (USFWS 1995). The MSO Recovery Plan provides guidelines for using prescribed fire within the PAC. To minimize disturbance to owls, the guidelines would be strictly adhered to during fire management activities within the PAC, and fire management activities would be avoided during the breeding season. If prescribed burning were to occur within a ½ mile of the MSO PAC during the breeding season, any days selected for ignition would be selected so as to have better ventilation to limit heavy concentrations of smoke for extended periods of time in the PAC.

As the Proposed Action would result in some benefits to plant community structure and diversity, such benefits carry over to avian species. Fire affects the structure, distribution, and diversity of migratory birds and their habitats. Results of the prescribed burns would help manage for gap-dependent birds and those that depend on a younger or more open canopy condition. Most birds are able to escape the lethal effects of fire by fleeing. Therefore, the majority of the effects would be indirect, a result of alterations in the vegetation structure and temporary loss of habitat or as a result of site erosion and sedimentation. These alterations may include the removal of favorable nesting sites, disappearance of host and forage plants, and loss of protective vegetation cover. Additionally, the loss of vegetation may result in changes to biophysical conditions, altering temperature, wind, incident radiation, and soil moisture among other parameters that make up a microhabitat. Wildfire suppression and prescribed burning activities can inadvertently and negatively affect birds through direct disturbance, even though both activities are designed to benefit habitat conditions in the long run.

Most avian species on NOFS are probably resilient to fires of limited frequency and intensity, unless fires become exceptionally frequent with intervals shorter than the habitat can recover from or uniformly large. A negative effect of an improperly managed fire regime would be an unnatural change in the abundance, diversity, and distribution of bird species. Changes could occur through direct disturbance or mortality or through destruction or alteration of habitats. In contrast, a beneficial effect would likely protect or restore the natural abundance, diversity, and distribution of birds. This would occur through protection and restoration of the natural structure, succession, and distribution of habitat.

The use of prescribed burning would also reduce the likelihood of a stand-replacing wildfire, which would likely have severe impacts on biological resources. The forest surrounding NOFS could continue to decline in overall health without the continuation of fire management tools. High tree and sapling density and thick duff stress trees and, ultimately, all the native species dependent on the habitat. The density of vegetation also increases the chance for stand-replacing fires. While the risk is not uniform across the project area, large areas of forested habitat would be affected if a large wildfire were to occur. This could include habitat within the project area's MSO PAC. In turn, this could affect the suitability of current nesting and foraging MSO habitat, the availability of MSO replacement nesting and foraging habitat, and MSO prey availability within the project area. The project area would continue to recover naturally but without the natural effect of fire and could lack components of the historical range of variation.

Both direct, short-term negative impacts and indirect, long-term beneficial impacts to biological resources would be expected with the Proposed Action. Guidelines, as outlined in the 2011 USFWS informal consultation and upcoming BO, minimizing disturbance to MSO would be followed. Therefore, there would be no significant impacts on biological resources from the Proposed Action.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI. The effects and finding of no significant impact on biological resources would remain the same (See 4.1.4 of 2001 INRMP EA).

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

Known locations of sensitive plant species would be avoided during mechanical brush cutting and fuel removal and would not be impacted by these activities. Minor short-term impacts to brush and localized areas of habitat may result from this alternative, however, in the long-term these actions would create more open conditions preferred by most shrub and forb species. Brush and fuel removal would also produce a forest that is less vulnerable to stand-placing wildfires.

Brush cutting and fuel removal operations would be recommended to occur outside of the bird breeding season to minimize the potential effects to birds. Brush cutting and fuel removal activities may temporarily alter the forest microhabitats of some migratory bird species, but would improve conditions for other species and result in a healthier forest that is less susceptible to catastrophic wildfires.

All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI (See 4.1.4 of 2001 INRMP EA). Therefore, these would be no significant impacts to biological resources from the implementation of Alternative 2.

Alternative 3: No Action Alternative – Continued Implementation of 2001 INRMP

The 2001 INRMP provides objectives for the protection of natural plant communities and sensitive plant species at NOFS through monitoring existing conditions and adjusting management practices to maintain healthy plant communities. Guidelines for monitoring and controlling exotic weed species that could out-compete native plant species are provided. In addition, erosion control methods would help stabilize soil and allow for continued growth of vegetation, thus providing a vegetative structure to support wildlife.

Known locations of sensitive plant species would be avoided during thinning, pile burning and construction activities and would not be impacted by these activities. Short-term negative impacts to understory vegetation and localized areas of habitat may result from thinning activities and pile burns. However, in the long-term, these actions would create more open conditions preferred by most shrub and forb species. Thinning would also produce a forest that is less vulnerable to stand-replacing wildfires.

Construction projects and thinning operations are recommended to occur outside of the bird breeding season to minimize negative effects. Thinning activities may alter the forest microhabitats of some migratory bird species, but would improve conditions for other species and result in a healthier forest that is less susceptible to catastrophic wildfires.

The No Action Alternative would improve conditions for wildlife species on NOFS through erosion control measures (described in 4.1.1 of the INRMP), invasive plant species management (described in 4.1.41 of the INRMP), timber management, surveying and monitoring, habitat enhancement, and limited use of pesticides. This alternative would include numerous measures that would ultimately improve the forest health at NOFS and provide indirect benefits to the MSO. There would be no significant impacts to biological resources from the No Action Alternative.

3.2 Constructed Environment

3.2.1 Safety and Environmental Health

Herbicides and pesticides are sometimes used as part of the pest management program. Chapter 17 of OPNAVINST 5090.1C requires that the use of pesticides comply with applicable federal, state, and local legal requirements to prevent pollution. A Partner Pest Management Plan exists for NOFS (DoN 2009a). Pest management on NOFS is awarded to contractors; as a safety precaution, herbicides, and pesticides used by these contractors on NOFS property are not stored or mixed on the property. Additionally, herbicides are not approved for use in developed or semi-developed areas.

Any additional hazardous waste generated at NOFS is handled, stored, and disposed of in accordance applicable federal, state and local legal requirements and with DoD and DoN policy. No hazardous wastes exist in the wildland areas where the action would occur.

Anti-terrorism/force protection is not a factor in either alternative and would not be required.

3.2.1.1 Impacts on Safety and Environmental Health

Federal agencies must "make it a high priority to identify and assess environmental health risks that may disproportionately affect children and shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks and safety risks" (EO 13045). Due to the distance of NOFS from developed areas, none of the alternatives propose measures that would present environmental health risks that disproportionately affect children or the public. Children are only present during field trips to the Observatory, which are infrequent.

The health and safety of the public and fire personnel could be affected to varying degrees under the alternatives. There are two major concerns related to health and safety. One is the actual danger of fire-caused injuries or fatalities – firefighters, military personnel or contractors becoming trapped and burned by fire or injuries that are indirectly caused by the fire. The other is smoke inhalation, either by firefighters on the fire line or by the personnel in areas away from the fire. Due to the location of NOFS within a highly flammable landscape, natural and human ignition sources, and hot, dry summers, no alternative eliminates the health risk of smoke for firefighters, military personnel or contractors. Unwanted wildland fires will occur and produce smoke under any alternative. Alternatives that allow more control over the timing, placement, and conditions under which fires burn would be more successful at minimizing smoke impacts over the long term.

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) Effects of prescribed burning on safety and environmental health – Even under controlled conditions, the potential for injuries or fatalities from fires exists. Potential impacts to health and safety of firefighters and others are prevented by improved wildfire suppression policies that keep firefighter safety as a first priority during incidents. Preparation and policies that provide adequate response time to fire, adequate infrastructure to contain them, and improved communications and notification procedures minimize dangers to fire management teams.

   This alternative would increase the survivability of human life and protect human health in the event of a wildfire, would reduce the risk of a large wildfire, and would allow more control over the timing, placement, and conditions under which fires burn. The prescribed burn projects would be managed under conditions and constraints consistent with the ADEQ regionally permissive burn days that allow for good convection and upper-level air transport. Permissive conditions would maintain smoke emissions below the legal thresholds as defined by the state of Arizona and the EPA. To accomplish this, smoke impacts would be managed and minimized according to requirements contained in the Smoke Management Plan appended to the Prescribed Burn Plan.

   Implementation of the Proposed Action would reduce long-term threats to public safety by reducing hazardous forest fuels through the use of prescribed fire. A reduction in forest fuels would minimize the chance of stand-replacing wildfires, which threaten persons and property. Following proper procedures and undertaking activities in appropriate conditions, there would be no significant impacts to public health and safety with the Proposed Action.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI. The effects and finding of no significant impact on safety and environmental health would remain the same (See 4.2.7 of the 2001 INRMP EA).

Alternative 2: Implementation of the 2011 Revised INRMP using Mechanical Methods Only

There are safety hazards associated with the use of chainsaws and hand tools. Prior to work beginning, a project safety plan would be written including instructions and safety protocols on the use of mechanized and non-mechanized tools and equipment. While this Alternative would reduce long-term threats to public safety by reducing hazardous fuels through the use of forest fuel management techniques, some flammable forest floor material would remain and continue to build. Therefore, a higher danger to public safety and that of firefighting crews in the event of a stand-replacing wildfire would be present. All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI (See 4.2.7 of the 2001 INRMP EA). Therefore, adherence to the safety plan would result in no significant impacts to public health and safety from the implementation of this alternative.

Alternative 3: No Action Alternative – Continued Implementation of the 2001 INRMP

The 2001 INRMP recommends limiting the application of herbicides and pesticides and mandates DoD integrated pest management procedures. Forest thinning can be a hazardous activity to those performing the operation; however, it would be performed by professional foresters that understand the risks and responsibilities of the work. Continued implementation of the No Action Alternative overall would reduce long-term threats to public safety by reducing hazardous fuels through the use of forest fuel management techniques. However, because flammable forest floor material would continue to build in the No Action Alternative, this in turn would present a higher danger to public safety and that of firefighting crews in the event of a stand-replacing wildfire.

With the implementation of safety measures during management activities, the No Action Alternative would not have direct negative impacts on public health and safety. Overall, there would be no significant impacts from the No Action Alternative.

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4.0 Cumulative Effects

4.1 Introduction

The approach taken to analyze cumulative impacts (or cumulative effects)[2] follows the objectives of the NEPA of 1969, CEQ regulations, and CEQ guidance. Council on Environmental Quality regulations (40 CFR §§ 1500-1508) provide the implementing procedures for NEPA. In this chapter, cumulative impacts are examined within each of the affected resources. The type of impact describes a relative measure of beneficial or negative effects on biological or physical systems. For example, negative impacts on ecosystems might be those that would degrade the size, integrity, or connectivity of a specific habitat. Conversely, a beneficial impact would enhance ecosystem processes, native species richness, or native habitat quantity or quality.

4.1.1 Definition of Cumulative Impacts

A cumulative impact is described in the CEQ regulations (1508.7) as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions." Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Chapter 3 for a detailed description of the current state of each resource area that would be affected by the alternatives.

4.1.2 Boundaries for Cumulative Impact Analysis

Geographic boundaries for analysis of cumulative impacts vary for the impacted resources and the extent of their reach. For example, air quality would be considered on a basin-wide basis, as defined by the ADEQ; whereas the project area would be the boundary for soil resources. The cumulative effects analysis includes regional projects that directly overlap in time or space.

4.2 Other Present and Reasonably Foreseeable Future Actions

Four Forests Restoration Initiative (4FRI) – In response to the growing concern of forest managers and citizens of Arizona over the risk of destructive wildfires to forest ecosystems and communities, USFS is leading a collaborative group of land managers, non-governmental organizations, researchers and private industry stakeholders in the Four Forests Restoration Initiative. The overall goal of the 4FRI is to create landscape-scale restoration approaches that will provide for fuels reduction, forest health, and wildlife and plant diversity. A key objective is to create sustainable ecosystems from the restoration.

In early 2008, an analysis area of 2.4 million acres (971,346 ha) was identified amongst the collaborative group. Because of the large-scale nature of the restoration, implementation could lead to as many as 50,000 acres (20,234 ha) per year being treated over a ten-year period. The first environmental assessment will assess about 750,000 acres (303,514 ha) of ponderosa pine vegetation in the Coconino and Kaibab forests (4FRI Stakeholder Group 2010).

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[2] CEQ Regulations provide that the terms "cumulative impacts" and "cumulative effects" are synonymous (40 C.F.R. § 1508.8[b]); the terms are used interchangeably in this document.

The first draft management document, The Four Forest Restoration Initiative Landscape Strategy, was completed in October 2010. This strategic document serves as the foundation for which the USFS can develop a Proposed Action for a comprehensive ponderosa pine forest restoration strategy for the 2.4 million acre (971,346 ha) assessment area. A major theme generated during document creation was the development of strategic approaches to reducing the threat of large and severe wildland fires, while restoring fire as an ecosystem process that plays a vital role in developing desired forest conditions. A resilient ecosystem responds better to climate change (4FRI Stakeholder Group 2010).

The working group identified “firescapes,” sub-landscapes within the analysis area where treatments were further defined and mechanical thinning and prescribed fire treatments could be applied to implement forest restoration. The first analysis area of the 4FRI lies primarily within the Western Mogollon Plateau, and the NOFS property is located within this delineated study area.

Long-term objectives for the 4FRI will be defined as “Desired Conditions.” Forest restoration activities will move toward these established qualitative and measureable ecological, social, and economic objectives.

Coconino National Forest Plan – The current Coconino National Forest Plan allows for, and encourages, the use of mechanical treatment and prescribed fire as forest management tools. The plan reiterates the need for fire and fuelwood treatments in maintaining a healthy and productive ponderosa pine forest (USFS 1987). Fire management methods, including pre-suppression, detection, suppression, prevention, and fuel treatment, as well as monitoring and analysis, are an integral part of the protection strategies offered within the plan.

Specific guidelines for fuels management and prescribed burning within the PACs provide protection for the MSO potential habitat. Prescribed fires are encouraged to reduce hazardous fuel accumulation to reduce the risk of crown fires.

Within the plan are protective measures for additional resources. Best Management Practices are required to protect soil, water, and resources required for developed areas, as well as implementing smoke reduction techniques and ADEQ burn guidelines. In addition to coordination with ADEQ, the current plan also prescribes coordination of fuel treatment plans with other resource agencies and specialists.

The current plan under which the Coconino National Forest operates was written in 1987 and last amended in 2005. Revisions for an updated plan are now being publicly solicited. An initial draft plan is currently being developed, and a draft EIS is anticipated for summer 2011 with a final EIS for summer 2012. It is anticipated that the revised plan will continue the use of prescribed fire as a fuel treatment method.

Coconino National Forest Fire Management Plan – Fire management within the Coconino National Forest is guided by an annual plan with supporting direction from the Federal Wildland Fire Management Policy. Current forest policy is “to manage fire and fuels in a consistent manner across the national forests, coordinate management strategies with other ownerships, and integrate fire and fuels management objectives with other natural resource objectives” (USFS

2009). Actions within the forest are created in context with the 10-Year Comprehensive Strategy, Five Year Fuels Plan, the National Fire Plan, and the Forest Service Strategic Plan.

Coconino National Forest utilizes prescribed fire as a tool to manage fuels for fire suppression, mitigate the potential for stand-replacing wildfires, and enhance natural habitat. It is the preferred treatment method in areas sensitive to impacts of mechanical treatment such as MSO habitat and on slopes greater than 40 percent.

Non-fire treatments also function within the plan. Removing or rearranging excessive ladder fuels reduces the potential for stand-reducing wildfires and prepares areas for future treatments.

Prescribed fires will meet specific objectives, will have a written approved prescribed fire plan, and meet all NEPA requirements prior to ignition. All prescribed fire activities will be coordinated with the ADEQ to ensure air quality and smoke monitoring standards are met.

The USFS considers the area of NOFS within the Wildland Urban Interface (WUI). Areas within this fire management unit (FMU 01– Ponderosa pine urban interface) have the highest priority for hazardous fuels reduction treatments because fires may pose an immediate threat to life and property.

Approved and Proposed Prescribed Burns within the Coconino National Forest

Clints Well Forest Restoration Project. The USFS has proposed fuel reduction activities, including prescribed burning and mechanical treatment, across approximately 16,500 acres (6,677 ha) in the Clints Well WUI area, 50 miles (80 km) south of Flagstaff. As in the Clints Well Forest Restoration Project, the treatment activities would occur over a 20-year time frame, targeting “the last major area of forest and privately held lands on the Mogollon Rim District where fuel reduction treatments have not been started” (USFS 2009a). Prescribed burning would consist of three different stages or types depending on the area within the project and all three stages may happen in the same area over a number of years.

Wing Mountain Fuels Reduction and Forest Health Restoration. This project, as proposed, is designed to reduce hazardous fuels and improve forest health in the Wing Mountain area located northwest of NOFS and the city of Flagstaff in the Coconino National Forest. Thinning small and medium diameter trees and prescribed fire treatments are the proposed project activities.

Long Valley Experimental Forest Restoration Project. This project, in the environmental analysis scoping stage, proposes to conduct experimental studies to further knowledge and practice of ecological restoration treatments in southwestern ponderosa pine ecosystems, reduce hazardous fuel accumulations, and create a demonstration area over about 1,100 acres (445 ha). The project area is located 50 miles (80 km) southeast of Flagstaff nestled within the Clints Well Forest Restoration Project. Within the experimental area, prescribed burning would be conducted on approximately 271 acres (110 ha) with potential future burning on another 247 acres (100 ha).

Marshall Fuel Reduction and Forest Restoration Project. Fuels reduction and forest restoration are proposed on approximately 12,000 acres (4,856 ha) southeast of Flagstaff. Pile, broadcast, and maintenance burns would be conducted for up to 20 years.

Hart Prairie Fuels Reduction and Forest Health Restoration Project. A FONSI was signed in May 2010 for a fuels reduction and restoration project on approximately 10,000 acres (4,047 ha) of various vegetation types in the Hart Prairie area. Located north of the city of Flagstaff and NOFS, ponderosa pine, mixed conifer, and aspen vegetation types would be the main targets of this forest improvement project. Initial burns and maintenance burns are approved for up to 20 years beyond the initial clearing.

Eastside Fuel Reduction and Forest Health Project. As part of the Greater Flagstaff Forests Partnership, this 22,000-acre (8,903-ha) fuels management and restoration project is located in the WUI and associated landscape east of the city of Flagstaff. Prescribed burning in combination with mechanical thinning will occur on more than 20,000 acres (8,093 ha) followed by maintenance burning. The EA and FONSI were signed in January 2007.

Healthy Forests Initiative. The Healthy Forests Initiative (HFI) expedites administrative procedures for hazardous fuel reduction and ecosystem restoration projects on federal land. The Healthy Forests Restoration Act of 2003 (Public Law 108-148) contains a variety of provisions to expedite hazardous fuel reduction and forest restoration projects on specific types of federal land that are at risk of wildland fire or insect and disease epidemics. The Act helps rural communities, states, tribes, and landowners restore healthy forest and rangeland conditions on state, Tribal, and private lands. It also:

- Encourages biomass removal from public and private lands;
- Provides technical, educational, and financial assistance to improve water quality and address watershed issues on non-federal lands;
- Authorizes large-scale silvicultural research;
- Authorizes acquisition of Healthy Forest Reserves on private land to promote recovery of threatened and endangered species and improve biodiversity and carbon sequestration; and,
- Directs the establishment of monitoring and early warning systems for insect or disease outbreaks.

Centennial Forest. This experimental forest was established through a cooperative, long-term agreement between Northern Arizona University and the ASLD. Over 50,000 acres (20,234 ha) of grass and forest land are designated as a research and teaching laboratory. About half of the forest is located southwest of the city of Flagstaff, immediately adjacent to NOFS. It is dispersed in a checkerboard pattern throughout the Coconino National Forest. The remaining half is a solid block of land located north of Flagstaff and west of Wupatki National Monument.

Arizona State Lands Department. More than seven square miles (11 square kilometers) of Arizona State lands border NOFS within a radius of 2.5 miles (4 km) on the west, southwest, south, and southeast. The mandate of ASLD is to support public schools, generally by the sale of merchantable timber or land. When NOFS was established in the mid-1950s, ASLD signed a Land Use Agreement with the U.S. government prohibiting development on adjacent sections that could compromise the NOFS mission. Starting in the mid-1980s, it became clear that ASLD considered this agreement void, believing themselves no longer constitutionally capable of making such agreements.

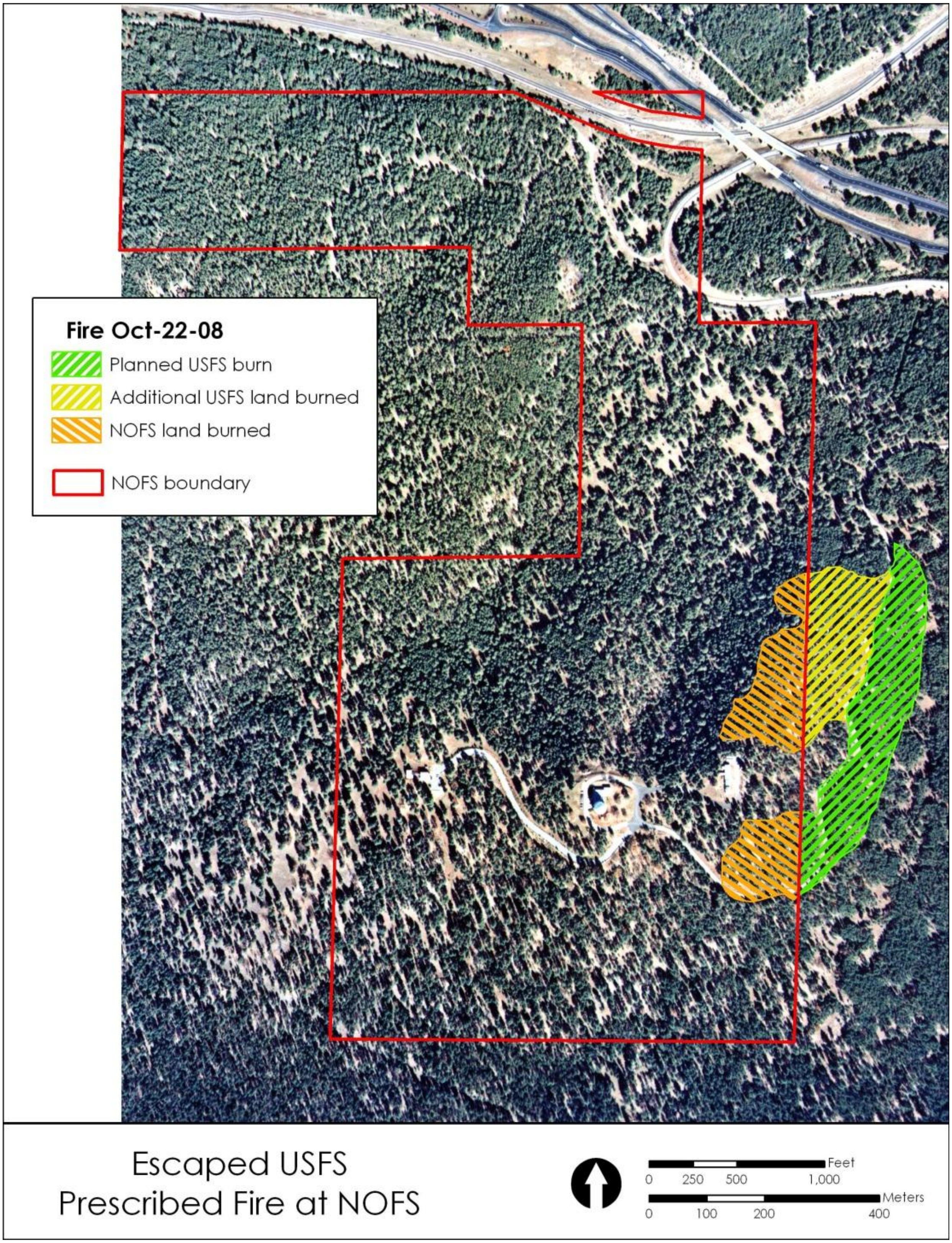
Flagstaff Regional Land Use and Transportation Plan. This plan contains a suite of goals, policies and strategies to be followed as the region develops and grows. It manages growth to maintain the area's sense of community and the natural environmental. It also focuses on developing a short- and long-term transportation plan emphasizing alternative transportation. It intends to maintain and improve upon the existing livability of the community as the region grows. The region is updating its current plan. Slated for 2012, it incorporates 22 elements into Environmental Quality, Community Character, and Development and Transportation.

Arizona Preserve Initiative. Designed to encourage the preservation of select parcels of State Trust land in and around urban areas for open space to benefit future generations, the Arizona Preserve Initiative (API) lays out a process by which Trust land can be leased for up to 50 years or sold for conservation purposes. Large parcels of land adjacent to NOFS property are eligible for conservation status. Rogers Lake, a property incorporating approximately 2,200 acres (890 ha) southwest of NOFS, is currently being evaluated for eligibility.

Coconino Parks and Open Space Program. Funded by Coconino County sales tax, the Coconino Parks and Open Space Program (CPOS) seeks the development and re-development of community parks in the county system and acquisition of open space within critical natural areas in the greater Flagstaff area. The County Parks plans to raise $19 million for acquisition of seven natural areas. Years of citizen input and community planning established a shared vision of protecting old growth forests, wetlands, and wildlife habitat to balance regional growth and development. Specific acquisitions in the vicinity of NOFS include wetlands and wildlife habitat in the Rogers Lake area (acquisition in progress) and acreage of old growth forest near NOFS, west of the Dry Lake area (petition filed to acquire).

Wildfire History. The only reported wildfire at NOFS in recent decades was in 2008. On October 22, 2008 the USFS was conducting a prescribed fire on its adjacent property to the east. This fire was designed to be bounded to the west along the main access road to the Observatory (Map 4-1). The fire unexpectedly jumped the road in two places and crept up the hill before it was extinguished. After a post-fire assessment, it was determined that the small fire (approximately 10 acres [4 ha]) that encroached onto Navy lands was beneficial to the forest. Because the ponderosa pine is a fire adapted tree species, most of the mature old growth ponderosa pine trees in the fire area appear to have rebounded and are green; thus there is little pine mortality. However, there is greater mortality of oaks in the fire area.

Within the Western Mogollon Plateau region, during the years 2000-2010, 56 wildfires greater than 100 acres (40 ha) occurred (4FRI 2010). One of the largest in Coconino National Forest history, the Schultz Fire, occurred in 2010 during which over 15,000 acres (6,070 ha) burned.



Map 4-1. October 22, 2008 fire showing Naval Observatory Flagstaff Station land burned during an escaped prescribed burn conducted by the U.S. Forest Service.

4.3 *Air Quality Effects*

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) <u>Effects of prescribed burning with cumulative impacts</u> – There are several identified large-scale prescribed burn projects that lie within airsheds surrounding Flagstaff, including those within which the NOFS property lies. These projects combined with prescribed burning on NOFS could have short-term effects on the Verde River or Little Colorado River airsheds' air quality from smoke, ash and, other particulates. However, since the ADEQ limits total acres burned per day per airshed, daily emissions from these prescribed burns would not accumulate to exceed air quality standards. Furthermore, the combination of these smaller prescribed burning projects could have long-term benefits to air quality. Reduced fuels throughout the Coconino National Forest and surrounding forests from these fuels management projects reduces potential smoke impacts from large-scale wildfires that could burn. Therefore, the Proposed Action, in combination with other identified projects, would have short-term negative impacts and long-term, beneficial cumulative impacts. Yet there would be no significant cumulative impacts on air quality from implementation of the Proposed Action.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI. The effects and finding of no significant cumulative impacts on air quality would remain the same (See 4.1.3 of the 2001 INRMP EA).

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

Implementation of Alternative 2 may result in cumulative impacts to air quality. The small amounts of air-borne short-term dust from treatment methods would not result in cumulative impacts. However, the risk of wildfires could increase with this alternative due to forest fuels remaining on the forest floor after treatment, thus increasing the potential for a stand-replacing wildfire. Under this Alternative, smoke from a wildfire in the project area could accumulate with smoke from other wildfires within the airshed to exceed air quality standards, or air quality standards may be exceeded during a larger number of days per year. Beyond the initial particulate matter from wildfires, bare soils areas may continue to produce air pollutants from winds.

When combined with other projects in the airshed, the cumulative impacts on air quality would be less than significant.

Alternative 3: No Action Alternative – Continued Implementation of 2001 INRMP

Cumulative impacts to air quality may result when combined with the No Action Alternative because the risk of wildfires could increase with this alternative. Although this alternative would allow for thinning to eliminate some forest fuels, it would not prevent ground fires from passing through the property nor eliminate highly flammable groundcover.

The history of fire suppression activities has increased the risk of uncharacteristic, stand-replacing wildfire throughout the forest. In the Coconino National Forest there are about 400 wildfires a year and large destructive wildfires average about four thousand acres a year (USFS 2010b). Emissions from a wildfire are generally double that of a prescribed fire (USFS 2010b);

and smoke from these large wildfires typically exceeds air quality standards. Under the No Action Alternative, smoke from a wildfire in the project area could accumulate with smoke from other wildfires within the airshed to exceed air quality standards, or there could be a greater number of days per year where air quality standards are exceeded. Beyond the initial particulate matter from the wildfire, bare soils areas could continue to produce air pollutants from winds.

Some exhaust emissions would be generated from mechanical thinning and construction activities and from slash pile burning in the No Action Alternative. These activities would be of short-duration, over a small project area, and would be spread out over a period of time to dissipate emissions (refer to Section 3.1.3). In addition, BMPs and smoke management techniques would be followed during any slash pile burning.

When combined with other projects in the airshed, the No Action Alternative's cumulative impacts on air quality would be less than significant.

4.3.1 Climate Change Effects

In February 2010, the CEQ issued a draft guidance memorandum for analyzing the environmental effects of GHG emissions and climate change in NEPA documents. Specifically the guidance states that if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2e GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public. For long-term actions that have annual direct emissions of less than 25,000 metric tons of CO_2e, the CEQ encourages federal agencies to consider whether the action's long-term emissions should receive similar analysis. The CEQ does not propose this as an indicator of a threshold of significant effects, but, rather, as an indicator of a minimum level of GHG emissions that may warrant some description in the appropriate NEPA analysis for agency actions involving direct emissions of GHGs (CEQ 2010). The treated areas under the Proposed Action would be performed in small patches with a maximum of 40 acres (16 ha) treated annually. Thus the emissions from prescribed burns and mechanical treatments would be far less than the 25,000 metric tons threshold referred to in the CEQ guidance.

In addition to GHG emissions are the cumulative effects on resource areas from climate change. These expected effects are analyzed here in the context of a naturally frequent fire ecosystem, but one that has changed over the last century. The historical fire regime in the project area and region was changed due to widespread fire exclusion, livestock grazing, and timber harvesting. The natural pattern of frequent, low-intensity surface fires was disrupted. Strong evidence suggests that widespread forest change has occurred during the last century, such as increased tree densities as a result of reduced fire activity for most Southwest forest types, thus greatly increasing forest vulnerability to large scale disturbances and climate change (Hurteau *et al.* 2010).

The climate change discussion that follows attempts to qualitatively and quantitatively contextualize the amount of impact of the proposed action will likely have upon climate change, as well as the possibility of climate change affecting the project.

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

The Proposed Action is designed for improving fuel and forest health management opportunities in the coming decades with a complete set of tools available to land managers. The Proposed Action would reduce the risk of high-severity wildfire in the stands and introduce low-severity fires. The forest would recover and benefit from low severity fire, but may be changed for decades, if not millennia, after a stand-replacing wildfire.

It is difficult to accurately predict and quantify the GHG emissions of a hypothetical prescribed burn of 40 acres (16 ha) at NOFS due to the considerable uncertainty in variables for potential fuel loading, fire duration, number of piles, fuel moisture, weather variables, and emission factors (the mass of CO_2 that is emitted per mass of species-specific biomass burned). Models to predict such emissions vary widely in their outputs despite recent efforts to understand GHG emissions from fire at the level of a forest (Wiedinmyer and Neff 2007; Larkin *et al.* 2010).

While estimating carbon emissions from wildfire or prescribed fire continues to prove difficult, measuring total carbon stocks of a forest at small scales is not problematic. A recent study located in areas within the vicinity of NOFS (NAU's Centennial Forest and Coconino National Forest) has determined the 2007 total carbon pools of both an unmanaged forest, a recently thinned forest, and a forest that had recently experienced a stand replacing wildfire (Dore *et al.* 2010). Of these three forest types, the unmanaged forest contained the largest total carbon pool of 12,378 grams (g) of carbon (C)/square meter (m^2) when all carbon was summed from pools such as aboveground trees, coarse roots, mineral soil, woody debris, etc. The thinned forest contained 8,836 g C/m^2, and the burnt forest contained 7,182 g C/m^2.

Supposing a wildfire were to occur in 40 acres (16 ha) of the unmanaged forest, and for the sake of argument, all carbon atoms within that forest were converted to CO_2, the total amount of CO_2 emissions would be 0.0073065 teragrams (Tg) of C. Table 4-1 presents the CO_2 emissions from a hypothetical release of all carbon across 40 acres within the three forest types described by Dore *et al*. (2010). These calculations describe a biophysically impossible scenario whereby all carbon within 40 acres (16 ha) of ponderosa pine forest would be emitted as CO_2 as part of a hypothetical fire. In a real world setting, the emissions of the type of prescribed fire in the Proposed Action would be much less than what is detailed in Table 4-1 as significant carbon pools remain in an ecosystem even after stand replacing wildfire. Nonetheless, it is immediately apparent that even in the biophysically impossible scenario presented in Table 4-1, the emissions from a 40-acre (16-ha) fire are entirely insignificant when expressed as a percentage of the CO_2 emissions from prescribed burns and wildfires across the U.S.

The Proposed Action is not spatially (40 acres [16 ha] per event) nor temporally (every several years) a meaningful percentage of the prescribed fire practice and wildfire regime currently occurring in the greater Flagstaff pine-oak forest ecosystem as described in Section 4.2. Over the time frame of several decades that constitute the existing fire return interval and the forest growth cycle, the proposed prescribed fire practice would be indistinguishable from background conditions. For example, the annual CO_2 emissions from fires in several western states can vary by a factor of ten to 20 from year to year (Wiedinmyer and Hurteau 2010). Currently, prescribed fire is being used frequently by land managers on all levels of government, and the natural incidence of fire is high due to high numbers of natural lightning strikes and other ignition sources (mostly human-related).

Table 4-1. Quantitative contextualization of CO_2 release from 40 acres ponderosa forest and total U.S. emissions from forest fire.

Quantity of CO_2	**Unmanaged forest[1]**	**Thinned forest**	**Unmanaged forest post-wildfire**
grams C/m^2 as determined by Dore *et al.* 2010	12378	8836	7182
Tg CO_2/40 acres[2]	0.0073065	0.0052407	0.0042597
Tg CO^2 emitted from all U.S. prescribed burns in 2007[3]	34.0	34.0	34.0
hypothetical 40 acre CO_2 release as % of all U.S prescribed burns	0.0002149	0.0001541	0.0001253
Tg CO_2 emitted from all U.S. burns in 2007[4]	318.0	318.0	318.0
hypothetical 40 acre CO_2 release as % of all U.S. burns (prescribed and wild) in 2007	0.00002298	0.00001648	0.00001340

1. Three ponderosa pine forest types in the vicinity of NOFS as measured in the 2007 by Dore *et al*. (2010).
2. Conversion consists of C to CO_2, grams to teragrams, and m^2 to acre.
3. Estimates of CO_2 (Tg/yr) emissions for the lower 48 states and Alaska (USEPA 2010).
4. Estimates of CO_2 (Tg/yr) emissions for the lower 48 states and Alaska (USEPA 2010).

Furthermore, it is uncertain whether the Proposed Action would incrementally exacerbate, ameliorate, or be neutral with respect to effects of climate change because of uncertainties about the future incidence of wildfire. Wiedinmyer and Hurteau (2010) modeled a potential decrease in carbon dioxide emissions in various western states when prescribed fire was used compared to past wildfire patterns. Climate change and land management practices over the past century have led to increases in wildfire intensity and size in western forests. The authors modeled the replacement of wildfire with prescribed burning with only the surface herbaceous fuel fractions compared (no live or standing dead trees were assumed to burn). This is similar to the Proposed Action.

It is probable that the Proposed Action would result in improved forest resiliency to the more frequent and severe fire disturbances that are anticipated in the future due to climate change. Fulé (2008) suggests that in fire-adapted pine forests, treatments that focus on the ecological role of fire and fire-related structure may reduce the risk of complete loss of the native forests and enhance resistance to increased fire risk in the future. Millar *et al.* (2007) suggests that strategies that manage for resistance and resilience in forests can be part of a “portfolio of strategies” that protects forests from the impacts of climate change. The Proposed Action would likely improve the resiliency of the ponderosa pine-Gambel oak forest to climate change by restoring the natural ecological process of fire in a manner that more closely mimics its natural pattern. This alternative is the most conservative with respect to forest health because it would more closely mimic the natural processes that maintained a healthy forest: a pattern of frequent, low-intensity surface fires.

The net long-term effect of the Proposed Action would be natural resources that are more resilient to climate change because a complete set of tools is available to the Navy to protect and manage risks to forest health and to its wildlife, including the MSO, related to the more extreme fire conditions expected with climate change.

Finally, forests are recognized to have a climate change stabilizing function with respect to GHG concentrations in the atmosphere due to the vegetation community’s ability to sequester carbon.

Under a prescribed fire scenario designed to protect forest health and the stand of trees, this ability would be more secure as the stand is expected to be less vulnerable to a stand-replacing fire. The regional activities that are utilizing prescribed fire while generating short-term emissions of GHGs, ultimately, could create a regionally healthier forest more adaptable to expected climate change.

Therefore, the Proposed Action, in combination with other identified projects, would result in overall beneficial impacts to climate change. There would be no significant cumulative impacts from implementation of the Proposed Action.

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

A small amount of GHG emissions, primarily from the motorized vehicles used to transport the brush and fuel away from the area, would result from the implementation of this alternative. These emissions would be spread out over several years. This Alternative may increase the site's vulnerability to a stand-replacing fire due over the long-term due to increased fuel loads from organic matter and debris on the forest floor. Post-fire forests may not be similar to the historical forests because shrubland and grassland often replace forest after severe fire.

The cumulative effect of historic forest management activities combined with this Alternative would be reduced forest resiliency against climate change impacts, along with a potentially reduced ability of the forest to sequester carbon. There could be negative cumulative impacts to climate change and GHG emissions under this alternative in combination with other identified projects. However, there would be no cumulative significant impacts to climate change.

Alternative 3: No Action Alternative – Continued Implementation of 2001 INRMP

The No Action Alternative would increase the site's vulnerability to climate change impacts including the expected more extreme wildfire severity and frequency due to more extreme droughts, water-stressed forest conditions, increased insect infestations and increased dead and dry vegetation. The project area would become increasingly vulnerable to a stand-replacing fire due to increased fuel loadings and reduced tree vigor and health. Post-fire forests may not be similar to the historical forests because shrubland and grassland often replace forest after severe fire.

Greenhouse gas emissions from activities conducted under the No Action Alternative would result from mechanical activities and slash pile burns. The mechanical activities are unquantifiable because not all of the projects are defined; however, these projects would be small, consisting of minor use of mechanical equipment spread out over several years. The carbon in pile burns represents a small percentage of the overall forest carbon; thus GHG emissions from pile burns would be even less significant than that from prescribed burns as described in the Proposed Action above.

The cumulative effect of historic forest management activities combined with the No Action Alternative would be reduced forest resiliency against climate change impacts, along with a potentially reduced ability of the forest to sequester carbon. There are potential negative impacts to climate change under the No Action Alternative in combination with other identified projects. However, when combined with GHG emissions from surrounding forest management activities, the impacts from the No Action Alternative would not be significant.

4.4 Biological Resources

Long-term fire suppression activities surrounding NOFS have resulted in dense, closed canopy forests inhibiting growth of shade-intolerant ponderosa pine and associated plants. Thinning activities conducted during the scope of the 2001 INRMP have opened up the forest on NOFS, providing a healthier habitat condition for native plants and wildlife.

All three alternatives include implementation of forest fuels management that would be consistent with the conditions to protect the MSO and its habitat, as established by the USFWS and included in the relevant INRMP. Fuels management would provide a regional benefit by alleviating fire hazards and contributing to long-term forest health, which benefits many species.

All three alternatives also focus on protecting long-term forest health. They would take measures to return the forest to a more natural, open condition while controlling light reflectance that affects telescope viewing; control erosion; provide invasive species control; monitor forest health; and document the use of the property by various plants and animals.

Regional fire management plans would support the long-term fire management goals of NOFS; and nearby acquisition of lands for conservation and low-impact recreation purposes would help buffer the property against encroachment from development. While the management of these public areas for biological resources is unknown at this time, they would comply with state and regional policies.

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) <u>Cumulative effects of prescribed burning</u> – The Proposed Action would enhance the current forest management techniques on NOFS, using prescribed burns to clear understory and "even-aged" patches and encourage growth of seedlings with variable aged forest patches. Implementation of the Proposed Action would result in localized disturbances in the project area during prescribed burning activities, but would ultimately create healthier vegetation and higher quality habitat while approximating historic forest conditions. Combined with other regional forest management plans, the Proposed Action would contribute to a contiguously better managed forest. Fuel loads that could exacerbate a stand-replacing wildfire would be reduced, thus protecting habitat and biological resources across the region. Effects from the Proposed Action would be beneficial when combined with other regional plans. Any cumulative impacts on biological resources would not be significant.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI. The effects and finding of no significant cumulative impacts on biological resources would remain the same (See 5.2.3 of the 2001 INRMP EA).

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

Under Alternative 2, brush cutting and fuel removal from the forest floor would be limited to 40 acres per year. These actions would provide overall benefits to wildlife and vegetative communities by managing the threat of wildfire. When added to the effects of other past, present, and foreseeable future actions in the area, the effects from this alternative to biological resources would not be cumulatively significant.

Alternative 3: No Action Alternative – Continued Implementation of the 2001 INRMP

As with the Proposed Action, a number of the management practices laid out in the No Action Alternative would provide benefits to wildlife by managing threats and gaining a greater understanding of the biological resources. Specifically, the forest thinning practices that have created a more open canopy and eliminated some forest fuels would continue, resulting in localized benefits to wildlife and a diminished threat of stand-replacing wildfire. However, without the implementation of additional fire management tools to manage the understory, the overall health of the forest surrounding NOFS could be threatened. Thick understory stresses trees and, ultimately, all the native species dependent on the habitat. While the risk is not uniform across the project area, large areas of forested habitat would be affected if a large wildfire were to occur. This could include habitat within the project area's MSO PAC. In turn, this could affect the suitability of current nesting and foraging in MSO habitat, the availability of MSO replacement nesting and foraging habitat, and MSO prey availability within the region.

Decades of fire-suppression activities throughout the region are now being alleviated with forest management activities. When combined with these regional management activities, the No Action Alternative would contribute beneficial impacts to biological resources through healthier forests overall. The cumulative impacts between the No Action Alternative and the regional forest management activities would be positive. There would be no significant cumulative impacts on biological resources from the No Action Alternative.

4.5 Topography, Geology, and Soil Resources

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) Cumulative effects of prescribed burning – Best Management Practices would be utilized during prescribed burning under the Proposed Action to reduce potential impacts to geology and soil resources. Fuel treatments would be conducted to minimize heat intensity and burning on slopes, thus minimizing erosion and stormwater runoff and confining any impacts to the property. The Proposed Action would result in better control of fire size and severity in the long term. Other projects identified in the region are also required to employ soil resource protection measures. Therefore, when added to the impacts from the other projects in the region, the Proposed Action would not result in significant cumulative impacts to soil resources.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI. The effects and finding of no significant cumulative impacts on topography, geology, and soil resources would remain the same (See 5.2.1 of the 2001 INRMP EA).

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

The effects to topography, soil, and geology from Alternative 2 would be negligible. Given that all of the past, present and foreseeable future projects in this area are required to reduce soil erosion through adherence to BMPs, there would be no significant cumulative impacts to topography, geology, and soil resources from the implementation of this alternative.

Alternative 3: No Action Alternative – Continued Implementation of the 2001 INRMP

Soil erosion control measures outlined in the 2001 INRMP would protect soil resources, and BMPs implemented during forest management activities would minimize impacts to soil resources on NOFS. Forest thinning activities would leave the forest floor largely undisturbed, protecting soil from erosion and stormwater runoff and confining any impacts to the property. Because other projects identified in the region are also required to employ soil resource protection measures, when added to the impacts from these other projects, the Proposed Action would not result in significant cumulative impacts to soil resources.

4.6 Hydrology and Water Resources

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) Cumulative effects of prescribed burning – Protecting headwaters on NOFS would protect downstream waters, yet prescribed burning could have direct impacts on water quality. Erosion from exposed soils and ash created during fires could flow into waterways and degrade waters downstream. However, implementation of BMPs, stream buffering, and careful planning of burns would reduce potential impacts to water resources. Management of forest fuels through prescribed burning minimizes the potential of a stand-replacing wildfire, which would expose soils, damage soil structure, and create more ash, all of which would degrade waterways. Furthermore, other projects in the region would be required to implement protective measures as well; thus the Proposed Action would not result in significant cumulative impacts to water resources in the area.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI. The effects and finding of no significant cumulative impacts on hydrology and water quality would remain the same (See 5.2.2 of the 2001 INRMP EA).

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

Implementation of Alternative 2 may result in minimal amounts of sediment entering area waterways. Reduction of forest fuels through mechanical methods would also prevent damage to riparian vegetation and sediment in the event of a stand-reducing wildfire. When implemented, Alternative 2, as well as all of the potentially cumulative projects in the area, would be required to follow BMPs to reduce impacts to water quality. Thus, there would be no significant cumulative impacts to water resources from this alternative.

Alternative 3: No Action Alternative – Continued Implementation of the 2001 INRMP

Because NOFS is located near headwaters, benefits here from controlling onsite erosion and resulting sedimentation would protect waters downstream. Also benefiting water quality and hydrology would be the closure of dirt roads, resulting in reduced erosion. The No Action Alternative's approach of minimizing public access to and proliferation of roads, maintaining trafficked roads in good condition, and following BMPs for soil and water management would protect the health of the watershed. Reduction of forest fuels through thinning practices would also prevent damage to riparian vegetation and sediment in the event of a stand-reducing wildfire. Furthermore, other projects in the region would be required to implement protective measures as well. Thus, the No Action Alternative would not result in significant cumulative impacts to water resources in the area.

4.7 Safety and Environmental Health

Alternative 1: Proposed Action – Implementation of the 2011 Revised INRMP with Prescribed Fire

a) <u>Cumulative effects of prescribed burning</u> – During prescribed burning, implementation of safety measures and coordination with cooperating entities would reduce potential impacts to safety and environmental health. Conducting the burns in small patch sizes under appropriate burn conditions with experienced professionals would minimize impacts in the localized activities. The reduction in forest fuels on NOFS would combine with other regional fuels management activities to create beneficial impacts on regional forests. Healthier forests in the area reduces the threat of large, regional wildfires; thus reducing potential harm to persons and property. When added to the cumulative impacts from other projects in the region, the Proposed Action would not result in significant impacts to safety and environmental health.

b) All of the other elements in the Proposed Action have only been slightly modified from those previously analyzed in the 2001 INRMP EA and FONSI. The effects and finding of no significant cumulative impacts on safety and environmental health would remain the same (See 5.2.9 of the 2001 INRMP EA).

Alternative 2: Implement the 2011 Revised INRMP using Mechanical Methods Only

The only direct safety risks associated with the implementation of Alternative 2 are those associated with chainsaw and hand tool use when cutting brush and removing fuel. These risks are reduced to insignificant through adherence to the project safety plan. All other potentially cumulative projects would also have to adhere to their project safety plan. Because Alternative 2 does not allow for the total elimination of flammable forest fuels, it does not go as far as the Proposed Action does toward protecting safety and environmental health. When combined with past fire suppression schemes in the surrounding forest that have increased the risk of harm to human life and safety from wildfire, this alternative does pose potentially negative cumulative impacts on safety and environmental health. However, there would be no significant cumulative impacts to health and safety from this alternative.

Alternative 3: No Action Alternative – Continued Implementation of the 2001 INRMP

The No Action Alternative would continue forest fuels reduction activities, limit public use of the property, and follow BMPs and established avoidance and minimization protocols when using pesticides on the property. These practices reduce potential impacts to safety and environmental health. However, because the No Action Alternative does not allow for the elimination of flammable forest fuels as they fill in the understory, it does not go as far as the Proposed Action does toward protecting safety and environmental health. When combined with past fire suppression schemes in the surrounding forest that have increased the risk of harm to human life and safety from wildfire, this alternative does pose potentially negative cumulative impacts on safety and environmental health. There would be no significant cumulative impacts to safety and environmental health from the No Action Alternative.

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5.0 Other NEPA Considerations

5.1 Possible Conflicts Between the Proposed Action and the Objectives of Federal, State, Local, and Regional Land Use Plans, Policies, and Controls

Implementation of the Proposed Action or other alternatives would comply with existing federal regulations and state, regional, and local policies and programs while maintaining the military mission. Relevant federal regulations to the action alternatives are listed in Chapter 1. Additional regulations that arose during the course of implementation of action alternatives would also be complied with.

5.2 Energy Requirements and Conservation Potential of Alternative and Mitigation Measure Being Considered

It is not anticipated that the Proposed Action, Alternative 2, or No Action Alternative would result in an overall increase in energy use at NOFS.

5.3 Irreversible or Irretrievable Commitment of Natural or Depletable Resources

Resources that are irreversibly or irretrievably committed to a project are those that are used on a long-term or permanent basis. This includes the use of non-renewable resources such as metal and fuel and other natural or cultural resources. These resources are irretrievable in that they would be used for this project when they could have been used for other purposes. Human labor is also considered an irretrievable resource. Another impact that falls under this category is the unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment.

The Proposed Action would result in a minor irreversible and irretrievable commitment of certain non-renewable resources. Under the Proposed Action, maintenance and construction activities, such as prescribed burning, construction of water bars, retaining walls, or diversion culverts would result in an irretrievable commitment of building materials, fossil fuels for construction vehicles and equipment, and other resources, such as human labor.

Alternative 2 would result in a minor irreversible and irretrievable commitment of certain non-renewable resources. Under the alternative, maintenance and construction activities, forest-thinning activities, construction of water bars, retaining walls, or diversion culverts would result in an irretrievable commitment of building materials, fossil fuels for construction vehicles and equipment, and other resources, such as human labor.

The No Action Alternative would result in a minor irreversible and irretrievable commitment of certain non-renewable resources. Maintenance and construction activities, such as forest thinning, hauling, construction of water bars, retaining walls, or diversion culverts would result in an irretrievable commitment of building materials, fossil fuels for construction vehicles and equipment, and other resources, such as human labor.

5.4 Relationship Between Local Short-Term Use of the Human Environment and Maintenance and Enhancement of Long-Term Natural Resource Productivity

The NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one option reduces future flexibility in pursuing other options or that giving over a parcel of land or other resource to a certain use often eliminates the possibility of other uses being performed at that site.

None of the alternatives would remove land or resources for other future or potential uses. Because all three alternatives are a collection of strategies and policies to manage the environment, there is no specific use of the environment. The one foreseeable comparison applies to the prescribed burning aspect of the Proposed Action. These prescribed burns would take place on a maximum of 14 percent of NOFS property annually. The burns would temporarily remove habitat use for wildlife, but that habitat is anticipated to recover so that the impacts would be insignificant. In the long-term, biological productivity would be enhanced by the alternatives through the preservation and enhancement of NOFS' natural resources.

5.5 Means to Mitigate and/or Monitor Negative Environmental Impacts

Avoidance measures and monitoring for the MSO would be incorporated into the Proposed Action, Alternative 2, and the No Action Alternative. Additional management activities for all alternatives would implement the use of BMPs and require following regulations to reduce impacts from erosion control, forest fuel management, and construction projects. By including these compensatory and monitoring measures in the project design, none of the alternatives would result in any significant negative environmental impacts. Therefore, no additional mitigation and/or monitoring measures would be implemented.

5.6 Any Probable Negative Environmental Effects that Cannot be Avoided and are Not Amenable to Mitigation

This EA has determined that neither the Proposed Action, Alternative 2, or the No Action Alternative would result in any significant impacts; therefore, there are no probable negative environmental effects that cannot be avoided or are not amenable to mitigation.

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Appendix A – Record of Non-Applicability

Appendix A: Record of Non-Applicability

Department of Defense
US Navy

Record of Non-Applicability

Naval Observatory Flagstaff Station
Integrated Natural Resources Management Plan
Flagstaff, Arizona

Pursuant to Section 176 (c) of the Clean Air Act, as amended by the 1990 amendments; the General Conformity Rule at 40 CFR Parts 51 and 93; and the Chief of Naval Operations Interim Guidance on Compliance with the Clean Air Act Conformity Rule, the Department of Defense (DoD) determined that the majority of practices outlined in the Naval Observatory Flagstaff Station (NOFS) Integrated Natural Resources Management Plan (INRMP) are exempt from conformity requirements. The plan outlines many routine activities that would result in no emission increase or an increase that is clearly *de minimis,* such as routine fuels management activities and small prescribed fires that would result in minor and insignificant emission increases. Prescribed burning activities would follow Arizona Department of Environmental Quality (ADEQ) guidelines for burning, including submission of an annual burn plan and burning only on permissible days, as determined by ADEQ. Fire-related projects would require the use of vehicles to transport personnel, and so would routinely add travel-related emissions to the air. The use of diesel or gas equipment for the above-mentioned projects would be short-term and temporary, and are considered routine and thus clearly *de minimis* under the General Conformity Rule. They are consistent with the General Conformity Rule in that emissions from proposed activities are already accounted for in Arizona's emissions budget as described in the State Implementation Plan. In addition, the airshed in which NOFS is located is not a non-attainment area for any emissions. Consequently, the Proposed Action is exempt from the conformity determination requirements of the Environmental Protection Agency's conformity rule.

To the best of my knowledge, the information contained in the DOI's applicability analysis is correct and accurate and I concur in the finding that air emissions associated with the proposed action are below *de minimis* levels, are not regionally significant, and therefore do not require further conformity analysis or determination.

Robert Fischer — October 5, 2011

Robert Fischer
Air Program Manager
Naval Air Facility El Centro
Commander, Navy Region Southwest

Date

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