U. S. AIR FORCE

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

Overseas Installations on Host Nation Lands

Kunsan Air Base

(See INRMP signature pages for plan approval date)

ABOUT THIS PLAN

This installation-specific Environmental Management Plan (EMP) is based on the U.S. Air Force's (AF) standardized Integrated Natural Resources Management Plan (INRMP) template for installations located on lands belonging to a Host Nation (HN). This INRMP has been developed in cooperation with applicable stakeholders, to include appropriate HN authorities. The INRMP documents how natural resources are managed and the roles and responsibilities of stakeholders in implementing the INRMP. Overseas installations will comply with applicable Final Governing Standards (FGS). External resources, including Air Force Instructions (AFIs); AF Playbooks and Department of Defense (DoD) policy, are referenced.

Certain sections of this INRMP begin with standardized, AF-wide "common text" language that addressees AF and DoD policy, FGS, HN, and applicable United States laws. This common text language is restricted from editing to ensure that it remains standard throughout all plans. Immediately following the AF-wide common text sections are installation sections. The installation sections contain installation-specific content to address local and/or installation-specific requirements. Installation sections are unrestricted and are maintained and updated by AF environmental Installation Support Teams (ISTs) and/or installation personnel.

NOTE: The terms 'Natural Resources Manager', 'NRM' and 'NRM/POC' are used throughout this document to refer to the installation person responsible for the natural resources program, regardless of whether this person meets the qualifications within the definition of a natural resources management professional in DODI 4715.03.

TABLE OF CONTENTS

DOCUMENT CONTROL

Record of Review – The INRMP is updated not less than annually, or as changes to natural resource management and conservation practices occur, including those driven by changes in applicable regulations. In accordance with (IAW) AFI 32-7064, *Natural Resources Management*, the INRMP is required to be reviewed for operation and effect not less than every five years. Annual reviews and updates are accomplished by the base Natural Resources Manager (NRM), and/or an Installation Support Team Natural Resources Media Manager. At a minimum, the installation NRM conducts an annual review of the INRMP in coordination with internal stakeholders where applicable, and accomplishes pertinent updates. Installations will document the findings of the annual review in an Annual INRMP Review Summary. By signature to the Annual INRMP Review Summary, the installation Asset Management Flight Chief asserts concurrence with the findings. Any agreed updates are then made to the document, at a minimum updating the work plans.

INRMP APPROVAL/SIGNATURE PAGES

Cross functional review of this plan was performed and implementation is recommended.

Signed on 18 June 2018	Signed on 19 June 2018
MATTHEW R. ALTMAN, Lt Col, USAF Commander, 8th Civil Engineer Squadron	WESLEY R. HALES, Lt Col, USAF Commander, 8th Operations Support Squadron

Approval for implementation of this plan is authorized by the undersigned.

Signed on 24 June 2018

TERRENCE L. WALTER, Colonel, USAF
Commander, 8th Mission Support Group

ANNUAL REVIEW and UPDATE

FY19	Signed by Lt Col Christopher D. Bulson	5 Aug 2019
	Commander, 8th Civil Engineer Squadron (8 CES/CC)	
FY20	Signed by Major Seanmichael T. Kelly	2 Oct 2020
	Deputy Commander, 8th Civil Engineer Squadron (8 CES/CD)	
FY21	Digitally signed by VICK.STEVEN.MICHAEL.1235400320 Date: 2021.09.12 13:53:34 +09'00'	12 Sep 2021
	Commander, 8th Civil Engineer Squadron (8 CES/CC)	Date Reviewed
FY22		
	Commander, 8th Civil Engineer Squadron (8 CES/CC)	Date Reviewed

EXECUTIVE SUMMARY

The purpose of this Integrated Natural Resources Management Plan (INRMP) is to provide a tool for managing Kunsan Air Base's (AB) natural resources. The goal of Kunsan's INRMP is to integrate the varied aspects of natural resources management with each other and with Kunsan AB's mission.

This INRMP provides a framework for base organizations to consult when making decisions regarding future base activities or development. The framework encourages base organizations to fully consider the natural resources present on Kunsan AB's property and the effect of increased development. This INRMP:

- Briefly presents a peninsula-wide summary of Korea and its natural resources
- Identifies current and future mission activities and constraints to development
- Records known natural resources present on Kunsan AB
- Identifies protected species
- Identifies bird aircraft strike hazard (BASH) issues
- Provides a land management and outdoor recreation plan
- Proposes management goals
- Proposes a course of action to attain those goals

Using an ecosystem based approach, the proposed course of action satisfies all natural resource management requirements prescribed by the Environmental Governing Standards (United States Forces Korea [USFK] Regulation 201-1, 30 July 2020) and all applicable requirements of the U.S. Department of Defense (DoD) and the Air Force (AF).

Thirteen specific action items were originally proposed in Kunsan AB's first INRMP (1997-2001) and the first 5-year revision to the plan (2003-2007). Five action items required biotic surveys and eight identified routine on-going planning and training requirements for the 8th Civil Engineer Squadron, Environmental Engineering Element (8 CES/CEIE) personnel. The status of the original thirteen action items is summarized as follows:

- Action 1 Habitat Delineation — Complete
- Action 2 Avian Survey — Complete (continues in Action 12)
- Action 3 Biotic Survey — Revised
- Action 4 Threatened and Endangered Species Survey — Complete
- Action 5 Natural Resource Management Planning — On-going requirement
- Action 6 Natural Resources Training — On-going requirement
- Action 7 Tacit Agricultural Agreement — Land Partnership Plan
- Action 8 Coastal and Marine Resources Plan — No longer required
- Action 9 Update Management of Special Species Guidebook — Complete
- Action 10 Outreach Communication with ROK Personnel — On-going
- Action 11 Post Signs at Protected Species Locations — On-going
- Action 12 Ecosystem Monitoring — On-going (Action 2)
- Action 13 Urban Forest Management — Not implemented

Section 9 provides an up-to-date status report of action items proposed during earlier iterations of this plan, a conformity matrix demonstrating compliance of this plan with the KEGS, and proposed actions and cost estimates for the next five years. Additionally, Section 7.8 summarizes the management strategies that have been proposed for the various Natural Resource Management Units found on Kunsan AB.

1.0 OVERVIEW AND SCOPE

This INRMP was developed to provide for effective management and protection of natural resources. It summarizes the natural resources present on the installation and outlines strategies to adequately manage those resources. Natural resources are valuable assets of the United States Air Force. They provide the natural infrastructure needed for testing weapons and technology, as well as for training military personnel for deployment. Sound management of natural resources increases the effectiveness of Air Force adaptability in all environments. The Air Force has stewardship responsibility over the physical lands on which installations are located to ensure all natural resources are properly conserved, protected, and used in sustainable ways. The primary objective of the Air Force natural resources program is to sustain, restore and modernize natural infrastructure to ensure operational capability and no net loss in the capability of AF lands to support the military mission of the installation. The plan outlines and assigns responsibilities for the management of natural resources, discusses related concerns, and provides program management elements that will help to maintain or improve the natural resources within the context of the installation's mission. The INRMP is intended for use by all installation personnel. The FGS is the driver for the INRMP.

1.1 Purpose and Scope

This INRMP guides short term natural resources management activities and long-range planning for Kunsan AB's mission needs. This plan is for all planning activities at Kunsan AB. The INRMP identifies potential environmental constraints to ecologically sensitive areas and a management approach to protecting resources while accommodating land uses and activities vital to the 8th Fighter Wing's (8 FW) mission. It serves as the information source on which commanders can base their decisions.

1.2 Management Philosophy

It is United States Department of Defense (DoD) policy to display environmental security leadership within DoD activities worldwide. The DoD's policy set forth in DoD Directive (DoDD) 4715.1E, *Environmental, Safety, and Occupational Health (ESOH)* is to:

a. Manage and apply DoD's installation assets to sustain the DoD national defense mission
b. Use the vision, missions, and goals of the DoD's Defense Installation Plan to guide ESOH decisions
c. Use ESOH management systems in mission planning and execution across all military operations and activities, including acquisition, procurement, logistics, and facility management
d. Ensure organizations plan, program, and budget to manage the ESOH risks their activities generate
e. Evaluate all activities of current and emerging ESOH resource requirements and make prudent investments in initiatives that support mission accomplishment, enhance readiness, reduce future funding needs, prevent pollution, prevent illness and injury, ensure cost-effective compliance, and maximize the existing resource capability
f. Ensure through a host-tenant agreement or otherwise, that all DoD tenants and non-DoD tenants comply with all applicable laws and DoD policies relating to ESOH requirements
g. Protect DoD personnel from accidental death, injury, or occupational illness
h. Protect the public from risk of death, injury, illness, or property damage because of DoD activities
i. Establish and maintain open and productive dialogue with host nation governments and, as appropriate, other foreign governments and relevant international organizations

DoD Instruction (DoDI) 4715.03, *Natural Resources Conservation Program*, requires INRMPs to:

- Incorporate the principles of ecosystem-based management
- Contain information needed to make appropriate decisions about natural resources management

- Maintain a relevant and updated baseline list of plans and animal species
- Ensure that biological and geographically significant or sensitive natural resources are monitored and managed for their protection and long-term sustainability

To implement this policy outside United States (U.S.) territory, the DoD promulgated DoDI 4715.5, *Management of Environmental Compliance at Overseas Installations*. That instruction sets forth requirements in the Overseas Environmental Baseline Guidance Document (OEBGD) establishing DoD Executive Agents for each foreign country to develop and publish the standards for environmental compliance.

Air Force Policy Directive (AFPD) 32-70, *Environmental Quality*, identifies achieving and maintaining environmental quality as an essential part of the AF mission. The directive establishes policies to manage responsibly the irreplaceable natural resources held in the public trust. In the U.S., the AF implements this policy through the requirement for integrated natural resources management planning (Air Force Manual [AFMAN] 32-7003, Environmenatl Conservation).

Ecosystem Management

Ecosystem management is now widely recognized as the central integrating concept in natural resources management. Instead of considering each element of the conservation program (protected species, forestry, cultural resources) and the military mission separately, the ecosystem approach views these elements collectively as a web of factors that affect each other and the overall ecosystem (Lillie and Ripley, 1998). Ecosystem management is a strategy that focuses on native species and natural processes across the regional landscape. The foundation of this approach is "contextual management" or "ecosystem thinking" at the regional level (Southerland, 1997).

The concept of ecosystem management is fully described in DoDI 4715.03, *Environmental Conservation Program*. 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 time, 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.

The ecosystem management approach is now inherent in and implemented in DoDI 4715.03 and in Chapter 3.10 of AFMAN 32-7003, *Environmental Conservation*. The requirements of these instructions are not applicable to installations overseas, but the approach is applicable and appropriate.

Biodiversity Conservation

Biodiversity conservation is an integral part of ecosystem management and refers to the maintenance of the variety of living organisms, the genetic differences among them, and their interactions, in the communities and ecosystems in which they live. Biodiversity conservation is a strategy that focuses on native species and natural processes (Southerland, 1997). Maintaining biodiversity is crucial to sustaining overall ecosystem structure and function.

A number of species are listed and protected by the Republic of Korea (see KEGS Tables 13-1 and 13-2), some of which have been reported on Kunsan AB. In addition to their protected status, these species also are integral elements of naturally functioning ecosystems. Ensuring the continued presence of these species will contribute to biodiversity conservation and the long-term structure and function of the ecosystems in which they reside. But ensuring their continued survival in a natural habitat requires a comprehensive

understanding of the life history and habitat requirements of each species.

Therefore, the biodiversity and protected species elements of Kunsan's INRMP focuses first on identifying the different types of habitats that are present on Kunsan AB. By identifying and developing management practices for habitats that support the greatest variety of life and its processes, the INRMP can serve the regional goal of preserving a core biodiversity that will ensure viable populations of native species and ecological communities.

1.3 Authority

The DoD Publication 4715.5-G, *Overseas Environmental Baseline Guidance Document* (*OEBGD*) August 31, 2018, requires the implementation of uniform conservation standards for natural resources at DoD installations and facilities in foreign countries. The OEBGD provides criteria, standards, and management practices to be used by DoD environmental Lead Environmental Components in determining Host Nation (HN) FGS in accordance with DoDI 4715.05, *Environmental Compliance at Installations Outside the United States* (2013). The OEBGD (Chapter 13) specifically requires preparation of integrated natural resource management plans for "Installations with significant land or water are"

AFMAN 32-7003, *Environmental Conservation* (20 Apr 2020) applies overseas to the extent that it is consistent with applicable international agreements, Unified Combatant Command (UCC) policy, environmental annexes to operational orders or plans, country specific FGS, or in their absence, the OEBGD.

AFI 32-7001, *Environmental Management*, requires installations to identify processes or activities that include reducing pollution, reducing the use of natural resources, and conserving water.

The Kunsan AB INRMP was prepared in accordance with AFI32-7091, *Environmental Compliance at Installations Outside the United States*, and complies with and satisfies the requirements of the following:

a. The National Environmental Policy Act (NEPA) does not directly apply overseas; E.O. 12114, *Environmental Effects Abroad of Major Federal Actions*, does directly apply.
b. The KEGS, Regulation 201-1, 18 June 2012 for United States Forces, Korea (USFK); the requirements can be found in Table 9.1
c. AFI 32-7091 implements Department of Defense Instructions (DoDI) 4715.05, *Environmental Compliance at Installations Outside the United States*, 4715.08, *Remediation of Environmental Contamination Outside the United States*, Title 32, Code of Federal regulations (C.F.R.) Part 187, *Environmental Effects Abroad of Major Department of Defense Actions*, and Air Force Policy Directive (AFPD) 32-70, *Environmental Quality*. It provides information, objectives, and practices that are unique to Air Force environmental activities in overseas areas. It identifies requirements for environmental compliance, remediation, and environmental impact analysis process (EIAP) at Air Force installations and other enduring locations. Regarding compliance, it complements AFI32-7001, *Environmental Management*.
d. AFI 32-1015, *Integrated Insatllation Planning,* relies on this INRMP as an element providing natural resources databases, documents, and maps

1.4 Integration with Other Plans

In accordance with AFI 32-1015, *Integrated Insatllation Planning*, the development of an Installation Development Plan (IDP) is mandatory for all bases. The AFI lists responsibilities and requirements for comprehensive planning and describes procedures for developing, implementing, and maintaining the IDP. The IDP is a document that compiles and integrates four component plans: Composite Constraints and

Opportunities, Infrastructure, Land Use, and Capital Improvements. Combined with the Integrated Cultural Resources Management Plan (ICRMP), this INRMP becomes an essential element of the Composite Constraints and Opportunities Component Plan of the IDP.

When planning a project, the 8 FW must comply with the aforementioned DoDI 4715.05, KEGS, Chapter 13, and AFI 32-7091, *Environmental Management Outside the United States*. Specifically, the EIAP is used to evaluate the potential impacts of new projects to natural resources through use of Air Force TRIRIGA service request and/or 813, and to coordinate activities that affect natural resources.

Planning elements to which this plan refers include the 8TH FIGHTER WING BIRD/WILDLIFE AIRCRAFT STRIKE HAZARD (BASH) PLAN, 1 Jan 2019) and the ICRMP. Other plans still to be developed include the Integrated Pest Management Plan, and Air Installation Compatible Use Zone (AICUZ) Plan.

2.0 INSTALLATION PROFILE

Office of Primary Responsibility	8 CES/CEIE has overall responsibility for implementing the Natural Resources Management program and is the lead organization for monitoring compliance with applicable federal, state and local regulations
Natural Resources Manager/POC	Name: Mr. Chon, MinSik Phone: DSN 782-6240 Email: min.chon.kr@us.af.mil
Host Nation POCs	Gunsan City, Department of Culture and Art, Tel: 063-454 3274 / Fax: 063-452-8210
Total acreage managed by installation	2,549
Total acreage of wetlands	Two seasonal wetlands in CE Area located between the munitions storage area and Haji Village, and one in Golf Course ponds
Total acreage of forested land	37
NR Program Applicability (Place a checkmark next to each program that must be implemented at the installation. Document applicability and current management practices in Section 7.0)	☒ Invasive species ☒ Wetlands Protection Program ☒ Grounds Maintenance Contract/SOW ☐ Forest Management Program ☐ Wildland Fire Management Program ☐ Agricultural Outleasing Program ☒ Integrated Pest Management Program ☒ Bird/Wildlife Aircraft Strike Hazard (BASH) Program ☐ Coastal Zones/Marine Resources Management Program ☒ Cultural Resources Management Program

2.1 Installation Overview

2.1.1 Location and Area

Kunsan AB is situated on approximately 2,557 acres on the western side of the Korean Peninsula in the Chollabuk-do Province. It is approximately 8 miles southwest of Kunsan and 130 miles south of Seoul (Figure 2.1). At one time, the southern boundary of the base was adjacent to an estuary formed by the confluence of the Mangyeung and Dongjin Rivers with the Yellow Sea. Collectively, this coastline and estuarine complex is known as the Saemangeum Wetland and is the most dominant natural feature and habitat type associated with Kunsan AB. Completion of the Saemangum Seawall in 2006 has resulted in the estuary coast now being located several miles to the west of the base boundary.

The base has two intersecting 9,000-foot runways, mission support structures, housing, and recreational facilities. The active north-south runway lies between two groups of low hills that were islands before the

base was constructed. To the south, two rocky outcrops flank the approach to the runway. The eastern hill, Little Coyote, is the location of the firing range and a Republic of Korea Air Force (ROKAF) Logistics storage facility. The western hill, Big Coyote, extends to the shore and is currently used by the ROK Army for coastal defense. Defensive perimeter positions dot the heights. A lower, less rugged hill to the north of the runway supports the water plant and Wolf Pack Park. A second runway branches to the northeast (Figure 2.1).

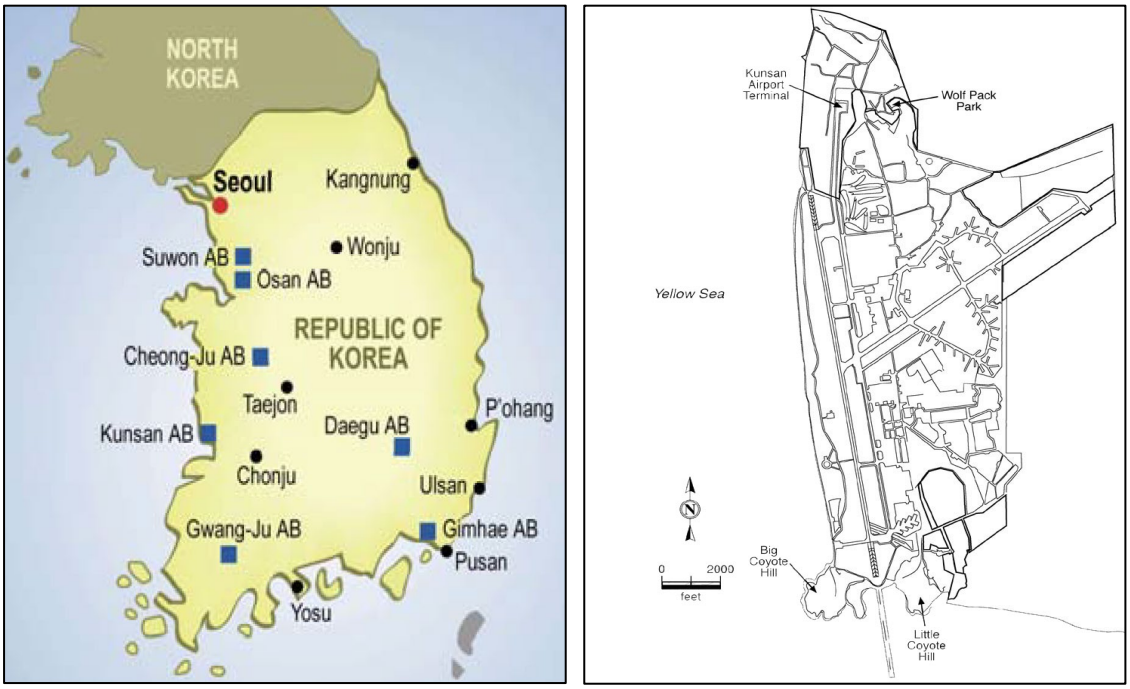

Figure 2.1 Location (left) and General Layout of Kunsan AB

Although in use by U.S. forces since 1945, the land for the base was not formally acquired until 1955. Maps associated with this acquisition have been lost. About 2,002 acres lie within the current fence line. Approximately 426 acres of land outside the fences are known as the "encroachment area," and contain the residences of the local population and their rice paddies (Figure 2.2).

Installation/GSU Location and Area Descriptions

Base/GSU Name	Main Use/Mission	Acreage	Addressed in INRMP?	Describe NR Implications
[Kunsan AB]	Air Base	2001.607	*Yes*	Addressed throughout plan
[Kayasan Mntn AFN]		0.028	No	N/A
POL Terminal	POL Transfer	1.19	No	N/A

2.1.2 Installation History

Figure 2.2 Aerial View of Kunsan AB.

Originally built by the Japanese as a fighter-interceptor base in 1938, Kunsan AB became the home of the U.S. Military Assistance Advisory Group in Korea at the end of World War II. In 1949, United States Forces left Korea, turning the base over to the then fledgling ROKAF. In July 1950, at the outset of the Korean Conflict, Kunsan AB was occupied by North Korean forces. The 3rd Battalion, 24th Infantry, United States Army, recaptured the base and Gunsan City on 30 September 1950. In April 1951, the 27th Air Base Group became the first AF unit assigned to the base. The 27th oversaw rehabilitation of Kunsan AB. The Army's 808th Engineer Aviation Battalion built a 5,000-foot runway to replace the old runway constructed by the Japanese. The 3rd Bombardment Wing moved to the base on 22 August 1951 as Kunsan AB's first assigned aircraft wing. After the 3rd Bombardment Wing returned to Japan at the end of the Korean conflict, Kunsan AB was home to many U.S. units. The 6170th Air Base Wing operated and maintained the base from 1954 to 1971. The 3rd Bombardment Wing returned to Kunsan AB as the 3rd Tactical Fighter Wing and stayed until the 1974 arrival of the 8th Tactical Fighter Wing, which was subsequently changed to the 8th Fighter Wing (8 FW) on 1 February 1992. A more detailed, in-depth historic discussion of Kunsan AB can be found in the ICRMP.

2.1.3 Military Missions

Kunsan AB is home to the 8 FW, known as the "Wolf Pack." The mission of the 8 FW is to "Defend the base, accept follow-on forces, take the fight North" and, to conduct training and engage in exercises to ensure combat readiness and to operate, maintain, and administer Kunsan AB.

The 8 FW is comprised of the 35th Fighter Squadron (FS) "Pantons" and the 80th FS "Juvats." They perform both air-to-ground and air-to-air missions in support of numerous operations throughout the Pacific.

With assigned F-16C/D aircraft and approximately 3,000 military and civilian members, the 8 FW carries out its daily peacetime duties and remains ready to execute its combat missions. The base makes an important contribution to the local economy through local employment and purchases from local businesses.

The organizations within the 8 FW that manage or otherwise have a potential management impact on natural resources include:

- **8th Civil Engineer Squadron (8 CES)**
  - Installation Management Flight (CEI) ensures this plan is current, accurate, and in accordance with applicable environmental requirements. 8 CES/CEIE provides technical assistance to activities in implementing this plan.
  - Pest Management (CEOIE) coordinates all pest management functions, including supporting the requirements of the BASH, landscape management, grounds maintenance programs and is the office of primary responsibility (OPR) for the development of the *Integrated Pest Management Plan*.
  - Engineering Flight (CEN) oversees the development of major new construction projects and ensures that all construction projects are coordinated with this plan, including the timely submission of AF Form 813.
  - Service Contracts (CEOES) oversees many of the maintenance operations and contracts, including grounds maintenance.
- **8th Fighter Wing Flight Safety (8 FW/SEF)** serves as the OPR for the 8 FW BASH Plan
- **8th Force Support Squadron (8 FSS)** surveys, operates, maintains, and develops outdoor recreational facilities, including the golf course, athletic fields, etc

Listing of Tenants and NR Responsibility

Tenant Organization	NR Responsibility
Air Force Judiciary Area Defense Counsel, Det QD7D *Air Force Office of Special Investigations, Det 613* *Grey Eagle* *Armed Forces Korea Network, Det 15, OL-B* *Army and Air Force Exchange Service* *Army Contracting Command, Korea* *Army Corps of Engineers, Project Office* *Contract Air Terminal Operations* *Defense Commissary Agency* *U.S. Army 2nd Battalion, 1st Air Defense Artillery Regiment; 35th Air Defense Artillery Brigade* *Defense Logistics Agency*	*All tenant units are required to comply with NR responsibility as specified in this INRMP. All military personnel are briefed on proper Natural Resources management through the new comers brief.*

2.1.4 Surrounding Communities

With a current population of approximately 300,000, Gunsan City (8 miles northeast of the base) is a deep-water port that accommodates large ocean-going vessels on the Yellow Sea. The port was built by the Japanese and opened in 1899. The city replaced the existing Korean fishing villages along the Kum River. A major effort to reclaim the estuarine mudflats started in 1923; the resultant polders were converted to rice paddies. The area's rice and fish were exported to Japan. Today, major economic activities include fishing, agriculture, tour industry preserved during Japanese colonial period, and heavy industry (e.g., ship building).

Several small, primarily farming communities are located immediately adjacent to Kunsan AB, and a golf course is operated southeast of Kunsan AB. North of the base, the village of Sun Rok Li extends from the main gate along Kunsan AB's northern perimeter below Wolf Pack Park and westward to the Kunsan Airport terminal. Largely an agricultural community, Sun Rok Li's residents are primarily rice farmers. Figure 2.3 shows some of the communities and farmlands bordering the base.

Figure 2.3 Communities Adjacent to Kunsan AB to the North (A), East (B), and South (C).

2.1.5 Local and Regional Natural Areas

Kunsan AB had been bounded on the west by the Yellow Sea and on the south by the Mankyung River estuary. This area, the Saemangeum Coastal Area is an estuarine tidal flat regarded as a significant ecological resource for migrating waterfowl and shorebirds. The Saemangeum Coastal Area lays at the mouths of the Dongjin and Mangyeong Rivers, on the coast of Jeollabuk-do. It is just south of the estuary of the Geum River. The broad estuary was a rich source of shellfish for local villagers. Shellfish, sea cucumbers, octopus, and other invertebrates were traditionally harvested daily by local villagers during low tide (Figure 2.4).

Figure 2.4 Local Residents Historically Harvested Shellfish from the Saemangeum Coastal Area west of and adjacent to Kunsan AB

The Saemangeum Coastal Area was dammed by the Saemangeum Seawall Project, contruction of which began in 1991 and was completed in 2006. The completed 33 km long seawall is the longest in the world and replaces a coastline that was approximately 100 km in length. The project is intended to create 400 km^2 (150 mi^2) of farmland and a freshwater reservoir. Figure 2.5 shows the area of the Saemangeum Coastal Area before and after construction and completion of the seawall.

Figure 2.5 The Saemangeum Coastal Area Before (left; May 1989) and After (right; May 2018) Completion of the Saemangeum Seawall.

With completion of the seawall in 2006 and subsequent reclamation of the tidal flats, the coastline has moved several miles to the west of Kunsan AB, with the mudflats and shallow estuarine habitat being replaced with dry grassland habitat. The seawall and the effects of its closure in 2006 are discussed further in later portion of this section as well and later sections of the INRMP.

The Yellow Sea is a semi-enclosed shallow sea between the Korean Peninsula and China and occurs along the East Asian-Australian Flyway. This flyway is one of eight major shorebird flyways around the world and stretches from Alaska and Siberia southward through east and southeastern Asia to New Zealand and Australia. It supports over 7 million shorebirds, of which approximately 5 million are migratory. With more than 2.5 million acres of tidal flats (Moores and Moores, 2003), the coastal areas of the Yellow Sea provide key migration stopover sites for many shorebird species and support important concentrations of some species during the non-breeding season. It is estimated that 1 million shorebirds use the Yellow Sea wetlands during the northern migration and around 1 million shorebirds pass through the region on southward migration (Barter, 2002).

The Saemangeum Coastal Area forms the single most important migratory water bird site on the Yellow Sea (Barter 2002), and is known to support over 100,000 shorebirds at peak times and many more through the year. A total of 30 species of migratory water birds may be found in the Saemangeum Coastal Area in internationally important concentrations (Moores, 2002). An internationally important wetland is defined as one that regularly supports 1% or more of of the individuals in a population of a species or subspecies of waterbird, or regularly supports 20,000 waterbirds (Ramsar 2017).

With completion of the seawall, seawater and river may only enter or leave the enclosed Saemangeum Coastal Area through two gates (Lie et al., 2004). The completed seawall now seals off the entire Saemangeum Coastal Area from the Yellow Sea's tidal flow and influence, and as a result (together with reclamation activities by the ROK), the Yellow Sea's coastline which was previously adjacent to Kunsan AB has to date withdrawn as much as 2 mi to the west of the base (Figure 2.6), and will continue to further withdraw to the west as reclamation of the area continues.

Figure 2.6 Yellow Sea Coastline Retreat at Kunsan AB following Completion of the Saemangeum Seawall, Present Day.

To date, environmental effects of the seawall closure have included:

1. Extensive loss of the tidal flats;
2. Extensive loss of a marine breeding grounds for fish and shellfish;
3. A commensurate loss of the local commercial fisheries;
4. A probable decline of many resident and migratory waterbird populations (Moores and Moores, 2003);
5. A potential lowering of the water table and mobilization of groundwater contaminants; and
6. Potential local meteorological changes for Kunsan AB.

2.2 Physical Environment

2.2.1 Climate

Current Climate Conditions

The climate of South Korea is continental with the extremes tempered by the presence of water on three sides (Figure 2.7). There are four distinct seasons roughly corresponding in time and temperature to those of the central United States. Winter at Kunsan AB extends from November through early March. During this period, daytime temperatures (°F) range from the mid-50s in November to mid-30s in January. Strong northwest surface winds during these months can produce wind-chill factors far below zero. Snowfall occurs most often in December and January, with an average monthly accumulation of 1.8 inches.

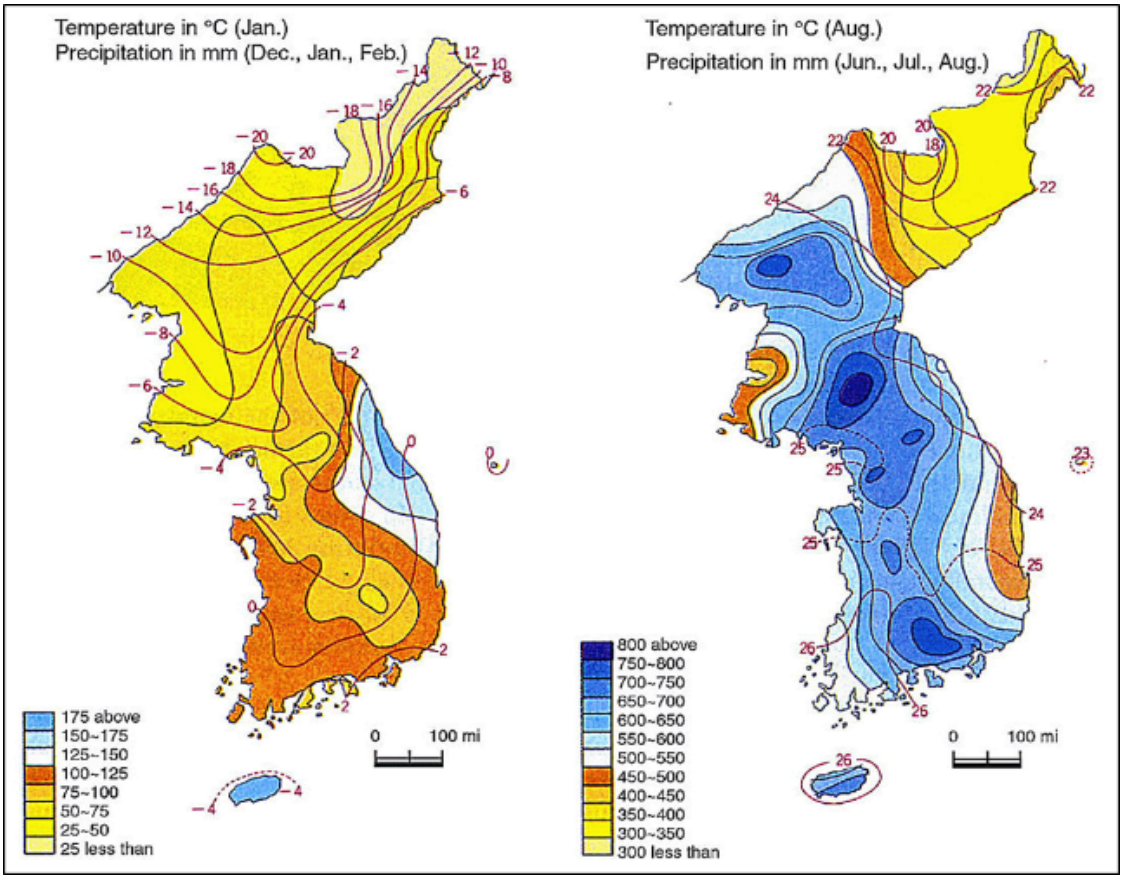

Figure 2.7 Contrast between Winter and Summer Temperatures and Precipitation
(KOIS, 1993)

Spring lasts from March to the end of May. Average daily high temperatures increase from about 50 ºF to 75ºF at Kunsan AB, while daily lows rise from 30ºF to 55ºF. Winds are generally westerly. About 10 inches of rain can be expected during this 3-month period.

Summer lasts from June to September. Average daily highs are in the upper 80s in July and August. Average low temperatures in July/August are around 70ºF. The maximum temperature on record is 99 ºF. Relative humidity is generally 70% during the day and approaches saturation every night. Visibility is restricted to less than 7 miles by a combination of haze and fog on the majority of days. The winds are typically easterly.

The summer months at Kunsan, June through mid-September, are commonly referred to as the "rainy season," or monsoon. Average rainfall for June is 5 inches, increasing to an average of 10 inches in July. Nearly one-half of the annual rainfall, about 24 inches, occurs during July and August at Kunsan AB. Rain tapers off toward summer's end to an average of 5 inches in September. June through September are Kunsan's most vulnerable months to be affected by north-westerly tracking typhoons and tropical storms in the western Pacific. Autumn at Kunsan begins at the end of September and all of October. The first killing frost usually occurs in early November.

Future Climate Conditions

A climate change assessment of Kunsan AB was conducted in 2019 (Colorado State University 2019). The results of this assessment suggest that minimum and maximum temperatures will increase over time under two carbon emission scenarios – a moderate emission scenario and a high emission scenario. The two climate change scenario assessments were developed using extracted climate data from 2026 to 2035 to represent the decadal average for 2030 and extracted data from 2046 to 2055 for the decadal average for 2050. The historical and projected future climate conditions are presentd in Table 2.1.

Table 2.1 Summary Climate Data for Kunsan AB.

Variable	Historical	Moderate Carbon Emission Scenario (RCP 4.5)		High Carbon Emission Scenario (RCP 8.5)	
		2030	2050	2030	2050
PRECIP (mm)	1259	1284	1301	1364	1570
TMIN (°C)	8.3	9.9	10.7	9.9	11.2
TMAX (°C)	18.2	19.9	20.7	19.6	20.8
TAVE (°C)	13.2	14.8	15.6	14.7	15.9
GDD (°C)	2356	2734	2916	2674	2962
HOTDAYS	12.6	33.4	49.8	27.3	46.6
WETDAYS	4.2	3.7	4.6	4.8	7.0

Notes: TAVE **°C** = annual average temperature; TMAX **°C** = annual average maximum temperature; TMIN **°C** = annual average minimum temperatures; PRECIP (cm) = average annual precipitation; GDD **°C** = Average annual accumulated growing degree days with a base temperature of 10 **°C**; HOTDAYS (average # of days per year) = average number of hot days exceeding 32 **°C** ; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 51 mm in a day.

For the decade centered around 2030, both scenarios project a similar degree of increase in average annual temperature (TAVE) of between 1.4 °C (2.6 °F) and 1.6 °C (2.9 °F) over the historical average (Table 2.1). Both emission scenario projections show higher warming by 2050, with the moderate emission scenario expressing a warming of 2.4 °C (4.3 °F), while the high emission scenario expresses a slightly greater warming of 2.7 °C (4.9 °F) for the same period.

Average annual precipitation (PRECIP) varies between emission scenarios and over time due to larger interconnected ocean-atmosphere dynamics associated with the NCAR CCSM model used to model the scenarios. For 2030, the moderate emission scenario projects a 2% increase in average annual precipitation while the high emissin scanrio shows an 8% increase. For 2050 RCP moderate and high emission sceanrios projected annual precipitation increases of 3% and 25%, respectively, over the historical average annual precipitation level (Table 2.1).

.

2.2.2 Landforms

The Korean Peninsula is an S-shaped peninsula extending about 600 miles south-eastward from the Asian continent. The peninsula is slightly smaller than the United Kingdom, covering a land area of about 85,256 mi^2, including approximately 200 coastal islands. The country is divided roughly in half just north of the 38th parallel. The Republic of Korea (ROK) (38,031 mi^2) is slightly larger than the state of Indiana. The ROK and the Demographic Peoples Republic of Korea (DPRK) (45,768 mi^2) are separated by the 2.5-mile-wide demilitarized zone (DMZ), which totals another 487 mi^2.

The Korean Peninsula borders China and Siberia in the north and is separated by the Amnok and Tuman Rivers. On the east, the peninsula is separated from Japan by the East Sea (Sea of Japan). The East Sea has a narrow shelf area (less than 19 miles wide) and abruptly deepens to the east (Lee, 1988). The South Sea, or Korea Strait, bounds the Peninsula on the south and connects the East Sea with the East China and Yellow Seas. The South Sea is approximately 34 miles wide but not as deep as the East Sea. The coast is extremely irregular with many points, peninsulas, and bays.

On the west, the ROK is separated from China by the Yellow Sea. The Yellow Sea occupies a shallow, flat and broad continental shelf with water depth of less than 330 feet (Lee, 1988). Kunsan and Mokpo are the best natural harbors on the west coast. At Chinnampo and Inchon, there is a difference of 29 feet between low and high tides, the second greatest tidal movement in the world. The exceptionally high tidal fluctuations of the Yellow Sea developed the broad, tidal mudflats once found at Kunsan AB. Wide areas of the coast and lower reaches of rivers (up to 30 miles above their deltas) are often flooded with salt water.

The widest plains in ROK can be found along the west coast near the major rivers where overall elevations are near sea level. These plains developed as a result of sedimentation related to the current sea level position. The plains are wide as compared with the associated rivers, leading to the alluvial deposits forming a relatively thin cover.

Most of the ROK's major rivers flow into the Yellow Sea or South Sea. The Geum (249 miles long) and Mangyeong (48 miles long) Rivers drain into the Yellow Sea at the City of Gunsan. Other major rivers include the Han River (319 miles long), which flows through Seoul into the Yellow Sea, and the Nakdong River (325 miles long), which flows into the South Sea east of the Kimhae Storage Annex. River discharge fluctuates seasonally, depending on the intensity of summer monsoons. In summer, the rivers swell, causing the valley plains to flood once or twice per season. During the dry seasons, the water level is very low, and most of the riverbeds are exposed. The gradient of the lower reaches of the major rivers is low, which permits navigation for long distances upstream from the rivers' mouths (Gunsan, Busan, and Seoul).

About 70% of the Korean Peninsula is characterized by rugged, mountainous terrain (Figure 2.8). The mountains are not high, averaging 1,580 feet. Mt. Paektu (9,000 feet) represents the highest peak in the DPRK, while Mt. Halla (Hallasan) is the highest peak (6,400 feet) in the ROK. It is located on the island province of Jeju.

The mountain ranges of the Korean Peninsula run in two general directions: north-to-south and northeast-to-southwest (Figure 2.8). In the ROK, the Taebaek Range is the major north-south range. The Taebaeks form the geologic backbone of the Peninsula and form the drainage divide between the eastern and western slopes. Low hills located mostly in the south and west, gradually give way north-eastward to the increasingly higher Taebaeks. The western and southern slopes are gentle with plains, low hills, and basins developed along the rivers.

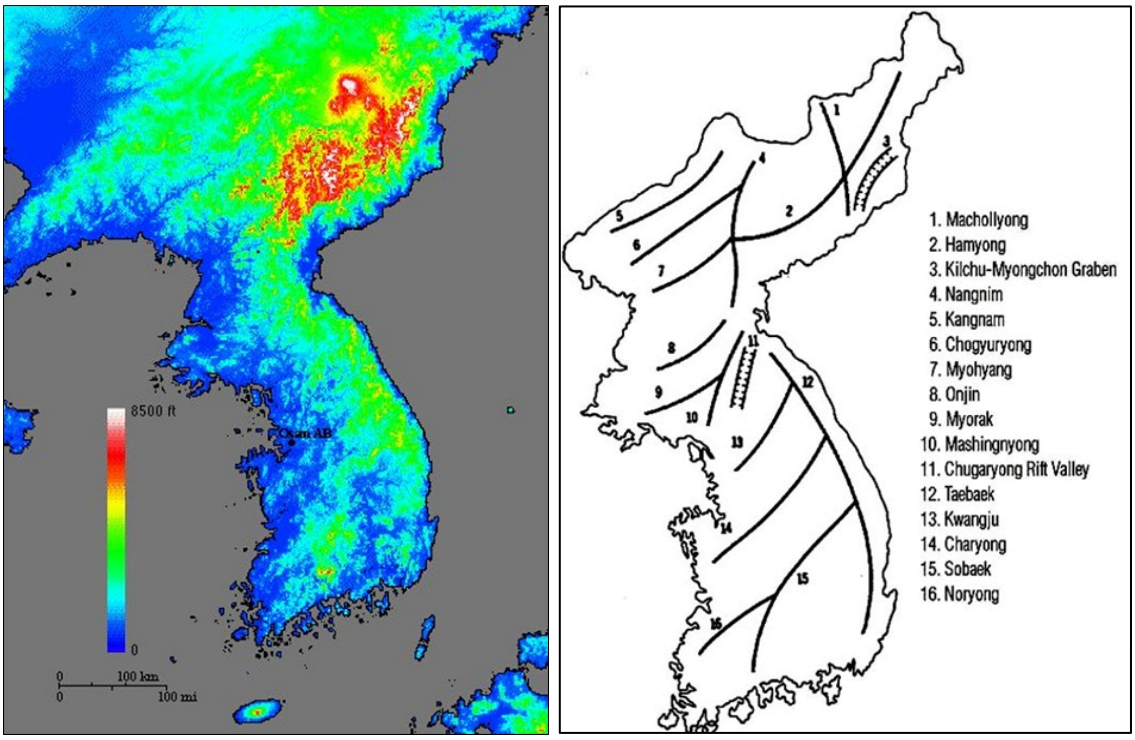

Figure 2.8 Topography (left) and Mountain Ranges (right) of Korea
(Sadalmelik, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=2665772); and Kim 1988a))

2.2.3 Geology and Soils

The Korean Peninsula is generally recognized as part of the Sino-Korean Platform. The geological, geologic and tectonic settings are very similar to those of northern China. Geologically, the Korean Peninsula consists of a block of an ancient Precambrian granite platform topped with later sediments and granitic intrusions. Overall, the platform is tilted downward toward the west and the Yellow Sea. Archeozoic rocks compose the foundation of the platform and crop out widely on the Peninsula as the Kwanmobong, Nangnim, Kyonggi, and Ryongnam Massifs. Most of the granite-gneiss hills of the present Korean landscape are Archeozoic rocks. Kunsan AB falls within the Okchon Paleosynclinal Zone of the Okchon Folde Belt (#7-2, green, in Figure 2.9). Geomorphologically, the base lies on the edge of the Honam Plain,

a relatively flat part of the Ogcheon Fold Belt (Chough 1983), where land gradually gives way to the Yellow Sea. The flats are punctuated by protruding rocky hills, which may have been islands in the past.

At Kunsan AB, the bedrock is buried beneath the combined sediments deposited by the Geum and Mangeung Rivers, with Pyongan outcrops of Big and Little Coyote Hills and Wolf Pack Park. Figure 2.10 shows the Little Coyote Hills outcrop. Visual inspection shows the outcroppings to be comprised of a reddish conglomerate matrix of coarse, red sandstone with well-rounded quartzite and limestone pebbles about 0.4 in. in size (Figure 2.10).

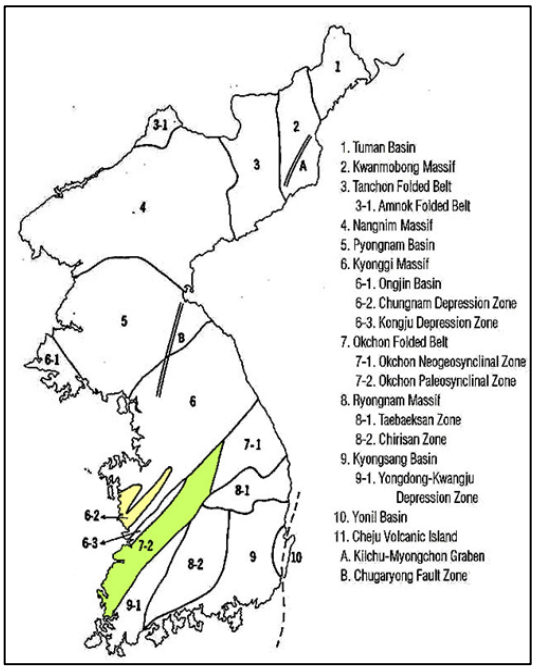

Figure 2.9 Physiographic Provinces of Korea)

Earthquake frequency and intensity in the Pacific are directly related to proximity to the Circum-Pacific Earthquake Belt. Japan is located on the belt, while the Korean Peninsula is some distance from it. Between 1905 and the early 1990s, more than 200 earthquakes were recorded, of which 48 were considered destructive (KOIS, 1993). Five earthquakes with a magnitude over 5.0 occurred between 1978 and 2009. About 24 minor and intermediate earthquakes occur annually (Korea Meteorological Administration 2009). In the ROK, the earthquake zones are generally coincident with river courses. For this INRMP, some generalizations regarding potential earthquakes at Kunsan AB can be made:

- The ROK has a comparatively stronger seismic stability of the ground than DPRK;
- The western half of the Peninsula has stronger seismicity than the eastern half;
- The middle and lower Geum River basins experience somewhat higher seismic activity; and
- Almost the entire area of the Okchon Folded Belt (Figure 2.9) shows higher seismicity.

Figure 2.10 Little Coyote Hill, a Pyongan Outcrop (left) and Reddish Manhong Conglomerate

The Korean Peninsula is a relatively stable land mass and has few volcanoes and no volcanic activity. Exceptions include the small island of Ullung Do in the East Sea and the island of Jeju off the southwest coast where Mt. Hallasan is a volcanic cone. Except on the highest mountains, glacial activity is not evident on the peninsula. Sheet glaciers did not exist (Nelson, 1993) on the Korean Peninsula during the Pleistocene.

Much of what is present-day Kunsan AB is a combination of rocky outcrops, sandbar, and mudflats that existed at the turn of the century. The rocky outcrops (Big and Little Coyote and Wolf Pack Park) were originally islands in the Yellow Sea as recently as the 1930s. A substantial sandbar formed between the outcrops and is the platform for much of what today is Kunsan AB. Figure 2.11 of the Kunsan Peninsula in the 1930s dramatically portrays the island/sandbar complex of what is now Kunsan AB clearly separated from the original shoreline by reclaimed mudflats. The north-south trending hills along the east edge of the figure were likely sand dunes. Today, these dunes are vegetated with plantations of Pitch Pine (*Pinus rigida*) and Korean Chestnut (*Castenea crenata*) interspersed with remnant stands of Japanese Black Pine (*Pinus thunbergii*).

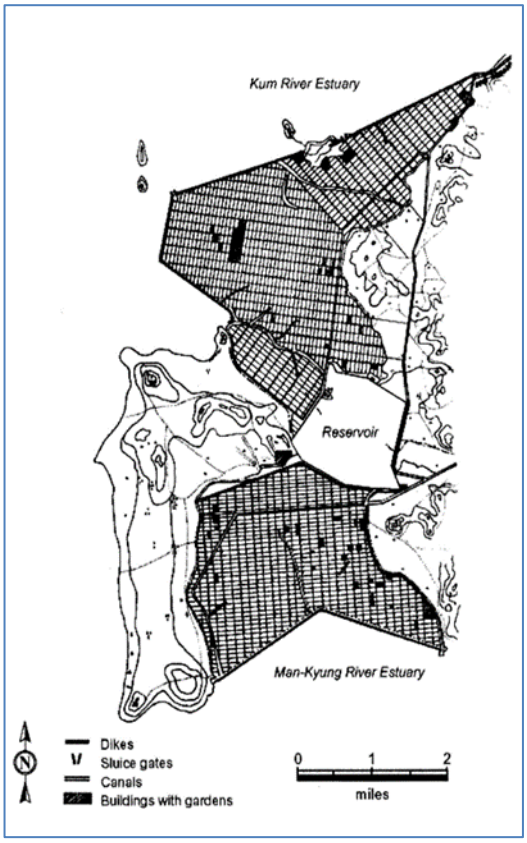

Figure 2.11 The Kunsan Peninsula in the 1930s (Lautensauch, 1945)

According to the Planning Assistance Team (PAT) study *Quality of Life Issues*, typical soils for the base consist of a gravelly sand surface and silty sand to a depth of 3 feet (PAT, 1994). Beneath that layer, fine sands extend down to 9 feet, with a clayey soil then extending down to 24 feet. Observations of excavations and construction sites around the base verify the presence of the layered sand. Engineers involved in the construction of Kunsan AB's runways during the Korean Conflict described the soils as "grayish-blue clay" that had been long inundated for rice culture (Futrell, 1983). The soils are reclaimed from the tidal flats and developed over time through plowing, irrigation, and fertilizing. Ground water is present about 2 to 3 feet below the surface. The average base elevation is only 12 feet, above mean sea level (MSL).

2.2.4 Hydrology

Kunsan AB was directly on the Yellow Sea coastline until the seawall completion in 2006, which relocated the coastline approximately three miles to the west (see Figure 2.6). The land reclamation project is impacting the offsite drainage patterns on base.

The four ponds on the base golf course are the only surface water impoundments on the base. Drainageways on the base may be found in the vicinity of the airfield, the CE Area, and along some of the base roadways, and many are actively managed to maintain water removal. Salt marshes and dune vegetation occur along some coastal stretches outside of the security fence below the southern end of the base. No floodplains are present within the boundary of Kunsan AB. Two small wetlands occur near the south end of the base. The first is an impeded drainage ditch that emerges from beneath the area overlain by the asbestos landfill. The second is immediately to the northwest of Little Coyote Hill. Several airfield drainage ditches empty into the reclaimed tidal flats area west edge of the base.

2.3 Ecosystems and the Biotic Environment

2.3.1 Ecosystem Classification

The Korean Peninsula is in the Palaearctic subregion of the Holarctic Region (KOIS, 1993). Although the southern extent of the northern boreal forests barely reaches the northern most latitudes of the PDRK, boreal forests can be found in the ROK in higher elevations such as the Taebaek Mountains and the Pilsung Range. A similar growing season would be found extending northward into the PDRK and Southern China where the elevations are similar to those associated with the Taebaek Mountain range. Slope aspect also creates microclimatic variation. For example, the timberline on a south facing slope mountain is significantly higher than on the north facing slope of the same mountain. The vegetation type varies, depending on elevation and slope.

Historical events, whether natural phenomena or human induced, also shape the biotic landscape of the Korean Peninsula. The peninsula has experienced two significant events. The first event is related to natural phenomena, specifically the lack of glaciation on the peninsula; the peninsula's mountains are not high enough to sustain glaciers or ice caps. Evidence indicates only alpine glaciers were formed above 2,000 meters in what is now the DPRK (KOIS, 1993). The resulting periglacial and somewhat arid climate during the Pleistocene Era spared many of the species that were extirpated by the continental ice sheets elsewhere. The Korean Peninsula acted as a natural refugium with a potential natural biodiversity greater than the adjoining continental regions.

Second, various conflicts and the Japanese occupation took a toll on Korea's environment. During the late 19th and early 20th centuries, peasants displaced from their lands took to the hills to practice slash-and-burn (swidden) agriculture (CRMP, 1997). Later, the Japanese exploited Korea's resources for the war effort, including deforestation and mineral extraction. Forest resources and fisheries were tightly controlled, and most forest lands were owned outright by the Government-General and logging leases were given predominantly to Japanese companies (Eckert et al., 1990). By the 1940s, forest cover remained only in the more remote regions of the Peninsula. At the end of Japanese rule, the bare hills were denuded of even brush cover and pocketed with gullies from erosion (Eckert et al., 1990). The Korean Peninsula regained its independence from colonial Japan at the end of World War II in 1945, as the ROK and the DPRK. Just five years later, the Korean Conflict (1950-1953) devastated the remaining ecosystems.

Cultural practices are also key factors affecting the condition and biodiversity of natural plant communities. Four major agricultural and/or forestry practices have been instrumental in shaping the forests and plant species seen in the vicinity of Kunsan AB today:

- Use by households and farmers of plant materials such as stems, branches, leaves, and undergrowth for fuel in cooking and "ondol" home heating (Kim et al., 1981);
- Use of similar volumes of plant materials to feed livestock;
- Collection of forest products as a food source; and
- Management of graveyards.

The management of graveyards is one of the most important factors in changing the vegetation structure in the ROK (Hong et al.,1993; Kamada and Nakagoshi 1993). On Kunsan AB, grave sites are found on and near the North POL area, Wolf Pack Park, and Little Coyote Hill. In grave construction, vegetation is removed, and soil is piled in a mound and covered by a grass crown. The graveyards are groomed once or twice a year, during which any seedlings, saplings, or other "weeds" are removed. Plants on the forest floor adjacent to the graveyards are also cut to make the graveyards more attractive (Hong et al., 1995). Security fencing and base access restrictions have suspended the other cultural practices on Kunsan AB.

2.3.2 Vegetation

The Korean Peninsula's long north-south orientation and topographic complexity provide considerable climatic and microclimatic variability, which, in turn, results in relatively high floral diversity. An enumeration of Korean plants (Lee 1993) identifies 3,161 species of native and non-native vascular plants representing 190 families. Additional subspecies, varieties, and formae extends this number beyond 4,500 kinds of vascular plants native to the pre-conflict Korea (Pak 1946). The Korean Peninsula is divided into six principal forest zones, with Kunsan AB in the Mixed Forest (South) zone (Figure 2.12).

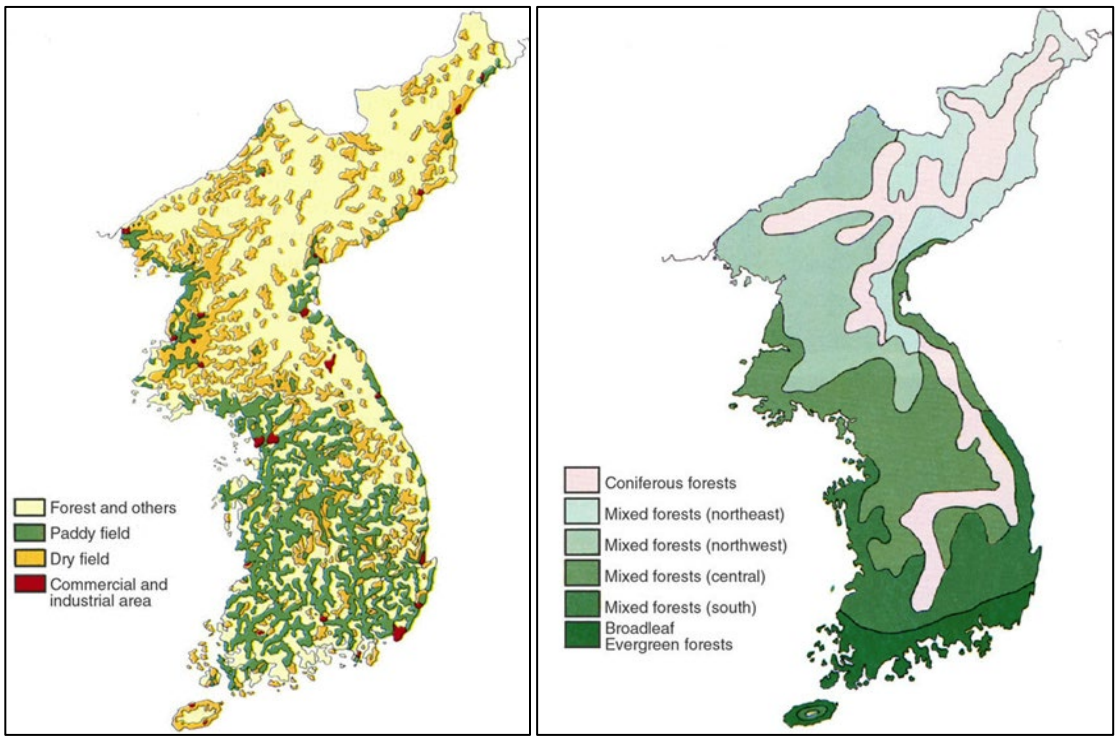

Figure *2*.12 Land Use Categories *(left)* and Vegetation Zones of Korea (KOIS, 1993)

The ROK has four forest types: (1) coniferous evergreen (or boreal) forests, (2) mixed forests (central), (3) mixed forests (south), and (4) broadleaf evergreen forest. These types are directly analogous to the three types already discussed (Yim 1977). The four basic types are discussed in more detail below.

Coniferous Evergreen Forests. The mountains of the ROK become progressively lower in altitude from north to south. At the highest elevations (above 3,000 feet, or 914 m) and on north- and northeast-facing slopes, cold-temperate evergreen forests predominate, dominated by Manchurian Fir (*Abies nephrolepis*) and Yedo Spruce (*Picea jezoensis*). Other species typically characteristic of these cold-temperate forests would include the following needle-leaved, evergreen trees: Korean Fir (*Abies koreana*), Japanese Larch (*Larix leptolepis*), Korean Arborvitae (*Thuja koraiensis*), and Korean Spruce (*Picea koraiensis*).

Mixed Forests (Central). Broadleaved deciduous tree and shrub species occupy the south- and southwest-facing slopes and lower elevations. The potential native forest vegetation would include the following broadleaved species: Mongolian Oak (*Quercus mongolica*), Daimyo Oak (*Quercus dentata*), Russian Rock Birch (*Betula ermanii*), Costata Birch (*Betula costata*), White Birch (*Betula platyphylla*), Willow (*Salix myrtilloides* var. *mandshurica*), and a relative of the willow, *Chosenia bracteosa*.

Mixed Forests (South). Kunsan AB is located in the southern Mixed Forest zone. Original natural vegetation of this zone would likely have included forests of the following broadleaved deciduous tree species: Oriental White Oak (*Quercus aliena*), Serrate Oak (*Quercus serrata*), Oriental Chestnut Oak (*Quercus acutissima*), Willow (*Salix gracilistyla*), Korean ash (*Fraxinus rhynchophylla*), Hornbeam (*Carpinus tschonoskii*), Loose-Flower Hornbeam (*Carpinus laxiflora*), White Birch (*Betula platyphylla*), Amur Linden (*Tilia amurensis*), and Japanese Snowbell (*Styrax japonica*)

Typical shrubs of the southern Mixed Forest include Korean Forsythia (*Forsythia koreana*), Shrubby Bushclover (*Lespedeza bicolor*), and several Korean Azaleas (*Rhododendron mucronulatum*, *R. schlipenbachii*, and *R. yedoense* var. *poukhanense*). Common herbaceous species include Chinese Silver Grass (*Miscanthus sinensis*), Amur Silver Grass (*Miscanthus sacchariflorus*), Feather Reed Grass (*Calamagrostis arundinacea*), Zawadzki chrysanthemum (*Chrysanthemum zawadskii*), Forest Poppy (*Hylomecon vernalis*), Siebold Primrose (*Primula sieboldii*), Chinese Bellflower (*Platycodon grandiflorum*), Japanee Lady Bell (*Adenophora triphylla* var. *tetraphylla*), Bonnett Bellflower (*Codonopsis lanceolate*), and *Melanophyrum roseum*.

Broadleaf Evergreen Forest. The south coast of the Peninsula and Jeju Island are the warmest and wettest parts of the country, and the native natural vegetation tends to be lush. More than 70 species of broadleaved evergreen species occur naturally. The vegetational variety diminishes rapidly as one approaches the southern coast from the offshore islands. Near Busan, the number of natural broadleaved evergreens is limited to fewer than 20 species, and most of those are at the northern limit of their natural distribution (KOIS 1993).

2.3.2.1 Historic Vegetative Cover

Originally most of the Korean Peninsula was forested (Figure 2.12), with grasses and herbs confined mainly to narrow alluvial riverbanks which were regularly flooded. Sporting great plant variety, the forests produced a number of trees useful to prehistoric peoples including oak, birch, fir, pine, and many kinds of fruit and nut bearing trees (Nelson 1993). The natural vegetation of the Gunsan Peninsula included pine forest on the hills. Historic accounts refer to a sandbar that is now the Kunsan AB area as being "sparsely forested," most likely with coastal pines (*Pinus* spp.) and oaks (*Quercus* spp.); and two islands, presumably Big and Little Coyote Hills, which were forested with pines.

2.3.2.2 Current Vegetative Cover

Little natural vegetation currently exists on or near Kunsan AB. The only areas of "natural" vegetation at Kunsan AB include a few remnant parcels of Japanese Black Pine on Big and Little Coyote Hills. The nearest 'natural' vegetation outside the base occurs about 1.25 miles north and about 2.2 miles east of the base and consists of stands of Pitch Pine and Korean Chestnut (Castenea crenata) with some intermixed remnant Black Pine stands (Figure 2.13). Kunsan AB's north and east boundaries are rice paddies. Reclaimed Yellow Sea estuary and mudflats are adjacent to or near the western and southern boundaries of the base.

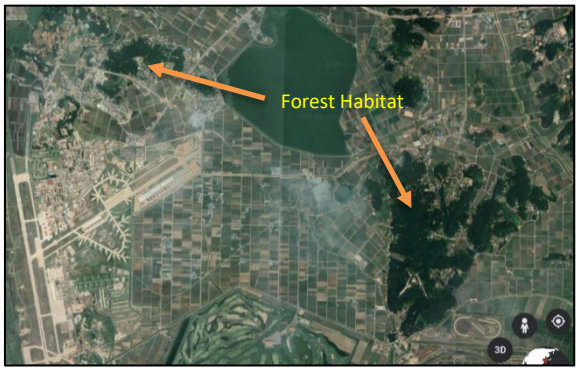

Figure 2.13 Location of Natural Vegetation in the Vicinity of Kunsan AB (MOE, 1993)

Today, Kunsan AB has no forest areas. Four small, separate tracts of unmanaged forest vegetation exist: the North POL compound, the 100 Area, Big Coyote Hill, and Little Coyote Hill. Each tract represents a distinct, natural asset though they do not resemble natural forest communities. Although these tracts do not resemble original old-growth, high-quality forest communities they do represent distinct natural assets on Kunsan AB requiring stewardship and management in accordance with the following KEGS criteria:

- KEGS Criterion 13-3.f: Installations shall maintain grounds to meet designated mission use and ensure harmony with the natural landscape and/or the adjacent ROK facilities where practical.
- KEGS Criterion 13-3.h: Installations shall place emphasis on the maintenance and protection of habitats favorable to the reproduction and survival of indigenous plants, fish, and wildlife.
- KEGS Criterion 13-3.i: Land and vegetative management activities will be consistent with current conservation and land use principles (e.g., ecosystem protection, biodiversity conservation, and mission-integrated land use), and complement the BASH program where applicable.
- KEGS Criterion 13-3.j: Installations shall utilize protective vegetative cover or other standard soil erosion/sediment control practices to control dust, stabilize sites and avoid silting of streams.

Habitat Delineation. The habitats of all unimproved areas on Kunsan AB were initially surveyed and delineated on May 18-22, 1998. Improved and semi-improved grounds, defined as either built-up or entirely managed grounds, are excluded from this discussion unless otherwise specified.

Field Surveys. First, preliminary surveys were conducted at each unimproved site for the dominant vegetative species. Natural breaks in topography, roadways, or changes in land management coupled with the dominant vegetation were used to broadly delineate four Natural Resource Management Unit (NRMUs) at the base. Detailed surveys of each NRMU were then conducted to more fully describe the plant community types present, document the plant species present, and identify any unique or critical indigenous, endemic, and ROK listed species or their habitats.

Each NRMU was given a unique locator designation. For example, if a NRMU is located on Big Coyote Hill, then it has a "BCH-" prefix followed by a unique numerical identifier (e.g., NMRU BCH-1, BCH-2, and BCH-3). On maps showing the NMRUs (e.g., Figure 2.14), the vegetation type is consistently color-coded according to the dominant species (e.g., green for pine, tan for locust, and yellow for grasslands). For vegetation mixtures, intermediate colors are used. Semi-improved areas are crosshatched.

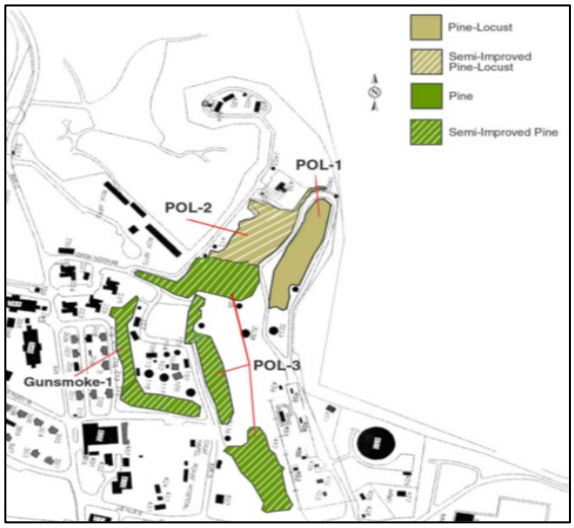

Figure 2.14 NRMUs of the North POL Area and the 100-Area

North POL Area: The North POL Area NRMUs (Figure 2.14) have undergone considerable changes since the original 1997 INRMP was written. The understory of NRMU POL-2 that was described in the original INRMP (1997) was cleared, and this NRMU was merged with NRMU POL-3 because they now both shared the same characteristics of a semi-improved pine forest. Similarly, the understory of the northwest segment of the former NRMU POL-1 was cleared and no longer shared the natural characteristics of the remainder of NRMU POL-1. Consequently, this northwest segment was re-designated in 2002 as

NRMU POL-2, a semi-improved pine-locust forest.

In addition, NRMU POL-3 as originally identified, consisted of three separate stands that extended along the west and southwest sides of the North POL Area (Figure 2.14). These stands were located on slopes facing primarily east to northeast within the North POL Area. However, the southernmost segment extended outside of the POL area and was removed by construction in 2007 and building 535 was constructed in 2010.

NRMU POL-1: Pine-Locust Forest. NRMU POL-1 is located on the northeast side of the POL area, on an east-southeast facing slope (Figure 2.14). The July 2012 field survey found NRMU POL-1 to be dominated mostly by Japanese Black Pine, and partly by Black Locust (*Robinia pseudoacacia*), Oriental White Oak, and Japanese Green Alder (*Alnus firma*). The 2019 survey found this NRMU to continue to be dominated by these same species. Figure 2.15 shows the pine-locust forest at NRMU POL-1.

Figure 2.15 Pine-Locust Forest at NRMU POL-1

The 2019 survey documented 21 plant species: the Silk Tree (*Albizia julibrissin*), Oriental Bittersweet (*Celastrus orbiculatus*), Peanut Butter Tree (*Clerodendrum trichotomum*), Queen Coralbead (*Cocculus triloba)*, Asiatic Dayflower (*Commelina communis*), Japanese Hop (*Humulus japonica*), Japanese Holly (*Ilex crenata*), Yellow Flag Iris (*Iris pseudacorus)*, Creeping Lilyturf (*Liriope spicata*), Japanese Honeysuckle (*Lonicera japonica*), Wavyleaf Basketgrass (*Oplismenus undulatifolius*), Japanese Black Pine, Platycarya (*Platycarya strobilacea*), Bracken Fern (*Pteridium aquilinum* var. *latiusculum*), Oriental White Oak, Serrate Oak, Black Locust, Multiflora Rose (*Rosa multiflora*), Smooth Greenbriar (*Smilax china*), Japanese Snowbell, and Sweet Leaf (*Symplocos chinensis* formerly *Pilosa ohwi*).

This pine-locust forest consists of 4 layers: a tree layer, a sub-tree layer, a shrub layer, and an herbaceous layer. The height of the tree layer is 26 to 33 ft, and the coverage is 90%. Common species include Japanese Black Pine and Black Locust. The height of the sub-tree layer is 20 ft with 5% coverage. Companion species include Black Locust, Oriental White Oak, Sawtooth Oak (*Quercus acutissima*), Oriental Chestnut Oak, and *Platycarya* spp. At the outskirts of the plant community are Silk Trees and Peanut Butter Trees.

The shrub layer is 3 ft high, with coverage of 5%. Common species include Sweet Leaf, Japanee Sumac (*Rhus trichocarpa*) and Chinese Sumac (*R. javanica)*, Multiflora Rose, Hazelnut (*Corylus heterophylla*), Japanese Snowbell, and Japanese Clarodendrum. The herbaceous layer is 1 ft high, with 10% coverage. The companion species were Sweetleaf, Oriental White Oak, Greenbriar, brackens (*Pteridium* spp.), Creeping Lilyturf, Chijimi-Zasa Grass, Chickweed (*Stellaria media*), Asiatic Dayflower, Pokeweed (*Phytolacca americana*), the sedge *Carex lanceolata*, Korean Raspberry (*Rubus crataegifolius*), Field Horsetail (*Equisetum arvense*) and the Wood Rush (*Luzula capitate)*.

NRMU POL-2: Semi-improved Pine-Locust Forest. NRMU POL-2 (Figure 2.16) is located on the northwest side of the POL area (Figure 2.14), occupying slopes facing primarily east-southeast. Japanese Black Pine and Japanese Green Alder are the dominant tree species. Other trees include Black Locust and Oriental White Oak. The 2019 survey of NRMU POL-2 documented 21 species: Japaneze Chaff Flower (*Achyranthes japonica*), Silk Tree, Japanese Green Alder, the invasive Common Ragweed (*Ambrosia artemisiifolia*), Korean Wormwood (*Artemisia princeps*), Asiatic Dayflower, Fireweed (*Erechtites hieracifolia*), the invasive Canadian Fleabane (*Erigeron canadensis*), Lawn Marshpennywort (*Hydrocotyle sibthorpioides*), Water Willow (*Justicia procumbens*), Waveyleaf Basketgrass, Korean Perilla (*Perilla frutescens*), Pokeweed, Japanese Black Pine, *Prunus* sp., Oriental White Oak, Black Locust, Multiflora Rose, Smooth Greebriar, Japanese Snowbell, and *Vitis thunbergii* var. *sinuata*.

Figure 2.16 Semi-improved Pine-Locust Forest at NRMU POL-2

The forest community at NMRU POL-2 consists of 3 layers: a tree layer, a shrub layer, and an herbaceous layer. The tree layer is 26 to 33 ft high, with 90% coverage. Species present include Japanese Black Pine, Japanese Green Alder, and Black Locust. The shrub layer is 7 ft high and covers about 30% of this NRMU. The companion species include Sweetlef, Oriental White Oak, Japanese Sumac, Prickly Castor Oil Tree (*Kalopanax pictus*), Glossy Privet (*Ligustrum lucidulum*), Shrubby Bushclover, Multiflora Rose, *Corylus heterophylla*, and Black Locust.

The herbaceous layer is 1.3 ft high with coverage of 10%. Species present include Oriental White Oak, Smooth Greenbriar, brackens (*Pteridium* spp.), Wavyleaf Basketgrass, Asiatic Dayflower, Pokeweed, the sedge *Carex lanceolata*, Korean Rasberry, Porcelain Berry (*Ampelopsis brevipedunculata*), Japanese Mountain Yam (*Dioscorea japonica*), Sewer Vine (*Paederia scandens*), the knotweed *Persicaria thunbergii*, Lawn Marshpennywort, Sloughgrass (*Beckmannia syzigachne*) and Asiatic Tearthumb (*Persicaria perfoliata*).

NRMU POL-3: Semi-improved Pine Forest. NRMU POL-3 (Figure 2.17) is characterized by three separate stands that extend along the west and southwest sides of the POL-North area. These stands are located on slopes facing primarily east to northeast within the POL area. The southernmost segment extends outside of the POL area and generally faces southwest (Figure 2.14). The 2019 field survey, documentd 33 plant species in this NRMU: Japanese Chaff Flower, Porcelain Berry, Korean Wormwood, *Aster* sp., Oriental Bittersweet, Chinese Hackberry (*Celtis sinensis*), Peanut Butter Tree, Queen Coralbead, *Dunbaria villosa*, the non-native Fireseed (*Erechtites hieracifolia*), Canadian Fleabane, Japanese Hop, Japanese Holly, Water Willow, Glossy Privert Border Privet (*Ligustrum obtusifolium*, Creeping Lilyturf, Chinese Silver Grass, White Mulberry (*Morus alba*), Waveyleaf Basketgrass, a *Persicaria* sp., Japanese Black Pine, *Prunus* sp., Bracken Fern, Kudzu (*Pueraria thunbergiana*), Oriental Chestnut Oak, Oriental White Oak, Black Locust, Multiflora Rose, Common Madder (*Rubia akane*), and Smooth Greenbriar.

Figure 2.17 Semi-improved Pine Forest at NRMU POL-3

This pine forest consists of 3 layers: a tree layer, a shrub layer, and an herbaceous layer. The tree layer is 39 to 49 ft high, with 60% coverage. Comon species are Japanese Black Pine, Black Locust and Oriental White Oak. The shrub layer is 4 to 6 ft high, with 30-50% coverage. The companion species are Asiatic Sweetleaf, Glory Tree, Oriental White Oak, Siberian Alder (*Alnus hirsute* var. *sibiroca*), White Mulberry, Glossy Privet, and Shrubby Bushclover. The herbaceous layer is 3 ft high with 10% coverage. Species present include Wavyleaf Basketgrass, Creeping Wood Sorrel (*Oxalis corniculata*), Japanese honeysuckle, Asiatic Tearthumb, knotweed, Japanese Hop, Daylily (*Hemerocallis fulva*), False Strawberry (*Duchesnea chrysantha*), and Common Madder.

100-Area: Even more so than the North POL Area, the 100-Area NRMUs have undergone significant changes since the original INRMP was written in May 1997. The 100-Area had two separate NRMUs: Gunsmoke-1 and Gunsmoke-2 (Figure 2.14). Gunsmoke-1 was a pine forest with a mature understory and shrub layer of native species that was developing naturally into a self-sustaining forest of indigenous species. Since that time, the understory and shrub layers have been removed and only the pine canopy remains with a groomed, grassy turf beneath. The former NRMU Gunsmoke-2 had similar vegetation character. These two former NRMUs were combined into a single NRMU and renamed as "Gunsmoke-1" in the first revision of the INRMP in 2002.

NRMU GUNSMOKE-1: Semi-improved Pine Forest. This NRMU extends along the north side of West 10th Street and the east side of Gunsmoke Road (Figure 2.14). The portion of this NRMU along West 10th Street is regularly mowed and therefore lacks an understory and shrub layer. Unmowed portions of this semi-improved pine forest that occurs at NRMU are shown in Figure 2.18. The 2019 survey documented 29 plant species in this NRMU: Japanese Maple (*Acer palmatum*), Japanese Chaff Flower, Porcelain Berry, Chinee Hackberry, Queen Coralbead, Asiatic Dayflower, Canadian Fleabane, Daylily, Japanaese Holly, Juniper, Glossy Privet, Border Privet, Japanese Honeysuckle, Oyama Magnolia (*Magnolia sieboldii*), Mondo Grass (*Ophiopogon japonicus*), Waveyleaf Basketgrass, Creeping Wood Sorrel, Japanese Black Pine, Bracken Fern, Oriental White Oak, Serrate Oak, Chinese Sumac (*Rhus chinensis*), Black Locust, Memorial Rose (*Rosa wichuraiana*), Thimbleberry (*Rubus parviflorus*), Smooth Greenbriar, Common Sowthistle (*Sonchus oleraceus*), Japanese Snowbell, and Korean Dandelion (*Taraxacum coreanum*)..

Figure 2.18 Semi-improved Pine Forest at NRMU Gunsmoke-1

The overstory of this unit is relatively open and is composed of Japanese Black Pine and Korean Red Pine (*Pinus densiflora*). These aesthetically pleasing pines are in the 80 to 100-year age class and are mature remnants of a former pine plantation. No other species have penetrated the canopy layer. Scattered herbaceous species also occur to varying extent and include Knotweed and Asiatic Tearthumb, Asiatic Dayflower, Dwarf Lily Turf Mondo Grass and Chickweed.

Big Coyote Hill: Big Coyote Hill consists of two major outcrops with three NRMUs (BCH 1-3)

(Figure 2.19). The smaller, eastern outcrop is vegetated with young Korean Red Pine and Japanese Black Pines near the crest and along the eastern edge. Other species present in this unit but more common species near the summit include False Indigo Bush (*Amorpha fruticosa*), Smooth Greenbriar, Queen Coralbeads, Serrate Oak, Persimmon (*Diospyros khaki*), Japanese Honeysuckle, and Cherry (*Prunus sp.*). The remainder is either grassy, old-field vegetation, or bare soil and roadbed. The larger, western outcrop is thickly vegetated around the mid-slopes between the bare rock cliffs above the shoreline and the ROKAF facilities on the hilltop.

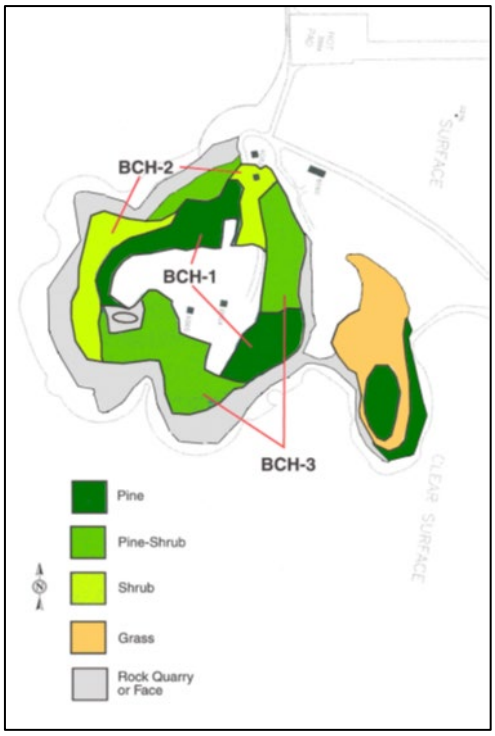

Figure 2.19 NMRUs and Vegetative Cover of Big Coyote Hill

NRMU BCH-1: Pine Forests. NRMU BCH-1 is composed of two segments located on the northwest and southeast slopes of Big Coyote Hill (Figure 2.19). This NRMU covers nearly the entire northwest slope, the upper half of the north and south slopes, and the upper 100 ft of the east slope. The 2019 survey documented 37 plant species: Japanese Onion (*Allium thunbergii),* Common Ragweed, False Indigo Bush, Korean Wormwood, *Aster sp.,* Asiatic Dayflower, Rough Buttonweed (*Diodia teres*), *Dunbaria villosa,* Canadian Fleabne, Rose of Sharon (*Hibiscus syriacus*), Japanee Hop, *Isodon japonicus,* Water Willow, Chinese Bushclover (*Lespedeza cuneate),* Silver Grass, Evening Primrose (*Oenothera odorata*), Wavyleaf Basketgrass, Japanese Honeysuckle, Creeping Wood Sorrel, a *Pennisetum sp.* fountaingrass, Knotweed, Pokeweed, Pitch Pine, Japanese Black Pine, Narrowleaf Plantain (*Plantago lanceolate*), Platycrya, Daymio Oak, Serrate Oak, Japanese Sumac, Black Locust, Common Madder, Thimbleberry, Field Sorrel (*Rumex acetosella*), Great Burnet (*Sanguisorba officinalis*), Smooth Greenbriar, Common Sowthistle, and Mastic-Leaf Prickly Ash (*Zanthoxylum schinifolium*). Figure 2.20 shows the Pine Forest in NRMU BCH-1.

Figure 2.20 Pine Forest NRMU BCH-1 on Big Coyote Hill

About 60% of the area is dominated by Japanese Black Pine and Pitch Pine (Figure 2.20). The tree layer is 26 to 33 ft high, with 60% coverage. Japanese Black Pine shows low coverage and individual density. The diameter at breast height of the tree shrub was 3.9 to 9.4 in. The shrub layer is 4.9 ft high, with 25% coverage. The companion species are Serrate Oak, Daimyo Oak, Shrubby Bushclover, Japanese Green Alder, the Korean Azalea *Rhododendron yedoense,* Smooth Greenbriar and Japanese Snowbell.

The herbaceous layer is 1.0 to 2.6 ft high, with 65% coverage. Species present include Japanese Hop, Japanese Green Alder, Sewer Vine, Multiflora Rose, Serrate Oak, Japanese Mountain Yam, Bracken, Smooth Greenbriar, Chinese silver grass, Korean Wormwood, Wavyleaf Basketgrass, Common Ragweed, Kirilo Indigo (*Indigofera kirilowii*), Japanese Fairybells (*Disporum smilacinum*), and Tiger Lily (*Lilium lancifolium*).

NRMU BCH-2: Pine-Shrub Community. NRMU BCH-2 is located principally on the north and west slopes of Big Coyote Hill (Figure 2.19), immediately below the pine stand and above the rock slope. No canopy or understory layers are associated with this young vegetation. NRMU BCH-2 is characterized by a bush layer and various shrub and herbaceous layers. The Pine-Shrub community of BCH-2 is pictured in Figure 2.21. The bush layer is characterized by Japanese Green Alder, Serrate Oak Oak, Black Locust, False Indigo Bush and Japanese Black Pine.

Figure 2.21 Pine-Shrub Community NRMU BCH-2 on Big Coyote Hill

The shrub layer is 3.3 to 8.2 ft high, although some shrubs are up to 9.8 ft high, with coverage ranging between 30 and 50%. Species present in the shrub layer include Japanese Green Alder, Serrate Oak, Black Locust, False Indigo Bush, Japanese Black Pine, Platycarya, Memorial Rose, the Korean Azalea *Rhododendron yedoense*, Daimyo Oak, Oriental White Oak, Korean Raspberry, Japanese Silverberry (*Elaeagnus umbellata*) and Shrubby Bushclover.

The herbaceous layer is 1.0 to 2.0 ft high, with coverage of 60%. Species present include Japanese Wormwood (*Artemisia japonica*), Japanee Sedge (*Carex kobomugi*), Japanese Thistle (*Cirsium japonicum*), False Indigo Bush, Chinese Silver Grass, Great Burnet, Field Sorrel, Narrowleaf Plantain, bracken ferns, the grass *Poa sphondylodes*, Orange Daylily, Pokeweed, Gooseneck Loosestrife (*Lysimachia clethroides*), *Vitis thunbergii*, Evening Primrose, and Japanee Ivy (*Parthenocissus tricuspidata*).

Fifty-two plant species plant species were found during the 2019 survey: Ladybells (*Adenophora polyantha*), Common Ragweed, False Indigo Bush, Korean Wormwood, Oriental Bittersweet, Feather Fingergrass (*Chloris virgate*), Japanese Thistle, Queen Coralbead, Asiatic Dayflower, Golden Tickseed (*Coreopsis tinctoria*), Rough Buttonweed, Japanese Mountain Yam, Japaneze Silverberry, Fireweed, Annual Fleabane (*Erigeron annuus*), Canadian Fleabane, Prostrate Spurge (*Euphorbia supina*), Ginko (*Gingko biloba*), Japanee Hop, *Isodon japonicus*, Corkscrew Rush (*Juncus effusus* var. *decipiens*), Castor Oil Tree, Chinese Sprangletop (*Leptocloa chinensis*), Shrubby Bushclover, Glossy Privet, the lily *Lilium callosum*, Japanese Honeysuckle, Silver Grass Evening Primrose, Wavyleaf Basketgrass, Creeping Wood Sorrel, *Paspalum thunbergii*, Korean Perilla, Chinese Plantain (*Plantago asiatica*), Narrowleaf Plantain,

Platycarya, the poplar *Populus tomentigladulosa*, Bracken Fern, Kudzu, Sawtooth Oak, Oriental White Oak, Black Locust, Multiflora Rose, Common Madder, Field Sorrel, Green Foxtail (*Setaria viridis*), Smooth Greenbriar, European Goldenrod (*Solidago virgaaurea*), Korean Arborvitae, a *Woodsia* sp. fern, *Youngia sonchifolia*, and Mastic-Leaf Prickly Ash.

NRMU BCH-3: Shrub Community. Two separate segments of this NRMU are located on the east and south facing slopes of Big Coyote Hill (Figure 2.19). The area is sparsely wooded by pine trees. The shrub layer is 4.9 to 9.8 ft high, with coverage of 30-50%. The dominant species are pine trees including Pitch Pine, Japanese Black Pine and Platycarya. The Shrub Community of BCH-3 is pictured in Figure 2.22.

The herbaceous layer is 1.3 to 3.3 ft high, with coverage of 30 to 50%. The companion species are Chinese Silver Grass, Chinese Bushclover, Tiger Lily, Evening Primrose, *Rubus parvifolius*, Japanese Mountain Yam, Japanese Honeysuckle, Green Foxtail, Smooth Greenbriar, False Indigo Bush, Common Ragweed, *Isodon japonicus*, Japanese Sedge, Memorial Rose, Korean Wormwood, and Asiatic Dayflower.

Figure 2.22 Shrub Community NRMU BCH-3 on Big Coyote Hill

During the 2019 surveys 43 plant species were recorded from BCH-3: Ladybells Silk Tree, Japanese Onion, Common Ragweed, False Indigo Bush Korean Wormwood, Redstem Wormwood (*Artemisia scoparia*), *Aster* sp., Three-Lobe Beggartick (*Bidens tripartite*), Queen Coralbead, Asiatic Dayflower, Golden Tickseed, Rough Buttonweed, Persimmon, Canadian Fleabane, the herbaceous perennial *Eupatorium lindleyanum*, Prostrate Spurge, *Hemerocallis* sp., Kirilo Indigo, *Isodon japonicus*, Corkscrew Rush, Prickly Castor Oil Tree, Chinese Sprangletop, Shrubby Bushclover, *Lilium callosum*, Japanese Honeysuckle, Silver Grass, *Patrinia scabiosifolia,* Korean Perilla, Black Pine, Chinese Plantain, Platycarya, *Populus tomentigladulosa*, Bracken Fern, Kudzu Oriental White Oak, Black Locust, Multiflora Rose, Thimbleberry, Great Burnet, Smooth Greenbriar, Japanese Snowbell, and *Youngia sonchifolia*.

Little Coyote Hill: Four NRMUs occur on Little Coyote Hill (Figure 2.23). The plant communities of three of the NRMUs are natural, early stages of plant succession. For the most part, these are old-field communities but can be discriminated from one another by the density of pine or broadleaf deciduous trees and shrubs present. Each community is held in the early stages of succession by disturbances associated with mission related activities. The fourth plant community is a persimmon orchard. It is not a natural community, but it is described here because of its areal coverage.

NRMU LCH-1: Shrub-Grassland Community. NRMU LCH-1 extends from the summit of the west slope of Little Coyote Hill to the base of the east slope and then wraps around the northeast edge of the east

slope of Little Coyote Hill (Figure 2.23).

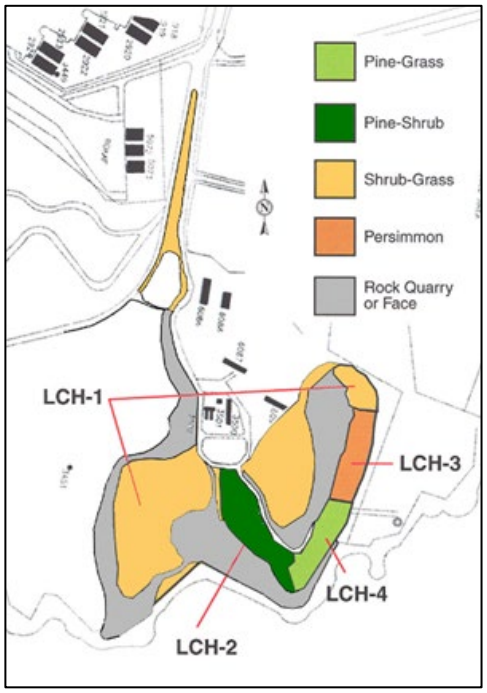

Figure 2.23 NRMUs and Vegetative Cover of Little Coyote Hill

This unit occupies a gentle slope, presumably a contoured sloping basin (Figure 2.24). As a result, slopes face all compass directions. The shrub layer includes Korean Red Pine (*Pinus densiflora*), Pitch Pine, *Populus tomentiglandulosa*, Memorial Rose, and Shrubby Bushclover. The herbaceous layer includes Chinese Silver Grass, Porcelain Berry, Lilies, Common Reed (*Phragmites communis*), Rough Potato (*Metaplexis japonica*), Korean Wormwood, Japanese Mountain Yam, *Potentilla chinensis*, Sea Bells (*Calystegia soldanella*), Japanese Sedge, Field Horsetail, and Rock Pine (*Orostachys japonica*).

During the 2019 surveys, 35 plant species were recorded from LCH-1: Japanese Onion, Common Ragweed, False Indigo Bush, Redstem Wormwood, *Aster* sp., Bindweed (*Calystegia davurica*), Feather Fingergrass, Queen Coralbead, Asiatic Dayflower, Golden Tickseed, Chinese Pink (*Dianthus sinensis*), Rough Buttonweed, Canadian Fleabane, Red Cedar (*Juniperus virginiana*), Leptocloa chinensis Chinese Sprangletop, Shrubby Bushclover, Chinese Bushclover, *Lilium callosum*, Japanese Honeysuckle, Rough Potato, Chinese Silver Grass, Evening Primrose, Rock Pine, Japanese Black Pine, Narrowleaf Plantain, *Ribes* sp., Black Locust, Memorial Rose, Common Madder, Thimbleberry, Field Sorrel, Stringy Stonecrop (*Sedum sarmentosum*), Green Foxtail, and Smooth Greenbriar.

Figure 2.24 Shrub-Grassland Community of NRMU LCH-1 on Little Coyote Hill

NRMU LCH-2: Pine-Shrub Community. The Pine-Shrub Community is located on the west side of the east slope of Little Coyote Hill (Figure 2.23). Densely vegetated, this unit occupies steep west facing slopes (Figure 2.25). The herbaceous layer is 1.0 to 2.6 ft high, with coverage of 30 to 40%. The companion species include Memorial Rose, Japanese Mountain Yam, Japanese Wormwood, Japanese Honeysuckle, Evening Primrose, Common Madder, Chinese Silver Grass, Smooth Greenbriar, *Isodon japonicus* and Japanese Thistle. This area is transfering into a sub-forest layer that is 20 to 26 ft high, with coverage of less than 50%. The dominating species in this layer are Pitch Pine, Serrate Oak and *Populus tomentiglandulosa*. The shrub layer is approximately 7 ft high, with coverage of 10%. Typical species are Serrate Oak, Shrubby Bushclover, Sweetleaf, Multiflora Rose, Memorial Rose, and Japanese Silverberry.

Figure 2.25 NRMU LCH-2 Pine-Shrub Community of Little Coyote Hill

The 2019 surveys documentd 22 plant species in LCH-2: Japanese Onion, Korean Wormwood, *Aster* sp., Queen Coralbead, Asiatic Dayflower, Rough Buttonweed, Annual Fleabane, Canadian Fleabane, *Isodon japonicus*, Shrubby Bushclover, Chinese Bushclover, Chinese Silver Grass, Evening Primrose, Rock Pine, Pitch Pine Japanese Black Pine, Platycarya, Serrte Oak, Japanese Sumac, Memorial Rose, Thimbleberry, and Smooth Greenbriar.

NRMU LCH-3: Persimmon Orchard This NRMU was an orchard located on the east slope of Little Coyote Hill (Figure 2.23). However, the 2012 survey of this area characterized this NRMU as consisting of a Pitch Pine and Persimmon trees shrub layer of approximately 10 to 16 ft high (Figure 2.26). The herbaceous layer is 1.6 to 3.3 ft high, with coverage of 50%. The companion species are Shrubby Bushclover, Chinese Silver Grass, *Carex lanceolata,* Smooth Greenbriar, Bracken Fern, and Daylily.

Twenty plant species were recorded from LCH-3 during the 2019 surveys: plant species: Japanese Onion, Common Ragweed, Feather Fingergrass, Asiatic Dayflower, Golden Tickseed, Rough Buttonweed, Persimmon, Canadian Fleabane, *Isodon japonicus*, Korean Clover (*Kummerowia stipulacea*), Shrubby Bushclover, Chinese Bushclover, Chinese Silver Grass, Pitch Pine, Japanese Black Pine, Narrowleaf Plantain, Bracken Fern, Chinese Sumac, Black Locust, and Memorial Rose.

Figure 2.26 Persimmon Orchard of NRMU LCH-3 on Little Coyote Hill

NRMU LCH-4: This area is located on the southeast side of Little Coyote Hill (Figure 2.23) and is characterized by a variety of woody species including Shrubby Bushclover, Platycarya, Japanese Sumac, Black Locust, Persimmon Trees and Pitch Pine (Figure 2.27). The herbaceous layer is dominated by Chinese Silver Grass, Smooth Greenbriar, Evening Primrose, Common Ragweed, and Korean Wormwood.

Figure 2.28 Pine-Grass Community of NRMU LCH-4 on Little Coyote Hill

During the 2019 survey, 33 plant species were reported from LCH-4: Japanese Onion, Common Ragweed, Korean Wormwood, Redstem Wormwood, *Aster* sp., Feather Fingergrass, Queen Coralbead, Asiatic Dayflower, Golden Tickseed, Rice Flatsedge (*Cyperus iria*), Rough Buttonweed, Annual Fleabane, Canadian Fleabane, Prostrate Spurge, *Isodon japonicus*, Shrubby Bushclover, Chinese Bushclover, Japanese Honeysuckle, Chinese Silver Grass, Morus alba, Evening Primrose, *Patrinia scabiosifolia*, Common Reed, Pitch Pine, Japanese Black Pine, Narrowleaf Plantain, Bracken Fern, Black Locust, Memorial Rose, Smooth Greenbriar, Sweet Leaf, and Mastic-Leaf Prickly Ash.

2.3.2.3 Future Vegetation Cover

Projected climate scenarios may influence the future vegetation associations within and surrounding Kunsan AB. A climate change assessment for Kunsan AB was conducted in 2019 (Colorado State University 2019). The results of this assessment predict that minimum and maximum temperatures will

increase over time under the two emission scenarios assessed– a moderate carbon emission scenario and a high carbon emission scenario. The potential impact of these two climate change scenarios on future vegetation cover at Kunan AB was analyzed using extracted climate data through the year 2050. Five natural habitat types were identified on Kunsan AB (Figure 2.28) and evaluated for their potential vulnerability to climate change under the two scenarios that were evaluated. The five natural habitats identified are as follows:

- Grasslands (48.7% of Kunsan AB);
- Shrub (5.1%);
- Forest (1.9%);
- Wetland (0.1%); and
- Open water (0.2%).

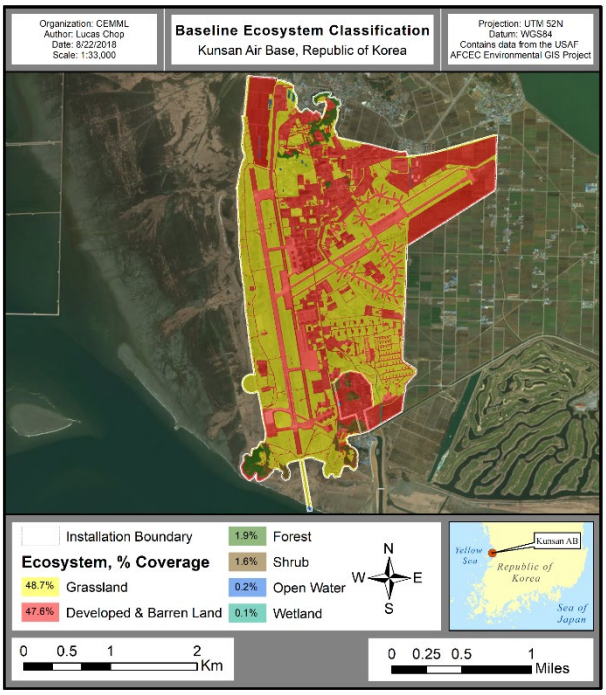

Figure 2.28 Land Cover and Habitats at Kunsan AB.

The dominant habitat present at Kunsan AB is grassland, which covers about 49% of the installation area. Increased seasonal, annual, minimum, and maximum temperature, together with changing precipitation patterns can impact shrubs and grassland habitats. Because these ecosystems are relatively dry with a strong seasonal climate, they are sensitive to climatic changes and vulnerable to shifts in climatic regime. Slight changes in temperature and precipitation can substantially alter the composition, distribution, and abundance of plant species in these habitats, as well as the products and services they provide. (e.g., wildlife habitat). The extent of these changes will depend on changes in precipitation and frequency of fire. Increased drought frequency could also cause major changes in vegetation cover. Losses of vegetative cover coupled with increases in precipitation intensity and climate-induced reductions in soil aggregate stability can dramatically increase potential erosion rates, especially in areas such as BCH and LCH. Rising temperatures under various climate change scenarios will likely enhance soil decomposition. Together with reductions in rainfall, this may also reduce plant productivity over large areas

In general, forest areas are susceptible to climate change. There is a temperature below which the equilibrium state of the forest appears constant, but above which the equilibrium of this vegetation cover declines steadily, which could mean that an irreversible die back of forested areas could occur by 2050 before it becomes noticeable.

2.3.2.3 Turf and Landscaped Areas

There are semi-improved grounds next to runways, taxiways, aprons, runway clear zones, lateral safety zones, weapons firing and bombing ranges, picnic areas, ammunition storage areas, antenna facilities, golf course roughs, and these areas are mowed less often than maintained turf grass on improved grounds.

2.3.3 Fish and Wildlife

Potential Native Fauna. The Korean Peninsula lies within the Palaearctic subregion, and its fauna is closely related to that of southern Manchuria, central China, and Japan. Throughout the peninsula, local wildlife populations are limited as a result of war and recent industrialization. Today, there are 53 species of terrestrial mammals in the ROK (Jo t al., 2018; IUCN 2020):

- 15 species of bats (Order Chiroptera);
- 17 species of mice/rats/voles/squirrels/flying squirrels (Order Rodentia);
- 12 species of cats/wolves/fox/bear/badger/weasels (Order Carnivora);
- 1 species of hedgehog (Order Erinaceomorpha);
- 7 species of shrews and moles (Order Soricomorpha);
- 5 species of deer/goats/boar (Order Artiodactyla); and
- 1 species of rabbit (Order Lagomorpha).

Other terrestrial and freshwater vertebrate species in the ROK include 25 species of reptiles, 14 species of amphibians, 130 species of freshwater fishes, and over 500 species of birds.

Fauna of Kunsan AB. The goal of Kunsan AB's biodiversity surveys is to determine and identify the presence of vertebrate species residing on Kunsan AB. To accomplish these goals, specific sampling regimes and periods have been selected to provide the greatest probability of encountering the various vertebrate species living on Kunsan AB. Spring, summer, and fall survey periods were selected to correspond to the different breeding and/or migration periods of species anticipated to occur on or in the vicinity of the base, and winter surveys were conducted to detect birds that over-winter at the base and its vicinity.

Aquatic habitats were sampled for fish in the spring of 2001 and in early summer in 2002 and 2012. These spring and early summer survey dates coincide with the spawning seasons of many fish species, during which times the species tend to congregate in localized areas, thereby enhancing sampling success. Amphibians and reptiles were surveyed in the spring and fall of 2001 and in the summers of 2002 and 2012. Insects were surveyed in the summer of 2012. Mammal surveys were conducted in the spring of 2001 and the summer of 2012.

Birds are the most intensively surveyed vertebrates at Kunsan AB. The primary objectives of the avian surveys were to determine what species of birds are present and to identify patterns of occurrence, relative abundance, and habitat requirements, per KEGS Chapter 13 (KEGS 2012). The information gathered contributed to Annex C.4 (1-4) of the 8 FW BASH OPLAN 91-212. The avian fauna at Kunsan AB were surveyed in 1999 through 2006 during construction of the Saemangeum Seawll, in 2010 and 2011, and from 2014 through January of 2020.

Beginning in 2017, a number of surveys were conducted specifically for amphibian and bird species that are ROK listed as endangered or as natural monuments and identified for additional management concern in KEGS 2012. In 2019, wildlife cameras were installed at several locations on Kunsan AB specifically targeting KEGS-listed mammals. These cameras also provided information on non-KEGS listed mammals at Kunsan AB.

2.3.3.1 Mammals

Most mammals are either nocturnal or highly secretive in their movements and thus are seldom observed at Kunsan AB. The red squirrel (*Sciurus vulgaris*) is the most frequently encountered mammal on the base (Figure 2.29). Today, they can be observed throughout the North POL area, Wolf Pack Park, the officer housing area, the golf course, and Big Coyote Hill. They prefer areas vegetated with mature Japanese Red

and Black Pines, where they can often be observed eating the seeds from pine cones. They remain shy and tend to avoid contact with people, and as such are not likely to become pests.

The second most common mammal observed on Kunsan AB is the stray or feral cat (*Felis catus*) (Figure 2.29). Feral cats are not under human control, but instead live and reproduce in the wild, usually in close association with humans. They prey on indigenous bird and wildlife species for survival. Feral cats can harbor and transmit a variety of fatal and nonfatal diseases to humans, domestic pets, and livestock. Parasites such as fleas are often a problem in areas inhabited by feral cats. Feral cats living in close association with humans can invade and damage buildings, contaminate food supplies, and create sanitary problems.

Figure 2.29 Red Squirrel (*Sciurus vulgaris*) (left) and Feral Cat (*Felis catus*), North POL, 2019.

The raccoon dog (*Nyctereutes procyonoides*) is a native species that may be found in many areas of Kunsan AB. This species is nocturnal and secretive; wildlife cameras installed at Kunsan AB have documented this species at the NPOL area and Big Coyote Hill, with individuals and pairs photographed at both locations (Figure 2.30).

Figure 2.30 Raccoon Dog (Nyctereutes *procynonoides*), Big Coyote Hill, 2019.

The Korean water deer (*Hydropotes inermis argyropus*) is a small deer that occurs across the entire Korean Peninsula (Jo et al., 2018). Despite a listing of 'vulnerable' across its entire range by the International Union for Conservation of Nature (IUCN), in the ROK it is thriving due to the lack of natural predators such.

Since 1994, Korean water deer have been designated as "harmful wildlife", a term given by the Ministry of Environment to wild creatures that can cause harm to humans or their property. Its habitat is typically marshlands associated with rich alluvial deltas, but may also be found on mountains, swamps, grasslands, and even open cultivated fields. This species occurs on Kunsan AB and in surrounding areas. Several individuals were observed below Big Coyote Hill during the 2014 – 2020 wildlife surveys (Figure 2.32). The water deer is the most primitive living member of the Cervidae family because the buck has large canine teeth or tusks (Figure 2.31) and no antlers, characteristics which other deer have evolved beyond.

Figure 2.31 Korean Water Deer (*Hydropotes inermis argyropus*), Big Coyote Hill, 2019. Note tusks on the male.

Another mammal widely found throughout and native to the Korean Peninsula is the Korean Hare (*Lepus coreanus*) (Figure 2.32). Korean hares occupy various habitats across their geographic distribution, from plains to mountains, preferring areas where vegetation is abundant. At Kunsan AB this species may be expected to occur in any areas with suitable habitats. Willdife surveys in 2019-2020 have documented its presence at Big Coyote Hill and the North POL area. The ROK removed this hare as a game species in 2005 because of declining populations, and the Ulsan and Gwangju Metropolitan governments have made it a provincially protected species (Jo et al., 2018).

Figure 2.31 Korean Hare (*Lepus coreanus*), Big Coyote Hill, 2019.

The presence of other species can be detected by the presence of burrows or the remains of a dead animal. For example, hills and tunnels created by moles are evident in many locations across Kunsan AB, and the confirmed remains of a large Asiatic mole (*Mogera wogura robusta*) were found in the North POL area in May 1998 (Figure 2.33).

Figure 2.33 Remains of a Large Asiatic Mole (*Mogura wogura robusta*) found at the North POL Area, 1998

Small mammal surveys were conducted at Kunsan AB in 2001 and 2012. One survey was conducted in early April 2001 by Det 3, AFIERA and the 18 MDG/SGPM. This survey employed 300 traps set at various locations around the base, primarily in improved and semi-improved areas. A total of 40 mammals were reported to have been collected, including striped field mice (*Apodemus agrarius*), shrews, rats, and a weasel. Another survey employed 182 traps set out nightly over a three-day period (April 29-May 1). Only seven striped field mice and one Dsinezumi shrew (*Crocidura dsinezumi*) were captured during this survey (Table 2.1) (Figure 2.34). These results were considered disappointing due to the small numbers collected. Although the weather was seasonably warm, the evenings of April 30 and May 1 were rainy, which may have contributed to few mammals collected.

Table 2.1 Results of Small Mammal Trapping at Kunsan AB, 2001.

Date	Location	Habitat	No. of Traps	Results
29 April	Airfield Little Coyote base (south) Little Coyote base (north) North POL basin	Grassland Grassland-Shrub Grassland-Shrub Wet Grassland	40/6 20/3 20/3 20/3	- 0 - 1 Striped field mouse 1 Dsinezumi shrew 4 Striped field mice - 0 -
30 April	Airfield Base of ILS[a] Little Coyote base (south) Little Coyote base (north)	Grassland Grassland Grassland-Shrub Grassland-Shrub	20/3 20/3 20/3 20/3	- 0 – 1 Striped field mouse - 0 – 1 Striped field mouse
01 May	North POL	Pine-Locust forest Pine Forest	40/3 20/3	- 0 – - 0 -

[a] Instrument Landing System

Figure 2.34 Dsinezumni Shrew (*Crocidura dsinezumi*) (left) and Striped Field Mouse (*Apodemus agrarius*) (right)

During the 2012 surveys, 9 species of mammals (from 4 orders and 6 families) were identified through trapping, direct observation of individuals, direct observation of tunnels, and the presence of excrement (Table 2.2). Specific observations reported from the 2012 surveys included:

- Tunnels of moles and back-striped field mice near the meadows
- Excrement of raccoon dogs and possibly leopard cats (*Prionailurus bengalensis*) in the densely vegetated areas on base
- Water deer footprints and excrement
- Feral cats and brown rats (*Rattus norvegicus*) were found near the buildings
- Domestic goats (*Capra hircus*)

Table 2.2 List of Mammals Observed during the 2012 Field Survey.

Order: Family	Scientific Name	English Name	Observation Type
Eulipotyphla: Talpidae	*Mogura wogura robusta*	Large Asiatic mole	T
Carnivora: Canidae	*Nyctereutes procyonoides*	Raccoon dog	D,F
Carnivora: Canidae	*Canis lupus familiaris*	Dog	D,F
Carnivora: Felidae	*Prionailurus bengalensis*	Leopard cat	D
Carnivora: Felidae	*Felis catus*	Feral cat	V
Artiodactyla: Cervidae	*Hydropotes insermis argyropus*	Korean water deer	D,F,V
Artiodactyla: Bovidae	*Capra hircus*	Domestic goat	V
Rodentia: Muridae	*Rattus norvegicus*	Brown rat	E
Rodentia: Muridae	*Apodemus agrarius*	Striped Field Mouse	T

Note: 1. D : excrement, F :footprint, V : witnessed, T : tunnel, E : trace of inhabitance

One other species, the Amur leopard cat (*Prionailurus bengalensis euptilura*), has also been documented from the base, at Big Coyote Hill. This species is listed as Class II Endangered Wildlife in KEGS Table 13-1 and is discussed in detail in this INRMP in Section 2.3.4, *Threatened and Endangered Species and Species of Concern*.

2.3.3.2 Reptiles and Amphibians

Aquatic habitats at Kunsan AB were surveyed in 2001, 2002, and 2012 for amphibians and reptiles, and additional surveys were conducted from 2017 through 2019 specifically targeting the native and protected Seoul frog (*Paleophylax chosenicus*) and the boreal digging frog (*Kaloula borealis*). Because of their small size, their habitats, and secretive nature, reptiles and amphibians are not readily observed. Generally, there are few habitats on the cantonment and airfield which can provide breeding grounds for amphibians. Potentially suitable habitats are restricted largely to the golf course ponds, drainage ditches and areas of seasonal ponding between the Perimeter Road and the running track along the western fence line of the base, drainage ditches and waterways in the CE Area, and a seasonal wetland at the western base of Little Coyote Hill. Habitat for reptiles occurs in these same general areas. More extensive habitat for reptiles, and possibly amphibians, may be found in the NRMUs of Big and Little Coyote Hills, the North POL area, Wolf Pack Park.

Amphibians. Frogs are the most evident taxa during the frost-free season. They seem to emerge somewhat later in the season in the ROK than in the United States. Most amphibians (and reptiles) may be expected to have already entered hibernation by October. A total of five amphibian species have been reported from

Kunsan AB, four native species (two of which are ROK protected) and one introduced species. Only the introduced American bullfrog (*Lithobates catesbeianus*) and the native black-spotted pond frog (*Pelophylax nigromaculatus*) were observed during the 2001 survey. During the 2002 survey, five species were found at the base: the American bullfrog, the black-spotted pond frog, the native Korean brown frog (*Rana coreana*), the Seoul frog and the boreal digging frog. During the 2012 field survey, only the black-spotted pond frog, the Korean brown frog, and the American bullfrog were found. The Seoul frog and the boreal digging frog were found on base during the targeted 2017 surveys, and the Seoul frog was again found in 2018. Due to a drier summer in 2018 than in 2017, there was no standing water during the 2018 surveys in the habitats where the boreal digging frog was found in 2017. Both species were also found during wildlife surveys in 2019.

Korean Brown Frog (*Rana coreana*). The native Korean brown frog is the smallest of the brown frogs in the ROK, with adults being less than 1.75 inches (45 mm) in body length (Fig 2.35). Marking for this species include a continuous white line along the upper lips, two dorsal stripes with black spots. The Korean brown frog may be found in wet areas within a variety of habitats, ranging from forests to shrublands and grasslands, where it breeds in shallow lakes, ponds, ditches, large puddles, and wetlands. In winter it hibernates in large numbers in the bottom mud of aquatic habitats.

Figure 2.35 Korean Brown Frog Adult and Larva

Black-Spotted Pond Frog (*Pelophylax nigromaculatus*). The black-spotted pond frog is the most common amphibian on Kunsan AB, as well as the ROK (Figure 2.36). This species is distributed throughout the Korean Peninsula, Japan, and China. At Kunsan AB, it can be found in all the golf course ponds and virtually all water containing drainage ditches.

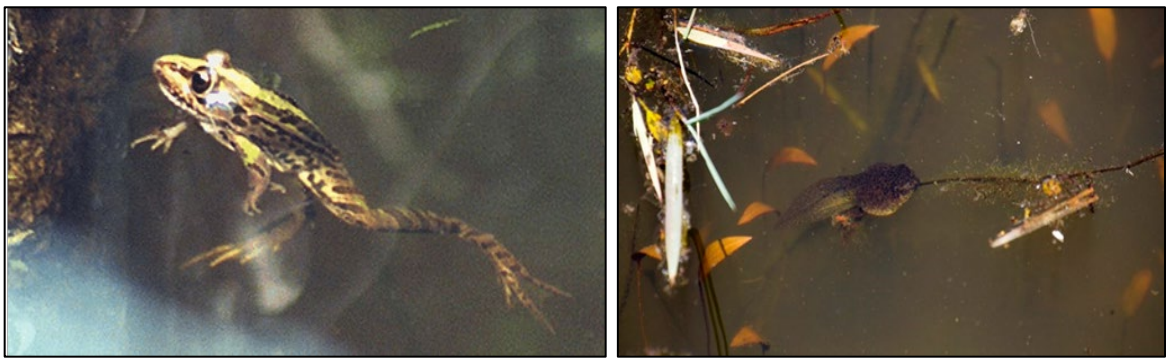

Figure 2.36 Black-spotted Pond Frog (left) and Larvae

The black-spotted pond frog is normally yellow green to brown in color with irregular black spots scattered on the lighter background color. However, sometimes the dark spots are completely lacking. Adults may range from 2.5 and 3.75 inches in length. It is the most common edible frog in the ROK and is used as food and in experimental research.

The black-spotted frog ranges across a variety of habitats, from deserts and bushland to meadows and forests, and is typically found in or near stagnant or slow-moving water, and in general prefers stagnant water covered with dense aquatic vegetation.

American Bullfrog (*Lithobates catesbeianus*). The American bullfrog, which is the largest frog in North America, has been widely introduced throughout the world for farming for human consumption, and is now common in the ROK. At Kunsan AB it is a common resident of golf course ponds and airfield drainage ditches. This frog is distinguished from others by the lack of lateral ridges running the length of the back (Figure 2.37).

This species has a prominent fold extending from the back of the eye to behind a large tympanum (ear drum). The skin on the back is rough with random tiny tubercles, or bumps. Adults average between 6 and 7 inches in body length. Because of their voracious feeding habits and the size and competitive ability of the bullfrog tadpoles, introduced populations of American bullfrogs are a serious threat to native frogs. The bullfrog feeds on crayfishes, beetles, frogs, fish, small birds, and even mice.

Figure 2.37 Male American Bullfrog at Airfield Drainage Ditch (left) and Female American Bullfrog in a Golf Course Pond

Seoul Frog (*Paleophylax chosenicus*) and Boreal Digging Frog (*Kaloula borealis*). Two additional amphibian species have been reported from Kunsan AB, both of which are listed as Class II Endangered Wildlife in KEGS Table 13-1. These species are discussed in detail in Section 2.3.4, *Threatened and Endangered Species and Species of Concern*, of this INRMP.

Reptiles. Reptiles were reported during surveys in 2001, 2002, but not during the 2012 survey. The species which were observed during the earlier surveys are discussed below. During the 2014-2019 willdife surveys, unidentified snakes were observed on several occasions at Big Coyote Hill.

Amur Grass Lizard (*Takydromus amurensis*). The Amur grass lizard is well-camouflaged and difficult to flush from its preferred grassy, rocky habitats (Figure 2.38). However, it was observed in the tall stands of Chinese silvergrass at the base of Little Coyote Hill and also on the closely mowed airfield infield. It was only observed during the October 2001 survey. Presumably, the April 2001 survey was too early in the season and the June 2002 survey period was too wet.

Amur grass lizards are slender with long tails. Their back is brown, and the underside is a lighter tan or white. They are covered with nearly square scales, giving their skins a rough feel. Adults may reach a total length of 7 to 10 inches, with most of the length being their tail. The non-tail body is generally only 2 to 3 inches in length.

Figure 2.38 Amur Grass Lizard

The Amur grass lizard typically inhabits grasslands, but is also found in gardens, edges of rice paddies, and shoulders of roads. They are active in the daytime and eat insects or spiders. At night, they sleep under leaves or on the grass. Amur grass lizards breed in spring to summer. Females deposit 2-6 eggs in the base of a grass clump. The eggs hatch in about 2 months. The new hatchlings are about 2.75 inches long.

Red-eared Slider (*Trachemys scripta elegans*). The red-eared slider is the only turtle observed on Kunsan AB (Figure 2.39). Red-eared sliders are native to North America and have become well established in the wild in the ROK. This introduced species may be impacting native turtle populations, but to date there is little supporting evidence for this.

Figure 2.39 Red-eared Slider

Three specimens were observed on 19 October 2001 in the sanitary ditch just west of the KAA taxiway to the commercial terminal. They were basking on the concrete culvert. It is likely they reside in the golf course ponds, although none have yet been observed in these ponds. This species hibernates under the water or under banks and hollow stumps and emerges in spring in early March to late April (Dawson, 1998; Smither, 1998).

Red-backed Rat Snake (*Oocatochus rufodorsatus*). This was the only species of snake observed or captured during any of the surveys at Kunsan AB. While previously listed as a "Specified Wild Species" by the Korean Ministry of Environment (MOE) and included in Table 13-2 of the 1997 KEGS, this species has been de-listed by the MOE and is no longer identified in the KEGS (2012). The red-backed rat snake is found throughout the Korean Peninsula. It is small, slender, and may reach 3 ft. in length. The color ranges from a reddish brown to tan, and a series of elongated dark brown spots on the head meet to form four stripes that extend the length of the body to the tail (Figure 2.40). The scales of the underside form a central dark brown strip bordered by a tan stripe on each side. This snake gives birth to live young instead of laying eggs. Foods include aquatic insects, snails, tadpoles, crawfish, fish, crustaceans, molluscs, and aquatic plants.

This is a semiaquatic species, living near water where it forages. Two individuals were observed during the 2001 survey; one on the warm asphalt of the Perimeter Road and the other at an airfield drainage ditch. Several individuals were also seen or captured during the 2002 survey. All were found either submerged in the airfield drainage ditches or in flooded depressions on the airfield's infield.

Figure 2.40 Red-backed Rat Snake (*Oocatochus rufodorsatus*)

Mamushi (*Gloydius blomhiffii*) and Korean Magpie Viper (*Agkistrodon saxatillis*). The mamushi and Korean magpie vipers (Figure 2.41) are two venomous pit vipers related to the copperhead (*Agkistrodon contortrix*) found in the U.S. These vipers often occur in agricultural areas where they prey on small mammals. The snakes are generally shy and avoid human contact when possible. Their bites are not considered life threatening unless left untreated.

Figure 2.41 Mamushi *(Gloydius blomhoffii)* (left) and Korean Magpie Viper *(Agkistrodon saxatillis)*

2.3.3.3 Insects

The insect fauna at Kunsan AB have only been surveyed in 2012, the results of which reported 119 species of ground insects (from 12 orders and 57 families) from the base (Appendix B.1). Observed insects included: 23 species of grasshoppers and their allies; 21 species of butterflies and moths; 19 species of beetles; 18 species of dragonflies and damselflies; 13 species of true bugs; 10 species of true flies; 7 species of wasps, bees, ants; 3 species of aphids, scale insects, leafhoppers; 2 mantis species, and single species each of cockroach, earwigs, and lacewings. No legally protected insect species were collected in the field survey. Most of the surveyed areas consisted of meadows, with some forest and water systems, providing various living environment for insects. Figures 2.42 through 2.48 show some representative insect species.

Figure 2.42 A Short-horned Grasshopper (*Oedaleus infernalis*) (left) and Chinese Grasshopper (*Acrida cinerea cinerea*)

Figure 2.43 Fischer's Blue (*Tongeia fischeri*) (left) and Japanese Carpenter Bee (*Xylocopa appendiculata circumvolans*)

Figure 2.44 An Admiral Butterfly (*Limenitis doerriesi*) (left) and a Short-horned Grasshopper (*Oxya chinensis sinuosa*)

Figure 2.45 A Katydid (*Gampsocleis ussuruensis*) (left) and a Spider Wasp (*Cyphononyx dorsalis*)

Figure 2.46 A Flutterer (*Rhyothemis fuliginosa*) (left) and a White-tailed skimmer (*Orthetrum albistylum*)

Figure 2.47 Scarlet Skimmer (*Crocothemis servilla*) (left) and Korean Horse Cicada (*Cryptotympana dubia*)

Figure 2.48 A Robber Fly (*Promachus yesonicus*) (left) and a Japanese Mantis (*Teondera angustipennis*)

2.3.3.4 Fish

Kunsan AB was surveyed for the presence of fish in the spring of 2001 and the summer of 2002, and seven species were collected during those surveys. The golf course ponds and the stream running through the CE Area are capable of supporting fish, but because of dense aquatic vegetation at that time, the golf course ponds and the stream running through the CE Area were not sampled.

The drainage ditches at the base provide potential habitat for freshwater fish. Before seawall completion, several of the ditches along the west side of the flight line drained directly to the Yellow Sea, and associated tidewaters allowed estuarin marine fish to enter. Marine and brackish water species collected in these drainages included the flathead grey mullet (*Mugil cephalus*), chameleon goby *(Tridenttiger trigonocephalus*), and the Japanese sea perch *(Lateolabrax japonicus).*

With seawall completion, however, these ditches are no longer directly in contact with or influenced by tidewaters, and it is doubtful that any of these the marine and brackish water fishes occur in any of the on-base ditcheds from where they had previously been collected. After the 2002 survey, the drainage ditches paralleling the runway were enclosed in concrete culverts, while those which had received Yellow Sea tidewaters were completely culverted in 2017 and 2018; none of these ditches now provide suitable habitat for either freshwater or marine fish.

Currently, only four species may occur in the aquatic habitats at Kunsan AB: the goldfish (*Carassius auratus*), Japanese rice fish (*Oryzias latipes*), shuttles hoppfish (or mud skipper) (*Periophthalmus modestus*), and the round-tailed paradise fish (*Macropodus ocellatus*).

Goldfish (*Carassius auratus*). The largest fish species captured from the drainage ditches was the goldfish (Figure 2.49). It varies in color from gold to olive green or even creamy white. The average adult size ranges from 4-8 in., but may reach lengths as much as 16 in. The goldfish is widely distributed throughout the Korean Peninsula (Choi et al., 1990), inhabiting ponds, lakes, and slow-flowing rivers where it feeds on macroinvertebrates, zooplankton, and aquatic vegetation. This fish is very tolerant of changing environmental conditions. At Kunsan AB, this species has been observed in the drainage channel that runs

through the CE Area. It may also occur other drainageways at the base and the golf course ponds.

Figure 2.49 Goldfish (*Carassius auratus*)
Photograph by B. Albert - USGS. 2005.

Japanese Rice Fish (*Oryzias latipes*). The smallest fish, less than 1.5 inches as an adult, collected in the 2001 and 2002 surveys was the Japanese rice fish, also called the Medaka (Figure 2.50). This species is native to east and southeast mainland Asia and is broadly distributed throughout the ROK (Choi et al. 1990). At Kunsan AB, Japanese rice fish were abundant in the ditch at the 3,200-foot mark. The female pictured in Figure 2.51 was releasing eggs. Currently, this species may be present in drainage ditches, the golf course ponds, and the drainage running through the CE area.

Shuttles Hoppfish (*Periophthalmus modestus*). The shuttles hoppfish (Figure 2.50) is a species of mudskipper native to fresh, brackish and marine waters in ROK, where it inhabits the swamps, marshes, and mud flats of the intertidal zone. It is a relatively small fish, with adults reaching a maximum length of about 4 inches. It is common to see them emerge from the water or water-filled burrows to sun themselves. They can scuttle rapidly around on land, preying on small insects, worms and other small invertebrates. Their presence in the runway drainage ditches is unknown; none were observed during the 2017-2018 targeted amphibian surveys. However, numerous individuals were observed in the stream that runs through the CE area during the 2014-2016 avian surveys.

Figure 2.50 Japanese Rice Fish (*Oryzias latipes*) (left) and Shuttles Hoppfish (*Periophthalmus modestus*)

Round-tailed Paradise Fish (*Macropodus ocellatus*). A single round-tailed paradise fish was captured using a dip net (Figure 2.51) in a flooded tire rut associated with the drainage system south of the asbestos landfill on June 22, 2002. This species is native to eastern Asia, inhabiting vegetated areas of irrigation ditches, marshes, rice paddies, pools, streams, and slow-moving backwaters of rivers. This species is extremely adaptable, tolerating both very low oxygen levels (typical of stagnant summer waters) as well as cold water temperatures.

Figure 2.51 Round-tailed Paradise Fish (*Macropodus ocellatus*)

Round-tailed paradise fish attain a length of only 2 to 3 inches long at maturity (Choi et al., 1990). This is a relatively colorful fish (especially courting males); they have a round, red tail with white spots, a charcoal grey body, white stripes on the head, and red and yellow dorsal and anal fins. This species may be present in the stream that runs through the CE area, and in some of the drainage ditches and golf course ponds at the base.

2.3.3.5 Birds

Avian surveys have been conducted at Kunsan AB since 1999 as part of Action Item 2, *Avian Survey*, and Action Item 12, *Ecosystem Monitoring*. The primary objectives of these surveys are to characterize the bird communities present at the base as well as their patterns of occurrence and relative abundance, and thereby meet the requirements of KEGS Chapter 13, *Natural Resources and Endangered Species*. The avian surveys also provide information to support the 8 FW BASH OPLAN 91-212. Avian surveys at Kunsan AB have been conducted over three periods: 1999-2006 (before the seawall completion), 2011-2012 (5 years after seawall closure), and 2014-2020 (10 years after seawall closure). Table 2.4 identifies the month and year of all the avian surveys that have been conducted at Kunsan AB since 1999.

The surveys conducted between 1999 and 2006 provide a historic look at avian residents and visitors at Kunsan AB before seawall completion altered the habitats along the western boundary of the base. The post-2006 surveys provide a look into how the avian fauna at and near the base has changed since seawall completion.

Table 2.4 Avian Surveys at Kunsan AB, 1999 – 2018.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Survey Date	2000 2010 2020	2002 2004 2011 2015	2002	2001 2006 2010 2015	2000 2005 2011 2017	2002 2003 2004 2010 2016 2018 2019	2001 2011 2017 2019	1999 2005 2016 2018	2002 2011 2014	2001 2010 2019	1999 2003 2004	2000

Survey Methods. A number of protocols have been used for the bird surveys conducted at Kunsan AB. Survey methods have included the use of transects along the runway and point counts at specific locations (for surveys conducted 1999 through 2006), and area surveys (for post 2006 surveys) involving specific routes within individual survey areas. Overall, the surveys assessed the presence and relative abundance of bird species from seven locations at Kunsan AB: along the flight line (this includes the area between the runway and the Perimeter Road, between the Perimeter Road to the western boundary of the base, and the extreme northern portion of the base between the KAL taxiway and the western boundary of the base), Big Coyote Hill, Little Coyote Hill, Wolf Pack Park, North POL Area, the CE Bulk Storage Area, and the cantonment area. Habitats at these areas collectively included forest, shrub, and grassland, and at some areas include many of the NRMUs described in Section 2.3 of this INRMP.

All surveys were conducted over 3-4 consecutive day periods, and the survey dates allow for a seasonal, as well as monthly assessment of the presence and relative abundance of bird species at the base. All survey results are presented using taxonomic nomenclature of Clements et al. (2016).

Survey Results 1999 – 2006: A total of 122 species from 36 families were observed on Kunsan AB and its immediate vicinity during the surveys conducted between 1999 and 2006 (Appendix B.2), including 10 species currently listed in KEGS 13-3 (2012) as protected (either as endangered wildlife or as natural monuments). During this time period, construction and completion of the Saemangeum Seawall occurred, and the results reflect the bird populations on or near the base prior to seawall completion and the subsequent recession of the shoreline adjacent to the western boundary of the base.

For the surveys, the number of species observed each month ranged from 24 species in July (1999) up to 64 species in April (2001) (Appendix B.2). Highest monthly number of species was reported during spring and fall migratory periods (April and May: 64 and 53 species, respectively, and August and September: 57 and 51 species, respectively). Among all species reported from Kunsan AB between 1999 and 2006, 17 were observed in 10 or more months (i.e., during almost all surveys), and thus represent year-round residents at the base or nearby vicinity (Table 2.5).

Table 2.5 Most Regularly Observed Bird Species at Kunsan AB during the 1999 – 2006 Avian Surveys (Species Observed Each Month).

Eastern Spot-billed Duck (*Anas zonorhyncha*)[a]	Eurasian Curlew (*Numenius arquata*)[a]	Japanese Tit (*Parus minor*)
Ring-necked Pheasant (*Phasianus colchicus*)	Black-tailed Gull (*Larus crassirostris*)[a]	Brown-eared Bulbul (*Hypsipetes amaurotis*)
Gray Heron (*Ardea cinerea*)	Oriental Turtle-Dove (*Streptopelia orientalis*)	White Wagtail (*Moticilla alba*)

Table 2.5 Most Regularly Observed Bird Species at Kunsan AB during the 1999 – 2006 Avian Surveys (Species Observed Each Month).

Great Egret (*Ardea alba*)	Eurasian Kestrel (*Falco tinnunculus*)[b]	Oriental Greenfinch (*Chloris sinica*)
Black-crowned Night Heron (*Nycticorax nycticorax*)	Oriental Magpie (*Pica pica*)	Eurasian Tree Sparrow (*Passer montanus*)
Kentish Plover (*Charadrius alexandrinus*)[a]	Eurasian Skylark (*Alauda aryensis*)	

[a] Species primarily associated with coastal and open water habitats adjacent to Kunsan AB.
[b] Species designated as threatened, endangered, or ROK protected in KEGS 13-3.

Survey Results 2010-2011: Avian surveys were conducted in 2010 and 2011 in support of Action 12, *Ecosystem Monitoring*, and were conducted approximately five years after completion of the seawall. These surveys covered all four seasons over the two years, and were carried out at several locations across Kunsan AB, including the flightline, cantonment, the shoreline, and undeveloped portions of the base containing thickets and wetlands. A total of 37 species from 24 families were identified (Appendix B.3). Four species listed as threatened, endangered, or ROK protected (KEGS 13-3, 2012) were observed during these surveys, including one protected species (the Taiga/Tundra Bean Goose[1]) not previously reported from Kunsan AB.

Survey Result 2014-2020: Avian surveys in support of Action 12, *Ecosystem Monitoring*, were conducted between 2014 and 2016 at Kunsan AB (Appendix B.4), approximately 10 years after closure of the Saemangeum Seawall. Five 3 to 4-day surveys were conducted at the following locations: the North POL Area, Wolf Pack Park, the CE Bulk Storage Area, Little Coyote Hill, Big Coyote Hill, and the west base perimeter along the length of the Flight Line. Birds observed incidentally in cantonment areas while traveling between survey sites or during other activities also were recorded. Because of previous access restrictions, these are the first avian surveys conducted at Big Coyote Hill. Each of these areas was surveyed in fall (September 2014), winter (February 2015), spring (April 2015) and summer (June and August 2016).

Surveys in support of Action 3, *Biotic Survey*, were conducted in 2017 (May and July) and in 2018 (June and August), June/July 2019, and January 2020 targeting specific KEGS-listed species. Avian surveys were conducted concurrently with these targeted surveys at the same locations surveyed in 2014-2016.

A total of 28,037 individual birds from 143 species were observed during the 2014-2020 surveys at Kunsan AB, including 50 species not previously reported from the base, and 17 species classified as protected as either endangered wildlife or as cultural monuments in KEGS 13-3 (KEGS 2020) (Table 2.6; full species lists are provided in Appendix B.4). An additional 20 individuals were observed that could not be identified to species due to distance, viewing conditions, or time in view. It is likely that the unidentified individuals belonged to species identified at other times during the survey rather than new species not recorded previously. Eighty of the species observed during the 2014-2020 surveys are also known to breed in the ROK (Birds of Korea 2014). With the exception of most of the waterfowl, shorebirds, gulls, and other

[1] Note that the Clements et al. nomenclature separates the Bean Goose (*Anser fabalis*) into two species—the Taiga Bean Goose (*Anser fabalis*) and the Tundra Bean Goose (*Anser serrirostris*). Both occur during migration on the Korean Peninsula, but were not differentiated in the Kunsan AB field surveys.

water birds, many of the confirmed breeding species may nest at or in the vicinity of Kunsan AB if appropriate habitat is available.

The fewest number of species and individuals were reported from the cantonment area (22 species, 417), the golf course (25 species, 364 individuals), Wolf Pack Park (40 species, 973 individuals), and Little Coyote Hill (36 species, 588 individuals) (Table 2.6). The relatively low numbers of species (≤ 25) and individuals (< 425) reported from the cantonment areas and the golf course was due to the largely incidental nature of these observations, and the developed nature of these areas. Numbers were likely low at Wolf Pack Park because of the relatively small size and mostly developed nature of the park. Aside from a small pine grove in the western portion of the site, undeveloped habitat occurred only outside of the boundary fence, and in the adjacent North POL Area. At Little Coyote Hill, the surveys were limited to the western portion of the site, which contains mostly mowed grassland with adjacent woodland, and includes areas that often support troop training activities.

Table 2.6 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020.

	Number Observed								
	Wolf Pack Park	North POL Area	Flightline	Big Coyote Hill	Little Coyote Hill	CE Bulk Storage Area	Cantonment	Golf Course	Total
Total individuals	973	2,700	4,201	16,559	588	2,235	417	364	28,037
Total identified species	40	65	67	104	36	51	22	25	143

More species and individuals were reported from the CE Bulk Storage Area (51 species, 2,235 individuals), the North POL Area (65 species, 2,700 individuals), and along the Flight Line (67 species, 4,201 individuals). These greater numbers of species and individuals reflect the greater availability and diversity of habitat at these areas, and relatively lower levels of human activity and disturbance. Among the eight survey areas, the greatest number of species and individuals were reported from Big Coyote Hill (104 species, 16,559 individuals) (Table 2.6). While this large number of species and individuals reflects the diversity of habitats at and adjacent to Big Coyote Hill (i.e., coastal shoreline, pine forest, pine-shrub, and shrub habitat), the large number of individuals included an estimated 8,200 Great Cormorants. These individuals were observed on the three most recent surveys dates (June/July 2019, October 2019, and January 2020), and account for 92% of all Great Cormorants and 50% of all birds regardless of species that have been observed at or from Big Coyote Hill since 2014. The large numbers observed in 2019 and 2020 likely reflect seawall-related changes occurring in the Saemangeum Coastal Area where these birds forage. Excluding these individuals, the number of individual birds observed at Big Coyote Hill would exceed the number reported from the other survey areas by a factor of two or more.

Of the 143 species identified during the 2014-2020 surveys, only 16 species (11% of all identified species) were observed in all six survey areas (excluding the cantonment area and golf course) (Table 2.7). In addition, seven of these 10 species were also observed on all 5 survey dates (Table 2.8). Although most of the 10 species were observed on survey sites (i.e., perched on fences, in shrubs and trees, or on the ground), the Intermediate Egret was typically observed flying over the sites and was observed using site habitat only

along the coastline behind Big Coyote Hill and in grassy areas along the Flight Line. Five additional species were reported from 5 of the 6 survey areas. Among these, the Gray Heron and Great Egret were only observed using habitat along the coastline behind Big Coyote Hill, in grassy areas of the Flight Line, and in rice fields adjacent to the North POL Area and the northern portion of the Flight Line.

Table 2.7 Most Widely Observed Species (by Location) at Kunsan AB, 2014 - 2020.

Observed from all Six Survey Areas[a]	Observed from Five of the Six Survey Areas
Eastern Spot-billed Duck (*Anas zonorhyncha*) [b,c]	Taiga/Tundra Bean Goose (*Anser fabalis/serrirostris*)
Ring-necked Pheasant (*Phasianus colchicus*)[d]	Great Cormorant (*Phalaccrocorax carbo*)[c]
Oriental Turtle Dove (*Streptopelia orientalis*)[d]	Great Egret (*Ardea alba*)[d]
Common Cuckoo (*Cuculus canorus*)	Cattle Egret (*Bubulcus ibis*)
Gray-headed Woodpecker (*Picus canus*)	Striated Heron (*Butorides striata*)
Eurasian Hobby (*Falco Subbuteo*)	Eastern Buzzard (*Buteo japonicus*)
Eurasian Kestrel (*Falco tinnunculus*)[d,e]	Bull-headed Shrike (*Lanius bucephalus*)
Oriental Magpie (*Pica serica*)[d]	Dusky Thrush (*Turdus eunomus*)
Azure-winged Magpie (*Cyanopica cyanus*)[c]	White-cheeked Starling (*Spodiopsar cineraceus*)
Barn Swallow (*Hirundo rustica*)[c]	Oriental Greenfinch (*Chloris sinica*)
Japanese Tit (*Parus minor*)[d]	Eurasian Tree Sparrow (*Passer montanus*)[d]
Vinous-throated Parrotbill (*Paradoxornis webbiana*)[c]	
Daurian Redstart (*Phoenicurus auroreus*)[c]	
Intermediate Egret (*Mesophoyx intermedia*)	
Gray Heron (*Ardea cinerea*)[d]	
Brown-eared Bulbul (*Hypsipetes amaurotis*)[d]	

[a] Excluding the cantonment area and golf course.
[b] Common and scientific names follow nomenclature from Clements et al., 2016 (available at eBird, Clements checklist; http://www.birds.cornell.edu/clementschecklist/).
[c] Also observed on 10 or more of the 12 survey dates.
[d] Also observed on all survey dates.
[e] Species has protected status per KEGS 13-3

About 42% of the species identified from Kunsan AB during the 2014-2020 surveys (60 of 143 species) were observed only from a single survey location (Appendix B.4). The survey location with the greatest number of such 'unique' species observations was Big Coyote Hill, with 34 species reported only from this area. The majority of these species were associated with the coastal shoreline and open water habitat located adjacent to Big Coyote Hill, and included ducks, sandpipers, plovers, and gulls.

Similarly, almost 34% (48 species) of all species identified during the 2014-2020 surveys were observed on only a single survey date (Appendix B.4). Of these species, 11 were observed only during the January 2020 survey and 10 species only during the April 2015 survey; the former likely being winter residents,

and the latter spring migrants. These species included a variety of waterfowl, shorebirds, gulls, and passerines.

Similar to the numbers of species observed at all or most survey locations, relatively few of the 143 identified species were observed during all survey dates (Appendix B.4). Only 10 species (7% of all identified species) were observed on each survey date, while another 4 species were observed on all but one survey date (Table 2.8). Among these 14 most often encountered species, 8 were also among the most widely observed species across the survey areas (Table 2.7).

Table 2.8. Most Frequently Observed Species (by Survey Date) at Kunsan AB, 2014-2020.

Species	Observed on all 12 Survey Dates	Observed on 11 Survey Dates
Gray Heron (*Ardea cinerea*)[a,b]	X	
Great Egret (*Ardea alba*)[b]	X	
Black-tailed Gull (*Larus crassirostris*)	X	
Ring-necked Pheasant (*Phasianus colchicus*)[b]	X	
Eurasian Kestrel (*Falco tinnunculus*)[b,c]	X	
Oriental Turtle Dove (*Streptopelia orientalis*)[b]	X	
Oriental Magpie (*Pica serica*)[b]	X	
Japanese Tit (*Parus minor*)[b]	X	
Brown-eared Bulbul (*Hypsipetes amaurotis*)[b]	X	
Eurasian Tree Sparrow (*Passer montanus*)	X	
Eastern Spot-billed Duck (*Anas zonorhyncha*)[b]		X
Little Egret (*Egretta garzetta*)		X
Barn Swallow (*Hirundo rustica*)[b]		X
Vinous-throated Parrotbill (*Paradoxornis webbiana*)		X

[a] Common and scientific names follow nomenclature from Clement et al., 2016 (available at eBird, Clements checklist; http://www.birds.cornell.edu/clementschecklist/).
[b] Also observed from five or more survey sites (see Table 2.7).
[c] Species has protected status per KEGS 13-3 (2012).

Changes in Bird Fauna of Kunsan AB following Closure of the Saemangeum Seawall. The 2014-2020 avian surveys were conducted after the completion of the Saemangeum Seawall; the most obvious ecological effect has been the elimination of much of the coastline habitat adjacent to the base. Former extensive estuarine saltmarsh and mudflat habitats have been replaced by early succession grassland and oldfield habitat. Any remaining coastal habitat near the base now occurs only below the southern and southwestern portions of Big Coyote Hill. This coastal habitat has very limited tidal range, exposed substrate, and wetland vegetation. Many of the waterfowl and shorebirds regularly observed during the 1999-2006 surveys were not observed during 2014-2020 surveys.

Comparison of the pre-2006 survey results with those of the 2014-2020 surveys shows some differences in the composition and occurrence of coastal, estuarine, and wetland bird species along the western and

southern boundary of Kunsan AB. The pre-seawall closure surveys reported 16 species of coastal waterfowl, gulls, and shorebirds that were not observed during the 2014-2020 surveys. While some of these species may still occur occasionally in the remaining coastal habitat below Big Coyote Hill, the loss of suitable habitat precludes the regular occurrence of these species along the western boundary of the base. However, birds such as the Vinous-throated Parrotbill, Oriental Reed-Warbler, and Siberian Stonechat and other grassland and/or shrub preferring species now occur more commonly and in greater numbers along the western boundary of Kunsan AB, whereas in the past these species would have been much less likely to occur in this area. Eleven of the most regularly observed avian species during the pre-2006 survey (Table 2.5) were also among the most regularly observed species during the 2014-2020 surveys (Table 2.8).

Common Birds of Kunsan AB. While 143 species of birds have been reported from Kunsan AB and its immediate vicinity since monitoring began in 1999, the majority of these species are likely to be observed only during certain time periods (i.e., spring migration), or at certain locations (i.e., shoreline below Big Coyote Hill). For example, during the 2014-2020 surveys, the Cattle Egret was one of the most abundant birds seen along the Flight Line in late summer (August-September). However, this species was not observed in winter, spring, or early summer from anywhere on the base and was not observed on any survey date at Wolf Pack Park or the North POL areas. Among the species that have been reported from Kunsan AB, 10 species have been observed from all areas of the base and in all seasons, and these are the species that base personnel are most likely to encounter at the site. Brief descriptions of these common species are provided below.

Oriental Turtle-Dove (*Streptopelia orientalis*). The Oriental Turtle-Dove is one of the most easily noticeable birds at Kunsan AB. Males and females are similar in color, with a gray head, throat and nape that may show a buff, blue, or pinkish wash, especially in good light (Fig. 2.52). There is a prominent black and gray striped patch that is easily visible on the side of the neck. The back is gray blue with blurry black blotches, and the wings are dark with broad buff or rufous fringes that give the bird a scaled appearance. This ground foraging species feeds on seeds and green shoots of a variety of plants, and may be found in woodlands, grasslands, farms, parks, industrial and urban areas. At Kunsan AB, this species is a year-round resident and may be regularly seen perching on overhead wires and foraging in grassy areas.

Figure 2.52 Oriental Turtle-dove
Photo: K. LaGory, Argonne National Laboratory

Japanese Tit (*Parus minor*). The Japanese Tit is a year-round resident of the Korean Peninsula, and is very common at Kunsan AB. This is a small bird with a distinctive black head and throat, white cheeks, gray wings, and white underparts with a distinct black belly stripe (Fig. 2.53). In winter they generally occur in feeding flocks with other species. This bird feeds primarily on insects in spring and summer and switch to seeds and berries in autumn and winter. The Japanese Tit has adapted well to the presence of humans and human activities, and is a common bird in residential areas, urban parks, and gardens. It nests in holes in trees, and often takes advantage of man-made cavities.

Figure 2.53 Japanese Tit
Photo: J. Levenson, Argonne National Laboratory

Oriental Magpie (*Pica serica*). The Oriental Magpie (recently taxonomically seperated from the Eurasian Magpie, *Pica pica*) is probably the most conspicuous bird on Kunsan AB where it is a year-round resident. This magpie occurs throughout Eurasia and the Korean Peninsula, and is present throughout Kunsan AB. It is a relatively large, very vocal, active bird with distinctive black and white markings and a long tail (Fig. 2.54). Nesting activities begin as early as February. It nests in all the wooded areas at Kunsan AB, as well as on utility poles, communication towers, and water towers, where it builds large stick nests. This bird is omnivorous, feeding on bird eggs and young, small mammals, insects, seeds, and vegetation. The Eurasian Magpie is well acclimated to aircraft operations at Kunsan AB and accustomed to human activity and disturbance.

Figure 2.54 Oriental Magpie
Photo: K. LaGory, Argonne National Laboratory

Eurasian Tree Sparrow (*Passer montanus*). The Eurasian Tree Sparrow is widespread throughout Eurasia where it is a year-round resident, and has been observed from all areas of Kunsan AB. During the 2014-2020 surveys, this species was most numerous in the CE Bulk Storage Area, where it was associated with the adjacent garden plots of Haji Village. This is a small bird, with a brown head and back, white cheeks with a distinctive black spot on each, a white collar, a small black bib under its bill, and a whitish/light gray belly (Fig. 2.55). They are gregarious and commonly move about in flocks with as many as 40 or more individuals. It a seed eater, and builds nests of dried grass and leaves, feathers, and other soft materials in natural (e.g. tree holes) and man-made (e.g., open pipe ends, holes in roof overhangs) cavities.

Figure 2.55 Eurasian Tree Sparrow
Photo: K. LaGory, Argonne National Laboratory

Brown-eared Bulbul (*Hypsipetes amaurotis*). In eastern Eurasia, the Brown-eared Bulbul is largely limited to the Korean Peninsula and Japan, where it is a year-round resident. While preferring forested habitats, it readily adapts to urban and rural environments. The Brown-eared Bulbul is a medium-sized bird, grayish-brown in color with brown cheeks and a long tail (Fig. 2.56). In summer they feed primarily on insects, switching to berries and seeds in autumn and winter. They are vocal and often squawk loudly in flight from location to location. During the 2014-2020 surveys, this species was seen in greatest numbers and most often in the wooded habitats at North POL, Wolf Pack Park, and Big Coyote Hill.

Figure 2.56 Brown-eared Bulbul
Photo: K. LaGory, Argonne National Laboratory

Vinous-throated Parrotbill (*Paradoxornis webbiana*). The Vinous-throated Parrotbill occurs year-round in eastern Asia and the Korean Peninsula, and is a year-round resident of Kunsan AB. It is a small, rufous-brown bird with a small conical bill, long tail, reddish brown wings, and buff-colored underparts (Fig. 2.57). They forage in flocks of 10 to 30 or more individuals and are more often heard than seen as they chatter from dense tangles of undergrowth. It can be found in a variety of habitats including scrub, young woodlands, forest edges, thickets, reeds and marshes, where it forages for seeds and small insects. At Kunsan AB they have been observed in all survey areas.

Figure 2.57 Vinous-throated Parrotbill
Photo: K. LaGory, Argonne National Laboratory

Ring-necked Pheasant (*Phasianus colchicus*). The Ring-necked Pheasant is native to eastern and north-eastern China and the Korean Peninsula where it is present year-round. This pheasant is a large, chicken-like, ground dwelling bird with a long tail. Males have iridescent copper-and-gold plumage, a red face, and a distinct white collar; their loud squawking call can be heard from a long distance (Fig. 2.58). In contrast, females are overall brown in color and blend in with their preferred habitat. The Ring-necked Pheasant forages on the ground in fields and forest edge understory where it feeds on seeds, insects, and lizards. This species typically walks or runs, and usually resorts to flying only when disturbed at close range by predators or humans. This species was typically heard but often not directly seen at each of the survey sites. This is a large bird and should be considered a serious BASH concern.

Figure 2.58 Male Ring-necked Pheasant
Photo: Argonne National Laboratory

Eurasian Kestrel (*Falco tinnunculus*). The Eurasian Kestrel is the most common raptor at the base. This species occurs throughout southeast Asia and the Korean Peninsula and is a ROK designated natural monument (see Section 2.3.4). It is a small falcon with long wings and tail (Fig. 2.59). Adult males have a bluish-gray head, a rufous-brown back, buff-colored underparts, and plain gray tail with a broad black band at the tip. Females have a reddish-brown head, a rufous-brown back, buff-colored underparts, and a rufous-brown tail with many dark bars and a bold dark band at the tip.

Figure 2.59 Eurasian Kestrel
Photo: K. LaGory, Argonne National Laboratory

This species preys on small mammals, small birds, and insects, and characteristically hovers suspended with tail spread over open country, searching for prey and then diving to capture it. At Kunsan AB, the Eurasian Kestrel can often be observed flying and hovering over the airfield and other open areas of the base, as well as perching on

the fence along the western base boundary. This species nests at Little and Big Coyote Hills; parents and juveniles may often be observed flying to and from nest and roost sites at these locations. The Eurasian Kestrel has been involved in aircraft strike incidents and is a BASH concern.

Gray Heron (*Ardea cinera*). The Gray Heron is widespread through eastern Asia; it is a year-round resident in Japan, Korean Peninsula, much of China, and at Kunsan AB. This is one of the largest birds in the area, standing approximately 40 inches tall with a 6 ft wingspan. It is recognized by its size, gray and black coloration, large yellow bill, and long yellow legs (Fig. 2.60). This species is found in both salt and freshwater marshes, tidal flats, along rivers, and rice fields.

Figure 2.60 Gray Heron (left) and Great Egret (right)
Photo: K. LaGory, Argonne National Laboratory

At Kunsan AB, the Gray Heron seldom ventures inside of Perimeter Road, but is relatively common on mudflats, along the tide line south and west of Big Coyote Hill, and during the 2014-2020 surveys was observed in the rice fields adjacent to the KAL Terminal and the north eastern boundary of the Flight Line. The Gray Heron has been observed from most survey sites on base, usually flying above the site. The Gray Heron feeds primarily on fish, amphibians, small mammals (e.g., mice) and birds (e.g., ducklings), and invertebrates (e.g., crabs).

Great Egret (*Ardea alba*). The Great Egret is larger than other all-white egrets (Intermediate, Little, Cattle Egrets). The Great Egret is similar in size and shape of the Gray Heron but is all white with black legs (Fig. 2.60). Bill color changes from black during breeding to yellow after breeding. In spring, they spend time near rockery nest sites, but when the young are fledged, the adults disperse to inland rice paddies and irrigation ditches. The Great Egret is found in both salt and freshwater marshes, tidal flats, along rivers, and rice fields. At Kunsan AB, the Great Egret has mostly been observed flying overhead. During the 2014-2020 surveys the largest numbers were observed in late summer and early autumn, on the mudflats and along the tide line south and west of Big Coyote Hill. Like the Gray Heron, the Great Egret feeds primarily on fish, amphibians, small mammals and birds, and invertebrates.

2.3.4 Threatened and Endangered Species and Species of Concern

The management and stewardship of natural resources at Kunsan AB must strike an informed balance between regulatory and operational requirements. From the regulatory standpoint, the USFK KEGS (USFK REG 201-1, 30 July 2020) provide specific criteria for environmental protection on USFK installations.

Chapter 13 of KEGS, *Endangered Species and Natural Resources*, identifies USFK criteria for plans and surveys needed to ensure "proper protection, enhancement and management of natural resources any species (flora and fauna) declared endangered or threatened by either United States or Korean government." Compliance with these criteria ensures that USFK military actions are not likely to jeopardize the continued existence of any species listed as endangered or threatened by the ROK. The Korean government imposes restrictions on collecting, importing, and exporting endangered or otherwise designated species of wild animals and plants. These tables are provided in Chapter 14, Appendix C of this INRMP. Twenty-three of the species listed in KEGS Tables 13-1 and 13-2 have been reported from Kunsan AB since 1999. These are identified in Table 2.15, and include 2 mammal, 2 amphibian, and 20 bird species.

Table 2.15 Endangered, Threatened, or ROK designated Natural Monument Species (per KEGS 2012) Reported from Kunsan AB.

Species	Designated as Endangered Species	Designated as Natural Monument	Year Reported
Amphibians			
Seoul Frog (*Pelophylax chosenicus*)	X		2002, 2017-2019
Boreal Digging Frog (*Kaloula borealis*)	X		2002, 2017, 2019
Birds			
Eurasian Kestrel (*Falco tinnunculus*)		X	Pre-2006, 2010-2011, 2014-2020
Eurasian Sparrowhawk (*Accipiter nisus*)		X	2002, 2004, 2015, 2020
Chinese Sparrowhawk (*Accipiter soloensis*)		X	1999, 2001, 2018
Northern Boobook (*Ninox japonica*)		X	2000, 2002, 2005, 2017-2019
Oriental Scops Owl (*Otus sunia*)[c]		X	2017
Taiga/Tundra Bean Goose (*Anser fabilis/serrirostris*)	X		2011-2012, 2015, 2019-2020
Far Eastern Curlew (*Numenius madagascariensis*)	X		Pre-2006, 2015-2016
Eurasian Hobby (*Falco subbuteo*)	X		Pre-2006, 2010-2011, 2016-2019
Fairy Pitta (*Pitta nympha*)	X		2016
Easten Buzzard (*Buteo japonicus*)	X		2015, 2020
Rough-legged Hawk (*Buteo lagopus*)	X		2015, 2020
Osprey (*Pandion haliaetus*)	X		2020

Table 2.15 Endangered, Threatened, or ROK designated Natural Monument Species (per KEGS 2012) Reported from Kunsan AB.			
Species	**Designated as Endangered Species**	**Designated as Natural Monument**	**Year Reported**
Cinereous Vulture (*Aegypius monachus*)	X	X	2020
Eurasian Oystercatcher (*Haematopus ostralegus*)	X	X	Pre-2006, 2010-2011, 2014-2019
Hen Harrier (*Circus cyaneus*)	X	X	2015, 2020
Peregrine Falcon (*Falco peregrinus*)	X	X	2002, 2004, 2016-2017
Northern Goshawk (*Accipiter gentilis*)	X	X	2020
White-tailed Eagle (*Haliaeetus albicilla*)	X	X	2020
Eurasian Spoonbill (*Platalea leucordia*)	X	X	2002, 2003, 2004
Black-faced Spoonbill (*Platalea minor*)	X	X	2010-2011
Mammals			
Leopard Cat (*Prionailurus bengalensis*)	X		2012, 2019
Eurasian River Otter (*Lutra lutra*)	X	X	2019

Some of the species identified in Table 2.15 are not listed in KEGS 2020, but their inclusion here is warranted as a result of recent taxonomic evaluations of the species. These species are the Seoul Frog (*Pelophylax chosenicus*), the Northern Boobook (*Ninox japonica*), and the Oriental Scops Owl (*Otus sunia*). The basis for their inclusions is provided in the species-specific discussions presented below.

2.3.4.1 KEGS Listed Endangered, Threatened, and ROK protected Species at Kunsan AB

Amphibians

Seoul Frog (Gum-gae-goo-ree) (*Pelophylax chosenicus*). The eastern golden frog (*Rana plancyi*) is listed in KEGS Table 13-1 (see Appendix C) as a Class II Endangered Wildlife Amphibian and was reported at Kunsan AB during the 2002 amphibian surveys. Based on recent taxonomic evaluations, the eastern golden frog is now considered restricted to China and does not occur on the Korean Peninsula. The Seoul frog (*Pelophylax chosenicus*) was once considered a subspecies of the eastern golden frog but is now considered a separate species. The Seoul frog is restricted to the western portion of the Korean Peninsula (Matsui 2004) and is likely the species that previously had been reported from Kunsan AB as the eastern golden frog.

The Seoul frog lives in waterways, ponds, rice paddies, and marshes, and rarely leaves the water. It is a very sedentary frog, staying close to its breeding sites throughout much of its non-hibernation period, and leaving those areas only when it migrates to nearby terrestrial sites to hibernate (Ra et al., 2008). It is about 2.5-in. long, with a bright green back and a dark yellowish-red belly. It has a distinctive golden-brown

ridge along either side of the back from behind the eye, across the top of the ear to the base of the hind legs (Figure 2.61). The pupil of the eye is black and circular and is rimmed with a thin golden line. Breeding occurs from May to early July, and eggs are deposited near the water's edge. The tadpoles have a gold-rimmed eye pupil and a slightly thickened upper lip line. The Seoul frog coexists in the same habitat with the Korean brown frog, but they do not interbreed.

Figure 2.61 Seoul Frog
Photo: K. LaGory, Argonne National Laboratory

In 2002, the Seoul frog was reported from the base golf course ponds but was not found at the ponds during surveys in 2010-2011 nor during the 2017 – 2020 surveys specifically targeting this species. These ponds supported relatively large numbers of American bullfrog, which likely adversely impacted the Seoul frog in these ponds. In addition, the ponds were dredged in the summer of 2017 to remove accumulated sediments and aquatic vegetation. The Seoul frog likely no longer exists at the golf course ponds. However, during the June 2018 surveys, the Seoul frog was observed and heard vocalizing at the confluence of the drainage ditch that runs along the northern border of the golf course and the ditch that runs between the western border of the golf course and Avenue A (Figure 2.62; also Figure 2.65C).

Figure 2.62 Golf course drainage ditch (left) and resident adult Seoul frog (right).
Photo: K. LaGory, Argonne National Laboratory

While none was observed or heard at this location during the August 2018 survey, their absence may have been due to the prolonged dry spell and hot weather conditions at that time. In the future, Seoul frogs from this drainage may recolonize one or more of the golf courses ponds. However, the American bullfrog was observed at some of the ponds following the 2017 dredging, and likely will continue to pose a threat to any Seoul frogs that may move into the ponds in the future.

During the 2017 and 2018 surveys, the Seoul frog was found at two other base locations: the drainage in the southeastern portion of the CE Area (Figure 2.65B), and two drainage ditches between the runway and the western base boundary. At the CE Area, multiple Seoul frogs vocalized in response to playback of recorded calls during the May 2017 and June 2018 surveys, although no similar responses were heard during the July 2017 and August 2018 surveys. At this location, the drainage is a heavily vegetated, steep-sided, 20-ft. wide channel (Figure 2.63). During the June/July 2019 surveys, the Seoul frog was again heard from this same location at the CE Area. During the June/July survey, this frog was heard for the first time at Kunsan AB calling from a small wetland at the base of Little Coyote Hill, between the southwestern side

of the hill and the Perimiter Road (Figure 2.65D), and from some seasonally wet areas adjacent to the northeast corner of Big Coyote Hill between the Perimeter Road and runway (Figure 2.65F).

Figure 2.63 Seoul Frog Habitat, CE Area, 2018 Before and After Partial Vegetation Removal; May (left) and August (right) 2018. *Photo: K. LaGory, Argonne National Laboratory*

The American bullfrog was observed in the CE Area drainage from which Seoul frogs vocalized during the 2017 and 2018 surveys, and likely poses a threat to the Seoul frog in this habitat. In addition, extensive streambank vegetation removal and some limited sediment removal occurred in the southernmost reach of the drainage sometime prior to the August 2018 survey (Figure 2.63). This area included the area at which Seoul frogs were heard calling in 2017 and 2018. It is not known to what extent this clearing activity may have affected the Seoul frog population at this location, although one individual was heard vocalizing from this area during the June/July 2019 surveys.

During the May and July 2017 surveys, the Seoul frog were heard calling and also observed in two drainage ditches coming from the central portion of runway area, immediately east of the Perimeter Road and between the road and the western base boundary. (Figure 2.64). However, both drainages have been completely culverted, eliminating all habitat for this species at those locations (Figure 2.64). During the 2019 summer surveys, Seoul frogs were heard calling immedietaly offbase from a large pool adjacent to the base; this pool receives discharge from the northernmost of the two culverted drainages (Figure 2.65A).

Figure 2.64 Seoul Frog Habitat, Runway Drainage Ditch, 2017 (left) and 2018 (right)
Photo: K. LaGory, Argonne National Laboratory

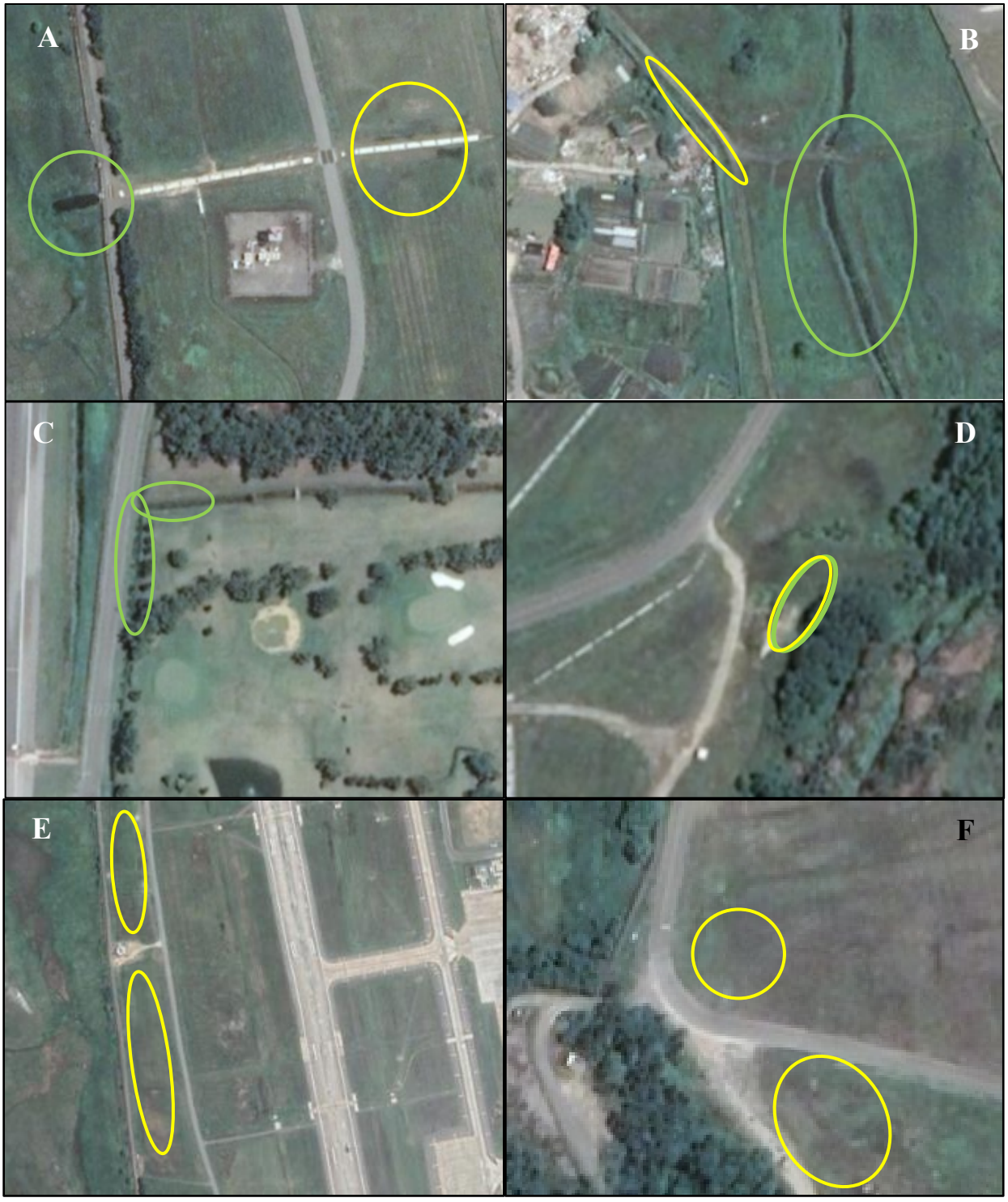

Figure 2.65. Locations where Seoul Frog (green) and Boreal Digging Frog (yellow) were found during the 2017-2019 surveys. A: Offbase pool receiving discharge from northern culverted runway drainage, and seasonal wet area between Perimeter Road and runway; B. Drainage way in southern end of CE Area and seasonal wet area between road and Han Village fenceline; C. Golf Course Drainageways; D. Wetland at western base of Little Coyote Hill; E. Seasonally wet areas between Perimeter Road and running track; F. Seasonally wet areas at northeastern corner of Big Coyote Hill.

Boreal Digging Frog. The boreal digging frog (Mang-kong-ee) (*Kaloula borealis*) is listed as a Class II Endangered Wildlife Species in KEGS Table 13-1. However, this species is common through much of its range and not considered to be in peril (Matsui and Wenge 2004). The range of this species includes central and northeastern China, the Korean Peninsula, and Jeju Island. Previous versions of the Kunsan INRMP as well as of KEGS have the common name for this frog as the Korean narrow-mouthed frog. However, the common name for this species is now the boreal digging frog.

The boreal digging frog is generally yellow in color with a marbled brown pattern on its sides (Figure 2.65). It has a short snout with a blunt tip (a characteristic of the narrow-mouthed frog family Microhylidae) and may reach a length up to 2 in. The boreal digging frog inhabits wetlands, ponds, and rice paddies where they dig and reside in narrow, deep underground holes. Breeding occurs between April and May, during which time adults call to one another. Tadpoles of this species are very distinctive and can be readily differentiated from tadpoles of the other 12 generally accepted frog species in Korea on the basis of having a simple oral disc (i.e., external mouth structure) (Fig. 2.66).

Figure 2.66 Boreal Digging Frog (*Kaloula borealis*): Adult (left), Tadpole (center), Simple Oral Disc (right)
Photos: J. Levenson (adult) and K. LaGory (tadpoles), Argonne National Laboratory

During the June 2002 biodiversity surveys at the base, the boreal digging frog was found in the airfield grass on either side of the Perimeter Road, approximately in line with the runway. The frogs were apparently moving back and forth across the road and there was high mortality due to vehicular traffic. While no boreal digging frogs were found during the 2010-2011 surveys, this species was again found in this area during the 2017 surveys. While no adults were observed or heard calling during the 2017 survey, numerous tadpoles were collected from temporary pools beneath the running path along the western boundary of the site (Figure 2.65E). While no adults or tadpoles were found at any locations during the 2018 surveys (most likely due to a dry summer and complete absence of standing water where tadpoles had been found in 2017), adult frogs were heard during the June/July 2019 survey vocalizing from several locations between the Perimeter Road and the western base boundary (Figure 2.65 A and E). These survey results indicate that this area of the base supports a self-sustaining population of the boreal digging frog.

During the 2017 surveys, boreal digging frog tadpoles were found in a drainage ditch located along the western boundary of the CE Bulk Storage Area (Figure 2.67). While recent construction has eliminated this habitat, boreal digging frogs were heard vocalizing further south, calling from wet areas along the eastern boundary of the CE Bulk Storage Area adjacent to the Han Village fence line (Figure 2.65B). The boreal digging frog had not previously been heard from this area during any of the earlier surveys in this area. The June/July 2019 surveys also found several boreal digging frogs vocalizing from a small wetland areas at the western base of Little Coyote Hill near the Perimiter Road (Figure 2.65D). This area has been regularly undergone avian surveys since 2014, but this is the first time this frog was heard at this location.

Figure 2.67 Boreal Digging Frog Habitat: Temporary Pools along Western Base Boundary (left) and Drainage Ditch along the Western Portion of the CE Area (right)
Photo: K. LaGory and I. Hlohowskyj, Argonne National Laboratory

Birds

Twenty species of birds listed as protected in KEGS 2012 have been observed from Kunsan AB since surveys began in 1999 (Table 2.15). Five of these species are designated as Natural Monuments, seven are designated as Endangered Wild Animals, and eight species are designated as both. These species and their status at Kunsan AB are discussed below.

Birds Designated Only as Natural Monuments

Chinese Sparrowhawk (Bul-gun-bae-sae-mae) (*Accipiter soloensis*). The Chinese Sparrowhawk is designated in KEGS 2012 Table 13-2 as Natural Monument No. 323-2 (see Appendix C). This listing also gives the older common name of Chinese Goshwak. This species breeds across eastern China, the Korean Peninsula, and far south-eastern Russia (IUCN 2020). The upperparts of the Chinese Sparrowhawk are slate blue-gray; there is a pale rusty wash on the breast and belly of the male which is barely discernible on the female (Figure 2.68). This bird is about 14 inches long and has a wingspan of 20 inches. The Chinese Sparrowhawk hunts a few feet above the ground. It is most noticeable after a hunt when it flares sharply upward in preparation for landing on an elevated perch.

Figure 2.68 Chinese Sparrowhawk (*Accipiter soloensis*)
Photo: K. LaGory, Argonne National Laboratory

The species prefers wooded hills bordered with rice paddies or wetlands. It is a secretive bird and is likely present during the warm weather season. It feeds chiefly on frogs, lizards, and large insects, catching prey on the ground or in the air. The Chinese Sparrowhawk was sighted during the November 1999 and July 2001 avian surveys, mostly in the North POL Area, Wolf Pack Park, and the Korean chapel. A breeding pair was observed in the North POL Area, perching on the perimeter fence before swooping over the adjacent rice paddies in search of frogs. This species was not reported from the base until it was observed in June 2018, twice at the North POL/Wolfpack Park area, perching on a utility post (Figure 2.68) in the same area where a breeding pair had been

observed in the earler 2001 survey, and once along the flightline. This species was also observed during the June 2018 survey at Little Coyote Hill.

As the Chinese Sparrowhawk prefers woodland habitats, it is not a direct hazard to aircraft operations. However, it feeds on frogs, so areas adjacent to the airfield that support frogs may attract foraging birds.

Eurasian Sparrowhawk (Sae-mae) (*Accipiter nisus*). The Eurasian Sparrowhawk is designated as Natural Monument No. 323-4 in KEGS Table 13-2 (see Appendix C). This species is common from western Europe to far eastern Russia and is a migrant and occassional winter visitor in the ROK (IUCN 2020). However, this species does not breed in the ROK. The upperparts of this bird are slate blue-gray; there are pale rusty bands on the breast and belly which are visible on the male but barely detectable on the female (Figure 2.69). It is very similar to the Chinese Sparrowhawk but is slightly larger and has a distinct white "eyebrow" marking. The Eurasian Sparrowhawk is about 15-in. high and has a 23 in. wingspan.

The Eurasian Sparrowhawk typically breeds from April to July in mountain forests between 2,000 and 5,000 ft. in elevation. In autumn it usually descends to the lowlands and spends the winter at lower altitudes; it is during these times that it may be found in the vicinity of Kunsan AB. A dead Eurasian Sparrowhawk was found at the corner of 10th Street and Avenue C on March 24, 2002 during the avian survey (Figure 2.69). It is likely that this individual was a winter visitor to the base. A living specimen was observed in the North POL Area on September 24, 2004. Most recently, this species was observed in 2015 in February and April flying over the North POL Area, Big and Little Coyote Hills, and the CE Area and in January 2020 over the North POL area. These birds were winter visitors or early spring migrants. Given its infrequent and likely transient occurrence at the base, this species is unlikely to present a hazard to aircraft operations.

Figure 2.69 Left: Male Eurasian Sparrowhawk (*Accipiter nisus*). Right: Dead Eurasian Sparrowhawk found on Kunsan AB, March 2002.
Photo: Left, F. Pestana, CC BY-SA 2.0; right, J. Levenson, Argonne National Laboratory

Eurasian Kestrel (Hwang-jo-rong-ee) (*Falco tinnunculus*). The Eurasian Kestrel (Figure 2.70) is listed in KEGS Table 13-2 as Natural Monument No. 323-8. This falcon can be found from western Europe to southeastern Asia, and is commonly observed year-round throughout Kunsan AB. It occurs in open lowlands, wooded clearings, and around cultivated fields where it preys on small rodents, birds, and insects. The Eurasian Kestrel breeds on ledges, buildings, and abandoned corvid nests (IUCN 2020). Breeding begins as early as late February and continues to June. The Eurasian Kestrel can be observed almost

anywhere on Kunsan AB. It is most commonly seen hunting over the airfield, Big and Little Coyote Hills, and the golf course, or perched on antennae or light posts in the ROKAF area.

Figure 2.70 Eurasian Kestrel (*Falco tinnunculus*)
Photo: K. LaGory, Argonne National Laboratory

The Eurasian Kestrel nests on the quarry walls at Little Coyote Hill and likely along the rock faces of Big Coyote Hill. In August 2001, at least three pairs of kestrels were observed with their young at Kunsan AB; two family units in the vicinity of Little Coyote Hill, and a third along the sea wall near the ROK compound. During the 2014-2019 avian surveys, this species was observed throughout the base, including multiple individuals observed on ledges at the Little Coyote Hill quarry, the rock face on the southwestern border of Big Coyote Hill, and soaring in the immediate vicinity of both hills. A family of kestrels was also observed at the CE Bulk Storage Area, suggesting that nesting occurred in the vicinity. The Eurasian Kestrel may pose a moderate hazard to flying operations because of its regular occurrence over, and in the vicinity of, the airfield and especially over its southern end. Dead Eurasian Kestrels from airstrikes have been found on occasion along the runway at Kunsan AB (Personal communication with MSgt N. Thomas, 8 FW/SE Flight Safety NCO, August 25, 2016).

Northern Boobook (Sol-boo-ong-ee) (*Ninox japonica*). The Northern Boobook (Figure 2.71) is designated as Natural Monument No. 324-3. Previous versions of the Kunsan AB INRMP, as well as KEGS Table 13-2, identified this species as the Brown Hawk Owl, *Ninox scutulata.* KEGS Table 13-2 misspells the genus as *Nixon* rather than *Ninox*. Based on recent evaluations of the distribution and taxonomy of hawk owls, the species that occurs in Korea is now called the Northern Boobook, *Ninox japonica* (Clements et al., 2016; IUCN 2020).

The Northern Boobook is a common summer visitor throughout much of eastern Asia, occurring in eastern Russia, northern and central China, Korea, Japan, southeastern Asia, and portions of India. It migrates through western ROK to breed from late May until July. It inhabits the coastal conifer belts, lowland woods, forests with tall trees, wooded parks as well as around shrines.

This is a medium sized owl with large golden eyes, about 10 inches in length with a 27-inch wingspan. It is dark brown above, white below, with long dark streaks on the breast. The diet of the Northern Boobook is predominantly large flying insects, but it eats lizards, small birds, and bats. The breeding season is from late May to late July. Preferred nest sites are natural cavities in trees ranging from 20 to 35-ft high. It also utilizes nest boxes.

Figure 2.71 Northern Boobook (*Ninox japonica*)
Photo: J. Levenson, Argonne National Laboratory

A pair of Northern Boobook were observed during the May 2000 survey in the North POL (NRMU POL-3). Additional sightings in June 2002 and May 2005 in the same area suggested that these birds may have been summer residents and potentially nested in the area at those times. However, this species was not observed during either the 2010-2011 or the 2014-2016 surveys. Surveys specifically targeting this species were conducted in 2017 (May and July), 2018 (June and August),

and 2019 (June/July), and it was found during each of the surveys. During these surveys, pre-recorded calls of this species were played in the vicinity of North POL Area and Wolf Pack Park (from where this species had previously been reported), and at Big Coyote Hill.

At Big Coyote Hill (NRMU BCH-3), at least two individual birds responded to pre-recorded calls on each of the 2017-2019 survey dates. The habitat in this area consists of pine forest (Figure 2.72).

Figure 2.72 Pine Forest Habitat, Big Coyote Hill
Photo: K. LaGory, Argonne National Laboratory

A single individual was observed during the May 2017 survey, perched on a utility pole at the ROK facilities at the top of Big Coyote Hill. As the May survey date corresponded to the general start of the breeding season for this species, the individuals responding to the pre-recorded calls at that time may have been male birds establishing nesting territories. The Northern Boobook was also heard at Big Coyote Hill during the July 2017 survey, with two individuals responding during the day and at/after sunset. On the evening of July 30, two adults and a juvenile were observed at the top of Big Coyote Hill at the ROK facilities, and one adult was observed feeding the young bird. This sighting confirms successful nesting of the Northern Boobook on Big Coyote Hill, most likely in the southern portion of NRMU BCH-3 (Figure 2.19). At least two individuals were heard calling (both morning and evening) during the two 2018 surveys, possibly the breeding pair observed the previous year. Single individuals were heard calling on three occasions at Big Coyote Hill during the June/July 2019 survey, these were likely the same individual.

The Northern Boobook was also heard in July 2017, responding on a single date to pre-recorded calls played at Wolf Pack Park, from offsite, east of the Wolf Pack Park/North POL Area vicinity, and a single response was also heard from the North POL Area. However, these responses were temporary and transient, and no birds were heard from Wolf Pack Park or the North POL Area at any other times during the 2017 and 2018 surveys. However, the presence of calling birds in this area suggests that the pine forest stands at the North POL Area, surrounding Wolf Pack Park, and in nearby offsite areas are used by this species, and on-site roosting and nesting in this area may occur on occasion.

Because of the location of on-base habitat for this species (pine forest), the Northern Boobook is unlikely to present any hazard to aircraft operations.

Oriental Scops Owl ((*Otus sunia*). The Oriental Scops Owl (Figure 2.73) is designated as Natural Monument No. 324-3. Previous versions of the Kunsan AB INRMP, as well as KEGS Table 13-2, identified two species as designated Natural Monuments. However, the Eurasian Scops Owl, *Otus scops*, (designated Natural Monument 324-6) has been taxonomically re-evaluated and is now considered to be restricted to Europe. KEGS 2020 also lists the Collared Scops Owl (*Otus lempiji*) as Natural Monument 324-7. *Otus lempiji* is now called the Sunda Scops Owl, which occurs in Malaysia and Indonesia and not on the Korean Peninsula. The Oriental Scops Owl (*Otus sunia*), is the Scops Owl species that occurs in the ROK, and it is this species that likely was originally designated as Natural Monument.

The Oriental Scops Owl occurs in eastern and southern Asia and may be found throughout the Korean Peninsula. It is a small bird, about 7 – 8 inches in length with a 20-inch wingspan that inhabits open and semi-open woodlands, parks, and savannahs, where it feeds on insects and occasionally small vertebrates. This species is a cavity nester, nesting in abandoned woodpecker holes and natural tree holes, and may also use artificial nest boxes. In the ROK, its breeding season may range from March to October (No et al., 2015).

Figure 2.73 Oriental Scops Owl (*Otus sunia*)
Photo: OrientalBirdImages.Org

During the 2017-2018 surveys, the Oriental Scops Owl was encountered only during the July 2017 surveys at two locations; Big Coyote Hill and the North POL Area. Shortly after sunset on July 30, an Oriental Scops Owl repeatedly called from within the pine forest at the top of Big Coyote Hill (from the northern portion of NRMU BCH-1 and the southern portion of NRMU BCH-3 [see Figure 2.19]) in response to a pre-recorded call, and the individual was subsequently observed perched in a nearby tree and flying overhead. The next morning, another individual was heard but not observed, calling from a wooded depression at the North POL Area (in NRMU POL-3 [see Figure 2.14]). While not previously reported from Kunsan AB, this somewhat secretive species is widespread and relatively common species throughout the ROK, and likely inhabits wooded areas throughout the base. The observations in 2017 were a direct result of the use of recently available pre-recorded calls of this species. While none were encountered during the 2018-2020 surveys, this species is likely present at and nests on the base.

Because of the on-base location of forest habitat for this species, the Oriental Scops Owl is unlikely to present any hazard to aircraft operations.

Birds Designated Only as Endangered Wildlife

Taiga/Tundra Bean Goose (Koon-kee-ro-kee) (*Anser fabilis/serrirostris*). The Bean Goose (*Anser fabilis*) is a Class II Endangered Wildlife Bird. This bird was previously considered as a single species with two subspecies, the larger Taiga Bean Goose, *A. f. middendorffi*, and the smaller Tundra Bean Goose, *A. f. serrirostris*, but are now considered separate species (Clements et al., 2016). The endangered status of these two species is not known. These species are difficult to differentiate. Both are large (30 to 40-inches in length with wingspans of 55 to 78 inches). Both species have a dark brown head and paler gray-brown lower neck, breast and belly (Figure 2.74).

The Taiga Bean Goose is slightly larger, with a longer and slenderer bill, more swan-like head and neck, and more orange on the bill. The Tundra Bean Goose has a shorter, thicker neck, rounder head, and stubbier bill with less orange. These species are relatively widespread across northern Eurasia, where they breed in taiga and Arctic tundra habitats, respectively. Both species winter in China, Korea and Japan, where they occupy large lakes, fields, marshy wetlands, and rice fields, and in spring they stage in large rivers in preparation for migration to their northern breeding grounds.

This species was first observed during the 2010-2011 surveys. During the 2014-2018 surveys, the Taiga/Tundra Bean Goose was only observed in February 2015; a small flock of 5 individuals overflying the southern end of the runway, and a large flock of 62 birds overflying Little Coyote Hill and the southern end of the runway. None were observd in subsequent surveys until October 2019 when 24 were observed flying over Big Coyote Hill, while in January 2020, multiple flocks totaling 134 individuals were observed

flying over multiple parts of the base. As all records of the Taiga/Tundra Bean Goose have been in autumn and winter, it is likely that these birds were either migrants passing through the area, or birds overwintering in the area. While no habitat exists on Kunsan AB, the airfield as well as the marsh/wetland complex of the region likely provide an overwintering habitat. Due to its large size, and at times the numerous flocks of eight or more birds observed flying over the base, they may pose a hazard to aircraft operations.

Figure 2.74 Left: Tundra Bean Goose (*Anser serrirostris*);
Right: Taiga Bean Goose (*Anser fabilis*).
Photos: Tundra Bean Goose, S. Russell, CC NC-ND 2.0
Taiga Bean Goose, D. Curtis, CC NC-ND 2.0

Far Eastern Curlew (Alak-ko-ri-ma-do-yo) (*Numenius madagascariensis*). KEGS 2020 li**sts t**he Australian Curlew (*Numenius madagascariensis*) as a Class II Endangered Wildlife Bird. The currently accepted common name for this species is the Far Eastern Curlew. The Far Eastern Curlew is considered endangered throughout the world (IUCN 2020). This species breeds in eastern Siberia and northeastern China, migrating through most of eastern Asia (including Korea) to winter in southeast Asia and Australia.

The Far Eastern Curlew is a large wading bird with a long downcurved bill, an overall brown body, and grayish legs (Figure 2.75). Its habitats include wet swampy meadows, and wet grasslands and swamps along rivers and coasts. During migration, this species frequents coastal wetlands and mudflats. The Far Eastern Curlew and its very close relative, the Eurasian Curlew (*Numenius arquata*), often form mixed flocks during migration, and both have been reported on base. They are very similar in appearance, and are difficult to differentiate while standing or at rest. In flight, the Far Eastern Curlew appears uniformly brown, while the Eurasian Curlew displays a white tail and rump extending up the lower back. The belly and underwing linings of the Eurasian Curlew appear whitish, while those of the Far Eastern Curlew are buff or brown.

Figure 2.75 Far Eastern Curlew (*Numenius madagascariensis*)
Photo: K. LaGory, Argonne National Laboratory

During the pre-2006 surveys, the Far Eastern Curlew was observed along the Kunsan AB shoreline in seven of the 12 months surveyed. As this species breeds and nests in the Arctic, it is presumed that some of the birds were fall or spring migrants, others were wintering residents, and still others (observed in summer

months) were juveniles too young to breed. With the seawall completion, fewer and fewer Far Eastern (and Eurasian) Curlews may be expected near Kunsan AB, and observations will be confined to the coastline adjacent to Big Coyote Hill. No Far Eastern Curlews were observed during the 2010-2011 surveys, while during the 2014-2020 surveys this species was observed only twice (in April 2015 and August 2016), both times along the coastline below Big Coyote Hill.

Despite its large size, the Far Eastern Curlew appears unlikely to pose a significant hazard to aircraft operations at Kunsan AB. This species is uncommon, no suitable habitat exists on the base, and individuals that may occur in the area would be confined to the shoreline and tidal flats adjacent to Big Coyote Hill, well away from the airfield. Thus, this species is very unlikely to pose a hazard to aircraft operations.

Eurasian Hobby (Sae-hul-li-kee) (*Falco subbuteo*). The Eurasian Hobby is classified as a Class II Endangered Wildlife Bird (listed as 'Hobby' in KEGS 2020). It is a small falcon, about 12 in. in length with a 30-in. wingspan, with uniformly dark gray-brown upper parts, contrasting white underparts and a heavily streaked breast. The Eurasian Hobby has distinct narrow 'teardrop' markings on each cheek, and the diagnostic field marks are the orange-red thighs and undertail coverts (Figure 2.76).

Figure 2.76 Eurasian Hobby (*Falco subbuteo*); Adult at Wolf Pack Park (left) and Adult, Juvenile, and Nestling at the Kunsan AB Golf Course (right)
Photo: K. LaGory, Argonne National Laboratory

This species occurs throughout eastern Asia, from southern Siberia through China, the Korean Peninsula, and Japan, and into southeast Asia (IUCN 2020). It occurs in a variety of habitats, including forested and open areas, agricultural lands with trees, and wooded parks, but always nests in trees. Breeding territories are established in May and June. The Eurasian Hobby preys on flying small birds such as swallows and skylarks, as well as large flying insects.

The Eurasian Hobby is a common summer resident at Kunsan AB and can be observed from June through September throughout the base and has been observed during all survey periods. During the June 2016 surveys, a pair was regularly observed flying in the immediate vicinity of Wolf Pack Park and perching together in the stand of pines by the burial site. In August 2016, a pair of hobbys was again observed in this same area, along with a single juvenile, suggesting that the pair successfully nested at Wolf Pack Park in 2016, although a nest was never found. The Eurasian Hobby was again observed at Wolf Pack Park in 2017, 2018, and 2019. During the August 2018 survey, two adults, two nestlings, and two juveniles were observed in the stand of pines next to the golf course club house. Successful nesting at the golf course was confirmed by the presence of the two nestlings. Because of the location of on-base habitat for this species

(pine stands at Wolf Pack Park, Big Coyote Hill, and the golf course), the Eurasian Hobby likely poses no more than a slight hazard to aircraft operations.

Fairy Pitta (Pal-Saek-Jo) (*Pitta nympha*). The Fairy Pitta is classified as a Class II Endangered Wildlife Bird. It is a very colorful, small ground-foraging bird about 6 to 8 in. in length. Its coloration includes a reddish-brown cap, a broad black eye-stripe, emerald-green back and wings, a pale-yellow throat, neck and breast, a bright red belly and undertail feathers, and bright blue patches on the upper wings and rump (Figure 2.77).

Figure 2.77 Fairy Pitta (*Pitta nympha*)
Photo: J. Thompson, CC BY 2.0

The Fairy Pitta is a migratory species, breeding in forest habitats in portions of southern Japan, the ROK, southeast China, and Taiwan, and wintering primarily on Borneo (IUCN 2020). The Fairy Pitta inhabits dark broadleaf evergreen, subtropical, and tropical forests, where it forages for invertebrates (e.g., earthworms, insects, snails) on the forest floor. Nesting occurs in late spring through mid-summer. Domed nests constructed of twigs are located on forested slopes, 3-15 ft above the forest floor, with males strongly defending the nests.

The Fairy Pitta has been reported from numerous locations in the ROK. Research in 2009 found 64 Fairy Pitta at 32 sites on Jeju Island, and an additional 11 individuals (including 5 juveniles in 3 nests) in Hampyeong County, Jeollanam Province (Kim et al. 2010). This species is known to breed east to Busan and occasionally north to Seoul (Edelsten et al. 2013, Moores et al., 2014). At Kunsan AB, a single male was heard on June 7, 2016, singing in the forest habitat along the western portion of Big Coyote Hill (NRMU BCH-1) and was subsequently observed in the forested undergrowth at the top of the hill. This was the only time to date that this species has been reported at Kunsan AB. The Fairy Pitta was not heard or observed during surveys conducted in 2017-2019 specifically targeting this species.

The status of this species at Kunsan AB is uncertain. Prior to 2014, Big Coyote Hill was not accessible for avian surveys. While access was available during the most recent survey period, hazards such as concertina wire prevent survey personnel from entering some forested areas of Big Coyote Hill. It is important to note that this species is very uncommon in the ROK. For example, there were only 16 reported sightings between 2014 and 2016, only 4 in 2017, none in 2018, and only a few in 2019 and 2020. These small numbers of sightings for the entire country suggests that the single bird observed at Kunsan AB in 2016 was likely a transient individual. However, any future avian surveys conducted at Big Coyote Hill should continue looking for this species. Because of its forest habitat, this species poses no hazard to aircraft operations.

Eastern Buzzard, Mal-tong-ga-ree (*Buteo japonicus*) - The Eastern Buzzard (Figure 2.78) is listed in the KEGS as Endangered, Class II. The Eastern Buzzard was previously included in the Buzzard (*Buteo buteo*), as it is listed in the KEGS. That species has since been reevaluated and divided into several species. The species that occurs in Korea is now called the Eastern Buzzard (*Buteo japonicus*). This species nests in portions of far northern China and Mongolia and in eastern Russia, occurs year-round in Japan, and overwinters in Korea, Southeast Asia, Nepal, the Himalayan portions of India and Pakistan (IUCN 2020).

The Eastern Buzzard is a medium-sized raptor, being about 16 to 23 inches in length with a 43 to 55-inch wingspan. It inhabits open areas (e.g., grasslands) with nearby forests, and forested habitats with nearby

openings. It is brown above, with a pale head and breast and flanks mottled in dark brown.

Figure 2.78 Eastern Buzzard (*Buteo japonicus*)
Photo: D. Delaney, CC BY 3.0

At Kunsan AB, this species was observed during surveys in February 2015 (11 sightings), October 2019 (one sighting), and January 2020 (14 sightings). These birds were observed flying along the coast near Big Coyote Hill, over the reclaimed grasslands west of the base, and over the North POL, Big Coyote Hill, Little Coyote Hill, and CE areas. These all were likely overwintering birds. Potentially suitable winter habitat at Kunsan AB may be found at Big and Little Coyote Hills and the North POL area.

Rough-legged Hawk (Tul-bal-mal-tong-ga-ree) (*Buteo lagopus*). The Rough-legged Hawk (Figure 2.79) is listed in KEGS Table 13-1 as a Class II Endangered Wildlife Bird. This a medium-large bird, about 18–24 inches in length with a wingspan ranging from 47 to 60 inches, and weighing from about 1.3 to 3.7 lbs. This hawk is predominantly brown in color and often shows a high degree of speckling. A wide variety of plumage patterns are exhibited between light and. dark color morphs, males and females, and adults and juveniles. Distinguishing characteristics in all plumages include long white tail feathers with one or more dark subterminal bands, and when perched its wing tips are long enough to reach or extend past the tail.

This species can be found in Arctic and Subarctic regions of North America, Europe and Russia and the Palearctic during the breeding season and migrates south for the winter (IUCN 2020). Nests are typically located on cliffs, bluffs or in trees. This hawks hunt over open land, feeding primarily on small mammals.

The Rough-legged Hawk has only been reported from the base in February 2015 (two individuals) and in January 2020 (one individual), from the reclaimed grasslands west of the base. Given that these sitings occurred during winter surveys, the Northern Harrier is likely to be present in the area only as a wintering or migratory bird. Thus, this species is unlikely to present any hazard to aircraft operations.

Osprey (Mool-soo-ree) (*Pandion haliae*tus). The Osprey (Figure 2.80) is a very large, distinctively shaped hawk. It about 22 inches in length and has a 60 to 70-inch wingspan. Ospreys fly with a marked kink in their wings, making an M-shape when seen from below. Adult Osprey are brown above and white below, and overall are whiter than most raptors. From below, the wings are mostly white with a prominent dark patch at the wrists. The head is white with a broad brown stripe through the eye.

This species is found on all continents except Antarctica. It is an uncommon to fairly common winter visitor to all parts of South Asia, and Southeast Asia from Myanmar through to Indochina and southern China, Indonesia, Malaysia and the Philippines (IUCN 2020). The diet of the Osprey is almost exclusively fish, and it may be found around nearly any body of water: saltmarshes, rivers, ponds, reservoirs, estuaries, and even coral reefs. Their conspicuous stick nests are placed in the open on poles, channel markers, and dead trees, often over water. This species does not nest in the ROK.

The Osprey has been seen from Kunsan AB on only two occasions. A single individual was observed during the October 2019 survey, and another individual was observed during the January 2020 survey. In both instances, the birds were observed from Big Coyote Hill, flying along the coast. Both were birds wintering in the area. When present in the area, it will be as a wintering or migratory bird. Thus, this species is unlikely to present any hazard to aircraft operations.

Figure 2.79 Rough-legged Hawk (*Buteo lagopus*)
Photo: D. Delaney, CC BY-SA 2.5

Figure 2.80 Osprey (*Pandion haliaetus*)
Photo: Public domainpictures.net

Birds Designated as both Endangered Wildlife and Natural Monuments

White-tailed Eagle (Hin-ko-ri-soo-ree) (*Haliaetus albica*). The White-tailed Eagle (Figure 2.81) is listed in the KEGS as Endangered, Class I, and also as a ROK-designated Natural Monument (Monument Number 243-4). Both KEGS 2020 tables call this species the White-tailed Sea Eagle. It is a very large species of sea eagle and is widely distributed across temperate Eurasia, breeding across northern Europe and Asia, to northeastern Russia and far northern Japan (IUCN 2020). On the Korean Peninsula, it is present mostly only during the winter months, although it been confirmed to breed in the ROK (Lee 2015).

The White-tailed Eagle occurs near large rivers, lakes, and coastal areas, and feeds on birds, mammals and fish. It is a large eagle, with a 26 to 37-inch length and a wingspan of 6-8 feet. Upperparts are brown, with a lighter brown head, while underparts are very dark brown. The conspicuous white tail may be darker in young birds. A single White-tailed Eagle was observed from Big Coyote Hill during the January 2020 survey flying out over the reclaimed grasslands west of the base. This birds is probably overwintering in the area. Although this is a very large birds, its very occasional occurrence in the area in winter, together with the absence of suitable habitat at the base, this species is unlikely to pose a hazard to aircraft operations.

Cinerous Vulture (Dok-soo-ree) (*Aegypius monachus*). The Cinereous Vulture (Figure 2.82) is listed in the KEGS as Endangered, Class II, as well as a ROK-designated Natural Monument (Monument Number 243-1). This species is listed in the KEGS as both the Cinereous Vulture (Table 13-1) and Black Vulture (Table 13-2). The Cinereous Vulture is considered vulnerable in Korea (Korean Red List 2014) and is a scarce winter visitor.

This vulture is a Eurasian species, and may be found from Spain and Portugal, through southern Europe and the central Middle East, through Afghanistan eastwards to northern India to its eastern limits in central Asia, where it breeds in northern Manchuria, Mongolia and the northern portions of the Korean Peninsula (IUCN 2020). Their range is fragmented especially throughout their European range.The Cinereous Vulture is dark brown to black and extremely large, with up to a 10-ft wingspan. Like all vultures, it is a carrion feeder.

This species has only been reported from Kunsan AB once, and that was during the January 2020 surveys. A single individual was observed soaring over Big Coyote Hill, another soaring out over the reclaimed

grasslands west of the base, and two individuals flying northward over the Perimeter Road and northern end of the unway. As elsewhere in Korea, this species is a very uncommon winter resident in the vicinity of the base. However, due to its large size it may pose a hazard to flight operations.

Figure 2.81 White-tailed Eagle (*Haliaetus albica*)
Photo: © Ian Davies, eBird.org

Figure 2.82 Cinereous Vulture (*Aegypius monachus*)
Photo: Oriental birdimages.org

Eurasian Oystercatcher (Gum-un-mo-ree-mool-tae-sae) ((*Haematopus ostralegus*). The Eurasian Oystercatcher (Figure 2.83) is listed in KEGS Table 13-1 as a Class II Endangered Wildlife Bird, and in Table 13-2 as ROK designated Natural Monument No. 326. In both these KEGS tables, this species is listed simply as Oystercatcher.

The Eurasian Oystercatcher is a large bird reaching 18 in. in length. It has a black head, wings, and back, and unmarked white underparts. In flight, especially, the bird becomes obvious due to their white patches on the wings and tail. Also distinctive is its large black-tipped orange bill, orange legs, and red eyes. The strong broad bill is used for opening mussels or for finding sediment-dwelling invertebrates. Despite the species' name, oysters are not an important component of the diet.

Figure 2.83 Eurasian Oystercatcher (*Haematopus ostralegus*)
Photo: A. Trepte, CC BY-SA 2.5

This species breeds in northeastern Russia, China, ad the Korean Peninsula (including the ROK) and winters along the Asian coastline to Korea, southeast and southern China, and Japan (IUCN 2020). Typical habitats include sand and mudflat areas along seacoasts, estuaries, and large rivers. While no suitable habitat for this species occurs on Kunsan AB proper, Eurasian Oystercatchers have been regularly reported along the coast in the immediate vicinity of the base. Prior to completion of the Saemangeum Seawall, this species was reported throughout the year along the shoreline adjacent to the base and at the base of Big Coyote Hill. For example, over 100 individuals were observed on the shell bar beyond Big Coyote Hill on September 24 and 25, 2002. With the completion of the seawall and the continued westward retreat of the shoreline along much of the base perimeter, Eurasian Oystercatchers will be less likely to be present in the vicinity of the base, and when present will be restricted to the shoreline

below Big Coyote Hill. A total of 107 individuals were observed along this shoreline during the 2014-2020 avian surveys, with the greatest number of individuals (77) observed during the August 2018 surveys.

Black-faced Spoonbill (Jo-awe-sae) (*Platalea minor*). The Black-faced Spoonbill (Figure 2.84) is listed in KEGS Table 13-1 as a Class I Endangered Wildlife Bird and in Table 13-2 as ROK designated Natural Monument No. 205-1. This species breeds on islands off the west coast of the Korean Peninsula, and in Liaoning Province in mainland China; it winters in Taiwan; parts of coastal and mainland China; Cheju, ROK; southern Japan; and parts of southeast Asia (IUCN 2020). This spoonbill is considered endangered worldwide, with an estimated 2016 worldwide adult population of approximately 2,000 individuals. It forages on coastal mudflats and shallow muddy wetlands and lakes, and rests and sleeps in a variety of sites including trees, man-made structures, and shallow water.

It is a tall, white, wading bird about 2.5 ft in length with a 40-in. wingspan, and a long, black, spoon-shaped bill and black face (Figure 2.81). This species, similar in appearance to the more common Eurasian Spoonbill, and is has only been reported once at Kunsan AB, during the 2010-2011 surveys. This is an extremely rare species, and there is no suitable habitat for this species on the base. The only potentially suitable habitat in the immediate vicinity of Kunsan AB is the shoreline that remains immediately west of and adjacent to Big Coyote Hill.

Figure 2.84 Black-faced Spoonbill (*Platalea minor*);
Eurasian Spoonbill (*Platalea leucorodia*), right.
Photos: Black-faced Spoonbill, commons.wikimedia.org, CC BY-NC 2.0;
Eurasian Spoonbill, J. Caldas

Eurasian Spoonbill (No-rang-boo-ree-jo-awe-sae) (*Platalea leucorodia*). The Eurasian Spoonbill (Figure 2.84) is listed in KEGS Table 13-1 as a Class I Endangered Wildlife Bird and in Table 13-2 as ROK designated Natural Monument No. 205-2. The preferred habitats for this species are estuaries and mudflats, but they may also be seen in reservoirs and rice paddies. No suitable habitat occurs on the base proper. The Eurasian Spoonbill is a tall, white, crested wading bird with a 3 ft length and a 50-in. wingspan. In eastern Asia, this species is a summer visitor to northeastern China and southeastern Russia, and overwinters in southeast China, Korea, and Japan (IUCN 2020).

An uncommon winter visitor to the Kunsan AB area, they were recorded in autumn and winter during avian surveys in 2002, 2003, and 2004, in groups of 3 to 4 birds along the shoreline adjacent to the base. With the completion of the Saemangeum Reclamation Project, most suitable shoreline habitat adjacent to the base has disappeared, although this species may forage along the shoreline habitat that remains immediately west of and adjacent to Big Coyote Hill. No spoonbills have been observed during any of the post-2006 surveys, which is likely due, in part, to the completion of the Saemangeum Reclamation Project. With its large size, this species could pose a hazard to aircraft operations. However, because of the absence of

suitable habitat on the base as well as the disappearance of suitable habitat along the western boundary of Kunsan AB, it is unlikely that this species will be observed at the base.

Hen Harrier (Jat-bit-gae-goo-ri-mae) (*Circus cyaneus*). The Hen Harrier (*Circus cyaneus*) (Figure 2.85) is listed in KEGS Table 13-1 as a Class II Endangered Wildlife Bird, and in Table 13-2 as ROK-designated Natural Monument No. 323-6. This is a widespread species, occurring across Eurasia. In eastern Asia, it breeds in northeastern China and eastern Russia, and winters in southern China, the Korean Peninsula, and Japan (IUCN 2020). Habitats include open areas such as open grasslands, marshes, and agricultural fields.

Figure 2.85 Hen Harrier (female) (*Circus Cyaneus*) Photo: M.C. April

Hen Harriers are slender, medium-sized raptors with long, fairly broad wings and a long, rounded tail (Figure 2.88). They have a flat, owl-like face and a small, sharply hooked bill. Males are gray above and whitish below with black wingtips, a dark trailing edge to the wing, and a black-banded tail. Females and immatures are brown, with black bands on the tail. Adult females have whitish undersides with brown streaks, whereas immatures are buffy, with less streaking. All Northern Harriers have a white rump patch that is obvious in flight.

The Hen Harrier has only been reported at the base in February 2015 (a single individual flying over the reclaimed grasslands west of the base) and in January 2020 (two individuals over Big Coyote Hill and two over the reclaimed grasslands west of the base). Given that these sitings occurred during winter surveys, the Hen Harrier is likely to be present in the area only as a wintering or migratory bird. Thus, this species is unlikely to present any hazard to aircraft operations.

Peregrine Falcon (Mae) (*Falco peregrinus*). The Peregrine Falcon is designated as Endangered Wildlife Bird Class I in KEGS Table 13-1, and in Table 13-2 as ROK designated Natural Monument No. 323-7. This is a relatively large falcon, with an average length of 18 in. and a 4-ft wingspan. Its dark gray upperparts contrast with pale, lined underparts. The large bold cheek "teardrop" is diagnostic for the Peregrine Falcon (Figure 2.86).

Figure 2.86 Peregrine Falcon (*Falco peregrinus*)
Photo: USFWS, CC BY 2.0

The Peregrine Falcon has a worldwide distribution, with some areas having resident populations, others migratory populations, and still others nomadic populations (IUCN 2020). On the Korean Peninsula, this species is present year-round. The Peregrine Falcon preys on birds while diving on them from above. While this falcon may be seen in nearly any open habitat, it nests on ledges on cliffs. In areas without cliffs, the Peregrine Falcon has been reported to nest on transmission towers, quarry walls, silos, skyscrapers, churches, and bridges.

The Peregrine Falcon has been only infrequently observed at Kunsan AB. A Peregrine Falcon was first observed on February 24, 2002, eating a fish on the beach just north of Big Coyote Hill, and another was seen in this same area in February 2004. A single individual was observed soaring along the western side of Big Coyote Hill in August 2016, and another was observed over the flightline in July 2017. Given its

very infrequent occurrence at the base, this species is unlikely to present any hazard to aircraft operations.

Northern Goshawk (Cham-mae) (*Accipiter gentilis*). The Northern Goshawk (Figure 2.87) is designated as Endangered Wildlife Bird Class II in KEGS Table 13-1, and in Table 13-2 as ROK designated Natural Monument No. 323-1. It is a wides pread species inhabiting forests of North America, Europe and Asia. In eastern Asia, it may be found in parts of Tibet and the Himalayas, western China and Japan, and the Korean Peninsula (IUCN 2020). Adults may range from 18 to 24 inches in length, with 35 to 41-inch wingspans. Adult goshawks are dark slate gray above with pale gray barred underparts, while the juveniles are brown and streaky, with narrow dark bands in the tail.

In eastern Asia, this species breeds in portions of Russia and Japan, portions of the ROK, China and Mongolia, and the Himalya region. It overwinters in Korea and portions of southern China, northern Vietnam, and northern Laos. It inhabits mature woodland, preferring areas near clearings and the forest edge, feeding on birds, mammals, invertebrates and reptiles. This species has only been reported a single time from Kunsan AB, when a single individual was observed at Big Coyote Hill during the January 2020 survey. This individual was likely overwintering in the area, and possible at Big Coyote Hill. Given its very infrequent occurrence at the base, this species is unlikely to present any hazard to aircraft operations.

Figure 2.87 Northern Goshawk (*Accipiter gentilis*)
Photo: Japari Library

Mammals

Amur Leopard Cat (sark) (*Prionailurus bengalensis euptilura*). The leopard cat (*Prionailurus bengalensis*) is identified in KEGS 2012 Table 13-1 as a Class II Endangered Wildlife Mammal. Populations in Korea are classified as the subspecies *P. b. euptilura*, the Amur leopard cat (Jo et al. 2018). The leopard cat is a widespread species, occurring in parts of India, Pakistan and Afghanistan, through the Himalayan foothills, throughout most of China, the Korean peninsula and into the Russian Far East (IUCN 2020). Its range extends south throughout Southeast Asia, and includes the islands of Sumatra, Java, Borneo and Taiwan, where it may be found in a variety of habitats, including tropical rainforests, temperate broadleaf and coniferous forests, shrub forests, and successional grasslands. An IUCN review for Red List consideration ranked the leopard cat (*Prionailurus bengalensis*) as a Least Concern species because it has a widespread distribution and is common within its range (Ross et al., 2015). While widely distributed, generally abundant, and tolerant of human activities, population declines due to habitat loss and degradation, and hunting, are occurring in some regions. The entire Korean Peninsula is within the range of this species (Jo et al., 2018), and numerous sightings have occurred in many areas of the ROK.

The leopard cat is a small feline, about the size of a domestic cat but is slenderer, with longer legs and well-defined webbed toes. The background color of its spotted fur is tawny, with a white chest and belly (Figure 2.88). Its head has two prominent dark stripes, a short and narrow white muzzle, and a prominent white spot on the back of each ear (Jo et al. 2018). Body and limbs are marked with black spots of varying size and color, and its back has two to four rows of elongated spots. The thick tail is about half the size of its body length and is spotted with a black tip. While occasionally active during the day, most hunt at night, preying on mice and other small mammals. It is an agile climber and may spend considerable time up in trees. Leopard cats are solitary except during breeding season, which occurs in spring in Korea.

During the 2012 mammalian survey at the base, feces were found and attributed to this species. Wildlife cameras targeting the Amur leopard cat where installed at Kunsan AB in 2018 in forest areas of the North POL, Little Coyote Hill, and Big Coyote Hill. The presence of this cat at Kunsan AB was confirmed when cameras captured images of the cat on Big Coyote Hill on two occasions in October, 2019 (Figure 2.89). As these cats are typically solitary outside the breeding season, the photos are probably of the same individual.

Figure 2.88 Amur Leopard Cat (*Prionailurus bengalensis euptilura*)
Photo: Zoosite.com.us

Figure 2.89 Amur Leopard Cat Big Coyote Hill, October 7, 2019.

Eurasian River Otter (Soo-dal) (*Lutra lutra*). The Eurasian otter (Figure 2.90) is identified in KEGS 2020 Table 13-1 as a Class I Endangered Wildlife Mammal, and in Table 13-2 as ROK designated Natural Monument No. 330. This river otter is also known as the European otter, common otter, and Old World otter. It is found in the waterways and coasts of Europe, many parts of Asia, and parts of northern Africa (IUCN 2020). This species ranges over the entire Korean Peninsula and adjacent coastal islands with freshwater, except on Jeju and Ulleung Islands (Jo et al 2018). This otter is brown above and cream below, with adults ranging from 22 to 37 inches in length and weighing from 15 to 26 lbs. The Eurasian otter has a diet mainly of fish. The Eurasian Otter lives in a wide variety of aquatic habitats, including highland and lowland lakes, rivers, streams, marshes, swamp forests and coastal areas. It is primarily nocturnal, largely solitary, and strongly territorial.

The Eurasian river otter has never been reported during any of the natural resource surveys at Kunsan AB. However, in May 2019, while storm draina at the base were being visually inspected using a snake camera, a Eurasian river otter was photographed in one of the drains. The drain runs from the flightline to the western boundary of the base and discharges to a drainageway in the reclaimed grasslands adjacent to the base. Given the absence of sufficient on-site habitat, the otter photographed in the storm drain was probably a solitary individual that was passing moving through the area (rather than a resident or regular visitor) and entered the drain while exploring its outfall.

Figure 2.90 Eurasian River Otter (*Lutra lutra*)
Photo: Alchetron.com .

2.3.4.2 Protected Species Management

A total of 23 ROK listed endangered, threatened and/or Natural Monument species have been reported from Kunsan AB (Table 2.15) since biotic surveys began in 1999. While these species have been observed at or in the immediate vicinity of the base, not all warrant the development of management plans.

A number of the protected species listed in Table 2.15 have been only infrequently observed. Thirteen of the species have been reported during three or fewer of the 12 surveys, and with fewer than 10 total individuals, since 2014:

- Hen Harrier (two surveys, five individuals);
- Peregrine Falcon (two surveys, two individuals);
- Eurasian Sparrowhawk (three surveys, seven individuals);
- Fairy Pitta (one survey, one individual);
- Oriental Scops Owl (one survey, two individuals);
- Osprey (two surveys, two individuals);
- Cinereous vulture (one survey, four individuals);
- White-tailed Eagle (one survey, one individual);
- Northern Goshawk (one survey, one individual);
- Chinese Sparrowhawk (one survey; three individuals);
- Rough-legged Hawk (two surveys, three individuals);

Two aditional species have also been observed on three or fewer surveys since 2014, but with higher numbers. The Taiga/Tundra Bean Goose was observed during one fall and two winter surveys, with numbers ranging from 16 to 111 birds per survey. A total of 26 Eastern Buzzards were also observed during one fall and two winter surveys, with 25 observed during the winter surveys. For both species, the observed individuals were birds overwintering in the area and in the case of the Eastern Buzzard possibly also on base. Neither of these species breeds in Korea.

Because of the infrequent and transient occurrence of these 15 species at and in the vicinity of Kunsan AB, and the absence of on-base nesting habitat for many of the species (some do not breed in the ROK), no management strategies or plans are warranted for these species at this time.

In addition to the above-mentioned species, four of the protected species reported from the base are strongly dependent on aquatic habitats adjacent to the base and associated with the Saemangeum estuarine system. These species are:

- the Eurasian Spoonbill;
- the Black-faced Spoonbill;
- the Far Eastern Curlew; and
- the Eurasian Oystercatcher.

No suitable habitat for any of these species occurs on the base, and none breed, nest, or forage on the base. Neither of the spoonbills nor the curlew breed in the ROK. With the loss of the Saemangeum estuarine system adjacent to the base (due to seawall and associated grassland reclamation) it is likely that sightings of these species in the immediate vicinity of Kunsan AB will decline even further over time. Thus, it is unnecessary to develop any type of management strategy or plan for these four species.

The Chinese Sparrowhawk, a designated natural monument, was previously observed at the base in 1999 and 2001 in the North POL Area and Wolf Pack Park (with possible nesting reported at that time at or in

the immediate vicinity of the base), and most recently from the North POL Area in 2018. However, no nesting has been documented at or in the immediate vicinity of the base, and there is little evidence to suggest this species occurs with any regularity or nests at the base. While a management plan was previously developed for this species, it is currently not warranted.

The Amur leopard cat has now been documented to occur at Kunsan AB (see Section 2.3.4.1). Among the thousands of photographs taken by the wildlife cameras that were installed at the base in 2018, the Amur leopard cat was only photographed on two occasions, Octoer 7 and Oct 25, 2019. Given the reported low densities of this species in other parts of its range (4-16 individuals per 100 km^2) (Ross et al. 2015), the relative absence of forest habitat in the vicinity of Kunsan AB, and the small amount of forested habitat at the base, the number of leopard cats that may be residing at the base or regularly visiting the base from surrounding areas is likely very small (e.g., 1-2 individuals). Similarly, the single Eurasian Otter reported from the base was most certainly a transient individual, and there is little on-site habitat that could support this otter beyond more than transient visit by a single individual. Thus, no management strategies or plans are warranted for either of these species at this time. However, monitoring for the Amur leopard cat should continue, and if this species is seen on base with more regularity, or if a female with young is observed, then a management plan for this species should be developed.

Climate Vulnerability

A climate change assessment of Kunsan AB was conducted in 2019 (Colorado State University 2019). The results of this assessment suggest that minimum and maximum temperatures will increase over time under the two scenarios evaluated (Table 2.1). The climate change assessment results also indicate that average annual precipitation will increase over tme under the two scenarios.

Habitat change and disruption to food availability are two major climate-related threats to all species at Kunsan AB (Coorado State University 2019). Habitat requirements, such as need for refugia, for some species may change, as may prey populations or forage abundancein response to changes in temperature and precipitation. The climate change assessment for Kunsan AB (Colorado State University 2019) also assessed the vulnerability to climate change (risk) of several of the protected species that have been reported from Kunsan AB. This assessment identified a very high risk for the boreal digging frog, a high risk for the Seoul frog, Eurasian Hobby, and Eurasian Kestrel, and a moderate risk for the leopard cat and the Chinese Sparrowhawk, although all vulnerability risks all have low levels of confidence.

Protected Species Management Plans

Only five of the 17 ROK protected species reported from the base are known to nest or reproduce on the base: the Seoul frog, the boreal digging frog, the Northern Boobook, the Eurasian Kestrel, and the Eurasian Hobby. Management plans for these species are provided below.

Seoul Frog Management Plan

Status: The IUCN (Red List) status for the Seoul frog (*Pelophylax chosenicus*) is "Vulnerable" (IUCN 2020). This classification is based on this species occurring in a relatively limited geographic area (Figure 2.94), a limited distribution within its range, a continuing decline in the extent and quality of its habitats, and a decreasing population trend. In 2004 this species was known from fewer than 10 locations, and currently (2018) is known from only 4 locations.

Distribution: The Seoul frog is endemic to the Korean Peninsula and occurs throughout the southwestern provinces of the ROK (Figure 2.91).

Habitat on Kunsan AB: At Kunsan AB, the Seoul frog has been found in the drainage ditches at the northwest corner of the golf course, in the drainage running south through the CE Bulk Storage Area, in a small wetland at the southwestern portion of Little Coyote Hill, in an offbase pool immdiatey outside the western base boundary that receives discharge from northern culverted runway drainage, and in a seasonal wet area between Perimeter Road and runway (Figure 2.65).

Major Threats: Throughout its range, the major threat to this species is habitat destruction and degradation brought about changes in agricultural land use from rice production to other crops. Other threats that may also affect this species include habitat alteration, degradation, and loss from urbanization, drainage of habitat, use of pesticides and fertilizers, and pollutants.

In addition, the American bullfrog also poses a significant threat (Ra et al., 2010). This bullfrog, which may be found at all on-base locations where the Seoul frog currently exists, is a ravenous predator and likely preys on Seoul frog adults, tadpoles, and eggs. Bullfrog tadpoles may outcompete tadpoles of the Seoul frog and other frog species native to the ROK.

On Kunsan AB, the loss of the open water habitat by invasive emergent aquatic vegetation may also pose a threat to the Seoul frog. For example, the drainage channel at the CE Bulk Storage Area where the Seoul frog occurs, is becoming progressively filled-in with emergent vegetation.

Figure 2.91 Distribution of the Seoul Frog
Source: Modified from IUCN

Kunsan AB Management Actions: To maintain viable breeding populations of Seoul frogs in the habitats where they have been found at Kunsan AB, several action items are recommended.

1. Continue monitoring habitats which currently support the Seoul frog (Figure 2.67) for the presence of the Seoul frog and the American bullfrog. Because the Seoul frog is difficult to directly observe, but has a unique and distinct call, monitoring activities should rely on playback of the recordings of its call and listening for a response. Develop measures to control bullfrog populations in these locations.
2. To minimize impacting adult frogs during any drainage ditch maintenance activities (e.g., sediment removal, vegetation removal) where the Seoul frog is known to occur, such activities should be limited to small sections (e.g., 50 – 100 ft.) of the drainage at any one time. To minimize affecting reproduction, drainage maintenance activities in known habitat areas should occur only in autumn (i.e., after September), well after egg laying and tadpole metamorphosis have been completed.
3. Ensure all personnel, military and civilian, can recognize the Seoul frog and especially its vocalization, and understand that it is a protected species. At known habitats, post signage that includes photos of this frog, as well as a description of its call. Harvesting the frog for any reason, including human consumption, is prohibited.
4. 8 CES/CEIE should have AF Form 813 signature authority on any projects that may potentially affect the on-site habitats where the Seoul frog currently occurs (Figure 2.67). At those habitats, prohibit the use of herbicides and insecticides that are known to be harmful to amphibians.

Boreal Digging Frog Management Plan

Status: The IUCN (Red List) status for the boreal digging frog (*Kaloula borealis*) is LC, "Least Concern" (IUCN 2020). It is is a common species across much of its range but is listed as an "Endangered Category II Species" by the Korean Ministry of Environment.

Distribution: This frog occurs throughout much of central and northeastern China, most of the Korean Peninsula (except for the mountainous areas along the eastern and southern portions of the peninsula), and JeJu Island (Figure 2.92).

Figure 2.92 Distribution of the Boreal Digging Frog
Source: Modified from IUCN

Habitat on Kunsan AB: Current known populations of the boreal digging frog at Kunsan AB occur at the seasonally wet area at the CE Area near the Han Village fenceline, a wetland at western base of Little Coyote Hill, several seasonally wet areas between the Perimeter Road and running track west of the runway, and some seasonally wet areas at northeastern corner of Big Coyote Hill. (Figure 2.65).

Major Threats: The IUCN Red List status of Least Concern (LC) for this species is based on this species being relatively common through its range, although popultions across its range are showing signs of decline. In the ROK, habitat loss (rice paddies, ditches and ponds) has caused populations to decline in some areas. General threats to amphibians that may also affect this species include habitat alteration, degradation, and loss from urbanization, use of pesticides and fertilizers, and pollutants. At Kunsan AB, the biggest threat is the potential reduction of seasonally wet areas between the runway and the western base boundary due to ground maintenance acivities.

Kunsan AB Management Actions: To maintain viable breeding populations of boreal digging frogs at Kunsan AB, the following action items are recommended.

1. Continue monitoring for the boreal digging frog in habitats which currently support known populations of this species (Figure 2.65). As this species is difficult to directly observe, but has a unique and distinct call, monitoring activities should rely on playback of the recordings of its call and listening for a response.
2. Use of herbicides/insecticides that are known to be toxic to amphibians should be avoided in areas known to support this species (see Figure 2.65), especially during the periods when the frogs are breeding and eggs and tadpoles are present (generally June and July, during the rainy season).
3. Ensure all personnel, military and civilian, can recognize the boreal digging frog and especially its vocalization, and understand that it is a protected species. At known habitats, post signage that includes photos of this frog, as well as a description of its call. Harvesting the frog for any reason, including human consumption, is prohibited.
4. 8 CES/CEIE should have AF Form 813 signature authority on any projects and routine activities that may potentially affect the seasonally wet grassy areas between the Perimeter Road and the seawall. However, the airfield is maintained according to the provisions of the 8 FW BASH Plan, and such maintenance is mission-critical.

Northern Boobook Management Plan

Status: The IUCN (Red List) status for the Northern Boobook (*Ninox japonica*) is LC, or "Least Concern" (IUCN 2020), and its populations are considered to be stable across its range. The Northern Boobook is a common, widespread species, and is designated as a Natural Monument by the Korean Ministry of Culture and Tourism.

Distribution: The Northern Boobook is distributed throughout most of southern and eastern Asia including India, Bangladesh, Cambodia, Thailand, Viet Nam, Indonesia, Malaysia, China, Japan, Korea, and the Russian Federation (Figure 2.93). Although this species migrates to and from the Kunsan AB area, it is a year-round resident along the southern tip of the Korean Peninsula.

Figure 2.93 Range of the Northern Boobook
Source: IUCN 2018

Habitat on Kunsan AB: This species inhabits forested areas where it nests in cavities in large trees. On Kunsan AB, the Northern Boobook has in the past (pre-2005) been observed in the forests of the North POL area and on Gunsmoke Hill. More recently (2017 – 2019), adults have been heard calling and were also observed at Big Coyote Hill (NRMU BCH-3). During the July 2017 survey, adults were observed feeding a juvenile. These observations clearly indicate successful nesting of this species occurs in the pine foret habitat on Big Coyote Hill. During the July 2017 survey, the Northern Boobook was also heard from offsite, east of the Wolf Pack Park/North POL Area vicinity.

Major Threats: On Kunsan AB, the greatest potential threat to the Northern Boobook is the loss of cavity trees for nesting. The pine forest habitats at Kunsan AB where the Northern Boobook has been documented to nest (NRMU BCH-3), as well as pine stands in the North POL Area, Gunsmoke Hill, and Wolf Pack Park, provide suitable nesting habitat for this species. Pine wilt disease, which was first reported in Busan in 1988 and is now affecting pine forests throughout the ROK, has been identified at Kunsan AB. This disease has been documented to affect the most common pine species at Kunsan AB, and the base has begun removing affected trees at Big Coyote Hill to limit its spread and impact.

Kunsan AB Management Actions: To protect and enhance Northern Boobook habitat at the base, several action items are recommended.

1. 8 CES/CEIE should have AF Form 813 signature authority on any projects that may affect the pine stands and forests in the North POL Area, Wolf Pack Park, the golf course, Gunsmoke Hill, and especially at Big Coyote Hill.
2. Perform a monthly census for the Northern Boobook during the pre-nesting and nesting season (April through June) each year at each of these pine forest stands. The monthly census should include both diurnal visual surveys and nocturnal recorded-call surveys.
3. Only mature trees large enough to accommodate nesting cavities are of concern. In general, trees less than 10 in. in diameter at breast height (dbh) will not be large enough to accommodate a potential nest cavity. Steps to mitigate the negative impacts to Northern Boobook from nesting habitat loss include:

a. Obtaining and maintaining a census of suitable cavity-bearing trees in the North POL Area, Gunsmoke Hill, Wolf Pack Park, the pine stand along the northern edge of the golf course, and Big Coyote Hill.

   i. If suitable nest-cavity trees are located, they should be monitored April - June for signs of nesting activity.

   ii. If nesting activity is indicated, minimize disturbance of the nesting birds by limiting human activities in the immediate vicinity of the nesting site.

b. Avoid disturbing or removing cavity-bearing trees, especially during the nesting season (April through June). If such trees must be removed, schedule removal for late autumn and early winter.

Eurasian Kestrel Management Plan

Status: While protected as a designated Natural Monument, the Eurasian Kestrel is a common species, with an IUCN (Red List) status of LC "Least Concern" (IUCN 2020).

Distribution: The Eurasian Kestrel is a widespread kestrel species, found throughout Europe, Asia, and Africa (Figure 2.94), ranging from Great Britain to Japan, and as far south as South Africa. It may be found throughout the Korean Peninsula, where in some locations it is a year-round resident.

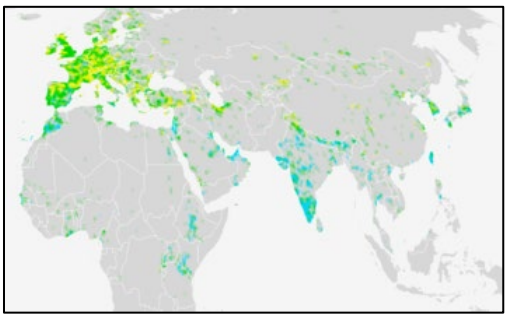

Figure 2.94 Range of the Eurasian Kestrel
Green = year-round occurrence; Yellow = summer; Blue = winter
Source: Wikipedia

Habitat on Kunsan AB: Eurasian Kestrels are the most common birds of prey on Kunsan AB, being present throughout the year. The open expanses of grassland at the base provide suitable foraging habitat. Nesting has been confirmed at several locations, including on the walls of the quarry at Little Coyote Hill. Suitable nesting locations are highly variable, ranging from crossbeams of maintenance hangars, the eaves of a dormitory, to the pine trees of the North POL area. There is no critical or unique habitat on Kunsan AB for the Eurasian Kestrel. Because this species routinely forages over the open grasslands of the sir field, it may present a hazard to aircraft operations.

Major Threats: At Kunsan AB, the major threats to the Eurasian Kestrel are collisions with aircraft.

Kunsan AB Management Actions: To maintain a viable breeding population of Eurasian Kestrel on Kunsan AB, several action items are recommended.

1. 8 CES/CEIE should have AF Form 813 signature authority on any projects that may involve the quarry at Little Coyote Hill from February through summer when nesting is likely.

2. Steps to mitigate potential negative impacts on the Eurasian Kestrel include:

   a. Birds nesting on Kunsan AB structures is not appropriate. Steps should be taken, per 8 FW BASH Plan (8 FW OPLAN 91-212), to discourage and preclude Eurasian Kestrels from nesting on structures. However, if nesting should occur, the nest should not be disturbed until

after any eggs have hatched and the young have been fledged. Only then can the nest be destroyed, and steps taken to prevent nesting reoccurrence at that location.

b. Prior to aircraft operations, the airfield should be surveyed for the presence of hunting Eurasian Kestrels. Pyrotechnics and other non-destructive methods (as specified in 8 FW BASH Plan) should be employed prior to resorting to depredation.

c. Maintain the airfield in accordance with the provisions specified in the 8 FW BASH Plan. In particular, seed-producing grasses and other monocotyledonous plants should be mowed in the flowering stage to preclude seed-set. Maintaining the airfield as seed free as possible will reduce rodent (and seed-eating bird) populations, thus reducing foraging levels by the Eurasian Kestrel at airfield grasslands. Herbicides should be used to eliminate seed-producing weedy dicotyledonous plants from the airfield.

d. Prior to initiating any construction projects that may require the removal of large trees, the trees should be inspected for evidence of active Eurasian Kestrel nests. During the non-breeding period, such trees can be removed as necessary. Trees found to contain Eurasian Kestrel nests should not be removed and the nests should remain undisturbed.

e. Perform a census each year of base infrastructure (e.g., maintenance hangars, dormitory eaves) early during the nesting season (late February through April) to identify any nest building activities by Eurasian Kestrels at undesired locations. If nest building activity is observed, harassment to discourage and displace the birds should be initiated, followed by the removal of any partially built nests.

f. Prior to any activities within the Little Coyote Hill quarry, the quarry should be surveyed for the presence of nesting Eurasian Kestrels. If active nests are found, activities should be delayed until any eggs have hatched and the young have been fledged.

Eurasian Hobby Management Plan

Status: Although the Eurasian Hobby is a Class II Endangered Wildlife Bird, it is a common species throughout its range, with an IUCN (Red List) status of LC "Least Concern" (IUCN 2020).

Distribution: The Eurasian Hobby is a very widely distributed species, occurring throughout Europe, Asia, the Middle East, and southern Africa (Figure 2.95). On the Korean Peninsula, it is a regular migrant, as well as an uncommon summer breeding resident.

Habitat on Kunsan AB: The Eurasian Hobby is a common summer visitor at Kunsan AB. Nesting occurs almost always in trees, often in abandoned nests of other raptors or corvids. The Eurasian Hobby has been observed at Wolf Pack Park in every summer from 2016 to 2019, and 2017, 2018, and successful nesting has been documented at Wolf Pack Park (2016) and at the pine stand next to the golf course club house

(2018). There is no critical or unique habitat on Kunsan AB for the Eurasian Hobby. With the small numbers that may be present at the base at any one time, together with the location of on-base habitat (pine stands at Wolf Pack Park, Big Coyote Hill, and the golf course), the Eurasian Hobby likely poses no more than a slight hazard to aircraft operations.

Figure 2.95 Range of the Eurasian Hobby
Source: WWF Wildfinder

Major Threats: At Kunsan AB, the major threat to the Eurasian Hobby is the loss of nesting habitat (i.e., pine stands), which would not directly impact adult birds. With such habitat loss, this species would likely only occur at the base as a migrant passing through the area. In addition, collisions with aircraft pose an additional threat to this species at the base.

Kunsan AB Management Actions: To maintain Eurasian Hobby nesting on Kunsan AB, several action items are recommended.

1. 8 CES/CEIE should have AF Form 813 signature authority on any projects that may potentially affect the mature pine stands at the base, including at Wolf Pack Park and the golf course, where successful nesting has been documented, and at Big Coyote Hill (NRMU BCH-1).
2. Steps to mitigate potential negative impacts on the Eurasian Hobby include:
    a. If nesting is observed, human activities (such as mowing) within the pine stand should be minimized to the extent practicable, until the eggs have hatched, and young have fledged.
    b. In summer, when this species is present, the airfield should be surveyed prior to aircraft operations for the presence of hunting Eurasian Hobby. If hunting birds are observed, pyrotechnics and other non-destructive methods as specified in 8 FW BASH Plan should be employed.
    c. Maintain the airfield per the 8 FW BASH Plan. In particular, seed producing grasses and other monocotyledonous plants should be mowed in the flowering stage to preclude seed-set. Herbicides should be used to eliminate seed producing weedy dicotyledonous plants from the airfield. Maintaining the airfield in a seed-free condition will reduce seed-eating bird populations which are prey for the Eurasian Hobby.

Prior to initiating any construction projects that will result in the removal of large trees, the trees should be inspected for evidence of Eurasian Hobby nests. During the non-breeding period, such trees can be removed as necessary. But from April through September, trees that contain Eurasian Hobby nests should not be removed and the nests should remain undisturbed.

2.3.4.3 Ecosystem and Landscape Conservation Areas

The ROK has designated a number of Ecosystem and Landscape Conservation Areas (these are listed in KEGS Table 13-3) for protection because they include migratory habitats for birds, habitats for protected wildlife and plants, unique wetland and forest habitats, and areas with diverse plant communities. For an area to be designated as an Ecosystem and Landscape Conservation Area, the area is evaluated with regard to being:

- Worthy of scientific research due to natural ecosystems or abundant natural resources
- Requires preservation for scientific research or natural scenery due to unique topographic or geologic features
- An area worthy of preservation due to the presence of endangered or native Korean species
- An area that represents diverse ecosystems or a sample of an important ecosystem
- An area that requires special protection of other natural ecosystems

None of the ROK designated areas listed in KEGS 2020 Table 13-3 occur on or in the vicinity of Kunsan AB. However, several areas on base do support endangered or native Korean species (e.g., the temporary pools and the drainages that support on-base populations of the Class II Endangered Seoul frog and boreal digging frog [see Section 2.3.4.1]).

2.3.4.4 Wetland Protected Areas

The ROK has also designated a number of wetland areas for protection, and these are listed in KEGS Table 13-4. A designated wetland may be worthy of protection and conservation due to its value as a water supply, for aesthetic reasons, or for biodiversity maintenance. A wetland is considered for protection if any of the following criteria are met:

- A wetland that is natural or near natural with high biodiversity
- A wetland that supports rare, endangered, or threatened species
- A wetland that contains unique landscape, geomorphic, or geological values

None of the ROK designated wetland protected areas listed in KEGS 2020 Table 13-4 occur on or in the vicinity of Kunsan AB. However, several areas on base do support endangered or native Korean species (e.g., the temporary pools and the drainages that support on-base populations of the Class II Endangered Seoul frog and boreal digging frog [see Section 2.3.4.1]).

2.3.5 Wetlands and Floodplains

Because of the disturbed character of the terrain, there are no natural bodies of water on Kunsan AB, and only non-natural hydrological systems exists near the base. The southern portion of the CE Bulk Storage Area, between the munitions storage area and Haji Village, is a semi-improved area with two wetlands. One wetland is in the form of a drainage way that trends east-southeast through the CE Area and exits the base immediately east of Haji Village. The second wetland is a marsh and associated drainages that has formed along the southern edge of the CE area at the base of the Haji Village ridge. Neither wetland is a natural feature but rather developed from the construction of the drainage ditch and inadvertently from land filling activities.

The base golf course ponds and associated drainges also provide wetland habitat on Kunsan AB. The ponds are managed as part of the golf course, and in 2017 underwent extensive vegetation removal and sediment dredging. There are also numerous drainage ditches in the vicinity of the airfield, the golf course, and elsewhere across the base are the only other on-base features that provide wetland habitat. These are all man-made features which are actively managed to maintain water removal. No floodplains are present within the boundary of Kunsan AB.

Two wetlands reported in the original INRMP (1997) near the south end of the base have been filled or modified. The first was located along and either side of the Perimeter Road near the base of Little Coyote

Hill. That wetland has been filled and now only exists at the base of Little Coyote Hill, east of Perimeter Road. The second wetland was a drainage ditch that formerly received surface water from the ROKAF flight line and drained off base near the south-western foot of Little Coyote Hill. Today, this drainage is completely culverted and discharges offsite at the foot of the former asbestos landfill.

As previously mentioned, the airfield drainage ditches provide wetland habitat. Their primary function is to effectively remove surface water from Kunsan AB's industrial, flight line and airfield areas as required by the Kunsan AB mission. While management recommendations beyond operational requirements would not be necessary for these drainages, two of the drainages support viable populations of the endangered Seoul frog (see Figure 2.65). Management recommendations for these ditches associated with management of this protected species are provided in Section 2.3.4.2.

Several grassy areas along the base of the western boundary of Kunsan AB develop temporary pools during the June-July monsoon season (see Figure 2.65). These types of temporary pools, also called vernal or ephemeral pools, often provide temporary but important habitat for distinctive plants and animals. At Kunsan AB, these pools provide breeding habitat for the endangered boreal digging frog (see Section 2.3.4.1). Management recommendations for these wetland areas are associated with management of the boreal digging frog at Kunsan AB and are provided in Section 2.3.4.2.

2.3.6 Other Natural Resource Information

Guidance from FGS and AFMAN 32-7003: Birds and animals are monitored by BASH personnel.

2.4 Mission Impacts on Natural Resources

2.4.1 Natural Resource Constraints to Mission and Mission Planning

The main things that can affect the installation's mission include bird strikes on aircraft and periodic floods. Response methods and plans for these factors are detailed in section 7.7.6 and 7.7.7.

2.4.2 Land Use

Kunsan AB is located on approximately 2,549 acres of land. The base is bounded to the north by encroachment lands, to the west by reclaimed mudflats from the Yellow Sea, to the south by the Mangyeung River, and on the east by agricultural land. Kunsan AB was originally established on July 1, 1951, under acquisition document PAC-KUNSAN-231. A total of 2,167 acres was acquired as USFK Exclusive Use Real Estate. The TRIRIGA 7115 Report indicates 2,167 acres for the base plus another 382 acres of land easement with and without restrictions. Figure 2.96 illustrates the land use pattern of Kunsan AB by functional area.

2.4.3 Current Major Impacts

Even though Kunsan AB occupies nearly 2,549 acres, numerous constraints reduce the areas that can be developed on Kunsan AB without a waiver. Future development requirements at Kunsan AB are restricted by limited real estate. As facilities age and require replacement, the siting of new facilities becomes increasingly more difficult.

Existing and future development of Kunsan AB must be compatible with airfield operations and other mission-related activities. The most important factors affecting development decisions include encroachment, airfield clear zones, aircraft noise contours, and explosive safety quantity distance (ESQD)

arcs. Each of these operational factors requires land surfaces that prohibit construction and occupancy for other purposes.

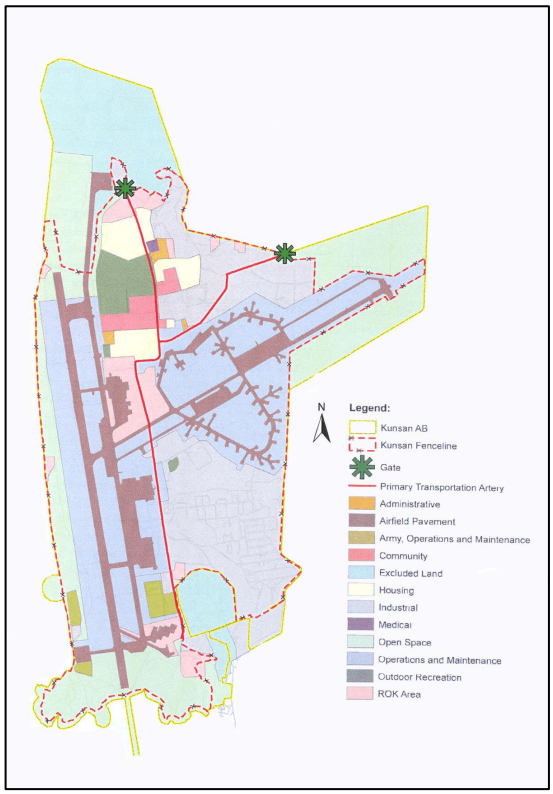

Figure 2.96 Existing Land Use

Encroachment

USFK and Korean officials negotiated an amendment to the Land Partnership Plan (LPP) on October 4, 2006. The amendment includes real estate transactions that will exchange ownership and easement rights to several parcels of land currently on Kunsan AB and immediately adjacent to the base. Parcel A, (excluding the railroad tracks about 49 acres) and Parcel B (about 73.4 acres) were re-granted June 2007. The proposal is to acquire the restrictive easement for Parcel E (22 acres) and land grant for Parcel D (102 acres). Under the LPP, USFK will return approximately 200 acres of USFK exclusive use land to local ownership.

Haji Village is a 44-acre land tract occupied by Koreans. Although technically outside of both the fence line and the base boundary, the village resides as an island within Kunsan AB contiguous property. Under the LPP, Haji Village is part of the estimated 500 Korean homes which currently exist in the ESQD arc easement and planned to be relocated by 2019 but it is still in negotiation. This migration plan is on hold. In addition to LPP land acquisition, Kunsan AB is negotiating an easement for an additional 78 acres to accommodate the ESQD arcs associated with an expanded munitions storage area.

The Figures 2.07 is derived from the 2012 General Plan and illustrates the Land Partnership Plan (LPP) and the composite constraints on Kunsan AB by clear zones, noise impacts, and ESQDs. The specific issues are addressed below.

Figure 2.97 Clear Zones, Noise Control, and ESQDs (left); Land Partnership Plan (middle); Land Reclamation Plan (right).

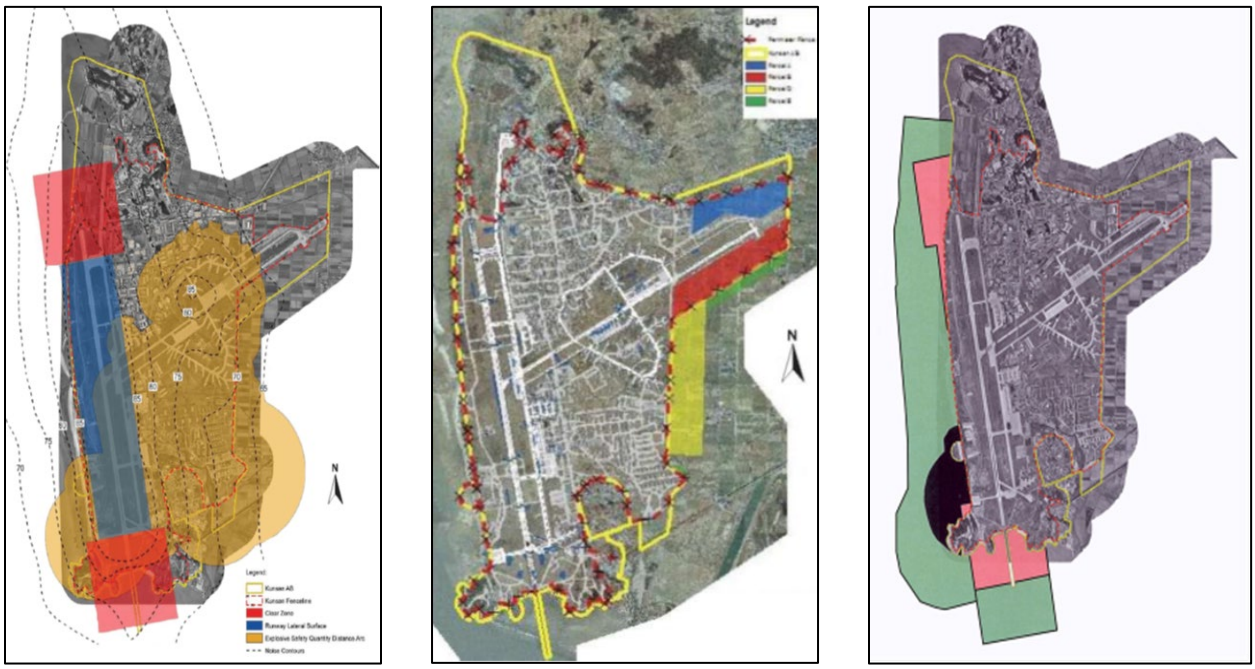

Figure 2.97 Existing Land Use on Kunsan AB

Clear Zones

Clear zones are established such that no construction is permitted within:

- 1,000 feet of the runway center lines,
- 200 feet of taxiways,
- 125 feet of parking aprons, or a
- 3,000-foot box at each end of the runway.

Explosive Safety Zones

Because of the quantity and distribution of munitions, nearly two-thirds of Kunsan AB falls within the ESQD arcs. The ESQD zone extends into the 600-Area dormitories and a significant portion of the industrial area (Figure 2.97). Existing off-base explosive distance easements are somewhat outdated (Bergman, 1998). Since the last signed easements (1985), in 1985, explosive packages and distances have changed, requiring renegotiation of the extent of the easement. Even though easements exist, civilians still reside in hazardous areas.

The land security clear-zone requested under the LPP is also required to provide adequate explosive arc and safety quantity distances for the airfield. The explosive ordnance disposal (EOD) thermal unit range is located within this area. Beddown of the Patriot battery severely limits the maximum explosive quantity

for this area.

Noise

The Air Installation Compatible Use Zone (AICUZ) program provides guidelines for base development so that other land uses are compatible with aircraft operation. AICUZ data indicate the 80-Ldn noise contours extend east of Avenue C, reaching the 200-Area dormitories, the medical clinic, and the administrative and industrial areas. The 75-Ldb noise contours extend nearly to the east gate (Figure 2.97).

Land Reclamation Plan Project

There is an on-going Land Reclamation Project (LRP) in the Yellow Sea around the seaward perimeter to the west and south of Kunsan AB. (Figure 2.97). Kunsan AB is exploring the possibility to acquire a strip of the reclaimed land approximately 200 ft wide, which will primarily serve as encroachment protection and an additional security barrier to mission operations. However, this plan is treated as non-existent.

Mission Impacts on Natural Resources

Historically, natural resources on Kunsan AB have been confined to four areas: North POL area, Little Coyote Hill, Big Coyote Hill, and the Saemangeum estuary. The natural resources found in the North POL Area are always in a state of flux due to construction projects and vegetation removal to reduce the wildfire hazard. As such, none of the projects described in the General Plan will have a significant impact on the semi-managed natural resources of the North POL area.

Little or no activity is planned to occur on Little Coyote Hill, according to the General Plan. Much of the hill has been quarried and used for exercises over the decades. Vegetation on Little Coyote Hill consistes of early successional plant communities, and no significant impacts to these communities will occur with continued use of the hill. However, the small wetland at the eastern base of Little Coyote Hill supports populatipns of two KEGS-listed species, the Seoul frog and the boreal digging frog, both ROK-classified as Class II Endangered Wildlife species, and mission activities affecting this wetlands will likely have adverse impacts on both species in this area.

The Saemangeum estuarine system has been significantly impacted by the ROK Saemangeum Seawall Project. Proposed uses of the former tidal flats adjacent to Kunsan AB's west perimeter will have no negative impact on the remaining estuarine system. The only ecological impacts will be on those pioneer species beginning to colonize the former tidal flats.

Finally, the most significant environmental impact would be associated with the development of a parallel runway. As part of that process, Big Coyote Hill is proposed to be levelled. Prior to 2012, comprehensive biological surveys of Big Coyote Hill were never conducted because the hill was for the most part "off limits" due to the ROKAF's exclusive use. Pedestrian surveys in the mid-1990s identified no unique or critical habitats, and much of the native flora is either pine plantation or early successional communities.

Access to Big Coyote Hill, however, has been relaxed, and comprehensive bird surveys were conducted in 2014 – 2018. During the 2016 survey, a Fairy Pitta, a KEGS listed protected species (see Section 2.3.4.1) was observed in the forest habitat at the top of the hill. Additional bird surveys in 2017 and 2018 found successful nesting by the Northern Boobook, a KEGS listed Natural Monument species, and also resulted in the first record for Kunsan AB of another Natural Monument species, the Oriental Scops Owl. Additional avian and comprehensive plant surveys are scheduled in the near future at Kunsan AB (including Big Coyote Hill), and additional KEGS-listed species may be encountered.

Any birds, mammals, reptiles, and amphibians that nest or reproduce on Big Coyote Hill (including some

KEGS-listed protected species) as well as their habitats, will be displaced and negatively affected or permanently lost with the levelling of Big Coyote Hill.

2.4.4 Potential Future Impacts

Kunsan AB presents a development challenge due to the base's remote location, and limited land area, ESQD arcs, and airfield/airspace clearance criteria. Mission growth opportunities at Kunsan AB are similarly constrained. A key factor in all planning scenarios is the aged and deteriorated condition of Kunsan's facilities and infrastructure. Another consideration is that Kunsan AB hosts both a permanent party F-16 fighter mission and a Theater Security Package (TSP) and must be prepared to accept follow on forces in the event of war. Information presented in this section summarizes key elements of future facilities development at Kunsan AB. It is important to note that development in one area often impacts development in another; therefore, on-going refinement of Kunsan AB will serve to prioritize associated projects and help to identify necessary phasing requirements. The following development areas are part of the IDP:

- Maintenance Development
- Flight Line Development
- Base Support Development
- Dormitory Development

Proposed Second Runway

As discussed in Section 2.4.3, the completion of the Saemangeum Seawall Project has opened the door to securing the western perimeter as well as the ESQDs associated with the EOD range and cargo hot pad. Long-range plans for Kunsan AB include a second, parallel runway. The proposed runway would be offset 1,000 ft from the current runway centerline and extend approximately along the former coastline.

2.4.5 Natural Resources Needed to Support the Military Mission

Natural resources necessary to support the installation's military mission included vegetation cover, stable soils and open areas for testing of munitions. Adequate vegetation cover throughout the installation is essential to maintain stable soils and minimize fugitive emissions which could negatively impact maintenance activities and aircraft operations. Large vegetation also provides concealment cover for some installation equipment. An open area is maintained on the southwest boundary on the installation for munitions testing. In addition, the military mission relies on natural resources to provide relaxation and recreation opporturinties for those training and working on Kunsan AB. Implementation of an ecosystem-based management plan ensures that natural resources will provide the proper arena for supporting the military mission and personnel.

3.0 ENVIRONMENTAL MANAGEMENT SYSTEM

The AF environmental program adheres to the Environmental Management System (EMS) framework and it's Plan, Do, Check, Act cycle for ensuring mission success. Executive Order (EO) 13693, *Planning for Federal Sustainability in the Next Decade*, U.S. Department of Defense Instruction (DoDI) 4715.17, *Environmental Management Systems*, AFI 32-7001, *Environmental Management*, and international standard, ISO 14001:2004, provide guidance on how environmental programs should be established, implemented, and maintained to operate under the EMS framework.

The natural resources program employs EMS-based processes to achieve compliance with all legal obligations and current policy drivers, effectively managing associated risks, and instilling a culture of continuous improvement. The INRMP serves as an administrative operational control that defines compliance-related activities and processes.

4.0 GENERAL ROLES AND RESPONSIBILITIES

General roles and responsibilities that are necessary to implement and support the natural resources program are listed in the table below. Specific natural resources management-related roles and responsibilities are described in appropriate sections of this plan.

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	**Installation Role/Responsibility Description**
Installation Commander	• Responsible for the overall development, implementation, and periodic review and approval of this plan • Ensure that all unit commanders are knowledgeable in their areas of responsibility as outlined in this plan • Ensure that personnel and contractors implement this plan • Designate other specific responsibilities, as required
AFCEC Natural Resources Media Manager/Subject Matter Expert (SME)/ Subject Matter Specialist (SMS)	• Ensure the INRMP is current, accurate, and in compliance with applicable requirements
Installation Natural Resources Manager/POC	• Ensure this plan is current, accurate, and in compliance with applicable environmental directives • Provide technical assistance in implementing this plan • Act as the office of primary responsibility (OPR) for the development and review of this INRMP • Act as a coordinator in the development of the Integrated Pest Management Plan, outdoor recreation activities in undeveloped areas, and the Grounds Maintenance contracts • Revise this plan with current information regarding land use, pest management, and natural resources • Ensure all projects are coordinated through the AF 813 process (EIAP)

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	Installation Role/Responsibility Description
Installation Security Forces	Monitor posted protected areas IAW this plan
Installation Unit Environmental Coordinators (UECs); see AFI 32-7001 for role description	• Report all compliance concerns related to their unit facilities involving nonconformance with the INRMP • Inform unit members for any natural resources protection requirements
Installation Wildland Fire Program Manager	CEF
Pest Manager	Pest Management (8 CES/CEOIE) act as the OPR for the development, review, and maintenance of Kunsan's Integrated Pest Management Plan
Safety Office (8 FW/SE)	Act as the OPR for the currency and maintenance of the 8th Fighter Wing's BASH Plan
Environmental, Safety, and Occupational Health Committee (ESOHC)	• Advise the 8 FW/CC on issues related to this plan • Review and approve all significant aspects and environmental action plans related to the Natural Resouces Program • Monitor the implementation of all environmental action plans related to the Natural Resouces

5.0 TRAINING

AF installation NRMs/POCs and other natural resources support personnel require specific education, training and work experience to adequately perform their jobs. Chapter 14 of the FGS requires that trained personnel perform the tasks necessary to update and carry out certain actions required within this INRMP. Specific training and certification may be necessary to maintain a level of competence in relevant areas as installation needs change, or to fulfill a permitting requirement.

Installation Supplement – Training

Guidance from FGS and AFMAN 32-7003:

- *The Integrated Natural Resourced Management Plan (INRMP) identifies the appropriate natural resources training requirements for the installation conservation staff and other supporting staff. Natural resources program managers at installations that maintain an INRMP should take the DoD Natural Resources Compliance course endorsed by the Department of Defense (DoD) Interservice Environmental Education Review Board, and offered to all DoD components by the Navy Civil Engineer Corps Officers School. See https://public.navy.mil/netc/centers/csfe/cecos/Default.aspx for Navy Civil Engineer Corps Officers School course schedules and registration information. Other applicable environmental*

management courses are offered by the Air Force Institute of Technology (https://www.afit.edu) and the National conservation Training Center, which is managed by the USFWS and the Bureau of Land Management Training Center.

- *Natural resource management personnel shall be encouraged to attain professional registration, certification, or licensing for their related fields, and may be allowed to attend appropriate national, regional, and state conferences and training courses.*
- *All individuals who will be enforcing fish, wildlife and natural resources laws on AF lands must receive specialized, professional training on the enforcement of fish, wildlife and natural resources in compliance with the Sikes Act. This training may be obtained by successfully completing the Land Management Policy Training course at the Federal Law Enforcement Training Center (http://www.fletc.gov/).*
- *Individuals participating in the capture and handling of sick, injured, or nuisance wildlife should receive appropriate training, to include training that is mandatory to attain any required permits.*
- *Personnel supporting the BASH program should receive flight line drivers training, training in identification of bird species occurring on airfields, and specialized training in the use of firearms and pyrotechnics as appropriate for their expected level of involvement.*
- *The DoD supported publication Conserving Biodiversity on Military Lands -- A Handbook for Natural Resources Managers (http://dodbiodiversity.org) provides guidance, case studies and other information regarding the management of natural resources on DoD installations.*

6.0 RECORDKEEPING AND REPORTING

6.1 Recordkeeping

The installation maintains required records IAW Air Force Manual 33-363, *Management of Records*, and disposes of records IAW the Air Force Records Management System (AFRIMS) records disposition schedule (RDS). Numerous types of records must be maintained to support implementation of the natural resources program. Specific records are identified in applicable sections of this plan, in the Natural Resources Playbook and in referenced documents.

Installation Supplement – Recordkeeping

Records are maintained by the Natural Resources Manager in 8 CES/CEIE program files.

6.2 Reporting

The installation NRM is responsible for responding to natural resources-related data calls and reporting requirements. The NRM and supporting AFCEC Media Manager and Subject Matter Specialists should refer to the Environmental Reporting Playbook for guidance on execution of data gathering, quality control/quality assurance, and report development.

Installation Supplement –Reporting

The discovery of any endangered, threatened, or ROK designated natural monument species is reported to the USFK Commander, who is the Environmental Executive Agent (EEA) for the ROK, or to his delegate.

7.0 NATURAL RESOURCES PROGRAM MANAGEMENT

This section describes the current status of the installation's natural resources management program and program areas of interest. Current management practices, including common day-to-day management

practices and ongoing special initiatives, are described for each applicable program area used to manage existing resources.

Installation Supplement –Natural Resources Program Management

Management action plans for protected species are detailed in Section 2.3.4. Section 7.8 summarizes the management strategies that have been proposed for the various NRMUs found on Kunsan AB. Section 9 provides an up-to-date status report of action items proposed during earlier iterations of this plan.

7.1 Fish and Wildlife Management

Applicability Statement

This section applies to AF installations that manage fish or wildlife on AF property. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

Guidance from FGS and AFMAN 32-7003:

- Fish and wildlife program management
- Enforcement of fish and wildlife laws
- Demand for hunting, fishing, and non-consumptive resource uses
- Wildlife education and interpretation programs
- Nuisance wildlife problems and techniques used for wildlife control
- Policies, programs and methods used to control feral animals
- Requirements for fish and wildlife habitat improvement
- Measures to protect significant fossil resources

7.2 Outdoor Recreation and Access to Natural Resources

Applicability Statement

This section applies to AF installations that provide outdoor recreation activities and/or provide off-site personnel with access to natural resources on AF property. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

This section provides an integrated management approach to increasing and enhancing outdoor recreational experiences at Kunsan AB without adversely affecting natural or cultural resources. It presents procedures to be used to integrate outdoor recreation management into natural resources planning and management. In the USAF, “outdoor recreation” refers to recreational activities that take place outside in a natural setting, that is, on unimproved or semi-improved land. The majority of the land at Kunsan AB is either fully improved or semi-improved. However, small areas of unimproved forest and grassland survive on Kunsan AB’s hills (Section 2.3.2). It is in the semi-improved and pockets of unimproved areas that outdoor recreation has the greatest potential to affect natural resources.

Roles and Responsibilities

The Commander, 8th Force Support Squadron (8 FSS/CC), is ultimately responsible for outdoor recreation management on Kunsan AB. The Outdoor Recreation Director (8 FSS/SFWO), Natural Resource Manager (8 CES/CEIE), Service Contracts Support (8 CES/CEOES), and Portfolio Optimization (8 CES/CENP) cooperatively execute the outdoor recreation program. In accordance with AFI 34-101, Air Force Morale,

Welfare and Recreation (WRM) Program and Use Eligibility, 8 FSS/FSWO is required to complete an inventory of local natural resources and to work with 8 CES/CEIE to ensure that outdoor recreational facilities and operating instructions (OIs) comply with environmental regulations.

Policy

DoDI 1015.10, Programs for Military Morale, Welfare and Recreation (MWR), identifies outdoor recreation as a major component of MWR programs. DoDD 4700.4, Natural Resources Management Program directs that "…Conservation of outdoor recreation resources shall be considered in all plans, programs, site feasibility studies, and project planning and design."

Authority

AFMAN 32-7003, Environmental Conservation, requires that installations with outdoor recreation potential compatible with the mission develop an outdoor recreation component to the INRMP. The program is described in AFI 34-101, Air Force Morale, Welfare, and Recreation (WRM) Program and Use Eligibility. Providing quality outdoor recreation experiences enhances the quality of life for Air Force personnel; however, if not properly managed, outdoor recreation can have adverse effects on the very natural environment that makes it enjoyable.

Recreational Land Classification

Although not applicable in Korea, AFMAN 32-7003, Environmental Conservation, Section 3J, requires that installations "zone land designated for outdoor recreation into classes of use based on multiple use potential and ecosystem sustainability."

The AFMAN authorizes military installations to carry out a program for the development, enhancement, operation, and maintenance of public outdoor recreation resources in accordance with the installation INRMP, and to ensure that all developed and dispersed outdoor recreation activities are consistent with the INRMP. While much of the AFMAN focuses on large facilities with extensive ranges or the natural areas, Kunsan AB is a relatively small, densely developed base. Increased emphasis on force protection and quality of life makes it likely that this trend will continue. Landward areas adjacent to Kunsan AB are primarily rural but are being increasingly developed.

The western boundary of the base was the shore of the Yellow Sea. Access to the beach was restricted for force protection purposes and because Kunsan's EOD range is located there. The ROK has completed the initial phases of the land reclamation project west of the base, pushing the coastline several kilometres further to the west. The 2005 Kunsan Air Base General Plan does not acknowledge any expansion or enhancement of opportunities for additional outdoor recreation space.

Recreational Land Classification – Kunsan AB

There are 86 acres (34 ha) of land at Kunsan AB that are dedicated to recreation. (Table 7.1). With the exception of Wolf Pack Park, this land is classified as improved and is used for developed sports and recreation facilities, most of which falls under the Director of Fitness and Sports or the Golf Course Director, rather than the Outdoor Recreation Director. These facilities include a golf course; athletic fields for soccer, football, baseball, and softball; and a running track. In addition, roughly 29 acres (12 ha) of unimproved and semi-improved lands have been designated as NRMUs (Table 7.1). These units have some potential for outdoor recreation, including hiking, jogging, mountain biking, and rock climbing. There are only a few acres of unimproved native Korean forest at Kunsan AB and a little over an acre of lands that are traditional Korean burial sites. These have the potential to be classified as special interest areas.

Table 7.1 Potential Recreational Lands at Kunsan AB.		
Class	**Area (acres)**	**Area (hectares)**
General Recreation	86	34
Potential Natural Environment	29	12
Potential Special Interest	<1	<1

Potential Recreation Facilities. Of the recreation facilities at Kunsan AB, the following are part of the Outdoor Recreation Program: Wolf Pack Park, with picnic and barbeque facilities; jogging trails; and a paintball facility located near Wolf Pack Park in NRMU POL-2.

Potential Natural Environment Areas. Section 2.3.2.2 of this INRMP identifies 11 NRMUs at Kunsan AB. Three of these are located in restricted areas and are not currently available for outdoor recreational use. The remaining seven NRMUs have potential for watchable wildlife programs and could support jogging and walking trails.

Potential Special Interest Areas. The NRMUs that are pockets of Korean pine and pine-locust forest are particularly valuable, since they represent the regeneration of native forest through natural succession. Such forest pockets are becoming increasingly rare as the areas surrounding Kunsan AB continue to be developed, and should be protected, if possible. In particular, Big and Little Coyote Hills provides habitat for a number of protected species. Scattered within the NRMUs are 7 traditional Korean burial sites; USFK Regulation 405-7 and Korean law require that they be protected. As long as proper protection and monitoring occur, any Class III areas would be suitable for low-impact recreation. Some of these habitats have the potential for designation as Class III Special Interest Areas.

Specific Outdoor Recreation Activity Planning and Monitoring

Specific outdoor recreation activity plans are Air Force actions and are subject to the Environmental Impact Assessment Process (EIAP) as described in AFI 32-7091. Activity proponents should integrate outdoor recreation plans in the EIAP early in the planning process to determine whether the planned activity would have an adverse effect on natural or cultural resources. A management plan should be developed for each proposed or current outdoor recreation activity, containing:

- A description of the outdoor recreation activity;
- A local operating instruction (OI);
- Explicit management goals for the area;
- Estimate of potential participation in the activity in relation to the carrying capacity of the area;
- A monitoring plan; and
- A mitigation plan.

Recreational Carrying Capacity. AFMAN 32-7003 requires that the recreational carrying capacity of each proposed or current outdoor recreation facility or area be determined. The "recreational carrying capacity" of a natural resource area is defined as:

> *The amount and type of use that an area can sustain over a given time period, given goals to maintain the physical environment (natural and cultural resources) and experience of the visitor.*

Methods for determining carrying capacity vary; however, in general, the determination of carrying capacity requires the informed judgment of the resource manager based on a program of regular monitoring. The resource manager must consider the impacts of actual recreational use and determine if those impacts

are compatible with the management goals for the area or facility. Impacts on the ecosystem and built facilities and the experience of the recreational user should all be taken into account. Careful monitoring should focus on the deterioration of those aspects of the use area that support the goals for the activity (Leung and Lee, 2003). Since the greatest impact results from the initial use of the area, frequent monitoring of the use area at the outset of the program or activity is critical.

Examples of potential resource impacts include:

- Trail deterioration through trail erosion, excessive trail muddiness, excessive trail width, excessive trail depth/development of tread ruts or grooves, and development of social trails;
- Picnic area deterioration through excessive picnic area size, loss of vegetation, erosion of picnic area soils, and deterioration of pavilions;
- Cultural resource deterioration through erosion, deterioration, defacement, or theft of cultural resources;
- Vegetation deterioration with loss of herbaceous vegetation or seedlings and introduction of invasive species; and
- Soil deterioration by compaction, erosion of organic litter and soil, and non-point source pollution.

Examples of potential impacts on the recreational user experience include:

- Inadequate or inappropriate levels of access to facilities, natural areas, or cultural resources; and
- Unacceptable levels of crowding at trails, picnic areas, or attraction sites.

Monitoring Plan. Monitoring the effects of outdoor recreation activities on natural and cultural resources is required by AFMAN 32-7003. Determination of carrying capacity also requires careful monitoring. A monitoring plan should be developed for each outdoor recreation activity to identify any adverse effects of the activity on natural or cultural resources and the recreational user experience. A plan should include a determination of the number of use visits the resource or facility receives and a monitoring schedule that includes written and photographic documentation of resource deterioration of the site or facility.

Mitigation Plan. Standard best management practice at recreation areas require recreation with adverse impacts to natural or cultural resources be mitigated or abandoned. Each outdoor recreation activity plan should specify a strategy for mitigating adverse impacts. Impacts identified early in the monitoring process can be mitigated utilizing strategies such as reduced utilization, trail modification, or relocation of the activity. Severe impacts to resources as the result of outdoor recreation activities will usually lead to the elimination of that activity and remediation of the affected resource.

Protection of Special Areas. Kunsan AB includes pockets of native Korean habitat that support protected species and include traditional Korean graves (sections 2.3.2 and 2.3.4). Given the anticipated growth and construction at Kunsan AB, an evaluation of these NRMUs should occur to determine if portions of them should be classified as special areas. Signs identifying the location of traditional Korean burial mounds have already been erected on Kunsan AB, and the grave sites have been fenced.

Kunsan AB Outdoor Recreation Program Description

There is potential for focused outdoor recreation development at Kunsan AB. The NRMUs provide natural areas suitable for the development of hiking, walking, jogging, and biking trails. All of the accessible NRMUs have some potential for watchable wildlife, but Little Coyote Hill has the most potential. Relatively remote from both the base and surrounding communities, the hill provides habitat for resident and visiting protected species. Its pine-dotted slopes overlook the flight line, Haji Village, and, for now, the

Yellow Sea. Because natural resources are limited at Kunsan AB, specific outdoor recreation activity plans and OIs should be developed for each such activity.

Paintball. Paintball is an active outdoor recreational activity that enjoys wide popularity throughout the USAF. A paintball course has been established by 8 FSS/FSWO just west of the North POL yard, near the radar dome between Fac 496 and Beacon Road. The course, consisting of canvas and wooden blinds, is located in NRMU POL-2, a pine-locust forest with considerable understory development that adds cover for the paintball players. A steep bank between the upper and lower portions of the course adds to the challenge of the course, but also makes the course susceptible to erosion. Adverse environmental impacts are mitigated by restricting the use of the course. Current paintball procedures limit the number of players and the hours of use. The course is used only 10 hours a month by 15 to 20 players. 8 FSS/FSWO and 8 CES/CEIE should monitor the impacts of paintball play in this area and revise mitigation procedures as necessary. Shifting the course from time to time, to allow the vegetation to recover, is one such possibility.

Hiking and Jogging Trails. The existing designated jogging routes emphasize fitness, but there is the potential to develop trails in the natural areas and incorporating them into the network of jogging and walking paths and trails. Consideration should be given to establishing alternative trails on Big and Little Coyote Hills, as security and mission constraints permit. Roads and paths exist in these areas that could be incorporated into walking and jogging trails. Consideration should also be given to establishing a footpath leading to Wolf Pack Park from the vicinity of Building 405.

The proper development of trails in natural areas can be a powerful tool in directing use patterns and influencing the influencing the users experience. The USDA National Forest Service recommends that trails follow the contours of the land as much as possible and minimize the disturbance of soil and vegetation (Hendee et al., 1978). Properly laid out trails could be used to provide access to areas of watchable wildlife. Once trails are established, appropriate literature should be developed by 8 FSS/FSWO to make the Kunsan AB community aware of the trails and appropriate regulations for their use.

Mountain Bicycling. Given the relatively compact and level nature of Kunsan AB, bicycles are an efficient and ecologically sound form of transportation on the base. In addition, Kunsan AB's rocky hills provide some opportunity for mountain biking in a more natural setting. Bicycle tire tracks on the dirt and gravel roads are evidence that some informal mountain biking already occurs on the hill. Mountain bikes are considered off-road recreational vehicles (ORVs) and should be restricted to areas that can sustain their use without damage to natural or cultural resources. A network of existing gravel roads along Little Coyote Hill provides the opportunity for a challenging although short mountain bike trail. It may be possible to integrate the existing trails on Little and Big Coyote Hills into the current road network or alternatively construct a special "free riding" trail with challenging curves, descents, and obstacles.

Sample Operating Instruction for Paintball

1. Responsibilities - The Outdoor Recreation Director or designated representative is responsible for the organization and implementation of the Paintball program. The Outdoor Recreation staff and volunteer help are responsible for maintaining the playing field, equipment, and ensuring all participants are participating in a safe manner.

2. Eligibility - The following individuals are eligible to participate in paintball:

(a) Active-duty military personnel and their dependents.

(b) Dependents ages 10 to 18 are authorized to participate, providing a sponsor signs a youth authorization waiver and hold-harmless agreement. Children of the ages 10 to 12 are permitted only as long as their parent/guardian remains on the site. Parents of participants ages 12–17 are encouraged (but not required) to remain on site.

(c) Department of Defense civilian employees, NAF employees, contractors currently working on base, and base-sponsored groups. All individuals will be required to sign a hold-harmless agreement.

3. Operating Procedures - A monthly schedule of events will be posted at least two weeks before the beginning of the month.

(a) Private groups may sign up for private games by calling the Outdoor Recreation Director at least two weeks before the requested play date. Upon signing up for a private game, the group will need to indicate how many people will attend (10 people minimum) and what equipment is needed, and pay a security deposit of $100. No reservations will be confirmed or committed to without receipt of a deposit. Cancellation notification must be confirmed at least two business days prior to date of event. Failure to comply with the cancellation procedures will result in loss of deposit.

(b) All new players must sign the hold harmless waiver prior to participating in the program. All waivers will be kept on file for one year.

(c) Each paintball staff member will attend natural resource awareness training.

(d) Each player must be present 15 minutes prior to the first game for the safety rules briefing. All safety rules briefed will be strictly adhered to, or players risk removal from the activity grounds.

(e) All paintball markers and paintballs will be permitted upon inspection by a referee or staff member prior to the game. Only "field paint" from the Outdoor Recreation Facility will be used on rented paintball markers. Two hundred eighty-five feet per second (fps) is the maximum allowable velocity. Maximum velocity settings may be lowered, depending on the skill level of players or type of game being played. Velocity adjusting tools cannot be carried to the playing area. Markers can be chronographed at any time during the day in order to check for infractions.

(f) Any participant showing poor sportsmanship or endangering themselves or others will be ejected from the game. This player can further receive a suspension for the remainder of the day or future dates. If necessary, the authorities may be called to escort individuals from the area.

Sample Operating Instruction for Paintball - Continued

(g) Players observed disobeying the rules will be dismissed from the current game. A player consistently disobeying the rules will be dismissed for the remainder of the day. Infractions include but are not limited to removal of goggles during play, failure to "plug" the barrel during down time, and shooting in unauthorized areas.
(h) Each game will have a referee, and all final decisions on interpretation of rules and player conduct will be determined by this individual. It is the responsibility of the referees and players to ensure that all participants are wearing approved safety paintball goggles at all times while on the firing range and during play.
(i) With the exception of tournaments, players with exceptional skills can be divided equally among the teams to make the teams more balanced.

4. Tournaments and Special Events - A variety of tournaments and special events will be held during the year. Squadrons or groups may reserve the paintball field for private games. Equipment issued during special events will be on a first-come- first-served basis. Note that equipment may be unavailable for some individuals. Tournament rules may vary depending on the number of players and the type of event. All organized tournaments will have a set of written bylaws. These bylaws will be approved by the tournament sponsor and made available for review. Prior to a tournament, the head referee will brief all players on safety, rules, point systems, etc.

5. Closures - Paintball can be canceled in the event of bad weather conditions. Closure will be determined by the referee with approval from the Outdoor Recreation Director. Walk-on games may be canceled if there are not a minimum of 10 players.

6. Injury Reporting Procedures - A CPR-qualified staff member must be on site at all times.
(a) First aid for minor injuries, such as cuts and scratches, will be self-administered by the injured party. A staff member or volunteer will assist only when asked to help by the injured party.
(b) Injuries requiring immediate medical attention will be called in to paramedics through the medical facilities at Kunsan AB. If necessary, an ambulance will be dispatched to the location.
(c) Injuries will be reported to the unit safety officer in accordance with established policy. All injuries brought to the attention of paintball program staff will be reported to the Outdoor Recreation Director for action.

7. Monitoring and Mitigation - 8 SVS/SVRO and 8 CES/CEV will monitor the course monthly to determine the extent of increased erosion and/or damage to the natural vegetation in the area. If significant deterioration is detected, access to the course will be temporarily restricted to allow regeneration. Paintball activities will be moved to an alternative location. 8 CES/CEV will determine if any physical erosion protection measures need to be installed.

Adverse impacts of mountain biking on the natural environment include soil compaction, erosion, trail widening, and vegetation disturbance. These factors can be mitigated through good trail design, placement, and management (maintaining a firm surface, avoiding trail widening, and minimizing erosion). The U.S. Bureau of Land Management's National Mountain Bicycling Strategic Action Plan, issued November 2002, provides a compilation of "best practices" for the design and management of mountain bicycling trails.

The 8 FSS/FSWO and 8 CES/CEIE should work together to designate areas appropriate for mountain biking and to establish mountain biking trails. Consideration should be given to the International Mountain Bicycling Association (IMBA) Rules of the Trail, available at http://www.imba.com.

Watchable Wildlife. Recent studies have shown a marked increase in the popularity of watching wildlife in its natural habitat. In 1990, the USAF was a signatory to a Memorandum of Understanding (MOU) pledging to cooperate in carrying out watchable wildlife programs on its facilities. While security requirements preclude public access, there is an opportunity for USAF and civilian contractor personnel to enjoy them. The unimproved and semi-improved areas at Kunsan AB provide habitat for Korean wildlife, particularly birds, and several protected species (including amphibians, birds, and mammals). The wooded portions of Gunsmoke Hill and the heights of Big and Little Coyote Hills are especially well suited to watching wildlife, particularly for bird watching. Properly designed and laid out trails would guide users to areas where natural habitats could be observed, while providing for the protection of the resources. Section 2.3.3, provides extensive information on the wildlife to be found at Kunsan AB.

Outdoor Rock Climbing. There is a rock-climbing wall in the fitness center. Due to the inherent risk involved and the need for qualified instructors, outdoor rock climbing is not permitted on Kunsan Air Base.

Outdoor Recreation Management Goals

Compile an Inventory of Local Natural Resources - AFI 34-101 requires 8 FSS/FSWO to complete an inventory of local natural resources. The AFI requires the Outdoor Recreation Director to use the natural resources inventory to devise activities and identify potential locations for outings. Outreach materials based on these inventories should be incorporated in the Outdoor Recreation Program. The 8 FSS/FSWO could sponsor or facilitate field trips to watchable wildlife locations on Kunsan AB, as well as to natural resources in the surrounding areas such as national and provincial parks.

Complete Specific Outdoor Recreation Activity Plans and Operating Instruction. A specific outdoor recreation activity plan or OI should be completed for each current or planned outdoor recreation activity at Kunsan AB that could affect natural resources or special areas. Each outdoor recreation activity plan or OI should contain a complete written description of the activity and include facility maps and identify any potential impacts to natural or cultural resources. It should also include an explicit statement of management goals for the area, an estimate of potential participation in the activity in relation to the carrying capacity of the outdoor recreation facility or recreation area, a monitoring plan, and a mitigation plan.

In accordance with AFI 34-101, Air Force Outdoor Recreation Programs, 8 FSS/FSWO is required to:

1. Work with 8 CES/CEIE and the Bioenvironmental Engineer (8 MDOS/SGOAB) to ensure that recreational facilities and maintenance practices comply with environmental regulations (§6)
2. Complete an inventory of local natural resources and existing local programs and services (§27)
3. Develop and annually update local OIs to standardize program procedures as well as safety and risk-management plans (§27)

The 8 FSS/FSWO coordinates the local OIs with 8 CES/CEIE, 8 FSS/CC, 8 FW/SE, and 8 FW/JA. In

coordination with 8 CES/CEIE, the individual OIs can be developed to provide the greatest outdoor recreational opportunities while ensuring the stewardship of Kunsan AB's natural resources.

Establish Class III Areas, Where Appropriate. Kunsan AB includes unimproved forest where native forest communities are reestablishing themselves, habitat that supports protected species, and seven traditional Korean grave sites. Habitats that support protected species require protection and could be incorporated into Class III areas. USFK Regulation 405-7 (§10-8) requires that traditional Korean graves be protected from desecration. As long as graves remain on base, they must be protected and are therefore candidates for Class III status.

Implement Watchable Wildlife Program in the Natural Areas. The 8 FSS/FSWO should work with 8 CES/CEIE to develop materials and facilities for a Watchable Wildlife program. Watchable Wildlife facilities and materials should include:

- Appropriate activity plans and OIs;
- Well laid out trails and viewing areas;
- Watchable wildlife signs identifying native Korean flora and protected species, good areas for birding, and the habitat of protected species; and
- Materials from the Management of Special Species at Kunsan Air Base guidebook and Section 2.3 of this INRMP illustrating and describing native species at Kunsan AB.

Off-road Vehicles Policy Letter. Air Force Manual 32-7003, Environmental Conservation has expanded the definition of ORVs to include mountain bikes. Section 11.3 requires "a policy on the use of ORVs, to include mountain bikes. Allow use of (ORVs) only after thoroughly analyzing the impact of such use on soils, wildlife, water quality, and other ecosystem attributes." Furthermore, Subsection 11.3.1 restricts the use of mountain bikes to "areas that can sustain their use without damage to natural or cultural resources."

Currently, motorized ORV use is not allowed at Kunsan AB, given the limited nature of land resources, while the use of mountain bikes is a possibility. Currently, Kunsan AB does not have an installation ORV policy letter. It is recommended that an ORV policy letter including motorized vehicles and mountain bikes should be generated by 8 FSS and signed by the installation commander.

Monitor the Paintball Activity. The current paintball course is located in one of the few pockets of native Korean forest remaining on base, and is susceptible to erosion caused by overuse. The 8 FSS/FSWO should work with 8 CES/CEIE to monitor the effects of paintball play on this area. Shifting paintball activities between alternative locations would allow vegetation to recover during periods of inactivity. If the paintball facility affects any natural areas, they should be regularly monitored for deterioration and corrective steps should be taken as necessary.

7.3 Conservation Law Enforcement

Applicability Statement

This section applies to AF installations that provide law enforcement in support of natural resources protection activities. This section **IS NOT** applicable to this installation.

Program Overview/Current Management Practices

N/A

7.4 Management of Threatened and Endangered Species, Species of Concern and Habitats

Applicability Statement

This section applies to AF installations that have threatened and endangered species on AF property. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

Upon examination of the number of sightings of protected species at Kunsan AB, the timing and nature of the sightings, and numbers observed, together with known life histories (e.g., habitat and nesting requirements, diets, migration patterns, and regional distributions), five of the protected species reported at Kunsan AB are known to nest on Kunsan AB, and a sixth species is likely to do so. The other species are present largely as individuals migrating through the region, or as individuals wintering or nesting in areas around Kunsan but not on the base itself. The five species known to nest or breed on the base are the Seoul frog, the boreal digging frog, the Northern Boobook, the Eurasian Hobby and the Eurasian Kestrel (Section 2.3.4.1). The Oriental Scops Owl is also likely to nest on base.

For several of the protected species reported from Kunsan, additional targeted surveys were conducted in 2017, 2018, and 2019 to better determine the occurence of the Seoul frog, boreal digging frog, Northern Boobook, Fairy Pitta, the Oriental Scops Owl, and Chinese Sparrowhawk at the base. The surveys confirmed the presence of all of these species except the Fairy Pitta. Not only were the two frog species and the Northern Boobook once again found on base, successful breeding and nesting on site was confirmed for each species, and all were found in areas of the base from which they had not previously been reported.

7.5 Water Resource Protection

Applicability Statement

This section applies to AF installations that have water resources. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

Guidance from FGS and AFMAN 32-7003: There is a general risk of storm water pollution associated with certain activities that occur at numerous facilities around the Base, rather than at specific locations. Storm water may be impacted by activities such as:

- Unprotected outdoor storage, transfer, and disposal of materials or wastes;
- The presence of aboveground storage tanks base-wide;
- Discharges from oil/water separators that are not connected to the sanitary sewer system;
- Incidents such as spills or leaks, which are not expected and must be managed by planning response procedures; and
- Non-point sources: application of chemical fertilizers and pesticides, surface and channel erosion.

Another outdoor chemical application which has the potential to be a source of storm water pollution at Air Force facilities is aircraft de-icing and anti-icing. These activities are occasionally conducted during the winter months from December to March, depending on the severity of the weather.

7.6 Wetland Protection

Applicability Statement

This section applies to AF installations that have existing wetlands on AF property. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

Wetlands on Kunsan AB are confined to the undeveloped portion of the CE area located between the munitions storage area and Haji Village. This semi-improved area contains two wetlands. One wetland is in the form of a drainage ditch from the munitions storage area that trends east south east across the CE yard and exits the base east of Haji Village. The second wetland is a marsh that has formed along the southern edge of the CE yard at the base of the Haje Village ridge. Neither wetland is a natural feature and developed from the construction of the drainage ditch and inadvertently from land filling activities.

Water hazards on Kunsan AB's golf course also provide permanent freshwater wetland habitat on base. These ponds, together with an associated drainage ditch, harbor wetland vegetation and create habitat for freshwater fish and amphibian species. The water hazards are managed as part of the golf course.

Two other wetlands reported in the original INRMP (1997) near the south end of the base have been filled or modified. The first was located along and either side of the Perimeter Road near the base of Little Coyote Hill. That wetland has been filled and no longer exists. The second wetland is a drainage ditch that formerly received surface water from the ROKAF flightline and drained off base near the south-western foot of Little Coyote Hill. Today, it is an impeded drainage ditch emanating from the foot of the asbestos landfill. In spring, a small area along the northwestern foot of the hill develops standing water.

Airfield drainage ditches are the only other potential wetland areas. Their primary function is to effectively remove surface water from Kunsan AB's industrial, flightline, and airfield areas as required to support the Kunsan AB mission. Therefore, management recommendations beyond operational requirements are not provided.

7.7 Grounds Maintenance

Applicability Statement

This section applies to AF installations that perform ground maintenance activities that could impact natural resources. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

This section contains procedures addressing grounds maintenance and includes guidance for:

- Kunsan AB's cantonment area
- Erosion control management
- Airfield maintenance
- Landscaping

7.7.1 Ground Maintenance – Kunsan AB Cantonment

Currently, grounds maintenance duties on the USAF controlled portions of Kunsan AB are shared among three organizations. A local service contractor performs grounds maintenance in the improved and semi-improved areas of Kunsan AB, excluding the airfield, the golf course, and designated "in house" areas (Figure 7.1). The ground maintenance contract is administered by the U.S. Army Contracting Command Korea (USACCK), Kunsan Branch, but direct supervision of the contractor is provided by 8 CES/CEOES which provides the Contracting Officer Representative (COR), who also acts as the contract Quality

Assurance Evaluator (QAE). While the current contract provides for "grass cutting, trimming, edging, and trimming of shrubbery, hedges, and trees" by the contractor, the current contractor does provide some of these services. Trimming of shrubbery, hedges, and trees is performed by the 8 CES/CEOHH, which also provides airfield grounds maintenance. The golf course is maintained by 8 FSS/FSWG civilian employees and is not discussed in this INRMP. The ROKAF provides grounds maintenance in areas it controls, including housing areas on the north end of the base, mission areas near the central flight line, and most of Big Coyote Hill.

7.7.2 Improved Grounds

Improved grounds are the developed areas of an installation that have lawns and landscape plantings. They usually include the cantonment, parade grounds, drill fields, athletic areas, golf courses (excluding roughs), cemeteries, and housing areas, shown in yellow in the Figure 7.1. By definition, improved grounds are those for which personnel annually plan and perform intensive maintenance activities. The following procedures are recommended for the maintenance of Kunsan AB's grounds. USACCK should specify these procedures in the development of the grounds maintenance contract.

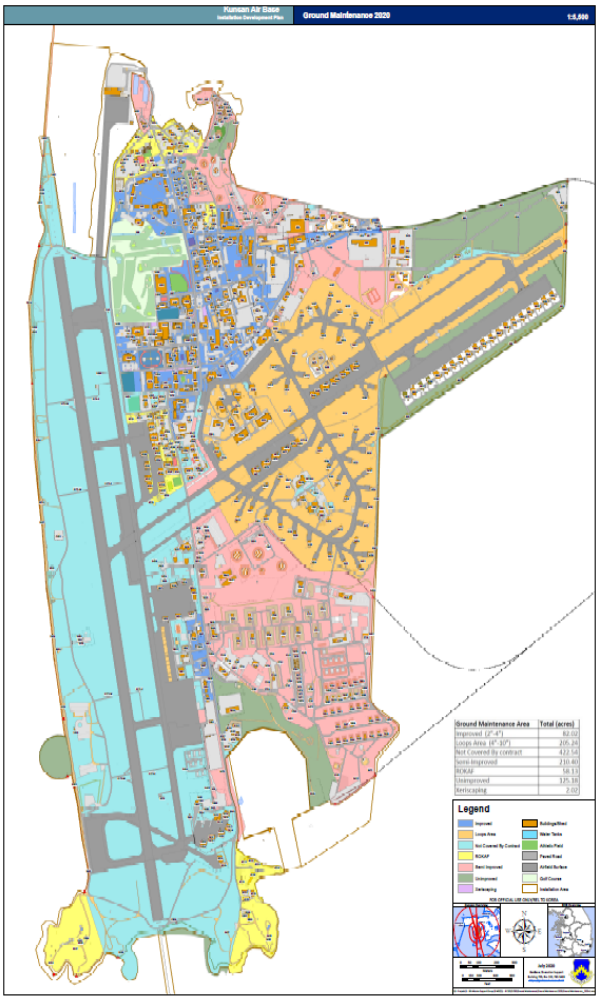

Figure 7.1 Grounds Maintenance Zones

7.7.2.1 Grass Cutting Standards**.** To help reduce erosion, grass should be maintained at a height of 2 to 4 inches (5 to 10 cm) on Kunsan AB's improved grounds. This standard will be maintained during the active growing period from April through October. After mowing, all visible grass clippings shall be removed. Improved grounds shall look well manicured at all times.

Prior to the operation of power mowing equipment and powered nylon monofilament trimmers, the area shall be cleared of any wire, bottles, cans, rocks, stones, loose trash, or any other debris that may cause damage to real property and vehicles and injury to personnel. These items are collected and stored as solid waste and shall be disposed of off base.

7.7.2.2 Edging Standards. Any soil surface damage caused as a result of the edging or curb dressing operation shall be repaired.

7.7.2.3 Organic Debris and Plant Litter Removal. All grass clippings, weeds, tree or shrub branches, leaves, stumps, roots, vines, dead plants, and other debris produced by the grounds keeping operations shall be raked up and collected daily. Sidewalks and paved areas affected by the operations shall be swept clean of all debris.

During grounds maintenance activities, all litter will be removed. Responsibilities shall also include man-

made debris (litter). The groundskeeper shall police areas concurrent to mowing and as required to maintain a neat and professional appearance. The groundskeeper shall ensure that no debris produced by grounds maintenance operations will enter the base storm drainage system. All organic and other debris are to be removed from the base.

7.7.2.4 Damage Repair. Lawn areas damaged as a result of grounds maintenance activities shall be seeded, sprigged, sodded, or alternatively managed to meet the appearance standards of the surrounding areas. Damage includes situations in which lawn grass has been trimmed to the bare soil surface. Such damaged areas are difficult to recover without considerable cost and effort. In the meantime, these areas are sources of dust and sediment in violation of *KEGS 13-3.j*. Scalping lawn grass to a height below 2 inches (5 cm) is prohibited.

The groundskeeper will repair damaged sod as requested by the COR/QAE. 8 CES/CEIE will approve all remedial sodding plans, including method and scope, prior to initiation of the project. In locations where lawn turf will not grow as a result of deep shade or excessive dampness, the establishment of alternative ground cover may be appropriate also required by *KEGS 13-3.j*.

Non-lawn areas will be repaired to match the surrounding area. Damage to trees and shrubs from trimming shall be repaired by the contractor. Shrubs or trees that die or are damaged due to improper pruning procedures will be replaced by the groundskeeper with similar species or native species as selected by the base landscape architect. The groundskeeper may submit a suggestion to the COR/QAE for approval using AF Form 3000. Plant replacement shall occur within 15 days of verified damage. However, if the season is not appropriate for planting, an appropriate schedule will be negotiated between 8 CES/CEOES and the groundskeeper.

7.7.2.5 Lawn Seeding. Lawns of improved grounds shall be seeded annually. A seeding schedule will be developed each year. USACCK and 8 CES/CEOES shall periodically inspect seeded areas to ensure that the area is growing, and that proper maintenance is being performed.

Seeded areas that are not responding shall be re-evaluated for lawn grass suitability. The physical conditions of some locations may be too shady, too damp, heavily trafficked, or have soil that is too shallow to support lawn grass. When such conditions exist, alternatives to lawn grass should be employed. Such alternatives may include vegetative ground covers (e.g., species of *Pachysandra*, *Hedera*, *Vinca*), organic mulches, stepping stones, or a combination of these alternatives. The groundskeeper should report such areas to COR/QAE. 8 CES/CEOES, in cooperation with 8 CES/CEIE, will assess the condition and make appropriate recommendations.

7.7.2.6 Plant Trimming and Pruning. Trees, shrubs, and hedges will be trimmed on a 1 to 2-year pruning cycle to maintain the form, shape, or size of woody plants. Trimming frequencies may vary due to differential growth rates of different tree and shrub species. 8 CES/CEIE will provide guidance for determining the frequency and requirements for trimming and pruning trees. Additional trimming and pruning may be performed, as required, to maintain safe conditions, adequate overhead clearances, or to prevent structural damage from dead, diseased, or injured branches. The COR/QAE may request additional tree trimming at any time in addition to the groundskeeper's established schedule. But topping and dehorning work shall require the written approval of 8 CES/CEIE.

Shrubs, small trees, and other plants shall be pruned as required to maintain their natural growth characteristics. Shrubs and small trees shall be trimmed and pruned to enhance the beauty and health of the plants. Hedges shall be maintained to their natural mature height and shape. Where shrubs or trees have obviously been previously sculpted, the groundskeeper shall follow the same overall pattern and lines

of the previous sculpting. Shrubs, small trees, and other plants shall be maintained according to American Society of Landscape Architects standards.

> Basic trimming - This guidance is provided for maintenance of trees and shrubs greater than 6 ft (2 m) in height at all sites. Basic trimming removes approximately 50% of the tree branches with associated leaf mass. The goals of basic trimming are to shorten and thin tree crowns, permit greater infiltration of sunlight, and lessen wind resistance by removing excess branches, dead wood, branchlets, suckers, and other undesirable plant growth. The purpose of basic trimming is to reduce or prevent potential damage by branches near utility lines or buildings. Also, basic trimming is done to encourage future branch structure so that the trees and shrubs will develop a symmetrical shape.
>
> Slight trimming (improved areas) - This type of work is performed on trees in the improved areas. Not as drastic as the basic trim, the slight trim is performed as preventative maintenance during the summer and autumn typhoon season to lesson wind resistance. Slight trimming is also done to reduce or prevent potential damage by branches near utility lines or buildings. Slight trimming removes approximately 25% of the tree branches, as well as overgrown branches, dead wood, and suckers. The trimmed trees should have a symmetrical shape.

Trees or limbs leaning towards the ground shall be raised and, if required, either supported or removed. Any damaged supporting material shall be repaired by the groundskeeper. 8 CES/CEIE or 8 CES/CEOHH may request the removal of old or damaged supporting material. Pruning and trimming will be conducted between the months of April and October. High-priority conditions include trees along streets whose branches extend into the path of buses, trucks, and similar vehicles. Minimum safety clearances for trees are 16 ft (5 m) above a roadway, 12 ft (4 m) above driveways, 8 ft (2.5 m) over walkways, and 5 ft (1.5 m) between trees and adjacent structures, buildings, and poles. For electrical primary lines, electrical secondary lines, and communication lines, the minimum clearance is 10 ft (3 m). Branches of other trees shall be pruned to provide a clear height of 5 ft (1.5 m) above ground level.

7.7.2.7 Weed Control. Any surface damage resulting from weeding will be repaired. Repairs to damaged surfaces may include, but are not limited to, sodding. Mechanical means of weed control are preferred over chemical means. The groundskeeper shall use only mechanical means of weed control. Only the Pest Management Shop (8 CES/CEOIE) shall use chemical means.

Vines growing on fences shall be removed neatly and completely, including their root systems. Any surface damage resulting from vine removal shall be repaired, which will include sodding, if necessary.

7.7.2.8 Soil Aeration. All lawn grass on improved grounds will be aerated to maintain the lawns in a healthy state.

7.7.2.9 Removal of Trees and Shrubs. The COR/QAE must ensure that the groundskeeper follows the requirements set forth in USFK Regulation 405-7, 6-6, *Trimming, Transplanting, and Removal of Trees*, when performing grounds maintenance activities associated with removal of trees.

The groundskeeper shall remove unwanted trees and shrubs in their entirety, down to ground level. To remove tree stumps, the groundskeeper shall excavate around the trunk of the tree, and cut and remove the trunk and associated roots to a depth of at least 5 inches (13 cm) below the existing grade. Surface roots protruding above ground level will also be cut to depth of at least 5 inches (13 cm) below the ground and removed. The COR/QAE may request that the entire root system be removed from underground. Roots running under a concrete slab or asphalt pavement shall be cut flush to the slab or pavement edge. When

the removal work is completed, the work site shall be refilled with black soil up to the ground level and sodded by the groundskeeper. Any support materials (stakes, ropes) shall be removed and disposed of by the groundskeeper.

7.7.2.10 Relocation of Trees and Shrubs. The groundskeeper shall relocate trees and shrubs upon request. The tree or shrub must be appropriately trimmed prior to relocation, to minimize potential damage, and then again after relocation, to remove any damaged limbs. Trimming shall be performed in such a way as to preserve and promote the health and natural growth form of the species.

When the tree or shrub is placed in the relocation hole, the hole shall be refilled with black soil. Excavated dirt from the relocation site shall be used to refill the removal site. The removal site shall be filled to ground level. Holes not completely filled shall be made level with the ground by using black soil.

The groundskeeper must decide if the relocated tree or shrub requires physical support. If physical support is required, new support materials shall be installed on recovered relocated trees and shrubs. Section 7.7.8.7.b *Planting* provides suggested methods for tree support. The COR/QAE will approve all remedial tree support plans, to include method and scope, prior to initiation of the work. The groundskeeper shall maintain the tree or shrub for a period of three months after relocation to ensure that the plant remains healthy. Maintenance shall include watering, fertilization, and any other action required to keep the plant alive.

7.7.2.11 Storm Cleanup. The groundskeeper shall assist in the cleanup and removal of storm debris including, but not limited to, fallen branches, trash, and leaves from grounds, ditches, sidewalks, and pavement surfaces.

7.7.3 Semi-improved Grounds

Semi-improved grounds require periodic maintenance for operational purposes such as erosion and dust control, bird control, visual clear zones, as well as aesthetic reasons. Semi-improved grounds usually include land adjacent to runways, taxiways, and aprons, runway clear zones, lateral safety zones, rifle and pistol ranges, picnic areas, ammunition storage areas, antenna facilities, and golf course roughs. The semi-improved grounds at Kunsan AB are shown in the Figure 7.1. Where practical, consideration should be given to less active management of semi-improved areas in accordance with DoDI 4715.3 and AFI 32-7074. Where security, fire hazard, and perceived aesthetics are not an issue, natural regeneration should be allowed to progress.

7.7.3.1 Grass Height Standards. Grass on semi-improved grounds shall be cut according to a schedule approved by the COR/QAE. Grass heights shall be maintained between 7 to 14 inches (18 to 38 cm) on semi-improved grounds. The grass shall not be shorter than 7 inches (18 cm) in height, to prevent dust from semi-improved grounds, but the grass shall never be more than 14 inches (36 cm) in height, to discourage bird and small mammal habitation. Grass shall be trimmed away from all concrete and asphalt to provide a clean, edged appearance with no grass growing onto the paved surfaces.

7.7.3.2 Plant Trimming and Pruning. The same standards apply as stated in section 7.7.2.6.

7.7.4 Unimproved Grounds

Grounds not expressly defined as improved or semi-improved are unimproved. Unimproved grounds include weapons firing and bombing ranges, forest lands, crop lands, grazing lands, grasslands or ranges, lakes, ponds, wetlands, and airfield areas beyond the safety zones. Pockets of forest remain on Kunsan AB's hills that may be considered unimproved grounds. These grounds have been divided into the NRMUs

described in Section Current Vegetative Cover of this INRMP 2.3.2.2. The NRMUs are not managed or maintained under the grounds maintenance contract. They are managed by 8 CES/CEIE in compliance with the *KEGS 13-3.f*, *h* and *i*.

7.7.5 Cantonment Grounds Maintenance Management Goals

7.7.5.1 Compatibility with the Korean Natural Landscape. The 8 CES/CEIE and the COR/QAE will ensure that new landscaping includes only species native to this part of Korea, and that all non-native species will be eliminated from Kunsan AB. Wherever possible, semi-improved areas will be managed passively and allowed to return to unimproved ground.

7.7.5.2 Non-point Source Pollution Remedies. The 8 CES/CEIE will recommend procedures to 8 CES/CEOES regarding reduction and control of wind-borne dust and water-borne sediment resulting from inappropriate grounds maintenance procedures.

7.7.5.3 Oversight and Quality Assurance. 8 CES/CEIE and CEOES will develop an oversight and corrective action procedure in accordance with the grounds maintenance contract. Oversight will concentrate on ensuring correct trimming and pruning procedures are employed at the right times, and will include recommendations for specialized landscaping techniques (groundcover vegetation and mulches) to be used in difficult to manage areas.

7.7.5.4 Grounds Maintenance Contract Revision. The 411 CSB incorporates revised procedures into the grounds maintenance contract to ensure that grounds keeping practices are implemented to prevent soil erosion and non-point source pollution (lawn scalping and trimming damage to trees). Specific procedures should address a reduction in the frequency of grass cutting and vegetation removal in semi-improved areas. The current contractual grass height standard of 1.2 to 2.3 inches (3 to 6 cm) is too low to prevent soil erosion and non-point source pollution. A standard of 2.0 to 4.0 inches (5 to 10 cm) for lawns in improved areas and 7 to 14 inches (18 to 36 cm) for grass in semi-improved areas should be substituted.

7.7.6 Ground Maintenance - Airfield

The unpaved open areas associated with the airfield are classified as semi-improved grounds. This includes the areas surrounding the taxiways and from Runway 18/36 west to the seawall. Grounds maintenance of the airfield consists mainly of grass mowing, weed control, and drainage channel maintenance. Airfield grounds maintenance is conducted by 8 CES/CEOHH. Herbicides are applied by the Pest Management Shop (8 CES/CEOIE) to pavement cracks and joints, around airfield lights, and at the base of the concertina wire surrounding the airfield. Timing of herbicide applications is to be scheduled on the results of regular inspections conducted by 8 CES/CEOIE from April through September or upon request by 8 CES/CEOHH. Application of pesticides to discourage grasshoppers, which attract birds, is regularly conducted by 8 CES/CEOIE from April through October.

Examples of specific conditions that exist on Kunsan AB are identified in the following discussion along with recommendations that will reduce the overall BASH potential. Detailed information can be found in the 8 FW Operation Plan 91-212 BASH Plan Annex B 9, and the role and responsibility of 8 CES/CC are presented in Section 7.12 of this INRMP.

7.7.6.1 Drainage Ditch Maintenance

Execute the land management recommendations identified in OPLAN 91-212, Annex C.3. The airfield's drainage gradient is slight, so regrading the sides of ditches will not improve the rate of drainage; however, keeping the ditches clear of vegetation and debris will facilitate the flow of the water and reduce habitat availability for prey species, thereby making the ditches less attractive to birds. (Figure 7.2). The Seoul frog, a KEGS-listed protected species, was recently found in two of the airfield drainage ditches (see Section 2.3.4.1; Figure 2.65). Because grounds maintenance activities at these ditches have the potential to impact the Seoul frog, the management actions recommended for these drainages must be coordinated with 8 CES/CEIE (see Section 2.3.4.2).

Figure 7.2 Overgrown vegetation impedes water flow (left) and overgrown vegetation creates bird habitat.

Other actions, such as enclosing or covering the drainage ditches adjacent to the active runway will also help to relocate the large wading birds and ducks from the immediate area of the runway. (Figure 7.3). The 2003 effort to enclose the drainage ditches along the active runway was effective in displacing the large wading birds and ducks from the area immediately adjacent to the runway.

Figure 7.3 Airfield drainage ditch prior to enclosure (left) and above-grade lateral drainage after enclosure.

However, while the enclosed drainages continued to function well in channelling surface water from the cantonment and industrial areas of the base, they prevented lateral drainage from the airfield's infield. As a result, areas that were formerly well drained are now, during the rainy season, developing temporary wetlands due to the impeded drainage. (Figure 7.4).

Figure 7.4 Impeded lateral flow following ditch enclosure (left) and resultant standing

These temporary pools provide habitat for aquatic invertebrates and attract a variety of wading and shore birds. In addition, these temporary pools provide breeding habitat for the boreal digging frog, a KEGS-listed protected species (Section 2.3.4.1).

7.7.6.2 Surface Water Reduction

Ground Safety helps identify the tire ruts and other low spots around the airfield, and request to fill the spots if deemed necessary. (Figure 7.5). Tire ruts and low spots retain water and provide habitat for reptiles, amphibians (including the protected boreal digging frog), fish, and aquatic invertebrates that attract waterfowl and wading birds. By attracting the larger wading birds, the ruts increase the BASH risk.

Figure 7.5 During the wet season, water-filled tire ruts provide unwanted wetland habitat (left). During the dry season, hardened tire ruts impede airfield maintenance and grooming.

7.7.7 Alternative Mowing Equipment and Procedures

Investigate alternative mowing machines to avoid the creation of deep, water retaining tire ruts. Alternatives might include equipping mowing machines with wide balloon tires that more evenly distribute the mower weight. Design mowing patterns that employ wide turns rather than tight turns. Wider turns will reduce tire ruts. When wet, the tire ruts act as miniature ponds and harbor frogs, crabs, and other invertebrates that attract feeding birds. The compacted soil forming the ruts even prevents drainage. When dry, the clay forming the tire ruts hardens preventing mowing, dulling blades, and increasing the wear-and-tear on mowing equipment (Figure 7.5).

7.7.7.1 Enhanced Bird Harassment

Implement more effective harassment methods for persistent individuals or flocks of birds (e.g., Cattle Egrets) (Figure 7.6). Procure additional gas cannons or relocate existing cannons to the locations where birds congregate. Portable cannons mounted in the bed of a small pickup truck can be moved to where birds pose the greatest hazard.

Figure 7.6 Deploy pyrotechnics and other harassment methods to high-risk areas.

7.7.7.2 Restricted Mowing Schedules

Limit mowing activities to periods when there are no flying operations. Mowing machines disturb, maim, and disorient insects, other invertebrates, reptiles, amphibians, and even small mammals, which can attract bird predators. For example, the Cattle Egret (common in late summer and autumn) is naturally well adapted to foraging on the ground among animal herds; mowing machines provide the same benefits as herd animals. They have learned to associate mowing machines with an ample source of food and are attracted to mowing operations (Figure 7.7). Mowing operations should be limited to non-flying hours because the egrets frequently follow mowers to feed on the insects that are stirred up. Also, mowing activities should be avoided when the airfield is saturated or soggy. All other motor vehicle operations should be restricted on the airfield.

Figure 7.7 Cattle Egrets attracted to mowing operations.

7.7.8 Landscaping

The implementation of a landscape management strategy at Kunsan AB includes the elements of design, installation, and maintenance. These elements must be implemented while meeting the requirements of Air

Force policy, KEGS 2012, and the National Biodiversity Strategy for the Republic of Korea. In particular, landscaping management practices at Kunsan AB should incorporate strategies for sustainable landscape design and management, which include using native species of plants for landscaping, ground cover to reduce erosion, and green waste as mulch.

7.7.8.1 Landscape Design

New construction is being planned for Kunsan AB in an on-going effort to replace aging and inadequate infrastructure. In addition, some buildings and associated grounds will be rehabilitated. During the design phase of these projects, the 8 CES/CEIE should review landscape design plans. A well-designed and implemented landscape design plan can result in healthier, longer lived plantings that rely less on pesticides and fertilizers, minimize water use, require less maintenance, and increase erosion control. Landscaping can be integrated with camouflage, concealment, and deception techniques to defeat target acquisition systems. Such techniques include natural screens and disguises.

7.7.8.2 Planting Guidelines

The following specifications and practices are recommended elements for the establishment of new plants for new landscape or areas undergoing repair at Kunsan AB.

7.7.8.3 Recommended Plants - *KEGS 13-3.f* and *j* require grounds be maintained in harmony with the natural landscape; all plants should be native Korean species well suited to the local climate and soils. Much of Kunsan AB is located on sandy soils with a shallow saline water table. 8 CES has found that Ginkgo and Juniper do best in these conditions. Tables 7.2 through 7.4 provide a recommended list of trees, ground covers, and shrubs that are suitable for landscaping projects at Kunsan AB. These lists include plants suggested in a Planning Assistance Team Study (AFCEE, 1994) with some corrections, recommendations, and additions. Selecting plants on this list ensures compliance with *KEGS 13-3.f*. The lists may include other indigenous species, but these must be approved by the landscape architect and 8 CES/CEIE.

7.7.8.4 Plant Specimens**.** Living plants and turf shall be nursery or plantation grown stock and shall be of the varieties specified in Tables 7.2 through 7.4. Plants shall have been grown under climatic conditions similar to those of Okku County. Plants budding into leaf or having soft growth shall be sprayed with an anti-desiccant at the nursery before digging. Plants shall be dug and prepared for shipment in a manner that will not cause damage to branches, shape, and future development after planting.

Table 7.2 Recommended Ground Cover Plants for Landscaping Projects.

Korean Name	Scientific Name	English Name	Type
Malnari	*Lilium distichum*	Day Lily	Perennial
Songaksok	*Hedera spp.*	Ivy	Vine
Maekmoondong	*Liriope muscari*	Lily Turf	Forb
Kotjandi	*Phlox subulata*	Creeping Phlox	Evergreen forb
Pankka	*Vinca major*	Great Periwinkle	Evergreen forb
Soohocho	*Pachysandra terminalis*	Japanese Spurge	Evergreen forb

Table 7.3 Deciduous and Evergreen Shrubs for Landscaping Projects.

Korean Name	Scientific Name	English Name	Type
Mikuknunhyang	*Juniperus chinensis* var. *horizontalis*	Creeping Juniper	Evergreen
Nunhyang	*Juniperus chinensis* var. *sargentii*	Sargent Juniper	Evergreen
Hwiyangmok	*Buxus microphyllus* var. *koreana*	Korean Boxwood	Evergreen
Sanamu	*Aucuba japonica*	Japanese Aucuba	Evergreen
Kalkichopobnamu	*Spirea trichocarpa*	Korean Spirea	Deciduous
Jangmi	*Rosa centifolia*	Rose	Deciduous
Mukunghwa	*Hibiscus syriacus*	Rose Mallow	Deciduous
Paelongnamu	*Lagerstroemia indica*	Crape Myrtle	Deciduous
Jolchuk	*Rhododenron lateritium*	Korean Azalea	Deciduous
Hwangcholchuk	*Rhododendron schlippenbachii*	Korean Rhododendron	Deciduous

Table 7.4 Recommended Deciduous and Evergreen Trees for Landscaping Projects.

Korean Name	Scientific Name	English Name	Type
Himalaya sida	*Cedrus deodara*	Deodar Cedar	Evergreen
Dokilkamunbi	*Picea abies*	Norway Spruce	Evergreen
Sonamu (joksong)	*Pinus densiflora*	Japanese Red Pine	Evergreen
Pansong	*Pinus densiflora* for. *multicaulis*	Japanese Umbrella Pine	Evergreen
Waesong	*Pinus thunbergii*	Japanese Black Pine	Evergreen
Susong	*Metasequoia glyptostroboides*	Dawn Redwood	Deciduous
Hwabaek	*Chamaecyparis pisifera*	Sawara Cypress	Evergreen
Silhwabaek	*Chamaecyparis pisifera* var. *filifera*	Moss Sawara Cypress	Evergreen
Hyangnamu	*Juniperus chinensis*	Chinese Juniper	Evergreen
Kaijukkahyang	*Juniperus chinensis* var. *kaizuka*	Kaizuka Juniper	Evergreen
Unhaengnamu	*Ginkgo biloba*	Ginkgo	Deciduous
Ipanmoklyon	*Magnolia obovata*	Japanese Cucumber Tree	Deciduous
Salkunamu	*Prunus armeniaca*	Flowering Pear	Deciduous
Bojnamu	*Prunus serrulata*	Flowering Cherry	Deciduous
Yakeangnamu	*Malus baccata*	Siberian Crabapple	Deciduous
Baktaeki	*Cercis chinensis*	Chinese Redbud	Deciduous
Danpungnamu	*Acer palmatum*	Japanese Maple	Deciduous
Hongtanpyong	*Acer palmatum* var. *sanguineum*	Japanese Red Maple	Deciduous
Sotanpung	*Acer takesimense*	Green Maple	Deciduous
Tokalnamu	*Quercus dentata*	Daiymo Oak	Deciduous
Sinkalnamu	*Quercus mongolica*	Mongolian Oak	Deciduous
Sasule	*Betula ermanii*	Russian Rock Birch	Deciduous
Kochesu	*Betula costata*	Costata Birch	Deciduous
Chajaknamu	*Betula platyphylla* var. *japonica*	Asian White Birch	Deciduous
Nungsupotul	*Salix Koreensis*	Korean Willow	Deciduous
Soonamu	*Carpinus laxiflora*	Looseflower Hornbeam	Deciduous
Nutinamu	*Zelkova serrata*	Sawleaf Zelkova	Deciduous

7.7.8.5 Deciduous and Evergreen Trees and Shrubs. Deciduous trees and shrubs shall be symmetrically developed. They must exhibit uniform growth with straight trunks or stems and have no objectionable disfigurements.

Mat-type turf (11 x 14 inches, 28 x 36 cm) shall be used for sodding. Turf mat is acceptable when it has a healthy rhizome and root system with enough dirt and is without holes or looseness.

Prior to accepting delivery of any nursery stock, the groundskeeper should inspect the plants to ensure they appear to:

- Be well-branched and well-formed for the variety
- Have healthy, normal, and unbroken root systems
- Show no sun scald, wind burn, abrasion, or other physical damage
- Be free of disease, harmful insects, and insect eggs

7.7.8.6 Establishment of New Plants. Site preparation and planting of new plants are governed by the following specifications and practices:

7.7.8.6.a Site Preparation

Site Selection. Plants should be placed in soil and shade conditions appropriate to the species. Shrubs and trees should be planted so that their natural growth will not interfere with buildings, wires, roadways, and walkways without drastic pruning. Inappropriate site selection often results in unsightly landscaping with on-going liabilities for maintenance and costs (Figure 7.8).

Figure 7.8 Poor Site Selection Results in Unsightly Appearance and On-going Maintenance

Clearing/grading. Clearing shall consist of the removal and disposal of brush, snags, and rubbish.

Layout. Plant locations shall be marked with lime or stakes on a project site before any pits or beds are dug. If lawns have been established prior to planting operations, the surrounding turf shall be covered in a protective manner. Existing trees and shrubbery should be protected during planting operations.

Turf Removal. If planting beds occur in existing turf areas, the turf shall be removed to a depth that will ensure the removal of the entire root system.

Transplanting. Trees shall be pruned before or after the transplant work. The tree's root ball shall be formed carefully to avoid excessive removal of dirt, cutting of roots and wrapped with straw or hemp mat and straw rope.

Plant Pits. Plant pits shall be dug to produce vertical sides with flat bottoms of loose soil. When pits are dug with an auger and the sides become glazed, the glazed surface shall be roughened. The minimum allowable dimensions of plant pits shall be 6 inches (15 cm) deeper than the depth of the ball or the depth of base roots. For ball or root spreads up to 2 ft (0.6 m), pit diameters shall be twice the root spread. For ball or root spreads from 2 to 4 ft (0.6 to 1.2 m), pit diameters shall be 2 ft (0.6 m) greater, and for ball or root spreads over 4 ft (1.2 m), pit diameters shall be 1.5 times the ball root spread.

7.7.8.6.b Planting

Setting Plants. Balled and burlapped and container grown plants shall be handled and moved only by the ball or container. Plants shall be set and held in position until sufficient soil has been firmly placed around roots or ball. Plants shall be set in relation to the surrounding grade so that they are even with the depth at which they were grown in the nursery or collection field. Care shall be taken to avoid contaminating the mulch with the planting soil. Balled and burlapped stock shall be backfilled with black soil to approximately half the depth of the ball and then tamped and watered. Plastic wrap shall be completely removed before the placement of backfill. The remainder of the backfill of black soil shall be tamped and watered. Bare root stock shall be planted so that the roots are arranged in a natural position. Damaged roots shall be removed with a clean cut. Backfilled black soil shall be carefully worked in among the roots.

Watering. All watering shall provide uniform coverage and will not cause erosion or damage to the finished surface. Sufficient water shall be applied to penetrate to the bottom of the planting bed.

Edging Plant Beds or Individual Plants. Plants shall be uniformly edged, using a sharp tool for a clear-cut division line between the planted area and the adjacent lawn. Individual plant pits shall be circular in shape.

Trunk Wrapping. The trunks of deciduous trees 3 inches (8 cm) or greater shall be wrapped, beginning at the base and extending to the first branches. Wrapping material for trees and larger shrubs shall be linen cloth or other approved materials. Wrapping material shall be a minimum of 4 inches (10 cm) in width and have a stretch factor of 33.3%. Protective wrappings should be secured to the trunk base of newly planted trees and stem bases of shrubs, after being inspected for physical damage or insect infestation. The wrapping provides protection from mishandled grass cutting equipment and prevents sun scald.

Staking and Guying. Plants shall be staked and guyed. The plants shall be held firmly between the stakes with guying lines to each stake (see this section Stakes and Supports below).

Pruning. New plants shall be pruned; dead and broken branches shall be removed. Deciduous trees and shrubs shall be pruned to reduce total amounts of anticipated foliage by one fourth to one third. Typical growth habits of individual plants shall be retained with as much height and spread as is practicable. Cuts shall be made with sharp instruments flush with the trunk or adjacent branch to ensure elimination of stubs. Trees shall not be poled or the leader removed, nor shall the leader be pruned or “topped off.” Trimmings shall be removed from the site. Tree pruning and cavity work shall be performed by skilled workmen.

Dead and diseased branches interfering with or hindering the healthy growth of the trees shall be removed. To remove large limbs, the initial cut shall be made on the underside at a safe distance from the trunk or lateral, to prevent ripping of bark. Large branches or limbs that cannot be safely removed in one piece shall be removed in sections and lowered by ropes. Workmen shall not be permitted to climb trees with climbing spurs. Stubs or improper cuts shall be cut off flush. Girdling roots shall be removed. Cuts or wounds 0.5 in. (1.3 cm) or more in diameter and exposed wood and scars resulting from previous work or damage shall be cleaned. Decayed wood shall be removed to expose healthy tissue.

Black Soil. Trees and shrubs, after being placed should be backfilled with black soil. Black soil is a natural, friable soil representative of the soils at Kunsan AB. The soil should originate from a well drained area, free of subsoil, objects larger than .5 inches (1.25 cm) in any dimension, toxic substances, and any material or substances that may be harmful to plant growth.

Stakes and Supports. Stakes and supports should be made from sturdy, long lasting materials such as bamboo, cedar, or hardwood. Bamboo supports shall be healthy, older than 2 years, straight, sturdy, and free from rot, worm damage, or other weakening defects. Standard bamboo supports should be Chinese

bamboo. Bamboo should be cut at the point nearest to a burl. Cedar or hardwood stakes and supports should be rough-sawn and free from knots, rot, cross grain, or other defects that might weaken them.

The two-legged plant support is generally used on medium-sized trees (Figure 7.9). Stakes used for support are usually cedar; however, other untreated hardwoods can also be used. The stakes should have a minimum diameter of 3 in. (8 cm) and have a length of 6 ft (1.8 m). The stakes should be cut to a point at one end to allow for easier penetration into the soil.

The horizontal bamboo plant support system is used for high-density planting such as hedges (Figure 7.9). Plants should be secured by a horizontal bamboo rod placed at approximately two thirds the height of the plant(s). A bamboo rod should be cross-braced at intervals of 8 ft (2.4 m). The single bamboo plant support system is typically used on small trees with a height of 5 ft (1.5 m).

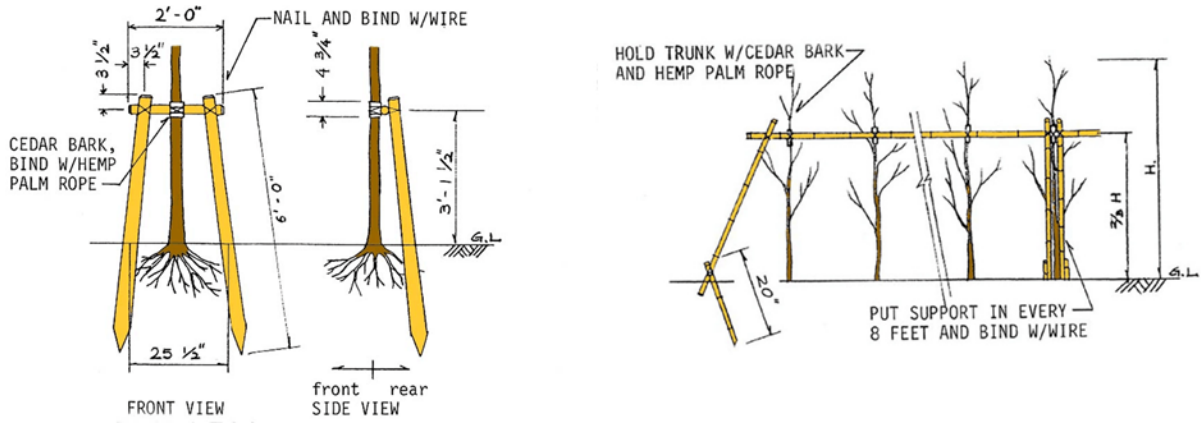

Figure 7.9 Two-legged (left) and Horizontal (right) Plant Support.

The Lamber tripodal plant support system is used for tall trees in excess of 5 ft (1.5 m) in height (Figure 7.10). Wood used for stakes and the support structure for this support method should be rough-sawn wood free from knots and other defects that could affect strength and longevity. The support wood should have a minimum diameter of 1.2 in. (3 cm) and have a maximum length of 13.3 ft (4 m). Standard support wood and stakes should be constructed from Japanese Cedar or other untreated hardwoods. The support stakes should have a minimum diameter of 2.3 inches (6 cm) and a maximum length of 3 feet (1 m). Stakes should be cut to a point at one end to allow easy penetration into the soil.

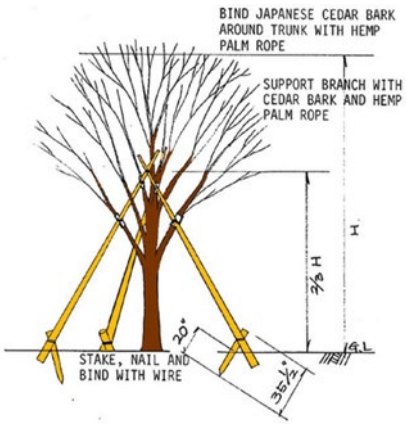

Figure 7.10 Lamber Tripodal Support

Wood supports should be fastened at a location two thirds the height of the tree. The bamboo tripodal plant support system utilizes bamboo to support medium-sized trees (Figure 7.11). The bamboo material used to support the tree should be at least 2 years old and be free of defects that could affect its strength and longevity.

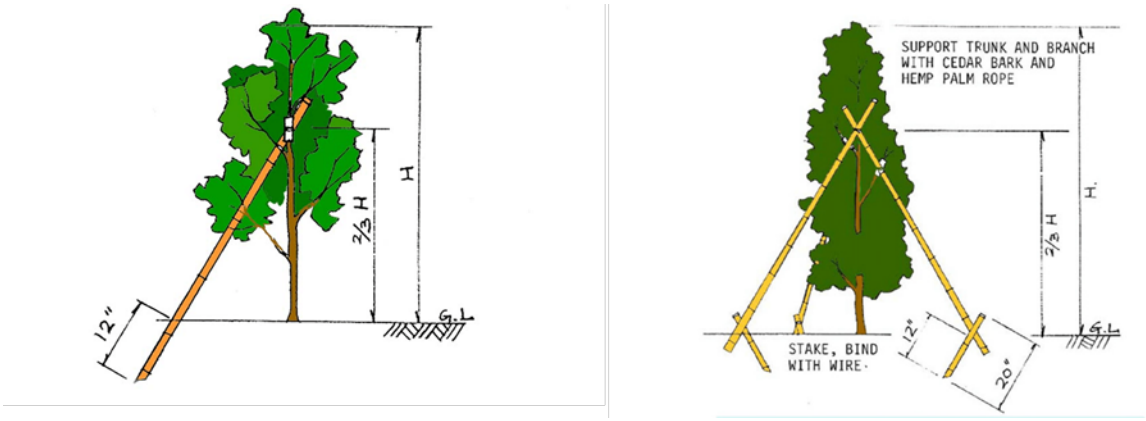

Figure 7.11 Single (left) and Tripodal Bamboo Supports.

7.7.9 General Landscape Maintenance

An effective landscape maintenance program includes the development of specific plans for improved and semi-improved areas and performance matrices. These plans and performance matrices cover the following major elements of a landscape maintenance program. The following discussions have been derived from the USAF Landscape Design Guide.

7.7.9.1 Aeration. Aeration is the process of improving the gas and air exchange capabilities of soil being utilized for growing plant material. Compacted or water-logged soil conditions limit plant growth. Aeration reduces shallow rooting, improves nutrient infiltration, and increases overall plant vigor. Turf grass is the most commonly aerated landscape element. Any aeration method that increases the permeability of compacted soils has merit and should be considered for use.

7.7.9.2 Fertilization. Fertilization is the supplemental application of nutrients required in the soil for healthy and sustained plant growth. There are 16 elements required for plant growth, most soils contain traces of each. The three major elements, nitrogen (N), phosphorus (P), and potassium (K), are usually required in greater amounts. Soil should be tested to determine exact fertilization requirements.

The most important aspect of fertilization is regularity; irregular fertilization actually causes more harm than good. There is also the possibility of root burn if too much fertilizer is applied. Always follow recommended application rates and water immediately after fertilizing any plant. Regular irrigation ensures the nutrients are diluted and disbursed throughout the root zone.

7.7.9.3 Mulching. Mulching is the placement of organic material over a plant's root zone. Mulch keeps the soil near plant roots cool and moist longer than soil exposed to the sun and drying wind. Mulch provides insulation during winter, discourages weed germination, reduces soil erosion, impedes soil compaction, and protects plants from the damage caused by mowers and trimmers. Mulching should be accomplished annually, as it decomposes, breaks down, and shifts. Depth should be 2 to 4 inches (5 to 10 cm), depending on plant type and geographical location.

Available mulch materials include compost, ground or shredded bark chips, pine needles, leaves, straw, processed by-products such as grape and apple pomace, cottonseed or rice hulls. Organic materials are preferred over inert materials as these reflect sunlight and retain heat, which causes plant stress. Green wastes from grounds maintenance activities and waste wood can be processed into mulch. Green waste includes grass clippings, tree branches, and other debris. The current grounds management contract requires the groundskeeper to remove all green waste generated by landscape management work from the base daily. 8 CES/CEIE should consider the establishment of a composting and chipping operation to recycle the base's green waste. Kunsan AB could modify the grounds maintenance contract to require the groundskeeper to chip wood debris for use as mulch and to implement a chipping program on base.

7.7.9.4 Soil Amendments. Soil amendments are materials added to improve or maintain its texture, pH, friability, to encourage healthy plant growth. Organic matter is the decaying remains of plants and animals. Organic matter is a desirable component of all soils, and because they are continually being decomposed by soil bacteria, even the best soils benefit from periodic application. They can improve aeration and drainage in clay and compacted soils. In sandy soil, they help retain moisture and available plant nutrients.

Many soils require pH modifications to improve their ability to support plant growth. Acidic soils have a low pH and require the addition of lime, or calcium carbonate to raise the pH. Alkaline soils have a high pH and require the addition of gypsum, or calcium sulfate, to lower the pH. Amendments are added to the drip or root zone as a long-term supplement. This improves aeration and releases many of the trace elements present in the soil that are otherwise unavailable. Korean soils tend to be acidic; indigenous species, accustomed to the acidity do not usually require pH adjustments. A few examples of pH adjustments include perpetual flower beds (periodic lime applications) and construction fill areas (slight acidification).

7.7.9.5 Pruning. Pruning is the selective removal of foliage or branches from trees and shrubs. It contributes to the quality, attractiveness, and longevity of plants. Pruning should remove dead or diseased branches, reduce foliage density or crossing branches, or to improve the beauty of the plant.

Tree Pruning Techniques. Pruning should restore a tree to a healthier condition and a more attractive shape, making it stronger and better able to withstand storms and disease. Proper pruning is paramount to long-term tree health and vitality and aesthetic and energy-conservation value. Many trees are incorrectly topped or pollarded, forever destroying their natural shape and size while greatly shortening their lives. It is better to leave a tree alone than to prune it improperly. Topping a tree removes the terminal bud and results in irregular and oddly shaped trees. Figure 7.12 illustrates some common tree pruning techniques.

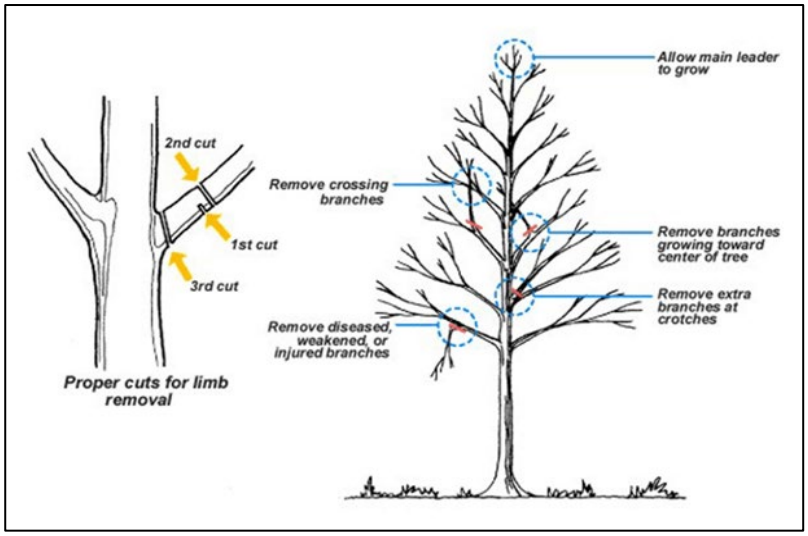

Figure 7.12 Tree Pruning Techniques.

Shrub Pruning Techniques. Most shrubs that receive regular pruning do not need it. When pruned improperly or unnecessarily, the labor and associated costs are wasted, the plant suffers, and the aesthetic quality of the landscape declines. If the shrub is pruned in the wrong season, the individual

branches will die, destroying the shape of the plant. Allow shrubs to take on their natural shape, pruning only to reduce crowded foliage, crossed branches, an asymmetrical shape, or branches growing into the heart of the shrub. Figure 7.13 illustrates some common shrub trimming techniques.

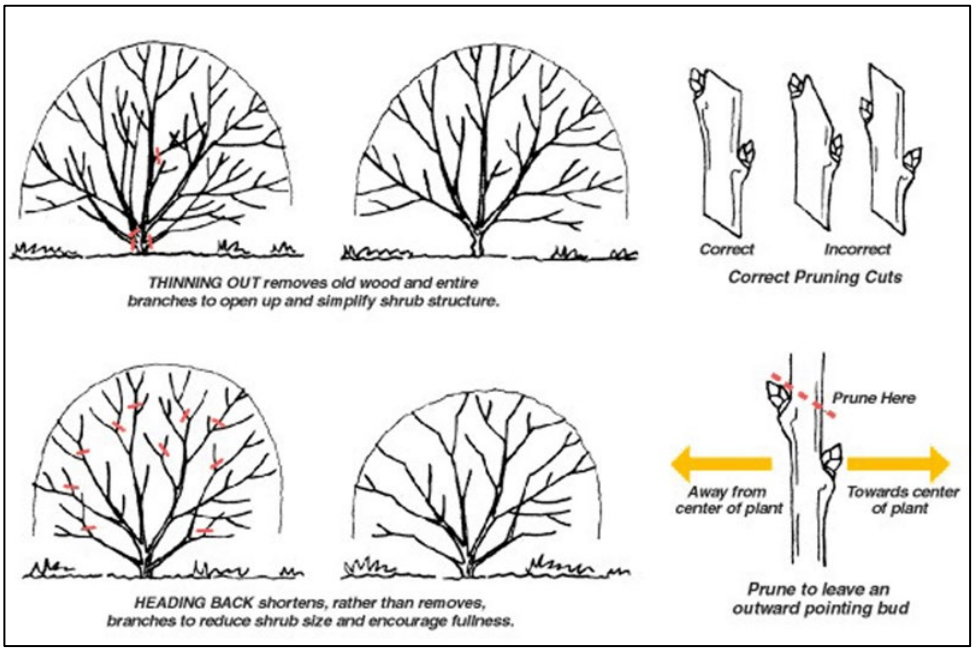

Figure 7.13 Shrub Pruning Techniques.

Selective pruning restores a shrub to a healthy condition and an attractive shape. Overuse of sculpted "lollipop" shapes should be avoided (AFCEE, 1994). Allow plants intended for screening to grow naturally; workers must be trained in proper pruning techniques and supervised in the field by an experienced person. Experienced grounds keepers should know the proper season and timing for pruning.

7.7.9.6 Ground Cover**.** The term ground cover is applied to low growing plants, other than turf grass, that spread to form dense mats and are used to cover areas. The plants used for ground cover are generally 12 in. (30 cm) or less in height, but taller plants may also be appropriately used in certain landscape situations. The benefits of an established ground cover in a landscape maintenance strategy are as follows:

- Provides vegetative cover in areas of shade where it is difficult to establish or maintain turf grass
- Provides protection for tree roots and trunks from mowing and trimming damage
- Prevents the germination of weeds and egress of perennial weeds
- Protects soil from erosion on steeply sloped areas along roadways
- Eliminates mowing, thus potentially reducing some landscape maintenance
- Provides an insulating cover for soil, keeping it cooler in the summer and warmer in the winter

Many of the maintenance practices at Kunsan AB have the potential to damage the trunks and roots of trees. In some cases, vegetation has been removed down to the plant's roots, thereby promoting soil erosion. Utilization of native ground covers can eliminate these problems, reduce non-point source sediments and dust, reduce grounds keeping effort and costs, and improve the biodiversity of the plant community.

7.7.9.7 Weed Control. A weed is any plant growing where it is not wanted; weed control is the process of controlling or eliminating unwanted plants. Chemical herbicides are efficient at controlling weed but can

cause serious problems if not used properly. Runoff to adjacent agricultural fields is of particular concern at Kunsan AB. The groundskeeper uses only mechanical means of weed control, while 8 CES/CEOIE is authorized to use herbicides for grounds maintenance. Table 7.5 summarizes weed control techniques.

Table 7.5 Weed Control Methods.

Method		Comments
Chemical	Chemicals used for weed control vary greatly in their makeup, use, and purpose. They include pre-emergent, contact, and systemic types and soil sterilants. Pre-emergent herbicides attack seeds during germination. Contact herbicides effectively 'burn' weeds to death. Systemic herbicides are more effective, as they work through the plants' physical structure and kill from within. There are two types of systemic chemicals commonly used in landscape maintenance: non-selective and selective.	
	Pre-emergent	Pre-emergent weed control kills seeds during germination. The well-timed use of pre-emergent herbicides will eliminate the need for large-scale systemic chemical or mechanical weed-removal operations. These chemicals are extremely valuable when used to treat inert material areas. Depending on the climate, two to three annual applications may be required.
	Contact	Contact or foliar herbicides kill tissue with which they make direct contact. They weaken and disorganize the plant cell membranes, causing leakage and eventual localized death. Contact herbicides are generally most effective against annuals. Complete coverage is essential in weed control with contact herbicides.
	Non-selective Systematic	Non-selective systemic chemicals are applied to the foliage of unwanted plant material. The chemicals work through the chlorophyll in plant leaves and bark and move inside the plant to the roots. Although somewhat slow-acting, these chemicals will severely damage or kill almost anything they are sprayed on.
	Selective Systematic	Selective systemic weed-control chemicals are used to kill specific classes of plants. Plants are classified as either monocotyledons, which include palms and grasses, or dicotyledons, which include all broadleaf plants such as willows, oaks, dandelions, and privet. Chemicals can be selected to control broadleaf weeds in turf grass or grasses in broadleaf ornamentals. These chemicals are effectively used to eliminate clover in Bermuda grass turf or to remove Bermuda grass from Asian jasmine ground cover. Some damage can occur to desirable plants during these operations.
	Soil Sterilants	Soil sterilants should almost never be used in landscape maintenance operations. Security fence lines, railroad tracks, and POL tank farms are potential candidates, but the tendency of these chemicals to migrate and kill mature trees and shrubs by poisoning the soil usually limits their value and widespread use.
Non-Chemical	Uprooting	Mechanical weed control can be accomplished using shovels, hoes, spades, or by hand.
	Mulching	The use of mulch in plant beds and around trees discourages weed germination (see Section 7.3.3.5).
	Ground cover	The appropriate use of ground cover plants, particularly in shaded areas, also discourages weed germination (see Section 7.3.3.10).

7.7.9.8 Pest and Plant Disease Control. Pest and plant disease control, while not specifically discussed in this document, is covered in Kunsan AB's Pest Management Plan.

7.7.10 Landscape Maintenance Management Goals

7.7.10.1 Green Waste Determination. 8 CES/CEIE should determine the amount of green waste generated at Kunsan AB, develop a recycling program for wastes produced and incorporate this mulch into landscape maintenance.

7.7.10.2 Integrate the Integrated Pest Management (IPM) Plan. Ensure this plan includes landscape maintenance. Issues should include a written policy regarding the use of chemicals for landscape and airfield maintenance.

7.7.10.3 Alternative Landscaping Strategies. 8 CES/CEIE should identify landscaped areas affected by shade or poor maintenance practices that might be converted to a low maintenance ground cover or mulch to protect existing trees and shrubs. 8 CES/CEIE should identify appropriate native species for landscaping purposes.

7.7.11 Erosion Control

Poor erosion control measures result in soil loss, increased sedimentation, and elevated waterborne suspended solids and airborne particulates. Most soil erosion on base results from improper construction, maintenance, or landscaping activities. Soil erosion damage is more costly in terms of remedial actions, impacts to operational activities, and environment degradation than the cost of implementing appropriate erosion control measures.

The KEGS mandates the incorporation of practices that reduce erosion and minimize non-point source pollution into land management practices at USFK facilities. Specifically, KEGS 13-3.i requires that land vegetative management activities be consistent with modern conservation and land use principles*, and* KEGS Section 13-3.j requires a protective vegetative cover or other standard soil erosion/sediment control practice be utilized to control dust onsite.

7.7.11.1 Activities That Contribute to Soil Erosion

Various activities on Kunsan AB contribute to soil erosion by exposing soils to the forces of water and wind. Erosion impacts can often extend beyond the immediate location of these activities to surrounding areas. (Figure 7.14). Activities that could contribute to soil erosion and non-point source pollution include:

- *Construction projects*. Construction projects can contribute to soil erosion both during and after construction. Grading, clearing, and other activities that disturb the surface of the soil, alter existing topography, and remove existing vegetation can increase erosion potential. As Kunsan AB continues to improve base facilities and infrastructure; it is essential to control runoff during project execution.
- *Increased paved area*. Increased paved surfaces without incorporating construction design control measures to stabilize slopes, re-establish cover on exposed soils, or avert runoff increases soil erosion.
- *Grounds maintenance activities*. Grounds maintenance activities contribute to soil erosion when appropriate consideration is not given to the protection of soil. Maintenance practices at Kunsan AB with the potential to contribute to erosion include:
    a. Cutting grass too short. The current grounds maintenance contract mandates the maintenance

of grass at 1.2 to 2.3 in. (3 to 6 cm). This virtually guarantees scalping, in which the groundskeeper cuts the grass to the soil surface, which then promotes soil erosion (Figure 7.14).

b. Cutting and eliminating vegetation. On sloped grounds, soils erode and destabilize the slope. This practice is prohibited by *KEGS 13-3.j*. The manicured lawns on the slopes of Gunsmoke Hill provide good examples of these practices.

c. Drainage system maintenance. Infrequent or inappropriate maintenance of drainage systems, vegetation, and potentially erodible areas can also contribute to erosion. The failure to repair damaged drainage structures or regularly remove growth, debris, and sediment from channels, traps, and basins can increase flooding and runoff.

Figure 7.14 Tree Root Exposure (left) and Lawn Scarring Caused by Scalping and Erosion.

7.7.11.2 Erosion Control Measures

Measures to protect steep slopes and erosion suggested by the U.S. EPA that may be implemented during a construction project or can be used to remediate already eroding sites are presented in Table 7.6 (EPA, 2003). Of immediate concern is the erosion of Kunsan ABs sandy soil due to a lack of vegetation cover. The following solutions are recommended:

- Maintain lawns in improved areas at 2 to 4 in. (5 to 10 cm)
- Maintain grass in semi-improved areas at 7 to 14 in. (18 to 36 cm)
- Where possible, allow semi-improved areas to revert to the natural understory so no mowing is required
- Evaluate shaded areas where grass does not do well and, where appropriate, replace the grass with a low, shade-tolerant ground cover, as has been done between Buildings 392 and 387.

Table 7.6 Protection Measures to Protect of Steep Slopes and Erosion Control Measures	
Method	**Comments**
Geotextiles	Geotextiles are porous fabrics, also known as filter fabrics, road rugs, construction fabrics, or simply fabrics. Some geotextiles are made of biodegradable materials such as mulch matting and netting. Matting and netting can be used separately or in combination to stabilize soils while the plants are growing; however, they do not retain moisture or temperature well. Geotextiles can aid in plant growth by holding seeds, fertilizers, and topsoil in place. Geotextiles can also be used as separators, such as between rip-rap and soil. This "sandwiching" prevents the soil from being eroded from beneath the rip-rap and maintains the rip-rap's base. Geotextiles can also be used alone to protect exposed soils, such as when active piles of soil are left overnight.
Soil retention	Soil-retention measures are used to hold soil in place or to keep it contained within a site boundary. Some soil-retaining measures are used for erosion control, while others are used for protection of workers during construction projects such as excavations. Reinforced soil-retaining structures should be used when sites have very steep slopes or loose, highly erodible soils that render other methods, such as chemical or vegetative stabilization or regrading, ineffective. To the extent possible, the preconstruction drainage pattern should be maintained.
Temporary slope drain	A temporary slope drain is a flexible conduit extending the length of a disturbed slope and serving as a temporary outlet for a drainage diversion. Properly installed temporary slope drains, also called pipe slope drains, convey runoff without causing erosion along a slope or at its base. Such structures are temporary measures to be used during grading operations until permanent drainage structures are installed and until slopes are permanently stabilized. They are typically used for less than 2 years. Temporary slope drains can be used on most disturbed slopes to eliminate gully erosion problems resulting from concentrated flows discharged at a diversion outlet.
Vegetation buffer	Vegetation buffers are areas of either natural or established vegetation that are maintained to protect the water quality of neighboring areas. Buffer zones reduce the velocity of storm water runoff, reducing soil erosion, providing an area for the runoff to permeate the soil and contribute to groundwater recharge, and acting as filters to catch sediment. Vegetated buffers can be used in any area that is able to support vegetation, but they are most effective and beneficial on floodplains, near wetlands, along stream banks, and on steep, unstable slopes. They are also effective in separating land-use areas that are not compatible and in protecting wetlands or water bodies by displacing activities that might be potential sources of non-point source pollution.
Chemical stabilizers	Chemical stabilizers, also known as soil binders or soil palliatives, provide temporary soil stabilization. Materials made of vinyl, asphalt, or rubber are sprayed onto the surface of exposed soil to hold the soil in place and protect against erosion from runoff and wind. Chemicals used for stabilization are easily applied to the surface of the soil, can be effective in stabilizing areas where stabilizing vegetation cannot be established, and provide immediate protection.
Mulching	Mulching is highly recommended as a temporary stabilization method in which materials such as grass, hay, wood chips, wood fibers, straw, or gravel are placed on exposed or recently planted soil surfaces. It is most effective when used in conjunction with vegetation establishment. In addition to stabilizing soils, mulching can reduce storm water runoff velocity. When used in combination with seeding or planting, mulching can aid plant growth by holding seeds, fertilizers, and topsoil in place, preventing birds from eating seeds, retaining moisture, and insulating plant roots against extreme temperatures. Mulch mats are woven mats of jute or other wood fibers that are more stable than loose mulch. Netting or binders may also be used to stabilize loose mulches.

Table 7.6 Protection Measures to Protect of Steep Slopes and Erosion Control Measures	
Method	**Comments**
Permanent seeding	Permanent seeding establishes perennial vegetative cover from seed. Vegetation controls erosion by protecting bare soil surfaces from displacement by raindrop impacts, reducing the velocity and quantity of overland water flow, and reducing exposure to wind. It decreases sediment yields from disturbed areas and provides permanent stabilization. This practice is economical, adaptable to different site conditions, and allows selection of the most appropriate plants. Permanent seeding is well suited to areas where permanent, long-lived vegetative cover is the most practical or most effective method of stabilizing the soil. Permanent seeding can be used on roughly graded areas that will not be regraded for at least a year. The advantages of seeding over other means of establishing plants include lower initial costs and labor inputs.
Sodding	Sodding is a permanent erosion-control practice that involves laying a continuous cover of grass sod on exposed soils. In addition to stabilizing soils, sodding can reduce the velocity of storm water runoff. Sodding can provide immediate vegetative cover for critical areas and stabilize areas that cannot be vegetated by seed. It also can stabilize channels or swales that convey concentrated flows and can reduce flow velocities. Sodding is appropriate for any graded or cleared area that might erode and requires immediate vegetative cover. Locations particularly well suited to sod stabilization are residential or commercial lawns and golf courses where prompt use and aesthetics are important, steeply sloped areas, waterways and channels carrying intermittent flows, and areas around drop inlets that require stabilization.
Soil roughening	Soil roughening is a temporary erosion-control practice that reduces runoff velocity, increases infiltration, reduces erosion, traps sediment, and prepares the soil for seeding and planting. Soil roughening involves increasing the relief of a bare soil surface with horizontal grooves, stair-stepping, tracking using construction equipment, or omitting fine grading. Roughening should be performed immediately after grading activities have ceased. Soil roughening is appropriate for all slopes. This technique is especially appropriate for soils that are frequently mowed or disturbed, because roughening is relatively easy to accomplish. Roughening can be used with both seeding and planting and temporary mulching. For steeper slopes and slopes that will be left roughened for longer periods of time, a combination of surface roughening and vegetation is appropriate.
Silt fences	Silt fences are used as temporary perimeter controls around sites where there will be soil disturbance due to construction activities. They consist of lengths of filter fabric stretched between anchoring posts spaced at regular intervals along the site perimeter. The filter fabric should be entrenched in the ground between the support posts. When installed correctly and inspected frequently, silt fences can be an effective barrier to sediment leaving the site in storm water runoff. Silt fences are generally applicable to construction sites with relatively small drainage areas. They are appropriate in areas where runoff will be occurring as a low-level shallow flow not exceeding 0.5 cfs (15 liters/sec). The drainage area for silt fences generally should not exceed 0.25 acre (1,000 m^2) per 100-foot (30-m) fence length. Slope length above the fence should not exceed 100 feet (30 m).

7.7.12 Erosion Control Management Goals

7.7.12.1 Non-point Source Pollution Control**.** Storm water runoff across sites disturbed by construction or overzealous grounds maintenance results in water pollution. In accordance with *KEGS 13-3.i*, land and vegetation management activities must be consistent with current conservation and land use principles. Ensure that a protective vegetation cover or other standard erosion/sediment control practice is employed to control dust, stabilize sites, and avoid silting (*KEGS 13-3.j*). Ensure soil containment requirements are included in construction contracts and reiterated, if appropriate, in preconstruction plans.

7.7.12.2 Construction Project Review. 8 CES has an EIAP which incorporates them in the project review process.

7.7.12.3 Grounds Maintenance Contract Revision. 411 CSB will incorporate revised procedures into the grounds maintenance contract. Specific procedures should address changes in vegetation removal and grass cutting height in the improved and semi-improved areas.

7.7.12.4 Oversight and Quality Assurance. The 8 CES/CEIE and CEOHH will develop a site monitoring system to identify areas that are either prone to or are eroding and contributing to non-point pollution and monitor those areas that have undergone remedial measures to prevent further soil erosion. Oversight will ensure correct trimming and pruning procedures are employed and provide recommendations for specialized landscaping techniques (ground cover vegetation, mulches) to be used in difficult to manage areas.

7.8 Forest Management

Applicability Statement

This section applies to AF installations that maintain forested land on AF property. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

An example of a young, self-sustaining forest system can be found in the North POL Area (Section 2.3.2.2). This stand represents an example of DoD and USAF policy goals for achieving native, self-sustaining forests on Kunsan AB. Simple, modern forestry practices performed in accordance with the requirements of USFK Reg 405-7 (6-6) can be used to remove senescent and damaged pine and locust trees to "release" the native oaks. Release of the oaks will initiate a self-sustaining forest of native species.

Section 2.3.2.2 describes the current composition and dominant plants in each of the base NRMUs. The NRMUs require stewardship and management in accordance with the 2012 KEGS Sections f, h, i and j, found in Table 9.1.

Pine Forest Management

A number of KEGS-listed species have been reported from pine forest stands at Kunsan AB (Section 2.3.4.1). In the North POL Area, NRMUs POL-1, POL-2, and POL-3 provide habitat for three designated Natural Monument species, the Chinese Sparrowhawk, the Northern Boobook, and the Oriental Scops Owl. The Eurasian Hobby has recently nested in the pine stand at Wolf Pack Park, while the Northern Boobook has been documented to successfully nest in the pine forest at NRMU BCH-3. The Fairy Pitta was reported for the first time at the base in 2016 in the pine forests associated with NRMUs BCH-1 and BCH-2, and the Oriental Scops Owl was reported for the first time at the base in 2017 in pine forests associated with NRMUs BCH-1 and BCH-3. Finally, the Amur leopard cat has been photographed at BCH-1 in 2019. KEGS 2012 directs installations to "… shall take reasonable steps to protect and enhance known endangered or threatened species and ROK designated Natural Monument species and their habitat."

Many forest-nesting birds, and especially cavity-nesting ones (such as the Northern Boobook) are especially dependent on the presence of trees of sufficient size to support cavity nesting by larger species, and on the presence of dead trees and snags for nesting, roosting, and foraging by other species. Management of the pine forests at the North POL ad Big Coyote Hill NRMUs must be congicent of these requirements and manage tree removal accordingly. Cavity-nesting bird densities and nesting success decline if snag densities are low or snags with appropriate characteristics are not available. Additional pine forest management recommendations are included in the protected species management recommendations presented for the Northern Boobook and Eurasian Hobby in Section 2.3.4.2.

Management prescriptions for managing pine forest habitats at Kunsan AB that may support forest-nesting species that rely on pine forest stands include the following actions:

- The pine stands should be disturbed as little as possible;
- The remnant plantations are undergoing natural regeneration. In these plantations, senescent and standing dead pine and locusts should be thinned (while incorporating the need to retain som dead trees and snags for cavity-nesting birds – see below) to release the native oaks and other natural understory components;
- Except for the invasive Tree of Heaven, the practice of removing naturally regenerating trees from the understory should be discontinued; and
- Where practical, consideration should be given to less active management of semi-improved areas in accordance with DoDI 4715.03 and AFMAN 32-7003. Where security, fire protection, and perceived aesthetics are not an issue, natural regeneration should be allowed to progress

Additional forest management prescriptions for supporting forest nesting (and especially cavity nesting) birds may include leaving dead or dying trees with the following characteristics:

- Have large diameters (≥ 10-inch diameters);
- Have existing woodpecker holes or cavities;
- Have areas of heart rot fungi, wounds or scars from fire, lightning, or mechanical damage;
- Dead areas on living trees;
- Have both sound and decayed wood;

When conducting forest management activities such as thinning, it is also important to retain some trees that are likely to be good snags in the future. These "snag recruitment" trees should be as large as possible, and may have sections of dead wood, scars, and features that predispose them to dying, such as sparse, declining crowns or broken tops. Thinning the forest in variable patterns including relatively open to dense patches of trees will encourage a steady recruitment of natural snag formation, while reducing the risk of wildfires.

Hill Community Management

The plant communities of Little Coyote Hill (NRMUs LCH 1, 2, 3, and 4) and of portions of Big Coyote Hill (NRMU BCH-2) are all associated with secondary successional stages ranging from bare rock outcrops to grassy old fields to shrub communities. If left undisturbed and where organic material can accumulate, these sites will support grasslands and naturally progress to a pine-shrub community. Where security, fire hazard, and perceived aesthetics are not an issue, natural regeneration should be allowed to progress.

Trimming, Transplanting, and Removing Trees Korean law forbids the cutting of trees composing the canopy stratum. However, USFK Reg 405-7, Section 6-6, provides specific guidance for military installations. The text of that guidance is provided below. Also, Section 7.7.8.6.a of this INRMP provides information for planting new vegetation, including trees, while Section 7.7.9.5 provides information for pruning trees.

USFK Reg. 405-7

Section 6-6 TRIMMING, TRANSPLANTING, AND REMOVAL OF TREES

a. Forestry management is a matter of vital concern to the ROKG and must be carefully considered in construction and installation improvement programs. Service components are authorized to take the following actions regarding routine tree trimming, transplanting, and removal. This regulation does not prohibit the service components from delegating this authority to the installation level.

(1) Routine trimming and transplanting of trees consistent with established forestry management practices.

(2) Minor tree removal programs in improved areas (e.g., administrative, billeting, and housing areas), provided such removal does not adversely impact the environmental or aesthetic quality of the area. Significant tree removal programs in such areas must be coordinated with the ROK military real estate authority.

b. Removal of trees in unimproved areas, such as training areas or ranges, requires the prior approval of FKEN. Accordingly, requests to remove trees in such areas will be forwarded to FKEN-RE/S for review, coordination, and approval. Requests must include justification for the removal and two copies of a location map (seven copies if a Greenbelt Zone) showing the tree locations. Reasonable effort will be made to transplant the trees. When approved, removal will be accomplished IAW any reasonable conditions requested by MND. Residual wood resulting from tree removal may be used or disposed of within the confines of the military compound at the discretion of the service component. The removal, however, of such residual wood from the confines of the military compound involved must be coordinated with the ROK military real estate authority. Diseased, decaying, or dead trees (or even healthy trees) that constitute a clear and present danger to life and property, may be removed from any area without prior coordination or approval. There is no restriction on the removal of bushes and shrubs (i.e., secondary growth not ordinarily classified as trees).

7.9 Wildland Fire Management

Applicability Statement

This section **IS NOT** applicable to this installation.

Program Overview/Current Management Practices

Kunsan Fire and Emergency services does not posture for wildland fire fighting. In the event of a wildland the sole capability would be defensive operations to prevent further spread to other areas of the installations. Any direct operations would require assistance from off base resources that have the appropriate equipment and training. The overall risk to life and property is extremely low and would not warrant the development of a Wildland Fire Management Plan.

7.10 Agricultural Outleasing

Applicability Statement

This section **IS NOT** applicable to this installation.

Program Overview/Current Management Practices

N/A

7.11 Integrated Pest Management Program

Applicability Statement

This section applies to AF installations that perform pest management activities in support of natural resources management, e.g. invasive species, forest pests, etc. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

Reference the installation Integrated Pest Management Plan, Section 15.0, Tab 3 of this plan.

The Pest shop (CEOIE) applies insecticides and pesticides, and nonmilitary base personnel perform fertilizer application. Fence lines, streets, and sidewalks are sprayed seasonally, and other areas of the base are only sprayed on request. No invasive pests or noxious weeds have been encountered other than common crack grass.

Recently Korea has been experiencing a peninsula wide pine tree disease called “Bursaphelenchus xylophilus” and commonly known as “pine wood nematode” or “pin wilt nematode (PWN)”. PWN is caused by worms. The disease is fatal once pine trees are hosted by PWN causing worms. PWN larvas typically incubate in dead pine trees and move to healthy trees during the spring season. Infected trees should be incinerated or chipped into pieces less than 0.75-inches (2-cm) in diameter to prevent further infection.

7.12 Bird/Wildlife Aircraft Strike Hazard (BASH)

Applicability Statement

FW Operations Plan 91-212 Bird Aircraft Strike Hazard (BASH) Plan Annex C

The 8 FW Operations Plan 91-212 BASH Plan is shown in Annex C

Program Overview/Current Management Practices

General Information

The BASH program focuses on reducting and preventing wildlife related aircraft mishaps through natural resources management on the airfield to reduce wildlife hazards to aircraft operations. At Kunsan AB, the main BASH hazard is birds either foraging along or flying across the runways. Native deer are found on Big and Little Coyote Hills, and cross portions of the runway between the two hills.

Avian surveys have been conducted at Kunsan AB since 1999, the objectives, methods, and results are presented in Section 2.3.3.5. One of the objectives of these surveys is to determine what species of birds are present on the airfield during the critical seasons of the year and identify their respective habitat requirements. This provides information identified as a program requirement and responsibility in Annex B.3.d and e, and Annex B.9.c of the 2015 8 FW BASH Plan 91-212.

More than 90 percent of all bird species are diurnal - active during the day. Peak bird activity typically occurs from before sunrise until about 1100 hours and in the late afternoon and early evening. Bird activity is lowest at midday. The majority of day-to-day movements occur between 30 and 300 ft (9-90 m) above ground level. Little regular bird activity occurs above 1,000 ft (305 m) although flocks of some species

have been documented as high as 20,000 to 30,000 ft (6 – 9 km) during migration. Some species regularly exhibit towering, which occurs as birds use rising columns of warm air to gain altitude to soar or glide. Such rising columns of warm air are regularly produced over areas such as runways and open grassy fields. Hawks, gulls, and crows are species that commonly tower on Kunsan AB. Rooks (a native crow) have been observed forming large flocks during winter months on warm air currents arising from the runway complex.

Avian Survey Results and BASH Risk Analysis

More than 150 bird species have been reported from Kunsan AB and its immediate shoreline areas (Section 2.3.3.5; Appendix B). Evaluations considering location, timing, and numbers were conducted of each species to determine their BASH risk. In addition, specific characteristics such as body size, habitat needs (e.g., nesting, feeding, overwintering, roosting), migration periods, and behaviour (e.g., flocking), were also considered for each species, as available (e.g., IUCN Red List, Moores et al., 2014, Clements et al., 2016).

A subjective scale ("high" to "low") was used to rank each bird species according to the potential hazard it poses to aircraft operations, shown below.

Birds with High BASH Risk Potential

Six species are characterized to pose a high BASH risk to aircraft operations; the Cattle Egret, the Rook, the Daurian Jackdaw, the Taiga/Tundra Bean Goose, Greater White-frontd Goose, and the Great Cormorant (Table 7.9). The first three are seasonal residents, the Cattle Egret in spring through autumn and the two corvids in winter. The Bean Goose had previously been considered to pose a potentially moderate BASH risk, but numbers of this bird in the vicinity of Kunsan AB have increased over the past few years, while large numbers of the Greater White-fronted Goose have recently been observed in the area. The Great Cormorant was also previously considered have a low BASH risk potential, but numbers have greatly increased over the past few years.

Table 7.9 Birds Posing a Potentially High BASH Risk at Kunsan AB.

Species	Size	Occurrence and Abundance at Kunsan AB	Nature of Hazard
Cattle Egret (*Bubulcus ibis coromandus*)	0.7 – 0.9 lbs (340 – 390 gm) 2.9 to 3.2 ft wingspan (88 – 96 cm)	Seasonal resident most abundant in late summer and autumn. Commonly forages in large flocks (20+ birds) in grassy areas next to the runway.	A moderately large bird present in large flocks on the airfield. Not readily disturbed by ground activities or aircraft operations; entire flock takes flight if startled.
Rook (*Corvus frugilegus*)	0.6 – 0.7 lbs (280 - 340 gm) 2.7 – 3.2 ft wingspan (81 – 99 cm)	Winter resident, forming huge flocks (100s to 1,000s of individuals) on and around Kunsan AB. Often roosts on base.	A moderately large bird that forms large flocks over airfield, flies daily between on-base areas to the surrounding country, from ground level up to 1,000 ft (300 m).

Table 7.9 Birds Posing a Potentially High BASH Risk at Kunsan AB.			
Species	**Size**	**Occurrence and Abundance at Kunsan AB**	**Nature of Hazard**
Daurian Jackdaw (*Corvus dauuricus*)	0.4 – 0.6 lbs (180 – 260 gm) 2.2 – 2.4 ft wingspan (67 - 74 cm)	Winter resident, often intermixed with Rook flocks.	Same as for the Rook.
Taiga/Tundra Bean Goose (*Anser fabilis/serrirostris*)	6.6 – 11 lbs (3 – 5 kg) 4.6 – 6.6 ft wingspan (140 - 200 cm)	Winters in vicinity, observed as flying over various areas of the base, including the southern end, along the western base boundary, over the CE Bulk Storage Area, and the northern end of the runway.	A very large bird feeding and resting in agricultural fields and grasslands around the base and which may visit grassy areas of the base.
Greater White-fronted Goose (*Anser albifrons*)	4.4 – 7.3 lbs (1.9 – 3.3 kg) 4.2 – 5.4 ft wingspan (130 0 165 cm)	Same as Taiga/Tundr Goose.	Same as Taiga/Tundr Goose.
Great Cormorant (*Phalacrocorax carbo*)	5.7 – 8.2 lbs (2.6 – 3.7 kg) 2.8 – 3.0 ft wingspan (85 – 91 cm)	Year-round and winter resident of nearby coastal areas, observed as flying over the southern end of the base and airfield.	A large bird that forages in waters of the Saemangeum Coastal Area and the Saemangeum Seawall area.

Cattle Egret. The Cattle Egret is a moderately large, long-legged, ground-feeding bird (Figure 7.15). This species first appears in the area in April, but it does not nest on base. From the nesting period until June, the numbers on base are generally low. Beginning in late summer, Cattle Egrets congregate in large flocks (30 to 90 individuals) which regularly visit the open grasslands of the airfield to feed. They are not disturbed by human activity and follow mowing equipment to feed on the disturbed insects and other prey (Figure 7.7). When flushed an entire flock may take flight with individuals flying off in separate directions. Because of its size, tendency to flock, and flushing behavior, this species poses a significant hazard to aircraft operations.

Figure 7.15 Cattle Egret (*Bubulcus ibis coromandus*)
Photo: S. Nygaard

Hazard Reduction: The species uses grassy areas to forage for food. Insecticides may be used to decrease insect prey populations, reducing the suitability of the area as a foraging habitat. The applied insecticides should not pose a toxic risk to Cattle Egret or other bird species. In addition, pyrotechnics, gas cannons, and other dispersal techniques (8 FW OPLAN 91-212) may be employed to harass and flush the flocks from the airfield. However, because the birds often flush in a random manner and fly erratically in multiple directions, care should be taken to flush birds well in advance of aircraft operations.

Rook and the Daurian Jackdaw. The Rook and Daurian Jackdaw are only present in the winter. Both of these large crow species begin congregating in large flocks in November and remain into February. The Daurian Jackdaw is less abundant than the Rook, it poses a BASH hazard due to its intermixing with Rook flocks. The following discussion focuses on the Rook but is applicable to the Daurian Jackdaw well.

On base, huge flocks of Rooks numbering thousands are common, filling trees, power lines, antennae, and guy wires (Figure 7.16). In the late morning, they form large flocks throughout Kunsan AB. The Rooks roost all over the base, notably in the pines in and around the CE Bulk Storage Area, building 535 and the Clinic. They forage for food in the agricultural fields between the seawall and the commercial airport taxiway. In late afternoon, they forage in rice paddies and coastal mud flats and return to the base in the evening to roost. If allowed, they will land and rest on the runway, taxiways, and infield.

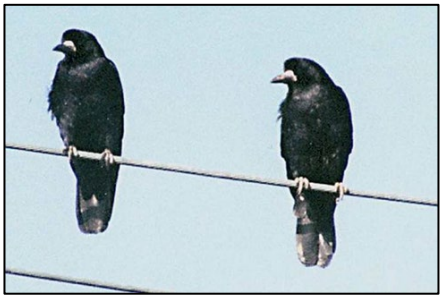

Figure 7.16 Rook (*Corvus frugilegus*)
Photo: J. Levenson, Argonne National Laboratory

The BASH hazard comes from both individuals and flocks flying from their off-base feeding areas across the airfield to their roosting areas. The birds present a FOD risk when they drop debris onto hard surfaces of the airfield.

Hazard Reduction. To discourage the use of the airfield, especially the runway and taxiways, vehicles equipped with sirens/horns, gas cannons, and pyrotechnics are used to frighten birds (8 FW OPLAN 91-212). Aircraft should avoid flying over or near known roosting areas, especially at sunrise and sunset.

Taiga/Tundra Bean Goose and Greater White-fronted Goose. These species occur as birds overwintering in the area. These three species have recently been observed flying over portions of the base in large numbers, in flocks ranging from only a few birds to some totalling 100 or birds. At times thse flocks included all three species. In January 2020, over 650 individuals were observed over the four days of surveys, with one flock totalling 120 birds. The large increase in overwintiering birds observed in 2019 and 2020 may be due to the increasing amount of reclaimed grassland that is developing because of the Saemangeum Seawall Project. Due to their very large size (Table 7.9) and recent increase in numbers, these three species pose a high BASH risk in winter months. Flocks of these geese were seen flying over the southern and northern ends of the runway, across the CE Area, and along the western boundary of the base. While none have been observed resting on any areas of the base, grassy areas of the airfield may provide feeding and resting areas for these geese. The greatest risk may be associated with aircraft taking off or landing at the base nd encountering flocks flying across their flight paths.

Hazard Reduction. Should birds be observed on the site, vehicles equipped with sirens/horns, and pyrotechnics can be used to frighten and disperse birds from the area. Because of the status of the Taiga/Tundra Bean Goose as an ROK-designated endangered species (KEGS 2012), depredation is not an option for reducing their BASH risk potential.

Great Cormorant. This species was not previously identified as posing more than alow BASH risk. However, since 2018, numbers have been increasing of birds flying over parts of the base and along the coast off of the southern end of the base. Over 3,500 individuals were observed during each of the June and October surveys, and over 1,000 birds during the January 2020 survey. In October 2019, a single flock consisting of over 500 birds flew above the shoreline south past Big Coyote Hill. In addition, several new dikes have appeared beneath the southern approach to the runway (Figure 7.17), and these have attracted thousands of wading birds and waterfowl, including hundreds of Great Cormorant. Due to these greatly increased numbrs in the area and its very large size (Table 7.9) the Great Cormorant poses a high BASH risk throughout the year. Whle no on-base habitat occurs for this species, the greatest risk may be associated with aircraft landing at the base from the south and encountering flocks flying across their flight paths.

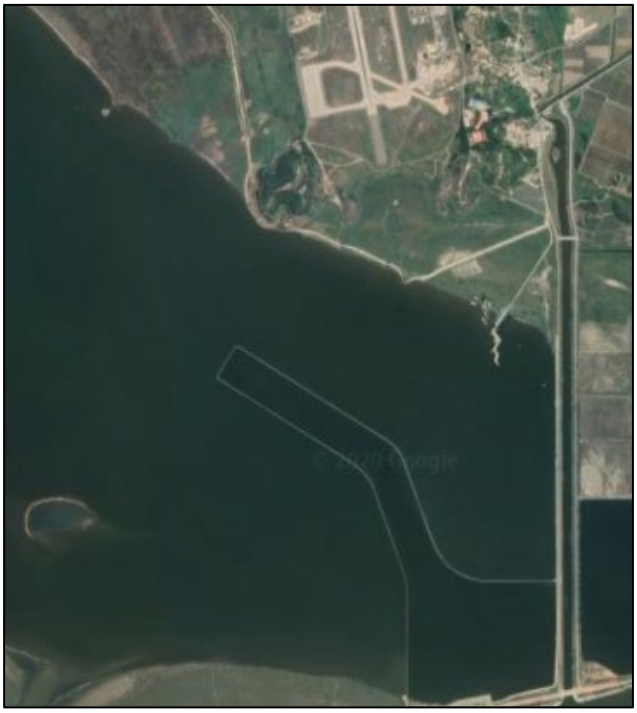

Figure 7.17 New Dikes Below the Southern End of Kunsan AB.

Hazard Reduction. While sirens/horns and pyrotechnics can be used to frighten and disperse birds that are present on the base, but no on-site habitat for the Great Cormorant occurs on Kunsan AB. The biggest BASH risk comes from birds flying along the southern coast and to and from the offshore dikes, which are outside of the base boundary.

Birds with Moderate BASH Risk Potential

Nine species are considered to pose a moderate BASH risk at Kunsan AB: Ring-necked Pheasant, Grey Heron, the Great, Intermediate, and Little Egrets, Black-tailed Gull, Eurasian Kestrel, and Eurasian Magpie (Table 7.10). These species are among the most frequently and widely observed species at the base (Tables 2.7 and 2.8; Appendix B.2).

Table 7.10 Birds Posing a Potentially Moderate BASH Risk at Kunsan AB.

Species	Size	Occurrence and Abundance at Kunsan AB	Nature of Hazard
Ring-necked Pheasant (*Phasianus cholchicus*)	2.2 – 4.6 lbs (1 – 2.1 kg) 2.3 – 2.9 ft wingspan (70 - 90 cm)	Year-round resident, regularly heard in multiple areas of the base, and especially in grasslands outside of the western base boundary.	A moderate sized bird. While primarily ground dwelling, when startled bursts vertically into the air and flies a short distance before landing.

Table 7.10 Birds Posing a Potentially Moderate BASH Risk at Kunsan AB.			
Species	**Size**	**Occurrence and Abundance at Kunsan AB**	**Nature of Hazard**
Gray Heron (*Ardea cinerea*)	2.2 – 4.4 lbs (1 – 2 kg) 5.1 – 5.7 ft wingspan (155 - 175 cm)	Year-round resident, occurring along adjacent shorelines, wetlands, rice fields, drainage ditches, and grassy wet areas along the runway. Often observed in rice fields adjacent to the northern end of runway.	A very large, slow-flying bird; often observed flying over the airfield. Not readily disturbed by ground-based activities or aircraft operations.
Great Egret (*Ardea alba*)	1.5 – 3.3 lbs (700 – 1,500 g) 4.6 – 5.6 ft wingspan (140 - 170 cm)	Same as for the Grey Heron.	Same as for Grey Heron.
Intermediate Egret (*Mesophoyx intermedia*)	0.8 – 1.1 lbs (400 - 500 g) 3.4 – 3.8 ft wingspan (105 - 115 cm)	Spring through fall resident, occurring singly or in small numbers along adjacent shorelines, wetlands, rice fields, drainage ditches, and grassy wet areas including areas along the runway.	A moderately large, slow-flying bird; often observed flying over the airfield. Not readily disturbed by ground based activities or aircraft operations.
Little Egret (*Egretta garzetta*)	0.6 – 1.4 lbs (280 - 638 g) 2.9 – 3.5 ft wingspan (88 - 106 cm)	Common year-round resident, occurring singly or in small numbers along adjacent shorelines, wetlands, rice fields, drainage ditches, and grassy wet areas including areas along the runway.	Same as for Intermediate Egret.
Black-tailed Gull (*Larus crassirostris*)	1 – 1.4 lbs (460 - 640 g) 4.1 – 4.2 ft wingspan (126 - 128 cm)	Year-round resident along coastal and open water areas adjacent to base; most abundant spring through autumn.	A large bird; in warm seasons may be present in large flocks along the coast below the runway approach.
Eurasian Kestrel (*Falco tinnunculus*)	0.3 – 0.4 lbs (150 - 185 g) 1.9 – 2.6 ft wingspan (57 - 79 cm)	Year-round resident, likely nesting at Big and Little Coyote Hills. Regularly observed perching on the perimeter fence along the western and southern base boundaries.	A moderate sized bird, regularly hovering over grassy areas of the airfield while hunting.
Oriental Magpie (*Pica serica*)	0.4 – 0.6 lbs (182 – 272 gm) 1.7 – 2.0 ft wingspan (52 – 60 cm)	Common year-round resident, nesting on site. Routinely seen along runway, perching on the perimeter fence and feeding in grassy areas.	Moderate sized, relatively slow flying bird. Not readily disturbed by ground based activities or aircraft operations.

Ring-necked Pheasant. The Ring-necked Pheasant is a year-round resident (Figure 7.18) and is among the 10 most often observed and recorded birds at Kunsan AB (Tables 2.7 and 2.8). With the completion of the Saemangeum seawall, the new grassland and shrub habitats are suitable for this bird. During the

2014-2020 surveys, more individuals were observed or heard just beyond the airfield western perimeter fence than from any other location at the base with the excep[tion of Big Coyote Hill (Appendix B.4).

The Ring-necked Pheasant runs swiftly to cover when disturbed; however, when flushed, it explodes from the undergrowth nearly vertically into the air reaching speeds of nearly 40 miles per hour, flies low for a short distance (typically no more than 600 ft [182 m]) before disappearing back into the undergrowth. This species has been observed running or flying low across runways and taxiways, as well as walking out and standing on the runway during flying operations (8 FW OPLAN 92 212). Because of its large size and weight (Table 7.9) and explosive vertical flight when flushed, this species is considered to pose a moderate BASH risk, especially during takeoffs and landings.

Figure 7.18 Ring-necked Pheasant (*Phasianus cholchicus*)
Photo: Public domain

Hazard Reduction. Maintaining the grass height at less than 14 in (35 cm) and eliminating all brush and weed patches from the airfield are the best means of discouraging the Ring-necked Pheasant, as it is hesitant to venture into open areas without protective cover. Implementing a mowing cycle that limits plants from producing fruits and seeds would further reduce the attraction of the open areas for foraging. Without cover and seed, pheasants will be less likely to regularly use the airfield. The use of pyrotechnics, gas cannons, or other dispersal techniques would be useful to harass birds that may be in areas along the runway and discourage their entry onto the runway during aircraft operation.

Grey Heron, Great Egret, Intermediate Egret, and Little Egret. These four species are similar, large, wading birds (Figure 7.19) that forage along shorelines, wetlands, rice fields, drainage ditches and grassy areas throughout the Kunsan area, feeding on invertebrates, fish, amphibians, reptiles, and small mammals. The Grey Heron and the Great Egret are the largest birds found on Kunsan AB, and with the Little Egret occur year-round (Appendix B). The Intermediate Egret is a seasonal resident, present from spring through autumn. None of the species nest on the base.

Figure 7.19 From left to right: Grey Heron (*Ardea cinerea*), Great Egret (*A. alba*), Intermediate Egret (*Mesophoyx intermedia*), and Little Egret (*Egretta garzetta*).
Photos: J. Levenson, Argonne National Laboratory

None of these species flock, although individuals may congregate during foraging in areas food is abundant. There are usually only a few individuals of any of these species near the airfield at any time. Water in airfield drainage ditches or low grassy areas attracts the birds, and especially the Little Egret. None of these species panic or are otherwise affected by aircraft operations. When approached, they typically "freeze" in an attempt to blend into their background, and if flushed they slowly fly away from the perceived danger.

Hazard Reduction. Control for all four species may be accomplished by reducing food sources along the runway and taxiways and in drainage ditches along the airfield. This can be facilitated through the elimination of the water in grassy areas and periodic maintenance of the drainage ditches to remove vegetation, in accordance with the BASH Plan Annex C.3.a (8 FW 92-212). Bird dispersal techniques such as gas cannons and sirens may be employed when birds are present prior to planned aircraft operations.

Black-tailed Gull. The Black-tailed Gull (Figure 7.20) is found near coastal and open water habitats; prior to the completion of the Saemangeum seawall, this species was regularly seen along the coast adjacent to the western perimeter of the base. Now the Black-tailed Gull is most often seen flying or resting along the coast or feeding in offshore areas adjacent to Big Coyote Hill and beneath the approach to the main runway.

Black-tailed Gull is a year-round resident, most abundant in summer and autumn. This species primarily occurs along coastlines and offshore and may on occasion use open areas of the airfield to rest.

Figure 7.20 Black-tailed Gull (*Larus crassirostris*)
Photo: J. Levenson, Argonne National Laboratory

Hazard Reduction. If present on the base, harassment using pyrotechnics, gas cannons, and other dispersal techniques, as recommended in BASH Plan Annex C.3.b (8 FW OPLAN 92-212). However, no on-base habitat exists for this species.

Eurasian Kestrel. The Eurasian Kestrel (Figure 7.21) is the most common raptor on Kunsan AB, regularly seen flying and hovering over the airfield as well as perching on the perimeter fence along the western and southern boundaries of the base. The Eurasian Kestrel is present year-round at the base, and nests at the Big and Little Coyote Hills. The Eurasian Kestrel may pose a moderate hazard to flying operations because of its regular occurrence over the airfield. Dead Eurasian Kestrels from airstrikes have been found on occasion along the runway at Kunsan AB (Personal communication with MSgt. N. Thomas, 8 FW/SE Flight Safety NCO, August 25, 2016).

Hazard Reduction. Due to its regular presence over the airfield, the Eurasian Kestrel presents a hazard to flying operations. Most times, the falcon will see and avoid oncoming aircraft. They use the grassy areas of the airfield for foraging and may be discouraged through habitat modification to reduce food availability, and harassment techniques (Annex C.3.b.1; 8 FW OPLAN 92-212) may harass hovering birds away from the airfield during flight operations. Because this species is a ROK designated Natural Monument (KEGS 2012), depredation is not an option for controlling their occurrence on the airfield. Similarly, insect and rodent control through the use of pesticides is not advised.

Figure 7.21 Eurasian Kestrel (*Falco tinnunculus*)
Photo: J. Levenson, Argonne National Laboratory

Oriental Magpie. The Oriental Magpie (Fig. 7.22) is probably the most conspicuous bird on Kunsan AB, where it is a year-round resident. This species nests in all of the wooded areas, on utility poles, communication towers, and water towers, on which it builds large stick nests. It is regularly observed foraging for food in grassy areas of the airfield, perching on the perimeter fence along the airfield boundary,

and flying across the runways and taxiways. The Oriental Magpie is well acclimated to aircraft operations and accustomed to human activity and disturbance.

Hazard Reduction. The use of pyrotechnics, gas cannons, and other dispersal techniques (Annex C.3.b.1; 8 FW OPLAN 92-212) may harass feeding or resting birds from grassy areas of the airfield, although this species is accustomed to human activities. Depredation (Annex C.3.b.1) may be appropriate, as the Oriental Magpie is not a protected species (per designation in KEGS 2012).

Figure 7.22 Oriental Magpie (*Pica serica*)
Photo: J. Levenson, Argonne National Laboratory

Birds with a Low BASH Risk Potential

Of the 155 species (92%) of birds reported from Kunsan AB, 142 (92%) were determined to have only slight or low BASH risk potential. This determination is based on the preferred habitats of many species, their presence in low numbers, and/or their seasonal or transient occurrence on the base.

7.13 Coastal Zone and Marine Resources Management

Applicability Statement

This section applies to AF installations that are located along coasts and/or within coastal management zones. This section **IS NOT** applicable to this installation.

Program Overview/Current Management Practices

7.14 Cultural Resources Protection

Applicability Statement

This section applies to AF installations that have cultural resources that may be impacted by natural resource management activities. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

A base-wide archaeological survey was completed for Kunsan AB. Seven traditional gravesites were identified; these are fenced and maintained. It is unlikely further gravesites will be discovered within the current fenceline. No ROK designated cultural properties have been identified. There are potentially some Cold War-era structures that may be determined to be significant in the future. There are currently no natural resources activities that should affect cultural resources on the installation.

7.15 Public Outreach

Applicability Statement

This section applies to AF installations that perform community outreach activities in support of natural resource programs. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

AF personnel arriving on base are required to attend a Newcomer's briefing. 8 CES/CEIE staff provide awareness training on Kunsan AB protected species, restrictions regarding capturing or transporting them, and the need to report newly identified protected species.

A Management of Special Species at Kunsan Air Base guidebook was developed in 2001. The guidebook identifies species with photographs and describes protected species and high and moderate BASH risks at Kunsan AB. It provides some airfield management recommendations, identifies nesting and roosting areas for birds presenting a BASH risk, and identifies animal species that attract birds to the airfield. An update to this guidebook is planned for 2021.

7.16 Geographic Information Systems (GIS)

Applicability Statement

This section applies to all AF installations that maintain geospatial information within a GeoBase system. The section **IS** applicable to this installation.

Program Overview/Current Management Practices

The geospatial data acquisition and management standard used for Kunsan AB natural resources management is the Spatial Data Standards for Facilities, Infrastructure and Environment (SDSFIE) 3.1 Air Force adaptation. SDSFIE uses Data Layer Specifications (DLS) to define geospatial data specifications and methods for data layers implemented under the United States Air Force Civil Engineer Center (AFCEC) Environmental GIS Program.

The DLS contain the Coordinate System, Positional Accuracy and Attribute requirements for each GIS data layer in Natural Resources. Possible sources for the data layer are: planimetric data extracted from stereo or ortho-imagery, differential GPS survey, conventional surveys using a survey grade GPS, computer aided design (CAD), imagery, hardcopy documents, attribute or tabular data. For positional accuracy, data developed within this layer should be within 3 to 6 meters of the actual location at the 95% confidence level. Accuracy reported at the 95% confidence level means that 95% of the positions in the dataset would have an error with respect to true ground position that is equal to or smaller than the stated accuracy threshold value. The coordinate system uses bounding coordinates to capture the north, south, east, and west most spatial extents based on the Universal Transverse Mercator (UTM) Zone, meters. Datasets within the database should have a spatial reference with a precision of 1000. The horizontal datum utilized for all data is the World Geodetic System 1984 (WGS84), the vertical datum is the Mean Sea Level (MSL, Height), and the projection is the Universal Transverse Mercator (UTM) zone for the installation.

7.17 Climate Vulnerability

The climate change summary report for the Kunsan AB (Colorado State University 2019) presents the modeled vulnerabilities of natural resources to future climate change. This assessment characterized vulnerabilities of vegetation communities to future climate change, including grassland systems that dominate the site and smaller forested areas that are of ecological importance. Based on the modeled vulnerabilities, the majority of fish and wildlife communities at Kunsan AB are not expected to experience significant changes due to climate change. A substantial portion of Kunsan AB is developed, and the majority of wildlife species on post are widespread generalists.

However, changing climate has the potential to affect some rare species and species with specialized habitat requirements. The Seoul frog and the boreal digging frog are both considered to be highly susceptible to climate change-induced changes to their aquatic and seasonal wetland habitats. Due to their limited distribution, reliance on wet ecosystems, and endangered status, continued management plans for these species on Kunsan AB should be considered of high importance. Several rare bird species known to nest at Kunsan AB including the Northern Boobook, the Eurasian kestrel, and the Eurasian Hobby, and these may be moderately susceptible to climate change because all known and probable impacts are indirect, with climate change impacting habitat, prey populations, or phenology.

8.0 MANAGEMENT GOALS AND OBJECTIVES

The installation establishes long term, expansive goals and supporting objectives to manage and protect natural resources while supporting the military mission. Goals express a vision for a desired condition for the installation's natural resources and are the primary focal points for INRMP implementation. Objectives indicate a management initiative or strategy for specific long or medium range outcomes and are supported by projects. Projects are specific actions that can be accomplished within a single year. Also, in cases where off-installation land uses may jeopardize AF missions, this section may list specific goals and objectives aimed at eliminating, reducing or mitigating the effects of encroachment on military missions. These natural resources management goals for the future have been formulated by the preparers of the INRMP from an assessment of the natural resources, current condition of those resources, mission requirements, and management issues previously identified. Below are the integrated goals for the entire natural resources program.

The installation goals and objectives are displayed in the 'Installation Supplement' section below in a format that facilitates an integrated approach to natural resource management. By using this approach, measurable objectives can be used to assess the attainment of goals. Individual work tasks support INRMP objectives. The projects are key elements of the annual work plans and are programmed into the conservation budget, as applicable.

Installation Supplement – Management Goals and Objectives

The basic habitat delineation and most of the biotic surveys are complete. This revised INRMP presents the next phase of actions that focus on (1) ecosystem management, (2) biodiversity conservation, (3) ecosystem monitoring, and (4) community outreach and public information.

The USAF established five principles for ecosystem management in AFMAN 32-7003. Accordingly, installations should:

1. Maintain or restore native ecosystem types across their natural range where practical and consistent with the military mission
2. Maintain or restore ecological processes such as fire and other disturbance regimes where practical and consistent with the military mission.
3. Maintain or restore hydrological processes in streams, floodplains, and wetlands when feasible.
4. Use regional approaches to implement ecosystem management on an installation in collaboration with other DoD components as well as other host nation and local agencies and adjoining property owners.
5. Provide for outdoor recreation, agricultural production, harvesting of forest products, and other practical utilization of the land and its resources, provided that such use does not inflict long-term

ecosystem damage or negatively impact the mission.

Kunsan AB should implement the following straightforward course of action to achieve these principles: continue periodic biodiversity surveys, manage protected species (and their habitats), support on-going INRMP revisions, and support on-going training for the natural resource manager(s).

This INRMP focuses on identifying habitats (vegetation types/cover types). Habitats are recognized as useful surrogates for the unstudied/unknown species (Southerland, 1997). By protecting and managing habitats, one also protects and manages the constituent species.

The following pages lay out a series of actions that will ensure Kunsan AB is in full compliance.

Action 1: Habitat Delineation (Section 2.3) Habitat delineation at Kunsan AB was completed in May 1998 and provides the basis for natural resources management and baseline information for the EIAP. It satisfies the requirements of *Korea Environmental Governing Standards* (*KEGS*) *13-3.h-j*. Base management and maintenance recommendations are provided in Section 7. During the habitat delineation and on-going biotic surveys, 24 ROK-protected species, as identified in Section 2.3.4, and Table 2.15, have been reported from Kunsan AB. Comprehensive plant surveys are recommended in order to revisit the on-base habitats and revise the delineations as appropriate.

In accordance with *KEGS 12-3.i* and *13-3.d*, installation Commanders must report the discovery of any endangered, threatened or ROK designated Natural Monument species to the EEA. Kunsan AB must take reasonable steps to protect and enhance known endangered, threatened, or ROK designated Natural Monument species and their habitats.

Action 3 - Revised: Biotic Survey

Biodiversity surveys (KEGS 2012 Criteria 12-3.e.1 and 13-3.e.1) should be continued to determine the presence or absence of indigenous species and also identify any threatened, endangered, or ROK protected species on base. Seasonal surveys are required to account for migrant/transient/ephemeral individuals (especially amphibians, bats, and spring flora).

With the exception of the avian survey, no biotic surveys conducted prior to 2017 were “targeted” to determine the presence of specific taxa (i.e., KEGS-listed species). Surveys targeting specific amphibian and avian species were begun in 2017. These continued in 2019 and 2020, when wildlife cameras were installed to target the Amur leopard cat. Based on the current knowledge of the biota of Kunsan AB, the following surveys are warranted:

1. Monitoring surveys for the Seoul frog and the boreal digging frog at known locations of these species (Section 2.3.4.1). These may be conducted concurrently with any vegetation or avian surveys being conducted at the base during breeding periods of the frogs
2. Continued surveys for the KEGS-listed bird species, including the Northern Boobook, Oriental Scops Owl, Chinese Sparrowhawk, and other listed species. These can be integrated with scheduled avian or other surveys.
3. Continue surveys for the Amur leopard cat.
4. A targeted survey for KEGS-listed invertebrates (to be initiated in late 2020).

Action 5 - Revised: Natural Resource Management Planning

The information in this plan provides the Constraints and Opportunities component of the Kunsan AB

Installation Development Plan (IDP). To be in compliance with the KEGS and several AFIs, the following planning activities must be developed and implemented:

a. INRMP Annual Updates (AFI 32-7003 (Section 3.8): Annual review is required to certify this INRMP is valid and current. Annual review and certification may be delegated to not lower than the 8 CES/CC.
b. INRMP 5-year Revision (AFMAN 32-7003 (Section 3.7): The 5-year revision requires approval of the 8 FW/CC. The 8 FW/CC may re-delegate signature authority to a lower level provided that the signatory has control over all aspects and management objectives addressed within the INRMP.

Action 6 - On-going: Natural Resources Training

Kunsan AB has significant natural resources and has a need for trained personnel. Per *KEGS Criteria 13-3.g*, the designated Natural Resources Manager must be trained in the management of natural resources.

Natural resources management training is critical from two aspects: the manager must be trained to execute day-to-day decision making and the manager must develop newcomer orientations, brochures, and educational materials for installation personnel. The specific tasks are as follows:

a. Designate a Natural Resource Manager as required (*KEGS Criteria 13-3.g*).
b. Establish training requirements for the Natural Resources manager; ensure funds are available.
c. If training cannot be fulfilled, establish a network of "outside experts" (university staff, contractors) to support the natural resources management function.
d. Ensure compliance with ROK requirements by evaluating and improving environmental awareness programs. Provide personnel who are sponsoring new personnel with the prohibitions regarding importation of exotic species and the collection of protected species.
e. Promulgate awareness and sensitivity to natural resources, particularly protected species, by providing an education program for Kunsan AB personnel.

Action 9 - On-going: Update Management of Special Species Guidebook

Kunsan AB has a Management of Special Species at Kunsan AB guidebook (2001). Specific tasks are as follows:

a. Update the guidebook with the most recent information (initiated in late 2020). Additional topics might be added to include exotic or invasive species, cultural resource information, or regulatory requirements.
b. Distribute the guidebooks to appropriate installation personnel - especially those who can assist in on-going monitoring activities.
c. Distribute the updated Management of Special Species at Kunsan Air Base guidebook to the ROK leadership in charge of perimeter defense support on Big and Little Coyote Hills (see Action 10).

Action 10 - On-going: Outreach Communication with ROK Personnel

ROK forces provide perimeter defensive support on Little and Big Coyote Hills. These forces maintain gun emplacements and train in trenches cut into the hillsides. The development of outreach documents for these forces and routine communication with them regarding natural resources protection may improve stewardship of the resources. The specific tasks involved are as follows:

a. Schedule a meeting with ROK leadership to review the INRMP and discuss the role Kunsan AB has in the protection of Kunsan's natural resources and indigenous species.

b. Propose and discuss mitigation strategies to better protect the natural resources of Big and Little Coyote Hills.
c. Coordinate access to Big Coyote Hill such that biotic surveys can be accomplished.
d. Distribute the Management of Special Species at Kunsan Air Base guidebook (2001) to the ROK leadership (see Task c for Action 9).

Action 11 - Revised: Post Signs at Protected Species Locations

Informational signs are posted at many of the cultural resource sites around the base; however, none are posted where protected species reside. Five KEGS-listed protected species are known to reside and nest/breed on Kunsan AB. This project would post signs in areas with populations or nest sites are known to occur. The signs should include pictures and information on each, when they might be encountered, and what action should be taken to protect the habitat or site. Additional signages were installed on Big Coyote Hill targeting recreational hunters and providing information about the Amur leopard cat.

Action 12: Ecosystem Monitoring

The habitats delineated in the Kunsan AB INRMP represent the various ecosystems found on Kunsan AB. Monitoring the success of thoee ecosystems to become self-sustaining through periodic (annual) assessment is the primary objective of this task. Examples of ecological monitoring studies appropriate for Kunsan AB include the monitoring of (1) inappropriate management practices (e.g., tree cutting), (2) plant diseases and infestations (e.g., pine bark beetle), (3) invasion of exotic species (e.g., American bullfrogs, feral cats), (4) changes in breeding habitats for indigenous species, and (5) changes (presence/absence) in protected species and the quality of their associated habitats. Historical monitoring results can be found in Sections 2.3.3 and Appendix B.

Action 13: Urban Forest Management

The objective of this is to document the species composition of urban forest tracts. When the density and size-class distributions of the separate forested tracts are known, better management strategies can be developed. Strategies include reducing potential fuel loads (preventing fires), documenting exotic and invasive species and developing eradication strategies, and identifying natural communities of indigenous species and fostering their development. Potential specific tasks which could be implemented are as follows:

a. Identify natural communities of indigenous species and develop management prescriptions to foster their development.
b. Identify and flag diseased and malformed individuals for removal. Also identify and flag exotic, invasive species for removal.
c. Develop a management plan to reduce potential fire fuel loads.
d. Recommend appropriate indigenous species for reintroduction or restocking, depending on mission requirements.

9.0 INRMP IMPLEMENTATION, UPDATE, AND REVISION PROCESS

9.1 Natural Resources Management Staffing and Implementation

The INRMP is an integrated plan based on ecosystem management that shows the interrelationships of individual components of natural resources management to mission requirements and other land use activities affecting an installation's natural resources (Southerland, 1997). The approach requires complete inventories of habitats and sensitive species; and characterization of the natural processes connecting

Kunsan AB's lands to the regional ecosystems. The following discussion tracks the completion of action items set forth in the 1997, 2003, 2008, 2013, and 2016 INRMPs.

Habitat Delineation. Habitat delineation was described as Action 1 in the Kunsan AB 1997 INRMP, per the 1997 *KEGS Criteria 13-3.b*. All terrestrial and aquatic habitats on Kunsan AB have been identified, characterized by vegetation type, and delineated. Updated descriptions are found in Section 2.3.2.2.

Habitat Management Prescription Plan. Action 1 of the 1997 INRMP called for the development and implementation of management objectives and strategies to protect and enhance indigenous species and their habitats in accordance with the 1997 *KEGS Criteria 13-3.a* and *13-3.h*. Updated ecosystem management strategies are found in Section 7.8.

Avian Survey. Action 2 of the 1997 INRMP required avian surveys per the 8 FW BASH Plan and 1997 *KEGS Criteria 13-3.e* and *h*. Seasonal avian surveys were conducted from 1999-2002, 2010-2012, and 2014-2016. Additional surveys were conducted from 2017-2020, concurrent with the targeted species surveys conducted in those years. Under Action 12 of the 2003 INRMP, quarterly avian surveys were conducted from 2003-2006. The results of all the avian surveys conducted at the base are in Section 2.3.3.5.

Biotic Survey/Inventory. Action 3 of the 1997 INRMP required a complete inventory of natural resources, including vegetation and wildlife, in accordance with the 1997 *KEGS Criteria 13-3.e*. Each habitat type has been surveyed for plants and animals. The results of the surveys are in Section 2.3.3.

Threatened and Endangered Species Survey. Action 4 called for a protected species survey in accordance with *KEGS Criteria 13-3.d* and *e*. This was not feasible from a budgeting perspective so a variety of surveys (habitat delineation, avian, and "targeted" vertebrate) were completed to document the presence of common and protected species. Targeted surveys for selected amphibian and avian species were conducted in 2017, 2018, and 2019. A targeted survey for the leopard cat, using wildlife cameras, was initiated in 2019. The protected species reported from Kunsan AB are in Section 2.3.4.

Natural Resource Management Planning. Action 5 of the INRMP (1997) listed a series of supporting, or component, plans required under several 1997 *KEGS Criteria* (*13-3.b, e, f, h, i*, and *j*). Such plans can be found in Section 7.0.

Natural Resources Training. Action 6 of the 1997 INRMP identified the need for on-going training for the Natural Resources Manager in accordance with KEGS Criteria 13-3.g. The training is provided to the base populace through sponsor packets and Newcomers Briefings.

Tacit Agricultural Agreement. Action 7 of the 1997 INRMP identified the need for a "Tacit Farm Agreement" with local residents. This responsibility is being handled under the Land Partnership Plan discussed in Section 2.4.3. No additional effort is required under this INRMP.

Coastal and Marine Resources Plan. Action 8 originally identified the need for a Coastal and Marine Resources Plan per AFMAN 32-7003, Section 3E. With the completion of the seawall, the need no longer exists.

Update Management of Special Species Guidebook. Action 9 of the 2003 INRMP originally was to revise the subject document. Most of the objectives were met with the revision of the Avian Field Guide and Checklist for Kunsan Air Base Korea (2005). A completed update of the guidebook is planned for 2021.

Outreach Communication with ROK Personnel. Action 10 of the 2003 INRMP was proposed to sensitize the ROK forces to the natural resources on Kunsan AB. The objective was to develop educational

documents regarding natural resources protection leading to improved stewardship of the resources.

Post Signs at Protected Species Locations. Action 11 of the 2003 INRMP was proposed to provide information regarding ROK protected species to base personnel. The purpose was two-fold: first, to educate personnel regarding the species and, second, to warn personnel not to disturb protected species.

Ecosystem Monitoring - Avian Populations. Action 12 of the 2003 INRMP calls to document the avifauna present on Kunsan AB, especially how they affect flying operations. The results of the avian surveys are in Section 2.3.3.5.

Urban Forest Management. Action 13 of the 2003 INRMP was proposed to quantitatively document the species composition and size-class distributions of the urban forest tracts in the North POL area and where applicable on Big Coyote and Little Coyote Hills.

Kunsan AB Ecosystem Management Summary

The table below summarizes Kunsan AB's progress in developing and incorporating the 2012 INRMP into overall ecosystem management.

Table 9.1 KEGS-INRMP Conformity Matrix

Korean Environmental Governing Standard	KEGS Criteria	INRMP Section Number(s)/Status
Installations that have land and water areas shall take reasonable steps to protect and enhance known endangered or threatened species and ROK designated Natural Monument species and their habitat.	*KEGS 13-3.a*	Section 2.3.4
Installations will maintain or have access to Table 13-1 and a current list of the ROK Species Designated as Natural Monuments, listed in Table 13-2.	*KEGS 13-3.b*	Appendix C
Installations with significant land or water areas shall develop natural resources management plans.	*KEGS 13-3.c*	INRMP 1997, 2003, 2008, and 2013
Installation Commanders shall report the discovery of any endangered, threatened, or ROK-designated natural monument species to the EEA.	*KEGS 13-3.d* *KEGS 12-3.i*	Section 5.1.1 - A letter of record is on file. Section 5.2 - A letter of record is on file.
Installations having natural resources management plans shall, if financially and otherwise practical and in such a way that there is no net loss of mission capability: (1) Initiate surveys for endangered or threatened species and host nation protected species identification or support host nation-initiated surveys. (2) Implement natural resources management plans.	*KEGS 13-3.e*	Sections 2.3.4 and 7
Installations shall maintain grounds to meet designated mission use and ensure harmony with the natural landscape and/or the adjacent ROK facilities, where practical.	*KEGS 13-3.f*	Section 7
Installations shall ensure that personnel performing natural resource functions have the requisite expertise in the management of their discipline (i.e. endangered or threatened species, ROK protected species, wetlands, soil stabilization). This may be accomplished through in-house training, contract, or consultation with another agency. Government personnel directing such functions must have training in natural resources management.	*KEGS 13-3.g*	Training records for the designated manager should be available.

Korean Environmental Governing Standard	KEGS Criteria	INRMP Section Number(s)/Status
Installations shall place emphasis on the maintenance and protection of habitats favorable to the reproduction and survival of indigenous plants, fish, and wildlife.	*KEGS 13-3.h*	Section 4.5
Land and vegetative management activities will be consistent with current conservation and land use principles (ecosystem protection, biodiversity conservation, and mission-integrated land use), and complement the Bird Aircraft Strike Hazard program where applicable.	*KEGS 13-3.i*	Section 7 and 7.12
Installations shall utilize protective vegetative cover or other standard soil erosion/sediment control practices to control dust, stabilize sites, and avoid silting of streams.	*KEGS 13-3.j*	Section 7.5 and 7.6
No one is permitted to capture, collect, transplant, export, process, distribute, or store specified wild species, except in specially permitted cases.	*KEGS 13-3.k*	Info is included in sponsor's packet to newcomers and in the Newcomers Briefing.

9.2 Monitoring INRMP Implementation

8 CES/CEIE is the responsible organization for implementation of the INRMP and development and maintenance of the plan, including annual updates. The new Environmental Chief took the DoD Natural Resources Compliance course, endorsed by the DoD Interservice Environmental Education Review Board and offered for all DoD Components by the Naval School, Civil Engineer Corps Officers School (CECOS) in May 2017.

9.3 Annual INRMP Review and Update Requirements

The INRMP must be revised at least every five years. During this 5-year period, the INRMP is to be updated annually by Kunsan AB's Natural Resources Manager and approved by the 8 CES/CC. Each Kunsan AB INRMP annual update should be developed in concert and close coordination with the current IDP.

10.0 ANNUAL WORK PLANS

The INRMP Annual Work Plans are included in this section. These projects are listed by fiscal year, including the current year and four succeeding years. For each project and activity, a specific timeframe for implementation is provided (as applicable), as well as the appropriate funding source, and priority for implementation. The work plans provide all the necessary information for building a budget within the AF framework. Priorities are defined as follows:

- High: The INRMP signatories assert that if the project is not funded the INRMP is not being implemented and the Air Force is non-compliant with the Sikes Act; or that it is specifically tied to an INRMP goal and objective and is part of a "Benefit of the Species" determination necessary for ESA Sec 4(a)(3)(B)(i) critical habitat exemption.
- Medium: Project supports a specific INRMP goal and objective, and is deemed by INRMP signatories to be important for preventing non-compliance with a specific requirement within a natural resources law or by EO 13112 on Invasive Species. However, the INRMP signatories would not contend that the INRMP is not be implemented if not accomplished within programmed year due to other priorities.

- Low: Project supports a specific INRMP goal and objective, enhances conservation resources or the integrity of the installation mission, and/or support long-term compliance with specific requirements within natural resources law; but is not directly tied to specific compliance within the proposed year of execution.

5-Year Natural Resources Management Plan with Projected Costs

Table 10.1 Five-year Natural Resources Management Plan and Projected Costs[1,2]

	FY17	FY18	FY19	FY20	FY21	Total
Action 3 - Biotic Survey						
Targeted endangered amphibian & protected bird surveys (during FY17 surveys will scope out targeted FY19 protected mammal survey)	$75K	$78.4K				$153.4K
Targeted protected bird survey					$64K	$64K
Targeted protected mammal survey (combine with the seasonal invasive species & comprehensive plant surveys to reduce cost)			$66K			$66K
Exotic/invasive species survey			$70K	$70K	$70K	$210K
Comprehensive plant inventory						
Targeted invertebrate survey				$75K		$75K
Action 5 - Natural Resource Management Planning Man-Kyung Estuary Plan (not required due to Sea Wall installation) INRMP annual update (Accomplished by Kunsan CEIE staff) INRMP 5 -year revision (Accomplished by Kunsan CEIE staff)						
Action 6 - Natural Resources Training (Accomplished internally by Kunsan CEIE staff)						
Action 9 - Update *Mgmt of Special Species* Guidebook			$25K	$3K		$28K
Action 10 - Outreach Communication with ROK (Accomplished by Kunsan CEIE staff)						
Action 11 - Post Signs at Protected Species Locations (Accomplished by Kunsan CEIE staff – Argonne Labs to identify sites to be posted)						
Action 12 - Ecosystem Monitoring - Avian Populations			$70K			$70K
Action 13 - Urban Forest Management (to be evaluated during 1st Comprehensive plant inventory)						
Total ($K)	$75K	$78.4K	$231K	$148K	$134K	$666.4K

[1] Cost estimates in FY 17 dollars. All of the projects are rated as medium priority except for Action 9 project for update of the Management of Special Species Guidebook, which is rated as a low priority.
[2] Implementation of some FY20 and FY21 tasks will be affected by DoD and ROK travel restrictions associated with the COVID-19 pandemic.

11.0 REFERENCES

11.1 Standard References (Applicable to all AF installations)

- AFI 32-7064, *Integrated Natural Resources Management*
- eDASH Natural Resources Program Page
- Natural Resources Playbook – a Internal AF reference available at https://cs1.eis.af.mil/sites/ceportal/CEPlaybooks/NRM2/Pages/

11.2 Installation References

- 8 CES/CE, 1995. Utilization Survey, Encroachment Report, Kunsan Air Base, Korea . 08 Nov 1995 memorandum for HQ USFK/FKEN-RE/S(405).
- 8 FW Operations Plan 91-202. Bird Aircraft Strike Hazard (BASH) Plan (01 May 2004).
- AFCEE (Air Force Center for Environmental Excellence), 1994. Planning Assistance Team Study, Quality of Life Issues, Kunsan Air Base, Republic of Korea.
- AFCEE, 1998. USAF Landscape Design Guide. HQ AFCEE/DCD, Brooks Air Force Base, Texas. Available: http://www.afcee.brooks.af.mil/dc/dcd/land/ldg/.
- AFI 32-7091. Environmental Outside the United States (13 Nov 2019).
- AFI 32-1015. Integrated Installation Planning (30 Jul 2015).
- AFMAN 32-7003. Environmental Conservation (20 Apr 2020).
- Bergman, Capt. Kurt, 1998. Background Paper on Facilities and Area Subcommittee Tasking #3069, Kunsan AB, Republic of Korea. 8 CES/CER, 07 May 1998.
- CRMP (Cultural Resources Management Plan), 1997. Cultural Resources Management Plan, Kunsan Air Base, prepared for the Environmental Flight, 8 Civil Engineer Squadron, Kunsan Air Base, Republic of Korea by Argonne National Laboratory, Argonne, Ill.
- Cultural Properties Protection Act, Wholly Amended Law No. 3644, Dec. 31, 1982, as amended.
- DoD (U.S. Department of Defense), 1992. Overseas Environmental Baseline Guidance Document (OEBGD), prepared by DOD Overseas Environmental Task Force, October.
- DoDD 6050.7. Environmental Effects Abroad of Major Federal Actions.
- DoDI 4715-DD-R. Integrated Natural Resources Management in the Department of Defense.
- Enforcement Decree of the Cultural Properties Protection Act, Wholly Amended by Presidential Decree No. 11184, Aug. 3, 1983, as amended.
- IDP (Installation Development Plan), 2012. Kunsan 2025: General Base Plan, Kunsan Air Base, Korea, prepared for the 8 Civil Engineer Squadron, Kunsan Air Base, Republic of Korea.
- ICRMP (Integrated Cultural Resources Management Plan), 1997. Integrated Cultural Resources Management Plan, Kunsan Air Base, Revision 2, prepared for the Environmental Flight, 8 Civil Engineer Squadron, Kunsan Air Base, Republic of Korea by Argonne National Laboratory, Argonne, Ill.
- INRMP, 2004. Integrated Natural Resources Management Plan, Kunsan Air Base, Revision 1, prepared for the Environmental Flight, 8 Civil Engineer Squadron, Kunsan Air Base, Republic of Korea by Argonne National Laboratory, Argonne, Ill.
- INRMP, 2008. Integrated Natural Resources Management Plan, Kunsan Air Base, Revision 2, prepared for the Environmental Flight, 8 Civil Engineer Squadron, Kunsan Air Base, Republic of Korea by Argonne National Laboratory, Argonne, Ill.
- KEGS (Korean Environmental Governing Standards). Korean Environmental Governing Standards. Headquarters United States Forces, Korea, USFK Pamphlet 201-1 (21 July 2012).
- Levenson, J.B., 2005. Avian Field Guide and Checklist for Kunsan Air Base, Korea, prepared for the Environmental Flight, 8 Civil Engineer Squadron, Kunsan Air Base, Republic of Korea by Argonne National Laboratory, Argonne, Ill.
- Law for Conservation of Nature (Law, Rules, and Regulations) Amendments (03 Aug 94).

Ministry of Environment, Kwachon. [covers international trade of T&E for researchers and the addition of biodiversity requirements].

- MOE (Ministry of Environment) 1993. Actual Vegetation Maps, Chollabuk-Do, 1:50,000. Ministry of Environment.
- MOE, 1994a. Pictorial Report of Specified Wild Fauna and Flora. Ministry of Environment, Kwachon, Korea. MOE, 1994b. Environmental Protection in Korea. Ministry of Environment, Kwachon, Korea.
- MOE, 1995. Nationwide Green Networkization Concept - Creating an Environment which Harmonizes Between Man and Living Things, Ministry of Environment, Kwachon, Korea.
  Open Literature.
- Natural Environment Preservation Act (Law No 4492, Dec. 31, 1991). Ministry of Environment, Kwachon, Republic of Korea.
- PAT, 1994. Planning Assistance Team Study, Quality of Life Issues, Kunsan Air Base, Korea, June.
- AmphibiaWeb: Information on amphibian biology and conservation, 2002. Berkeley, California. Available: http://amphibiaweb.org/.
- Barter, M.A., 2002. The Yellow Sea and Its Shorebirds, Oriental Bird Club Bulletin 37:35-42.
- Cheong, Chang-Hi, 1988. Chapter 5, "Paleozoic Erathem." p 85-156 in Lee, Dai-Sung (Ed.), Geology of Korea. Kyohak-Sa Publishing Co. & Geological Society of Korea, Seoul.
- Chough, Sung Kwun, 1983. Marine Geology of Korean Seas. International Human Resources Development Corporation, Boston, Mass.
- Clements, J. F., T. S. Schulenberg, M. J. Iliff, D. Roberson, T. A. Fredericks, B. L. Sullivan, and C. L. Wood. 2016. The eBird/Clements Checklist of Birds of the World: v2016. Downloaded from http://www.birds.cornell.edu/clementschecklist/download/
- Dawson, Jeff. 1998. Available: http://www.geocities.com/Heartland/Plains/3550/ slider01.htm.
- Eckert, Carter J., et al., 1990. Korea Old and New: A History. Ilchokak Publishers, Seoul, Korea.
- EPA (U.S. Environmental Protection Agency), 2003. Construction Site Storm Water Runoff Control . U.S. Environmental Protection Agency, Office of Waste Water Management, Washington, D.C., February. Available: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/con_site.cfm.
- Fletcher, Harry R., 1993. Air Force Bases, Vol. 2 Air Bases Outside the United States of America. Center for Air Force History, United States Air Force, Washington, D.C.
- Froese, R. and D. Pauly (Editors), 2002. FishBase. Available: http://www.fishbase.org.
- Futrell, Robert F., 1983. The United States Air Force in Korea 1950-1953, revised ed. Office of Air Force History, United States Air Force, Washington, D.C.
- Hendee, John C., George H. Stankey, and Robert C. Lucas, 1978. Wilderness Management. U.S. Department of Agriculture Forest Service, Miscellaneous Publication 1365, Washington, D.C.
- Hong, S.K., N. Nakagoshi, and M. Kamada, 1995. "Human Impacts on Pine-dominated Vegetation in Rural Landscapes in Korea and Japan. Vegetatio 116(2): 161-172.
- IUCN 2016. International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species. Available: www.iucnredlist.org.
- Jo, Y-S, J.T. Baccus, and J.L. Koprowski, 2018. Mammals of Korea: a review of their taxonomy, distribution, and conservation status. Zootaxa 4522(1): 1-216. Magnolia Press, Aukland, New Zealand.
- Kim, C., K.W. Lee, and C.S. Kim, 1981. "The Study on Energy Supply in Rural Korea."Bulletin 42 of Korea Rural Economic Institute (in Korean).
- Kim, Ok-Joon, 1988a. Chapter 3 "Outlines of Geology of Korea." p 11-13 in Lee, Dai-Sung (Ed.),

Geology of Korea. Kyohak-Sa Publishing Co. & Geological Society of Korea, Seoul, Korea.

- Kim, Ok-Joon, 1988b. Chapter 10 "Tectonic Provinces." p 237-52 in Lee, Dai-Sung (Ed.), Geology of Korea. Kyohak-Sa Publishing Co. & Geological Society of Korea, Seoul, Korea.
- Kim Y-H, Jang Y-C, Oh H-S, Choi S-S. 2010a. Habitat, environment and distribution of Fairy Pitta *Pitta nympha* in Jeju Island and Hampyung County of Korea. Korean Journal of Ornithology, Vol.17 No.4, pp. 317-330. (In Korean with English abstract).
- KOIS (Korean Overseas Information Service), 1993. A Handbook of Korea. Hollym Corporation, Publishers, Seoul, Korea.
- Lee, Dai-Sung (Ed.), 1988. Geology of Korea. Kyohak-Sa Publishing Co. and Geological Society of Korea, Seoul, Korea.
- Lee, Woo-Shin, Tae-Hoe Koo, and Jin-Young Park, 2000. A Field Guide to the Birds of Korea . Toyokan Publishing Co., Ltd. Tokyo, Japan.
- Leung, Yu Fai and Ju Hee Lee, 2003. "Recreation Ecology and Visitor Carrying Capacity Management Implications for Protected Areas in East Asia." Korean Journal of Ecology 26(2):53-58.
- Lie, Heung-Jae, Cheol-Ho Cho, Seok Lee, and Eun-Pyo Lim, 2004. An Integrated Study on the Marine Environmental Impacts by the Saemangeum Sea Dike, Korea: Introduction and Preliminary Results. OCEIES '04. MTS/IEEE Techno-oCEIE '04, Vol. 2., p.694-701. Nov 9-12, 2004.
- Lillie, Thomas H., and J. Douglas Ripley, 1998. "A Strategy for Implementing Ecosystem Management in the United States Air Force." Natural Areas Journal 18(1):73-80.
- Maki, Hirozo, 1998. "Wild Birds: 287 Species Found in Japan." Workshop Bridge, Nature Pro. Ed. Tokyo, Japan.
- Matsui, M., 2004. *Pelophylax chosenicus*. The IUCN Red List of Threatened Species : e.T58577A11806007.
- Matsui, M., and Z. Wenge. 2004. *Kaloula borealis*. The IUCN Red List of Threatened Species: e.T57849A11693398
- Moores, N., 2002. Wetlands: Korea's Most-Threatened Habitat. Oriental Bird Club Bulletin 36:54-60.
- Moores, N., and C. Moores, 2003. Saemangeum - A Vital Wetland. Oriental Bird Club Bulletin 37:47-49.
- Moores, N., A. Kim, and R. Kim, 2014. Status of Birds, 2014. Birds Korea report on Bird Population Trends and Conservation Status in the Republic of Korea. Birds Korea, Busan, Republic of Korea.
- Na, Ki-Chang, 1988. Chapter 4, "Precambrian Eonothem." p 17-34 in Lee, Dai-Sung (Ed.), Geology of Korea. Kyohak-Sa Publishing Co. and Geological Society of Korea, Seoul.
- Nelson, Sarah M., 1993. The Archaeology of Korea. Cambridge University Press, Cambridge.
- Ramsar 2017. The Designation and Management of Ramsar Sites – A practitioner's guide. Ramsar Regional Center – East Asia. Available at www.ramsar.org and www.rrcea.org.
- Ross, J., Brodie, J., Cheyne, S., Hearn, A., Izawa, M., Loken, B., Lynam, A., McCarthy, J., Mukherjee, S., Phan, C., Rasphone, A. & Wilting, A. 2015. *Prionailurus bengalensis*. The IUCN Red List of Threatened Species 2015: e.T18146A50661611. Available: www.iucnredlist.org.
- Smither, Bob, 1998. Gulf Coast Turtle & Tortoise Society. Available: http://www.gctts.org/care_sheets/ red_eared_turtle/red.eared.turtle-2.
- Southerland, Mark T., 1997. "Considering Biodiversity in Integrated Natural Resource Management Plans." Federal Facilities Environmental Journal, p 59-69, Winter.
- USDA (United States Department of Agriculture), 1965. Silvics of Forest Trees of the United

States . Agricultural Handbook No. 271, USDA, Washington D.C.
- Woo, Han-Jeong, and Moo-Boo Yoon, 1989. Coloured Wild Birds of Korea. Academy Press, Seoul, Korea.
- Yamamoto, Tokio (Ed.), 1975. "Intoductory Remarks on the Medaka." p 1-16 in Medaka, Biology and Strains. Yugakusya Publishers, Tokyo, Japan.
- Yim, Y.J., 1977. *Distribution of Forest Vegetation and Climate in the Korean Peninsula. IV, Zonal Distribution of Forest Vegetation in Relation to Thermal Climate*. Japanese J. Ecol., 27(4):269-78.
- Lee, T.B., 1993. *Illustrated Flora of Korea*. Hyang Moon Publishers, Seoul, Korea.
- IUCN 2020. The IUCN Red List of Threatened Species. Version 2020-2. https://www.iucnredlist.org. Downloaded on 09 July 2020.
- Jo, Yeong-Seok, J.T. Baccus, and J.L. Koprowski. 2018. Mammals of Korea: a review of their taxonomy, distribution, and conservation status. Zootaxa 4522: 1-216.

12.0 ACRONYMS

12.1 Standard Acronyms *(Applicable to all AF installations)*

- eDASH Acronym Library
- Natural Resources Playbook – Acronym Section

12.2 Installation Acronyms

- **BCH –** Big Coyote Hill
- **DMZ –** Demilitarized Zone
- **EEA –** Environmental Executive Agent
- **ESQD –** Explosive Safety Quantity Distance
- **FS –** Fighter squadron
- **GP –** General Plan
- **IDP** – Installation Development Plan
- **ILS –** Instrument Landing System
- **IMBA –** International Mountain Bicycling Association
- **IUCN –** International Union for Conservation of Nature and Natural Resources
- **KACN –** Korean Association for the Conservation of Nature
- **KAL –** Korean Air Lines
- **KEGS –** Korea Environmental Governing Standards
- **LCH –** Little Coyote Hill
- **LPP –** Land Partnership Plan
- **MOE –** (Korean) Ministry of Environment
- **MSL –** Mean sea level
- **NRMU(s) –** Natural Resource Management Unit(s)
- **OEBGD –** Overseas Environmental Baseline Guidance Document
- **OI –** Operating instruction
- **OPLAN –** Operations Plan
- **PAT –** Planning Assistance Team
- **QAE –** Quality Assurance Evaluator

- **ROK –** Republic of Korea
- **ROKAF –** Republic of Korea Air Force
- **SOFA –** Status of Forces Agreement
- **USA –** United States Army
- **USFK –** United States Forces Korea
- **411 CSB –** 411th Contracting Support Brigade
- **8 FW –** 8th Fighter Wing
- **8 FW/CC –** Commander, 8th Fighter Wing
- **8 FW/JA –** Judge Advocate, 8th Fighter Wing
- **8 FW/SE –** Safety, 8th Fighter Wing
- **8 FW/SEF –** Flight Safety
- **8 CES/CC –** Commander, 8th Civil Engineer Squadron
- **8 CES/CENPD –** Civil Engineer Squadron, Engineering Project Development
- **8 CES/CEOIE –** Pest Management
- **8 CES/CEOHH –** Pavements/Equipments
- **8 CES/CEIE –** Environmental Engineering Element
- **8 MDOS –** 8th Medical Operations Squadron
- **8 MDOS/SGOAB –** Bioenvironmental Engineers
- **8 FSS/CC –** Commander, 8th Services Squadron
- **8 FSS/FSWO –** Outdoor Recreation Director

13.0 DEFINITIONS

13.1 Standard Definitions (Applicable to all AF installations)

- Natural Resources Playbook – Definitions Section

13.2 Installation Definitions

- **Action (KEGS 13-2.a)** - All activities or programs of any kind authorized, funded, or carried out, in whole or in part, by USFK installations.
- **Adverse Effect (KEGS 13-2.b)** - Changes that diminish the quality or significant value of natural resources. For biological resources, adverse effects include impacts on overall population diversity, abundance, and fitness.
- **Conservation (KEGS 13-2.c)** - Planned management, use, and protection; continued benefit for present and future generations; and prevention of exploitation, destruction, and/or neglect of natural resources.
- **Cultural Properties (KEGS 12-2.f)** - This refers to the following lists:
- (1) – **Tangible cultural properties:** Buildings, classical books, calligraphic ancient documents, paintings, sculptures, industrial art objects, etc. and other tangible cultural products which possess high historic or artistic value and other archeological specimens which belong to categories above.
- (2) – **Monuments:** Shell-mound, ancient tombs, castle sites, palace sites, pottery remains, layers containing remains, etc., and other sites of historic remains which possess high artistic or ornamental values and animals (including the places of habitat, breeding, and migration), plants (including habitat) (Table 12), minerals, and caves which have high scientific value.
- **Endangered or Threatened Species (KEGS 13-2.d)** - Any species of flora or fauna listed in Table

13-1 (of the KEGS).

- **Management Plan (KEGS 13-2.f)** - A document describing natural resources, their quantity, condition, and actions to ensure conservation and good stewardship.
- **Natural Ecosystem Preservation Area (KEGS 13-2.g)** - Refers to areas listed in Table 13-3 (of the KEGS) which fall under one of the following designated areas.
- **Natural Resource (KEGS 13-2.h)** - All living and inanimate materials supplied by nature that are of aesthetic, ecological, educational, historical, recreational, scientific, or other value.
- **Natural Resource Management (KEGS 13-2.i)** - Action taken to protect, manipulate, or alter natural resources in harmony to meet present and future human needs.
- **ROK-designated Natural Monument Species (KEGS 13-2.e)** - Any species of flora or fauna listed in Table 13-2, "ROK Species Designated as Natural Monuments" (of the KEGS) or designated by ROK.
- **Significant Land or Water Areas (KEGS 13-2.j)** - A land or water area outside the cantonment that is normally at least 500 acres in size; smaller areas may be included if they have natural resources that are especially sensitive.
- **Wetland Protected Areas (KEGS 13-2.k)** – A designated wetland that is worthy of protection and conservation due to its authorizied values of water supply & quality, aesthetics, and biodiversity maintenance (refer to Table 13-4): A wetland should be considered a "Wetland Protected Area" if any of the following criteria are met:
    1) A wetland that is natural or near natural with high biodiversity
    2) A wetland that supports rare, endangered or threatened species
    3) A wetland that contains unique landscapic, geomorphic or geological values

14.0 APPENDICES

Appendix A. Annotated Summary of Key Legislation Related to Design and Implementation of the INRMP

Federal Public Laws and Executive Orders	
32 CFR Part 187, Environmental Effects Abroad Of Major Department Of Defense Actions	Provides the exclusive and complete requirement for taking account of considerations with respect to actions that do significant harm to the environment of places outside the United States
32 CFR Part 989, Environmental Impact Analysis Process (EIAP)	Implements the Air Force EIAP and provides procedures for environmental impact analysis both within the United States and abroad.
DoD Policy, Directives, and Instructions	
DoD Instruction 4150.07, DoD Pest Management Program	Implements policy, assigns responsibilities, and prescribes procedures for the DoD Integrated Pest Management Program.
USAF Instructions and Directives	
AFI 32-7001, Environmental Management	Establishes the framework for an Environmental Management System (EMS) at Headquarters, United States Air Force (HQ USAF), major commands (MAJCOMs), and at installations
AFI 32-7062, Air Force Comprehensive Planning	Provides guidance and responsibilities related to the USAF comprehensive planning process on all USAF-controlled lands.
AFI 32-7064, Integrated Natural Resources Management	Implements AFPD 32-70, Environmental Quality; DODI 4715.03, Natural Resources Conservation Program; and DODI 7310.5, Accounting for Sale of Forest Products. It explains how to manage natural resources on USAF property in compliance with Federal, state, territorial, and local standards.
AFI 32-7065, Cultural Resources Management	This instruction implements AFPD 32-70 and DoDI 4710.1, Archaeological and Historic Resources Management. It explains how to manage cultural resources on USAF property in compliance with Federal, state, territorial, and local standards.
AFPD 32-70, Environmental Quality	Outlines the USAF mission to achieve and maintain environmental quality on all USAF lands by cleaning up environmental damage resulting from past activities, meeting all environmental standards applicable to present operations, planning its future activities to minimize environmental impacts, managing responsibly the irreplaceable natural and cultural resources it holds in public trust and eliminating pollution from its activities wherever possible. AFPD 32-70 also establishes policies to carry out these objectives.

Appendix B. Biota of Kunsan Air Base

Page intentionally blank.

Appendix B.1 Vascular Plant Species Identified on Kunsan AB

A total of 357 vascular plant species were identified to occur on Kunsan AB, including 20 non-flowering plant species (Table B.1.1) and 337 flowering species. Table B.1.2 lists 247 species of dicotyledonous flowering plants. Table B.1.3 lists 90 species of monocotyledonous flowering plants. By virtue of the different purposes, objectives, and sampling regimes, it is acknowledged that the list is not comprehensive and does not include every species that exists on Kunsan AB. The most rare plant species on Kunsan AB have probably not been documented. From a practical standpoint, this floral list is sufficiently comprehensive for habitat management purposes.

Table B.1.1 Non-Flowering Plants Identified on Kunsan AB

FAMILY Name –Common Name	Scientific Name	Life Form
***EQUISETACEAE* – Horsetail Family**		
Field Horsetail	*Equisetum arvense*	Herb
Meadow Horsetail	*E. pratense*	Herb
***OPHIOGLOSSACEAE* – Adder's-tongue Family**		
Grape Fern	*Botrychium ternatum*	Fern
***OSMUNDACEAE* – Royal Fern Family**		
Japanese Royal Fern	*Osmunda japonica*	Fern
***WOODSIACEAE* – Wood Fern Family**		
Glade Fern	*Athyrium conilii*	Fern
Japanese Glade Fern	*A. nipponicum*	Fern
Glade Fern	*A. yokoscence*	Fern
***THELYPTERIDACEAE* – Marsh Fern Family**		
Marsh Fern	*Thelypteris palustris*	Fern
***DENNSTAEDTIACEAE* – Bracken Family**		
Bracken Fern	*Pteridium aquilinum* var. *latiusculum*	Fern
***MARSILEACEAE* – Water Clover Family**		
European Water Clover	*Marsilea quadrifolia*	Aquatic
***GINKGOACEAE* – Ginkgo Family**		
Ginkgo Tree	*Ginkgo biloba*	Tree
***PINACEAE* – Pine Family**		
Fir	*Abies holophylla*	Tree
Larch	*Larix gmelini* var. *principis-ruprechtii*	Tree
Japanese Red Pine	*Pinus densiflora*	Tree
Pitch Pine	*P. rigida*	Tree
***TAXODIACEAE* – Bald Cypress Family**		
Bald Cypress	*Taxodium distichum*	Tree
***CUPRESSACEAE* – Cypress Family**		
Chinese Juniper	*Juniperus chinensis*	Shrub
Sargent's Juniper	*J. chinensis* var. *sargentii*	Tree
White Cedar; Arbor Vitae	*Thuja occidentalis*	Tree
Chinese Arborvitae	*T. orientalis*	Tree

Table B.1.2 Dicot Flowering Plants Identified on Osan AB

Family Name – Common Name	Scientific Name	Life Form

***SALICACEAE* – Willow Family**		
White Poplar	*Populus alba*	Tree
Cottonwood	*P. deltoides*	Tree
Poplar	*P. davidiana*	Tree
Hybrid Suwon Poplar	*P. tomentiglandulosa*	Tree
White Willow	*Salix alba*	Tree
Weeping Willow	*S. babylonica*	Tree
	S. dependens	Tree
	S. glandulosa	Tree
	S. gracilistyla	Tree
Korean Willow	*S. koreensis*	Tree
	S. nipponica	Tree
	S. pseudo-lasiogyne	Tree
Pekin Willow	*S. matsudana* for. *tortuosa*	Tree
***BETULACEAE* – Birch Family**		
Japanese Green Alder	*Alnus firma*	Shrub
Alder	*A. hirsuta*	Shrub
Japanese Alder	*A. japonica*	Shrub
Birch	*Betula platyphylla* var. *japonica*	Tree
Heterophylla Hazel	*Corylus heterophylla*	Shrub
***FAGACEAE* – Beech Family**		
Japanese Chestnut	*Castanea crenata*	Shrub
Oriental Chestnut Oak	*Quercus acutissima*	Tree
Oriental white oak	*Q. aliena*	Tree
Daimyo Oak	*Q. dentata*	Tree
Mongolian Oak	*Q. mongolica*	Tree
Serrate-Leaved Oak	*Q. serrata*	Tree
***ULMACEAE* – Elm Family**		
Japanese Elm	*Ulmus davidiana* var. *japonica*	Tree
Zelkova	*Zelkova serrata*	Tree
***MORACEAE* – Mulberry Family**		
Common Fig	*Ficus carica*	Shrub
Mulberry	*Morus alba*	Tree
***CANNABACEAE* – Hemp Family**		
Japanese Hop	*Humulus japonicus*	Shrub
***URTICACEAE* – Nettle Family**		
False Nettle	*Boehmeria nivea*	Forb
***POLYGONACEAE* – Buckwheat Family**		
Black Bindweed	*Fallopia convovulus*	Forb
Dog Smartweed	*Persicaria blumei*	Forb
Climbing Buckwheat	*P. chinensis*	Forb
Water Pepper	*P. hydropiper*	Forb
Smartweed	*P. japonica*	Forb
	P. lapathifolia	Forb
	P. maackiana	Forb
	P. nodosa	Forb

Table B.1.2 (Cont.)

***POLYGONACEAE* – Buckwheat Family (Cont.)**		
	P. perfoliata	Forb
	P. posumba var. *laxiflora*	Forb
	P. senticosa	Forb
	P. thunbergii	Forb
Indigo Smartweed	*P. tinctoria*	Forb
Prostrate Knotweed	*Polygonum aviculare*	Forb
Erect Knotweed	*P. erectum*	Forb
Sour Dock	*Rumex acetosella*	Forb
Clustered Dock	*R. conglomeratus*	Forb
Curly Dock	*R. crispus*	Forb
***CHENOPODIACEAE* – Goosefoot Family**		
Goosefoot	*Chenopodium album*	Forb
Red Goosefoot	*C. album* var. *centrorubrum*	Forb
Mexican Tea	*C. ambrosioides*	Forb
	C. bryoniaefolium	Forb
	C. ficifolium	Forb
Saltwort	*Salsola* sp.	Forb
***AMARANTHACEAE* – Amaranth Family**		
Pig's Knee	*Achyranthes japonica*	Forb
	Amaranthus deflexus	Forb
Dog Amaranth	*A. lividus*	Forb
Green Amaranth	*A. retroflexus*	Forb
Long-Spiked Amaranth	*A. viridis*	Forb
Khaki-Weed	*Alternanthera pungens*	Forb
***NYCTAGINACEAE* – Four-o'clock Family**		
Bougainvillea	*Bougainvillea* sp.	Forb
***PHYTOLACCACEAE* – Pokeweed Family**		
Pokeweed	*Phytolacca americana*	Forb
***PORTULACACEAE* – Purslane Family**		
Common Purslane	*Portulaca oleracea*	Forb
***CARYOPHYLLACEAE* – Pink Family**		
Thyme-Leaved Sandwort	*Arenaria serpyllifolia*	Forb
Mouse-Ear Chickweed	*Cerastium holosteoides*	Forb
Baby's Breath	*Gypsophila oldhamiana*	Forb
Spurrey	*Spergula arvensis*	Forb
Aquatic Starwort	*Stellaria aquatica*	Forb
Starwort	*S. filicaulis*	Forb
Chickweed	*S. media*	Forb
***CERATOPHYLLACEAE* – Hornwort Family**		
Hornwort	*Ceratophyllum demersum*	Forb
***RANUNCULACEAE* – Crowfoot Family**		
Creeping Buttercup	*Ranunculus repens*	Forb
Crowfoot	*R. sceleratus*	Forb
	R. tachiroei	
***MENISPERMACEAE* – Moonseed Family**		
Coralbeads	*Cocculus trilobus*	Vine

Table B.1.2 (Cont.)

***MAGNOLIACEAE* – Magnolia Family**		
Magnolia	*Magnolia obovata*	Tree
Lily Magnolia	*M. liliflora*	Shrub
Oyama Magnolia	*M. parviflora*	Shrub
***LAURACEAE* – Laurel Family**		
Japanese Spicebush	*Lindera obtusiloba*	Shrub
***PAPAVERACEAE* – Poppy Family**		
Asian Celandine	*Chelidonium majus* var. *asiaticum*	Forb
Bleeding Heart	*Dicentra spectabilis*	Forb
***CRUCIFERAE* – Mustard Family**		
Mustard	*Brassica* sp.	Forb
Shepherd's Purse	*Capsella bursa-pastoris*	Forb
Bitter Cress	*Cardamine flexuosa*	Forb
Sophia	*Descurainia sophia*	Forb
	Iberis amara	Forb
Poor-Man's Pepper	*Lepidium apetalum*	Forb
Poor-Man's Pepper	*L. virginicum*	Forb
Watercress	*Nasturtium officinale*	Forb
False Mustard	*Rorippa cantoniensis*	Forb
Yellow Cress	*R. indica*	Forb
Field Pennycress	*Thlapsi arvense*	Forb
***CRASSULACEAE* – Stonecrop Family**		
Stonecrop	*Sedum sarmentosum*	Forb
	S. spectabile	Forb
***SAXIFRAGACEAE* – Saxifrage Family**		
Saxifrage	*Saxifraga fortunei*	Forb
***PLATANACEAE* – Plane-tree Family**		
Sycamore	*Platanus occidentalis*	Tree
***ROSACEAE* – Rose Family**		
Serviceberry	*Amelanchier asiatica*	Shrub
Chinese Quince	*Chaenomeles sinensis*	Tree
False Strawberry	*Duchesnea chrysantha*	Forb
Loquat; Japanese Medler	*Eriobotrya japonica*	Tree
Strawberry	*Fragaria* sp.	Forb
Korean Apple	*Malus asiatica*	Tree
Siberian Crab Apple	*M. baccata*	Tree
Toringo Crab	*M. sieboldii*	Tree
Cinquefoil	*Potentilla bifurca* var. *glabrata*	Forb
	P. fragarioides	Forb
	P. kleiniana	Forb
Rose-Bud Cherry	*Prunus leveilleana*	Tree
European Bird Cherry, Japanese Flowering Cherry	*P. padus*	Shrub
	P. serrulata var. *spontanea*	Shrub
Dagalet Cherry	*P. takesimensis*	Tree
Korean Cherry	*P. tomentosa*	Tree
Japanese Cherry	*P. yedoensis*	Tree
Crab Apple, Cultivated Apple	*Pyrus malus*	Tree

Table B.1.2 (Cont.)

***ROSACEAE* – Rose Family (Cont.)**		
Baby Brier	*R. multiflora*	Shrub
Bramble	*Rubus crataegifolius*	Shrub
Bramble	*R. oldhamii*	Shrub
Trailing Bramble	*R. parvifolius*	Shrub
Burnet	*Sanguisorba hakusanensis*	Forb
Burnet	*S. tenuifolia* var. *alba*	Forb
Mountain Ash	*Sorbus alnifolia*	Tree
Bridal Wreath	*Spiraea prunifolia* for. *simpliciflora*	Shrub
***LEGUMINOSAE* – Bean Family**		
Silk Tree	*Albizzia julibrissin*	Tree
False Indigo	*Amorpha fructicosa*	Shrub
Hog Peanut	*Amphicarpaea edgeworthii* var. *trisperma*	Forb
	Cassia mimosoides	Tree
Korean Honey Locust	*Gleditsia japonica* var. *koraiensis*	Tree
Soybean	*Glycine soja*	Forb
Korean Indigo	*Indigofera kirilowii*	Forb
False Indigo	*I. psuedotinctoria*	Shrub
Korean Lespedeza	*Kummerowia stipulacea*	Forb
Common Lespedeza	*K. striata*	Forb
Bush Clover	*Lespedeza bicolor*	Shrub
Burclover	*Medicago hispida*	Forb
Black Medick	*M. lupulina*	Forb
	Phaseolus multiflorus	Forb
	P. nipponensis	Forb
Kudzu	*Pueraria montana* var. *lobata*	Vine
Rose Acacia	*Robinia hispida*	Shrub
Black Locust	*R. pseudo-acacia*	Tree
Red Clover	*Trifolium pratense*	Forb
	Vicia angustifolia	Forb
White Clover	*T. repens*	Forb
Cow-Pea	*Vigna sinensis*	Forb
Wisteria	*Wisteria floribunda*	Vine
***OXALIDACEAE* – Wood-sorrel Family**		
Creeping Wood-Sorrel	*Oxalis corniculata*	Forb
***SIMAROUBACEAE* – Quassia Family**		
Tree of Heaven	*Ailanthus altissima*	Tree
***EUPHORBIACEAE* – Spurge Family**		
Three-Seeded Mercury	*Acalypha australis*	Forb
Eyebane	*Euphorbia maculata*	Forb
Milk Purslane	*E. supina*	Forb
Castor-Bean	*Ricinus communis*	
***BUXACEAE* – Boxwood Family**		
Korean Boxwood	*Buxus microphylla* var. *koreana*	Shrub
***ANACARDIACEAE* – Cashew Family**		
Sumac	*Rhus javanica*	Tree

Table B.1.2 (Cont.)

***CELASTRACEAE* – Spindle Tree Family**		
Bittersweet	*Celastrus orbiculatus*	Vine
Wintercreeper	*Euonymus fortunei*	Shrub
***ACERACEAE* – Maple Family**		
Japanese Red Maple	*Acer palmatum*	Tree
Nakai Maple	*A. palmatum* var. *nakaii*	Tree
Manchurian Fullmoon Maple	*A. pseudo-sieboldianum*	Tree
Manchurian Maple	*A. triflorum*	Tree
***HIPPOCASTANACEAE* – Horse-Chestnut Family**		
Horse Chestnut	*Aesculus turbinata*	Tree
***RHAMNACEAE* – Buckthorn Family**		
Jujube	*Zizyphus jujuba*	Tree
***VITACEAE* – Grape Family**		
Boston Ivy	*Parthenocissus tricuspidata*	Vine
Wild grape	*Vitis* sp.	Vine
***MALVACEAE* – Mallow Family**		
Rose of Sharon	*Hibiscus mutabilis*	Shrub
***VIOLACEAE* – Violet Family**		
White Violet	*Viola acuminata*	Forb
Manchurian Violet	*V. mandshurica*	Forb
	V. yedoensis	Forb
***TRAPACEAE* – Water Chestnut Family**		
Water Chestnut	*Trapa japonica*	Aquatic
***ONAGRACEAE* – Evening Primrose Family**		
	Oenothera erythrosepala	Forb
	O. lamarckiana	Forb
	O. stricta	Forb
***HALORAGACEAE* – Water-milfoil Family**		
Water-milfoil	*Myriophyllum* sp.	Forb
***ARALIACEAE* – Ginseng Family**		
Japanese Ivy	*Hedera rhombea*	Vine
Castor Aralia	*Kalopanax pictus*	Tree
***UMBELLIFERAE* – Parsley Family**		
Chervil	*Anthriscus caucalis*	Forb
Dropwort	*Oenanthe javanica*	Forb
***CORNACEAE* – Dogwood Family**		
Korean Dogwood	*Cornus walteri*	Tree
***ERICACEAE* – Heath Family**		
Smile Rosebay	*Rhododendron schlippenbachii*	Shrub
False Rosebay	*R. yedoense* var. *poukhanense*	Shrub
***PRIMULACEAE* – Primrose Family**		
	Lysimachia barystachys	Forb
***EBENACEAE* – Ebony Family**		
Persimmon	*Diospyros kaki*	Tree
***STYRACACEAE* – Styrax Family**		
Fragrant Snowbell	*Styrax obassia*	Shrub

Table B.1.2 (Cont.)

***SYMPLOCACEAE* – Symplocos Family**		
Sweet Leaf	*Symplocos chinensis* for. *pilosa*	Shrub
***OLEACEAE* – Olive Family**		
Autumn Olive	*Elaeagnus umbellata*	Shrub
Korean Forsythia	*Forsythia koreana*	Shrub
Border Privet	*Ligustrum obtusifolium*	Shrub
Lilac	*Syringa dilatata*	Shrub
***ASCLEPIADACEAE* – Milkweed Family**		
Dog's Bane	*Cyanchum wilfordii*	Forb
	Metaplexis japonica	Forb
***CONVOLVULACEAE* – Morning-glory Family**		
Japanese Bindweed	*Calystegia japonica*	Forb
Bindweed	*Convolvulus arvensis*	Forb
Dodder	*Cuscuta australis*	Forb
Morning Glory	*Pharbitis nil*	Forb
***LABIATAE* – Mint Family**		
	Mosla dianthera	Forb
	M. japonica	Forb
	M. punctulata	Forb
Sage	*Salvia plebeia*	Forb
Hedge Nettle	*Stachys rierderi*	Forb
***SOLANACEAE* – Nightshade Family**		
Petunia	*Petunia hybrida*	Forb
Fox Grape	*Solanum nigrum*	Forb
***SCROPHULARIACEAE* – Figwort Family**		
Lesser Snapdragon	*Antirrhinum orontium*	Forb
	Lindernia crustacea	Forb
	Mazus miquelii	Forb
	M. stachydifolius	Forb
Princess Tree	*Paulownia tomentosa*	Tree
Speedwell	*Veronica filiformis*	Forb
Speedwell	*Veronica persica*	Forb
***BIGNONIACEAE* – Trumpet Creeper Family**		
Chinese Trumpet Creeper	*Campsis grandiflora*	Vine
Japanese Catalpa	*Catalpa ovata*	Tree
***LENTIBULARIACEAE* – Bladderwort Family**		
Bladderwort	*Utricularia pilosa*	Forb
***PLANTAGINACEAE* – Plantain Family**		
Asian Plantain	*Plantago asiatica*	Forb
Long Plantain	*P. lanceolata*	Forb
***RUBIACEAE* – Madder Family**		
Bedstraw	*Galium spurium*	Forb
Madder	*Rubia akane*	Forb
Madder	*R. cordifolia*	Forb
***CAPRIFOLIACEAE* – Honeysuckle Family**		
Japanese Honeysuckle	*Lonicera japonica*	Shrub
Korean Alder	*Sambucus williamsii* var. *coreana*	Shrub
Cranberry Bush	*Viburnum sargentii*	Shrub

Table B.1.2 (Cont.)

***VALERIANACEAE* – Valerian Family**		
	Petrinia villosa	Forb
***CUCURBITACEAE* – Cucumber Family**		
Bur Cucumber	Sicyos angulatus	Vine
Mongolian Snakegourd	Trichosanthes kirilowii	Vine
***COMPOSITAE* – Sunflower Family**		
Yarrow	*Achillea millefolium*	Forb
Aster	*Aster pilosus*	Forb
Common Ragweed	*Ambrosia artemisifolia* var. *elatior*	Forb
	Artemisia feddei	Forb
Wormwood	*A. princeps* var. *orientalis*	Forb
	A. rubripes	Forb
Spanish Needles	*Bidens bipinnata*	Forb
Beggar-Ticks	*B. frondosa*	Forb
Knapweed	*Centaura maculosa*	Forb
Common Thistle	*Cirsium japonicum*	Forb
Common Cosmos	*Cosmos bipinnatus*	Forb
Daisy Fleabane	*Erigeron annuus*	Forb
Horseweed	*E. canadensis*	Forb
Fireweed	*Erechtites hieracifolia*	Forb
	Gnaphalium japonicum	Forb
Fox Thistle	*Hemistepta lyrata*	Forb
Hawkweed	*Hieracium* sp.	Forb
	Hololeion maximowiczii	Forb
Spotted Cat's Ear	*Hypochaeris radicata*	Forb
	Kalimeris pinnatifidus	Forb
Lettuce	*Lactuca indica* var. *laciniata*	Forb
Pineapple-weed	*Matricaria matricarioides*	Forb
Pinewood	*Rudbeckia bicolor*	Forb
Common Groundsel	*Senecio vulgaris*	Forb
Goldenrod	*Solidago serotina*	Forb
Spiny-Leaved Sow Thistle	*Sonchus asper*	Forb
Common Sow Thistle	*S. oleraceus*	Forb
African Marigold	*Tagetes erecta*	Forb
Korean Dandelion	*Taraxacum coreanum*	Forb
Common Dandelion	*T. officinale*	Forb
Goat's Beard	*Tragapogon pratensis*	Forb
	Youngia sonchifolia	Forb

Table B.1.3 Monocot Flowering Plants Identified on Osan AB

FAMILY NAME –Common Name	Scientific Name	Life Form
***TYPHACEAE* – Cattail Family**		
	Typha angustata	Cattail
Broad-leaf cattail	*T. latifolia*	Cattail
Oriental cattail	*T. orientalis*	Cattail
***SPARGANIACEAE* – Bur reed Family**		
Bur Reed	*Sparganium stoloniferum*	Aquatic
***ZOSTERACEAE* – Pondweed Family**		
Pondweed	*Potamogeton distinctus*	Aquatic
	P. octandrus	Aquatic
	P. oxyphyllus	Aquatic
***ALISMATACEAE* – Water Plantain Family**		
Water Plantain	*Alisma plantago-aquatica* var. *orientale*	Aquatic
Arrowhead	*Sagittaria aginashi*	Aquatic
	S. trifolia	Aquatic
***HYDROCHARITACEAE* – Frog's-bit Family**		
Duck-lettuce	*Ottelia alismoides*	Aquatic

Table B.1.3 (Cont.)

***RAMINEAE* – Grass Family**		
Quackgrass	*Agropyron repens*	Grass
Creeping Bentgrass	*Agrostis stolonifera*	Grass
Short Awn	*Alopecurus aequalis* var. *amurensis*	Grass
Black Foxtail	*A. myosuroides*	Grass
	Arthraxon hispidus	Grass
Wild Oats	*Avena fatua*	Grass
American Slough Grass	*Beckmannia syzgachne*	Grass
False Brome Grass	*Brachypodium sylvaticum*	Grass
Japanese Brome Grass	*Bromus japonicus*	Grass
Rip-Gut Brome Grass	*B. rigidus*	Grass
Feather Fingergrass	*Chloris virgata*	Grass
	Cleistogenes hackelii	Grass
Bermuda Grass	*Cynodon dactylon*	Grass
Orchard Grass	*Dactylis glomerata*	Grass
Crabgrass	*Digitaria sanguinalis*	Grass
Crabgrass	*D. violascens*	Grass
	Eragrostis poaeoides	Grass
Centipede Grass	*Eremochloa ophiuroides*	Grass
Dallis Grass	*Eriochloa villosa*	Grass
Rat's Tail	*Festuca myuros*	Grass
Sheep Fescue	*F. ovina*	Grass
English Rye Grass	*Lolium perenne*	Grass
Japanese Silver Grass	*Miscanthus sinensis*	Grass
	Microstegium vimineum	Grass
Chijimi-Zasa Grass	*Oplismenus undulatifolius*	Grass
	Paspalum thunbergii	Grass
Timothy Grass	*Phleum pratense*	Grass
Reed Canary Grass	*Phalaris arundinacea*	Grass
Common Reed	*Phragmites communis*	Grass
Canada Bluegrass	*Poa compressa*	Grass
Kentucky Bluegrass	*P. pratensis*	Grass
	P. viridula	Grass
Yellow Foxtail Grass	*Sacciolepis indica*	Grass
Foxtail Grass	*Setaria glauca*	Grass

Table B.1.3 (Cont.)

***GRAMINEAE* – Grass Family (Cont.)**		
	S. viridis	Grass
	Themeda triandra var. *japonica*	Grass
Japanese Lawn Grass	*Zoysia japonica*	Grass
***CYPERACEAE* – Sedge Family**		
Sedge	*Carex bostrychostigma*	Sedge
	C. dimorpholepis	Sedge
	C. humilis	Sedge
	C. incisa	Sedge
	C. neurocarpa	Sedge
	C. pediformis	Sedge
Umbrella sedge	*Cyperus glomeratus*	Sedge
	C. microiria	Sedge
	C. orthostachyus	Sedge
Spike rush	*Eleocharis kuroguwai*	Rush
Bulrush	*Scirpus fluviatilis*	Rush
Bulrush	*S. juncoides*	Rush
Chair-maker's rush	*S. tabernaemontani*	Rush
	S. triqueter	Rush
***ARACEAE* – Aroid Family**		
Wetland Arum	*Pinellia ternata*	Forb
***LEMNACEAE* – Duckweed Family**		
Duckweed	*Lemna paucicostata*	Aquatic
Duckweed	*L. perpusilla*	Aquatic
Greater Duckweed	*Spirodela polyrhiza*	Aquatic
***COMMELINACEAE* – Spiderwort Family**		
Dayflower	*Commelina communis*	Herb
Korean Dayflower	*C. coreana*	Herb
Marsh Dewflower	*Murdannia keisak*	Herb
***PONTEDERIACEAE* – Pickerelweed Family**		
Pickerelweed	*Monochoria korsakowi*	Aquatic
***JUNCACEAE* – Rush Family**		
Rush	*Juncus brachyspathus*	Aquatic
	J. effusus var. *decipiens*	Aquatic
	J. gracillimus	Aquatic
	J. setchuensis var. *effusoides*	Aquatic
Wood Rush	*Luzula capitata*	Herb
***LILIACEAE* – Lily Family**		
Garlic	*Allium thunbergii*	Herb
Daylily	*Hemerocallis* sp.	Herb
Plantain-Lily	*Hosta longipes*	Herb
Lily	*Lilium* sp.	Herb
Dwarf Lily Turf	*Ophiopogon japonicus*	Herb
Solomon's Seal	*Polygonatum odoratum*	Herb
Squill	*Scilla scilloides*	Herb
Smooth Greenbrier	*Smilax china*	Vine
Japanese Greenbrier	*S. nipponica*	Vine
Catbrier	*S. riparia*	Vine

Table B.1.3 (Cont.)

***LILIACEAE* – Lily Family (Cont.)**		
Greenbrier	*S. sieboldii*	Vine
Adam's Needle	*Yucca filamentosa*	Herb
Soapweed	*Yucca glauca*	Herb
Mound Lily Yucca	*Yucca gloriosa*	Herb
***DIOSCOREACEAE* – Yam Family**		
Tokoro	*Dioscorea tokoro*	Vine
***IRIDACEAE* – Iris Family**		
Mountain Iris	*Iris ensata*	Herb
Yellow Flag Iris	*I. pseudoacorus*	Herb

Appendix B.2 Insects

Table B.2 List of Insects Observed during the 2012 Field Survey.

Order	Family	Scientific Name	Common Name[a]
Odonata	**Calopterygidae**	*Calopteryx atrata*	jewelwing
		Calopteryx japonica	jewelwing
	Coenagrionidae	*Coenagrion hastulatum*	Spearhead bluet
		Paracercion plagiosum	narrow-winged damselfly
		Ischnura asiatica	Asian bluetail
	Platycnemididae	*Platycnemis phyllopoda*	featherleg
	Aeshnidae	*Anax parthenope julius*	Lesser emperor
	Gomphidae	*Anisogomphus maacki*	clubtail dragonfly
		Davidius lunatus	clubtail dragonfly
		Ophiogomphus obscurus	clubtail dragonfly
	Corduliidae	*Macromia amphigena*	macromia dragonfly
	Libellulidae	*Orthetrum albistylum*	White-tailed skimmer
		Orthetrum melania	skimmer
		Crocothemis servilia mariannae	Scarlet skimmer
		Sympetrum frequens	Spotted darter
		Sympetrum infuscatum	skimmer
		Pantala flavescens	Orange glider dragonfly
		Rhyothemis fuliginosa	flutterer
Blattaria	**Blattellidae**	*Blattella nipponica*	Japanese field roach
Mantodea	**Mantidae**	*Tenodera angustipennis*	Japanese mantis
		Tenodera aridifolia	Japanese giant mantis
Dermaptera	**Forficulidae**	*Timomenus komarovi*	Komarov's earwig
Orthoptera	**Rhaphidophoridae**	*Atachycines apicalis*	camel (or cave) cricket
		Anoplophilus acuticercus	camel (or cave) cricket
	Tettigoniidae	*Ducetia japonica*	Pacific ducetia
		Elimaea fallax	katydid
		Phaneroptera falcata	Sickle-bearing bush-cricket
		Hexacentrus unicolor	katydid
		Xizicus coreanus	katydid
		Decma improvisum	katydid
		Atlanticus sinensis	katydid
		Gampsocleis sedakovi obscura	katydid
		Gampsocleis ussuriensis	katydid
		Metrioptera bonneti	katydid
		Paratlanticus ussuriensis	Usser brown katydid
	Gryllidae	*Teleogryllus emma*	Emma field cricket
		Velarifictorus ornatus	burrowing cricket
	Gryllotalpidae	*Gryllotalpa orientalis*	Oriental mole cricket
	Tetrigidae	*Tetrix japonica*	Pygmy grasshopper
	Acrididae	*Oxya chinensis sinuosa*	short-horned grasshopper
		Shirakiacris shirakii	short-horned grasshopper
		Acrida cinerea cinerea	Chinese grasshopper
		Podismopsis ussuriensis ussurie	short-horned grasshopper

Table B.2 Continued

Order	Family	Scientific Name	Common Name[a]
Orthoptera	**Acrididae**	*Oedaleus infernalis*	short-horned grasshopper
		Trilophidia annulata	short-horned grasshopper
Hemiptera	**Reduviidae**	*Polididus armatissimus*	Spiny assassin bug
	Coreidae	*Cletus punctiger*	leaf-footed bug
	Alydidae	*Riptortus clavatus*	Bean bug
	Rhopalidae	*Rhopalus parumpunctatus*	scentless plant bug
	Plataspidae	*Coptosoma bifarium*	bean plataspid
	Acanthosomatidae	*Elasmucha dorsalis*	shield bug
	Cydnidae	*Geotomus pygmaeus*	Pygmy stinkbug
	Scutelleridae	*Eurygaster testudinaria*	Tortoise bug
	Pentatomidae	*Troilus luridus*	Bronze shieldbug
		Carpocoris purpureipennis	stink bug
		Halyomorpha halys	Brown marmorated stink bug
		Laprius gastricus	stink bug
		Nezara antennata	Eastern green stink bug
Homoptera	**Aphrophoridae**	*Lepyronia coleoptrata*	spittlebug
	Cicadellidae	*Bothrogonia ferruginea*	Black-tipped leafhopper
	Cicadidae	*Cryptotympana dubia*	Korean horse cicada
Neuroptera	**Corydalidae**	*Protohermes grandis*	dobsonfly
Coleoptera	**Cicindelidae**	*Cicindela gemmata*	tiger beetle
	Carabidae	*Anisodactylus signatus*	ground beetle
	Melolonthidae	*Holotrichia kiotoensis*	Whitegrub beetle
	Scarabaeidae	*Popillia mutans*	shiny leaf chafer
		Mimela splendens	shiny leaf chafer
		Anthracophora rusticola	flower scarab
	Buprestidae	*Dicerca furcata*	Birch jewel beetle
		Chrysochroa fulgidissima	jewel beetle
	Coccinellidae	*Coccinella septempunctata*	Seven-spot ladybird
		Harmonia axyridis	Asian lady beetle
		Henosepilachna vigintioctopunctata	Phytophagous lady-beetle
	Alleculidae	*Hymenalia rufipennis*	Comb-clawed beetle
	Cerambycidae	*Acmaeops angusticollis*	Grass green beetles
		Agapanthia pilicornis	Navy grassland beetle
	Chrysomelidae	*Lema honorata*	Red thorax leaf beetle
		Chrysomela populi	Broad-shouldered leaf beetle
		Agelastica coerulea	Alder tree leaf beetle
	Attelabidae	*Apoderus jekelii*	Leaf-rilling weevil
	Curculionidae	*Curculio sikkimensis*	Chestnut weevil
Hymenoptera	**Pompilidae**	*Cyphononyx dorsalis*	spider wasp
	Vespidae	*Vespa crabro flavofasciata*	European Hornet
		Vespula flaviceps	Korean Yellow-Jacket Wasp
	Sphecoidae	*Ammophila sabulosa infesta*	mud dauber
	Apidae	*Xylocopa appendiculata circumvolans*	Japanese carpenter bee
		Apis cerana	Asiatic honey bee
		Apis mellifera	Western honey bee

Table B.2 Continued

Order	Family	Scientific Name	Common Name[a]
Diptera	**Tipulidae**	*Nephrotoma virgata*	yellow gnat
	Culicidae	*Aedes albopictus*	Tiger mosquito
	Tabanidae	*Tabanus mandarinus*	horse fly
	Asilidae	*Promachus yesonicus*	robber Fly
	Syrphidae	*Cheilosia illustrata*	hoverfly
		Eristalis cerealis	drone fly
		Eristalis tenax	drone fly
	Calliphoridae	*Aldrichina grahami*	blow fly
		Lucilia caesar	blow fly
	Muscidae	*Muscina stabulans*	false stable fly
Lepidoptera	**Papilionidae**	*Papilio xuthus*	Asian swallowtail
		Papilio bianor dehaanii	Chinese peacock
	Pieridae	*Colias erate poliographus*	Eastern pale clouded yellow
		Pieris rapae orientalis	Common cabbage butterfly
		Pieris canidia kaolicola	Indian cabbage white
		Pieris melete	Gray-veined white butterfly
	Lycaenidae	*Tongeia fischeri*	Fischer's blue
		Palaeochrysophanus hippothoe amurensis	Short-tailed scarlet-blue butterfly
		Cupido minimus magnus	Small blue butterfly
		Celastrina argiolus ladonides	Holly blue
		Lycaeides argyronomon ussurica	Silver-studded blue
	Nymphalidae	*Libythea celtis celtoides*	Nettle-tree butterfly
		Melitaea arcesia	Blackvein fritillary
		Argyronome laodice japonica	Eastern silverstripe
		Limenitis doerriesi chosensis	An admiral
		Neptis philyroides	typical sailer
		Polygonia c-aureum	Asian comma
		Ypthima motschulskyi	Large three ring
		Mycalesis gotama	Chinese bushbrown
	Hesperidae	*Lobocla bifasciata*	scrub hopper
		Parnara guttata	Common Straight Swift
		Total Species:	**119**

[a] Where no common name for a species was found, the common name for the family or genus was used.

Appendix B.3 Birds Reported from Kunsan AB, 1999-2006

Table B.3 Birds Reported from Kunsan AB, 1999-2006.

Family, Common, and Species Names[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Anatidae – Ducks, Geese, and Waterfowl												
Northern Pintail (*Anas acuta*)					U							
Green-winged Teal (*Anas crecca*)		A					C					
Eurasian Wigeon (*Anas penelope*)					C							
Mallard (*Anas platyrhynchos*)	A	A	A	A	A	A	U					U
Eastern Spot-billed Duck (*Anas zonorhyncha*)	C	A	C	A	C	A	C	C	C	U	U	U
Gadwall (*Anas strepera*)					U							
Red-breasted Merganser (*Mergus serrator*)			U		R							
Common Shelduck (*Tadorna tadorna*)			A	A	A	A	U					
Phasianidae - Pheasants, Grouse, and Allies												
Japanese Quail (*Coturnix japonica*)											R	
Ring-necked Pheasant (*Phasianus colchicus*)	C	C	C	C	C	C	C	C	C	C	C	C
Phalacrocoracidae - Cormorants and Shags												
Great Cormorant (*Phalacrocorax carbo sinensis*)	R[b,c]				R							
Ardeidae - Herons, Egrets, and Bitterns												
Great Egret (*Ardea alba*)	U	U	C		C	U	U		C	C	U	C
Gray Heron (*Ardea cinerea*)	C	C	C	C	C	C	C	C	A	C	C	C
Cattle Egret (*Bubulcus ibis coromandus*)		R									A	C
Striated Heron (*Butorides striata*)												R
Little Egret (*Egretta garzetta*)	U	C						U		U	C	C
Intermediate Egret (*Mesophoyx intermedia*)											U	U
Black-crowned Night Heron (*Nycticorax nycticorax*)	C	C	C	C	C	C	C	C	C	R	C	C
Threskiornithidae - Ibises and Spoonbills												
Eurasian Spoonbill (*Platalea leucorodia*)[d]	U				U							U
Accipitridae - Hawks, Eagles, and Kites												
Eurasian Sparrowhawk (*Accipiter nisus*)						R						R
Chinese Sparrowhawk (*Accipiter soloensis*)		U						U		U	C	
Common Buzzard (*Buteo buteo buteo*)		U		R								
Rallidae - Rails, Gallinules, and Coots												
Eurasian Moorhen (*Gallinula chloropus chloropus*)							R					
Ruddy-breasted Crake (*Zapornia fusca*)	R										R	
Haematopodidae - Oystercatchers												
Eurasian Oystercatcher (*Haematopus ostralegus*)		C			U		C	C	U		C	C

Table B.3 continued.

Family, Common, and Species Names[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Charadriidae - Plovers												
Kentish Plover (*Charadrius alexandrinus*)	A	U	U	U	U	C	U	U	C	C	U	A
Little Ringed Plover (*Charadrius dubius*)		R				C	C	C	C	C	C	
Lesser Sand-plover (*Charadrius mongolus*)							U	U			C	U
Pacific Golden Plover (*Pluvialis fulva*)							R	U			C	C
Black-bellied Plover (*Pluvialis squatarola*)	R	U						R			C	U
Northern Lapwing (*Vanellus vanellus*)					R							
Scolopacidae - Sandpipers												
Common Sandpiper (*Actitis hypoleucos*)		C			U	R		U	R		U	C
Ruddy Turnstone (*Arenaria interpres*)							R				U	
Sharp-tailed Sandpiper (*Calidris acuminata*)											U	
Dunlin (*Calidris alpina*)	U	A				U	A	A				U
Red Knot (*Calidris canutus*)							C					
Red-necked Stint (*Calidris ruficollis*)		U					A	C		U	C	U
Great Knot (*Calidris tenuirostris*)	R					R	A	A			A	C
Common Snipe (*Gallinago gallinago*)	R	R				U	U				C	C
Black-tailed Godwit (*Limosa limosa*)						R	C	A			C	R
Eurasian Curlew (*Numenius arquata*)	U	A	A	R	A	A	A	U	C	U	A	A
Far Eastern Curlew (*Numenius madagascariensis*)		U	U			C	A		A	C	U	
Whimbrel (*Numenius phaeopus*)							C	A			C	U
Eurasian Woodcock (*Scolopax rusticola*)				R								
Grey-tailed Tattler (*Tringa brevipes*)								U			C	C
Wood Sandpiper (*Tringa glareola*)											C	R
Common Greenshank (*Tringa nebularia*)	C	C					C	C		C	C	C
Green Sandpiper (*Tringa ochropus*)											U	
Common Redshank (*Tringa totanus*)									R		U	
Terek Sandpiper (*Xenus cinereus*)	U	U					U	C			C	C
Glareolidae - Pratincoles and Coursers												
Oriental Pratincole (*Glareola maldivarum*)											R	
Laridae - Gulls												
Herring Gull (*Larus argentatus*)	U	U	A	A	A	A	A					
Black-tailed Gull (*Larus crassirostris*)	C	A	U	U	C	U		A	A	A	A	A
Black-headed Gull (*Chroicocephalus ridibundus*)					R				U			
Slaty-backed Gull (*Larus schistisagus*)			U	U	U		U					
Little Tern (*Sternula albifrons*)								C	C		C	
Columbidae - Pigeons												
Rock Pigeon (*Columba livia*)					R							
Oriental Turtle-Dove (*Streptopelia orientalis*)	A	C	A	C	A	A	C	C	C	C	C	C

Table B.3 continued.

Family, Common, and Species Names[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Cuculidae - Cuckoos												
Common Cuckoo (*Cuculus canorus*)								C	C			
Strigidae - Owls												
Northern Boobook (*Ninox japonica*)								U	U			
Caprimulgidae - Nightjars												
Gray Nightjar (*Caprimulgus jotaka*)								U	U			R
Alcedinidae - Kingfishers												
Common Kingfisher (*Alcedo atthis*)							U				U	
Black-capped Kingfisher (*Halcyon pileata*)								R				R
Coraciidae - Rollers												
Dollarbird (*Eurystomus orientalis*)								U	C		C	
Upupidae - Hoopoes												
Eurasian Hoopoe (*Upupa epops*)						U		U	U		U	
Picidae - Woodpeckers												
Great Spotted Woodpecker (*Dendrocopos major*)	C	C			U	C	U		C		C	C
Gray-headed Woodpecker (*Picus canus*)		U	U		U		U			R		U
Falconidae - Falcons												
Peregrine Falcon (*Falco peregrinus*)	R	R			R							
Eurasian Hobby (*Falco subbuteo*)									U		C	U
Eurasian Kestrel (*Falco tinnunculus*)	C	C	U	C	U	U	U	C	C	C	C	C
Laniidae - Shrikes												
Brown Shrike (*Lanius cristatus*)				R	R						R	
Bull-headed Shrike (*Lanius bucephalus*)	C	U	U	C	U				R			U
Oriolidae - Orioles												
Black-naped Oriole (*Oriolus chinensis*)								C				U
Corvidae - Crows												
Carrion Crow (*Corvus corone*)					U	R						
Rook (*Corvus frugilegus*)		A	A	A	C							
Daurian Jackdaw (*Corvus dauuricus*)			C	A								
Eurasian Magpie (*Pica pica*)	C	C	C	C	C	C	C	C	C	C	C	C
Alaudidae - Larks												
Eurasian Skylark (*Alauda arvensis*)	C	C	C		C	U	C	C	C	C	C	
Hirundinidae - Swallows												
Red-rumped Swallow (*Cecropis daurica*)								U	U		C	
Barn Swallow (*Hirundo rustica*)	U						U	C	C	C	C	A

Table B.3 continued.

Family, Common, and Species Names[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Paridae - Tits												
Coal Tit (*Periparus ater*)	C	U			C	C	U	C				
Japanese Tit (*Parus minor*)	C	C	C	C	C	C	C	C	C	U	C	C
Marsh Tit (*Poecile palustris*)					C	U						U
Varied Tit (*Sittiparus varius*)		U										
Pycnonotidae - Bulbul												
Brown-eared Bulbul (*Hypsipetes amaurotis*)	U	C	C	C	C	C	C	C	C		C	U
Regulidae - Kinglets												
Goldcrest (*Regulus regulus*)		R				U	U	C				R
Phylloscopidae – Leaf Warblers												
Arctic Warbler (*Phylloscopus borealis*)							U					
Eastern Crowned Leaf Warbler (*Phylloscopus coronatus*)							C	U				
Dusky Warbler (*Phylloscopus fuscatus*)							R					
Yellow-browed Warbler (*Phylloscopus inornatus*)	R						U					
Cettiidae (Bush-Warblers and Allies)												
Asian Stubtail (*Urosphena squameiceps*)							R	R				
Acrocephalidae – Reed Warblers and Allies												
Oriental Reed-warbler (*Acrocephalus orientalis*)								C	C		C	
Cisticolidae – Cisticolas and Allies												
Zitting Cisticola (*Cisticola juncidis*)									C			
Paradoxornthidae – Parrotbills, Wrentits, and Allies												
Vinous-throated Parrotbill (*Paradoxornis webbiana*)		C					C	C	U		C	C
Muscicapidae – Old World Flycatchers												
Blue-and-white Flycatcher (*Cyanoptila cyanomelana*)							C					
Narcissus Flycatcher (*Ficedula narcissina*)		R					U					
Red-breasted Flycatcher (*Ficedula parva*)		R										
Korean Flycatcher (*Ficedula zanthopygia*)							U				R	
Asian Brown Flycatcher (*Muscicapa latirostris*)							R	U				
Gray-streaked Flycatcher (*Muscicapa griseisticta*)								R				
Daurian Redstart (*Phoenicurus auroreus*)		C	C	C	U	U	U	C				
Siberian Stonechat (*Saxicola maurus*)						R	C					
Red-flanked Bluetail (*Tarsiger cyanurus*)							C					

Table B.3 Continued.

Family, Common, and Species Names[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Turdidae - Thrushes and Allies												
Blue Rock-Thrush (*Monticola solitarius*)									R			
Gray-backed Thrush (*Turdus hortulorum*)							R					
Naumann's Thrush (*Turdus naumanni*)				C	C	C	U					
Eyebrowed Thrush (*Turdus obscurus*)								U				
Pale Thrush (*Turdus pallidus*)							R					
Sturnidae - Starlings												
White-cheeked Starling (*Spodiopsar cineraceus*)						C	C	C	A	C	C	
Motacillidae - Wagtails and Pipits												
Red-throated Pipit (*Anthus cervinus*)							R					
Olive-backed Pipit (*Anthus hodgsoni*)		U	C		C	U	U					U
American Pipit (*Anthus rubescens*)	C	C	C									C
White Wagtail (*Motacilla alba*)	C		U		R	C	U	C	C	C	C	C
Emberizidae - Buntings												
Yellow-throated Bunting (*Emberiza elegans*)		C	C	C	C							
Rustic Bunting (*Emberiza rustica*)	R		C									
Fringillidae - Finches												
Oriental Greenfinch (*Chloris sinica*)	U	C	C	C	C	C	C	C	C		U	U
Eurasian Siskin (*Spinus spinus*)					C		U					
Hawfinch (*Coccothraustes coccothraustes*)					R	R						
Brambling (*Fringilla montifringilla*)	U				C		C					
Red Crossbill (*Loxia curvirostra*)					U	U						
Passeridae – Old World Sparrows												
Eurasian Tree Sparrow (*Passer montanus*)	A	C	C	C	C	C	C	C	C	C	C	C
TOTAL SPECIES	**38**	**48**	**32**	**27**	**49**	**41**	**64**	**53**	**39**	**24**	**57**	**51**

[a] Common and scientific names follow nomenclature from Clement et al., 2016 (available at eBird, Clements checklist; http://www.birds.cornell.edu/clementschecklist/).

[b] A - Abundant; C – Common; U – Uncommon; R – Rare.

[c] **Brown** shading indicates the species is a year-round resident and red shading that it is a summer visitor; both may breed at Kunsan AB or vicinity. **Green** shading indicates the species is a winter resident only. **Blue** shading indicates the species to be a migrant, observed primarily in spring and/or fall, and is not a resident at the base.

[d] Species listed in **red** are currently identified in KEGS 13-3b as endangered or ROK protected.

Page intentionally blank.

Appendix B.4 Birds Reported from Kunsan AB, 2011-2012

Table B.4 Species Observed during Avian Surveys on Kunsan AB, 2010-2011.	
Family	**Species (Scientific Name)[a]**
Anatidae - Ducks, Geese, and Waterfowl	Eastern Spot-billed Duck (*Anas zonorhynca*)
	Taiga/Tundra Bean Goose (*Anser fabalis/serrirostris*)
	Northern Shoveler (*Anas clypeata*)
Phasianidae – Pheasants, Grouse, and Allies	Ring-necked Pheasant (*Phasianus colchicus*)
Phalacrocorcidae – Cormorants and Shags	Unidentified cormorant
Ardeidae - Herons, Egrets, and Bitterns	Gray Heron (*Ardea cinerea*)
	Great Egret (*Ardea alba*)
	Little Egret (*Egretta garzetta*)
Rallidae – Rails, Gallinules, and Coots	Eurasian Moorhen (*Gallinula chloropus*)
Haematopodidae - Oystercatchers	Eurasian 0ystercatcher (*Haemotopus ostralegus*)
Charadriidae – Plovers and Lapwings	Little Ringed Plover (*Charadrius dubius*)
	Kentish Plover (*Chadrus alexandinus*)
Scolopacidae - Sandpiper and Allies	Great Knot (*Calidris tenuirostris*)
	Dunlin (*Calidris alpine*)
	Whimbrel (*Numenius phaeopus*)
	Eurasian Curlew (*Numenius arquata*)
Threskiornithidae - Spoonbills	Black-faced Spoonbill (*Platalea minor*)
Laridae – Gulls, Terns, and Allies	Black-tailed Gull (*Larus crassirostris*)
Columbidae – Pigeons and Doves	Oriental Turtle-Dove (*Streptopelia orientalis*)
Picidae - Woodpeckers	Great Spotted Woodpecker (*Dendrocopus major*)
Falconidae - Falcons	Eurasian Hobby (*Falco subbuteo*)
	Eurasian Kestrel (*Falco tinnunculus*)
Laniidae - Shrikes	Chinese Gray Shrike (*Lanius sphenocercus*)
	Bull-headed Shrike (*Lanius bucephalus*)
Corvidae – Crows, Jays, and Magpies	Eurasian Magpie (*Pica pica*)
	Carrion Crow (*Corvus corone*)
	Azure-winged Magpie (*Cyanopica cyanus*)
Paridae – Tits, Chickadees, and Titmice	Japanese Tit (*Parus minor*)
Pycnonotidae - Bulbuls	Brown-eared Bulbul (*Hypsipetes amaurotis*)
Acrocephalidae – Reed Warblers and Allies	Oriental Reed-Warbler (*Acrocephalus orientalis*)
Paradoxornithidae - Parrotbills	Vinous-throated Parrotbill (*Paradoxornis webbiana*)
Zosteropidae –White-Eyes	Japanese White-eye (*Zosterops japonicus*)
Musicapidae – Old World Flycatchers	Asian Brown Flycatcher (*Musicapa latiostris*)
	Daurian Redstart (*Phoenicurus auroreus*)
Sturnidae - Starlings	White-cheeked Starling (*Spodiospar cineraceus*)
Fringillidae – Finches and Allies	Oriental Greenfinch (*Chloris sinica*)
Passeridae – Old World Sparrows	Eurasian Tree Sparrow (*Passer montanus*)

[a] Common and scientific names follow nomenclature from Clement et al., 2016 (available at eBird, Clements checklist; http://www.birds.cornell.edu/clementschecklist/). Species highlighted in **red** have protected status per Kegs 13-2,d, e.

Appendix B.5 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020

Table B.5.1 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020

Family and Species[a,b]	Breeding Status in ROK[c]	Number Observed							Total Number Observed
		Wolf Pack Park	North POL Area	Flight Line	Big Coyote Hill	Little Coyote Hill	CE Area	Cantonment	
Anatidae - Ducks, Geese, and Waterfowl									
Greater White-fronted Goose *Anser albifron)*	0	0	0	105	225	73	128	0	531
Taiga/Tundra Bean Goose *Anser fabilis/serrirostris*	0	2	0	31	41	73	77	0	224
Common Shelduck *Tadorna tadorna*	0	0	0	0	15	0	0	0	15
Mallard *Anas platyrhynchos*	1	0	0	0	1,334	0	0	0	1,334
Eastern Spot-billed Duck *Anas zonorhyncha*	1	36	2	25	108	3	18	0	192
Northern Pintail *Anas acuta*	0	0	0	0	153	0	0	0	153
Green-winged Teal *Anas crecca*	0	0	0	0	5	0	0	0	5
Common Pochard (n) *Aythya ferina*	0	0	0	0	2	0	0	0	2
Tufted Duck (n) *Aythya fuligula*	0	0	0	0	4	0	0	0	4
Greater Scaup (n) *Aythya marila*	0	0	0	0	196	0	0	0	196
Common Goldeneye (n) *Bucephala clangula*	0	0	0	0	3	0	0	0	3
Common Merganser *Mergus merganser*	1	0	0	0	6	0	0	0	6
Red-breasted Merganser *Mergus serrator*	0	0	0	0	2	0	0	0	2
Unidentified Waterfowl sp. *Anatidae* sp.		0	0	4	371	0	0	0	375
Phasianidae - Pheasants, Grouse, and Allies									
Ring-necked Pheasant *Phasianus colchicus*	1	11	44	90	90	15	30	0	280
Gaviidae - Loons									
Red-throated Loon (n) *Gavia stellata*	0	0	0	0	1	0	0	0	1
Podicipedidae - Grebes									
Great Crested Grebe (n) *Podiceps cristatus*	1	0	0	0	13	0	0	0	13
Horned Grebe (n) *Podiceps auritus*	0	0	0	0	57	0	0	0	57
Eared Grebe (n) *Podiceps nigricollis*	0	0	0	0	7	0	0	0	7
Phalacrocoracidae - Cormorants and Shags									
Great cormorant *Phalacrocorax carbo*	1	11	1	1,147	7,775	2	0	7	8,943

Table B.5.1 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020									
Family and Species[a,b]	Breeding Status in ROK[c]	Number Observed							Total Number Observed
		Wolf Pack Park	North POL Area	Flight Line	Big Coyote Hill	Little Coyote Hill	CE Area	Cantonment	
Ardeidae - Herons, Egrets, and Bitterns									
Black-crowned Night Heron *Nycticorax nycticorax*	1	1	5	0	0	0	26	0	32
Cattle Egret *Bubulcus ibis coromandus*	1	0	3	747	45	5	83	56	939
Gray Heron *Ardea cinerea*	1	3	6	21	313	2	18	2	365
Great Egret *Ardea alba*	1	1	4	53	431	0	7	0	496
Intermediate Egret *Mesophoyx intermedia*	1	2	13	27	72	1	2	1	118
Little Egret *Egretta garzetta*	1	1	6	20	21	0	0	1	49
Unidentified Areidae sp. *Ardea/Mesophoyx/Egretta* sp.		0	12	1	196	0	4	0	213
Striated Heron *Butorides striata*	1	1	15	2	2	0	1	0	21
Accipitridae - Hawks, Eagles, and Kites									
Osprey *Pandion haliaetus*	0	0	0	0	2	0	0	0	2
Cinereous Vulture *Aegypius monachus*	0	0	0	3	1	0	0	0	4
Chinese Sparrowhawk *Accipiter soloensis*	1	1	1	0	1	0	0	0	3
Eurasian Sparrowhawk *Accipiter nisus*	0	0	3	0	2	1	1	0	7
Northern Goshawk *Accipiter gentilis*	1	0	0	0	1	0	0	0	1
Northern Harrier (n) *Circus cyaneus*	0	0	0	3	2	0	0	0	5
Rough-legged Hawk (n) *Buteo lagopus*	0	0	0	3	0	0	0	0	3
Eastern Buzzard (n) *Buteo japonicus*	0	0	4	10	5	1	6	0	26
White-tailed Eagle *Haliaeetus albicilla*	0	0	0	0	1	0	0	0	1
Unidentified Accipiter sp. *Accipiter* sp.		0	1	0	0	0	0	0	1
Rallidae - Rails, Gallinules, and Coots									
Eurasian Moorhen (n) *Gallinula chloropus*	1	0	0	3	0	0	6	0	9
Eurasian Coot *Fulicia atra*	0	0	0	0	53	0	0	0	53
Haematopodidae - Oystercatchers									
Eurasian Oystercatcher *Haematopus ostralegus*	1	0	0	0	107	0	0	0	107
Black-winged Stilt *Himantopus himantopus*	1	0	0	0	6	0	0	0	6
Charadriidae - Plovers and Lapwings									
Pacific Golden Plover *Pluvialis fulva*	0	0	0	0	1	0	0	0	1

Table B.5.1 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020									
Family and Species[a,b]	Breeding Status in ROK[c]	Number Observed							Total Number Observed
		Wolf Pack Park	North POL Area	Flight Line	Big Coyote Hill	Little Coyote Hill	CE Area	Cantonment	
Black-bellied Plover *Pluvialis squatarola*	0	0	0	0	3	0	0	0	3
Northern Lapwing *Vanellus vanellus*	0	0	0	1	0	0	0	0	1
Little Ringed Plover *Charadrius dubius*	1	0	0	6	0	0	0	0	6
Scolopacidae - Sandpipers and Allies									
Eurasian Woodcock *Scolopax rusticola*	0	0	0	0	0	3	0	0	3
Common Snipe *Gallinago gallinago*	0	0	0	9	0	3	2	0	14
Eurasian Curlew *Numenius arquata*	0	0	0	0	13	0	0	0	13
Far Eastern Curlew *Numenius madagascariensis*	0	0	0	0	13	0	0	0	13
Common Greenshank *Tringa nebularia*	0	0	0	9	48	0	0	0	57
Whimbrel *Numenius phaeopus*	0	0	7	24	10	0	12	0	53
Common Sandpiper *Actitis hypoleucos*	1	0	0	0	1	0	0	1	2
Temminck's Stint (n) *Calidris temminckii*	0	0	0	0	17	0	0	0	17
Dunlin *Calidris alpina*	0	0	0	0	62	0	0	0	62
Green Sandpiper *Tringa ochropus*	0	0	0	6	0	0	0	0	6
Laridae - Gulls, Terns, and Skimmers									
Black-headed Gull *Chroicocephalus ridibundus*	0	0	0	0	6	0	0	0	6
Black-tailed Gull *Larus crassirostris*	1	0	0	0	1,695	0	0	0	1,695
Herring Gull *Larus argentatus*	0	0	0	0	6	0	0	0	6
Unidentified Gull sp. *Larinae* sp.		0	0	0	783	25	0	0	808
Little Tern *Sternula albifrons*	1	0	0	0	47	0	0	0	47
Unidentified Tern sp. *Sterna sp*		0	0	1	2	0	0	0	3
Columbidae - Pigeons and Doves									
Rock Pigeon *Columba livia*	1	0	0	80	0	1	5	1	87
Oriental Turtle-dove *Streptopelia orientalis*	1	154	407	34	99	26	414	71	1,205
Cuculidae - Cuckoos									
Common Cuckoo *Cuculus canorus*	1	10	22	3	14	2	4	0	55
Unidentified Cuckoo sp. *Cuculus sp.*		0	1	0	0	0	0	0	1

Table B.5.1 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020									
Family and Species[a,b]	Breeding Status in ROK[c]	Number Observed							Total Number Observed
		Wolf Pack Park	North POL Area	Flight Line	Big Coyote Hill	Little Coyote Hill	CE Area	Cantonment	
Strigidae - Owls									
Oriental Scops-owl (n) *Otus sunia*	1	0	1	0	1	0	0	0	2
Northern Boobook *Ninox japonica*	1	2	0	0	27	0	0	0	29
Caprimulgidae – Night Jars									
Grey Nightjar *Caprimulgus jotaka*	1	0	0	0	6	1	0	0	7
Upupidae - Hoopoes									
Eurasian Hoopoe *Upupa epops*	1	0	8	4	4	0	1	4	21
Alcedinidae - Kingfishers									
Common Kingfisher *Alcedo atthis*	1	0	0	1	2	0	0	0	3
Coraciidae - Rollers									
Dollarbird *Eurystomus orientalis*	1	11	28	0	6	0	4	3	52
Picidae - Woodpeckers									
Pygmy Woodpecker (n) *Dendrocopos kizuki*	1	1	3	0	4	1	0	0	9
Great Spotted Woodpecker *Dendrocopos major*	1	13	18	0	29	0	0	2	62
Gray-headed Woodpecker *Picus canus*	1	5	15	3	9	1	4	2	39
Falconidae - Falcons and Caracaras									
Eurasian Kestrel *Falco tinnunculus*	1	17	38	61	65	60	42	14	298
Eurasian Hobby *Falco subbuteo*	1	27	5	1	6	1	1	7	48
Peregrine Falcon *Falco peregrinus*	1	0	0	1	1	0	0	0	2
Unidentified Falcon sp. *Falco* sp	0	3	0	0	0	0	0	0	3
Pittidae - Pittas									
Fairy Pitta (n) *Pitta nympha*	1	0	0	0	1	0	0	0	1
Laniidae - Shrikes									
Bull-headed Shrike *Lanius bucephalus*	1	0	4	19	7	4	1	0	35
Brown Shrike *Lanius cristatus*	1	0	0	1	2	1	2	0	6
Chinese Gray Shrike (n) *Lanius sphenocercus*	2	0	0	7	0	0	0	0	7
Tiger Shrike (n) Lanius tigrinus	1	1	1	0	1	0	0	0	3
Long-tailed Shrike *Lanius schach*	0	0	0	0	0	0	1	0	1
Brown/Bull-headed Shrike *Lanius* sp.	1	0	4	2	2	1	0	0	9
Oriolidae - Old World Orioles									
Black-naped Oriole *Oriolus chinensis*	1	10	31	0	11	2	0	0	54

Table B.5.1 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020									
		Number Observed							
Family and Species[a,b]	Breeding Status in ROK[c]	Wolf Pack Park	North POL Area	Flight Line	Big Coyote Hill	Little Coyote Hill	CE Area	Cantonment	Total Number Observed
Corvidae - Crows, Jays, and Magpies									
Eurasian Jay (n) *Garrulus glandarius*	1	9	31	10	11	0	0	0	61
Azure-winged Magpie *Cyanopica cyanus*	1	115	168	8	85	38	32	28	474
Oriental Magpie *Pica serica*	1	94	279	473	180	86	128	144	1,384
Daurian Jackdaw *Corvus dauuricus*	0	0	0	1	0	0	0	0	1
Carrion Crow *Covus corone*	1	0	0	1	1	0	0	0	2
Large-billed Crow *Corvus macrorhynchus*	1	1	0	0	2	0	0	0	3
Unidentified Crow sp. *Corvus* sp.		0	1	0	0	0	0	0	1
Alaudidae - Larks									
Eurasian Skylark *Alauda arvensis*	1	0	0	97	8	0	0	0	105
Hirundinidae - Swallows									
Barn Swallow *Hirundo rustica*	1	23	59	60	119	4	210	0	475
Red-rumped Swallow *Cecropis daurica*	1	0	0	2	0	0	0	0	2
Asian House-martin *Delichon dasypus*	1	0	0	0	1	0	0	0	1
Unidentified Swallow sp. Hirundinidae sp.		0	1	5	4	0	0	0	10
Paridae - Tits, Chickadees, and Titmice									
Coal Tit *Periparus ater*	1	13	6	0	16	0	0	0	35
Varied Tit *Sittiparus varius*	1	0	0	2	6	0	0	0	8
Marsh Tit *Poecile palustris*	1	14	35	0	15	3	0	0	67
Japanese Tit *Parus minor*	1	125	325	125	512	39	11	42	1,179
Remizidae - Penduline-Tits									
Chinese Penduline-tit (n) *Remiz consobrinus*	0	0	0	5	0	0	13	0	18
Aegithalidae - Long-tailed Tits									
Long-tailed Tit (n) *Aegithalos caudatus*	1	0	21	4	113	5	0	0	143
Troglodytidae - Wrens									
Eurasian Wren (n) *Troglodytes troglodytes*	1	0	7	0	0	0	1	0	8
Pycnonotidae - Bulbuls									
Light-vented Bulbul (n) *Pycnonotus sinensis*	1	0	0	0	0	1	0	0	1
Brown-eared Bulbul *Hypsipetes amaurotis*	1	127	329	1	273	36	19	27	812

Table B.5.1 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020									
Family and Species[a,b]	Breeding Status in ROK[c]	Number Observed							Total Number Observed
		Wolf Pack Park	North POL Area	Flight Line	Big Coyote Hill	Little Coyote Hill	CE Area	Cantonment	
Regulidae - Kinglets									
Goldcrest *Regulus regulus*	0	0	4	0	4	0	0	0	8
Phylloscopidae - Leaf Warblers									
Yellow-browed Warbler *Phylloscopus inornatus*	0	0	4	0	1	0	0	0	5
Eastern Crowned Leaf Warbler *Phylloscopus coronatus*	1	0	16	1	4	0	0	0	21
Arctic Warbler *Phylloscopus borealis*	0	0	3	0	0	0	0	0	3
Kamchatka Leaf Warbler (n) *Phylloscopus examinandus*	0	0	2	0	7	1	0	0	10
Arctic/Kamchatka Leaf/Japanese Leaf Warbler *Phylloscopus borealis/ examinandus/xanthodryas*		0	4	0	1	0	0	0	5
Unidentified Leaf Warbler sp. *Phylloscopus* sp.		0	2	0	1	0	0	0	3
Acrocephalidae - Reed-Warblers and Allies									
Oriental Reed-warbler *Acrocephalus orientalis*	1	0	0	45	1	0	14	0	61
Cettiidae – Bush-Warbers and Allies									
Asian Stubtail Urosphena squameiceps	1	0	0	0	1	0	0	0	1
Cisticolidae - Cisticolas and Allies									
Zitting Cisticola *Cisticola juncidis*	1	0	1	28	20	1	0	0	50
Paradoxornithidae - Parrotbills, Wrentit, and Allies									
Vinous-throated Parrotbill *Paradoxornis webbiana*	1	28	81	106	303	55	105	0	678
Muscicapidae - Old World Flycatchers									
Dark-sided Flycatcher (n) *Muscicapa sibirica*	0	0	0	0	1	0	0	0	1
Asian Brown Flycatcher *Muscicapa latirostris*	1	0	5	0	0	0	0	1	6
Gray-streaked Flycatcher *Musicapa grieisticta*	0	0	5	0	4	0	2	1	12
Unidentified Flycatcher sp. *Muscicapa* sp.		0	0	0	1	1	0	2	4
Blue-and-white Flycatcher *Cyanoptila cyanomelana*	1	0	4	0	3	1	0	0	8
Red-flanked Bluetail (n) *Tarsiger cyanurus*	0	0	53	0	1	0	5	0	59
Korean Flycatcher *Ficedula zanthopygia*	1	0	2	0	0	0	0	0	2
Daurian Redstart *Phoenicurus auroreus*	1	2	11	4	21	4	1	0	43
Siberian Stonechat (n) *Saxicola maurus*	1	0	0	27	0	0	0	0	27

Table B.5.1 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020									
		Number Observed							
Family and Species[a,b]	Breeding Status in ROK[c]	Wolf Pack Park	North POL Area	Flight Line	Big Coyote Hill	Little Coyote Hill	CE Area	Cantonment	Total Number Observed
Turdidae - Thrushes and Allies									
White's Thrush (n) *Zoothera auerea*	1	0	0	0	1	0	0	0	1
Gray-backed Thrush (n) *Turdus hortulorum*	1	0	18	4	0	0	0	0	22
Pale Thrush (n) *Turdus pallidus*	1	0	7	8	4	0	0	0	19
Brown-headed Thrush (n *Turdus chrysolaus*	0	0	0	0	0	0	1	0	1
Dusky Thrush *Turdus eunomus*	0	15	6	22	2	0	11	73	129
Naumann's Thrush (n) *Turdus naumanni*	0	0	0	0	0	0	0	8	8
Unidentified Thrush sp. *Turdus* sp.		0	13	0	0	0	1	0	14
Sturnidae - Starlings									
Red-billed Starling (n) *Spodiopsar sericeus*	1	1	39	0	0	0	0	1	41
White-cheeked Starling *Spodiopsar cineraceus*	1	15	58	58	39	0	276	14	460
Motacillidae - Wagtails and Pipits									
Gray Wagtail (n) *Motacilla cinerea*	1	0	1	0	0	0	1	0	2
White Wagtail *Motacilla alba*	1	3	2	4	0	0	5	9	23
Olive-backed Pipit *Anthus hodgsoni*	1	0	1	35	0	0	0	2	38
American Pipit *Anthus rubescens*	0	0	0	116	0	0	0	0	116
Richard's Pipit *Anthus richardi*	0	0	0	9	0	0	0	0	9
Blyth's Pipit *Anthus godlewski*	0	0	0	1	0	0	0	0	1
Unidentified Pipit sp. *Anthus* sp.	0	1	0	4	0	0	3	0	8
Emberizidae - Buntings and New World Sparrows									
Tristram's Bunting (n) *Emberiza tristrami*	1	0	1	0	0	0	0	0	1
Rustic Bunting *Emberiza rustica*	0	0	0	0	1	0	0	0	1
Yellow-throated Bunting *Emberiza elegans*	1	7	131	17	59	0	0	4	218
Black-faced Bunting (n) *Emberiza spodocephala*	2	0	0	0	0	0	1	0	1
Pallas's Bunting *Emberiza pallasi*	0	0	0	5	0	0	0	0	5
Reed Bunting *Emberiza schoeniclus*	0	0	0	3	0	0	0	0	3
Fringillidae - Finches, Euphonias, and Allies									
Brambling *Fringilla montifringilla*	0	0	1	2	1	0	0	30	34

Table B.5.1 Birds Observed during Avian Surveys on Kunsan AB, 2014-2020

Family and Species[a,b]	Breeding Status in ROK[c]	Number Observed							Total Number Observed
		Wolf Pack Park	North POL Area	Flight Line	Big Coyote Hill	Little Coyote Hill	CE Area	Cantonment	
Fringillidae - Finches, Euphonias, and Allies									
Oriental Greenfinch *Chloris sinica*	1	13	19	54	3	0	16	38	143
Hawfinch *Coccothraustes coccothraustes*	0	0	0	0	0	0	0	5	5
Eurasian Siskin *Spinus spinus*	2	5	20	0	29	0	0	0	54
Passeridae - Old World Sparrows									
Eurasian Tree Sparrow *Passer montanus*	1	38	68	312	0	5	324	161	908
Total individuals		688	2,146	2,786	6,298	468	1,347	673	14,406
Total species (including unidentified)		33	72	59	94	35	44	43	139
Total identified species		33	64	56	88	34	42	43	124

[a] Common and scientific names follow nomenclature from Clements et al., 2016 (available at eBird, Clements checklist; http://www.birds.cornell.edu/clementschecklist/). Species shown in red have protected status per Kegs 13-3.

[b] An 'n' denotes a species not previously reported from Kunsan AB.

[c] Breeding status codes: 0 = not breeding; 1 = confirmed breeding record in South Korea; 2 = presumed breeding in South Korea; from the *Birds Korea Checklist for the Republic of Korea*,2014 (www.birdskorea.org).

Table B.5.2. Birds Observed during Avian Surveys on Kunsan AB, 2014-2020, by Survey Date.

Family and Species[a,b]	Number Observed									Total
	Sep 2014	Feb 2015	Apr 2015	June 2016	Aug 2016	May 2017	July 2017	June 2018	Aug 2018	
Anatidae - Ducks, Geese, and Waterfowl										
Taiga/Tundra Bean Goose *Anser fabilis/serrirostris*	0	67	0	0	0	0	0	0	0	67
Common Shelduck *Tadorna tadorna*	0	14	1	0	0	0	0	0	0	15
Mallard *Anas platyrhynchos*	0	1066	49	0	0	0	0	0	0	1,115
Eastern Spot-billed Duck *Anas zonorhyncha*	2	61	11	13	14	1	0	3	6	111
Northern Pintail *Anas acuta*	0	151	0	0	0	0	0	0	0	151
Common Pochard (n) *Aythya ferina*	0	2	0	0	0	0	0	0	0	2
Tufted Duck (n) *Aythya fuligula*	0	0	2	0	0	0	0	0	0	2
Greater Scaup (n) *Aythya marila*	0	0	87	0	0	0	0	0	0	87
Common Goldeneye (n) *Bucephala clangula*	0	3	0	0	0	0	0	0	0	3
Common Merganser *Mergus merganser*	0	1	0	0	0	0	0	0	0	1
Red-breasted Merganser *Mergus serrator*	0	2	0	0	0	0	0	0	0	2
Unidentified Waterfowl sp. Anatidae sp.	0	0	0	0	4	0	0	0	0	4
Phasianidae - Pheasants, Grouse, and Allies										
Ring-necked Pheasant *Phasianus colchicus*	26	20	43	35	8	27	6	37	49	251
Gaviidae - Loons										
Red-throated Loon (n) *Gavia stellata*	0	0	1	0	0	0	0	0	0	1
Podicipedidae - Grebes										
Great Crested Grebe (n) *Podiceps cristatus*	0	0	3	0	0	0	0	4	0	7
Horned Grebe (n) *Podiceps auritus*	0	2	0	0	0	0	0	0	0	2
Eared Grebe (n) *Podiceps nigricollis*	0	0	3	0	0	0	0	0	0	3
Phalacrocoracidae - Cormorants and Shags										
Great cormorant *Phalacrocorax carbo*	21	20	0	1	0	2	4	8	607	663
Ardeidae - Herons, Egrets, and Bitterns										
Black-crowned Night Heron *Nycticorax nycticorax*	25	1	3	2	0	0	1	0	0	32
Cattle Egret *Bubulcus ibis coromandus*	246	0	0	0	168	0	238	0	277	929
Gray Heron *Ardea cinerea*	58	3	7	26	21	15	30	14	26	200

Table B.5.2. Continued.

Family and Species[a,b]	Number Observed									Total
	Sep 2014	Feb 2015	Apr 2015	June 2016	Aug 2016	May 2017	July 2017	June 2018	Aug 2018	
Ardeidae - Herons, Egrets, and Bitterns (continued)										
Great Egret *Ardea alba*	153	3	3	30	102	5	7	5	50	358
Intermediate Egret *Mesophoyx intermedia*	20	0	0	6	0	7	58	15	3	109
Little Egret *Egretta garzetta*	4	2	0	2	7	1	19	1	3	39
Unidentified Areidae sp. *Ardea/Mesophoyx/Egretta* sp.	0	0	0	1	15	10	`11	1	165	203
Striated Heron *Butorides striata*	0	0	0	5	2	2	3	2	4	16
Accipitridae - Hawks, Eagles, and Kites										
Chinese Sparrowhawk *Accipiter soloensis*	0	0	0	0	0	0	0	3	0	3
Eurasian Sparrowhawk *Accipiter nisus*	0	1	4	0	0	0	0	0	0	5
Northern Harrier (n) *Circus cyaneus*	0	1	0	0	0	0	0	0	0	1
Rough-legged Hawk (n) *Buteo lagopus*	0	2	0	0	0	0	0	0	0	2
Eastern Buzzard (n) *Buteo japonicus*	0	11	0	0	0	0	0	0	0	11
Unidentified Accipiter sp. *Accipiter* sp.	0	1	0	0	0	0	0	0	0	1
Rallidae - Rails, Gallinules, and Coots										
Eurasian Moorhen (n) *Gallinula chloropus*	5	0	0	0	0	0	0	0	0	5
Haematopodidae - Oystercatchers										
Eurasian Oystercatcher *Haematopus ostralegus*	7	0	5	3	0	5	0	7	77	104
Charadriidae - Plovers and Lapwings										
Pacific Golden Plover *Pluvialis fulva*	0	0	1	0	0	0	0	0	0	1
Black-bellied Plover *Pluvialis squatarola*	0	3	0	0	0	0	0	0	0	3
Little Ringed Plover *Charadrius dubius*	0	0	6	0	0	0	0	0	0	6
Scolopacidae - Sandpipers and Allies										
Eurasian Woodcock *Scolopax rusticola*	1	2	0	0	0	0	0	0	0	3
Common Snipe *Gallinago gallinago*	7	1	0	0	0	2	0	0	0	8
Whimbrel *Numenius phaeopus*	0	0	0	0	0	53	0	0	0	53
Eurasian Curlew *Numenius arquata*	3	0	3	0	4	0	0	0	3	13
Far Eastern Curlew *Numenius madagascariensis*	0	0	6	0	7	0	0	0	0	13
Common Greenshank *Tringa nebularia*	22	0	0	0	0	1	0	29	0	52

Table B.5.2. Continued.

Family and Species[a,b]	Number Observed									Total
	Sep 2014	Feb 2015	Apr 2015	June 2016	Aug 2016	May 2017	July 2017	June 2018	August 2018	
Scolopacidae - Sandpipers and Allies (continued)										
Common Sandpiper *Actitis hypoleucos*	0	0	0	0	1	0	0	0	1	2
Temminck's Stint (n) *Calidris temminckii*	0	17	0	0	0	0	0	0	0	17
Dunlin *Calidris alpina*	0	0	62	0	0	0	0	0	0	62
Green Sandpiper *Tringa ochropus*	0	0	0	0	0	0	6	0	0	6
Laridae - Gulls, Terns, and Skimmers										
Black-headed Gull *Chroicocephalus ridibundus*	0	6	0	0	0	0	0	0	0	6
Black-tailed Gull *Larus crassirostris*	798	6	4	34	159	9	58	18	257	1,343
Herring Gull *Larus argentatus*	0	4	1	0	0	0	1	0	0	6
Unidentified Gull sp. *Larinae* sp.	0	1	0	5	776	1	0	0	0	783
Little Tern *Sternula albifrons*	0	0	0	3	0	0	0	18	0	21
Unidentified Tern sp. *Sterna sp*	1	0	0	0	0	1	0	0	0	2
Columbidae - Pigeons and Doves										
Rock Pigeon *Columba livia*	0	0	1	12	23	0	23	4	6	69
Oriental Turtle-Dove *Streptopelia orientalis*	87	202	93	88	68	40	32	62	100	772
Cuculidae - Cuckoos										
Common Cuckoo *Cuculus canorus*	0	0	0	21	1	11	1	13	0	47
Unidentified Cuckoo sp. *Cuculus sp.*	0	0	1	0	0	0	0	0	0	1
Strigidae - Owls										
Oriental Scops-owl (n) *Otus sunia*	0	0	0	0	0	0	2	0	0	2
Northern Boobook *Ninox japonica*	0	0	0	0	0	8	8	7	3	26
Caprimulgidae – Night Jars										
Grey Nightjar *Caprimulgus jotaka*	0	0	0	0	0	0	2	3	1	6
Upupidae - Hoopoes										
Eurasian Hoopoe *Upupa epops*	0	1	0	0	3	0	2	3	2	11
Alcedinidae - Kingfishers										
Common Kingfisher *Alcedo atthis*	0	0	0	0	1	0	0	2	0	3
Coraciidae - Rollers										
Dollarbird *Eurystomus orientalis*	0	0	0	5	13	12	3	8	8	49

Table B.5.2. Continued.

Family and Species[a,b]	Number Observed									Total
	Sep 2014	Feb 2015	Apr 2015	June 2016	Aug 2016	May 2017	July 2017	June 2018	Aug 2018	
Picidae - Woodpeckers										
Pygmy Woodpecker (n) *Dendrocopos kizuki*	0	1	0	1	0	0	2	1	1	6
Great Spotted Woodpecker *Dendrocopos major*	18	4	1	3	2	2	0	12	4	46
Gray-headed Woodpecker *Picus canus*	6	8	5	2	0	6	2	0	0	29
Falconidae - Falcons and Caracaras										
Eurasian Kestrel *Falco tinnunculus*	14	13	7	36	49	1	35	33	73	264
Eurasian Hobby *Falco subbuteo*	0	0	0	10	8	2	1	7	11	39
Peregrine Falcon *Falco peregrinus*	0	0	0	0	1	0	1	0	0	2
Unidentified Falcon sp. *Falco* sp	0	0	0	0	3	0	0	0	0	3
Pittidae - Pittas										
Fairy Pitta (n) *Pitta nympha*	0	0	0	1	0	0	0	0	0	1
Laniidae - Shrikes										
Bull-headed Shrike *Lanius bucephalus*	0	9	0	0	8	0	0	0	0	17
Brown Shrike *Lanius cristatus*	1	0	0	0	0	0	3	0	2	6
Tiger Shrike *Lanius tigrinus*	0	0	0	0	0	2	0	0	1	3
Chinese Gray Shrike (n) *Lanius sphenocercus*	4	0	0	0	0	0	0	0	0	4
Brown/Bull-headed Shrike *Lanius* sp.	1	0	0	0	0	0	0	0	1	2
Oriolidae - Old World Orioles										
Black-naped Oriole *Oriolus chinensis*	0	0	0	8	7	8	1	12	8	44
Corvidae - Crows, Jays, and Magpies										
Eurasian Jay (n) *Garrulus glandarius*	7	0	0	19	1	3	11	2	3	46
Azure-winged Magpie *Cyanopica cyanus*	26	0	0	4	149	2	85	48	75	389
Eurasian Magpie *Pica pica*	69	69	85	248	171	65	60	166	208	1,141
Daurian Jackdaw *Corvus dauuricus*	1	0	0	0	0	0	0	0	0	1
Carrion Crow *Corvus corone*	0	0	0	0	0	0	0	1	0	1
Unidentified Crow sp. *Corvus* sp.	0	1	0	0	0	0	0	0	0	1
Alaudidae - Larks										
Eurasian Skylark *Alauda arvensis*	0	0	9	8	0	10	5	6	0	38

Table B.5.2. Continued.

Family and Species[a,b]	Number Observed									Total
	Sep 2014	Feb 2015	Apr 2015	June 2016	Aug 2016	May 2017	July 2017	June 2018	Aug 2018	
Hirundinidae - Swallows										
Barn Swallow *Hirundo rustica*	67	0	8	34	92	9	9	58	92	369
Red-rumped Swallow Cecropis daurica	0	0	0	2	0	0	0	0	0	2
Asian House Martin *Delichon dasypus*	0	0	0	0	0	0	1	0	0	1
Unidentified Swallow sp. Hirundinidae sp.	0	0	0	6	2	0	0	0	2	10
Paridae - Tits, Chickadees, and Titmice										
Coal Tit *Periparus ater*	0	1	0	0	0	0	0	2	0	3
Varied Tit *Sittiparus varius*	6	0	0	0	2	0	0	0	0	8
Marsh Tit *Poecile palustris*	9	7	12	12	2	6	0	3	0	51
Japanese Tit *Parus minor*	41	203	113	135	83	49	79	105	86	894
Remizidae – Penduline Tits										
Chinese Penduline-Tit (n) *Remiz consobrinus*	0	0	13	0	0	0	0	0	0	13
Aegithalidae - Long-tailed Tits										
Long-tailed Tit (n) *Aegithalos caudatus*	0	32	19	24	9	5	15	0	13	117
Troglodytidae - Wrens										
Eurasian Wren (n) *Troglodytes troglodytes*	0	1	7	0	0	0	0	0	0	8
Pycnonotidae - Bulbuls										
Light-vented Bulbul *Pycnonotus sinensis*	0	0	0	0	0	0	0	1	0	1
Brown-eared Bulbul *Hypsipetes amaurotis*	26	25	46	83	64	95	48	129	61	577
Regulidae - Kinglets										
Goldcrest *Regulus regulus*	0	5	3	0	0	0	0	0	0	8
Phylloscopidae - Leaf Warblers										
Yellow-browed Warbler *Phylloscopus inornatus*	1	0	4	0	0	0	0	0	0	5
Eastern Crowned Leaf Warbler *Phylloscopus coronatus*	0	0	12	0	4	1	0	0	4	21
Arctic Warbler *Phylloscopus borealis*	0	0	0	0	0	3	0	0	0	3
Kamchatka Leaf Warbler (n) *Phylloscopus examinandus*	0	0	0	9	0	1	0	0	0	10
Arctic/Kamchatka Leaf/Japanese Leaf Warbler *Phylloscopus borealis/ examinandus/xanthodryas*	0	0	0	0	2	0	0	0	0	2

Table B.5.2. Continued.

Family and Species[a, b]	Number Observed									Total
	Sep 2014	Feb 2015	Apr 2015	June 2016	Aug 2016	May 2017	July 2017	June 2018	Aug 2018	
Phylloscopidae - Leaf Warblers (continued)										
Unidentified Leaf Warbler sp. *Phylloscopus* sp.	0	0	1	0	2	0	0	0	0	3
Acrocephalidae - Reed-Warblers and Allies										
Oriental Reed-Warbler *Acrocephalus orientalis*	1	0	0	47	4	1	5	1	0	59
Cisticolidae - Cisticolas and Allies										
Zitting Cisticola *Cisticola juncidis*	11	0	0	0	2	7	5	2	3	30
Paradoxornithidae - Parrotbills, Wrentits, and Allies										
Vinous-throated Parrotbill *Paradoxornis webbiana*	20	30	61	28	107	53	63	54	141	557
Muscicapidae - Old World Flycatchers										
Dark-sided Flycatcher (n) *Muscicapa sibirica*	1	0	0	0	0	0	0	0	1	2
Asian Brown Flycatcher *Muscicapa latirostris*	0	0	1	0	0	5	0	0	0	6
Gray-streaked Flycatcher *Muscicapa griseisticta*	0	0	0	0	0	12	0	0	0	12
Unidentified Flycatcher sp. Muscicapa sp.	0	0	0	0	1	2	0	0	0	3
Blue-and-white Flycatcher *Cyanoptila cyanomelana*	0	0	8	0	0	0	0	0	0	8
Red-flanked Bluetail (n) *Tarsiger cyanurus*	0	0	59	0	0	0	0	0	0	59
Korean Flycatcher *Ficedula zanthopygia*	0	0	0	0	2	0	0	0	0	2
Daurian Redstart *Phoenicurus auroreus*	3	1	3	2	0	5	4	0	5	23
Siberian Stonechat (n) *Saxicola maurus*	3	0	8	0	12	0	0	0	3	26
Turdidae - Thrushes and Allies										
White's Thrush *Zoothera aurea*	0	0	0	0	0	0	0	0	1	1
Gray-backed Thrush (n) *Turdus hortulorum*	0	0	22	0	0	0	0	0	0	22
Pale Thrush (n) *Turdus pallidus*	0	2	17	0	0	0	0	0	0	19
Brown-headed Thrush (n *Turdus chrysolaus*	0	1	0	0	0	0	0	0	0	1
Dusky Thrush *Turdus eunomus*	0	28	80	0	0	0	0	0	0	108
Naumann's Thrush (n) *Turdus naumanni*	0	4	0	0	0	0	0	0	0	4
Unidentified Thrush sp. *Turdus* sp.	0	0	14	0	0	0	0	0	0	14
Sturnidae - Starlings										
Red-billed Starling (n) *Spodiopsar sericeus*	0	0	0	14	0	6	0	9	1	14

Table B.5.2. Continued.

Family and Species[a, b]	Number Observed									Total
	Sep 2014	Feb 2015	Apr 2015	June 2016	Aug 2016	May 2017	July 2017	June 2018	Aug 2018	
Sturnidae – Starlings (continued)										
White-cheeked Starling *Spodiopsar cineraceus*	2	0	10	57	0	21	19	42	3	154
Motacillidae - Wagtails and Pipits										
Gray Wagtail (n) *Motacilla cinerea*	1	0	0	0	0	0	0	0	0	1
White Wagtail *Motacilla alba*	0	0	3	0	0	5	0	1	1	10
Olive-backed Pipit *Anthus hodgsoni*	0	34	2	0	0	0	0	0	0	36
American Pipit *Anthus rubescens*	0	19	20	0	0	0	0	0	0	39
Emberizidae - Buntings and New World Sparrows										
Tristram's Bunting (n) *Emberiza tristrami*	0	0	1	0	0	0	0	0	0	1
Rustic Bunting *Emberiza rustica*	1	0	0	0	0	0	0	0	0	1
Yellow-throated Bunting *Emberiza elegans*	0	125	34	0	0	0	0	0	0	159
Black-faced Bunting (n) *Emberiza spodocephala*	0	0	1	0	0	0	0	0	0	1
Fringillidae - Finches, Euphonias, and Allies										
Brambling *Fringilla montifringilla*	0	31	2	0	0	0	0	0	0	33
Oriental Greenfinch *Chloris sinica*	0	53	22	26	0	8	0	11	2	122
Eurasian Siskin *Spinus spinus*	0	0	21	0	0	0	0	0	0	21
Passeridae - Old World Sparrows										
Eurasian Tree Sparrow *Passer montanus*	70	101	65	141	126	30	62	71	92	758
Total individuals	1,899	2,485	1,199	1,252	2,312	640	1,030	1,046	2,543	14,406
Total species (including unidentified)	44	57	61	44	47	51	43	47	48	139
Total identified species	42	54	58	41	43	47	42	46	44	124

[a] Common and scientific names follow nomenclature from eBird (Clements checklist; http://www.birds.cornell.edu/clementschecklist/). Species shown in red have protected status per Kegs 13-3.
[b] An 'n' denotes a species not previously (<2014) reported from Kunsan AB.

Page intentionally blank.

Appendix C

Species Listed as Protected in KEGS Table 13-1, Endangered Wild Animals and Plants, and KEGS Table 13-2, ROK Species Designated as Natural Monuments.

Table C.1 Endangered Wild Animals and Plants (KEGS 2012).				
Classification	**Number**	**Scientific Name[a]**	**Korean Common Name**	**English Common Name[b]**
Mammals Class I	1	*Canis lupus coreanus*	Nuk-dae	Asiatic or Chinese Wolf
	2	*Cervus nippon hortulorum*	Dae-ryuk-sa-sum	Dybowski's Sika Deer
	3	*Zalophus californianus japonicus*	Ba-da-sa-ja	Japanese Sea Lion
	4	*Ursus thibetanus ussuricus*	Ban-dal-ga-sum-gom	Macchurian Black Bear
	5	*Myotis formosus chofukusei*	Bul-gun-bak-jui	Korean Orange Whiskered Bat, Golden-winged Myotis, or Jobokseong's Bat
	6	*Moschus moschiferus parvipes*	Sa-hyang-no-roo	Korean Musk Deer
	7	*Naemorhedus caudatus*	San-yang	Chinese or Long-tailed Goral
	8	*Lutra lutra*	Soo-dal	Eurasian River Otter
	9	*Lynx lynx*	Shi-ra-so-nee	Eurasian Lynx
	10	*Vulpes vulpes peculiosa*	Yo-woo	Fox (Korean Fox, Korean Red Fox)
	11	*Panthera pardus orientalis*	Pyo-bum	Leopard (Amur Leopard)
	12	*Panthera tigris altaica*	Ho-rang-ee	Tiger (Siberian Tiger)
Mammals Class II	1	*Martes flavigula*	Dam-bee	Yellow-throated Marten
	2	*Mustela nivalis*	Moo-san-jok-jae-bee	Weasel (Least Weasel)
	3	*Callorhinus ursinus*	Mool-gae	Northern Fur Seal
	4	*Phoca largha*	Mool-bum	Spotted Seal
	5	*Phoca* spp.	Mool-bum spp.	Seal spp. (includes the spotted seal and/or harbor seal [*Phoca vitulina*])
	6	*Prionailurus bengalensis*	Sark	Leopard Cat
	7	*Murina ussuriensis*	Ja-gun-gwan-ko-bak-jee	Ussuri Tube-nosed Bat
	8	*Eumetopias jubatus*	Kun-ba-da-sa-ja	Steller Sea Lion
	9	*Plecotus auritus*	To-kee-baak-jee	Long-eared Bat (Brown Long-eared Bat)
	10	*Pteromys volans aluco*	Ha-nul-da-ram-jee	Korean Small Flying Squirrel (Siberian Flying Squirrel)
Birds Class I	1	*Aquila chrysaetos*	Gum-dok-soo-ree	Golden Eagle
	2	*Eurynorhynchus pygmeus* (*Calidris pygmeus)*	Nup-jok-boo-ree-do-yo	Spoon-billed Sandpiper
	3	*Egretta eulophotes*	No-rang-boo-ree-bak-ro	Chinese Egret
	4	*Platalea leucorodia*	No-rang-boo-ree-jo-awe-sae	Spoonbill (Eurasian Spoonbill)
	5	*Grus japonensis*	Doo-roo-me	Manchurian or Japanese Crane (Red-crowned Crane)
	6	*Falco peregrinus*	Mae	Peregrine Falcon
	7	*Platalea minor*	Jo-awe-sae	Black-faced Spoonbill
	8	*Haliaeetus pelagicus*	Cham-soo-ree	Steller's Sea-eagle

Table C.1. Continued.

Classification	Number	Scientific Name[a]	Korean Common Name	English Common Name[b]
Birds Class I (continued)	9	*Tringa guttifer*	Chong-da-ri-do-yo-sa-chon	Nordmann's Sandpiper (Nordmann's Greenshank)
	10	*Dryocopus javensis*	Knok-sae	White-bellied Woodpecker
	11	*Cygnus olor*	Huk-go-nee	Mute Swan
	12	*Ciconia boyciana*	Hwang-sae	Oriental White Stork (Oriental Stork)
	13	*Haliaeetus albicilla*	Hin-ko-ri-soo-ree	White-tailed Eagle
Birds Class II	1	*Anas formosa*	Ga-chang-o-ree	Baikal Teal
	2	*Circus areuginosus*	Gae-goo-ree-mae	Marsh Harrier (Eurasian Marsh-harrier)
	3	*Anser cygnoides*	Gae-ree	Swan Goose
	4	*Larus saundersi (Chroicocephalus saundersi)*	Gum-un-mo-ree-gal-mae-kee	Saunder's Gull (Saunders's Gull)
	5	*Haematopus ostralegus*	Gum-un-mo-ree-mool-tae-sae	(Eurasian) Oystercatcher
	6	*Grus grus*	Gum-un-mok-doo-roo-me	(Common) Crane
	7	*Cygnus columbianus*	Go-nee	Bewick's Swan (Tundra Swan)
	8	*Strix uralensis*	Gwyn-jom-bak-ee-ol-pae-me	Ural Owl
	9	*Dryocopus martius*	Ka-mak-tak-da-goo-ree	Great Black Woodpecker (Black Woodpecker)
	10	*Otis tarda*	Nu-shee	Great Bustard
	11	*Aegypius monachus*	Dok-soo-ree	Cinereous Vulture
	12	*Gallicrex cinerea*	Tum-boo-kee	Watercock
	13	*Buteo buteo*	Mal-tong-ga-ree	Buzzard (Common Buzzard)
	14	*Ciconia nigra*	Muk-hwang-sae	Black Stork
	15	*Pandion haliaetus*	Mool-soo-ree	Osprey
	16	*Pernis ptilorhynchus*	Bol-mae	Oriental Honey-Buzzard
	17	*Aythya baeri*	Bul-gun-ga-sum-hin-jook-jee	Baer's Porchard
	18	*Gorsachius goisagi*	Bul-gun-hae-o-ra-kee	Japanese Night-Heron
	19	*Falco amurensis*	Bee-dool-kee-jo-rong-ee	Red-footed Falcon (Amur Falcon)
	20	*Synthliboramphus wumizusume*	Pul-sae-o-ree	Japanese Murrelet
	21	*Galerida cristata*	Pul-jong-da-ree	Crested Lark
	22	*Terpsiphone atrocaudata*	Sam-gwang-jo	Japanese Paradise-Flycatcher
	23	*Falco subbuteo*	Sae-hul-li-kee	Eurasian Hobby
	24	*Milvus migrans*	Sol-gae	Black Kite
	25	*Falco columbarius*	Sae-hwang-jo-rong-ee	Merlin

Table C.1 Continued

Classification	Number	Scientific Name	Korean Common Name	English Common Name
Birds Class II (continued)	26	*Bubo bubo*	Soo-ri-boo-ong-ee	Eagle Owl (Eurasian Eagle-Owl)
	27	*Grus leucogeranus (Leucogeranus leucogeranus)*	Siberia hin-doo-roo-me	Siberian Crane
	28	*Circus melanoleucos*	Alak-gae-goo-ree-mae	Pied Harrier
	29	*Numenius madagascariensis*	Alak-ko-ri-ma-do-yo	Australian Curlew (Far Eastern Curlew)
	30	*Strix aluco*	Ol-pae-me	Tawny Owl
	31	*Grus vipio (Antigone vipio)*	Jae-doo-roo-me	White-naped Crane
	32	*Circus cyaneus*	Jat-bit-gae-goo-ri-mae	Hen Harrier (Northern Harrier)
	33	*Larus relictus*	Jok-ho-gal-mae-kee	Relict Gull
	34	*Accipiter gularis*	Jo-rong-ee	Japanese Sparrowhawk
	35	*Accipiter gentilis*	Cham-mae	(Northern) Goshawk
	36	*Cygnus cygnus*	Kun-go-nee	Whooper Swan
	37	*Anser fabalis*	Kun-kee-ro-kee	Bean Goose (Taiga Bean-Goose)
	38	*Ixobrychus eurhythmus*	Kun-dumble-hae-o-ra-kee	Schrenck's Bittern
	39	*Buteo hemilasius*	Kun-mal-tong-ga-ree	Upland Buzzard
	40	*Buteo lagopus*	Tul-bal-mal-tong-ga-ree	Rough-legged Buzzard (Rough-legged Hawk)
	41	*Pitta nympha*	Pal-sak-jo	Fairy Pitta
	42	*Aquila clanga (Clanga clanga)*	Hang-ra-mo-ri-dok-soo-ree	Greater Spotted Eagle
	43	*Mergus squamatus*	Ho-sa-bee-o-ree	Chinese Merganser (Scaly-sided Merganser)
	44	*Branta bernicla*	Huk-kee-ro-kee	Brant
	45	*Grus monacha*	Huk-doo-roo-me	Hooded Crane
	46	*Charadrius placidus*	Hin-mok-mool-tae-sae	Long-billed Ring Plover (Long-billed Plover)
	47	*Anser erythropus*	Hin-ee-ma-kee-ro-kee	Lesser White-fronted Goose
	48	*Aquila heliaca*	Hin-jook-jee-soo-ree	Imperial Eagle (Eastern Eagle)
Amphibian and Reptiles Class I	1	*Elaphe schrenckii*	Goo-rong-ee	Russian Rat Snake (Manchurian Black Water Snake)
Amphibians and Reptiles Class II	1	*Pelophylax chosenicus*	Gum-gae-goo-ree	Eastern Golden Frog (Seoul Frog, Seoul Pond Frog)
	2	*(Chinemys reevesii) Mauremys reevesii*	Nam-saeng-ee	Reeve's Turtle (Chinese Pond Turtle)
	3	*Kaloula borealis*	Mang-kong-ee	Korean Narrow-mouthed Frog (Boreal Digging Frog)

Table C.1 Continued.

Classification	Number	Scientific Name	Korean Common Name	English Common Name
Amphibians and Reptiles Class II (continued)	4	*Sibynophis collaris*	Be-ba-ree-baem	Many tooth Snake (Common Many toothed Snake, Collared Black headed Snake)
	5	*Eremias argus*	Pyo-bum-jang-jee-baem	Tiger Lizard (Mongolian Racerunner, Korean Tiger Lizard)
Insects Class I	1	*Metopodontus astacoides blanchardi* *(Prosopocoilus a. blanchardi)*	Doo-jom-ba-kee-sa-sum-bol-lae	Chinese Stag Beetle
	2	*Hipparchia autonoe*	San-gool-took-na-bee	Esper Butterfly (Russian Grayling)
	3	*Aporia crataegi*	Sang-jae-na-bee	Black-veined White
	4	*Polyphylla laticollis manchurica*	Soo-yom-poong-dang-ee	Garden Chafer
	5	*Callipogon relictus*	Jang-soo-ha-nul-so	Korean Relict Long-horned Beetle (Asian Callipogon Longhorn Beetle)
Insect Class II	1	*Challia fletcher*	Go-ryo-jib-gae-bol-lae	earwig
	2	*Protantigius superans*	Guipon-san-boo-jon-na-bee	Butterfly
	3	*Nannophya pygmaea*	Ko-ma-jam-ja-ree	Scarlet Dwarf
	4	*Cicindela anchoralis*	Dot-moo-nee-guil-ap-ja-bee	(Tiger) Beetle
	5	*(Carabus) Acoptolabrus mirabilissimus*	Mot-cho-rong-bak-tak-jong-bol-lae	(ground) Beetle
	6	*Lethocerus deyrolli*	Mool-jang-goon	Giant Water Bug
	7	*Parnassius bremeri*	Bool-gun-jom-mo-shi-na-bee	Red-spotted Apollo Butterfly
	8	*Chrysochroa fulgidissima*	Bee-dan-bol-lae	Jewel Beetle (Japanese Beetle)
	9	*Gymnopleurus mopsus*	So-tong-goo-ree	Dung Beetle
	10	*Cigaritis takanonsis*	Saang-ko-ri-boo-jon-na-bee	(hairstreak) Butterfly
	11	*Copris tripartitus*	Ae-kee-pool-so-tong-goo-ree	dung beetle
	12	*(Fabriciana) Argynnis nerippe*	Wang-un-jom-pyo-bum-na-bee	Silver-spotted Leopard Butterfly
	13	*Psacothea hilaris*	Wool-do-ha-nul-so	Yellow-spotted Longicorn Beetle
	14	*Cicindela hybrida nitida*	Joo-hong-guil-ap-jab-ee	(Northern Dune Tiger) Beetle
	15	*Osmoderma opicum*	Kun-ja-sak-ho-rang-kkot-moo-jee	Silver/black Beetle (fruit chafer scarab beetle)

Table C.1 Continued.

Classification	Number	Scientific Name	Korean Common Name	English Common Name
Fish Class I	1	*Pseudopungtungia nigra*	Gam-dol-go-kee	Black Shinner
	2	*Pseudobagrus brevicorpus*	Ko-chee-dong-ja-gae	Korean Stumpy Bullhead
	3	*Cobitis choii*	Me-ho-jong-gae	Miho Spine loach
	4	*Koreocobitis naktongensis*	Olook-sae--sae-ko-me-koo-ree	White-nosed Loach (Naktong Nose Loach)
	5	*Liobagrus obesus*	Tong-sa-ree	Bullhead Torrent Catfish
	6	*Gobiobotia nakdongensis*	Hin-soo-ma-ja	Hin-soo-ma-ja
Fish Class II	1	*Pseudopungtungia tenuicorpa*	Gam-dol-go-kee	Silver/black Fish (Slender Shiner)
	2	*Pungitius sinensis*	Ga-shi-go-kee	Amur Stickleback
	3	*Gobiobotia macrocephala*	Koo-goo-ree	Yellow/black Fish
	4	*Lethenteron reissneri*	Da-mook-jang-o	Sand Lamprey (Far Eastern Brook Lamprey)
	5	*Gobiobotia brevibarba*	Dol-sang-o	Yellow/black Fish
	6	*Cottus poecilopus*	Dook-joong-gae	Alpine Bullhead
	7	*Microphysogobio koreensis*	Mo-rae-joo-sa	Silver Fish with Black Spots
	8	*Acheilognathus signifier (Tanikia signifier)*	Mook-nob-ja-roo	Korean Gudgeon
	9	*Acheilognathus somjinensis (Tanakia somjinensis)*	Yim-sil-nob-ja-roo	Korean Bitterling
	10	*Pungitius kaibarae*	Jan-ga-shi-go-kee	Ninespine Stickleback (Amur Stickleback)
	11	*Lethenteron japonicum (Lethenteron camtschaticum)*	Chil-sung-jang-o	Lamprey (Arctic Lamprey)
	12	*Cottus hangiongensis*	Han-dook-joong-gae	Scorpion Fish (Tumen River Sculpin)
	13	*Saurogobia dabryi Bleeker*	Du-u-jaeng-i	Asian Gudgeon (Chinese Lizard Gudgeon)
	14	*Iksookimia pumila*	Bu-an-jong-gae	Buan Spine Loach (Puan spine loach)
	15	*Coreoperca kawamebari*	Kkuk-juh-gi	Japanese Aucha Perch
	16	*Kichuchoia brevifasciata* (*Niwaella brevifasciata*)	Jom-su-su-chi	Dwarf Spine Loach
Invertebrate Animals Class I	1	*Cristaria plicata*	Gui-ee-pal-dae-ching-ee	Leech (Cockscomb Pearl Mussel)[c]
	2	*Charonia lampus sauliae*	Na-pal-go-doong	Saul's Triton
	3	*Pseudohelice subquadrata*	Nam-bang-bang-gae	Grey Shore Crab
	4	*Lamprotula coreana*	Dud-ruk-jo-gae	mussel
	5	*Gammarus zoengogensis*	Kal-sae-o-ri-yop-sae-woo	amphipod
Invertebratye Animals Clas II	1	*Chasmagnathus convexus*	Get-gae	mud-flat crab
	2	*Dendronephthya suensoni*	Gum-bul-gun-soo-ji-mand-ra-me	soft coral
	3	*Clithon retropictus*	Kee-soo-gal-go-doong	Brackish Water Snail

Table C.1 Continued.

Classification	Number	Scientific Name	Korean Common Name	English Common Name
Invertebrate Animals Class II	4	*Triops longicaudatus*	Gwyn-ko-ri-too-goo-sae-woo	Longtail Tadpole Shrimp
	5	*Plumarella spinosa*	Git-san-ho	coral
	6	*Ellobium chinense*	Dae-choo-gui-go-doong	snail
	7	*Euplexaura crassa*	Doon-han-jin-chong-san-ho	coral
	8	*Plexauroides reticulata*	Mang-sang-map-si-san-ho	coral
	9	*Dendronephthya castanea*	Bam-soo-jee-mand-ra-me	soft coral
	10	*Verrucella stellate* (*Ellisella ceratophyta*)	Byol-hok-san-ho	Lichen (Red Whip Coral)[c]
	11	*Sesarmops intermedius*	Bul-gun-bal-mal-tong-gae	nad crab
	12	*Ophiacantha linea*	Sum-chim-gaw-mi-bool-ga-sa-ri	brittle star
	13	*Dendronephthya mollis*	Yon-soo-ji-mand-ra-me	soft coral
	14	*Dendrophyllia cribrosa*	Yu-chak-na-mu-dol-san-ho	stony cup coral
	15	*Nacospatangus alta*	Ui-yom-tong-sung-gae	sea urchin
	16	*Dendronephthya putteri*	Ja-sack-soo-ji-mand-ra-me	Soft Coral (Putter's giant sea anemone)[c]
	17	*Dendrophyllia ijimai*	Jan-ga-ji-na-moo-dol-san-ho	soft coral
	18	*Scelidotoma vadososinuata hoonsooi*	Jang-soo-sot-got-jo-gae	keyhole limpet
	19	*Tabastraea coccinea*	Jin-hong-na-pal-dol-san-ho	cup coral
	20	*Plumarella adhaerens*	Chak-saeng-git-san-ho	sea fan/ sea whip
	21	*Koreanohadra koreana*	Cham-dal-paeng-ee	land snail
	22	*Menella complexa* (*Plexauroides complexa*)	Chuk-map-si-san-ho	sea fan
	23	*Myriopathes japonica* (*Antipathes japonica)*	Hae-song	black coral
	24	*Dendronephthya alba*	Hin-soo-ji-mand-ra-me	soft coral
Land Plants Class I	1	*Cypripedium japonicum*	Gwang-run-yo-gang-kkot	Lady's Slipper (Japanese Lady Slipper)
	2	*Sedirea japonica*	Na-do-poong-ran	orchid
	3	*Euchresta japonica*	Man-nyon-kong	evergreen shrub
	4	*Cotoneaster wilsonii*	Sum-gae-ya-gwang-na-mu	low dense shrub

Table C.1 Continued.

Classification	Number	Scientific Name	Korean Common Name	English Common Name
Land Plants Class I (continued)	5	*Diapensia lapponica* var. *obovata*	Am-mae	pincushion plant
	6	*Cymbidium lancifolium*	Jook-bag-ran	orchid
	7	*Neofinetia falcata*	Poong-ran	orchid
	8	*Cymbidium kanran*	Han-ran	orchid
Land Plants Class II	1	*Euryale ferox*	Ga-shi-yon-kkot	Fox Nut
	2	*Eleutherococcus senticosus*	Ga-shi-o-gal-pi-na-moo	Siberian Ginseng
	3	*Quercus gilva*	Gae-ga-shi-na-moo	red oak
	4	*Echinosophora koreensis*	Gae-nu-sam	Solbi Tree (Korean Necklace-pod)
	5	*Astilboides tabularis*	Gae-byong-poong	Shieldleaf Rodgersia
	6	*Paliurus ramosissimus*	Get-dae-choo	A tree in the buckthorn family
	7	*Trientalis europaea arctica*	Kee-seng-kkot	Green leaf plant with white flowers (Chickweed-wintergreen, Arctic Starflower)
	8	*Jeffersonia dubia*	Kang-kang-ee-pool	Twin Flower (Twin Leaf)
	9	*Drosera peltata* var. *nipponica*	Kun-kun-ee-gui-gae	A flowering plant (a sundew)
	10	*Kirengeshoma koreana*	Na-do-sung-ma	Yellow Wax Bells
	11	*Rhododendron aureum*	No-rang-man-byong-cho	Small flowering shrub (Yellow-flowered Rosebay)
	12	*Iris odaesanensis*	No-rang-moo-ni-boot-kkot	Mt. Odae Iris
	13	*Iris koreana*	No-rang-boot-kkot	Dwarf Yellow Iris (Dwarf Korean Woodland Iris)
	14	*Kalimeris altaica* (*Aster altaicus* var. *uchiyamae*)	Dan-yang-sook-boo-jaeng-ee	Korean Aster
	15	*Iris dichotoma*	Dae-chong-boo-chae	Purple Iris Fan (Vesper Iris)
	16	*Cymbidium macrorhizon*	Dae-hong-ran	An orchid (Large Root Cymbidium)
	17	*Cicuta virosa*	Dok-mee-na-ree	Northern Water Hemlock
	18	*Hylotelephium usseriense*	Dung-gun-yip-kong-ui-bi-rum	Round Leaf Stonecrop (Ussuri River Stonecrop)
	19	*Berchemia berchemiaefolia*	Mang-gae-na-moo	A tree in the buckthorn family
	20	*Ranunculus trichophyllus* var. *kadzusensis*	Mae-hwa-ma-rum	Diamond shaped plum demersum (Threadleaf Crowfoot or Threadleaf Water Crowfoot)

Table C.1 Continued.

Classification	Number	Scientific Name	Korean Common Name	English Common Name
Land Plants Class II (continued)	21	*Lasianthus japonicus*	Moo-joo-na-moo	Muji Tree
	22	*Isoetes japonica*	Mool-boo-choo	Quillwort (quillroot)
	23	*Abeliophyllum distichum*	Mee-sun-na-moo	Korean Abelia
	24	*Osmanthus insularis*	Bag-dal-mok-saw	An evergreen in the olive family
	25	*Aconitum coreanum*	Bag-boo-ja	Korean aconite
	26	*Kuhlhasseltia yakushimensis (Vexillabium yakusimense* var. *nakaianum*)	Bag-woon-ran	orchid
	27	*Paeonia obovata*	San-jak-yak	Obovata Peony (Grass Peony)
	28	*Saururus chinensis*	Sam-bag-cho	Chinese Lizard's Tail
	29	*Viola raddeana*	Sun-jae-bi-kkot	Perennial herb (a violet)
	30	*Bupleurum latissimum*	Sum-shi-ho	A small flowering plant (plant in the parsley family)
	31	*Scrophularia takesimensis*	Sum-hyon-sam	A small flowering plant (figwort)
	32	*Aconitum austrokoreense*	Sae-pool-too-goo-kkot	Purple flowering plant (aconite or monkshood)
	33	*Lilium cernuum*	Sol-na-ri	Nodding Lily
	34	*Psilotum nudum*	Sol-yip-ran	orchid (Whisk or Skeleton Fork Fern)[c]
	35	*Leontopodium coreanum*	Som-da-ri	Whisk Fern (a plant in the aster family)[c]
	36	*Brasenia schreberi*	Soon-chae	Water Shield
	37	*Milletia japonica*	Ae-kee-dung	A vine (Summer or Dwarf Wisteria)
	38	*Thalictrum coreanum*	Yon-nip-kkong-ui-da-ri	China Meadow Rue
	39	*Viola websteri*	Wang-jae-bee-kkot	Yellow/white flowering plant (violet)
	40	*Cyrtosia septentrionalis*	U-rum-nan-cho	Eureum Orchid (orchid)
	41	*Utricularia uliginosa* (*Utricularia yakusimensis*)	Ja-joo-tang-gui-gae	Aquatic water plant (Asian Bladderwort)
	42	*Smilacina bicolor (Maianthemum bicolor)*	Ja-joo-som-dae	Green leafy plant (lily of the valley)
	43	*Mankyua chejuense*	Jeju-go-sa-ri-sam	fern
	44	*Menyanthes trifoliata*	Jo-rum-na-mool	Buckbean
	45	*Sarcandra glabra*	Jook-jol-cho	Decorative evergreen shrubbery (Glabrous Sarcandra Herb)
	46	*Cleisostoma scolopendrifolium (Pelatantheria scolopendrifolia)*	Jee-nae-bal-lan	orchid

Table C.1 Continued.

Classification	Number	Scientific Name	Korean Common Name	English Common Name
Land Plants Class II (continued)	47	*Lycoris chinensis* var. *sinuolata*	Jin-no-rang-sang-sa-hwa	Yellow wildflower (hurricane lily)
	48	*Polygonatum stenophyllum*	Chung-chung-doong-gul-lae	Dung-tiered bridle (Solomon's Seal)
	49	*Trillium tschonoskii*	Kun-yol-lyong-cho	White Japanese Trillium or Tschonoski's Wake Robin
	50	*Cypripedium guttatum*	Tul-bok-joo-mo-ni-ran	Orchid (Spotted Lady's Slipper)
	51	*Asplenium antiquum*	Pa-cho-il-yop	spleenwort
	52	*Leontice microrrhyncha (Gymnospermium microrrhynchum)*	Han-gae-ryong-pool	A plant in the barberry family
	53	*Arctous alpinus* var. *japonicas (Arctostaohylos alpinus)*	Hong-wol-gyul	Red Manzanita, Red Bearberry (Alpine Bearberry)
	54	*Hibiscus hamabo*	Hwang-gun	Flowering shrub (hibiscus)
	55	*Astragalus propinquus* (*Astragalus membranaceus)*	Hwang-kee	Yellow Leader
	56	*Corylopsis coreana* (*Corylopsis* gotoana var. *coreana*)	Hearee	Yellow flowering tree (Korean Winter Hazel)
Macroalgae (Sea Plants Class II		*Coccophora langsdorfii*	Sam-na-moo-mal	Flowering sea plant

[a] Scientific names are presented as listed in KEGS Table 13-1. However, some scientific names have changed since KEGS 2012. More recent scientific names (as of 2016) are presented parenthetically, as applicable.

[b] English common names as presented in KEGS 2012 Table 13-1. More recent common names are presented parenthetically as applicable.

[c] The English common name, presented as listed in Kegs 2012 Table 13-1, is incorrect. A correct common name is presented parenthetically.

Table C.2. ROK Species Designated as Natural Monuments (KEGS 2012).			
Monument Designation No.	**Korean Name**	**English Name (Scientific Name)[a]**	**Classification[b]**
197	Knok-sae	White-billed Woodpecker (*Dryocopus javensis horsfield*)	Bird I-10
198	Tao-kee	Japanese Crested Ibis (*Nipponia nippon* temminck)	
199	Hwang-sae	Oriental White Stork (*Ciconia boyciana*)	Bird I-12
200	Muk-hwang-sae	Black Stork (*Ciconia ciconia linne*)	Bird II-14
201	Back-jo group	Bewick's Wooper and Mute Swan (*Cygnus bewickii* varrell and *C. olor* Gmelin)	
201-1	Go-nee	Bewick's Swan (*Cygnus columbianus*)	Bird II-7
201-2	Kun-go-nee	Whooper Swan (*Cygnus Cygnus*)	Bird II-36
201-3	Huk-go-nee	Mute Swan (*Cygnus olor* Gmelin)	Bird I-11
202	Doo-roo-me	Manchurian Crane (*Grus japonensis*)	Bird I-5
203	Jae-doo-roo-me	White-napped Crane (*Grus vipio*)	Bird II-31
204	Pal-sak-jo	Fairy Pitta (*Pitta nympha*)	Bird II-41
205	Jo-awe-sae group	Black-faced Spoonbill and Spoonbill (*Platalea minor* and *Platalea leucorodia*)	
205-1	Jo-awe-sae	Black-faced Spoonbill (*Platalea minor*)	Bird I-7
205-2	No-rang-boo-ree-jo-awe-sae	Spoonbill (*Platalea leucorodia*)	Bird I-4
206	Nu-shee	Great Bustard (*Otis tarda*)	Bird II-10
215	Huk-bee-dool-kee	Japanese Wood Pigeon (*Columba janthina* Temminck)	
228	Huk-doo-roo-me	Hooded Crane (*Grus monacha*)	Bird II-45
242	Ka-mak-tak-da-goo-ree	Great Black Woodpecker (*Dryocopus martius*)	Bird II-9
243	Soo-ree group	Cinereous Vultures, Golden Eagle, Steller's Sea Eagle, and White-tailed Sea Eagle (*Aegypius monachus, Aguila chrysaeros, Haliaeetus pelagicus,* and *Haliaeetus albichilla*)	
243-1	Dok-soo-ree	Black Vulture (*Aegypius monachus*)	
243-2	Gum-dok-soo-ree	Golden Eagle (*Aquila chrysaetos*)	Bird I-1
243-3	Cham-soo-ree	Steller's Sea Eagle (*Hallaeetus pelagicus*)	Bird I-8
243-4	Hin-ko-ri-soo-ree	White-tailed Sea Eagle (*Haliaeetus albicilla*)	Bird I-13

Table C.2. Continued.			
Monument Designation No.	**Korean Name**	**English Name (Scientific Name)[a]**	**Classification[b]**
323	Mae group	Goshawk, Chinese Goshawk, Eurasian Sparrow Hawk, Marsh Harrier, and Kestrel (*Accipiter gentilis, Accipiter soloensis, Accipiter nisus, Circus aeruginosus,* and *Falco tinnunculus*)	
323-1	Cham-mae	Goshawk (*Accipiter gentilis*)	Bird II-35
323-2	Bul-gun-bae-sae-mae	Chinese Goshawk (*Accipiter soloensis*)	
323-3	Gae-goo-ree-mae	Marsh Harrier (*Circus aeruginosus*)	Bird II-2
323-4	Sae-mae	Eurasian Sparrowhawk (*Accipiter nisus*)	
323-5	Alak-gae-goo-ree-mae	Pied Harrier (*Circus melanoleucus*)	Bird II-28
323-6	Jat-bit-gae-goo-ree-mae	Hen Harrier (*Circus cyaneus*)	Bird II-32
323-7	Mae	Peregrine Falcon (*Falco peregrinus*)	Bird I-6
323-8	Hwang-jo-rong-ee	Kestrel (*Falco tinnunculus*)	
324	Ol-pae-me and Boo-ong-ee group	Tawny Owl, Eurasian Scops Owl, Eagle Owl, Brown Hawk Owl, Long-eared Owl, Short-eared Owl, Eurasian Scops Owl, and Collared Owl (*Strix aluco* Linne*, Otus scops, Bubo bubo, Ninox scutulata, Asio flammeus, Asio otus, Otus lempiji ,* and *Otus scops*)	
324-1	Ol-pae-me	Tawny Owl (*Strix aluco*)	Bird II-30
324-2	Soo-ri-boo-ong-ee	Eagle Owl (*Bubo bubo*)	Bird II-26
324-3	Sol-boo-ong-ee	Brown Hawk Owl (*Ninox scutulata*)	
324-4	Soe-boo-ong-ee	Short-eared Owl (*Asio flammeus*)	
324-5	Chick-boo-ong-ee	Long-eared Owl (*Asio otus*)	
324-6	So-chok-sae	Eurasian Scops Owl (*Otus scops*)	
324-7	Kun-so-chok-sae	Collared Scops (*Otus lempiji*)	
325	Kee-ro-kee group	Swan Goose and Brent Goose (*Anser cygnoides* and *Branta bernicla*)	
325-1	Gae-ree	Swan Goose (*Anser cygnoides*)	Bird II-3
325-2	Huk-kee-ro-kee	Brent Goose (*Branta bernicla*)	Bird II-44

Table C.2. Continued.			
Monument Designation No.	**Korean Name**	**English Name (Scientific Name)[a]**	**Classification[b]**
326	Gum-un-mo-ree-mool-tae-sae	Oystercatcher (*Haematopus ostralegus*)	Bird II-5
327	Won-ang	Mandarin Ducks (*Aix galericulata* linne)	
361	No-rang-boo-ree-bak-ro	Chinese Egret (*Egretta eulophotes*)	Bird I-3
446	Tum-boo-kee	Watercock (*Gallicrex cinerea*)	Bird II-12
447	Doo-kyon	Lesser Cuckoo (*Cuculus poliocephalus*)	
448	Ho-sa-bee-o-ree	Chinese Merganse (*Mergus squamatus*)	Bird II-43
449	Ho-sa-do-yo	Painted Snipe (*Rostratula benghalensis*)	
450	Pal-sae-o-ree	Japanese Murrelet (*Synthliboramphus wumizusume*)	Bird II-20
451	Gum-un-mok-doo-roo-me	Crane (*Grus grus*)	Bird II-6
216	Sa-hyang-no-roo	Korean Musk Deer (*Moschus moschiferus paryipes*)	Ma I-6
217	San-yang	Chinese or Long-tailed Goral (*Naemorhedus caudatus*)	Ma I-7
328	Ha-nul-da-ram-jee	Korean Small Flying Squirrel (*Pteromys volans aluco*)	Ma II-10
329	Ban-dal-ga-sum-gom	Manchurian Black Bear (*Ursus thibetanus ussuricus*)	Ma I-4
330	Soo-dal	Eurasian River Otter (*Lutra lutra*)	Ma I-8
452	Bul-gun-bak-jui	Korean Orange Whiskered Bat, Golden-winged Myotis or Jobokseng Bat (*Myotis formosus chofukusei*)	Ma I-5
258	Moo-tae-jang-awe	(*Anguilla mauritiana*)	
259	O-rum-chee	Cyprinid Fish (*Ganoprokspterus myloden*)	
454	Me-ho-jong-gae	Miho Spine Loach (*Iksookimia choii*)	Fish I-3
455	Ko-chee-dong-ja-gae	Korean Stumpy Bullhead (*Pseudobagrus brevicorpus*)	Fish I-2
218	Jang-soo-ha-nul-so	Korean Relict Long-horned Beetle (*Callipogon relictus*)	Ins I-5

Table C.2. Continued.

Monument Designation No.	Korean Name	English Name (Scientific Name)[a]	Classification[b]
458	San-gool-took-na-bee	Chinese Stag Beetle[c] (*Metopodontus blanchardi*)	Ins I-2
453	Nam-saeng-ee	Reeve's Turtle (*Chinemys reevesii*)	AR II-2
456	Hae-song	(*Antipathes japonica*)	Inv II-23
457	Gwyn-ga-ji-hae-song	Gwyn-ga-ji-hae-song (*Antipathes lata*)	

[a] English and scientific names as presented in KEGS 2012, Table 13-2. For some species, the common name, scientific name, or both are no longer correct.

[b] Classification indicates the category of endangered species defined in Article 2 of Enforcement Rule for Law on Wildlife Protection (Ma: mammals, Ins: insect, AR: amphibians and reptiles, Inv: invertebrate. *e.g*. Inv II-23: endangered invertebrate species Class II, number 23).

[c] In KEGS 2012, the common nme 'Espers Butterfly' is incorrectly assigned to the species name *Metapodontus blanchardi*. The common name has been corrected to the Chinese Stag Beetle as indicated.

15.0 ASSOCIATED PLANS

Tab 1 – Bird/Wildlife Aircraft Strike Hazard (BASH) Plan

Plan is maintain on AF Portal eDASH website at: https://cs1.eis.af.mil/sites/edash-ins4/Kunsan/Pages%20%20Programs/Natural%20Resources.aspx

Tab 2 – Integrated Cultural Resources Management Plan (ICRMP)

Plan is maintain on AF Portal eDASH website at: https://cs1.eis.af.mil/sites/edash-ins4/Kunsan/Pages%20%20Programs/Cultural%20Resources.aspx

Tab 3 – Integrated Pest Management Plan (IPMP)

Plan is maintain on AF Portal eDASH website at: https://cs1.eis.af.mil/sites/edash-ins4/Kunsan/Pages%20%20Programs/Natural%20Resources.aspx