Technical Report SERDP-97-11
September 1997

US Army Corps of Engineers
Waterways Experiment Station

Strategic Environmental Research and Development Program

Species Profile: Florida Scrub Jay (*Aphelocoma coerulescens*) on Military Installations in the Southeastern United States

by Wilma A. Mitchell

Prepared for Headquarters, U.S. Army Corps of Engineers

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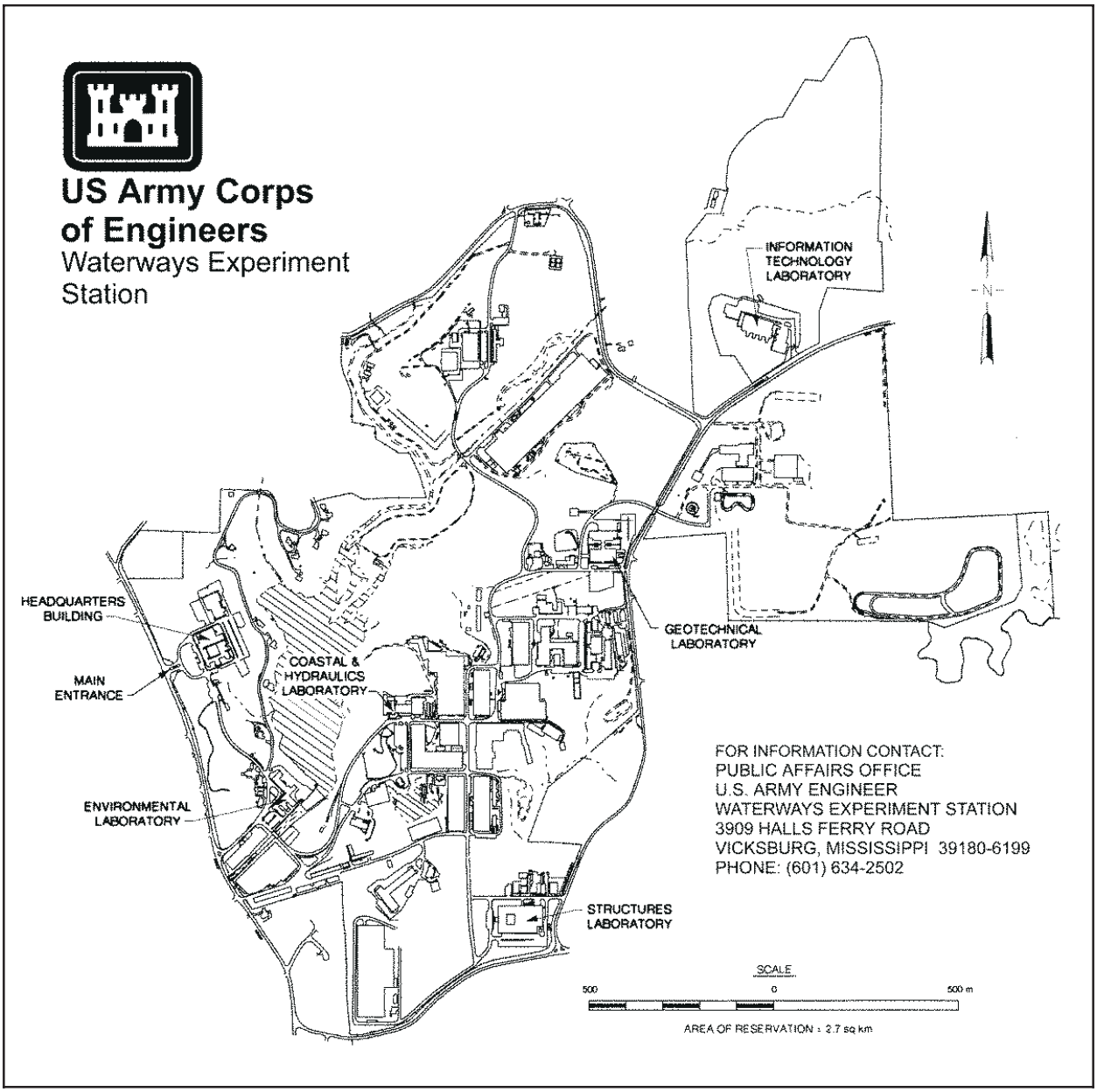
U.S. Army Corps of Engineers
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Final report

Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000



Waterways Experiment Station Cataloging-in-Publication Data

Mitchell, Wilma A.

Species profile : Florida scrub jay (*Aphelocoma coerulescens*) on military installations in the Southeastern United States / by Wilma A. Mitchell ; prepared for U.S. Army Corps of Engineers.

23 p. : ill. ; 28 cm. — (Technical report ; SERDP-97-11)

Includes bibliographic references.

1. Scrub jay — Speciation — United States. 2. Aphelocoma — Speciation — United States. 3. Endangered species. I. Mitchell, Wilma A. II. United States. Army. Corps of Engineers. III. U.S. Army Engineer Waterways Experiment Station. IV. Strategic Environmental Research and Development Program (U.S.) V. Title. VI. Series: Technical report (U.S. Army Engineer Waterways Experiment Station) ; SERDP-97-11.

TA7 W34 no.SERDP-97-11

Preface

The work described herein was authorized by the Strategic Environmental Research and Development Program (SERDP), Washington, DC. The work was performed under the SERDP study entitled "Regional Guidelines for Managing Threatened and Endangered Species Habitats." Dr. John Harrison was Executive Director, SERDP.

This report was prepared by Dr. Wilma A. Mitchell, Natural Resources Division (NRD), Environmental Laboratory (EL), U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS. Report review was provided by Dr. Joel W. Snodgrass, Savannah River Ecology Laboratory, Aiken, SC; Drs. Reed Bowman and Glen Woolfenden, Archbold Biological Station, Lake Placid, FL; and Dr. David Breininger, Dr. Paul Schmalzer, Ms. Donna Oddy, and Ms. Vickie Larson, Kennedy Space Center, Florida. WES technical review was provided by Mr. Chester O. Martin and Dr. Richard A. Fischer, EL. Mr. Martin, EL, WES, and Ms. Ann-Marie Trame, Land Management Laboratory, U.S. Army Construction Engineering Research Laboratories, were Primary Investigators for the work unit. Dr. Fischer, EL, WES, managed and coordinated preparation of species profiles for this study. Mr. John J. Lane and Ms. Tiffany Cook, EL, provided valuable assistance in assembling species information.

This report was prepared under the general supervision of Dr. Michael F. Passmore, Chief, Stewardship Branch, NRD; Dr. Dave Tazik, Chief, NRD; and Dr. John Harrison, Director, EL.

At the time of publication of this report, Dr. Robert W. Whalin was Director of WES.

This report should be cited as follows:

Mitchell, W. A. (1997). "Species profile: Florida scrub jay (*Aphelocoma coerulescens*) on military installations in the southeastern United States," Technical Report SERDP-97-11, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Species Profile: Florida Scrub Jay
(Aphelocoma coerulescens)

Photo by Dan Polin. Courtesy of Vireo©, Cornell Laboratory of Ornithology

Taxonomy

Class . . . . . Aves
Order . . . . . Passeriformes
Family . . . . . Corvidae
Genus/species . . . . . *Aphelocoma coerulescens*
Other Common Names . . . . . Florida jay

Description

The Florida scrub jay is a blue and gray, crestless jay, approximately 30 cm (12 in.) long, with a mean mass of 79.2 g (2.8 oz) (National Geographic Society 1983). The nape, wings, and rump are dark sky-blue; the tail is long and indigo in color; and the back and belly are smoke gray (Sprunt 1954, Woolfenden 1978, U.S. Fish and Wildlife Service 1990). A light gray line over the eye blends into a blue-gray forehead, and a blue breast band separates the light gray throat from gray underparts (National Geographic Society 1983). Juveniles are similar to adults but have duller colors, less blue on the breast, and a paler head. The sexes are alike in all plumages (Sprunt 1946).

Similar Species

The Florida scrub jay recently was elevated to full-species status (American Ornithologists' Union 1995), along with the Western scrub jay (*A. californica*) and island scrub jay (*A. insularis*). The Florida scrub jay is similar in size to the blue jay (*Cyanocitta cristata*) but lacks the crest and white-tipped wing and tail feathers of the latter (U.S. Fish and Wildlife Service 1990). The scrub jay is less vocal than the blue jay; its notes are essentially jaylike but are less constant and repeated at greater time intervals.

Status

Legal designation

Federal. The Florida scrub jay was listed as threatened on 3 June 1987 (52 FR 20719). Its status was based primarily on loss of habitat, which is highly specific and abundant in areas of Florida considered to be prime real estate for urban development (U.S. Fish and Wildlife Service 1990). The Florida scrub jay was listed as threatened rather than endangered because it was thought that the jay could survive as long as its habitat was not completely destroyed (Cox 1987).

State. The Florida scrub jay is endemic to Florida and therefore limited in habitat and range. It was listed as threatened by the State of Florida in 1975 (Wood 1996).

Military installations

See Table 1.

Table 1
Known Status of Florida Scrub Jays on Military Installations in the Southeastern United States

State	Installation	Status on Installation
FL	Avon Park Air Force Base (AFB)	Documented onsite; 84 families (260 individuals); one of largest remaining populations.
	Patrick AFB	Documented onsite.
	Naval Air Station Jacksonville	Documented onsite; Pinecastle Bombing Range (Sandra Maynard, Personal Communication, 1996).
	Camp Blanding	Documented onsite.
	Cape Canaveral Air Force Station	Documented onsite.

Distribution and numbers

The Florida scrub jay is found almost exclusively in peninsular Florida (U.S. Fish and Wildlife Service 1990) (Figure 1). It has been reported from 39 of the 40 peninsular counties in Florida (Cox 1984) but only twice from outside this region; these alleged sightings were from Jekyll Island, Georgia (Moore 1975), and the Florida Keys. However, these sightings are thought to be either erroneous observations or escaped individuals (Stevenson and Anderson 1994). The historical range of the scrub jay extended from Taylor, Gilchrist, Alachua, and Duval counties in northern Florida to Collier, Monroe, and Dade counties at the southern tip the State (Sprunt 1954, Cox 1984). Today it is restricted to scattered and often small, isolated patches of scrub habitat (Woolfenden 1978, Woolfenden and Fitzpatrick 1996). The jay has been extirpated in Broward, Dade, Duval, Pinellas, and St. Johns counties, and populations have been greatly reduced in Brevard, Highlands, Orange, Palm Beach, and Seminole counties (Cox 1984).

Figure 1. Current distribution of the Florida scrub jay (from U.S. Fish and Wildlife Service 1990, Woolfenden and Fitzpatrick 1996) (found in scattered populations within hatched area)

Although the extent of the Florida scrub jay's decline is not precisely known, it has been substantial (U.S. Fish and Wildlife Service 1990). Scrub jays have disappeared from 40 percent of the historic locations reported in the literature, and their numbers have severely declined in remaining areas. Cox (1987) estimated that the number of jays had declined by 50 percent in the past 100 years. The estimated population loss is at least

80 percent along the Lake Wales Ridge, which is considered to have been at the heart of the species range before human settlement. This estimate is based on the amount of scrub habitat that has been destroyed or rendered unsuitable for jays. More recently, Woolfenden and Fitzpatrick (1996) suggested that ≤10 percent of presettlement populations still existed.

In 1989, the statewide population of the Florida scrub jay was estimated at 7,000 to 11,000 birds (Breininger 1989). In 1993, Woolfenden and Fitzpatrick (in preparation) estimated that approximately 4,000 breeding pairs remained statewide. The largest populations (approximately 80 percent of total numbers) are associated with the Ocala National Wildlife Refuge (NWR), Merritt Island NWR, Kennedy Space Center, Highlands County (near Sebring, Lake Placid, Venus, and on Avon Park Air Force Range) (U.S. Fish and Wildlife Service 1990; Woolfenden and Fitzpatrick 1996). Another large concentration of scrub jays occurs in fragmented habitat on the Lake Wales Ridge in Highlands and Polk counties (U.S. Fish and Wildlife Service 1990). Outside of these areas, the Florida scrub jay occurs in widely scattered populations inhabiting patches of scrub along the interior and coastal sand ridges of the Florida peninsula.

Life History and Ecology

Social organization

Florida scrub jays live in permanently defended territories that contain all the resources necessary for their survival (Woolfenden and Fitzpatrick 1990). The basic social unit occupying a territory is a monogamous breeding pair that usually remain together until one of them dies. A typical territorial group consists of two to eight adults and zero to five juveniles with a mean group size of approximately three individuals (Woolfenden and Fitzpatrick 1991). However, juveniles will not always be present, particularly if spring nests have failed (Donna Oddy, Personal Communication, 1996). About half of the groups have one or two helpers that are resident nonbreeding offspring from previous years (Woolfenden and Fitzpatrick 1990). At the onset of nesting season, about 30 to 40 percent of the population are helpers (Woolfenden and Fitzpatrick 1991), of which approximately two-thirds are yearlings and one-fourth are two-year-olds (Woolfenden and Fitzpatrick 1990).

Florida scrub jays function effectively within a system of cooperative breeding (Woolfenden and Fitzpatrick 1991). Division of labor among scrub jays is well developed (Woolfenden and Fitzpatrick 1990). Only breeding females incubate, brood, and shade the nestlings. The breeding male provides food to the female and nestlings, defends the nest, and serves as a sentinel in predatory surveillance. Helpers assist with territorial defense, predatory surveillance, and feeding of the female and nestlings. A dominance system exists within families wherein males dominate females, breeders dominate nonbreeders, and same-sex helpers have linear hierarchies based on age. Dominant helpers tend to disperse or inherit breeding space earlier than their subordinates (Woolfenden and Fitzpatrick 1977, 1984). Helper males may remain nonbreeders as long as 5 years, but

helper females usually disperse after 1 or 2 years. Both sexes live at home while monitoring the neighborhood for breeding vacancies (Woolfenden and Fitzpatrick 1984). The first breeding is most common at 2 years of age, when 58 percent of females and 47 percent of males have paired (Woolfenden and Fitzpatrick 1990). By 3 years of age, 98 percent of females and 77 percent of males that eventually breed have paired.

Territories

The Florida scrub jay has a well-defined, relatively large territory (Woolfenden and Fitzpatrick 1990). Annual mean territory size fluctuates very little; at Archbold Biological Station (ABS) in Highlands County, mean size was 9.0 ha (22 acres) with a range of approximately 1 to 21 ha (2.5 to 50 acres). The annual density of territories at ABS remained stable over a period of 17 years with a mean of 3.2 territories per 40 ha (100 acres). However, density varied from approximately two to six territories within habitat types (Woolfenden and Fitzpatrick 1991). Variables affecting territory size include habitat quality, group size, and population density (Woolfenden and Fitzpatrick 1978, 1984).

New territories are rarely established in habitat previously unoccupied because essentially no such land exists (i.e., almost all available habitat is occupied) (Woolfenden and Fitzpatrick 1991). Widowed individuals usually attain a new mate on the same territory; established territories disappear after the death of both the male and female or when a widowed female jay moves to a neighboring territory to form a new pair bond (Woolfenden and Fitzpatrick 1984). Potential breeders greatly outnumber any breeding vacancies, and vigorous territorial defense suppresses the establishment of new territories by nonbreeders (Woolfenden and Fitzpatrick 1991).

When new territories are established, approximately 90 percent of them occur from territorial "budding," a process restricted to males (Woolfenden and Fitzpatrick 1978). With assistance from parents and other family members, budding occurs when a male helper actively expands his natal territory by fighting with neighbors and gaining new ground that contains scrub. The young male pairs with a female from outside his family, and the two defend the newly acquired ground while the parents and other family members retreat to the now smaller territory. Newly budded territories encompass about 35 percent of the original expanded territory, averaging only 4.5 ha (11 acres); however, growth is rapid, and second-year territories do not differ significantly from the mean for the population. About 40 percent of new breeders acquire breeding status through the budding process (Woolfenden and Fitzpatrick 1986). Establishment of a territory away from the home territory is rare, occurring among only 4 percent of new breeders.

Reproduction and development

The nesting season for Florida scrub jays extends from mid-March through mid-June (Woolfenden and Fitzpatrick 1990). Most first-clutches have been laid by the first week in April, and renesting after failed attempts occurs until mid-May. The ovate eggs are various shades of green (primarily bluish-green) and spotted with irregular-shaped, cinnamon-colored markings that are heaviest around the larger end (Woolfenden and Fitzpatrick 1984). Mean clutch size is 3.33 eggs; factors that influence clutch size include

age and experience of the breeders, time laid in the nesting season, heredity, and annual food supply (Woolfenden and Fitzpatrick 1990). Incubation lasts for 15 to 17 days (Sprunt 1946).

The mean number of nesting attempts at Archbold Biological Station is 1.4 per pair per breeding season (Woolfenden and Fitzpatrick 1991). The probability of nest success decreases rapidly as the season progresses (Woolfenden and Fitzpatrick 1990). Clutches laid in March have about a 70-percent success rate, whereas those laid in May have less than 40-percent success. Nest failures are almost always the result of predation; inclement weather, fire, and starvation account for fewer than 2 percent of losses.

Annual reproductive success shows large fluctuations. Woolfenden and Fitzpatrick (1990) found that fledgling production varied from 0.9 to 2.9 fledglings per pair over a 17-year period with mean production of approximately 2 fledglings per pair per year. Approximately 25 percent of pairs failed to produce any fledglings (Woolfenden and Fitzpatrick 1991). Reproductive success increases with duration of the pair bond (Woolfenden and Fitzpatrick 1984), and thus age of the birds (Joel Snodgrass, Personal Communication, 1996). At Archbold Biological Station, the reproductive success rate increased from 1.7 fledglings per pair the first year to 3.0 fledglings per pair by the sixth year of breeding.

Breeding pairs with helpers raise approximately 1.5 times as many young as breeders without helpers (Woolfenden and Fitzpatrick 1990). The aid from helpers influences several independent stages: the hatching of eggs, fledging of nestlings, and survival of fledglings to independence (McGowan 1987). The survival of breeders also correlates with the presence of helpers. Survival of fledglings to yearlings (1 year of age) has been found to average about 35 percent (Woolfenden and Fitzpatrick 1991).

Food habits

Florida scrub jays are omnivorous, with animal matter composing about 60 percent of the diet (U.S. Fish and Wildlife Service 1990). Insects and other arthropods living in the shrubby vegetation form the major portion of their diet throughout most of the year (Woolfenden and Fitzpatrick 1990). Orthopteran and lepidopteran larvae are frequently eaten, as well as mature insects such as grasshoppers, locusts, crickets, termites, burrower-bugs, squash bugs, leafhoppers, earwigs, beetles, weevils, butterflies, moths, bees, wasps, ants, anglewings, and flies (Woolfenden and Fitzpatrick 1984). Other invertebrate dietary items include millipedes, centipedes, spiders, scorpions, ticks, mites, and snails. Scrub jays have been observed to capture and consume about 20 species of vertebrates, mostly frogs (primarily pine woods treefrogs (*Hyla femoralis*)), lizards (primarily green anoles (*Anolis carolinensis*)), and snakes (Woolfenden and Fitzpatrick 1990). Vertebrate prey also includes small rodents, bird eggs, nestlings, and carrion of larger vertebrates (Woolfenden and Fitzpatrick 1984).

Although a variety of berries and other small fruits are occasionally eaten, acorns are the principal plant food (Woolfenden and Fitzpatrick 1990). Acorns are eaten throughout

the year and compose nearly 50 percent of the food intake during certain seasons. In autumn each jay caches several thousand acorns from oaks within its territory. The acorns are plucked directly from shrubs, buried in the sand, and unearthed during winter, spring, and summer (DeGange et al. 1989). Other plant foods occasionally consumed include small nuts, seeds (e.g., tread-softly (*Cnidoscolus* spp.), pine (*Pinus* spp.) seeds), and berries (e.g., blueberries (*Vaccinium* spp.), gallberries (*Ilex* spp.), and greenbriar (*Smilax* spp.)) (Woolfenden and Fitzpatrick 1984, Woolfenden and Fitzpatrick 1996).

Predation

Mammalian predators of the Florida scrub jay include bobcats (*Felis rufus*) and raccoons (*Procyon lotor*). The eastern coachwhip (*Masticophis f. flagellum*) and eastern indigo snake (*Drymarchon corais couperi*) will eat fledglings, and the merlin (*Falco columbarius*), sharp-shinned hawk (*Accipiter striatus*), and Cooper's hawk (*A. cooperii*) prey on adult scrub jays. Avian nest predators are the great horned owl (*Buteo virginianus*), eastern screech-owl (*Otus asio*), red-tailed hawk (*B. jamaicensis*), northern harrier (*Circus cyaneus*), fish crow (*Corvus ossifragus*), American crow (*C. brachyrhynchos*), and blue jay (Woolfenden and Fitzpatrick 1990).

Habitat Requirements

Florida scrub jays are nonmigratory birds that inhabit open, low-growing scrub communities endemic to peninsular Florida (Woolfenden 1978, Woolfenden and Fitzpatrick 1990). They usually avoid forests, prairies, and marshes (Sprunt 1954). Optimal habitats include xeric oak scrub, open sand pine (*P. clausa*) scrub, open scrubby flatwoods with slash pines, and rosemary (*Ceratiola ericoides*) scrub. Scrub jays are most abundant in oak-dominated scrub communities of the interior and Atlantic coast sand ridges of peninsular Florida (Fitzpatrick et al. 1991). These communities are characterized by a single layer of evergreen shrubs usually dominated by myrtle oak (*Quercus myrtifolia*), sand live oak (*Q. geminata*), and Chapman oak (*Q. chapmanii*) that occur as dense thickets less than 3 m (10 ft) in height and are interspersed with bare sand. These open areas are used by jays for foraging and storing acorns (Cox 1984). The stunted oaks that characterize Florida scrub grow only on the tops and slopes of sand dunes, where they are mixed with low-growing palmettos, woody shrubs, rosemary, and prickly pear cactus (*Opuntia* spp.) (Woolfenden and Fitzpatrick 1990). Other species common to oak scrub communities include Archbold oak (*Q. inopina*), crookedwood (*Lyonia ferruginea*), silkbay (*Persea humilis*), rosemary, scrub palmetto (*Sabal etonia*), and saw palmetto (*Serenoa repens*). Communities with a predominance of palmetto, rosemary, or turkey oak (*Q. laevis*) are called, respectively, palmetto scrub, rosemary scrub, and turkey oak scrub.

Florida scrub jays also use coastal scrub and communities with a pine component. Coastal scrub is characterized by live oak (*Q. virginiana*), tough buckthorn (*Bumelia tenax*), nakedwood (*Myricanthes fragrans*), and saw palmetto (Schmalzer and Hinkle 1985). Sand pine scrub and slash pine scrub have shrub layers like that of oak scrub and

a canopy of either sand pine or slash pine (*P. elliottii*) (Cox 1984). The pine community types have less than 50-percent canopy cover by trees over 3 m (10 ft) tall.

Optimal scrub jay habitat occurs as patches possessing the following attributes (Woolfenden 1974; Cox 1984; Woolfenden and Fitzpatrick 1984, 1991; Breininger 1992; Breininger et al. 1995; Duncan et al. 1995):

a. Ten to thirty percent of the patch is comprised of bare sand or sparse herbaceous vegetation.

b. More than 50 percent of the shrub layer is comprised of scrub oaks.

c. Shrub height is 120 to 170 cm (4 to 5.5 ft).

d. Pine canopy cover is less than 15 percent.

e. Distance from a forest is greater than 100 m (328 ft).

On Merritt Island, Florida, the highest densities of scrub jays were found in oak scrub communities composed of sandy herbaceous areas (Breininger 1981). At least 60 percent of the vegetation was covered by oaks, and less than 40 percent was covered by palmettos. Scattered patches of scrub were estimated to be from 15 to 50 m (50 to 165 ft) in diameter.

Scrub jay habitat quality is not uniform because of disruptions in the natural fire regime (Woolfenden and Fitzpatrick 1984, 1991). Periodic fire, historically a frequent natural event in Florida, is necessary for the maintenance of scrub jay habitat in its natural condition (Woolfenden and Fitzpatrick 1991). A fire frequency averaging once every 8 to 20 years provides optimal habitat conditions. Fire that is too frequent (2 to 3 years) maintains major oak species below acorn-bearing height, and palmetto may replace the oaks. Low-frequency fire produces tall, dense oak scrub with an overstory of scattered pines. Scrub jays tend to avoid this late successional scrub, and they are often replaced by blue jays in this habitat (Woolfenden and Fitzpatrick 1984).

Nesting habitat

The typical nest site is an isolated scrub oak or one on the edge of a coppice adjacent to open ground (Woolfenden 1974). Nest heights range from 0.5 to 3.5 m (1.6 to 11.5 ft) (Amadon 1944, Pitelka 1951, Woolfenden 1974). The mean height of 129 of the nests at the Archbold Biological Station was 1.2 m (3.9 ft); one nest was located 4 m (13 ft) above the ground (Woolfenden 1974). The mean height of vegetation in habitat occupied by different scrub jay families affects nest height. Mean nest height was 1.4 m (4.6 ft) in communities with a shrub layer up to 4 m (13 ft), whereas it was 0.9 m (2.5 ft) in habitats with shrub layers less than 1.5 m (4.9 ft).

Although Florida scrub jays build nests in a variety of plant species, they most commonly use scrub oaks (Pitelka 1951, Woolfenden 1974). Of 130 nests observed at Archbold Biological Station, 101 were located in oak shrubs (Woolfenden 1974). The remaining nests were in rosemary, saw palmetto, crookedwood, sand pine, fetterbush (*Lyonia lucida*), American holly (*Ilex opaca*), wax myrtle (*Myrica cerifera*), scrub hickory (*Carya floridana*),

bamboobrier (*Smilax laurifolia*), and orange (*Citrus* spp.). Pitelka (1951) reported that scrub jays occasionally nested in grapefruit (*Citrus* spp.), wild olive (*Osmanthus floridanus*), rose (*Rosa* spp.), and jasmine (*Jasminum* sp.). Scrub jays have also been observed nesting in nakedwood, tough buckthorn, Brazilian pepper (*Schinus terebinthifolius*), Florida privet (*Foresteria segregata*), and sea grape (*Coccoloba uvifera*) (Donna Oddy, Personal Communication, 1996).

The nest is a bulky, open-cup structure composed of course outer twigs, usually from oaks, and a few rootlets and finer sticks from a variety of plants, including vines and sand pines (Woolfenden 1974). The firm lining is made from the tough fibers of sand palmetto (*Sabal etonia*) (Woolfenden 1974) or cabbage palm (*Sabal palmetto*) (Donna Oddy, Personal Communication, 1996; Woolfenden and Fitzpatrick 1996). Scrub jays do not reuse nests (Hardy 1961) nor use material from old nests (Amadon 1944). Most of the nest twigs appear to be taken directly from shrubs rather than from ground litter.

Critical or essential habitat

The U.S. Fish and Wildlife Service has not designated specific geographic areas as critical habitat for the Florida scrub jay. However, the oak-dominated scrub communities of Florida are essential for its preservation and recovery (Woolfenden and Fitzpatrick 1991). This relict vegetation, which is endemic to peninsular Florida, forms one of North America's rarest habitats (Woolfenden and Fitzpatrick 1990) and is found on well-drained sandy soils of old coastal dunes or paleodunes (Laessle 1958, 1968; Abrahamson et al. 1984). The most extensive patches of scrub occur in the central peninsula and on sandy hills along the Atlantic Coast (Woolfenden and Fitzpartick 1990). In optimal habitat, most oak shrubs are 1 to 3 m (3 to 10 ft) tall, and taller trees and dense herbaceous vegetation are rare (Woolfenden and Fitzpatrick 1991). The oak thickets are interspersed with numerous patches of bare sand that jays use for acorn storage each fall (DeGange et al. 1989).

Habitat Assessment Techniques

Installation lands located in peninsular Florida should be assessed for scrub communities that provide potential habitat for the Florida scrub jay. Fitzpatrick et al. (1991) developed procedures for determining if proposed development will negatively affect scrub jays. With a few modifications, these procedures can be applied to scrub jay habitat assessment on military installations. The procedure for habitat inventory and mapping is described below.

Plant communities of the entire installation should be mapped on either a 7.5-ft U.S. Geological Survey topographic map or on an aerial photograph at a scale of no more than 48 m per cm (400 ft per in.). The Florida Land Use Cover and Forms Classification System (Florida Department of Transportation 1985) should be used for vegetation mapping. If vegetation on military installations has not been included in the Classification System, a field inspection can be conducted to define similar areas on a particular installation.

Classes of the System that would be especially useful in delineating habitat types include rangeland, pine flatwoods, longleaf pine-xeric oak, sand pine, sand-pine plantations, forest regeneration areas, sand other than beaches, and disturbed burned areas. The vegetation map should show artificial structures such as roads and buildings, recreational areas, and lands used for military exercises.

Three types of scrub jay habitat should be added to the vegetation map. Two of these, collectively, include any and all areas where one or more species of scrub oak are present, even if only vestigially represented. The habitat types are described as follows:

TYPE I - Any upland plant community in which percent cover by scrub oak species is 15 percent or more.

TYPE II - Any plant community, not meeting the definition of Type I habitat, in which one or more scrub oak species is represented.

TYPE III - Any upland or seasonally dry wetland within 0.4 km (0.25 mile) of any area designated as Type I or Type II habitat.

The vegetation map should be gridded into 0.40-ha (1-acre) units and a field inspection conducted to identify the three habitat types. Each acre identified as one of these habitat types is then labeled on the map. Qualitative field inspection should be adequate to assess active or potential jay habitat on military installations. Breininger (1981, 1989) modified the line transect method of Canfield (1941) to assess jay habitat, but a quantitative approach requires considerable time for design and analysis and probably would not be feasible for installation objectives. However, if a quantitative vegetation analysis is conducted, variables to be measured include height of trees and shrubs, percent canopy cover, percent and type herbaceous vegetation, and percent sandy areas. As discussed in the section on habitat requirements, the appropriate proportions of these variables determine the degree of habitat suitability for Florida scrub jays.

On the Kennedy Space Center (KSC), Florida, a habitat suitability model was created from scrub jay density and habitat characteristic data at nearly 100 locations (Breininger 1981, 1992). Although not published yet, this model is being tested and refined using reproductive success and survival studies of colorbanded birds at 10 locations on KSC (Woolfenden and Fitzpatrick 1996).

Inventory and Monitoring—Census Methods

The primary objective of a Florida scrub jay census is to estimate the population size of scrub jays on an installation. The extent of a scrub jay census will probably be determined by the availability of funds and manpower. If scrub jays have not been documented, a survey of potential habitat may be sufficient to determine the presence of jays on the installation. However, more detail about a jay population can be acquired by mapping the

location of each jay group and estimating its size and age structure. The census method described below was developed by Fitzpatrick et al. (1991) and found to be highly effective in obtaining an accurate count of scrub jays on a site.

Sampling design

The census area, including all known and potential scrub jay habitat, should be traversed systematically with a high-quality tape recording to attract jays. The recording should have clear examples of all typical Florida scrub jay territorial scolds, including the female "hiccup" call. (Copies of taped vocalizations may be obtained from Archbold Biological Station in Lake Placid, Florida.) On the vegetation map (see Habitat Assessment Techniques), parallel line transects are established with playback stations along each transect. The transects and playback stations should be spaced so that all Type I, II, and III habitat on each site will be sampled for jays. Distances between transects and between stations along the transects depend on topography, density of surrounding vegetation, and power of the speaker used for broadcasting the calls. A distance of 100 to 200 m (330 to 660 ft) between transects and between stations is generally adequate when using a high-quality, hand-held cassette player broadcasting at full volume. The observer should be able to accurately perceive the location of jay calls up to 100 m and limit estimation to that distance.

The best times of the year to conduct surveys are during (a) early spring (especially March); (b) September and October, when territorial displays are most frequent and vigorous; and (c) July, when young of the year are independent but still distinguishable by plumage. The poorest times to survey are late winter, when jays are most likely to fly far for food, and in late spring, when the young are quiet and adults are occupied with molting and feeding fledglings.

Surveys should be conducted on calm, clear days, beginning about 1 hr after sunrise and terminating before midday. Surveys should not be carried out in mist, fog, winds stronger than 5 to 8 mph, or precipitation exceeding a light, intermittent drizzle. Heat and wind lower the tendency for jays to respond to distant territorial scolds, and wind reduces the distance over which recordings can be heard. Jays are also reluctant to fly on windy days.

Survey protocol

Transects may be driven or walked. On sites with roads, large areas of scrub can be surveyed in 1 day with a vehicle. The process requires a much longer time on foot because scrub jay territories are 4 to 16 ha (10 to 40 acres) in size. If the survey is driven, the observer must turn off the engine and stand outside or atop the vehicle at each playback station. The calls should be broadcast for at least 1 min in all four directions around each station, emphasizing any direction in which low-growing oak scrub is the predominant vegetation. The location of all Florida scrub jay groups should be plotted on the vegetation map, group size indicated, and adults distinguished from juveniles by plumage whenever possible.

Observers must be careful to plot each group of jays where it was first seen or heard, not at the site to which it was attracted. Several groups may be attracted to one station from different directions, and the result may give a false impression of extremely high jay density. Numbers will shift as groups arrive and depart. To avoid overestimation of jay groups, the observer should watch the directions from which the jays come or to which they return.

An occupied site should be visited as often as necessary to accurately determine the number of jay groups. If more than 8 to 10 jays are encountered at a playback station during spring or fall surveys, the jays at that site should be monitored over several visits and at different times of day. The key products of this procedure are a complete count of all jay groups onsite and an approximate territory map or home range center for each group.

Impacts and Causes of Decline

The decline of the Florida scrub jay has been attributed chiefly to the loss of Florida's scrub communities to agriculture, silviculture, and commercial and residential development (U.S. Fish and Wildlife Service 1990). Most of the scrub lands favored by jays lie in areas of high real estate value. Coastal scrub has been cleared for beachfront hotels, houses, and condominiums, and scrub habitats in the interior of Florida are subject to development for citrus groves and housing. The increasing human population is continually placing more pressure on natural habitats. The population in Florida nearly doubled between 1960 and 1980, increasing from 4.95 to 9.75 million people (Terhune 1982). In 1994, the population was estimated at 13.9 million people with a projection of 15.5 million by 2000 (Florida Department of Commerce 1997). Most housing developments located in scrub habitats are less than 20 years old; in many of these, scrub jay populations are barely persisting and will probably disappear in a few years as land clearing continues (U.S. Fish and Wildlife Service 1990).

Although habitat loss has been a major cause of scrub jay decline, habitat degradation now poses a serious threat to many populations (Breininger et al. 1996). Residential development causes major changes in scrub, including habitat fragmentation, fire suppression, vehicle traffic, and introduction of exotic plants and predators (Woolfenden and Bowman 1992). Historically, fires caused by lightning were major factors in maintaining the sparse, low scrub vegetation preferred by scrub jays (U.S. Fish and Wildlife Service 1990). In some areas, prevention and/or control of natural fires have allowed the scrub to become too dense and tall to support jay populations. Roadkills may also be a significant mortality factor in the extirpation of small populations, as jays frequently forage along roadsides and in the adjacent vegetation (Cox 1984, Dreschel et al. 1990).

Continued decline is inevitable because of the disruption of natural fire regimes and the difficulty in restoring many scrubs to conditions where the production of new potential breeders exceeds breeder mortality (Breininger et al. 1996). None of the core populations have been demonstrated to be secure. Much of the Lake Wales population core is

in private ownership. Stability in the Ocala National Forest has not been demonstrated and seems unlikely. Years of study and population modeling of the Merritt Island population show that the population is declining because of habitat degradation, and data collected by researchers from Archbold Biological Station and the University of Florida show that this is also true for the scrub jay population on Cape Canaveral Air Station.

Military training maneuvers that degrade oak and pine scrub will result in habitat loss for the Florida scrub jay, since it is endemic to Florida scrub vegetation types. The elimination of nesting and foraging sites ultimately results in loss of a local population, since recolonization is uncommon among scrub jays. Unoccupied habitat is almost nonexistent, and occupied habitat cannot be colonized further because of the highly territorial nature of this species (Woolfenden and Fitzpatrick 1991).

All Federal agencies must consult with the U.S. Fish and Wildlife Service about any planned activity on their lands that could adversely affect populations of the threatened Florida scrub jay (U.S. Fish and Wildlife Service 1990). Such activities on a military installation include pesticide use, road construction, certain types of training exercises, and land clearing for new buildings and runways.

Management and Protection

Recovery plan

The best way to protect the Florida scrub jay is to maintain it on the threatened and endangered species list (U.S. Fish and Wildlife Service 1990). Delisting is not presently a goal for the recovery of the species, as that would eliminate its protection on Federal lands where the three most viable populations occur. Recovery criteria that must be met to maintain the scrub jay at its present status (threatened) are the following:

a. Stable or increasing populations at the three existing, large population sites (Ocala National Forest, Merritt Island/Cape Canaveral, and Archbold Biological Station) and an approved management plan from each site.

b. Documented evidence that scrub jays are recolonizing restored or uninhabited areas throughout their historic range

c. Establishment of several scrub preserves that contain sufficient acreage to sustain viable scrub jay populations.

d. Use of scrub jay habitat management guidelines by developers when proposing development in scrub habitat.

Five necessary actions needed to maintain scrub jay populations are set forth in the species recovery plan (U.S. Fish and Wildlife Service 1990). These are as follows:

a. Protect, manage, and enhance populations on public and private lands.

b. Work with Federal, State, and private organizations to establish protected scrub preserves through acquisition, landowner agreements, or easements.

c. Implement habitat management guidelines with specific recommendations for developers and landowners.

d. Conduct research to determine basic biological needs of the scrub jay.

e. Reestablish populations of scrub jays where they have been extirpated, and reclaim suitable habitat.

The U.S. Fish and Wildlife Service (1990) did not propose a date for recovery of the Florida scrub jay because delisting the species may never be feasible. Completion of the suggested recovery actions are deemed necessary to prevent reclassification from threatened to endangered.

Management techniques

The Florida scrub jay recovery plan (U.S. Fish and Wildlife Service 1990) recommends the development and implementation of long-term, site-specific management plans to protect scrub jay populations on public lands. Since the jay's survival depends on the availability of suitable habitat, management on installations with existing or potential populations should be directed toward maintaining, improving, and restoring oak scrub communities. Management tasks outlined in the recovery plan include the following actions.

a. Conduct periodic burns of oak scrub to prevent it from reaching a height (4 m/13 ft) unsuitable for jays. The application of fire should be conducted so that scrub jay habitat burns as a mosaic, leaving resident jays some unburned habitat (Breininger et al. 1996). Because jays are site tenacious and tend to remain in the same territories, the burning regime should be rotated so that all habitat is not burned during one burning period. It is usually sufficient to burn only one-third of an area during one burning period. Burns should be conducted at approximately 8-year intervals; burning too frequently interferes with nesting, as jays usually do not nest in an area for at least 2 years after a burn (Breininger 1981). However, during the restoration of scrub that has not been burned for many years, fires may need to be more frequent than 8-year intervals until suitable habitat conditions are reestablished (Breininger et al. 1996).

b. Create habitat by mechanically opening and clearing areas in oak scrub. Selected areas should also be burned initially and maintained in suitable condition by periodic burning (Schmalzer et al. 1994).

c. Conduct periodic timber harvest and regeneration of sand pine on lands having a commercial sand pine timber resource. On lands where burning is not an option, timber harvest is an economically profitable alternative.

Habitat should be restored to areas where scrub jay populations have been extirpated (U.S. Fish and Wildlife Service 1990). Efforts should be made to locate any of these sites to evaluate the rehabilitation potential for scrub jay habitat. Wherever possible,

such areas should be returned to conditions suitable for jays. Some areas may be restored by controlled burning or chopping to thin out vegetation and create openings for foraging. Others may require the reestablishment of scrub communities by allowing time for oaks, pines, and associated vegetation to return. Although scrub species can be planted, reestablishment on previously cleared areas is slow and vegetation may not reestablish (Schmalzer et al. 1994). When restoring and maintaining habitat, managers should use landscape and habitat objectives to effect adaptive management, as every patch of scrub habitat responds individually (Breininger et al. 1996).

Although all scrub habitat is not optimal for the Florida scrub jay, all areas occupied by jays are significant and should be maintained (Fitzpatrick et al. 1991). Habitats in less suitable conditions may provide corridors for dispersal and allow overall populations to be larger in areas that would otherwise support smaller populations.

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY ***(Leave blank)***

2. REPORT DATE
September 1997

3. REPORT TYPE AND DATES COVERED
Final report

4. TITLE AND SUBTITLE
Species Profile: Florida Scrub Jay (*Aphelocoma coerulescens*) on Military Installations in the Southeastern United States

5. FUNDING NUMBERS

6. AUTHOR(S)
Wilma A. Mitchell

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Engineer Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

8. PERFORMING ORGANIZATION REPORT NUMBER
Technical Report SERDP-97-11

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Corps of Engineers
Washington, DC 20314-1000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 words)***

The Florida scrub jay (*Aphelocoma coerulescens*) is a nonmigratory, highly social bird endemic to Florida. The species is both Federally and State listed as threatened. The historical range extended from northern Florida to the southern tip of the State, but the species is currently restricted to scattered, small, and often isolated patches of scrub habitat almost exclusively in peninsular Florida. Optimal habitat for the Florida scrub jay consists of open, low-growing scrub communities having shrubs and sparsely vegetated sandy areas. It is most abundant in oak-dominated scrub communities but also uses coastal scrub and some communities with a pine component. The Florida scrub jay has been documented on five military installations in Florida. This report is one of a series of Species Profiles being developed for threatened, endangered, and sensitive species inhabiting southeastern United States plant communities. The work is being conducted as part of the Department of Defense (DoD) Strategic Environmental Research and Development Program (SERDP). The report is designed to supplement information provided in plant community management reports for major United States plant communities found on military installations. Information provided on the Florida scrub jay includes status, life history and ecology, habitat requirements, impacts and causes of decline, habitat assessment techniques, inventory and monitoring, and management and protection.

14. SUBJECT TERMS
DoD installations
Florida scrub jay
Management techniques
Plant communities
SERDP
Species profile
Threatened and Endangered species

15. NUMBER OF PAGES
23

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED		