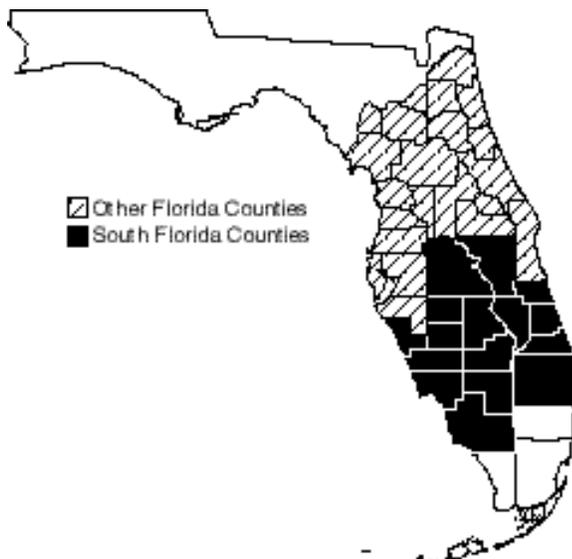

Florida Scrub-jay

Aphelocoma coerulescens

Federal Status:	Threatened (June 3, 1987)
Critical Habitat:	None Designated
Florida Status:	Threatened
Recovery Plan Status:	Contribution (May 1999)
Geographic Coverage:	South Florida

Figure 1. County distribution of the Florida scrub-jay.



The Florida scrub-jay is a relict species of fire-dominated oak scrub habitat that occurs on well-drained sandy soils in peninsular Florida. Scrub-jays are extremely habitat-specific, sedentary, and territorial. Florida scrub-jays form family groups; fledglings remain with their parents in their natal territory as helpers. The Florida scrub-jay was listed as a threatened species because of loss, fragmentation, and degradation of scrub habitats throughout Florida, due primarily to urbanization, agriculture, and fire suppression. During the last 10 to 12 years, the population has declined by an estimated 25 to 50 percent, and they have been extirpated from seven counties statewide. The most recent estimate of the scrub-jay population (1993) is 11,000 birds. Conservation measures for Florida scrub-jays will involve protection and long-term management of suitable scrub habitat.

This account represents South Florida's contribution to the range-wide recovery plan for the Florida scrub-jay (FWS 1990).

Description

Florida scrub-jays are about 25 to 30 cm long and weigh about 77 grams. They are similar in size and shape to the blue jay (*Cyanocitta cristata*), but differ significantly in coloration (Woolfenden and Fitzpatrick 1996a). Unlike the blue jay, scrub-jays lack a crest. They also lack the conspicuous white-tipped wing and tail feathers, black barring and bridle of the blue jay. The Florida scrub-jay's head, nape, wings and tail are pale blue, and it is pale grey on its back and belly. Its throat and upper breast are lightly striped and bordered by a pale blue-gray "bib." The sexes of Florida scrub-jays are not distinguishable by plumage, and males average only slightly larger than females (Woolfenden 1978). The sexes may be differentiated by a distinct "hiccup" call vocalized only by females (Woolfenden and Fitzpatrick 1986). Scrub-jays less than about 5 months of age are easily distinguishable from

adults; their plumage is smokey gray on the head and back, and they lack the blue crown and nape of adults. Molting occurs between early June and late November, and peaks between mid-July and late September (Bancroft and Woolfenden 1982). During late summer and early fall, when the first basic molt is nearly complete, fledgling scrub-jays may be indistinguishable from adults in the field (Woolfenden and Fitzpatrick 1984). The wide variety of vocalizations of Florida scrub-jays are described in detail by Woolfenden and Fitzpatrick (1996b).

Taxonomy

Scrub-jays (*Aphelocoma coerulescens*) are in the order Passeriformes and the family Corvidae. They have been called a “superspecies complex,” and described in four groups that differ in geographic distribution within the United States and Mexico: *A. californicus*, from southwestern Washington through Baja California; *A. insularis*, on Santa Cruz in the Channel Islands, California; *A. woodhousii*, from southeastern Oregon and the Rocky Mountains and Great Plains to Oaxaca, Mexico; and *A. coerulescens* in peninsular Florida (AOU 1983). Other congeners are the Mexican jay or gray-breasted jay (*A. ultramarina*) and the unicolored jay (*A. unicolor*) of southern Mexico and northern Central America (Woolfenden and Fitzpatrick 1996b).

The Florida scrub-jay, which was originally named *Corvus coerulescens* by Bosc in 1795, was transferred to the genus *Aphelocoma* in 1851 by Cabanis. In 1858, Baird made *coerulescens* the type species for the genus, and it has been considered a subspecies (*A. c. coerulescens*) for the past several decades (AOU 1957). It recently regained recognition as a full species (Florida scrub-jay, *Aphelocoma coerulescens*) from the American Ornithologists’ Union (AOU 1995) because of genetic, morphological and behavioral differences between the other members of this group: the western scrub-jay (*A. californicus*) and the island scrub-jay (*A. insularis*). The group name is retained for species in this complex; however, it is now hyphenated to “scrub-jay” (AOU 1995).

Distribution

Florida scrub-jays historically were distributed throughout the Florida peninsula in suitable scrub habitat in 39 of the 40 counties south of, and including, Levy, Gilchrist, Alachua, Clay, and Duval counties (Fitzpatrick *et al.* 1991). Historically, the only county on the peninsula that lacked scrub-jays was Monroe, although they were never considered abundant on the Atlantic coast south of Martin County, and occurred only in a narrow coastal band there. The current county distribution of Florida scrub-jays is shown in Figure 1. On the Atlantic coast, scrub-jays extend from Flagler to Palm Beach counties. On the Gulf coast, scrub-jays persist patchily from Levy, Citrus, western Marion, and northwestern Sumter counties south to Sarasota, western DeSoto, Charlotte, Lee, and northwestern Collier counties. In central Florida, scrub-jays range from southwestern Clay through Putnam and Marion counties, south through Polk, Highlands, and Glades counties. Florida scrub-jays have been extirpated from Broward, Dade, Duval, Gilchrist, Pinellas, and St. Johns counties.

Florida scrub-jay.

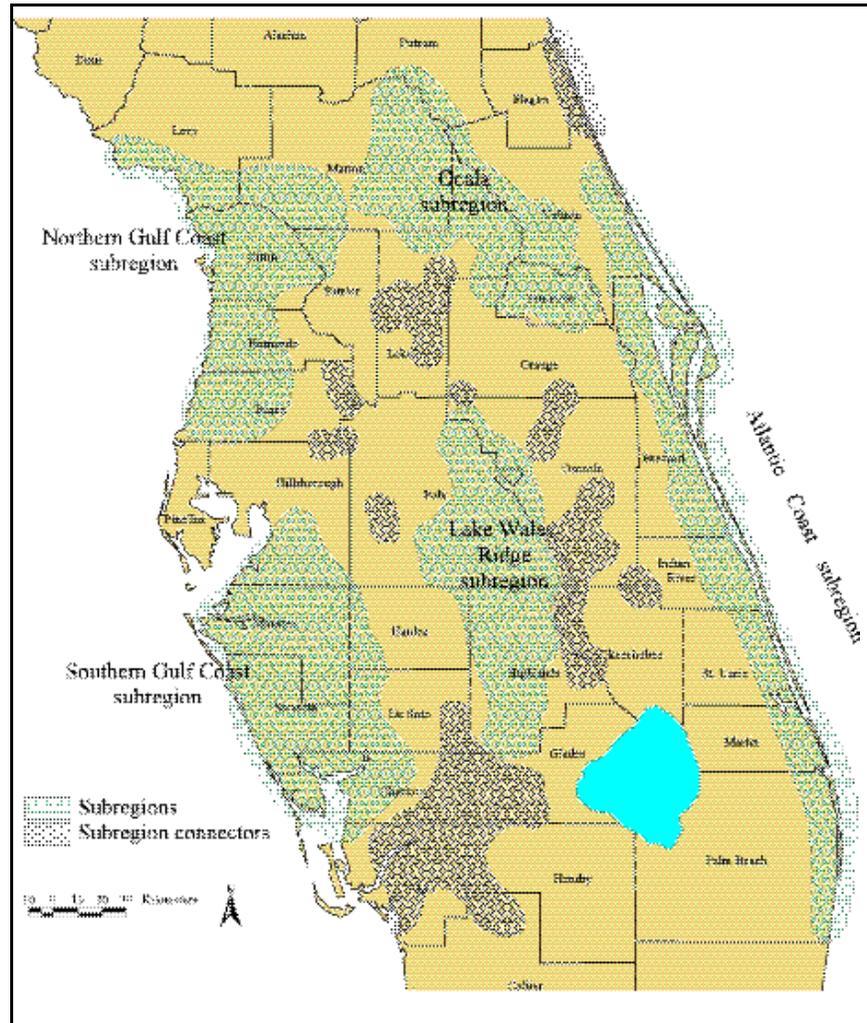
Original photograph by Brian Toland.



The distribution and status of the Florida scrub-jay across its entire range was updated during 1992 and 1993 (Fitzpatrick *et al.* 1994b). Based upon that survey, the overall Florida population of scrub-jays was divided into five subregions, corresponding to the major sand deposits located on the peninsula (Figure 2). Three of these subregions are considered “core populations” because they contain well over half of the state’s remaining scrub-jays. These population cores occur at Merritt Island/Cape Canaveral Complex, Ocala NF, and on the southern Lake Wales Ridge, and are respectively named the Atlantic Coast Subregion, the Ocala Subregion, and the Lake Wales Ridge Subregion (Fitzpatrick *et al.* 1994a).

All extant scrub-jay populations outside of the three core population subregions consist of smaller subpopulations that are isolated to varying degrees (Fitzpatrick *et al.* 1994b). Along the Gulf coast from Levy County south to Lee County, scrub-jays historically occurred in a contiguous fourth major population: the Gulf Coast Subregion. Today, however, this population is divided into two subregions: the Northern Gulf Coast Subregion and the Southern Gulf Coast Subregion, because of the extensive amount of habitat fragmentation and loss that has occurred in Pinellas, Hillsborough, Pasco, and Hernando counties (Fitzpatrick *et al.* 1994b).

Figure 2. Location of Florida scrub-jay subregions and the habitats connecting the subregions adapted from Fitzpatrick et al. 1994a).



Habitat

The Florida scrub-jay has extremely specific habitat requirements. It is endemic to peninsular Florida's ancient dune ecosystems or scrubs, which occur on well-drained to excessively well-drained sandy soils (Laessle 1958, 1968, Fitzpatrick *et al.* 1994b). This relict oak-dominated scrub, or xeric oak scrub, is essential habitat to the Florida scrub-jay. This community type is adapted to nutrient-poor soils, periodic drought, high seasonal rainfall and frequent fires (Abrahamson 1984). Xeric oak scrub on the Lake Wales Ridge is predominantly comprised of four species of stunted, low-growing oaks: sand live oak (*Quercus geminata*), Chapman oak, (*Q. chapmanii*), myrtle oak, (*Q. myrtifolia*), and scrub oak, (*Q. inopina*) (Myers 1990). In optimal habitat for scrub-jays, these oaks are 1 to 3 m high, interspersed with 10 to 50 percent unvegetated, sandy openings, and a sand pine (*Pinus clausa*) canopy of less than 20 percent (Woolfenden and Fitzpatrick 1990). Trees and dense herbaceous vegetation are rare. Other vegetation noted along with the oaks includes saw palmettos (*Serenoa repens*) and scrub palmetto (*Sabal etonia*), as

well as woody shrubs such as Florida rosemary (*Ceratiola ericoides*) and rusty lyonia (*Lyonia ferruginea*). Although there is more species diversity in the Lake Wales Ridge oak scrub, the Atlantic Coastal Ridge oak scrub is similar in structural composition.

On the Merritt Island/Cape Canaveral Complex and in southwest Florida, scrub-jays occupy areas with less scrub oak cover and fewer openings than xeric oak scrub habitat on the Lake Wales Ridge (Breininger 1981, Thaxton and Hingtgen 1996). The predominant communities here are oak scrub and scrubby flatwoods. Scrubby flatwoods differ from scrub by having a sparse canopy of slash pine (*P. elliotii*); sand pine are rare. Although *Q. inopina* and *S. etonia* are restricted to the Lake Wales Ridge, the other species mentioned above are predominant in these areas as well. In addition, runner oak (*Q. minima*), turkey oak (*Q. laevis*), bluejack oak (*Q. incana*), and longleaf pine (*P. palustris*) have been reported.

Kennedy Space Center, in Brevard County, has one of the largest contiguous populations of the Florida scrub-jay. Studies conducted there provide good descriptions of this habitat type (Schmalzer and Hinkle 1992). Although Kennedy Space Center is geographically located just north of the ecosystem boundaries for South Florida, habitat data for scrub-jays are included for comparative purposes with xeric oak scrub on the Lake Wales Ridge. In a recent study, Breininger *et al.* (1995) reported that scrub-jays occupied all areas at Kennedy Space Center that were more than 136 m from a forest, and that supported more than 29 percent scrub oak cover and more than 4 percent open space. Areas closer to forested habitat, or with greater than 20 percent pine cover, were used infrequently by scrub-jays, even when the percentages of scrub oak cover and open space were suitable. Highest densities of scrub-jays, as an indication of habitat preference, were in areas greater than 136 m from forested habitat, where scrub oak cover exceeded 60 percent, open space exceeded 10 percent, and pine cover was less than 20 percent.

Behavior

Social Structure

Florida scrub-jays have a social structure that involves cooperative breeding, a trait that the western North American populations of scrub-jays do not exhibit (Woolfenden and Fitzpatrick 1984). Florida scrub-jays live in groups ranging from two (a single mated pair) up to large, extended families of eight adults and one to four juveniles. Fledgling scrub-jays remain with the breeding pair in their natal territory as “helpers,” forming a closely-knit, cooperative family group. Pre-breeding numbers are generally reduced to either a pair with no helpers or families of three or four individuals (a pair plus one or two helpers).

Florida scrub-jays have a well-developed intrafamilial dominance hierarchy, with breeder males most dominant, followed by helper males, breeder females, and, finally, female helpers (Woolfenden and Fitzpatrick 1977). Helpers participate in sentinel duties (McGowan and Woolfenden 1989), territorial defense, predator-mobbing, and the feeding of both nestlings (Stallcup and Woolfenden 1978) and fledglings (McGowan and Woolfenden

1990). The well-developed sentinel system involves having one individual occupying an exposed perch watching for predators or territory intruders. When a predator is observed, the sentinel jay gives a distinctive warning call and all group members seek cover in dense shrub vegetation (Fitzpatrick *et al.* 1991).

The only other population of scrub-jays that exhibits cooperative breeding is the southernmost form in Oaxaca, Mexico (Burt and Peterson 1993). Although it is well known that delayed dispersal by juvenile Florida scrub-jays is caused by limitations in the availability of breeding habitats, this does not appear to be the reason for cooperation among the southern Mexico population. It is still unclear why the Mexican population exhibits this social behavior; however, Burt and Peterson (1993) offer several possible explanations for this difference that will require further investigation.

Florida scrub-jay pairs occupy year-round, multi-purpose territories (Woolfenden and Fitzpatrick 1984; Fitzpatrick *et al.* 1991, 1994b). Territory size averages 9 to 10 ha, with a minimum size of about 5 ha. The availability of territories is a limiting factor for scrub-jay populations. Because of this limitation, non-breeding adult males may remain at the natal territory as helpers for up to five years, waiting for either a mate or territory to become available (Fitzpatrick *et al.* 1991). New territories are established several ways: by replacing a lost breeder on a territory (Woolfenden and Fitzpatrick 1984); through “territorial budding,” where a helper male becomes a breeder in a segment of its natal territory (Woolfenden and Fitzpatrick 1978); by inheriting a natal territory following the death of a breeder; by establishing a new territory between existing territories (Woolfenden and Fitzpatrick 1984); or through “adoption” of an unrelated helper by a neighboring family followed by resident mate replacement (B. Toland, FWS, personal communication 1996). Territories can also be obtained by creating suitable habitat in areas that were previously unsuitable through effective habitat management efforts (Thaxton and Hingtgen 1994).

Reproduction and Demography

To become a breeder, a scrub-jay must acquire a territory and a mate. Evidence presented by Woolfenden and Fitzpatrick (1984) suggests that Florida scrub-jays are permanently monogamous. The pair retain ownership and sole breeding-privileges in their particular territory year after year. Courtship to form the pair is lengthy and ritualized, and involves posturing and vocalizations made by the male to the female (Woolfenden and Fitzpatrick 1996b). Copulation between the pair is generally out of sight of other jays (Woolfenden and Fitzpatrick 1984). These authors also reported never observing copulation between unpaired jays, nor courtship behavior between a female and a jay other than her mate. Age at first breeding in the Florida scrub-jay varies from 1 to 7 years, although most individuals become breeders between 2 and 4 years of age (Fitzpatrick and Woolfenden 1988). Persistent breeding populations of Florida scrub-jays exist only where there are scrub oaks in sufficient quantity to provide an ample winter acorn supply, cover from predators, and nest sites during the spring (Woolfenden and Fitzpatrick 1996).

Florida scrub-jay nests are typically placed in shrubby oaks, at a height of 1 to 2 m. *Quercus inopina* and *Q. geminata* are the preferred shrub on the Lake Wales Ridge (Woolfenden and Fitzpatrick 1984) and *Q. myrtifolia* is favored on

the Atlantic Coastal Ridge and southern Gulf coast (Toland 1991, J. Thaxton Uplands Inc., personal communication 1998). In suburban areas, scrub-jays nest in the same evergreen oak species as well as in introduced or exotic trees; however they construct their nests in a significantly higher position in these oaks than when in natural scrub habitat (Bowman *et al.* 1996). Florida scrub-jay nests are an open cup, about 18 to 20 cm outside diameter, and 8 to 9 cm inside diameter. The outer basket is bulky and constructed of coarse twigs from oaks and other vegetation, and the inside is lined with tightly wound palmetto or cabbage palm fibers. There is no foreign material as may be present in a blue jay nest (Woolfenden and Fitzpatrick 1996b).

Nesting is synchronous, normally occurring from 1 March through 30 June (Woolfenden and Fitzpatrick 1990, Fitzpatrick *et al.* 1994b). On the Atlantic Coastal Ridge and southern Gulf coast, nesting may be protracted through the end of July (B. Toland, FWS, personal communication 1996; J. Thaxton, Uplands Inc., personal communication 1998). In suburban habitats, nesting is consistently initiated earlier (March) than in natural scrub habitat (Fleischer 1996), although the reason for this difference is unknown. Nesting failures are almost always caused by predation, most frequently by ground-based predators including eastern coachwhip (*Masticophis flagellum*), eastern indigo snake (*Drymarchon corais*), rat snake (*Elaphe obsoleta*), corn snake (*E. guttata*), raccoon (*Procyon lotor*), and domestic cat (*Felis catus*) (Fitzpatrick *et al.* 1991, Schaub *et al.* 1992).

Clutch size ranges from one to five eggs, but is typically three or four eggs. Clutch size is generally larger (up to six eggs) in suburban habitats, and the birds attempt to rear more broods (Fleischer 1996). Double brooding by as much as 20 percent has been documented on the Atlantic Coastal Ridge and in suburban habitat within the southern Gulf coast, compared to about 2 percent on the Lake Wales Ridge (B. Toland, FWS, personal communication 1996, J. Thaxton, Uplands Inc., personal communication 1998). Scrub-jay eggs measure 27.08 mm x 20.18 mm (length x breadth) (Woolfenden and Fitzpatrick 1996b), and coloration “varies from a pea green to pale glaucous green, blotched and spotted with irregularly shaped markings of cinnamon rufous and vinaceous cinnamon, these being heaviest about the larger end” (Bendire in Bent 1946). Eggs are incubated for 17 to 18 days, and fledging occurs 16 to 21 days after hatching (Woolfenden 1974, 1978; Fitzpatrick *et al.* 1994b). Only the breeding female incubates and broods eggs and nestlings (Woolfenden and Fitzpatrick 1984). Average production of young is two fledglings per pair, per year (Woolfenden and Fitzpatrick 1990, Fitzpatrick *et al.* 1994a), and the presence of helpers improves fledging success (Mumme 1992). Annual productivity must average at least two young fledged per pair for a population of scrub-jays to maintain long-term stability (Fitzpatrick *et al.* 1991).

Fledglings depend on adults for food for about 10 weeks, during which time they are fed by both breeders and helpers (Woolfenden 1975, McGowan and Woolfenden 1990). In optimal scrub, survival of scrub-jay fledglings to yearling age class averages about 35 percent, while annual survival of adult males and females is equal and averages around 80 percent (Fitzpatrick *et al.* 1994b). Data from Archbold Biological Station, however, suggest that survival and reproductive success of scrub-jays is substantially lower than these values under

Table 1. Mean survivorship and reproduction of Florida scrub-jays in several habitats at Archbold Biological Station, 1969-86 (taken from Woolfenden and Fitzpatrick 1991).

	Optimal Habitat		Suboptimal Habitat	
	Periodically burned, open oak scrub	Unburned, overgrown scrubby flatwoods	Unburned southern ridge sandhill (slash pine-turkey oak)	Mature citrus bordering unburned scrub
N (pair-years)	429	74	8	21
Seasonal nest attempts	1.38 (593/429)	1.49 (110/74)	1.50 (12/8)	1.11 (20/18)
Fledglings/pair	1.97 (843/429)	1.58 (117/74)	1.38 (11/8)	2.00 (38/18)
Independent young/pair	1.17 (500/429)	0.80 (59/74)	1.13 (9/8)	1.56 (28/18)
Yearlings/pair	0.60 (259/429)	0.36 (27/74)	0.50 (4/8)	0.61 (11/18)
First-year survival	0.307 (259/843)	0.231 (27/117)	0.364 (4/11)	0.289 (11/38)
Breeder survival	0.789 (697/883)*	0.723 (107/148)	0.688 (11/16)	0.619 (26/42)
Expected lifetime success/individual				
Breeding seasons	4.4	3.5	3.2	2.6
Fledglings	4.3	2.8	2.2	2.6
Independent young	2.6	1.4	1.8	2.0
Yearlings	1.3	0.6	0.8	0.8

*N=883 breeder years for calculating breeder survival

suboptimal habitat conditions (Woolfenden and Fitzpatrick 1991) (Table 1). The data help explain why local populations inhabiting unburned, late successional habitats become extirpated.

Similarly, data from Indian River County show that mean annual productivity declines significantly in suburban areas. Toland (1991) reported that productivity averaged 2.2 young fledged per pair in contiguous, optimal scrub, 1.8 young fledged per pair in fragmented, moderately developed scrub, 1.2 young per pair fledged in highly fragmented, suboptimal scrub, and only about 0.5 young per pair in residential lawns. Overall nest success (probability of fledging at least one young) is about 50 percent on the Lake Wales Ridge and about 70 percent on the Atlantic Coastal Ridge in Indian River County (B. Toland, FWS, personal communication 1996). The maximum observed lifespan of a Florida scrub-jay is 15.5 years (Woolfenden and Fitzpatrick 1996b).

Dispersal

Scrub-jays are nonmigratory, extremely sedentary, and permanently territorial. Juveniles remain in their natal territory for up to 5 years before dispersing to become breeders (Woolfenden and Fitzpatrick 1984). Once they pair and become breeders, generally within two territories of their natal ground, they remain on their breeding territory until death. In suitable habitat, fewer than 5 percent of

scrub-jays disperse more than 8 km (Fitzpatrick *et al.* 1994b). All documented long-distance dispersals have been in unsuitable habitat such as woodland, pasture, or suburban plantations. Scrub-jay dispersal behavior is affected by the intervening landscape matrix. Protected scrub habitats will most effectively sustain scrub-jay subpopulations if they are located within a matrix of surrounding habitats that can be utilized and traversed by scrub-jays. Brushy pastures, scrubby corridors along railway, utility, and country road rights-of-way, and open, burned flatwoods provide links for colonization among scrub-jay subpopulations. Stith *et al.* (1996) believe that a dispersal distance of 8 km is close to the biological maximum for Florida scrub-jays. Table 2 provides estimated distances across which scrub-jays normally disperse in the wild.

In suburban habitats in southwest Florida, however, average dispersal distances for scrub-jays is much greater than in natural habitat (Thaxton and Hingtgen 1996). In their study, these authors also noted that no dispersals were made from preserves to suburban territories, and attributed this to habitat degradation. Scrub-jays are known to disperse up to 94 km in suburban habitats in southeastern Florida and are thought to frequently disperse further than the 8 km average found in more natural conditions (G. Iverson, personal communication 1998).

Table 2. Dispersal distances of Florida scrub-jays in relation to habitat type (from Fitzpatrick *et al.* 1994)

Habitat Type	Normal Dispersal Distance (km)	Maximum Dispersal Distance (km)
Open Water	2	2
Urban areas	2	2
Dense pine forest	2	3
Unbroken, open pasture	3	7
Cropland	3	7
Unbroken citrus groves	5	8
Densely wooded suburbs	5	8
Suburbs with few trees	5	13
Flatwoods	5	17
Broken pasture, fence rows, roadsides	8	24
Overgrown scrub with some clearings	8	24

Foraging

Florida scrub-jays forage mostly on or near the ground, often along the edges of natural or man-made openings. They visually search for food by hopping or running along the ground beneath the scrub, or by jumping from shrub to shrub. Insects, particularly orthopterans and lepidopteran larvae, comprise the majority of the animal diet throughout most of the year (Woolfenden and Fitzpatrick 1984). Acorns are by far the most important plant food (Fitzpatrick *et al.* 1991). From August to November each year scrub-jays harvest and cache thousands of scrub oak acorns throughout their territory. Each scrub-jay may cache 6,000 to 8,000 acorns per year (DeGange *et al.* 1989). Acorns are typically buried 1 to 2 cm beneath the surface of bare sand in openings in the scrub during fall, and retrieved and consumed in winter and early spring. On the Atlantic Coastal Ridge, acorns are frequently cached in pine trees, either in forks of branches, in distal pine boughs, under bark, or on epiphytic plants, between 0.3 to 9 m in height (B. Toland, FWS, personal communication 1996). Other small nuts, fruits, and seeds are also eaten.

Vertebrate prey items comprise the minority of the diet, but may include a wide array of species weighing up to 25 g (B. Toland, FWS, personal communication 1996). Notable vertebrate prey species documented for scrub-jays on both the Lake Wales Ridge and the Atlantic Coastal Ridge include, green treefrog (*Hyla cinerea*), squirrel treefrog (*H. squirella*), green anole (*Anolis carolinensis*), brown anole (*A. sagrei*), Florida scrub lizard (*Sceloporus woodi*), six-lined racerunner (*Cnemidophorus sexlineatus*), black racer (*Coluber constrictor*), peninsula crowned snake (*Tantilla relicta relicta*), rough green snake (*Ophedrys aestivus*), house mouse (*Mus musculus*), cotton mouse (*Peromyscus gossypinus*), oldfield mouse (*P. polionotus*), and Florida mouse (*Podomys floridanus*) (Woolfenden and Fitzpatrick 1984).

In suburban areas, scrub-jays will accept supplemental foods offered by humans, such as peanuts, corn, and sunflower seeds.

Relationship to Other Species

Because Florida scrub-jays are endemic to oak scrub habitat in peninsular Florida, it occurs with many other species also endemic to this community type. As mentioned previously, the scrub-jays are dependent upon the species of evergreen oaks in the scrub. This oak scrub habitat is also essential to at least 21 federally listed plant species on the Lake Wales Ridge and at least two others on the Atlantic Coastal Ridge. The threatened blue-tailed mole skink (*Eumeces egregius lividus*) and sand skink (*Neoseps reynoldsi*) also occur on the Lake Wales Ridge, and the threatened eastern indigo snake (*Drymarchon corais couperi*) and state-listed gopher tortoise (*Gopherus polyphemus*) are also known to occur with scrub-jays. It is critical that management for scrub habitat and for the Florida scrub-jay consider possible effects on these and other scrub-endemic species.

Scrub-jays occasionally interact with blue jays in scrub and scrubby flatwoods habitats. It has been suggested that the presence of blue jays may limit use of woodland habitat by scrub-jays; however, B. Toland (FWS, personal communication 1996) reports successful fledging by both species nesting in close proximity to one another in Indian River, Polk, and Brevard counties. He also reports that in all cases, Florida scrub-jays were dominant over blue jays in agonistic encounters.

There are relatively few predators on adult Florida scrub-jays; however, the most dangerous native predators are the Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*A. striatus*), merlin (*Falco columbarius*), northern harrier (*Circus cyaneus*), and peregrine falcon (*F. peregrinus*) in descending magnitude of threat. House cats and bobcats (*Felis rufus*) have been documented to prey on scrub-jays (Fitzpatrick *et al.* 1994b). Eastern coach whips, eastern indigo snakes, and great horned owls (*Bubo virginianus*) also occasionally prey on adult scrub-jays (Fitzpatrick *et al.* 1994b).

Status and Trends

The Florida scrub-jay was federally listed as threatened in 1987 primarily because of habitat fragmentation, degradation, and loss (52 FR 20719). Scrub habitats associated with Florida's barrier islands, mainland coasts, and Lake

Wales Ridge are some of the most imperiled natural communities in the United States, with estimates of habitat loss since pre-settlement times ranging from 70 to more than 80 percent (Bergen 1994, Fitzpatrick *et al.* 1994b). Historically, this vegetative community type occurred as large, contiguous patches, some of them over hundreds of miles (Cox 1987). Today, only relict patches of xeric oak scrub remain. Throughout the northern part of the range, population declines of scrub-jays are attributed to scrub fragmentation and degradation, due primarily to widespread fire suppression. Citrus conversion and residential development continue to be the most important factors causing the decline of scrub-jay populations in the southern extremes of their range (Fernald 1989, Fitzpatrick *et al.* 1991).

The decreasing trend of the Florida scrub-jay population is closely correlated with loss of scrub habitat. A statewide survey of Florida scrub-jays conducted during 1992 and 1993 documented about 11,000 Florida scrub-jays (~4,000 pairs) as of 1993, extrapolating from the average scrub-jay group size of 2.8 individuals, and estimated that at least two-thirds of the population inhabits federal lands (Fitzpatrick *et al.* 1994a). This population estimate is no more than 15 percent of the pre-settlement population estimate, and corresponds to a similar reduction in the distribution of scrub habitat. As of 1993, half of all remaining Florida scrub-jays occurred in Brevard County (1,232 families) and Highlands County (890 families) (Fitzpatrick *et al.* 1994a). A total of 19 occupied counties contained 30 or fewer groups of scrub-jays. Cox (1987) estimated that 15,600 to 22,800 jays comprised the statewide population as of 1984. Even a conservative assumption that Cox found all of the breeding pairs of scrub-jays illustrates that the Florida scrub-jay has declined by an estimated 25 to 50 percent during the last 10 years (Fitzpatrick *et al.* 1994a).

Stith *et al.* (1996) used a buffering procedure and 3.5 km dispersal buffer to delineate 191 separate Florida scrub-jay subpopulations. Of these, 152 subpopulations (over 80 percent) contained fewer than 10 pairs of scrub-jays, 33 subpopulations contained between 10 and 99 pairs, and only six contained at least 100 pairs. When a 12 km dispersal buffer was applied to these data, 42 separate scrub-jay subpopulations were delineated; half of these subpopulations contained fewer than 10 pairs. Results from their population viability analysis indicate that a population of jays with fewer than 10 breeding pairs has a 50 percent probability of extinction over 100 years. This improves to a 2 to 3 percent chance of extinction for populations with at least 100 pairs. Only the three core subpopulations currently have enough breeding pairs each to provide a 99 percent probability of survival over 100 years (Fitzpatrick *et al.* 1994b).

To prepare this species account, the FWS conducted additional analyses of these data. Instead of the buffers Stith *et al.* (1996) used, we applied an 8.2 km buffer around occupied scrub-jay territories because this is considered the maximum dispersal distance for scrub-jays (Stith *et al.* 1996). Our analyses (Figure 3) revealed 55 distinct subpopulations instead of the 191 and 42 subpopulations Stith *et al.* (1996) identified. Thirty-six of our subpopulations contained fewer than 10 breeding pairs, 13 contained between 10 and 99 breeding pairs, and six contained more than 100 breeding pairs (the latter result was the same Stith *et al.* reached).

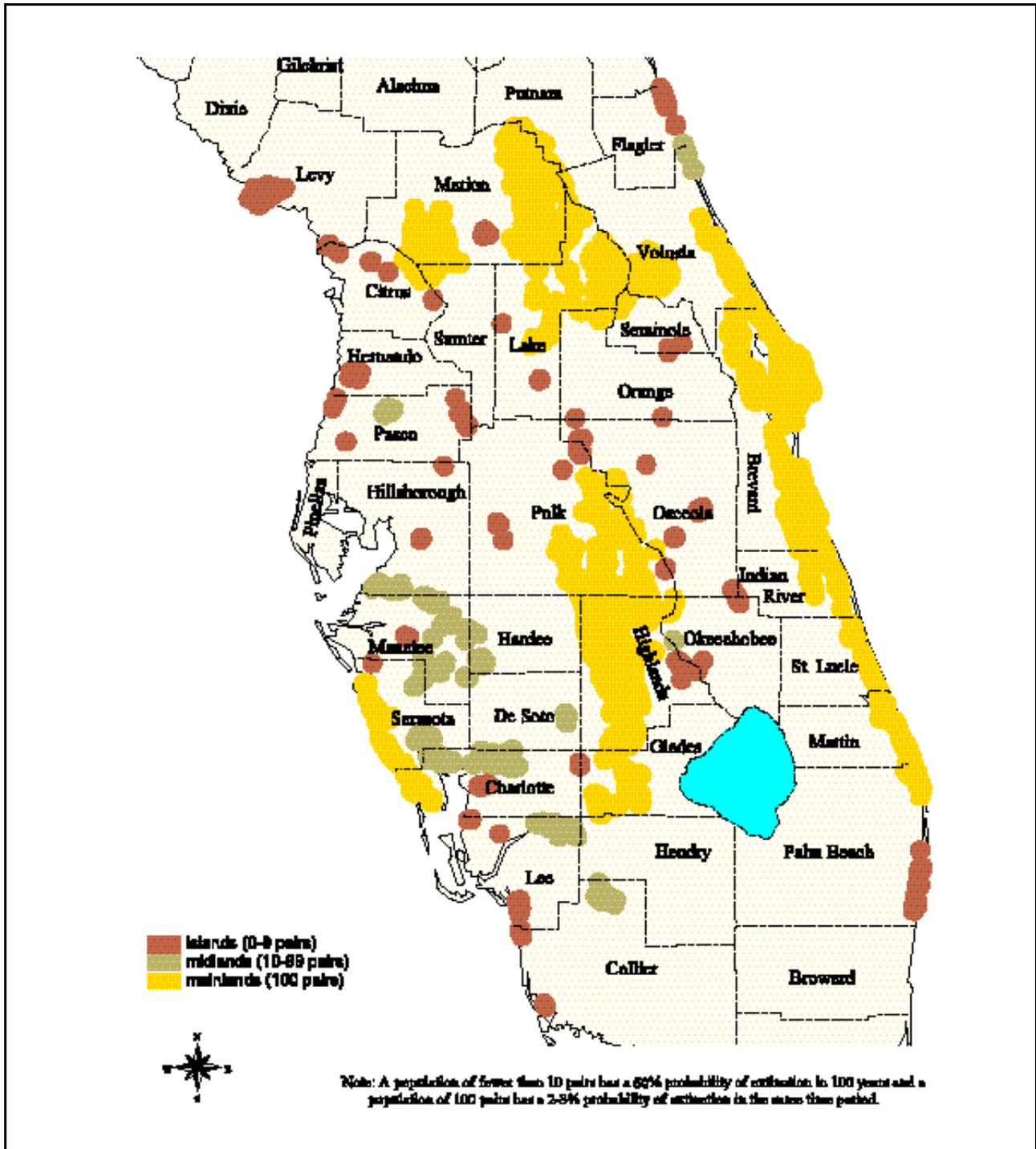


Figure 3. Distribution of Florida scrub-jay subpopulations with an 8.2 km dispersal buffer.

Based on these analyses, about 8.0 percent (324 pairs) of the remaining scrub-jay families have a 50 percent probability of extinction within 100 years. We believe this is a minimum extinction probability because it only addresses extinction risk caused by genetic and demographic phenomena, it does not incorporate the additional extinction risk caused by habitat loss and fragmentation in these territories. These families are important because they occur in the areas that historically connected core populations (see Figure 2); the loss of these birds and their habitat will effectively eliminate any connections between the core populations.

About 16 percent (about 650 pairs, assuming an average of 50 pairs per subpopulation) of the remaining scrub-jay families have an extinction probability ranging between 3 and 50 percent. These subpopulations, which occur primarily in southwestern Florida, particularly in Manatee and Sarasota counties, once comprised the southern part of the Gulf Coast Subregion. Since the 1992-1993 survey that produced these data, this area has experienced extensive habitat loss and fragmentation because of urbanization. Consequently, many (if not most) of these subpopulations have been reduced in area and fragmented, with a commensurate decline in the number of breeding pairs these subpopulations support.

The remaining breeding pairs occur in six subpopulations. Of those, the subpopulations centered in the Ocala NF, Lake Wales Ridge, and Merritt Island/Cape Canaveral Complex represent the “core subpopulations,” which are large enough to have only a 1 percent probability of extinction over 100 years. Of more concern are the two subpopulations along the Atlantic coast from Brevard County to Palm Beach County and along the Gulf coast in Sarasota and Charlotte counties. Since the 1992-1993 survey, these areas have also experienced extensive habitat loss and fragmentation because of urbanization. Consequently, these subpopulations have also been reduced in area with a commensurate decline in the number of breeding pairs they support. We feel these areas, in particular, warrant immediate management actions to preclude the extirpation of the scrub-jay.

In South Florida, the only core population that remains exists on the Lake Wales Ridge. This core population is also experiencing extensive habitat loss and fragmentation because of urbanization; the effects of continued urbanization raises concerns about the current status and trends of this population. We feel the Lake Wales Ridge population is critical to the survival and recovery of the Florida scrub-jay in South Florida; any further declines in the size and distribution of this core population places the Florida scrub-jay at a greater risk of extinction in South Florida.

Florida scrub-jays will also inhabit suburban areas where patches of scrub remain. In central Florida, the highest densities of scrub-jays are in areas where development is 33 percent or less (R. Bowman, Archbold Biological Station, personal communication 1995). Scrub-jay increases in habitats altered by human actions probably result from supplemental food sources (primarily peanuts) and the initial creation of openings in the scrub and visual buffers (buildings) to neighboring jay families. However, as the degree of habitat destruction and fragmentation increases, the survival of fledgling scrub-jays declines and failed nesting attempts increase (Toland 1991). Females from

suburban territories may have fewer opportunities to pair with single males, because most males in suburban areas gain territories through breeder replacement (Thaxton and Hingtgen 1996). In addition, the potential for males remaining as helpers to inherit suitable habitat in suburban areas is greatly reduced when compared to protected areas. Resident males may be less likely to maintain any natal territory as a breeder in suburban areas (Thaxton and Hingtgen 1996).

Scrub-jay population numbers are also affected by the frequency and severity of catastrophic mortalities. Epidemic disease is the only known catastrophe that affects Florida scrub-jay populations (Fitzpatrick *et al.* 1991). Archbold Biological Station experienced an epidemic between September 1979 and February 1980 that killed 70 percent of the scrub-jays on that site; the population was not recovered to pre-epidemic numbers as of 1991. The probability of such an epidemic occurring in the future should be considered, along with habitat quality and management, to better predict the future status of scrub-jay populations in Florida. Root (1996) used spatially explicit models to show that an annual epidemic rate of 0.001 (one in a thousand years) produced quasi-extinction probabilities of at least 66 percent for Florida scrub-jays in Brevard County, Florida under optimal habitat conditions and no dispersal, and at least 52 percent when dispersal was allowed among her modeled populations. The addition of connectivity between populations can mitigate the effects of epidemics, and should be an important component of reserve designs for conservation of Florida scrub-jays.

Management

Overall conservation measures for the Florida scrub-jay should include an understanding of the demography and behavior of the species as well as the long-term management needs of oak-dominated scrub habitat. All Florida scrub-jays reside within territories, and each territory must contain sufficient habitat to sustain a family throughout the year. Given that, it is critical to know the total area of suitable habitat needed, the density of territories supported by the habitat, and the long-term management needs for that habitat to maintain its suitability for scrub-jays.

Effective management of the remaining Florida oak scrub habitat, both on public and private lands, will ultimately determine the fate of the Florida scrub-jay. Management to maintain or increase numbers of scrub-jays is directly correlated with maintaining or increasing the amount of habitat available to support territorial pairs of these birds (Fitzpatrick *et al.* 1994b). Maintenance of suitable habitat not only requires management of the patches of scrub occupied by scrub-jays, it also necessitates maintenance of the landscape matrix within which scrub occurs (D. Breininger, DYN-2, personal communication 1998). Periodic fire maintains landscape diversity and reduces likelihood of fragmentation of scrub patches.

Florida scrub-jays will not persist in habitat that is not burned regularly. Natural fires, which typically occur from lightning strikes between May and September, are a frequent influence on scrub habitat succession. These fires probably occurred at intervals of 10 to 100 years in various types of scrub

during presettlement times (Myers 1990). Fire does not alter the vegetative species composition of scrub communities; most of the dominant plants either resprout from underground rhizomes, or recruit from seeds in the soil or released above ground after fire (Schmalzer and Hinkle 1987). Oak scrub revegetates to its preburn structure and species composition about 4 to 5 years after a fire (Abrahamson 1984, Schmalzer and Hinkle 1987, Breininger and Schmalzer 1990).

Fire frequencies necessary to maintain scrub and the surrounding landscape matrices vary depending on whether conditions are mesic or xeric. Within the xeric Lake Wales Ridge, fire return intervals averaging about once every 10 to 20 years is optimal for scrub-jays (Fitzpatrick *et al.* 1991). In more mesic conditions such as those found along the Gulf and Atlantic coasts, more frequent fires (every 6 to 12 years) are required to maintain suitable scrub-jay habitat. In mesic scrubs, more frequent fires may be needed initially to restore overgrown scrub and maintain the functions and values of adjacent ecosystems (D. Breininger, DYN-2, personal communication 1998). However, too frequent fires in scrub tend to maintain the principal oak species below acorn-bearing height and may encourage the spread of palmettos at the expense of oaks. Less frequent fires produce tall, dense oak understories and pine forests (also known as “overgrown scrub”) which are unsuitable to scrub-jays.

In the absence of natural fires the oak scrub community requires specific management prescriptions, including controlled burns and/or mechanical renovation, to maintain habitat suitability for scrub-jays (Myers 1990, Woolfenden and Fitzpatrick 1991, Breininger 1992, Fitzpatrick *et al.* 1994b). Prescribed burning is the preferred method of scrub management. Mechanical treatments, such as rollerchopping, are short-term alternatives but may be less effective in the long term. Studies conducted at Archbold Biological Station during the past 25 years conclude that small, isolated populations of Florida scrub-jays are more likely to become extinct due to normal demographic fluctuations if their habitat is not maintained by periodic burning (Fitzpatrick *et al.* 1991). Root (1996) also showed, through the use of various population models, that reserve designs for Florida scrub-jays must incorporate restoration of habitat quality for successful conservation of the species.

According to Fitzpatrick *et al.* (1991), habitat management prescriptions for scrub-jays should include rotations of prescribed burns, each covering relatively small portions of a preserved tract of scrub. Each point in the tract should be burned once every 10 to 20 years, on average; the shorter intervals are applicable to faster-growing coastal scrubs while the longer intervals are correlated to the slow-growing central ridge scrubs (Woolfenden and Fitzpatrick 1991). Small patches left unburned will provide cover and foraging sites as the scrub regenerates. No more than 25 percent of an area occupied by scrub-jays should be burned at any one time (Fitzpatrick *et al.* 1991). Again, it is critical to maintain or make connections between patches of suitable habitat to facilitate dispersal, and to include buffer habitat around scrub patches (Root 1996).

When creating or managing reserves for scrub-jays, consideration must be given to habitat composition, size, shape, and location (Fitzpatrick *et al.* 1991). Effective reserve design to support an adequate protected population of Florida scrub-jays in average habitat should include about 304 ha of periodically

burned oak scrub (Fitzpatrick *et al.* 1991). This assumes that an adequate protected population of scrub-jays consists of 15 to 30 territories located within 4 km of at least one other population containing more than 30 territories, and the need for 10 ha per territory. Florida scrub-jay populations containing fewer than 30 territories cannot be considered safe from extinction over the long term. Reserves separated by more than 12 km with no connecting scrub patches or corridors can cause isolation of populations by not allowing for dispersal and colonization (Woolfenden and Fitzpatrick 1996b). Small patches or corridors of scrub between larger tracts will reduce the probability that scrub-jays in any one patch will become extirpated. Fitzpatrick *et al.* (1991), therefore, recommend preservation of large tracts of oak scrub habitat over a number of smaller tracts for reserve design. In suburban areas, it has been shown that Florida scrub-jays may not disperse from natural to suburban territories (Thaxton and Hingtgen 1996). Therefore, it is critical to consider maintaining natural preserves for resident birds within dispersal distance; without these, the resident birds are extremely vulnerable to extirpation.

Although a majority of the population of Florida scrub-jays currently resides on public lands, overall numbers of the species are in decline. Management practices on public lands should focus on enhancing and creating scrub habitat to assist with scrub-jay recovery. Conservation on private lands includes acquisition programs for scrub habitat, through State efforts such as the CARL program, and the implementation of habitat conservation plans to protect large tracts of suitable scrub habitat. The FWS is using the digital data presented by Fitzpatrick *et al.* (1994b) to evaluate the amount of occupied scrub habitat as well as unoccupied but restorable scrub throughout Florida, and to identify areas suitable for creating reserves on both public and private lands, including establishing connections between existing protected habitat. In addition, we will be using spatially explicit models to predict results of various alternative reserve designs and help us implement the most optimal conservation measures for long-term protection of the Florida scrub-jay.

There are cases, however, where long-term management of scrub habitat is not possible, such as in rapidly expanding urbanized areas. Fitzpatrick *et al.* (1991) outline procedures to inventory habitat and protocols to survey for scrub-jays, intended as guidance for determining if proposed development projects will adversely affect Florida scrub-jays or their habitat. These authors also provide instruction on implementing preservation measures for agencies or individuals who believe scrub-jays or their habitat will be negatively affected by land clearing or related activities.

To address potential negative effects of land-use practices on scrub-jays and their habitat, we are adopting the terminology recommended by Fitzpatrick *et al.* (1994b). A subpopulation of scrub-jays consists of a number of territories, where each territory is not separated by more than 3.2 km. Clusters of subpopulations that are separated by more than 8 km are considered satellite systems. Satellite systems are also isolated from the core populations and from each other by this same distance. A subpopulation or satellite system is considered isolated if it is separated from the next nearest one by more than 24 km, the maximum documented dispersal distance for the species.

For projects where adverse effects to Florida scrub-jays and their habitats are likely, on-site minimization measures, as well as off-site habitat compensation may be required. Habitat compensation results in the protection and management of suitable scrub-jay habitat in another area. The FWS generally recommends that areas used as habitat compensation be located in the same subregion of the affected habitat to enhance existing subpopulations and satellite systems, and maintain any subregion-specific characteristics among the birds. It has been shown that genetic, ecological and behavioral differences exist among Florida scrub-jays within the different subregions (Fitzpatrick *et al.* 1994b). It is also important to understand the aforementioned dispersal distances to avoid further fragmentation and isolation of existing scrub-jay subpopulations and satellite systems. For compensation, the FWS also generally recommends conservation and management of two acres of occupied habitat for every one acre of occupied habitat affected. This recommendation is currently under review to determine whether adequate long-term protection to the Florida scrub-jay is afforded. Although the 2:1 ratio may result in scrub-jay persistence in many areas, it does not protect enough habitat to ensure long-term recovery of the species.

In areas where scrub habitat is threatened so that scrub-jays would not be able to survive, translocation of birds to protected areas of suitable habitat may be an alternative to salvage birds that would otherwise be lost. Translocation may also be useful to re-establish populations of scrub-jays from areas where they were extirpated, following habitat restoration. In 1989-90, Mumme and Below (1995) conducted an experimental translocation of 18 scrub-jays (12 helpers and 3 breeding pairs) into unoccupied protected scrub habitat in Collier County. Half of these birds disappeared or emigrated and half remained to eventually establish territories. As of December, 1996, this population consisted of six adults (1 female, 5 males) and three first-year birds (at least 1 female). Because of the apparent shortage of females, supplemental translocation may be needed (Mumme and Below 1996). Further research is still needed to assess translocation as a viable management option for these exceptional circumstances.

Literature Cited

- American Ornithologists' Union [AOU]. 1957. Check-list of North American Birds. Fifth edition. Allen Press; Lawrence, Kansas.
- American Ornithologists' Union [AOU]. 1983. Check-list of North American Birds. Sixth edition. Allen Press; Lawrence, Kansas.
- American Ornithologists' Union [AOU]. 1995. Fortieth supplement to the North American Ornithologists' Union check-list of North American Birds. *Auk* 112(3):819-830.
- Abrahamson, W.G. 1984. Post-fire recovery of the Florida Lake Wales Ridge vegetation. *American Journal of Botany* 71: 9-21.
- Bancroft, G.T., and G.E. Woolfenden. 1982. The molt of scrub jays and blue jays in Florida. Ornithological Monograph Number 29. American Ornithologists' Union; Washington, D.C.
- Bent, A.C. 1946. Life histories of North American jays, crows and titmice. U.S. National Museum Bulletin number 191. U.S. Government Printing Office; Washington, D.C.
- Bergen, S. 1994. Characterization of fragmentation in Florida scrub communities. Unpublished M.S. Thesis, Department of Biological Sciences, Florida Institute of Technology; Melbourne, Florida.
- Bowman, R. 1995. FWS Multi-Species Recovery Meeting. 5 December, 1995.
- Bowman, R, G. E. Woolfenden, A.L. Fleischer, Jr., and L.M. Walton. 1996. Nest site selection by Florida scrub-jays in natural and modified habitats. Abstract, Archbold Biological Station 1996 Symposium. 12 September, 1996. Lake Placid, Florida.
- Breining, D.R. 1981. Habitat preferences of the Florida scrub jay (*Aphelocoma coerulescens coerulescens*) at Merritt Island National Wildlife Refuge, Florida. Unpublished M.S. thesis, Florida Institute of Technology; Melbourne, Florida.
- Breining, D.R. 1992. Habitat model for the Florida scrub jay on John F. Kennedy Space Center. NASA Technical Memorandum no. 107543. NASA Biomedical Operations and Research Office, John F. Kennedy Space Center, Florida.
- Breining, D.R., and P.A. Schmalzer. 1990. Effects of fire and disturbance on plants and animals in a Florida oak/palmetto scrub. *American Midland Naturalist* 123: 64-74.
- Breining, D.R., V.L. Larson, B.W. Duncan, R.B. Smith, D.M. Oddy, and M.F. Goodchild. 1995. Landscape patterns of Florida scrub jay habitat use and demographic success. *Conservation Biology* 9(6):1442-1453.
- Breining, D.R. 1998. Comments on technical/agency draft multi-species recovery plan for South Florida. January 26, 1998.
- Burt, D.B. and A.T. Peterson. 1993. Biology of cooperative-breeding scrub jays (*Aphelocoma coerulescens*) of Oaxaca, Mexico. *Auk* 110:207-214.
- Cox, J.A. 1987. Status and distribution of the Florida scrub jay. Florida Ornithological Society Special Publication number 3. Gainesville, Florida.
- DeGange, A.R., J.W. Fitzpatrick, J.N. Layne, and G.E. Woolfenden. 1989. Acorn harvesting by Florida scrub jays. *Ecology* 70(2):348-356.

- Fernald, R.T. 1989. Coastal xeric scrub communities of the Treasure Coast Region, Florida: A summary of their distribution and ecology, with guidelines for their preservation and management. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program technical report number 6. Tallahassee, Florida.
- Fitzpatrick, J.W., and G.E. Woolfenden. 1988. Components of lifetime reproductive success in the Florida scrub jay. Pages 305-320 in T.H. Clutton-Brock, ed. Reproductive success. University of Chicago Press; Chicago, Illinois.
- Fitzpatrick, J.W., G.E. Woolfenden, and M.T. Kopeny. 1991. Ecology and development-related habitat requirements of the Florida scrub jay (*Aphelocoma coerulescens coerulescens*). Florida Game and Freshwater Fish Comm. Nongame Wildlife Program technical report number 8. Tallahassee, Florida.
- Fitzpatrick, J.W., R. Bowman, D.R. Breining, M.A. O'Connell, B. Stith, J. Thaxton, B.R. Toland, and G.E. Woolfenden. 1994a. Habitat conservation plans for the Florida scrub jay: a biological framework. Unpublished draft report. On file at U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- Fitzpatrick, J.W., B. Pranty, and B. Stith. 1994b. Florida scrub jay statewide map 1992-1993. Archbold Biological Station. Lake Placid, Florida.
- Fleischer, A.L., Jr. 1996. Pre-breeding time budgets of female Florida scrub-jays in natural and suburban habitats. Abstract, Archbold Biological Station 1996 Symposium. 12 September 1996. Lake Placid, Florida.
- Iverson, G. 1998. Comments on technical/agency draft multi-species recovery plan for South Florida. September 28, 1998.
- Laessle, A.M. 1958. The origin and successional relationships of sandhill vegetation and sand pine scrub. Ecological Monographs 28:361-387.
- Laessle, A.M. 1968. Relationships of sand pine scrub to former shore lines. Quarterly Journal of the Florida Academy of Science 30:269-286.
- McGowan, K.J., and G.E. Woolfenden. 1989. A sentinel system in the Florida scrub jay. Animal Behavior 37:1000-1006.
- McGowan, K.J., and G.E. Woolfenden. 1990. Contributions to fledgling feeding in the Florida scrub jay. Journal of Animal Ecology 59:691-707.
- Mumme, R.L. 1992. Do helpers increase reproductive success? An experimental analysis in the Florida scrub jay. Behavioral Ecology and Sociobiology 31:319-328.
- Mumme, R.L., and T.H. Below. 1995. Relocation as a management technique for the threatened Florida scrub jay. Annual project report, Florida Game and Fresh Water Fish Commission, December, 1995. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- Mumme, R.L., and T.H. Below. 1996. Viability of translocated scrub jays. Annual Project Report, Florida Game and Fresh Water Fish Commission, December, 1996. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- Myers, R.L. 1990. Scrub and high pine. Pages 150-193 in R.L. Myers and J.J. Ewel, eds. Ecosystems of Florida. University of Central Florida Press; Orlando, Florida.

- Root, K.V. 1996. Population viability analysis for the Florida scrub-jay (*Aphelocoma coerulescens coerulescens*) in Brevard County, Florida. Unpublished Ph.D. dissertation, Florida Institute of Technology; Melbourne, Florida, May 1996.
- Schaub, R., R.L. Mumme, and G.E. Woolfenden. 1992. Predation on the eggs and nestlings of Florida scrub jays. *Auk* 109:585-593.
- Schmalzer, P.A., and C.R. Hinkle. 1992. Species composition and structure of oak-saw palmetto scrub vegetation. *Castanea* 57 (4):220-251.
- Schmalzer, P.A., and C.R. Hinkle. 1987. Effects of fire on composition, biomass, and nutrients in oak scrub vegetation on John F. Kennedy Space Center, Florida. NASA Technical Memorandum no. 100305. NASA Biomedical Operations and Research Office, John F. Kennedy Space Center, Florida.
- Stallcup, J.A., and G.E. Woolfenden. 1978. Family status and contribution to breeding by Florida scrub jays. *Animal Behavior* 26:1144-1156.
- Stith, B.M., J.W. Fitzpatrick, G.E. Woolfenden, and B. Pranty. 1996. Classification and conservation of metapopulations: a case study of the Florida scrub jay. Pages 187-215 in D.R. McCullough, ed. *Metapopulations and wildlife conservation*. Island Press; Washington, D.C.
- Thaxton, J.E. and T.M. Hingtgen. 1994. Responses of Florida scrub jays to management of previously abandoned habitat. District 4 annual research report, Florida Park Service; Tallahassee, Florida.
- Thaxton, J.E. and T.M. Hingtgen. 1996. Effects of suburbanization and habitat fragmentation on Florida scrub-jay dispersal. *Florida Field Naturalist* 24 (2):25-60.
- Thaxton, J.E. 1998. Comments on technical/agency draft multi-species recovery plan for South Florida. July 21, 1998.
- Toland, B.R. 1991. Nest site characteristics of a Florida scrub jay population in Indian River County. Abstract. Florida scrub jay workshop. 23 May 1991. Ormond Beach, Florida.
- Toland, B.R. 1996. Unpublished data summaries from research conducted 1988-1993 with Florida Game and Fresh Water Fish Commission. Received November 1996.
- U.S. Fish and Wildlife Service [FWS]. 1990. Recovery plan for the Florida scrub-jay. U.S. Fish and Wildlife Service; Atlanta, Georgia.
- U.S. Fish and Wildlife Service [FWS]. 1995. Endangered and threatened wildlife and plants, 50 CFR 17.11 and 17.12. October 31, 1995.
- Woolfenden, G.E. 1974. Nesting and survival in a population of Florida scrub jays. *Living Bird* 12:25-49.
- Woolfenden, G.E. 1975. Florida scrub jay helpers at the nest. *Auk* 92:1-15.
- Woolfenden, G.E. 1978. Growth and survival of young Florida scrub jays. *Wilson Bulletin* 90:1-18.
- Woolfenden, G.E., and J.W. Fitzpatrick. 1977. Dominance in the Florida scrub jay. *Condor* 79:1-12.
- Woolfenden, G.E., and J.W. Fitzpatrick. 1978. The inheritance of territory in group-breeding birds. *BioScience* 28:104-108.

- Woolfenden, G.E., and J.W. Fitzpatrick. 1984. The Florida scrub jay: demography of a cooperative-breeding bird. Princeton University Press; Princeton, New Jersey.
- Woolfenden, G.E., and J.W. Fitzpatrick. 1986. Sexual asymmetries in the life histories of the Florida scrub jay. Pages 97-107 *in* D. Rubenstein and R.W. Wrangham, eds. Ecological aspects of social evolution: birds and mammals. Princeton University Press, Princeton, New Jersey.
- Woolfenden, G.E., and J.W. Fitzpatrick. 1990. Florida scrub jays: A synopsis after 18 years of study. Pages 241-266 *in* P.B. Stacey, and W.B. Koenig, eds. Cooperative breeding in birds. Cambridge University Press.
- Woolfenden, G.E., and J.W. Fitzpatrick. 1991. Florida scrub jay ecology and conservation. Pages 542-565 *in* C.M. Perrins, J.D. Lebreton, and G.J.M. Hirons, eds. Bird population studies: relevance to conservation and management. Oxford University Press; Oxford, United Kingdom.
- Woolfenden, G.E., and J.W. Fitzpatrick. 1996a. Florida scrub jay. Pages 267-280 *in* J. A. Rodgers, H. W. Kale, and H. T. Smith, eds. Rare and endangered biota of Florida, volume V. Birds. University Presses of Florida; Gainesville, Florida.
- Woolfenden, G.E., and J.W. Fitzpatrick. 1996b. Florida scrub-jay. Pages 1-27 *in* A. Poole and F. Gill, eds. The birds of North America, No.228. The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union; Washington, D.C.

Recovery for the Florida Scrub-jay

Aphelocoma coerulescens

Recovery Objective: To BE DETERMINED by the recovery team during the ongoing revision of the range-wide recovery plan for the Florida scrub-jay.

South Florida Contribution: STABILIZE and increase the South Florida population.

Recovery Criteria

Since its listing as a threatened species in 1987, the Florida scrub-jay population has declined by approximately 50 percent because of the destruction, fragmentation, and degradation of scrub communities throughout peninsular Florida, due to residential housing or commercial development. These areas are not restorable.

The South Florida recovery objective will be achieved when: a reserve design is developed that identifies contiguous patches of suitable-size scrub habitat, within and between all subregions, that is essential for preventing further declines in the population; any further loss, fragmentation, and degradation of habitat within the reserves has been prevented; occupied habitat within the reserves is protected through land acquisition or cooperative agreements with private landowners; scrub-jays and their scrub habitat are appropriately managed to assure population viability and habitat contiguity; unoccupied and overgrown scrub is restored and managed as suitable habitat within dispersal distance (up to 8 km) of occupied habitat to increase numbers of scrub-jays; and subpopulations within the reserves (throughout all subregions) exhibit an intrinsic rate of increase (r) equal to or greater than 0.0, sustained as a 3-year running average over at least 10 years.

Species-level Recovery Actions

- S1. Determine the distribution of scrub-jays and status of scrub habitat in South Florida.**
- S1.1. Update the 1992-1993 statewide survey** (Fitzpatrick *et al.* 1994) in 2002 by groundtruthing a sample of scrub sites that were considered “occupied” during those surveys to determine the current status of the habitat and to verify if scrub-jays are still present. Priority should be given to areas where habitat fragmentation has been the greatest over the past 5 years, *i.e.*, Polk, Highlands, Sarasota, Charlotte, and Indian River counties. Identify key metapopulations that may require more frequent surveys.
 - S1.2. Maintain scrub-jay distribution data in a GIS database.** Update the existing GIS database by including information obtained in **S1.1** on the distribution of known

scrub-jay territories throughout South Florida and the current status of scrub habitat. Ensure terminology is consistent with the 1992-1993 survey: currently occupied, occupied in 1992-1993, formerly occupied (both pre-1980 and current changes from 1992-1993 survey), and unknown.

S2. Protect and enhance Florida scrub-jay populations.

S2.1. Develop a reserve design for scrub-jays in South Florida using landscape maps, GIS and spatially explicit population models. These reserves will consist of areas identified as critical to the survival and recovery of the scrub-jay in South Florida. Large, contiguous patches of scrub habitat with minimum interspersion of forested and urbanized areas are most ideal. Non-contiguous patches, outside of the maximum dispersal distance for scrub-jays, must be large enough to maintain viable populations, or must have corridors to link to additional patches of suitable habitat.

S2.1.1. Identify all public lands, other conservation lands, and private lands where scrub-jays currently exist. Determine the current status and distribution of scrub-jays on protected and private lands from **S1.2**.

S2.1.2. Identify all unoccupied, potentially restorable scrub on public and other conservation lands. Work with Federal, State, and county agencies and non-governmental organizations to identify areas where scrub management is needed, and where such management would benefit scrub-jays.

S2.1.3. Identify additional key privately owned lands that could enhance existing scrub-jay preserves on conservation lands to which suburban scrub-jays could emigrate, or that would provide corridors to facilitate dispersal between occupied conservation lands. Consider willingness of sellers and economic feasibility.

S2.1.4. Use spatially explicit models with the existing information on suitable and restorable scrub remaining in South Florida, and scrub-jay biology, to identify the most suitable and feasible alternative for development of a reserve design to conserve scrub-jays in South Florida.

S2.1.5. Develop criteria under which private lands would be considered for conservation.

S2.2. Protect, manage, and enhance Florida scrub-jay populations on public lands. In South Florida, scrub-jays occur on Avon Park AFR (Highlands and Polk counties), Hobe Sound NWR (Martin County) Lake Wales Ridge NWR (Highlands and Polk counties), and on the BLM and U.S. Coast Guard Jupiter Inlet tract (Palm Beach County). Scrub-jays also occur on many State and county-administered lands with a multitude of land-use designations. The survival of the Florida scrub-jay depends to a large extent on maintaining and improving scrub habitat on these public lands.

S2.2.1. Develop management plans for scrub-jays where they occur on public lands. With assistance from the FWS, each public property manager should develop a long-term management plan designed to protect and enhance scrub-jay populations on their property. The plans should include fire and/or mechanical management to maintain scrub in a suitable condition for scrub-jays.

- S2.2.2. Implement management plans for scrub-jays on public lands.** Public land managers should coordinate to ensure that implementation and timing of management actions on adjacent properties minimize conflict, and that equipment and personnel are used effectively and efficiently.
- S2.2.3. Facilitate communication among entities responsible for carrying out management activities on public lands.** Establish a multi-agency team to assist in coordination of management planning.
- S2.3. Protect, manage, and enhance Florida scrub-jay populations on privately owned lands.** Scattered and disjunct scrub-jay populations occur widely on privately owned lands throughout central and South Florida. The largest of these is on the Archbold Biological Station in Highlands County, where the bird has been extensively studied and is well protected.
- S2.3.1. Protect the “core” population on the Lake Wales Ridge.** Continue to protect scrub-jays at Archbold Biological Station and initiate protective measures on other private lands. Maintain this core population at or above 400 pairs of birds, and maintain habitat for this population such that dispersal distance between habitat gaps is 3.5 km or less (Stith *et al.* 1996).
- S2.3.2. Work with landowners to protect and maintain suitable habitat for scrub-jays.** Small, isolated populations of scrub-jays occur on numerous small patches of privately owned scrub in South Florida. Make efforts to contact landowners to encourage them to enhance and maintain scrub habitat to benefit scrub-jays. Where appropriate, use existing local, State or Federal programs to provide funding assistance.
- S2.3.3. Recognize or reward protection and management efforts.** Management efforts on private lands should be recognized and rewarded in any way possible in light of the limited legal responsibilities involved.
- S2.3.4. Explore and implement other conservation programs.** The opportunities for a tax incentive program at county, State, and Federal levels should be explored and implemented if feasible.
- S2.3.5. Provide information on management and legal requirements to private landowners and managers.** Develop articles and guidelines that contain information and visual aids to identifying habitat of the species, detailed information for managing the species by an array of options depending on the total land management objectives of the owner or manager, and specific information on the legal responsibilities of private landowners through section 9 of the ESA.
- S2.4. Enforce available protective measures.** Identify and implement local, State and Federal regulations and guidelines to protect scrub-jays and their habitat.
- S2.4.1. Initiate section 7 consultation when applicable.** All Federal agencies must consult with the FWS on any of their activities (authorized, funded, or carried out) that may affect scrub-jays. Such activities include (among others) pesticide use, road construction, military training exercises, clearing of land for new buildings and runways and implementing management plans. Implement on-site minimization through section 7 when needed.

- S2.4.2. Implement on-site minimization, habitat compensation, and mitigation on non-Federal lands through section 10 when needed.** Where adverse effects cannot be avoided, measures must be taken to minimize on-site disturbance, and compensate or mitigate for the impacts that remain. The FWS generally recommends that areas used as habitat compensation be located in the vicinity of the affected habitat, where appropriate, to enhance existing scrub-jay families, and avoid further fragmentation and isolation of existing habitat.
- S2.4.3. Use reserve design in combination with draft management guidelines when scrub-jays and their habitat may be affected by proposed projects.** The FWS, in conjunction with the GFC, developed management guidelines in 1991 (Fitzpatrick *et al.* 1991) that discuss ways to minimize adverse effects of proposed projects to scrub-jays. Although these guidelines are not official FWS policy, they are useful when reviewing projects and for making recommendations about scrub-jay conservation.
- S3. Identify research needs on the biology and population demography.** Although scrub-jays have been well studied at Archbold Biological Station in xeric oak scrub habitat, additional research is needed on the biology of scrub-jays in other xeric communities and in suburban areas.
- S3.1. Gather information on the biology of scrub-jays in southwest Florida.** Conduct research on habitat use, reproductive success, nesting, role of helpers, juvenile dispersal, adult and juvenile survival and mortality, predation, and food habits of birds in the scrubby flatwoods habitats of southwest Florida to compare with information known from populations at Archbold Biological Station.
- S3.2. Conduct risk assessment analysis** to determine the probability of persistence of the scrub-jay in South Florida, given the current amount of suitable scrub habitat as well as potentially restorable scrub habitat.
- S3.2.1. Identify which subpopulations of scrub-jays are considered “viable”** according to recovery criteria, and which subpopulations or groups of birds are most vulnerable to extinction.
- S3.2.2. Incorporate results of S3.2.1. into the reserve design** for scrub-jays to assist with project review and ESA consultation process.
- S3.3. Study the effects of habitat fragmentation due to urbanization.** On a landscape level, determine how residential development affects the metapopulation dynamics of scrub-jays. On a population level, identify the conditions that scrub-jays can tolerate and adapt to in a suburban setting, in addition to the conditions that significantly alter their vital rates, such as reproductive success, growth, and survival.
- S3.4. Determine the biological and ecological conditions necessary to ensure natural colonization following habitat restoration.** Describe the conditions that are conducive to natural immigration of scrub-jays after restoration of unoccupied scrub. Collect life history information on scrub-jays that naturally immigrate to restored habitat, including immigration, habitat use, territoriality, reproduction, adult and juvenile survival, dispersal, and recruitment.

- S3.5. Continue studies on translocation of scrub-jays.** To date, only one study of translocation of scrub-jays has been undertaken. Further research on this technique is needed to assess its utility in recovery. Translocation should only be considered when natural dispersal/immigration to a suitable-sized restored scrub parcel is unlikely, or to “rescue” demographically isolated birds from habitat that will be adversely modified. Translocation could also be used to re-establish birds to historically occupied habitat that is now being appropriately managed.
- S3.5.1. Establish protocols for successful translocation of scrub-jays into unoccupied areas.** Establish criteria for successful re-establishment following translocation, such as the number, age structure, social structure, and gender ratios of birds to be used, geographic boundaries for obtaining source birds, and appropriate techniques for capture and release.
- S3.5.2. Release birds into new sites.** It is recommended to use birds from source populations within the same subregion for translocation efforts.
- S4. Monitor scrub-jay subpopulations.**
- S4.1. Monitor representative groups within each subregion in South Florida** to collect data on habitat use, reproduction, survival, mortality, dispersal, and recruitment to determine the status and trends of the subpopulations and assess recovery efforts.
- S4.2. Monitor birds in urban areas for changes in their vital rates,** such as reproductive success, growth, and survival as urbanization affects territory size.
- S4.3. Monitor natural immigrants and translocated birds.** Collect data as in **S4.1** to determine the success of birds that inhabit newly restored scrub habitat as well as birds that have been translocated to new areas.
- S5. Inform and involve the public.** Inform the public through articles for the news media and popular publications. Particular emphasis should be placed on explaining the status, importance, and biological needs of scrub-jays and the legal responsibilities for the species’ protection.

Habitat-level Recovery Actions

- H1. Prevent degradation of existing scrub habitat.** The long-term recovery of the Florida scrub-jay is dependent upon the immediate protection of as much of the remaining occupied and suitable and unoccupied suitable scrub communities as is economically feasible within South Florida.
- H1.1. Prioritize areas identified in reserve design for acquisition and management.** Large, contiguous habitat patches are the most ideal for conserving scrub-jays. High priority should be given to areas contiguous with, or within short dispersal distance of, existing conservation lands where scrub-jays occur. High priority should also be given to areas adjacent to suburban sites where scrub-jays occur, allowing natural dispersal of birds from suburban areas to protected habitat.
- H1.2. Protect scrub-jay habitat on private lands through easements, acquisitions, and donations.** Lands identified for acquisition should be located adjacent to, or be contiguous with, publicly owned conservation lands or other lands proposed for acquisition that contain scrub-jays. Lands containing scrub-jays should receive special consideration where these lands would consolidate Federal ownership or control and contribute to overall resource management objectives of the agencies. Private landowners should be encouraged to avail themselves of these options.

- H1.2.1. Continue Federal acquisition efforts.** Continue acquisition efforts within the Lake Wales Ridge NWR complex. Much of the habitat targeted for acquisition will be acquired by 1998. One or possibly two additional, but currently unidentified parcels may subsequently be targeted for acquisition.
- H1.2.2. Support State acquisition efforts.** The Florida (CARL) program has a number of ongoing projects and proposals for the acquisition of scrub habitat in Florida, totaling approximately 13,900 and 2,400 ha., respectively. About 90 percent of the ongoing projects are in South Florida, however the proposed projects are predominantly in North Florida. Florida's Save Our Rivers (SOR) acquisition program administered by the water management districts targets wetlands for protection but some sites also contain xeric uplands, and potentially scrub-jay habitat, that may also benefit.
- H1.2.3. Encourage acquisition by non-governmental organizations.** Occupied private sector and suitable, unoccupied scrub not targeted in Federal and State acquisition programs may become available for private purchase and management. Scrub habitats already protected such as those at Archbold Biological Station and The Nature Conservancy's Tiger Creek Preserve, Saddle Blanket Lakes, and Lake Apthorpe areas are important for the long-term persistence of scrub-jays.
- H1.2.4. Pursue acquisition of lands identified as necessary for developing scrub-jay reserves that are not covered under H1.2.1-H1.2.3 above.**
- H1.3. Maintain suitable habitat for scrub-jays.** Prescribed burning, where feasible, is the optimal management tool. The fire frequency will vary depending on the type and condition of habitat being managed and the natural fire return interval. Burns should be done in a rotation, with each covering small portions of a preserved tract of scrub. No more than 25 percent of an area occupied by scrub-jays should be burned at any one time (Fitzpatrick *et al.* 1991). In areas where burns are not feasible, mechanical treatments, such as rollerchopping, provide short-term alternatives.
- H1.4. Prevent loss or fragmentation of scrub habitat within scrub-jay reserves identified in S2.1.** Ensure that no habitat gaps > 8 km are created within and between scrub reserves that might preclude dispersal by scrub-jays. Also note any potential physical barriers to dispersal (Stith *et al.* 1996).
- H2. Restore overgrown or unsuitable scrub habitat.** After identification of unoccupied but potentially restorable scrub (see S2.1.2.), work with local, State and Federal agencies and non-governmental organizations to determine the most feasible and appropriate management protocols (*i.e.* controlled burns or mechanical techniques at specific rotations) to restore overgrown scrub to suitable habitat for scrub-jays. Implement mechanisms in the protocols or management plans for ensuring continued management of these sites.
- H3. Conduct research to determine the applicability and effectiveness of various mechanical treatments for scrub management.** Mechanical treatments, such as rollerchopping or thinning, are needed as an alternative to burning scrub habitat, particularly on lands in or adjacent to urbanized areas.
- H4. Monitor xeric communities that provide scrub-jay habitat.**
- H4.1. Monitor scrub habitat that is occupied by scrub-jays to ensure public lands are managed to maintain scrub in suitable condition for scrub-jays, and to assess when unmanaged areas become unsuitable for scrub-jays. Also monitor to ensure the site is not becoming a "sink" for the population.**

- H4.2. Monitor unoccupied scrub habitat following restoration to collect data on how habitat characteristics affect immigration and establishment of scrub-jays.**
- H4.3. Maintain scrub-jay habitat data in a GIS database.** Update the existing GIS database by including information obtained from surveys in **S1.1** on the current status of scrub habitat in South Florida. Denote the condition of the scrub, and the type and timing of all pertinent management actions.
- H5. Increase public awareness of the scrub ecosystem.** Efforts should highlight habitat acquisition initiatives, importance of biodiversity, and biology of scrub-dependent species. Federal, State, and county governments, as well as private organizations, should support the development and dissemination of educational materials pertaining to the conservation of the scrub ecosystem and endemic scrub species. Materials such as brochures, posters, postcards, slide programs and videotapes can improve public understanding of and increase appreciation for protection of scrub habitat. Environmental education programs across central Florida should be encouraged to distribute materials or develop lesson plans on scrub ecosystems, particular scrub species, and the importance of maintaining biological diversity.

