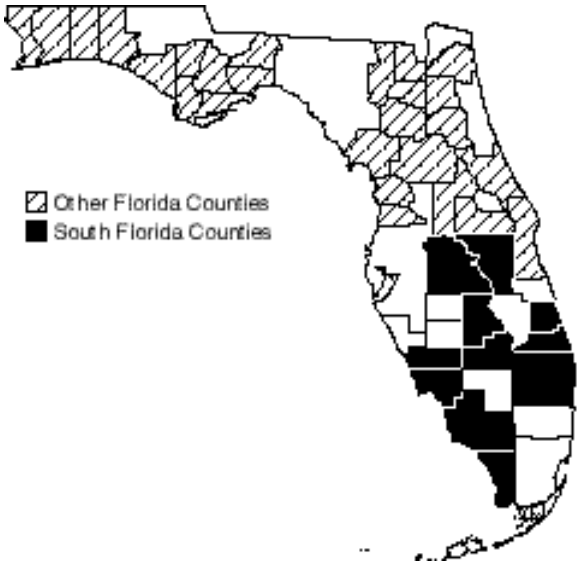
Red-cockaded Woodpecker

Picoides borealis

Federal Status:	**Endangered (October 13, 1970)**
Critical Habitat:	**None Designated**
Florida Status:	**Threatened**
Recovery Plan Status:	**Contribution (May 1999)**
Geographic Coverage:	**South Florida**

Figure 1. Florida distribution of the red-cockaded woodpecker.



The red-cockaded woodpecker is one of 22 species of woodpeckers native to North America. Its historic range encompassed the southeastern U.S. from eastern Texas and Oklahoma to New Jersey, and it was characterized as "abundant" in 19th century literature. Throughout the 20th century, however, the species' distribution within its historic range has become fragmented, and its total population numbers have decreased drastically due to the destruction of it's habitat. The red-cockaded woodpecker was federally listed as endangered in 1970, and currently is classified as threatened by the State of Florida. The primary threat to the species continues to be destruction or degradation of its habitat as a result of timbering and other land-clearing activities. Although South Florida is not a designated recovery population for red-cockaded woodpeckers, the area contains significant support populations for recovery of the species in the southeast. Additional surveys are needed to assess the current status of the birds in South Florida so that conservation measures used elsewhere can be implemented here.

This account represents South Florida's contribution to the range-wide recovery plan for the red-cockaded woodpecker (FWS 1985).

Description

Adult red-cockaded woodpeckers (*Picoides borealis*) are approximately 18 to 20 cm in length and have a wingspan that ranges between 35 to 38 cm. The weight of the adult red-cockaded woodpecker is approximately 45 g; males are slightly larger than the females (Porter 1984). The woodpecker nearest in size to the red-cockaded in Florida is the hairy woodpecker, which is slightly larger. The red-cockaded woodpecker is easily distinguished from the hairy woodpecker, however, by its large, conspicuous white cheek patches, black cap and neck, and black-and-white barred back and wings (Jackson 1994). The only

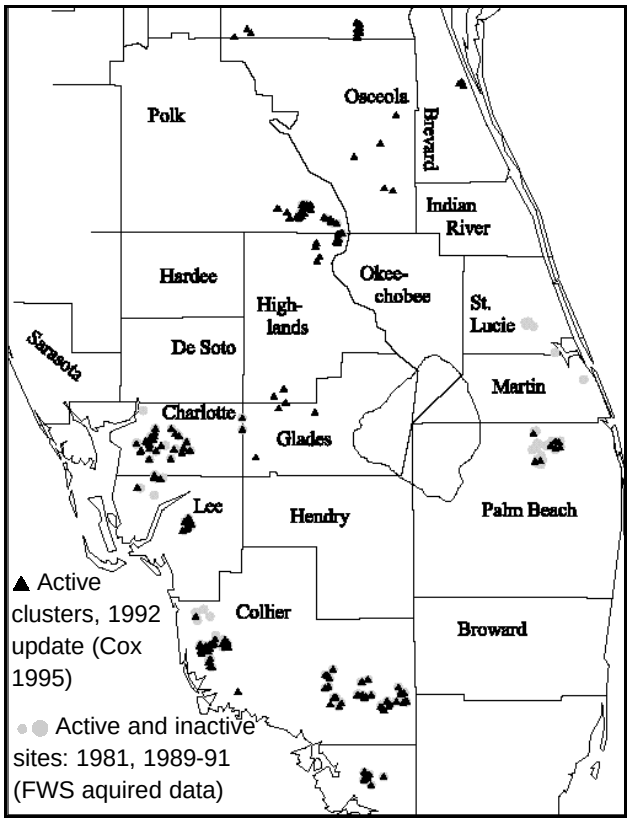
other woodpecker in Florida with a black-and-white barred back is the red-bellied woodpecker (*Melanerpes carolinus*), but that species is substantially larger than the red-cockaded, and a considerable amount of red is visible on its head and nape; no red is readily visible on adult red-cockaded woodpeckers.

Male red-cockaded woodpeckers have a few red feathers slightly above and behind each eye (the "cockades"), but that red spot is essentially covered by black feathers and rarely visible in the field, usually only when the male is displaying; otherwise, adult males and females are black and white in coloration and essentially indistinguishable from each other. The sex of nestlings and fledglings can be distinguished because males have scarlet crown patches until their first molt in the fall, whereas females lack any red coloration throughout their lives (Hovis and Labisky 1996).

Taxonomy

The red-cockaded woodpecker (Order Piciformes; Family Picidae) is one of nine *Picoides* congeners. Jackson (1971) provides a thorough discussion of the taxonomic history of *Picoides*. The red-cockaded woodpecker was formerly recognized in the genera *Picus* by Vieillot in 1807, and in the genera *Dendrocopos* by Peters in 1948. Interestingly, in 1941, Wetmore divided the red-cockaded woodpecker into two races, and described a separate subspecies from southern Florida with the subspecific name *hylonomus*. He described this race as similar to *borealis*, but with much shorter wings. These two subspecies were included as northern and southern races in the 1957 AOU checklist. The three-toed woodpeckers were later grouped with typical *Dendrocopos* woodpeckers, and the red-cockaded woodpecker's name was eventually changed to *Picoides borealis*.

Figure 2. Active and inactive clusters for red-cockaded woodpeckers in South Florida.



Distribution

The red-cockaded woodpecker probably once occurred in all 67 Florida counties, with exception of the Florida Keys in Monroe County (Hovis and Labisky 1996). The southernmost historic record is from the Florida City area in Miami-Dade County (Howell 1921). This species is still widely distributed in the state, but substantial populations now occur only in the Panhandle; elsewhere, populations are relatively small and disjunct. The estimated breeding population of the red-cockaded woodpecker in Florida is 1,500 pairs, with about 75 percent of that total occurring in the Panhandle (Cox *et al.* 1995). The population centered in the Apalachicola National Forest (680 active clusters as of 1996) is the most substantial population in the species' entire remaining range in Florida (R. Costa, FWS, personal communication 1997).

Red-cockaded woodpecker. *Original photograph courtesy of U.S. Forest Service.*

In South Florida, the status and distribution of the red-cockaded woodpecker is uncertain, particularly in Highlands, Glades, Hendry, St. Lucie, Martin, and Sarasota counties, because of the inability to access and survey private lands that may support suitable habitat. The current range and distribution of red-cockaded woodpeckers in South Florida is shown in Figures 1 and 2. The most current information on the numbers of active clusters in South Florida was obtained from Cox *et al.* (1995), and updated during the FWS South Florida Multi-Species Recovery Team meeting in 1996 (Table 1).

Habitat

Pine stands, or pine-dominated pine/hardwood stands, with a low or sparse understory and ample old-growth pines, constitute primary red-cockaded woodpecker nesting and roosting habitat. The low or sparse understory affords unimpeded access to cavities. Red-cockaded woodpeckers will abandon otherwise suitable nesting/roosting areas when the understory approaches cavity height (Wood 1996).

Nest and roost cavities are almost always excavated in old-age living pines; the average nest tree typically ranges between 63 and 130 years in age for longleaf pine (*Pinus palustris*) and between 62 and 149 years in age for other pine species (Hopkins and Lynn 1971, Wood 1983, Rudolph and Conner 1991). Longleaf pine is preferred where available (Hopkins and Lynn 1971, Lennartz *et al.* 1983, Hovis and Labisky 1985), however cavities are also constructed in all other pine trees in Florida with the exception of sand pine (*P. clausa*) and spruce pine (*P. glabra*). The old-age living pines selected for cavity excavation characteristically have thinner sapwood and greater heartwood diameter than other mature pines (Conner

Table 1. Known active clusters of red-cockaded woodpeckers in South Florida.

County	Location	Number of Clusters
Polk	KICCO WMA	1 active cluster
Osceola	Three Lakes WMA	34 clusters
Highlands	Avon Park Air Force Range	20 active clusters
	River Ranch	12 active clusters
	Venus Flatwood	1 cluster
St. Lucie	Campbell property	12 clusters
	The Reserves	1 cluster of 1 bird
Martin	Babcock Ranch	unknown number
Palm Beach	Corbett WMA	14 clusters
Glades	Walter Johnson Tract	estimate 4 clusters
Charlotte	Cecil M. Webb WMA	estimate 27 clusters
	Charlotte Harbor Flatwoods	5 to 6 clusters
	Fairway Woodlands	2 clusters
Collier/Monroe	Naples	estimate12 clusters
	Big Cypress National Preserve	33 active clusters
	Golden Gate Estates, north and south blocks	unknown number

et al. 1994). Many cavity trees are also typically infected with a fungus (*Phellinus pini*) that decays the heartwood, thus facilitating cavity excavation (Jackson 1977, Conner and Locke 1982, Conner *et al.* 1994).

In south central Florida, at Avon Park AFR, cavities are excavated only in longleaf pine, even though active red-cockaded woodpecker clusters occur in mixed longleaf/slash pine stands (Bowman and Fitzpatrick 1993). South of the longleaf pine range, red-cockaded woodpeckers can only excavate cavities in slash pine. In this region, cavity trees selected by red-cockaded woodpeckers are typically shorter and smaller in dbh, on average, than cavity trees elsewhere in the Southeast (Shapiro 1983, Bowman and Huh 1995).

In her survey of five wildlife management areas in South Florida, Shapiro (1983) compared the characteristics of cavity trees and vegetation used by red-cockaded woodpeckers in South Florida with that reported elsewhere in the literature; her results are reproduced in Table 2. The overstory vegetation surrounding cavity trees in South Florida is also very sparse. Red-cockaded woodpecker clusters are typically found in the older or oldest, sparsely stocked pine stands, where cavity trees are more widely spaced than trees found further north. Shapiro (1983) attributed the differences in cavity trees and vegetation to the poor site quality and growth conditions of South Florida flatwoods, and historic timber management practices.

Bowman and Huh (1995) also found that hydric slash pines greater than 60 years old were significantly smaller in dbh and height and tended to have smaller crown to bole ratios than either mesic slash or longleaf pines of the same age. They also found that hydric slash pine had more heartwood rot than the other pines.

Older growth pine or pine-dominated stands are also needed for foraging, but not to the extent needed for nesting or roosting. Red-cockaded woodpeckers will forage to some degree on hardwood trees and even in bayheads and cypress domes, but in general, mature pines constitute the primary foraging substrate. This habitat, in association with or proximal to nesting/roosting habitat, is necessary for population survival. In South Florida, red-cockaded woodpeckers need more habitat for foraging than in areas farther north because of the poor habitat quality (less than 7 m^2/ha pine basal area) (Hovis and Labisky 1996).

In southwest Florida (Charlotte, Collier, and Lee counties), the hydric slash pine (*P. elliotii* var. *densa*) flatwoods provide the preferred critical nesting and

Table 2. Characteristics of red-cockaded woodpecker cavity trees in south-central and South Florida and elsewhere in the literature [Adapted from Shapiro (1983)].

Parameter	South Florida			Literature		
	Longleaf	Slash	Mixed	Longleaf	Slash	Mixed
dbh (cm)						
x	32.1	33.8	27.9	39.4	40.6	43.7
N	133	168	42	770	15	729
Range	20.8-48.3	22.3-51.4	20.3-33.8	----	––	–––
Source[1]	----	----	----	4,5,7	7	2,5
Height (m)						
x	13.5	15.3	15.9	21.7	25	20.5
N	139	169	42	764	15	723
Range	6.7-24.1	2.7-30.2	8.8-28.0	----	––	–––
Source	----	----	----	4,5,7	7	2,5
Age (years)						
x	103.5	102.7	109.5	86	70	84
N	105 (+ 8 heartrot)[2]	91 (+ 20 heartrot)	39 (+ 3 heartrot)	610	15	627
Range	55-142	57-182	80-137	----	––	–––
Source	----	----	----	3	3	3
Cavity Height (m)						
x	4.9	7.8	6.4	7.4	No Data	7.9
N	156	191	45	70	––	1,164
Range	1.4-9.1	1.8-21.7	2.7-12.2	----	––	–––
Source	----	----	----	1,5,6	––	2,5
Cavities/Tree						
x	1.1	1.2	1.3	1.01	1.0	1.6
N	145	165	42	560	15	815
Source	----	----	----	7	7	2

2] = Baker, 1971; 2 = Carter, 1974; 3 = Wood, 1975; 4 = Hopkins and Lynn, 1971; 5 = Lay and Swepston, 1973; 6 = Ligon, 1970; 7=Thompson and Baker, 1971.

2Trees with heartrot could not be aged.

foraging habitat for red-cockaded woodpeckers (Beever and Dryden 1992). This community has been maintained by fire and hydroperiod, and therefore does not have the dense midstory more typical of xeric and mesic flatwoods in southwest Florida. Also, hydric pine flatwoods were not as accessible to historic forestry, agriculture, and land clearing practices as the xeric and mesic communities.

A common cavity tree is 20.5 to 30.8 cm dbh (Beever and Dryden 1992); the smallest cavity tree observed in southwest Florida was 15.4 cm dbh, the largest was 35.9 cm dbh (153 years old). Good quality hydric pine habitat in southwest Florida has approximately 133 trees/ha, 5 to 8 pine stems of 25.8 cm or larger in dbh, and a basal area of approximately 4.6 m^2/ha (Beever and Dryden 1992). Given this, foraging habitat per group would be estimated at

46.8 ha based on total pine stems, 183.6 ha based on pine stems greater than or equal to 25.8 cm, and 171.9 ha based on basal area.

The spatial extent needed to sustain red-cockaded woodpeckers depends primarily on habitat quality. Home ranges in optimal habitat in the Carolinas average 70 to 90 ha. In most of Florida, however, habitat quality is considerably lower than the optimal conditions in the Carolinas, as well as other areas within the species' range. Home ranges for red-cockaded woodpeckers in northern Florida average 120 to 140 ha (Porter and Labisky 1986). Habitat quality in southern and central Florida is particularly marginal in that respect; home ranges average 140 to 160 ha, but can exceed 200 ha (Patterson and Robertson 1981, Nesbitt *et al.* 1983, DeLotelle *et al.* 1987, Wood 1996). Territory sizes for red-cockaded woodpeckers in South Florida have been reported as large as 300 to 400 ha in Big Cypress National Preserve, because the pinelands are not contiguous (D. Jansen, Big Cypress National Preserve, personal communication 1996). At Avon Park AFR, the largest home range size reported was 360 ha, with an average of 160 ha. In constrained territories, home range is limited to 70 ha (Paul Ebersbach, Avon Park AFR, personal communication 1996).

Behavior

Social Structure

Red-cockaded woodpeckers are non-migratory, territorial, and live in cooperative breeding social units called groups. Such groups are typically comprised of a breeding pair and up to three "helpers," which are usually males (juvenile females disperse or are expulsed from the breeding groups) and most often offspring of the mated pair from previous years (Jackson 1994). In central Florida, however, the frequency of female helpers is higher than what is reported for populations elsewhere (DeLotelle and Epting 1992). Helpers assist in defending territories (territorial disputes between neighboring groups are common) and in feeding and otherwise caring for the young. Mated pairs usually remain together until one dies, but some inter-group movement of breeding adults occurs (Walters *et al.* 1988). Breeding groups average 2 to 4 birds prior to breeding and 4 to 6 afterward, but groups numbering up to 8 to 10 birds have been observed.

The cooperative breeding social structure of the red-cockaded woodpecker is comparable to the social structure of the Florida scrub-jay (*Aphelocoma coerulescens*), whose breeding groups likewise typically consist of a breeding pair and helpers. The red-cockaded woodpecker and the acorn woodpecker (*Melanerpes formicivorus*), which occur in western North America, are the only cooperatively breeding woodpeckers in North America, but breeding units of the acorn woodpecker commonly have more than one breeding male and/or female.

Cavity Excavation

The red-cockaded woodpecker is the only North American woodpecker which excavates its roost and nest cavities in living trees. Cavities are typically excavated on the west to southwest side of a mature pine tree. They are typically located 10 to 13 m above the ground and are found just below the lowest branches, although cavity height can range from less than 1 m up to

almost 100 m (Jackson 1994). Once a cavity is completed, small, conical "resin wells" are excavated above, alongside, and below the cavity, as well as on the opposite side of the tree (Jackson and Thompson 1971). Resin wells are continuously maintained to sustain exudation of sap for the life of the tree. The resulting resin flow gives the tree a glazed, "candle-like" appearance, which makes it unmistakable as a red-cockaded woodpecker cavity. The resin flow is an effective deterrent to rat snakes (*Elaphe guttata*) and perhaps other predators of cavity-nesting birds (Jackson 1974, Rudolph *et al*. 1990).

In south-central Florida, in both hydric and mesic habitats, red-cockaded woodpeckers excavate cavities in trees with the crown-bole ratios associated with the maximum resin flow (Bowman and Huh 1995). Red-cockaded woodpeckers also chip away the bark from the immediate vicinity of cavities, creating a smooth "plate." Red-cockaded woodpeckers can excavate cavities within a few months, but more typically take 1 to 3 years. It is also possible for a "start hole" to be created that remains unattended for several months or even years before excavation is resumed; the heartwood may be initially too hard for successful cavity completion, but will soften over time.

Cavity trees tend to be aggregated into geographic areas known as "clusters" (Walters 1990) which support a breeding group. The number of cavity trees in these clusters usually exceeds the size of the breeding group, which allows the breeding group to grow in size and shift its nest locations. Within an active cluster, cavities under construction are called "starts," while those that have been completed and are in use are called "active" (FWS 1985). It is also typical for a cluster to have a number of trees with start holes and several abandoned cavity trees. Abandoned or inactive trees are often trees that have died (red-cockaded woodpeckers typically abandon cavity trees soon after they die) and/or trees with cavities that have been enlarged or taken over by other species.

Reproduction and Demography

Red-cockaded woodpeckers attain breeding age at 1 year; however, reproductive success improves with increased age (Walters 1990). The nesting season in Florida is late April through early June. The nest cavity is usually the roost cavity of the breeding male (Ligon 1970, Lennartz *et al.* 1987). The red-cockaded woodpecker is monogamous, and essentially single-brooded, although rare instances of double-brooding in a given year have been documented (Jackson 1994, Schillaci and Smith 1994). Clutch size is normally two to four eggs (Ligon 1970), and incubation is 10 to 11 days; this is one of the shortest incubation periods among birds (Ligon 1970, Crosby 1971). Both parents and helpers incubate the eggs (Jackson 1994). Usually one to three young fledge at 26 to 29 days of age (Ligon 1970), but they are dependent to some degree upon their parents and any helpers for 2 to 5 months thereafter (Jackson 1994). Although not all groups produce young, in South Florida, 81 percent of groups were found to be successful.

The red-cockaded woodpecker is long-lived for a bird its size; banded birds in the wild have reached 15 years of age, and a captive-reared bird was documented at 13 years (Jackson 1994).

Dispersal

Most female red-cockaded woodpeckers disperse within 1 year after fledging. They may attain breeding status in another territory or become "floaters" that are not definitively associated with a particular group of birds or cluster of cavity trees (Hovis and Labisky 1996). Some fledgling males also disperse to become breeders or floaters, or to establish and defend a territory, while others remain on their natal territory as helpers until a breeding opportunity arises (Walters *et al.* 1988). There is little information on dispersal distances for birds in South Florida; however, a dispersal distance of 17 km was reported from Avon Park AFR (P. Ebersbach, Avon Park AFR, personal communication 1996).

Foraging

Red-cockaded woodpeckers forage primarily on arthropods, taken by chipping away the outer layer of tree bark and gleaning what they find underneath. They will occasionally feed on vegetative matter such as pine mast and fruits (Jackson 1994). They have also been observed taking flying insects on the wing. Red-cockaded woodpeckers typically forage in larger pines in pine-dominated habitat (90 percent), rather than in hardwoods (Ramey 1980, Bradshaw 1990). Male red-cockaded woodpeckers tend to forage primarily on the branches and upper trunk of pines, whereas females forage primarily on the trunk below the lowest branches (Ligon 1968, Ramey 1980, Jackson and Parris 1995). As stated previously, because of the poor habitat quality in South Florida, more habitat is needed for foraging than in areas farther north (Beever and Dryden 1992).

Relationship to Other Species

The hairy woodpecker (*P. villosus*) and downy woodpecker (*P. pubescens*) are two closely related species that coexist with the red-cockaded woodpecker throughout Florida. Other species compete with the red-cockaded woodpecker for cavity use, including the flying squirrel (*Glaucomys volans*), red-bellied woodpecker, red-headed woodpecker (*M. erythrocephalus*) and pileated woodpecker (*Dryocopus pileatus*) (Jackson 1994, Kappes and Harris 1995). Those species will usurp red-cockaded woodpecker cavities, either temporarily or permanently, particularly if the invading species enlarges the cavity. Competition for foraging areas may also occur between red-cockaded woodpeckers and red-bellied woodpeckers, although the effects on reproductive success of red-cockadeds have not been documented.

The Florida grasshopper sparrow (*Ammodramus savannarum floridanus*) occurs with the red-cockaded woodpecker at Three-Lakes WMA and Avon Park AFR in transitional flatwoods/dry prairie habitat. In scrubby flatwoods/high pine habitat, the red-cockaded woodpecker may occur with the Florida scrub-jay.

Status and Trends

The red-cockaded woodpecker was federally listed as endangered in 1970 due to documented declines in local populations, presumed reductions in available nesting habitat, and because of its perceived rarity (35 FR 8495). As a result of its listing, research efforts were initiated on the biology, status, and distribution of the species.

Jackson (1978) estimated the total population of red-cockaded woodpeckers to be between 1,500 to 3,000 clusters and 4,500 to 10,500 birds, based upon extensive literature reviews and questionnaire surveys. This was revised from his earlier estimate of 2,939 birds-a conservative estimate based upon limited data.

The most extensive, rangewide population surveys for red-cockaded woodpeckers have been conducted on federal lands. In 1979, the FWS southeast region and the USFS initiated a rangewide survey of clusters on federal lands in the Southeast. The results of this effort estimated 2,677 (+/- 456) active red-cockaded woodpecker clusters on the lands censused (Lennartz *et al.* 1983). With the addition of a few federal properties not included in the census, the population was subsequently estimated to exceed 3,000 active clusters (FWS 1985). Among the federal lands censused (national forests, military bases, national wildlife refuges), the largest number of active clusters (2,121) was found on national forests. More recent surveys estimate the rangewide population at 4,694 active clusters (Costa and Walker 1995).

In Florida, the largest population of red-cockaded woodpeckers (~590 active clusters) is on the Apalachicola National Forest, and the second largest population (~208 active clusters) is on Eglin Air Force Base; both populations are in the northwestern part of the state (Cox *et al.* 1995). The population on the Apalachicola NF is also the largest for the red-cockaded woodpecker throughout its range. Statewide, the population size has been estimated as 2,646 birds (943 active and inactive clusters) between 1969-1978 (Baker *et al.* 1980); 2,262 to 3,431 birds (1,139 active clusters) in 1983 (Wood and Wenner 1983); and, 1,146 active clusters in 1992 (Cox *et al.* 1995). The apparent increase in population size between the first and latter estimates reflects improved survey techniques (Wood and Wenner 1983; Cox *et al.* 1995).

In South Florida, the status of the red-cockaded woodpecker is still uncertain, particularly on private lands in Highlands, Glades, St. Lucie, Martin, and Sarasota counties. Populations on private lands in the Naples area (Collier County), however, are declining (K. Dryden, GFC, personal communication 1996). Populations on public lands at Avon Park AFR, River Ranch, Three Lakes Wildlife Management Area, and Big Cypress National Preserve are presently stable (J. Pederson, Three Lakes WMA, personal communication 1996; D. Jansen, Big Cypress National Preserve, personal communication 1996).

Throughout its range, the red-cockaded woodpecker is threatened by habitat loss and fragmentation and lack of fire or infrequent fire that maintains habitat quality; in Florida, invasion by exotic vegetation is also a problem. In South Florida, destruction and fragmentation of pine flatwoods habitat on private lands due to urbanization is a major threat, particularly in southwest Florida. In addition, trees in foraging habitat, as well as cavity trees, have been illegally removed, and landowners are using a variety of tactics to discourage use by red-cockaded woodpeckers.

The loss of habitat on private lands has demographically isolated red-cockaded woodpeckers remaining on public lands, which could affect the genetic viability of these birds. Historically, and even as recently as 30 years ago, there was probably genetic interchange among red-cockaded woodpeckers in South Florida. Increasing isolation from current rates of habitat loss could lead to inbreeding and genetic depression.

Changes in hydrology in South Florida have resulted in the loss of pineland habitat. Hydrologic changes have caused a major loss of pines in the Lostman's Pines area of Big Cypress National Preserve (D. Jansen, Big Cypress National Preserve, personal communication 1996). Alteration of the hydroperiod for residential housing construction has killed a large area of pines on Cecil M. Webb WMA. The restoration of Golden Gate Estates, Collier County, may help red-cockaded woodpeckers in Belle Meade through draining, and all of the south blocks area of Golden Gate Estates through an increase in hydroperiod or surface water.

Management

Management for the red-cockaded woodpecker should include efforts to ensure the long-term survival and viability of the species. The carrying capacity of red-cockaded woodpecker habitat is directly correlated with habitat quality — the availability and abundance of old-age, living pines for nesting and roosting in combination with the availability and abundance of pines for foraging. The most critical factor is the abundance and availability of old-age, living pines. Not only do such trees constitute ideal foraging substrates, they are required for nesting and roosting. Red-cockaded woodpeckers abandon cavity trees soon after the trees die, therefore suitable potential replacement trees must be available. Red-cockaded woodpeckers will not persist where the abundance of mature pines is insufficient to offset the loss of cavity trees that die, regardless of the amount of otherwise suitable foraging habitat that may be available.

Effective management strategies for the long-term survival and viability of red-cockaded woodpecker populations, as adapted from (Wood 1996), are discussed below. They are presented in descending order of importance based on efficacy and logistical implications.

Understory Control: Red-cockaded woodpeckers will abandon cavity tree clusters when the height of the understory/midstory approaches cavity heights. The most effective method for controlling understory growth is to burn nesting/roosting habitat every 3 to 5 years (Komarek 1974). Cavity trees, including abandoned trees and trees with start holes, should be afforded some degree of protection during such burns, by manually removing fuel from their vicinity, creating fire lanes (but not so near cavity trees as to damage root systems), and/or executing burns when climatic conditions would minimize their vulnerability. Existing snags should likewise be afforded the same protection so as to provide nest/roost substrates for other cavity-nesting species that would otherwise compete with red-cockaded woodpeckers. Such precautions may be logistically prohibitive in areas supporting large numbers of cavity tree clusters, but in such instances the loss of a few cavity trees would be offset by the benefits of burning. Manual removal of understory and midstory vegetation may be needed in cavity tree clusters or in the immediate vicinity of individual cavity trees when such vegetation is approaching cavity heights and burning has been ineffective in killing it. Foraging habitat should be similarly burned, to reduce fuel that could eventually result in a devastating crown fire, and to promote potential nesting/roosting habitat conditions.

While burning and thinning are recommended to maintain proper spacing and species composition, such treatments should be scheduled outside the nesting season-which occurs from April through June-to avoid possible disruption of reproductive activities. Considerable caution and skill is required when using fire to control hardwoods in clusters. Beckett (1971) noted that when the resin or pitch flow on cavity trees ignites, cavity trees can be damaged and cavities burnt out and enlarged. Hopkins and Lynn (1971) suggested that combustible materials be raked away from the base of cavity trees to reduce the probability of damage. Connor and Locke (1979) and Stamps *et al.* (1983) have documented, however, that even raking out cavity trees will not protect against fire damage where the fuel load around trees is heavy or when fires become too hot due to wind and other weather conditions. A direct effect of raking is that resins may build up on the base of the tree and eventully lead to a very hot fire directly on the tree trunk. Raking too deeply can also remove wiregrass so the areas will not burn as well. The best solution for preventing fire damage to cavity trees is to burn frequently enough that fuel loads do not become excessive. Where hardwoods have become well developed in a stand, and a hotter than normal burn is required to control them (*i.e.*, a spring or summer fire), or where understory fuel loads are especially heavy (*e.g.*, dense palmetto), the protective measures suggested by Connor and Locke (1979) and Stamps *et al.* (1979) are recommended. These intensive protective measures are probably also warranted on areas supporting just a few active clusters, where the loss of just a few trees could have a significant impact on the local population.

Tree Thinning: Dense stands of young pines (10 to 30 years old) should be thinned to create better foraging habitat. This opens up the habitat and also ensures long-term foraging value by increasing the growth rate of the remaining trees.

Artificial Start Hole Creation: Suitable, sufficient substrate for cavity excavation can be a limiting factor in localized situations. To increase the number of cavities, artificial start holes can be excavated in selected trees both in clusters and in suitable but unoccupied nesting/roosting habitat. Selected trees should be >50 years old and/or >23 cm dbh, and the hole should be situated on the southwesterly side of trees 1 to 3 m below the lower crown branches. Individual holes should be 5.7 cm in diameter and deep enough to penetrate the heartwood. In active clusters, selected trees should be near active cavity trees, and in unoccupied areas selected trees should be grouped into a simulated cluster. In South Florida, artificial start holes are being used at Big Cypress National Preserve (D. Jansen, Big Cypress National Preserve, personal communication 1996) and at Three Lakes WMA (M. Salyer, GFC, personal communication 1996).

Artificial Cavity Creation: When the availability of trees suitable for cavity excavation in a cluster is severely restricted, or when a management objective is to induce occupation of an unoccupied but suitable area within a short period of time, artificial cavities can be drilled in available trees (Copeyon 1990, Taylor and Hooper 1991) and/or artificial "cavity inserts" can be installed (Allen 1991). Both techniques have been demonstrated to be effective in terms of red-cockaded woodpeckers adopting them (Copeyon *et al.* 1991, Richardson and Stockie 1995, Watson *et al.* 1995). However, the cavity insert technique requires relatively large trees, at least 38 cm in diameter at the height of the

planned insert, and the cavity excavation technique requires trees at least 75 years old with 25 cm of heartwood. In South Florida, cavity inserts are being used at Big Cypress National Preserve, in trees in Islesworth and Naples, and they are being considered at Avon Park AFR.

Installing Cavity Restrictors: Where competition for cavities from other species is a significant problem, or when rehabilitation of cavities in living trees that have been enlarged by competitors is needed, cavity restrictor devices can be installed on cavities. This technique can significantly reduce cavity competition and/or render previously unsuitable *(i.e.*, enlarged) cavities suitable for occupancy by red-cockaded woodpeckers (see Carter *et al.* 1989 for methodology).

Augmentation: Small, isolated populations are prone to eventual extinction due to stochastic events, demographic problems and/or a lack of genetic vigor. When the management objective is to maintain such populations, translocations of individual birds can be employed. The most effective technique for translocating red-cockaded woodpeckers is capturing and relocating juvenile females to groups comprised of bachelor males. This technique is only effective, however, when it also has been shown that relocating juvenile males to single female groups, and simultaneously translocating unrelated juvenile males and females to recruitment clusters, is effective in establishing new potential breeding groups (Rudolph *et al.* 1992, Costa and Kennedy 1994). When isolated populations are extremely small and destined to extirpation, it may be best to translocate the juveniles in those populations, as long as they persist, and introduce them into other, more secure populations.

Survey/Monitoring Techniques

Red-cockaded woodpecker cavity trees are so conspicuous and unmistakable that determining whether or not a particular area is being used for breeding is relatively simple. Habitats that warrant surveying include old growth (>50 years old) pinelands or pine-dominated pine/hardwood stands, or younger stands with scattered mature pines. Walking linear transects, spaced according to the visibility afforded by the vegetation present, usually 30 to 80 m apart, is the most effective technique for locating cavity trees. Helicopter transects can also be effective in some situations.

Cavities can be treated as active if the tree is living and the resin is flowing. Cavities in living trees that have not been enlarged by other species but with dry, caked and discolored (usually grayish or greenish) resin can be treated as inactive. Such cavities, however, may be reactivated by red-cockaded woodpeckers even after several years of inactivity. Cavities in dead trees and enlarged cavities usually have little direct benefit to red-cockaded woodpeckers, and for most purposes can be considered permanently abandoned. Inactive/abandoned cavities have indirect benefits, however, in that they provide nest/roost sites for species that might otherwise compete with red-cockaded woodpeckers, and thereby should be considered in management strategies.

The number of birds comprising a given group can be determined by positioning observers at cavity trees during morning departure times and/or evening return times. Several observers would normally be needed in that regard to ensure all occupied trees in a given cluster are under observation.

It is more complex to determine whether or not an area is being used as foraging habitat by red-cockaded woodpeckers. More specific guidelines for determining foraging areas in South Florida need to be developed. In general, any area dominated by mature pines which are proximal to nesting/roosting habitat is potentially suitable for foraging. There are subtle indications of red-cockaded woodpeckers foraging in an area, particularly if the area is heavily used. For example, observation of trees with smoother bark and a more reddish appearance (caused by the birds chipping away bark during foraging) can be a good indication of foraging habitat. A more definitive technique, although not altogether effective, is to play a tape recording of red-cockaded woodpeckers calls at stations throughout potential nesting/roosting or foraging habitat. Tape-recorded calls will often elicit a territorial response by any red-cockaded woodpeckers within hearing distance. However, this technique is only effective in the morning hours during the breeding season, and requires daily repetition for several consecutive days. Otherwise a group foraging out of hearing distance may not be detected.

Demographic monitoring typically requires banding red-cockaded woodpeckers. In banding operations, adults can be captured most effectively by deploying a mist net or mosquito net hoop connected to a pole over an occupied cavity either prior to the resident bird's morning departure, shortly after dawn, or just after its evening return near dusk. Hitting the tree trunk with a solid object will usually induce the bird to exit the cavity into the netting. Adults can also be captured, although much less effectively, by deploying a standard mist net in a cavity tree cluster and playing a tape recording of red-cockaded woodpecker calls under or very near the net. Resident birds will attempt to seek out and expel the "intruders," and in so doing may fly into the net. When color-banding red-cockaded woodpeckers (or any other species of woodpecker), red bands should not be used. The color red is a behavioral trigger for most woodpecker species, and red bands could disrupt social behavior patterns. State and Federal permits must be obtained prior to banding any birds.

Banding nestlings or inspecting nest contents requires climbing cavity trees with Swedish climbing ladders to reach cavities. A flashlight and mirror are needed to view the contents, and nestlings can be extracted with monofilament line snares (see Jackson 1982 for methodology).

Conservation

The conservation and management of red-cockaded woodpeckers in South Florida has not been seriously addressed. These efforts should focus on managing and restoring habitat. Additional surveys are needed to update our information on the status of active and inactive clusters, as well as the availability of suitable unoccupied habitat throughout South Florida. We also need to evaluate the potential carrying capacity for red-cockaded woodpeckers on existing public lands where suitable or restorable habitat exists.

Involvement and cooperation of private landowners is essential for the conservation of red-cockaded woodpeckers on private lands. Private lands can provide corridors of habitat or island populations between or in close proximity to other support populations, and can support juveniles to maintain demographic and genetic health, and increase population size (Costa and

Edwards 1997). Prior to 1991-1992, there was no comprehensive plan to address the management of private lands for red-cockaded woodpeckers. In 1992, the FWS developed a conservation strategy to address red-cockaded woodpecker losses on private lands, economic impacts to private landowners of providing habitat, and cooperative conservation efforts between the public and private sectors. This strategy contains a draft red-cockaded woodpecker procedures manual for private lands (Costa 1992) and discusses statewide Habitat Conservation Plans and Memorandums of Agreement (MOA) between private landowners and the FWS for habitat management and monitoring (Costa 1995). A number of incentives have been proposed to compensate private landowners willing to manage for red-cockaded woodpeckers.

One such mechanism that involves cooperation with landowners is the FWS Safe harbor Policy. This policy encourages private landowners to manage their properties for red-cockaded woodpeckers by providing assurances that the establishment of additional groups on their property will not result in further land use restrictions. Upon enrollment for Safe Harbor, private lands are surveyed for red-cockaded woodpeckers and the numbers of groups using the property at the time of enrollment are determined to be the "baseline." If better land management subsequently results in the establishment of additional groups above the baseline, the landowner has no responsibility, under the Safe harbor agreement, to maintain them. The Safe Harbor approach provides assurances to land owners about land uses, reduces uncertainty about the ESA requirements, and benefits red-cockaded woodpeckers by increasing available habitat. The Safe Harbor concept could work in South Florida for the large tracts of private pine flatwoods, such as in the southwestern part of the state. This program could be a key to maintaining population exchange of red-cockaded woodpeckers in South Florida and lend more demographic stability to population centers. It also may help curtail illegal activities that have harmed the woodpecker by removing the "fear" of the ESA.

In addition, land acquisition programs for suitable habitat in South Florida are being implemented through state efforts such as the Conservation and Recreation Lands (CARL) and Save Our Rivers programs. 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 red-cockaded woodpecker clusters (Beever and Dryden 1992). Two properties in South Florida identified through the CARL program to benefit red-cockaded woodpeckers are the Belle Meade and Charlotte Harbor Flatwoods parcels in Collier and Charlotte counties, respectively (DEP 1995). The GFC also identified numerous other parcels that may benefit red-cockaded woodpeckers if they are acquired and managed properly (Cox *et al*. 1994).

As the human population continues to increase in South Florida, there will be an increasing demand for residential, commercial, and agricultural uses of South Florida's pinelands. It is likely that many of these uses will be incompatible with red-cockaded woodpecker habitat needs; therefore, unavoidable adverse effects to the species are likely. Where adverse effects cannot be avoided, measures must be taken to minimize on-site disturbance, and compensate or mitigate for the impacts that remain. On-site minimization

measures can include relocating certain portions of projects to conserve the most suitable areas for red-cockaded woodpeckers, connecting portions of project areas to preserves, and establishing preserves similar in size to the amount of suitable habitat affected by a particular project.

Habitat compensation results in the protection and management of suitable red-cockaded woodpecker habitat in another area. The FWS generally recommends that areas used as habitat compensation be located in the vicinity of the affected habitat, where appropriate, to avoid further fragmentation and isolation of existing habitat. Mitigation must at least replace each red-cockaded woodpecker group in-kind (*i.e.,* potential breeding pair or solitary bird) from the affected property onto another property, either by creating artificial recruitment clusters and/or by the translocation of an adequate number of juveniles to existing recruitment clusters. Other examples of mitigation include purchase of portions of areas identified for acquisition as key conservation lands, or contributions toward the perpetual management of existing conservation lands. For off-site mitigation, the FWS is recommending requiring a management endowment to accompany the mitigation package to be used by the entity receiving the birds or cluster(s), in addition to the approximate average figure of $4,400 for each new cluster created.

In areas where habitat is so threatened that red-cockaded woodpeckers would not be able to survive, translocation of birds to protected areas of suitable habitat is an option under a number of conservation strategies through the FWS. Translocation of red-cockaded woodpeckers has been successful elsewhere in their range (Rudolph *et al.* 1992, Costa and Kennedy 1994, Reinman 1995). The translocation of red-cockaded woodpeckers from threatened private lands is intended to result in a net gain of red-cockaded woodpeckers on public lands or in establishment of larger, more secure private populations (Costa 1995).

Habitat restoration is also an important component of red-cockaded woodpecker conservation. Management activities in South Florida should promote regeneration and encourage establishment of the more densely stocked pine stands that occurred historically (Shapiro 1983). It is important to remember, however, that these areas are less than what is reported as optimal or acceptable habitat in other areas. The Federal guidelines for evaluating red-cockaded woodpecker habitat to prepare biological assessments (Henry 1989) are inadequate for South Florida, particularly the hydric slash pine flatwoods in southwest Florida. At least half of the areas in southwest Florida would fail to meet the 23.1 cm dbh criteria for determining suitable habitat, and more than half of the cluster sites would fail to meet the standard for identifying suitable cavity trees (Beever and Dryden 1992). As mentioned previously, good quality hydric slash pine habitat in southwest Florida has approximately 133 trees/ha, 5 to 8 pine stems of 25.8 cm or larger dbh, and a basal area of approximately 4.6 m^2/ha (Beever and Dryden 1992). Given this, foraging habitat per group would be estimated at 46.8 ha based on total pine stems, 183.6 ha based on pine stems greater than or equal to 25.8 cm, and 171.9 ha based on basal area. The FWS, in cooperation with the GFC and others, needs to work toward revising these guidelines to be beneficial for red-cockaded woodpeckers in South Florida.

Although South Florida is not a designated recovery population for red-cockaded woodpeckers (250 breeding pairs or groups based on the need for ~400 potential breeding pairs), it contains significant support-populations. A goal for this area should be to establish additional populations of red-cockaded woodpeckers on public and private lands, where feasible, and create as much habitat connectivity as possible, to maximize dispersal opportunities. Efforts should focus on protecting habitat for the birds on private lands where medium-sized populations (10 to 30 groups) are known to exist (*e.g.* Belle Meade, River Ranch, *etc.*), and expanding populations on key public lands. To achieve this, the FWS is undertaking a landscape approach, using GIS and spatially-explicit models, to identify important conservation areas for red-cockaded woodpeckers, including corridors to allow for interchange among populations, and conservation areas necessary for the long-term survival of red-cockaded woodpecker populations.

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Recovery for the Red-cockaded Woodpecker

Picoides borealis

Recovery Objective: RECLASSIFY to threatened.

South Florida Contribution: ESTABLISH support populations to facilitate range-wide recovery.

Recovery Criteria

South Florida can contribute the establishment of one or more viable populations of red-cockaded woodpeckers toward the overall recovery goal for the species throughout its range. In particular, we should focus on increasing numbers of birds in the hydric pine flatwoods community of southwest Florida; South Florida is the only place where red-cockaded woodpeckers inhabit this community type throughout their range.

This objective will be achieved when: a reserve design for South Florida is developed that identifies patches of suitable-size nesting and foraging habitat (stands of old-age, mature pines of adequate size) essential for preventing further declines in the population; when any further loss and fragmentation of habitat within these reserves has been prevented; when suitable, occupied habitat within the reserves is protected through appropriate management on public and private lands, land acquisition, and cooperative agreements with private landowners; when additional nesting and foraging habitats are created or restored adjacent to existing clusters; when augmentation or artificial cavities are successfully implemented where needed to establish new groups; and when groups of red-cockaded woodpeckers within the reserves sustain a rate of increase (*r*) greater than 0.0 as a 3-year running average for at least 10 years.

Species-level Recovery Actions

S1. Determine the distribution and status of red-cockaded woodpeckers in South Florida. The status of the red-cockaded woodpecker in South Florida will remain uncertain and controversial until reliable census data are acquired. A range-wide survey was completed for most Federal lands in 1982. Additional surveys are needed on public and private lands to update our information on the status of active and inactive clusters, as well as the availability of suitable unoccupied habitat throughout South Florida.

S1.1 Conduct surveys on Federal and other public lands. Current surveys should be expanded to include Federal properties not included in the original survey as well as other public lands such as state forests, parks, wildlife management areas, and conservation lands.

S1.2. Conduct surveys on private lands. Develop non-invasive techniques (*i.e.* use of aerial photography) to identify potentially suitable habitat on private lands that could be occupied by red-cockaded woodpeckers. Work with landowners to obtain

access to survey those lands and other private properties where red-cockaded woodpeckers are known to occur.

S1.3. Repeat surveys at 5 to 10 year intervals. Surveys should be repeated at 5 to 10 year intervals to determine local trends and to maintain consistency with region-wide surveys.

S1.4. Use survey techniques that are consistent with region-wide surveys. Use of standardized procedures in censusing local populations will facilitate communication among investigators, managers, and policy makers, and permit the integration of South Florida data into regional and range-wide estimates. Use these data to determine population status and trends.

S1.5. Maintain red-cockaded woodpecker distribution data in a GIS database. Update the existing GIS database by including information on the distribution of known clusters of red-cockaded woodpeckers and the current status of pine flatwoods communities throughout South Florida.

S2. Protect red-cockaded woodpeckers in South Florida.

S2.1. Develop a reserve design for red-cockaded woodpeckers in South Florida using landscape maps, GIS and spatially explicit models. Design reserves to consist of areas identified as critical to the survival of the red-cockaded woodpecker in South Florida. Large, contiguous patches of pineland habitat are ideal. Non-contiguous patches must be large enough to support at least short-term viable populations of at least 10 clusters, or must have corridors to link to additional suitable habitat.

S2.1.1. Identify all public lands, other conservation lands, and private lands where red-cockaded woodpeckers currently exist. Determine the current status and distribution of red-cockaded woodpeckers on protected and private lands from S1.5.

S2.1.2. Identify all unoccupied, potentially restorable pineland areas on public and other conservation lands. Work with Federal, State, and county agencies and NGOs to identify areas where management is needed, and where such management would benefit red-cockaded woodpeckers.

S2.1.3. Identify additional key privately owned lands that could enhance existing red-cockaded woodpecker preserves on conservation lands, that would serve as source sites for red-cockaded woodpeckers, or that would provide corridors to facilitate dispersal between occupied conservation lands.

S2.1.4. Use spatially explicit models with the existing information on suitable and restorable pineland habitat remaining in South Florida, and data on red-cockaded woodpecker biology, to identify the most suitable and feasible alternative for development of a reserve design to conserve red-cockaded woodpeckers in South Florida.

S2.2. Protect, manage, and enhance red-cockaded woodpecker populations on public lands. In South Florida, red-cockaded woodpeckers are Federally protected on Avon Park AFR and Big Cypress National Preserve, and also occur on state-administered lands. The survival of the red-cockaded woodpecker depends to a large extent on maintaining and enhancing clusters on these public lands.

S2.2.1. Develop management plans for red-cockaded woodpeckers 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 red-cockaded woodpecker clusters on their property. The plans should include fire and/or mechanical management to maintain the habitat in a suitable condition, as well as the use of starts or artificial cavities where feasible. Monitoring should be incorporated in the plan as feedback for adaptive management.

S2.2.2. Implement management plans for red-cockaded woodpeckers on public lands. Public land managers should coordinate efforts to ensure that the implementation and timing of management actions on adjacent properties are not in conflict, and that equipment and personnel are used effectively and efficiently.

S2.3. Encourage protection and management of red-cockaded woodpeckers on private lands. In 1992, the FWS began developing a conservation strategy to address red-cockaded woodpecker losses on private lands, economic impacts to private landowners of providing habitat, and cooperative conservation efforts between the public and private sectors (Costa 1995). A number of incentives have been proposed to compensate private landowners willing to manage for red-cockaded woodpeckers.

S2.3.1. Develop Memorandums of Agreement between the FWS, private landowners, and other cooperators. Agreements should specify management actions needed to protect the species and identify the party responsible (landowner or Federal agency) for implementing the various actions. Agreements should set forth the total commitments of the two parties including land base, funds, equipment, manpower, and time period, and provide a means and time frame for terminating the agreement.

S2.3.2. Implement Safe Harbor Policy for red-cockaded woodpeckers where it would benefit recovery. The Safe Harbor concept could work in South Florida for the large tracts of privately held pine flatwoods, such as in the southwestern part of the state. This program could be a key to maintaining population exchange of red-cockaded woodpeckers in South Florida and lend more demographic stability to population centers.

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. Develop and implement other conservation programs. The opportunities for a model tax incentive program at 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.

S2.3.5.1. Continue development of information articles and management guidelines oriented to private lands. These articles and guidelines should include information and visual

aids to identify 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. Legal responsibilities under section 7 of the ESA should also be detailed to explain the different obligations when there is Federal involvement of any kind.

S2.3.5.2. Distribute information to private landowners and managers through professional and industrial associations. The information developed in **S2.3.5.1.** should be distributed through a variety of professional and trade associations and agencies, such as the State and Private Forestry branch of the USDA Forest Service, county agricultural extension agents, and state forestry associations.

S2.4. Enforce available protective measures. Employ local, State and Federal regulations and guidelines to protect red-cockaded woodpeckers 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 might adversely affect resident red-cockaded woodpecker populations. Such activities include (among others) pesticide use, road construction, military training exercises, and clearing of land for new buildings and runways. Implement on-site minimization through section 7 when needed.

S2.4.2. Implement on-site minimization, habitat compensation, and mitigation on private 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 clusters, and avoid further fragmentation and isolation of existing habitat.

S2.5. Revise the Federal guidelines for evaluating red-cockaded woodpecker habitat in South Florida. The FWS needs to work toward revising the Federal guidelines (Henry 1989) to be beneficial for red-cockaded woodpeckers in South Florida. These guidelines are inadequate for South Florida, particularly for the hydric slash pine flatwoods in southwest Florida. At least half of the areas there would fail to meet the 23.1 cm dbh criteria for determining suitable habitat, and more than half of the clusters would fail to meet the standard for determining suitable cavity trees (Beever and Dryden 1992).

S3. Conduct research on the life history and population dynamics of red-cockaded woodpeckers in South Florida. Although red-cockaded woodpeckers have been well studied, very little is known about the life history and subsequent management needs of birds in South Florida.

S3.1. Gather basic life history and demographic data, such as reproductive success, juvenile and adult survival and mortality, juvenile recruitment into the breeding population, the role of helpers, home range size requirements, and dispersal of birds within the various subpopulations in South Florida.

S3.2. Conduct risk assessment analysis to determine the probability of persistence of red-cockaded woodpeckers in South Florida, given the current amount of available, suitable pineland habitat. Include pineland areas that could be restored or enhanced to become suitable habitat.

S3.2.1. Identify which subpopulations of red-cockaded woodpeckers are considered "viable" according to our recovery criteria, and which subpopulations or groups of birds are most vulnerable to extinction.

S3.2.2. Incorporate results of this effort into the reserve design for red-cockaded woodpeckers to assist with project review and consultation purposes.

S3.3. Study the effects of habitat fragmentation due to urbanization. On a landscape level, determine how residential development affects the metapopulation dynamics of red-cockaded woodpeckers. On a population level, identify the conditions that red-cockaded woodpeckers 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 red-cockaded woodpeckers after restoration of unoccupied pineland communities. Collect life history information on red-cockaded woodpeckers that naturally immigrate to restored habitat, including immigration, habitat use, territoriality, reproduction, adult and juvenile survival, dispersal, and recruitment.

S3.5. Research feasibility of translocation of red-cockaded woodpeckers in South Florida. Translocation of red-cockaded woodpeckers has been shown to be successful in areas outside of South Florida, and has not yet been attempted here. Explore opportunities for translocating red-cockadeds to establish new populations, to enhance gene flow, or to salvage groups permitted for incidental take.

S3.5.1. Identify areas in South Florida where red-cockaded woodpeckers occur in small, isolated populations that are subject to eventual extinction, or where habitat is so threatened that birds would not be able to survive due to stochastic events, demographic problems and/or a lack of genetic vigor.

S3.5.2. Conduct an experimental translocation of birds from one of the areas identified in 3.5.1. to an area with suitable habitat that can support additional birds. Follow the protocols established for red-cockaded woodpeckers that have been successful elsewhere (Costa and Kennedy 1994).

S4. Monitor red-cockaded woodpecker subpopulations.

S4.1. Monitor representative groups within each subpopulation in South Florida to collect data on habitat use, reproduction, survival, mortality, dispersal, and recruitment. Use these data to determine the status and trends of birds throughout South Florida.

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 habitat as well as birds that have been translocated to new areas.

S5. Inform and involve the public. This is an ongoing task. Particular emphasis should be placed on explaining the status, importance and biological needs of red-cockaded woodpeckers and the legal responsibilities for the species' protection.

S5.1. Prepare informative articles for the news media and popular publications. Information articles for the news media and popular publications should be prepared. The news media should be contacted and encouraged to utilize the information articles as prepared or incorporate all or part of the information in articles prepared by news media staff.

S5.2. Distribute information to the public via mailings to conservation groups and individuals and through public meetings. The popular publications should be distributed to the public via mailings to conservation groups and individuals, and through public meetings. Availability of the publications should be publicized and the public encouraged to request copies.

Habitat-level Recovery Actions

H1. Prevent degradation of existing red-cockaded woodpecker habitat in South Florida. The long-term survival of the red-cockaded woodpecker is dependent upon the immediate protection of as much of the remaining occupied and suitable, unoccupied pineland communities as possible, given biological, social, economic, and legal constraints.

H1.1. Prioritize areas identified in reserve design for management and acquisition. Large, contiguous habitat patches are the most ideal for conserving red-cockaded woodpeckers. High priority should be given to areas contiguous with, or within short dispersal distance of, existing conservation lands where red-cockaded woodpeckers occur. High priority should also be given to areas adjacent to suburban sites where red-cockaded woodpeckers occur, allowing natural dispersal of birds from suburban areas to protected habitat.

H1.2. Protect red-cockaded woodpecker 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 red-cockaded woodpecker clusters. Lands containing red-cockaded woodpeckers should receive special consideration where these lands would consolidate Federal ownership or control and contribute to overall resource management objectives of the agencies.

H1.2.1. Support State acquisition efforts. The Florida Conservation and Recreation Lands (CARL) program has a number of ongoing projects and proposals for the acquisition of threatened vegetative communities in 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 red-cockaded woodpecker habitat that could benefit from the SOR program.

H1.2.2. Encourage acquisition by Non-Governmental Organizations. Occupied and suitable, unoccupied areas not targeted in Federal and State acquisition programs may become available for private purchase and management.

H1.2.3. Pursue acquisition of lands identified as necessary for developing red-cockaded woodpecker reserves that are not covered under H1.2.1 or H1.2.2 .

H1.2. Maintain adequate nesting habitat in addition to currently active clusters, to replace clusters abandoned or lost through mortality, and to provide for population expansion. Cavity trees can be provided by lengthened rotations, by leaving old-growth remnant trees well distributed throughout younger stands, by perpetuating small remnant stands or patches of old-growth throughout the forest area, or by a combination of these methods. Manage clusters as stands rather than as individual trees and avoid isolating clusters from adjacent forest cover and foraging habitat. Burn or otherwise treat clusters to control hardwood stocking. Potential nesting habitat should be burned and thinned similarly to clusters.

H1.3. Maintain adequate foraging habitat to support existing groups and to facilitate establishment of new territories. Although the loss of nesting habitat is the most serious threat to red-cockaded woodpeckers, groups cannot survive without adequate foraging habitat as well. In South Florida, because of the difference in habitat structure and composition, more habitat is needed for foraging than in areas in the northern portion of the species' range (Hovis and Labisky 1996; Beever and Dryden 1992).

H1.4. Prevent loss or fragmentation of pine flatwoods within reserves identified in S2.1. Ensure that no habitat gaps are created within reserves that might preclude dispersal by red-cockaded woodpeckers.

H2. Restore and enhance red-cockaded woodpecker habitat.

H2.1. Use artificial starts in suitable areas. Suitable substrate for cavity excavation is a limiting factor in localized situations, so artificial starts should be excavated in selected trees both in clusters and in suitable but unoccupied nesting/roosting habitat.

H2.2. Create artificial cavities in suitable areas. When the availability of trees suitable for cavity excavation in a cluster is severely restricted, or when the management objective is to induce colonization of an unoccupied but suitable area, artificial cavities can be created in suitable trees (Copayon 1990; Allen 1991; Taylor and Hooper 1991).

H3. Conduct research on habitat needs and management for red-cockaded woodpeckers in South Florida.

H3.1. Determine the amount of foraging habitat needed to sustain a group of woodpeckers in South Florida in both mesic and hydric pine flatwood habitats. The current Federal foraging guidelines for red-cockaded woodpeckers are unsuitable for use in South Florida because of the significant differences in habitat quality. These data are needed to produce guidelines specific to South Florida.

H3.2. Investigate the best method(s) to provide and manage nesting habitat. Determine whether successful ongoing management activities for red-cockaded woodpeckers elsewhere are suitable for use in South Florida, or how they may be modified for use here.

H3.3. Determine the potential carrying capacity for clusters of red-cockaded woodpeckers on existing public and private lands where suitable or restorable habitat exists.

H3.4. Assess the biological processes associated with cluster abandonment (*e.g.*, interspecific competition, predation, *etc.*), and methods for preventing abandonment.

H3.5. Determine whether retention of snags and dead and abandoned cavity trees within clusters increases or decreases competitive pressure on red-cockaded woodpeckers.

H4. Monitor xeric communities that provide red-cockaded woodpecker habitat.

H4.1. Monitor pineland habitat that is occupied by red-cockaded woodpeckers to ensure public lands are managed to maintain habitat in suitable condition for red-cockaded woodpeckers, and to assess when unmanaged areas become unsuitable. Also monitor to ensure the site is not becoming a population "sink".

H4.2. Monitor unoccupied pine flatwood communities following restoration to collect data on habitat characteristics upon immigration and establishment of red-cockaded woodpeckers. This will provide information on the habitat conditions that are suitable for red-cockaded woodpeckers following restoration.

H4.3. Maintain red-cockaded woodpecker 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 pineland habitat in South Florida. Record the condition of the habitat, and the type and timing of all pertinent management actions.

H5. Increase public awareness of pine flatwoods communities. Efforts should highlight habitat acquisition initiatives, importance of biodiversity, and biology of pineland-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 remaining pine flatwoods in South Florida. Materials such as brochures, posters, postcards, slide programs and videotapes can improve public understanding of and increase appreciation for protection of this community. Environmental education programs throughout South Florida should be encouraged to distribute materials or develop lesson plans on the pine flatwoods community, highlight species such as the red-cockaded woodpecker, and discuss the importance of maintaining biological diversity.