

Management Indicator Species for the New Plan

Success in maintaining and restoring composition, structure, and function of forest ecosystems within desired ranges of variability is reflected by both changes in forest condition and by levels of management and other effects that are shaping these communities. Monitoring will include tracking the abundance of major forest cover/community types and levels of management activities conducted to maintain and restore desired conditions. Population trends and habitats of Management Indicator Species will be monitored to help indicate effects of national forest management within selected communities.

Indicator: Red-cockaded Woodpecker (*Picoides borealis*)



From USGS Patuxent Bird ID InfoCenter

Reasons for Selection: Trends in populations of this species will be used to help indicate the effectiveness of management at maintaining mature pine forests in open, fire-maintained conditions. (See also Monitoring Question 7.)

Reasons for Selection: Trends in presence and abundance of these species in mature pine forest will be used to help indicate effectiveness of management at maintaining these communities in open fire-maintained conditions.

Ecology & Life History

Basic Description: A small, zebra-backed woodpecker.

General Description: A small (18-20 cm long, 35-38 cm wingspan) woodpecker with black wings, a black cap, a dull white breast with small black spots, and a barred, black-and-white back; conspicuous large white cheek patch on each side

of the head; red streaks ("cockades") on either side of the head of adult males barely are visible; small white spots arranged in horizontal rows along the back convey a "ladder-back" appearance.

Juvenile males have a small, circular red patch on the top of the head that is visible until early fall (Ligon 1970, Jackson 1979, Hooper et al. 1980); this is lacking in juvenile females (Ligon 1970, Jackson 1983a). Photographs and a discussion of juvenile characteristics were presented by Jackson (1979) and Jackson (1983a).

Recordings of typical calls provided by Hardy (1978. Sounds of Florida's Birds. ARA Records, 1615 NW 14th Ave., Gainesville, Florida 32605). Drumming is less common in this species than in other woodpeckers (Ligon 1970).

Unless otherwise indicated, sources for this section are Hooper et al. (1980), Peterson (1980), U.S. Fish and Wildlife Service (1980), and Robbins et al. (1983).

Reproduction Comments: COOPERATIVE BREEDING SYSTEM: Live in groups containing a single breeding pair and zero to four 'helpers' (Walters 1990), rarely as many as nine (Hooper et al. 1980). Helpers help incubate eggs, feed nestlings and fledglings, and defend territories (Ligon 1970, Lennartz and Harlow 1979, Walters 1990). Mated pairs are monogamous (Ligon 1970, Walters 1990, Haig et al. 1993b). Walters et al. (1988) reported that male-female pairs were the most common social unit (60%); about 30% of the groups contained one or more adult helpers and about 10% consisted of solitary males; only 5% of groups had more than one helper.

Each member of a group usually has an exclusive roost cavity (Hooper and Lennartz 1983b, Harris and Jerauld 1983, Jansen 1983). Access to a cavity is critical to the nesting success of males, since the nesting cavity is almost always the cavity of the single breeding male (Ligon 1970, Hooper and Lennartz 1983).

It takes many months to excavate a cavity (Hooper et al. 1980, Walters 1991). The importance of attaining a cavity, contrasted with the extended time required to excavate one, has led (in part) to different strategies among young birds for coping with the common situation wherein most suitable cavities are occupied by conspecifics (Walters 1990). Almost all young females and most young males disperse and find an existing cavity with a new group (Walters et al. 1988). Another strategy, employed by 27 per cent of the young males, is to remain on the natal territory in hopes of inheriting the territory or another nearby territory. (Walters et al. 1988). Only very rarely do young birds disperse to new areas and excavate new cavities (Walters 1990).

Birds that remain in natal territories may do so for many years and help the breeding pair raise and care for new birds (Walters et al. 1988).

Once a male attains breeding status in a group, it usually retains that position until death. Females may switch groups after attaining breeding status, particularly when an offspring male inherits a territory; this may help avoid close inbreeding (Walters et al. 1989).

NESTING: Copulation observed November-December and March-May (Ligon 1970, Crosby 1971, Baker 1971), but egg laying usually occurs April-early May. Groups may not nest every year (Hopkins and Lynn 1971), perhaps in response to environmental factors.

Clutch size 2-5, 3-4 usual (Murphrey 1939). Incubation lasts about 10-12 days (Hooper et al. 1980), and often begins with the laying of the second egg. This means that some eggs hatch earlier than others, giving early hatchlings a size and competitive advantage over other nestlings; Ligon (1970) reported that later-hatching young often starved within 24 hours.

Nestlings are altricial and remain in the nest for 26-29 days (Ligon 1970). Ligon (1970) reported hatching rates of about 90% but fledgling rates of only 50%.

Neal et al. (1993a) found that roughly half of the older nestlings in their study area were eaten by snakes. Red-bellied Woodpeckers have also been observed pulling nestlings out of nests (Ligon 1971), and flying squirrels (*GLAUCOMYS VOLANS*) may destroy nests (Walters 1991). Bad weather represents another major source of nestling mortality (Neal et al. 1993b).

Lennartz et al. (1987) found that breeding groups with helpers fledge more young per year (2.05) than groups consisting of a single breeding pair (1.40).

Reproductive output increases with age, especially after approximately 2-3 years (Reed et al. 1988, Walters 1989).

Gowaty and Lennartz (1985) reported that the sex ratios of nestlings and fledglings favored males 59:41. This bias suggests that female nestlings may be more difficult to raise or males somehow have an advantage during the nestling period. Nests tended by a breeding pair and helpers produced more even sex ratios than did nests tended by a single pair (Gowaty and Lennartz 1985).

FLEDGING: Young birds leave the nest after 26-29 days (Ligon 1970), and most nesting activity is finished by early July (Baker 1983a, Wood 1983b). Within 3-5 days, fledglings are able to follow adults on extended foraging trips (Ligon 1971). Juveniles may beg for and receive food from adults for 5 months or longer (Ligon 1970).

Juveniles progress through a series of molts before attaining adult plumage; molting may become particularly heavy towards late summer and food requirements increase during these periods of heavy molt (Jackson 1983a).

Post-juvenile plumage is attained by late fall or early winter of the first year (Jackson 1983a).

Ecology Comments

TERRITORIALITY AND HOME RANGE: Maintain territories throughout the year, and appear to recognize precise boundaries (Ligon 1970). Groups seem to be least cohesive during the incubation period and when nestlings are being fed (Walters 1990). Helpers assist in the defense of territories (Ligon 1970), and territorial displays include characteristic vocalizations (Ligon 1970), wing-spreading displays, wing fluttering, raising of the red cockades (in the case of males, Hagan and Reed 1988), and physical attack (Walters 1990). Drumming is not as common a territorial display in red-cockaded woodpeckers as it is in other woodpeckers, but it may occur when territorial birds encounter an alien bird (Hooper et al. 1982).

Walters (1990) reported that adult males are the primary defenders against intruder males, and adult females against intruder females, for most of the year. During the breeding season, however, both sexes respond to a single intruder. Birds are also most aggressive towards intruders and neighboring groups during the breeding season. Outside the breeding season, a resident group may sometimes forage peaceably with an intruder within the territory, or near a neighboring group along a territory boundary.

A comprehensive 3-year study by Hooper et al. (1982) reported home ranges from 34-225 ha (mean of total ranges 86.9 ha, mean of year-round ranges 70.3 ha). In other studies, home range estimates varied from 15-220 ha and averaged around 67 ha (Baker 1977, Crosby 1971, Skorupa and McFarlane 1976, Nesbitt et al. 1978, Sherrill and Case 1980, Nesbitt et al. 1983b, Wood 1983a), although extremely large territories of about 400 ha may exist (Hooper et al. 1980).

Home range estimates may include "extra-territorial" areas that are utilized by other neighboring con-specifics as well as floaters in the population (Walters 1989); these are not strongly defended and are estimated to average about 8.4 ha (Hooper et al. 1982), but may be as large as 30 ha (Hooper et al. 1982, Repasky 1984, Blue 1985, Porter and Labisky 1986, DeLotelle et al. 1987). Repasky (1984) suggested that extra-territorial range is underestimated because sampling is usually not extensive in winter and late summer when birds use larger areas. However, in the few studies in which home range size estimates were subdivided into territorial and extra-territorial areas, similar mean territory sizes of 70 ha were obtained (Hooper et al. 1982, Repasky 1984, Blue 1985).

Seasonal variation in range size has been reported, though debate on this issue exists. Skorupa and McFarlane (1976) found that home ranges were smallest in summer and largest in winter. These authors warned that average range values

may be misleading since "... the increased winter foraging requirements of the species must be considered " as part of conservation and management efforts. Wood (1983) also found home range to be larger in winter in Oklahoma (52.8 ha) than in summer (44.1 ha) and spring (26.0 ha). However, these data were for a single, 5-member clan. In their larger study, Hooper et al. (1982) found larger (although not statistically significant) home ranges in spring (mean 49 ha) and summer (mean 47.7 ha) than in fall (mean 37.5 ha). They further found that birds had larger home ranges during the post-fledging period (mean 43.1 ha) than during the nestling period (mean 27.8). Jerauld et al. (1983) noted a restricted range during the first few days following fledging. They suggested that range sizes decreased during this time when fledglings had difficulty following adults.

Range size also appears to vary geographically to some degree, with larger home ranges occurring in south and central Florida. An early study of a single group in south Florida reported a range of 159 ha (Patterson and Robertson 1981). In central Florida, DeLotelle et al. (1983) found that four year-round range were 120-203 ha and averaged 150 ha. Nesbitt et al. (1983b) reported that five groups in southwest Florida had an average home range size of 148 ha and a range of 80-218 ha. Nesbitt et al. (1983b) noted that this species probably requires larger ranges at the southern limits of their distribution owing to poor habitat quality.

DISPERSAL: Although dispersal is primarily undertaken by young birds; mate loss and an apparent avoidance of inbreeding sometimes cause adults to disperse, and adults may also occasionally move to neighboring territories for unknown reasons (Walters 1989). In North Carolina, fledgling females dispersed an average of 4.8 km, maximum 31.5 km; breeding males dispersed an average of 2.1 km, maximum 15 km; fledgling males dispersed an average of 5.1 km, maximum 21.1 km; helper males dispersed an average of 1.8 km, maximum 17.1 km; and solitary males dispersed an average of 2.3 km, maximum 8.5 km (Walters 1989).

The relatively short dispersal distance implies that rates of inbreeding may be high even though close inbreeding is avoided (Walters 1990). That is, matings between second cousins may be common while parent-offspring matings are avoided. This may have led to the high similarities of DNA profiles reported by Haig et al. (1993b). However, Walters (1988) described a long-distance dispersal event for one female, which moved 90 km and seemed to follow a highway corridor that contained appropriate habitat conditions. The bird also traversed unfavorable habitats.

SURVIVAL CHARACTERISTICS: Reed et al. (1988) and Walters (1989) reported that the average annual rate of survival for birds in their first year is 57% for males and 32% for females. Females experience lower survival rates primarily as a result of the increased frequency of dispersal in this sex. Annual survival rates for 2-3-year-old birds is relatively high: approximately 77% for

males and 75% for females. About 25% of fledgling males live to be at least 4 years old, while only about 13% of fledgling females live to this age. Fewer than 1% of fledgling birds live to be 10 years old.

Major storms are one of the primary sources of mortality. Hurricane Hugo killed about 63% of the birds found on the Francis Marion National Forest (Hamrick 1992). Accipiter hawks may prey on adults (Ligon 1970). When an accipiter flies into an area, an alarm call is given and all birds "freeze" with their bills pointing straight up (Ligon 1970). They will often wait in this manner ten minutes after the hawk has left before resuming foraging (Ligon 1970). Other sources of mortality for adults include being stuck in resin (Locke et al. 1979) and killed by rat snakes while incubating eggs (J. Kappes, pers. comm.). No disease outbreaks have been reported.

EFFECTS ON OTHER SPECIES: At least 25 vertebrates (Kappes undated) have been recorded using red-cockaded woodpecker cavities. As many as 56% of the cavities in a cluster may be used by other species (Harlow and Lennartz 1983). Yellow-bellied sapsuckers have been observed feeding at resin wells (Rudolph et al. 1991). The sticky resin associated with cavity trees may pose an occasional hazard to woodpeckers and other birds (Locke et al. 1979, Barnett et al. 1983, Locke et al. 1979). Jackson (1983c) reported that brown-headed nuthatches seemed to follow foraging red-cockaded woodpeckers and gleaned anything the woodpeckers dislodged but did not consume. Beckett (1971) described similar behavior for the eastern bluebird. Morse (1970) also observed brown-headed nuthatches foraging in association with red-cockaded woodpeckers in Louisiana but felt that the woodpeckers were following the nuthatches.

Non-Migrant: Y

Terrestrial Habitat(s): WOODLAND - CONIFER

Habitat Comments: Inhabit open, mature pine woodlands, rarely deciduous or mixed pine-hardwoods located near pine woodlands (Steirly 1957, Hooper et al. 1980, U.S. Fish and Wildlife Service 1980, Kalisz and Boettcher 1991). Optimal habitat is characterized as a broad savanna with a scattered overstory of large pines and a dense groundcover containing a diversity of grass, forb, and shrub species (Hooper et al. 1980, AOU 1991). Mid-story vegetation is sparse or absent (Hooper et al. 1980, Locke et al. 1983, Hooper et al. 1991, Loeb et al. 1993).

The open, park-like characteristic of the habitat is maintained by low intensity fires, which occurred historically during the growing season at intervals of about 1-10 years (Christensen 1981, SNN 1990), evidenced by the rapid invasion of hardwoods into pine savannas following fire exclusion for brief periods (less than 10 years), the high annual frequency of lightning strikes in these habitats in

summer (Platt 1988), and the pyrogenic nature of characteristic plant species such as longleaf pine (*PINUS PALUSTRIS*) (Rebertus et al. 1989) and wiregrass (*ARISTIDA STRICTA*) (Platt et al. 1988). AOU (1991) concluded that this bird "...is a symbol of fire-maintained, old-growth pine savannas, once the dominant ecosystem in the Southeast."

CAVITY TREES

Nesting and roosting occur in tree cavities. Active cavity trees are almost exclusively old, living, flat-topped pine trees (but see Patterson and Robertson 1983, Hooper 1982). Typical non-cavity roosts include scars on the trunks of trees, forks on live pines (Hooper and Lennartz 1983), and the underside of large limbs (Baker, pers. comm.). However, juveniles often investigate dead trees and may roost in them until they obtain a cavity in a living tree (Ligon 1970).

Excavation through the sap wood appears to limit the speed with which cavities are constructed, perhaps because sap leaking into the tunnel interrupts excavation (Hooper et al. 1980, Walters 1991). The tunnel is excavated back into the tree at an upward slope such that resin or pitch from the sapwood drains from the hole, and that rainwater is prevented from collecting in the cavity (Ligon et al. 1980, Jackson 1978b). Even so, Teulings (1973) reported that many nest cavities were flooded with rain following violent storms.

Once birds have tunneled through the sapwood and into the heartwood, they excavate downward forming a gourd-shaped chamber 15-25 cm deep and 1.7-12.7 cm wide. The girth of the tree must be wide enough to allow the central chamber to be excavated in the resin-less heartwood, hence one of the reasons for selecting old trees (Ligon et al. 1980).

Roosting and nesting cavities have been found in longleaf, loblolly (*PINUS TAEDA*), shortleaf (*PINUS ECHINATA*), slash (*PINUS ELLIOTI*), pond pine (*PINUS RIGIDA*), and even bald cypress (*TAXODIUM DISTHICUS*) (Dennis 1971). Some evidence suggests longleaf pine is preferred even when mature stands of other pine species are available (Hopkins and Lynn 1971, Lay and Sweptson 1973, Baker 1981, Lennartz et al. 1983, Hovis and Labisky 1985, Ligon et al. 1986). The historic distribution of longleaf coincides with the region where Audubon (1839) reported the greatest abundance of Red-cockaded Woodpeckers. In addition, relict stands of old-growth longleaf today have some of the highest densities of this species (Engstrom 1982, Carter et al. 1983).

Even so, other species such as shortleaf and loblolly pine are important in areas where longleaf pine is uncommon or absent (Jackson 1971, Wood 1983a, Shapiro 1983).

Red-cockaded woodpeckers show a clear preference for older trees (Jackson et al. 1979, Jackson and Jackson 1986, Delotelle and Epting 1988, Engstrom and

Evans 1990), contrary to conclusions reached by Field and Williams (1985). The average age of cavity trees ranges from 63-126 years for longleaf pine, 70-90 years for loblolly pine, 75-149 years for shortleaf pine, 62-130 years for pond pine, and >70 years for slash pine (Hooper et al. 1980).

The diameter of cavity trees at breast height (dbh) is usually at least 35 cm (Lay and Russel 1970, Jones and Ott 1973, Hovis and Labisky 1985), except in south Florida where cavity trees averaged only about 25 cm dbh (Shapiro 1983, Delotelle et al. 1983, Beaver and Dryden 1992) and may be as small as 15.4 cm dbh (Beaver and Dryden 1992).

Cavity trees are generally infected with red heart disease, a fungus (*PHELLINUS PINI*) that attacks the heartwood, destroys cell walls, and causes the wood to become soft and pithy (Steirly 1957). Conner and Locke (1982) also found cavities in wood infected by one of four other fungi (*PHAEOLUS SCHWEINITZII*, *LENZITES SAEPIARIA*, *LENTINUS LEPIDEUS*, and *PHLEBIA RADIATA*). Although red heart disease is apparently not a strict prerequisite for cavity excavation (Conner and Locke 1982, Beckett 1971, Jackson 1977), Hooper et al. (1991) suggested there is a universal preference for trees with decayed heartwood. An independent group of researchers agreed with this statement (SNN 1990).

In addition to requirements for old pine trees, appropriate habitat also includes open, park-like conditions extending across the area surrounding a cluster of cavity trees Walters (1991).

Shapiro (1983) found that the average minimum distance between cavity trees was 104 m in south Florida, whereas Wood (1983) reported an average minimum distance of only 58 m in Oklahoma.

Various measurements of the vegetative structure surrounding clusters of cavities have been compared with different types of control sites lacking woodpeckers. However, the fidelity this species shows to cavity sites (Harlow 1983, Nesbitt et al. 1983a, Lennartz et al. 1987, Walters 1991), coupled with social interactions (Walters 1990), mean that measurements around "active cavities" may not indicate productive habitat (Hooper et al. 1980, Walters 1990, Walters 1991); a pair of birds or a solitary male, and even some nesting groups may remain at a cavity associated with low-quality habitat for many years (Walters 1989, 1991).

The basal area of pine overstory is one of the more important habitat components within cavity clusters. Hooper et al. (1980) maintained that appropriate conditions require a mature pine stand (more than 70 years old) with a stocking density of 11.5-18 sq m of overstory pines per ha. This stocking density is relatively high compared to that recommended by others. Conner and O'Halloran (1987) recommended a pine basal area of 9-14 sq m per ha, while

Hovis and Labisky (1985) recommended about 12 sq m per ha. The Recovery Plan (Lennartz and Henry 1985) recommended that cavity clusters have a pine basal area of 5.8-8.4 sq m per ha. The basal area of pines reported from studies in south and central Florida is much less than suggested by Hooper et al. (1980), averaging 4.0-7.0 sq m per ha (Delotelle et al. 1983, Shapiro 1983, Nesbitt et al. 1983b).

Multivariate techniques have been used to quantify habitat conditions surrounding active cavity clusters. Locke et al. (1983) measured 29 vegetative variables in a 0.04 ha area around active cavity trees and compared these with measurements at randomly selected old pines. Four variables were correlated with active sites: 1) the total number of hardwood trees (6.4 in occupied sites versus 12.8 in random sites); 2) the number of understory pines (6.9 in occupied sites versus 3.5 in control); 3) the mean ratio of bole length to height of pines greater than 28 cm diameter breast height (0.48 in occupied sites versus 0.43 in random sites); and 4) the number of mid-story hardwoods (1.1 in occupied sites versus 1.8 in random sites).

FORAGING HABITAT

Less is known about foraging habitat than about conditions needed around cavity clusters. Hooper et al. (1980) stated that "... the best cavity site is no good if adequate foraging habitat is unavailable." Recent studies (Delotelle et al. 1983, Hovis and Labisky 1985, Conner and Rudolph 1991b, Loeb et al. 1992) and anecdotal evidence provide some general indication of the importance of foraging habitat. However, this species appears to use a wide range of pine and hardwood habitats (Hooper et al. 1980, U.S. Fish and Wildlife Service 1985), and foraging behavior is influenced by con-specifics, group size, and many other factors (Conner and Rudolph 1991b, Walters 1991). These conditions make it difficult to ascertain with certainty the importance of specific habitat features within foraging areas.

Several lines of evidence point to a problem with large cleared tracts. Walters (pers. comm.) monitored a population of 12 cavity clusters for 9 years and found the population to be stable until logging cleared much of the foraging habitat in the area. Soon afterwards, the population showed signs of falling apart. Hooper et al. (1980) reported that sites were abandoned where extensive clear cuts were created within the foraging area. They also proposed that, when clearing reduces the foraging habitat to less than 40 ha, persisting groups may have difficulty raising young. Conner and Rudolph (1991b) found that the removal of forest cover within 800 m of cavity clusters was associated with cluster inactivation. The effects of forest removal were particularly noticeable in small populations.

Foraging occurs in a diversity of forested habitat types that includes pines of various ages as well as some hardwood-dominated habitats. Despite this

seemingly catholic use of different habitat types, most foraging appears to take place on older pine trees or in open pine habitats (Baker and Thompson 1971, Hooper et al. 1980, Hooper and Lennartz 1981, Delotelle 1983).

Delotelle et al. (1983) found that live pine stems greater than 23 cm dbh represented only 19% of available foraging substrate in central Florida but received 65% of the use, and also found that longleaf pine was used as the foraging substrate 90% of the time.

Similarly, Porter and Labisky (1986) found that longleaf pines made up only 40% of their study area yet were the foraging substrate approximately 77% of the time.

As described elsewhere, females forage on trunks more often than do males, and an abundance of trees with large trunk surfaces may be more important to females; Jackson (pers. comm.) suggested that females lost weight after pines larger than 25 cm dbh were removed from all but a small buffer surrounding cavity trees.

Other evidence supporting the need for foraging habitat consisting of large areas of old pines lies in the fact that the largest populations occur where old-growth pine trees and low hardwood densities extend throughout a broad area (Engstrom 1982, Hooper et al. 1980, Delotelle et al. 1983, Conner and Rudolph 1991a).

The Recovery Plan (Lennartz and Henry 1985) suggested suitable foraging habitat requires 6350 stems > 25.4 cm diameter at breast height, and 796 sq m basal area of pine stems in stands >30 years old within 1.3 km (0.5 miles) of a cavity cluster. These values do not apply in south Florida (Beaver and Dryden 1992) where birds use larger areas.

LANDSCAPE HABITAT FEATURES

Landscape features, such as fragmentation of foraging habitat, total area of foraging habitat, percentage of pinewood or hardwood cover, contiguity of the canopy and forest cover, and habitat patch size and shape may affect the habitat quality (Hooper et al. 1980, SNN 1990, Conner and Rudolph 1991b). The importance of such variables is not well known (Walters 1991), but a growing body of research focuses on this issue, particularly on some public lands where timber harvest patterns may create unfavorable landscapes (Conner and Rudolph 1991b). A potential problem in such research is the key role that cavity trees play in determining whether an area is ever actually used by red-cockaded woodpeckers (Walters 1991). Areas that have suitable habitat characteristics, yet lack suitable cavity trees, will not likely be occupied by red-cockaded woodpeckers (Walters 1991), and thus some comparisons will be misleading.

Seagle et al. (1992) compared characteristics of forest compartments with active colonies and those having no colonies. Active clusters were associated with: 1) an increased acreage of mature longleaf pine; 2) an increased acreage of all pine species; 3) a decreased percentage of acres of longleaf, loblolly, and slash pines in stands less than 20 acres in size; 4) a decreased percentage of acres of mature loblolly pine; and 5) a decreased acreage of loblolly pine between ages 20 and 39 years.

Conner and Rudolph (1991b) found that foraging habitat could be fragmented and isolated as a result of forest-harvest patterns, and that larger groups of woodpeckers had consistently fewer clear cuts near cavity sites. Fragmentation did not appear to have an effect on dispersal (e.g., the ability of dispersing females to find unmated males), but it did apparently affect the quality of foraging habitat. Conner and Rudolph (1991b) warned that it may be possible to have a sufficient quantity of foraging habitat within 800 m of an active cluster but still have insufficient arrangement of foraging habitat. Fragmentation influenced a group's access to foraging habitat by forcing birds to go through territories of adjacent groups. This increases the probability of cluster inactivation.

Food Habits: INVERTIVORE

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