Status and Management of the Red-cockaded Woodpecker on Goethe State Forest, Florida

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Abstract: A survey of red-cockaded woodpeckers (*Picoides borealis*) was conducted on Goethe State Forest, Levy County, Florida, in 1994 and 1995. Four hundred fifty-one living cavity trees, active and inactive, were located. The majority of living cavity trees (97%) were longleaf pines (*Pinus palustris*). Mean age of cavity trees was 123.6 years ($N = 108$). One hundred ninety-seven living cavity trees occurred in 26 clusters, and 25 of these clusters were active in 1995. Nestling production was confirmed in 73% and 65% of the active clusters monitored in 1994 and 1995, respectively. To maintain the red-cockaded woodpecker population at its current status, management activities should focus on improving habitat quality in active clusters, establishing replacement stands to provide future nesting and roosting habitat, and providing adequate foraging habitat. To enhance the population, recruitment stands of suitable nesting and roosting habitat should be established, including construction of artificial cavities and cavity starts.

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The red-cockaded woodpecker (RCW) is a nonmigratory, year-round resident of older-growth pine forests in the southeastern United States. The species is listed as endangered by the U.S. Fish and Wildlife Service and threatened by the Florida Game and Fresh Water Fish Commission (FGFWFC) (Wood 1996). Loss of nesting and roosting habitat due to commercial forestry practices constitutes the primary threat to the species. RCWs require mature (≥60 years old), living pines for cavity excavation (Hovis and Labisky 1985, DeLotelle and Epting 1988, Hooper 1988). Silvicultural practices that maximize timber production, such as short rotations and clearcutting, are incompatible with sustaining large or stable populations of RCWs because they reduce the availability of older-growth forests (Hovis and Labisky 1996).

The "Goethe tract" was acquired by the State of Florida in 1992 and subsequently designated as Goethe State Forest (GSF). Management authority was conveyed to the Florida Department of Agriculture and Consumer Services, Division of Forestry (DOF), with the FGFWFC cooperating. Prior to state acquisition, RCWs were known to occur on GSF, but the status of the population was unknown.

During 1994 and 1995, the FGFWFC conducted RCW surveys on GSF. The objectives of the surveys were to locate cavity trees, determine the number of active cavity-tree clusters, and monitor active clusters for nesting activity. These data were collected to provide a foundation for developing long-term management strategies for RCWs on GSF.

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Methods

The 17,953-ha GSF is located in southeastern Levy County, Florida, approximately 8 km northwest of Dunnellon and 5.5 km south of Bronson (Fig. 1). Based on Landsat satellite data, an estimated 11,696 ha (65%) of the tract is potential RCW habitat (J. A. Cox, Fla. Game and Fresh Water Fish Comm., unpubl. data). Most of the potential habitat is pineland (10,561 ha), followed by sandhills (889 ha) and mixed pine-hardwoods (246 ha). Other habitat types include cypress swamp (2,896 ha), hardwood swamp (1,555 ha), and freshwater marsh (396 ha).

To facilitate cavity-tree surveys, GSF was divided into 10 geographical units. Between January and June 1994, 2 2-person teams surveyed 4 units or approximately 40% of GSF. The survey was completed between February and June 1995 by a single 2-person team. Prior to surveying a unit, potential habitat was identified from aerial photographs and verified by driving or walking the roads and trails transecting the unit. Parallel transects, spaced at ≤50-m intervals, were walked through all large, contiguous older-growth pine stands. Smaller or more fragmented stands of suitable habitat were walked in a less systematic manner or surveyed from a vehicle with binoculars.

The location of each cavity tree was plotted on aerial photographs and a Global Positioning System was used to determine latitude and longitude. Cavity trees were classified as living or dead and 6 habitat variables recorded: species, diameter at breast height (dbh) (cm), height (m), height of the lowest living branch above ground (m), age (years), and number of cavities.

The status of use of living cavity trees was determined by examining the condition of the resin wells (i.e., small holes drilled by RCWs near cavity entrances) and the pine gum exuding from them. Cavity trees with reddish resin wells and clear, sticky gum were considered "active," whereas those with grayish resin wells and white, dry gum were considered "inactive" (Jackson 1977). The height above ground (m), directional orientation, and type of cavity were recorded. Cavities in the early stages of excavation were classified as "starts," fully excavated cavities were classified as "complete," and complete cavities with entrances enlarged by other species were classified as "enlarged." Start cavities with light-colored, recently-exposed wood were classified as active, whereas those with grayish, weathered wood were classified as inactive. Complete cavities with reddish resin wells and fresh pine gum were considered active; if the resin wells were grayish and the pine gum dry, the cavity was considered inactive (Jackson 1977). All enlarged cavities were classified as inactive. Although these classification criteria may yield erroneous conclusions regarding the status of individual cavity trees or cavities, they are the accepted standard when intensive monitoring is not feasible (Jackson 1977, Hooper et al. 1980, U.S. Dep. Agric. 1995).

Height of trees, limbs, and cavities was measured with a clinometer. Cavity orientation was determined with a compass and the data analyzed using Mardia's (1972:25–26) computational formula. Trees were aged by counting growth rings from increment core samples taken at breast-height, adding a correction factor of 7 years for longleaf pine and 4 years for slash pine (*P. elliottii*) to account for years of growth to breast height (U.S. Dep. Agric. 1992). Status data on cavity trees and cavities were collected during the nesting season in May and June. Cavity trees initially located in 1994 were revisited in 1995 to update their status.

The number of active cavity-tree clusters was estimated with the circular scale technique (Harlow et al. 1983). This technique was used because it provided an accurate alternative to comprehensive nest and roost counts, which are both time consuming and costly. In brief, a 460-m diameter circle was used to aggregate cavity trees, which had been plotted on aerial photographs, into active clusters. Each circle encompassed ≥2 cavity trees, with at least 1 active, complete cavity. Circles included as many cavity trees as possible and did not overlap; cavity trees occurring outside of circles were not assigned to clusters. Because there is only 1 nest/active cluster (Jackson 1977, Harlow et al. 1983), nesting data were used to confirm or modify cavity-tree cluster assignments. For example, the circular scale technique would divide a large, contiguous group of cavity trees into 2 active clusters, but the assignment of cavity trees between clusters was often subjective. If there were 2 RCW nest trees, their locations usually clarified how the cavity trees should be divided.

Active clusters were monitored for nesting activity every 7 to 14 days during May and June 1994 and 1995. Cavities where an adult RCW was observed entering or exiting between 0800 and 1800 hours on ≥1 separate days were considered probable nests. Confirmation of nestling production was based on audible vocalizations by young in the nest cavity or observed feeding of nestlings by adults. No attempt was made to determine fledging success.

Results and Discussion

Cavity-tree Survey

A total of 567 cavity trees was located; 180 and 387 cavity trees were found in 1994 and 1995, respectively. In 1995, 451 (80%) cavity trees were living and 116 (20%) were dead. The mortality rate of cavity trees between 1994 and 1995 was 4%.

In 1994, 23 (14%) of the living cavity trees showed signs of red-cockaded woodpecker activity; in 1995, 66 (15%) of the living cavity trees were active.

Of the 451 cavity trees living in 1995, 439 (97%) were longleaf pines and 12 (3%) were slash pines. Mean values of cavity-tree dbh and height (Table 1) were within ranges reported for RCW populations elsewhere (Hopkins and Lynn 1971, Carter 1974, Shapiro 1983, Hovis and Labisky 1985). Mean age of cavity trees also was comparable to other reported values (Hopkins and Lynn 1971, Jackson et al. 1979, Rudolph and Conner 1991). The majority of cavity trees had turpentine scars (62%) and a "flat-top" crown (77%).

A total of 606 cavities or 1.3 cavities/living cavity tree was recorded (Table 1). Mean height of cavities was 6.4 m and mean directional orientation was 203° or generally south-southwest. Eleven percent of all cavities faced north, 9% faced east, 52% faced south, and 27% faced west. Comparatively, throughout the range of red-cockaded woodpeckers cavities are oriented in a westerly direction (Locke and Conner 1983). In 1994, 1% of the cavities were active starts, 10% were active and complete, 18% were inactive starts, 61% were inactive and complete, and 10% were inactive and enlarged (*N* = 220 cavities). In 1995, 3% of the cavities were active starts, 9% were active and complete, 13% were inactive starts, 65% were inactive and complete, and 10% were inactive and enlarged (*N* = 606).

Cluster Status

One hundred ninety-seven living cavity trees were grouped into 26 clusters that were active in either 1994 or 1995 (Fig. 1, Table 2). Eleven clusters were found in 1994 and 15 in 1995. With 1 exception, clusters that were active in 1994 remained active in 1995.

The 26 active clusters were divided geographically. Fifteen occurred on the northern part of the forest near County Road 326 and 11 occurred approximately 5 to 7 km southward near County Road 336 (Fig. 1). Because the survey focused on cavity trees rather than birds, the amount of population exchange between the 2 areas is unknown.

Two hundred fifty-four living cavity trees did not meet the criteria for inclusion

Table 1. Characteristics of living red-cockaded woodpecker cavity trees, Goethe State Forest, Florida, 1994 and 1995.

Characteristic	*N*	$\bar{x}$	SD	Range
Diameter at breast height (cm)	451	40.8	6.7	22.9–63.9
Height of tree (m)	451	18.3	3.5	9.9–28.7
Height of lowest living branch (m)	451	11.6	2.7	4.1–20.1
Age of tree (years)	108[a]	123.6	35.1	65–211
Cavities/tree	451	1.3	0.7	1–6
Cavity height (m)	606	6.4	2.6	1.2–15.2

[a]Tree age was not determined for 343 living cavity trees due to equipment problems (e.g., broken increment borer), extensive heartwood decay, or large turpentine scars.

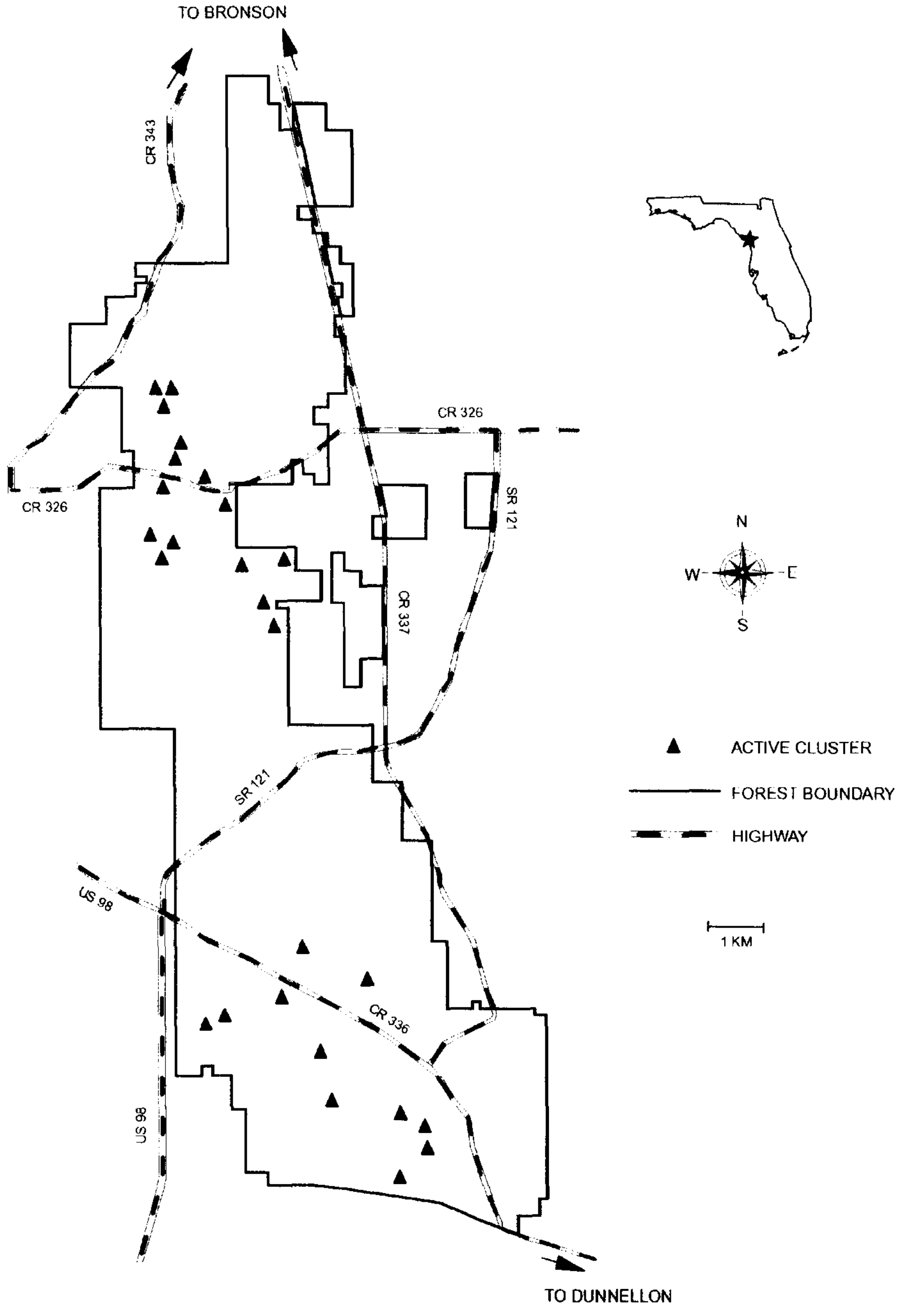

Figure 1. Location of active red-cockaded woodpecker cavity-tree clusters, Goethe State Forest, Florida, 1994 and 1995.

Table 2. Status of red-cockaded woodpecker clusters, Goethe State Forest, Florida, 1994 and 1995.

Cluster status	1994	1995
Active	11	25
Active with nestlings (%)[a]	8 (73)	15 (65)[b]
Inactive	0	1
Total	11	26

[a]Confirmation of nestling production was based on audible vocalizations by young in the nest cavity or observed feeding of nestlings by adults.

[b]Two active clusters were not monitored for nestling production in 1995. Reported percentage is based on number of active clusters monitored ($N = 23$).

in an active cluster. Six (2%) of these trees contained active start cavities, and 248 (98%) contained inactive start, completed, or enlarged cavities. Cavity trees outside of clusters were widely distributed and often occurred in distinct aggregations, which were presumed to be abandoned clusters. Several abandoned clusters were located in the central part of the forest, suggesting that the active clusters to the north and south were not always disjunct.

Nestling Production

In 1994, 8 (73%) of the 11 active clusters produced nestlings, and 3 (27%) had probable nests but nestling production was not confirmed (Table 2). In 1995, 15 (60%) of the 25 active clusters produced nestlings, 1 (4%) had a probable but unconfirmed nest, 7 (28%) exhibited no evidence of nesting, and 2 (8%) were not monitored during the nesting season. The rate of nestling production among the active clusters monitored in 1994 and 1995 was 73% and 65%, respectively. Comparable rates of nestling production have been reported for RCW populations: 62% in Oklahoma (Wood 1983), 78% in central Florida (DeLotelle and Newman 1981), 81% in south Florida (Patterson and Robertson 1981), and 73% in northern Florida (Labisky et al. 1995).

Management Implications

Active RCW clusters typically occur in open, mature pine stands with sparse midstory vegetation, and cluster abandonment has been statistically correlated with hardwood encroachment (Conner and Rudolph 1989). Although no quantitative measurements of overstory and midstory vegetation within clusters were taken during this survey, casual observations indicated that the overall habitat quality for RCWs on GSF was marginal. Prior to state acquisition, GSF was not intensively managed after the 1940s. Timber management activities were sporadic and no prescribed fires occurred for the 10 to 15 years previous to this study (Fla. Dep. Agric. Consumer Serv. 1993); consequently, fuel loads appeared high and both overstory and midstory vegetation was extremely dense in many areas.

Accordingly, RCW management activities on GSF should focus on protecting active clusters and improving habitat therein. Pine stands with active clusters should be burned every 2 to 5 years to control hardwood vegetation and be thinned as needed to maintain a low basal area (14–18 m^2/ha). A replacement stand should be established for each active cluster to provide future nesting and roosting habitat. Adequate foraging habitat also should be provided (U.S. Dep. Agric. 1995). To enhance RCWs on GSF, additional management actions are necessary. A population goal (i.e., number of active clusters) should be set and recruitment stands established to provide for population expansion. Emphasis should be placed on linking the active clusters to the north and south by establishing recruitment stands in the area between them. Recruitment stands should consist of the oldest pine stands available, be burned and thinned to control hardwoods and maintain low basal areas, and be connected to adequate foraging habitat. The number of recruitment stands should equal the difference between the actual and desired number of active clusters (U.S. Dep. Agric. 1995). Because RCWs are more likely to reoccupy abandoned clusters than to colonize previously unoccupied habitat (Doerr et al. 1989, Walters 1990, Hooper et al. 1991), pine stands containing inactive cavity trees should be selected as recruitment stands whenever possible. To encourage colonization, recruitment stands should be provisioned with artificial cavities and cavity starts (Copeyon et al. 1991). Recruitment stands should be managed as if they were active clusters and the cavity trees therein permanently marked and protected from fire (Conner and Locke 1979). Cavity trees disjunct from active clusters or recruitment stands also should be marked and protected. The GSF should be resurveyed for new cavity trees and clusters every 5 years.

Active clusters should be visited annually during May and June to update the status of living cavity trees, check for nestlings, and assess habitat quality (U.S. Dep. Agric. 1995). Annual roost checks are needed to determine the number of adult RCWs inhabiting each active cluster. A preponderance of clusters inhabited by ≥2 adults suggests a reproductively functional population, whereas an abundance of clusters with single birds may indicate a declining population (James 1991). In the event of an actual or potential decline, other management activities may be initiated. For example, if the proportion of clusters inhabited by single birds is high, then the population may require augmentation with birds from other, healthier populations (DeFazio et al. 1987, Allen et al. 1993, Hess and Costa 1995). If cavity availability is a limiting factor, then the use of cavity restrictors (Carter et al. 1989) or artificial cavities (Copeyon 1990, Allen 1991, Taylor and Hooper 1991) is warranted. These techniques have yielded favorable results for other RCW populations in South Carolina (Gaines et al. 1995, Watson et al. 1995), Florida (Reinman 1995), and Mississippi (Richardson and Stockie 1995).

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