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THE RED-COCKADED WOODPECKER: MANAGEMENT RESEARCH NEEDS

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The Red-cockaded Woodpecker (*Picoides borealis*), a species endemic to mature pine forests of the Southern United States, was officially classified as an endangered species in 1969 (U. S. Department of the Interior 1969). Under the Endangered Species Act of 1973, Federal agencies are required to protect and manage all endangered species and to insure that land management activities do not adversely affect their habitats. Various forest management organizations, most notably Region 8 of the Forest Service, have developed policies and guidelines for managing Red-cockaded Woodpeckers. Because of the scant information on habitat requirements, the effectiveness of guidelines to protect and perpetuate this species is controversial. Resolution of the controversy, however, is the key to the woodpecker's survival.

In hopes that more information and awareness will enhance the Red-cockaded Woodpecker's chances for survival, we shall discuss three topics here: what is presently known about the woodpecker's habitat requirements; where we feel critical information is lacking; and what is being done to fill the information void.

PRESENT KNOWLEDGE AND SPECULATION

Concern had been expressed about the survival of the Red-cockaded Woodpecker for many years prior to its legal classification as an endangered species in 1969. As early as 1939, Murphey (1939) felt that lumbering practices in the South were destroying its habitat and eliminating the species from certain portions of its range. Over the next 30 years, investigators throughout the species' range echoed the same concern (Burleigh 1958; Lay and Russell 1970; Ligon 1970; Sprunt and Chamberlain 1949).

The habitat destruction referred to was the loss of mature southern pines infected by the heart rot known as red heart (*Phellinus pini*, formerly *Fomes pini*); such trees are selected by the woodpecker for construction of nesting and roosting cavities. Investigators noted that as forest management became more intensive, old-growth timber was being harvested at an accelerated rate and replaced by stands managed on relatively short rotations (20 to 30 years for pulpwood and 40 to 60 years for sawtimber).

If provisions were not made to protect and continually replace the old-growth stands required by Red-cockaded Woodpeckers for breeding habitat, the species would be faced with steadily diminishing habitat and probable future extinction.

Increased public interest prompted the Bureau of Sport Fisheries and Wildlife in cooperation with the Tall Timbers Research Station to sponsor a symposium on the ecology and management of the Red-cockaded Woodpecker. The symposium (Thompson 1971) summarized practically all information published on the Red-cockaded Woodpecker prior to 1970. The proceedings are an excellent compendium of what is known about this species. At the same time, topics excluded from the symposium emphasize critical information voids.

Of the 17 technical papers presented at the symposium, 8 dealt mainly with characteristics of cavity trees and colony stands, and only 1 (Crosby 1971) discussed habitat needs outside the breeding colony. Consequently, the woodpecker's specialized nesting and roosting habits have been well described. With rare exception (Jackson 1971; J. W. McMinn, USDA For. Serv., Savannah River Plant, Aiken, S.C., pers. commun., 1976), Red-cockaded Woodpeckers excavate their cavity in mature, living pines. Loblolly (*Pinus taeda* L.), longleaf (*P. palustris* Mill.), shortleaf *P. echinata* Mill.), pond (*P. serotina* Michx.) and pitch (*P. rigida* Mill.) pines are all used as cavity trees, but the vast majority of cavities have been found in loblolly and longleaf pines (Hopkins and Lynn 1971; Jackson in press; Jones and Ott 1973; Lay and Russell 1970; Ligon 1970; Steirly 1957). In many areas two or more of the southern pines occur together in mixed or adjacent stands, but there is no evidence that the woodpeckers have a preference for one species over another.

Cavity trees are generally infected by red heart fungus, but the relationship of the fungus to cavity tree selection and cavity excavation by Red-cockaded Woodpeckers is uncertain. Steirly (1957) and Ligon (1971) felt that heart rot had to be present in a tree before Red-cockaded Woodpeckers could successfully excavate a cavity. This idea was challenged by Beckett (1971), who felt the presence of heart rot was merely a function of the age of the trees selected for cavities rather than a requirement for excavation. Jackson (in press) has suggested that heart rot may be necessary for successful cavity completion, and that perhaps excavation by the woodpeckers facilitates infection of the tree by the fungus. His evidence is not conclusive, but considering the high incidence of heart rot in trees with completed cavities, we agree with Jackson that the coexistence of the birds and the fungus does not seem to be one of chance.

In addition to characterizing individual cavity trees, several investigators have described habitat conditions in the colony stand (aggregation of individual cavity trees). However, few investigators have quantified habitat characteristics; rather, most have quantified only a limited number of vegetative variables. Thus, it is difficult to determine what stand conditions are preferred by Red-cockaded Woodpeckers. In Virginia, Steirly (1957) always found nesting sites in relatively dense stands of pine 70 years old or older; these stands always had dense understories of shrubs and saplings of deciduous trees. In contrast, Beckett (1971), Hopkins and Lynn (1971), Jones and Ott (1973), Lay and Russell (1970), Ligon (1970), and Morse (1972) found the woodpecker in open, park-like stands of mature pines with sparse understories. Subjective terms such as "dense," "sparse," "heavy," and "open" are imprecise, but it appears that clans can exist under various stand conditions if suitable cavity trees are available. Researchers who quantified habitat characteristics (Hopkins and Lynn 1971; Thompson and Baker 1971) found active colonies in stands ranging from 10 to 150 ft^2 of basal area.

Although understory conditions probably affect the suitability of a stand as a colony site, it is not known what conditions are acceptable, tolerable, or preferable. Beckett (1971) thought the birds would abandon the cavity if the understory reached the height of the entrance. Most biologists have accepted this opinion, but it has not been validated with published data. Jerome A. Jackson (Miss. State Univ., pers. commun., 1976) feels that a certain amount of shrub and hardwood understory is preferable to a low, open (grass-forb-shrub) understory. He contends that greater vegetative diversity in the understory will support a greater biomass and diversity of arthropods, the Red-cockaded's primary food source. While logical, this opinion also lacks supporting evidence.

Beyond the cavity tree and colony site, we know virtually nothing about habitat requirements of the Red-cockaded Woodpecker. Type, condition, and quantity of habitat needed to support a clan of woodpeckers are open questions which have received little attention. Estimates of the area used by woodpecker clans vary widely, depending on the methods used and the habitat types in the study area. In Texas, Lay and Russell (1970) estimated a clan's territory ranged from a minimum of 25 acres to a

maximum of 167 acres. Lay (1973) later suggested that a clan's home range should be considered as 120 to 160 acres. In Florida, Ligon (1970) noted that individual birds moved as far as 0.8 mile from the cavity tree, an indication that the home range could be quite large. In South Carolina, Beckett (1974) estimated that the average area of use is 213 acres per clan or 40 acres per bird.

All of these estimates were arrived at indirectly by observing the spatial arrangement of colonies, the distances between colonies, or the density of colonies in a circumscribed study area. Thus, at best, they provide weak indices of the area used by a clan of woodpeckers. One clan followed by Baker (1971) used an area of approximately 162 acres during the period of observation, but on any given day they used only about a third of this total area. Two clans studied by Crosby (1971) over a 5-month period used areas of 35.5 and 49.3 acres. In South Carolina, Skorupa and McFarlane (in press) have reported on the seasonal movements of two woodpecker clans. One clan foraged over 39 acres in the summer and 83 acres in the winter, and the second covered 45 acres in the summer and 78 acres in the winter. Overlapping the winter and summer ranges, the total area covered by the first clan was 92 acres and that of the second was 90 acres.

Although the latter three studies provide the most reliable estimate of home range, they are limited in scope (five clans) and do not identify the types of habitat selected by the woodpeckers for foraging. While it is logical to assume that home ranges vary with clan size, the habitat types available, and the location of adjacent clans, no studies have been published that explore these interrelated factors.

INFORMATION NEEDS

The studies cited have provided much important information on the characteristics of cavity trees used by Red-cockaded Woodpeckers and on the habitat in the immediate vicinity of cavity trees. However, the colony stand represents only a small portion of the habitat used by a woodpecker clan. Thus, we must study the habitat elements selected by the woodpeckers throughout their home range if we are to understand and provide for their total habitat requirements.

Although we are most knowledgeable about the species' breeding habitat, some important questions have been only partially answered. There appears to be a relationship between red heart fungus and cavity tree selection, but it has not yet been clearly explained. Whether or not the fungus is actually required for successful cavity excavation may well determine the rotation length necessary to provide suitable nest sites for this species.

The structure and composition of the understory may also influence the suitability of a stand as a colony site. However, no quantitative data is available on the quantity and type of understory that is acceptable, tolerable or preferred as nesting habitat.

Studies are also needed to determine what forest stand conditions are selected for foraging and how much of such habitat is required to support woodpecker clans of various sizes. Studies of habitat selection, by themselves, will provide only partial answers. Such studies must be linked with those on breeding biology and behavior to determine how habitat variability affects reproduction and survival among woodpecker clans. We know, for example, that there is variation in the number of young fledged in different woodpecker clans (Baker 1971; Lay 1973; Ligon 1970; T. A. Beckett, Magnolia Gardens, Charleston, S. C., pers. commun., 1976; J. A. Jackson, pers. commun., 1976). Ligon (1970) has suggested that this variation may be a function of habitat quality.

Ligon (1970) and Lay (1973) have also shown that breeding pairs with helpers fledge more young than a breeding pair alone. Presumably, good habitat could support larger clans, which in turn could fledge more young. Ligon (1970) thought the second-growth stands in his area were suboptimal for foraging and feeding nestlings compared with mature pine forests such as those found at the Tall Timbers Research Station. Baker (1971) noted that most of the clans at Tall Timbers were composed of breeding adults plus helpers, but he was unable to gather information on reproduction. Further study to determine the relationships between habitat selection, clan size, and productivity is urgently needed if we are to understand this species' habitat requirements and thus provide a sounder base for its management.

FOREST SERVICE RESEARCH EFFORTS

In response to these information needs, the USDA Forest Service in 1975 established a wildlife research unit at Clemson, South Carolina, to study the habitat requirements of the Red-cockaded Woodpecker. A comprehensive research program has been implemented to answer some of the questions that have been raised.

Twenty active Red-cockaded Woodpecker colonies have been selected in forest stands representative of the range of habitat conditions occupied by the species. The primary study area is on the Francis Marion National Forest in Berkeley and Charleston Counties, South Carolina. Because this area has one of the largest concentrations of Red-cockaded Woodpeckers in the South, it offers the opportunity for studying a large number of woodpecker clans under a variety of habitat conditions. Clans may also be studied on the Sumter National Forest in South Carolina and the Croatan and Uwharrie National Forests in North Carolina.

In each colony selected, plots have been established around cavity trees so that vegetative composition and structure can be quantified. Adults and nestlings in each colony are distinctively banded to aid in identification of specific clans and individuals. Nesting cavities are inspected periodically to determine the chronology and success of breeding, nesting, and nestling development. Throughout the year, observers follow the movements and activities of banded birds to delineate the clan's home ranges and identify the stands or habitats selected for foraging. As home ranges are delineated, plots are established both in vegetative communities selected and in those avoided by the woodpeckers. In both types of communities, vegetative composition and structure is sampled quantitatively. Appropriate analytical techniques will be employed to determine the relationships between habitat utilization, clan productivity, and parameters of the selected stands or habitats.

The total research program is outlined in Figure 1. The major research goal (to determine the habitat requirements of the Red-cockaded Woodpecker) has been broken down into an ordered sequence of objectives which must be achieved to accomplish the overall goal. A list of prospective studies and a schedule of study implementation are included in the Appendix.

To determine the range of habitat conditions selected by Red-cockaded Woodpeckers and to determine how habitat variability affects productivity, we must study the birds over the widest possible range of habitat conditions. Although the Francis Marion National Forest has active woodpecker colonies in a wide range of forest stand conditions, certain habitats are not available for study. Logistically, it is impossible for Forest Service personnel at Clemson to select additional study sites; cooperative studies have therefore been developed with investigators in other areas to cover the desired range of habitat conditions.

Dr. Gene Wood, Clemson University, is studying habitat selection and productivity of Red-cockaded Woodpeckers in old-growth stands at Hobcaw Barony, Georgetown County, S. C. Since some authorities feel large tracts of old-growth trees provide optimum habitat for this species, the Hobcaw area is an especially important study site.

In Mississippi, Dr. Jerome Jackson has been studying woodpecker colonies for several years on the Noxubee Wildlife Refuge. Several of the colonies on Noxubee are in pine stands with dense, encroaching hardwood understories. Also on Noxubee are a considerable number of abandoned woodpecker colonies, making this study area particularly suitable for studying the relationship between understory structure and cavity abandonment. During the course of his investigations at Noxubee, Dr. Jackson has distinctively banded approximately 75 Red-cockaded Woodpeckers from 11 colonies. Thus, the birds he has under observation are of known age and ancestry, providing an excellent opportunity for studying the social structure of Red-cockaded Woodpecker clans. A cooperative study with Dr. Jackson is extending both lines of investigation, i.e., habitat selection and social behavior.

The information derived from these studies on habitat requirements should provide the biological base for evaluating and managing habitats for Red-cockaded Woodpeckers. Recovery of this species, however, will depend on whether forest managers provide for the woodpecker's requirements in their land management activities. Since the woodpecker's future is linked to the availability of suitable habitat, the only way to assess the species' status is to develop a system for monitoring the trends in forest habitats across its range.

Although this is a large task, it is by no means impossible. Every 10 years, the Forest Survey units of the Southeastern and Southern Forest Experiment Stations complete their inventory of all forest lands in the South. During these surveys, statistics are compiled and analyzed on forest acreages and types and on stand ages and conditions. As we learn more about the woodpecker and are able to quantify habitat parameters, we are working with the Survey units to estimate the amount and distribution of forest lands suitable as Red-cockaded Woodpecker habitat. Since the surveys are a continuing effort, we should be able to assess habitat trends over time. Ultimately, the reliability of our estimates will depend on how

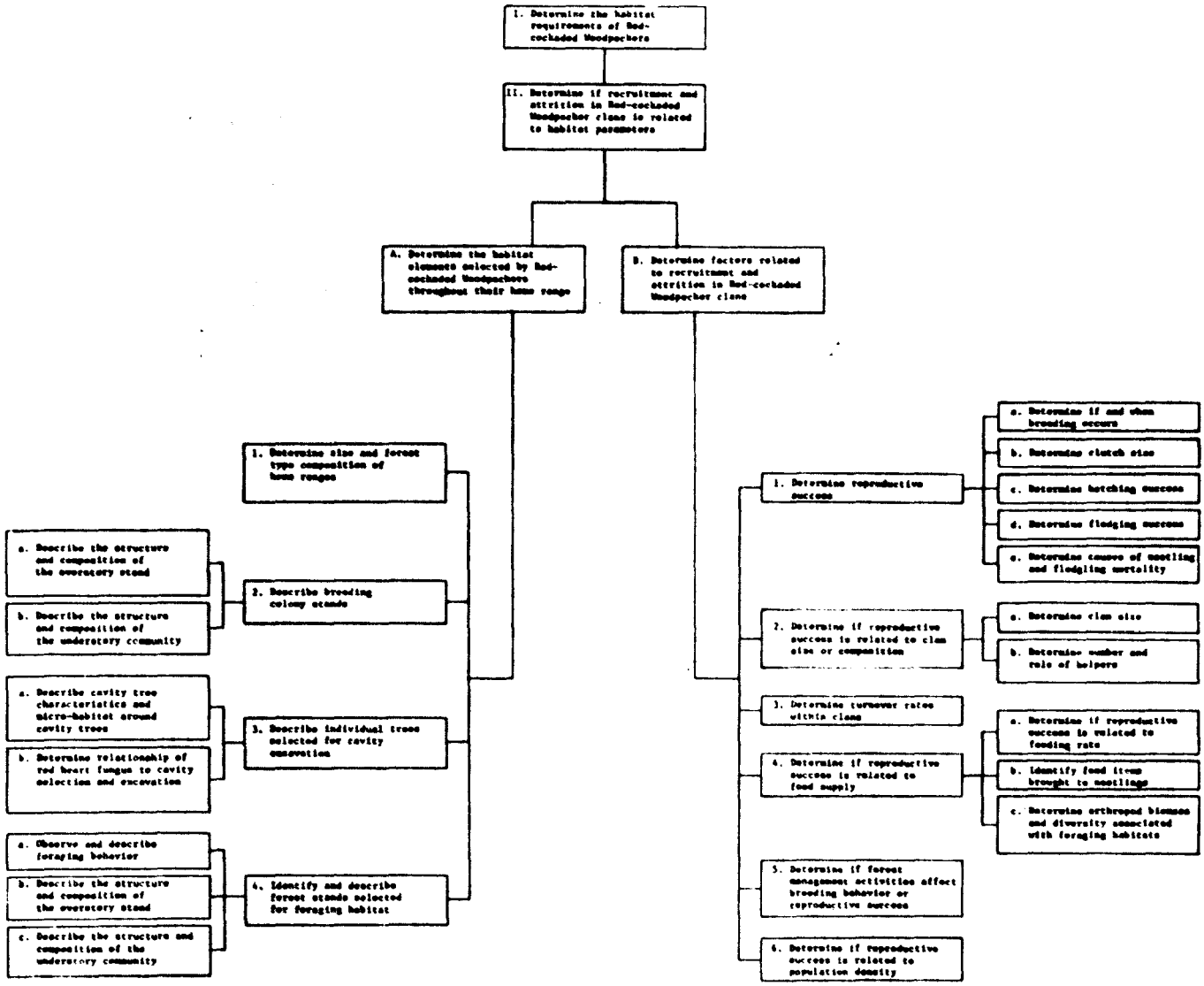

Figure 1.—Objectives of Red-cockaded Woodpecker research program.

well we understand and are able to quantify the habitat parameters involved.

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APPENDIX: STUDY SCHEDULE

Study Title	Schedule			
	Study plan	Implementation	Data collection and analysis	Reporting
Forest Service Studies				
Characteristics of cavity trees and colony sites selected by Red-cockaded Woodpeckers	April 1975	October 1975	1975, 1978, 1980	1980
Foraging habitat, foraging behavior and home range use by Red-cockaded Woodpeckers	March 1976	May 1976	1976—1980	1980
Vegetative characteristics of foraging habitats selected by Red-cockaded Woodpeckers	April 1976	September 1976	1976—1980	1980
Feeding rates and reproductive success of Red-cockaded Woodpeckers	March 1976	April 1976	1976—1980	1980
Reproductive rates of Red-cockaded Woodpeckers	April 1976	April 1976	1976—1980	1980
Relationship of Red-cockaded Woodpecker reproductive success to clan size and clan composition	April 1976	April 1976	1976—1980	1980
Relationship of red-heart fungus to cavity tree selection and cavity excavation by Red-cockaded Woodpeckers	September 1976	October 1976	1976—1978	1978
Effects of timber harvesting activity on breeding behavior and reproductive success of Red-cockaded Woodpeckers	January 1977	April 1977	1977—1978	1978
Relationship of population density to reproductive rates of Red-cockaded Woodpeckers	January 1977	September 1977	1977—1979	1980
Cooperative studies				
Social behavior and habitat use of the Red-cockaded Woodpecker (Jerome Jackson, Mississippi State University)	April 1976	April 1976	1976—1978	1978
Red-cockaded Woodpecker/habitat relations in the old-growth forests of Hobcaw Barony (Gene Wood, Clemson University)	March 1976	April 1976	1976—1978	1979
Productivity of the Red-cockaded Woodpecker in relation to colony stand conditions in South Carolina (Gene Wood, Clemson University)	March 1975	June 1975	1975—1977	1977
Distribution of Red-cockaded Woodpecker habitat in the Southeast (Peter Dress, University of Georgia)	June 1974	September 1975	1974—1976	1976
Arthropod biomass and diversity associated with Red-cockaded Woodpecker foraging habitat (Dept. Entomology and Economic Zoology, Clemson University)	September 1976	May 1977	1977—1979	1979

ADDENDUM

Since the time this paper was presented, the Red-cockaded Woodpecker has attracted a great deal of research attention. Curtis (1978) points out that in the Southeast the majority of research on nongame birds has been devoted to endangered and threatened species, and the Red-cockaded Woodpecker has attracted the majority of the research attention. Three important publications have refined our knowledge of cavity tree selection and habitat conditions in active

colony sites. Jackson *et al* (1979) have reported the mean ages of trees in which new cavities are being started as ranging from 75 years for loblolly pines, 85 years for pond pine to 95 years for longleaf pine. This information clearly indicates the woodpeckers select older trees for cavity excavation. In North Carolina, Van Balen and Doerr (in press) have provided the first quantitative information on the range of hardwood stocking and density at active Red-cockaded Woodpecker colony sites. This and other information from published and unpublished sources has been synthesized by Lennartz and McClure (in press) into a composite description of habitat conditions at active woodpecker colony sites. Using the habitat description and statistics derived from the periodic Forest Surveys, Lennartz and McClure (in press) have shown that Red-cockaded nesting habitat is very restricted in the Southeast, and the amount of available nesting habitat has steadily diminished over the past 40 years. Little additional information has been published on foraging habitat selection. Nesbitt *et al* (1978) have provided additional information on home range sizes, and they have also shown that in Florida the woodpeckers spend most of their foraging time in pine flatwoods habitats. Whether or not Red-cockadeds exhibit a preference while foraging for particular habitat types or stand conditions has not yet been determined. In addition to the habitat studies cited above, Harlow and Lennartz (1977) have added to the knowledge of Red-cockaded food habits by reporting on foods brought to nestlings. The nestling diet was essentially 100% animal matter and consisted of a wide array of arthropods. New knowledge on the social structure and behavior of woodpecker clans (Lennartz and Harlow 1979) indicated clans commonly have helpers; that helpers are generally male offspring of the breeding pair from previous years; helpers will remain with their natal clan for more than one year; and that helpers participate in many nesting activities including incubation and feeding of nestlings.

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