

Report of the American Ornithologists' Union Committee for the Conservation of the Red-cockaded Woodpecker

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The American Ornithologists' Union's Committee for the Conservation of the Red-cockaded Woodpecker was formed in late 1983 by Dr. Thomas R. Howell, then president of the A.O.U., at the request of Warren B. King of the United States Section of the International Council for Bird Preservation. The Committee's charge was to review the status of the federally endangered Red-cockaded Woodpecker (*Picoides borealis*), to evaluate the conservation and management practices impinging on the welfare of this species, and to further the A.O.U.'s interest in providing scientific advice and suggestions to managers of threatened and endangered species of birds.

SUMMARY

The Red-cockaded Woodpecker (*Picoides borealis*) in the southeastern United States has become endangered as a result of dependence on mature, open pine woodlands. This habitat, maintained in the past only by recurring fire, has become very scarce because of both the cutting of the pine forests for timber and the exclusion of fire. Moreover, modern timber management practices focus almost exclusively on the production and harvest of young trees on private land and middle-aged trees on public land. Although Red-cockaded Woodpeckers are legally protected by the Endangered Species Act, management practices detrimental to the birds continue. Enough is known about the habitat requirements of these woodpeckers that further declines in numbers on the national forest and other public lands could probably be prevented by the maintenance of suitable habitat. The new Red-cockaded Woodpecker Recovery Plan (USFWS 1985) makes many important recommendations for the conservation of this species, but in our view it should be more restrictive. The fate of an endangered species hangs in the balance.

Conservation of Red-cockaded Woodpeckers requires multiple approaches, including (1) accurate population censuses, (2) enforcement of legally mandated management procedures, (3) experimental studies of the production of cavity trees, (4) designation of at least one national forest primarily for studies of the woodpeckers, (5) evaluation of Recovery Plan recommendations concerning foraging habitat in different geographic regions, and (6) evaluation of the currently accepted replacement/recruitment stand concept, as described in "The Forest Service Wildlife Habitat Management Handbook." In addition, individuals can contribute significantly to the future of this species by working with conservation organizations to develop habitat corridors and by monitoring clans of Red-cockaded Woodpeckers.

I. INTRODUCTION

The conservation of the Red-cockaded Woodpecker, a federally designated endangered species, is one

of the most challenging and controversial issues in applied ornithology. The woodpecker's specialized habitat requirements for mature pine forests conflict with forestry practices in the southeastern United States. These practices emphasize clear-cutting of the woodpecker's prime habitat. As a result, prospects for long-term survival of the species are not encouraging.

Since 1970, when it was officially designated an endangered species, and during the 13 years since passage of the Endangered Species Act of 1973, the Red-cockaded Woodpecker has continued to decline, and local extirpations have been numerous. Indeed, because of its formal legal status, the presence of the woodpecker has been perceived as a serious economic burden by the timber industry and as a problem by those charged with managing national forest lands for multiple uses. Despite increased attention (see below), many studies, and extensive discussion and debate, no management program to date has led to increased numbers of Red-cockaded Woodpeckers.

In this report, we review the status of the Red-cockaded Woodpecker and evaluate conservation and management practices that impinge on its welfare. Specifically, we point out factors that threaten remaining populations; we evaluate the Recovery Plan¹ (USFWS 1985) and offer recommendations for managing the species more effectively.

II. STATUS OF THE RED-COCKADED WOODPECKER

A. Ecological Specialization and the Species' Increasing Rarity

The Red-cockaded Woodpecker is restricted to the pine forests of the southeastern United States. Once common or even abundant, the species has declined drastically in numbers and distribution. The following facts about its biology are relevant to understanding this decline.

1. The preferred habitat is open and parklike, lack-

¹ U.S. Fish and Wildlife Service. 1985. Red-cockaded Woodpecker Recovery Plan. Atlanta, Georgia, U.S. Fish and Wildl. Serv. Copies can be purchased from: Informatics General Corp., 6011 Executive Boulevard, Rockville, Maryland 20852 USA.

ing substantial hardwood under- or midstory. Such conditions are maintained only by recurring fire. Exclusion of fire eventually leads to disappearance of the birds, because of encroachment of hardwoods, even if the pine trees remain. This once geographically widespread habitat type is referred to as a fire-maintained subclimax community (Oosting 1956).

2. Although a variety of pine species are used, longleaf pine (*Pinus palustris*) appears to be preferred. Longleaf pine habitat has disappeared even more rapidly than other types of pine forest.

3. Nest and roost cavities are virtually always excavated in living, mature pines (80-120 yr of age) whose heartwood has been destroyed by a fungus (*Phellinus pini*). The use of large living trees means that cavity excavation is a slow process, sometimes requiring more than a year. Thus, cavities in live trees appear to be very valuable and limiting resources. Some cavity trees are known to have been used by several generations of birds over several decades. Colonies may have from 1 to 30 cavity trees, usually within a relatively small area. (The colony is the sum of all cavity trees owned by the clan.) Because of the time and effort involved in their excavation, the cavities represent a substantial investment, which the birds are reluctant to abandon.

4. The dependence of Red-cockaded Woodpeckers on mature living pines is related both to their availability and safety in a fire-maintained ecological community and to the protection from predators that they afford. Resin wells are excavated around the cavity entrance, as well as above and below it. The sticky resin almost certainly deters certain predators, such as the gray rat snake (*Elaphe obsoleta spiloides*; Jackson 1974).

5. The Red-cockaded Woodpecker is a cooperative breeding species. Like most such species, it is sedentary and occupies territories year-round. Within the group or clan, only one pair of birds breeds. Other mature group members serve as nest helpers. Depending on the time of year, immature birds also may be present.

6. Establishment of colonies and territories *de novo* is presently so rare as to be virtually undocumented, despite intensive observations of several populations for over a decade. Because this species is highly territorial and requires specialized cavity trees for nesting, there is no evidence that populations can expand rapidly into previous unused habitats. Each forest management decision therefore may have far-reaching consequences for the population in that forest.

Unlike the situation with some other endangered species, there is virtually no debate about the cause of the decline of the Red-cockaded Woodpecker: its habitat has been and continues to be destroyed, both by commercial logging and by the exclusion of fire. Much of the virgin southern pine forest was cut around the turn of the century. The number of Red-cockaded Woodpeckers almost surely decreased dras-

tically during this period, and probably has continued to decline ever since. Throughout the south only about 2.5% of the current pine acreage is considered to represent suitable nesting habitat (USFWS 1985). Even where old pines still exist, suppression of the natural fire regime frequently has allowed hardwoods to become established. Under these conditions, other cavity dwellers, particularly flying squirrels (*Glaucomys volans*) and Pileated and Red-bellied woodpeckers (*Dryocopus pileatus* and *Melanerpes carolinus*), become more abundant and displace Red-cockaded from their roosts and nests.

B. Current Estimates of Population Size and Trends

Wahlenberg (1960) estimated that by the mid-1900's the area occupied by southern pine forest at the time of European immigration had been reduced by 50-65%. The loss probably is even more serious for the Red-cockaded Woodpecker than this estimate suggests because the acreage of longleaf woodland, considered to be the preferred habitat for Red-cockaded, has declined three times more rapidly than that of loblolly-shortleaf forest (Lennartz et al. 1983b). Furthermore, about 75% of all suitable Red-cockaded nesting habitat is on private land (USFWS 1985), where the birds have inadequate legal protection (Freeman 1984). The species may eventually be restricted to state and national forests and other public lands (USFWS 1985). Some military bases currently have significant numbers of Red-cockaded Woodpeckers. We feel that it is unwise to depend on such sites for conservation of endangered species because they are subject to overriding national security considerations.

Jackson (1978b) estimated a total population of between 4,800 and 10,000 woodpeckers. Lennartz et al. (1983a) conducted censuses of selected federal land in the south (17 national forests, 9 military bases, 11 national wildlife refuges) and concluded that about 3,000 active colonies (6,000 breeding birds) were present on federal lands.

The abandonment of known colonies does not necessarily document a population decline, because birds could be colonizing new areas. There is no evidence, however, that they are doing so (USFWS 1985). Thompson (1971) reported losses of 13.1% of 312 active colonies in 10 states over a 4-yr period, and Baker (1983) recorded a 34% loss of 141 active colonies. Neither author reported any new colonies. Intensive studies at specific localities revealed similar decreases. For example, at the Savannah River Plant near Aiken, South Carolina, 16 colonies were present in 1977; seven years later, 2 breeding pairs and 2 lone males remained. Most abandonments could be attributed to Forest Service management practices (Jackson 1984). At the Tall Timbers Research Station in northwestern Florida, about 40 adult birds were present in 1970. The pines at Tall Timbers are old, and undergrowth was burned annually; nevertheless, the birds slowly but steadily disappeared and were gone by

1981 (Baker 1983). Thus, not every decline of a local population can be attributed to habitat alterations.

C. Fragmentation of Populations

The few thousand Red-cockaded Woodpeckers currently in existence occupy the area from the southern Atlantic coast to eastern Oklahoma and Texas. Within this area, suitable habitat is now highly fragmented. Remaining populations are becoming smaller and increasingly isolated as suitable habitat continues to disappear.

The isolation of small populations has led to two recognizable problems. Immature, unmated female Red-cockaded typically leave their natal territories during their first autumn, presumably in search of breeding sites. J. H. Carter III, P. D. Doerr, and J. R. Walters (MS, pers. comm.) found that 73% (91/124) of the young females that dispersed and obtained a breeding slot moved more than 1 mile (i.e. into terrain probably unfamiliar to them). Moreover, 26% (14/53) of the females from relatively poorer habitat moved more than 5 miles, whereas only 9% (3/33) of those from better habitat moved that far. Females seem to move in a straight line, and those produced in low-quality habitat or in sites isolated from other areas of suitable habitat probably have an increased probability of dispersal-related mortality. The presumed high mortality of females as a result of their dispersal behavior may limit the reproductive potential of populations in areas of suitable habitat. Territory-holding male Red-cockaded that do not have mates have been reported in Mississippi, South Carolina, and North Carolina, where 13% of social units are solitary males (J. R. Walters pers. comm.).

Another possible problem related to habitat fragmentation and the isolation of small populations of Red-cockaded Woodpeckers is reduction of genetic variability via inbreeding. The question of how few animals are required to maintain sufficient genetic variability for a population to persist in perpetuity, other things being equal, is a difficult one that we do not attempt to answer.

D. Timber Production and the Red-cockaded Woodpecker

Because of the economic value of timber and the lack of incentives to maintain mature forests on private lands, the federal lands in the southeast, particularly the national forests and possibly various defense installations, will play a central role in the continued survival of the Red-cockaded Woodpecker (USFWS 1985). The national forests are designated as multiple-use areas. They are managed for various purposes, including recreation and conservation as well as timber production. We believe that Red-cockaded Woodpeckers can exist in managed forests, including those used for timber production, if there are lengthened rotations (80 yr or more) and if suitable mature habitat is always maintained. Present forest management practices designed to maximize timber yield via short rotation schedules and replacement of loblolly pine with faster-growing species are not

compatible with the continued existence of the woodpeckers.

III. CURRENT CONSERVATION EFFORTS

A. Symposia and Studies Devoted to the Red-cockaded Woodpecker

Since 1970, when the Red-cockaded Woodpecker was placed on the United States list of endangered species, it has been the subject of two major symposia (Thompson 1971, Wood 1983), two recovery plans (USFWS 1979, 1985), and many individual studies dealing with its ecological requirements (e.g. home-range sizes, foraging habitat, characteristics of cavity trees) and demography. In addition, several important unpublished theses and at least one dissertation exist. An important result of this attention is recognition that the bird is declining rapidly in numbers in many areas. Also, our understanding of the basic habitat requirements of the Red-cockaded Woodpecker has been significantly improved.

B. The 1985 Red-cockaded Woodpecker Recovery Plan: An Evaluation of Its Major Aspects

The second recovery plan (USFWS 1985) was prepared by M. R. Lennartz of the U.S. Forest Service Southeastern Forest Experiment Station. The Recovery Plan accurately presents the factors responsible for the decline of Red-cockaded and points out the sole solution:

"The survival of the Red-cockaded Woodpecker ultimately depends on halting the loss of nesting habitat and providing adequate acreage in old-growth pines in perpetuity. Merely protecting existing colonies will delay extinction but not prevent it. A continuing supply of old-growth habitats is required to replace colonies lost or abandoned and to provide for population expansion" (USFWS 1985: 52-53).

With respect to management, the plan can be divided into five major parts, each of which we comment on below.

1. *Nesting and foraging habitat.*—Recommendations concerning habitat requirements have produced a series of specific management practices and guidelines for forest managers (i.e. USFWS 1985: ch. 420). Although we agree with many of them, the habitat management recommendations suffer from two deficiencies, either of which could affect the survival of the species.

a. The Recovery Plan's recommendation of an average of 125 acres/clan apparently reflects breeding-season territory size rather than year-round home-range requirements. Hooper et al. (1982) reported an average annual home range of 86.9 ha (214.6 acres). This point is important because, as Skorupa and McFarlane (1976) pointed out, "... the increased winter foraging requirements of this species must be considered by forest managers attempting to reconcile the dictates of timber production with the conservation measures necessary to insure the future survival of these birds."

The 125-acre recommendation is based on the re-

productive success of the woodpeckers as well as the mean acreage of 17 home ranges with territorial constraints in a single population at the Francis Marion Forest in South Carolina. This midpoint or average recommendation, while perhaps adequate in superior habitat (but see above), has been incorporated into the Wildlife Habitat Management Handbook. Because many other studies suggest that larger areas are required, our concern is that the Recovery Plan and Handbook recommendations will be inadequately modified for other areas. This is one danger of recommending a specific average value for a geographically widespread species. Recommendations for endangered species should risk error on the side of conservation (Conner 1979b), especially when many variables influence habitat quality.

b. The recommendation that 60% of 125 acres of foraging habitat be in trees "30 years of age or older" is questionable. This value is based on a study in the Francis Marion National Forest by R. G. Hooper and R. F. Harlow. Hooper and Harlow examined the extent to which stands of different age classes were used during foraging by individual clans as compared with their relative occurrence within the home ranges. They found that preference for stands, as expressed by the ratio of the use of a stand to its availability within the home range, "increased sharply with stand age up to 30 among 10-year age groups, but appeared to gradually increase with age" (Recovery Plan, draft copy, p. 11). They then concluded that stands 30 years or older were preferred habitat and were therefore suitable for the species. In their study, it was not possible to ensure equal representations of all stand age classes within each home range or other unit of analysis. For example, if a home range contained equal proportions of 10-, 20-, and 30-yr-old stands, but none in the 40-, 50-, 60-, or older classes, the 30-yr-old stands in that home range would inevitably have a preference ratio much greater than one. If older stands had been available to the birds, they might have been preferred, and the preference ratio for the 30-yr-old stands would then fall. Use/availability ratios for individual home ranges cannot provide information on truly preferred or even adequate habitat.

2. *Current status.*—The data presented in the Recovery Plan (USFWS 1985: table 1) show that the current status of the Red-cockaded Woodpecker is poorly known. Confidence limits in many cases are so large that they render a specific estimate meaningless (e.g. Ocala National Forest: 41 ± 76 colonies). We believe that accurate censuses of all populations are essential.

3. *Recovery objectives.*—On the basis of theoretical considerations concerning inbreeding (Franklin 1980, Frankel and Soulé 1981), the plan suggests that a minimum viable population size is 250 clans, or 500 breeding birds. Thus, any population of this size would, by definition, be considered "recovered." Ac-

ording to the plan, down-listing the entire species from endangered to threatened requires 6 recovered populations distributed over the species' range.

Serious questions remain as to how a population is to be delimited and how accurate the population estimates should be required to be. Six recovered populations equal only 3,000 breeding birds. Thus, it is conceivable that the Red-cockaded Woodpecker could be down-listed to "threatened" with only 0.3–0.5 the number of birds currently estimated to exist. This approach extends to "recovered" status as well. If there were 15 viable populations of 500 breeding birds, the species would be considered "recovered." The species could be delisted altogether, with even fewer birds than now occur. Finally, 500 birds of breeding status do not equal an effective population size of 500 (contra USFWS 1985: 37) because some percentage of them will be reproductively unsuccessful. Because total numbers of Red-cockaded Woodpeckers probably will continue to decrease for the foreseeable future (USFWS 1985: 33), designation of an untested minimal value as representing a viable population is not justified.

The 15-populations approach could jeopardize the species in other ways. The emphasis on 15 widely separated populations could increase the rate of disappearance of smaller, connecting populations if individual forest managers infer that all other populations are not critical. This perception, together with the emphasis on timber production, may lead managers with small populations to minimize their responsibility to the birds.

4. *Potential carrying capacity.*—The Recovery Plan states that under ideal habitat conditions clan densities in the Francis Marion National Forest are 1/112 acres. In areas where management is not intense, but where the habitat is good, densities of 1 clan/200–250 acres are attainable. Overall, the average in the Francis Marion National Forest is 1 clan/400 acres of habitat. The plan suggests as a realistic objective on managed forests that densities range from 1 clan/200 to 1 clan/400 acres. If such densities were attained and maintained on all national forest lands where woodpeckers occur or have occurred, it should be sufficient to safeguard the species.

5. *Recovery activities.*—This is an extremely important component of the Recovery Plan and one with which we have no disagreement. However, the estimated cost for 3 years is \$5,556,000, a sum unlikely to be obtained.

IV. RECOMMENDATIONS OF THE COMMITTEE

A. Management Programs Devoted to Increasing the Numbers of Red-cockaded Woodpeckers

Perhaps the foremost need is initiation of one or more programs specifically devoted to increasing the numbers of Red-cockaded Woodpeckers. No increases have been documented anywhere in its range;

thus, a demonstration of population increase is needed. We recommend that one or more national forests be designated as experimental recovery sites for Red-cockaded Woodpeckers, with the first priority in such forests to be expansion of the local woodpecker population. Demonstration that woodpeckers can increase in managed forests, especially where the local population is unarguably in decline, would be a significant contribution toward the preservation of the species.

B. Current Management Practices and Accountability As the Recovery Plan points out:

"The species' prospects for survival depend solely on *whether and when* [emphasis added] forest land managers implement programs to provide for the red-cockaded's habitat requirements" (USFWS 1985: 34).

The absence of a demonstrated increase of Red-cockaded Woodpeckers on national forest lands, together with the ongoing declines in many forests, suggests that current management practices are inadequate for the species' recovery. Current management of many forests does not provide fire, control of hardwoods, or the thinning prescribed by the Handbook. As of early 1985 only one national forest employed a management program judged acceptable by the Fish and Wildlife Service, and only two had implemented monitoring programs (M. R. Lennartz in litt.). Programs in most national forests have fallen short of their legal requirements.

The problem is the conflict between timber interests and habitat for the woodpecker. National forest managers often are evaluated on the basis of timber quotas, rather than on conservation programs. It is not surprising that most managers emphasize tree production and harvest. However, a legal means for enforcing compliance with the Endangered Species Act (ESA) exists. The Section 7 interagency consultation procedure of the ESA provides the legal responsibility for the Fish and Wildlife Service to ensure that other federal agencies, e.g. the Forest Service, provide adequate management programs for endangered species. They must also obtain approval from the Fish and Wildlife Service for changes in agreed-upon practices.

C. Habitat Management

1. *Mature forest.*—We recommend that the Red-cockaded Woodpecker and the mature pine forest upon which it depends be managed as a unit. A combination of lengthened rotations between timber harvests (≥ 80 yr) and controlled burning could provide suitable habitat for the woodpecker and the other plant and animal species characteristic of this ecosystem. If the decision were made to do so, the Forest Service could also provide what commercial forestry cannot: high-quality old-growth timber. National forests should not be under the same constraints as commercial forests to produce as much wood as possible as quickly as possible. Development of old-growth production is consistent with the approach

we advocate. Large tracts of old growth would allow the Red-cockaded Woodpecker to exist in managed forests and would obviate the necessity of managing the woodpeckers on a clan-by-clan basis.

2. *Alternative management of cavity trees.*—It is often assumed that if pines are permitted to grow old enough, they will eventually become suitable for excavation by Red-cockaded Woodpeckers. Few studies, however, have investigated the specific characteristics of cavity trees. A comparison of trees used by the woodpeckers with randomly selected mature pines suggests that the woodpeckers select trees that have undergone stress (suppression) for 50–100 years in the form of competition for light. The subsequent vigor of the cavity trees indicates that they were "released" from this competition through some form of thinning, either natural or managed (Conner and O'Halloran MS, J. R. Walters pers. comm.).

These findings suggest that an alternative management strategy should be tested, particularly in areas where woodpecker populations are low, decreasing, or both. A timber harvest system that creates suppression of growth followed by release may be necessary to grow suitable cavity trees (see Conner and O'Halloran MS for detailed recommendations). The high economic loss of pine timber to southern pine beetles throughout national forest lands in the south also suggests that creation of more open stands of longleaf pines should also be considered for pine forests outside areas where Red-cockaded Woodpeckers presently exist.

3. *Foraging habitat.*—Until adequately controlled studies indicate otherwise, foraging-habitat management should be more conservative than suggested by the Recovery Plan. Specifically, the assertion that 30-yr-old pine stands are adequate to provide "preferred" foraging habitat is misleading. Because Red-cockaded Woodpeckers are birds of the mature pine forest, we suggest that all trees within a 125-acre foraging habitat area be 60 years old or older, rather than the 40% suggested in the plan. This percentage should provide sufficient foraging substrate for a clan throughout its home range.

We recommend that, for at least 10 active colonies in each national forest, annual censuses be conducted to determine the number of adult birds present per colony before the young have fledged. If the adult population in the sample colonies declines in two consecutive years, and the decline cannot be attributed to changes in the number or quality of cavity trees, then we recommend careful monitoring of reproductive success (number of eggs laid, number hatched, number of young fledged) to determine whether the foraging habitat is adequate for the rearing of normal broods. As other investigators have pointed out, an indicator of the "health" of a population, and thus of the quality of the home ranges occupied by that population, is group size.

4. *Recruitment stands.*—The recruitment-stand con-

cept as described in the Wildlife Habitat Management Handbook is that the species will expand into new patches of appropriate habitat. Despite a number of long-term studies, we are aware of only one observation of the establishment of a new colony in habitat that was not previously occupied by a clan. In this case, the colony was abandoned after a single breeding season, when the sole cavity was usurped by Red-bellied Woodpeckers (J. A. Jackson pers. comm.). The available evidence indicates that, like those of other cooperatively breeding species that depend on specialized self-constructed resources, new Red-cockaded Woodpecker colonies are established primarily by the expansion and eventual budding of previously established territories. There is no current indication that the species will colonize isolated habitats. Most present colonies are in remnant patches of forest (M. R. Lennartz pers. comm.). Although replacement trees suitable for the construction of new cavities and areas of unoccupied but suitable habitat for the development of new clans will be required for long-term survival of the woodpeckers, the current recommendation of at least 10 acres of 60-yr-old trees is probably insufficient to support woodpeckers.

D. Alleviation of Problems Associated with Small or Fragmented Populations

Even assuming highly successful management of woodpeckers on public lands, suitable habitat will continue to decline on privately owned land and will lead to the increased frequency of local extirpations. It is unlikely that this pattern will be reversed. We offer two suggestions to address this problem.

1. *The corridor concept.*—To counteract the problem of increasing fragmentation and isolation of populations, Jackson (1976) suggested that the rights-of-way of interstate highway systems in the southeast be managed for use as habitat corridors to connect isolated "islands" of suitable habitat. Red-cockaded Woodpeckers have no aversion to roads or to traffic. The requirement would be to plant and maintain pine trees with long rotations and low or sparse ground cover. Such corridors could prove to be an important contribution to the welfare of this species. Long, narrow strips of mature open pine woodland might or might not be adequate for the establishment of permanent colonies, depending on adjacent habitat. However, development of even limited amounts of high-quality habitat along major highways could be beneficial to emigrating or displaced woodpeckers and at the least would provide individuals with a suitable foraging and roosting environment.

We propose that state and local conservation organizations, such as state ornithological societies, Sierra Club chapters, Audubon chapters, and others, contact their respective highway maintenance offices for approval to plan and maintain appropriate species of pine. Pine trees already existing on highway rights-of-way should be mapped by the conservation groups

and copies presented to highway maintenance personnel. We envision an effort similar to the nest-box construction and placement projects that have proved to be beneficial to some populations of Eastern Bluebirds (*Sialia sialis*).

2. *Relocations.*—A few relocations of adult Red-cockadeds have been attempted (Odom et al. 1982, Odom 1983), but success has been poor. In view of the sedentary nature of the species, its dependence on cavities in living pines, and its social structure, including strong territoriality, this result is not surprising. We do not recommend relocation as a means of promoting exchange of genetic material among populations. Loss of genetic diversity in isolated populations may have an important effect on the species' long-term survival. Transfer of eggs or small nestlings from one population to another may be an effective and relatively inexpensive way to increase genetic diversity. Egg transfer has been used successfully to establish a second population of the endangered Whooping Crane (*Grus americana*), and the required methodology is well understood. Because the presence of only one or two males in a colony with apparently suitable cavities and foraging habitat is not uncommon, artificial introduction of females into territories occupied by only one or two males may also be feasible (J. A. Jackson pers. comm.).

We emphasize that providing sufficient habitat clearly is the key to preserving this species and that artificial techniques should be used only in extreme circumstances.

E. Public Involvement

We suggest that local chapters of conservation groups develop a cooperative system for monitoring Red-cockaded Woodpecker populations on a state-by-state or forest-by-forest basis. These groups should become familiar with woodpecker populations in their areas and with the legal responsibilities of forest managers on public lands. They should become familiar with the new Recovery Plan and with the Forest Service's management scheme for the Red-cockaded Woodpecker as described in the Wildlife Habitat Management Handbook. Yaffee (1982) provides a readable guide to the Endangered Species Act.

Any improper, apparently illegal habitat alterations should be documented, as should all losses of cavity trees, from whatever source. When problems appear, as they will, the Fish and Wildlife Service should be notified. It has the legal responsibility to uphold the Endangered Species Act. In addition, communication concerning the Red-cockaded Woodpecker should be established and maintained among state and national conservation organizations. The National Wildlife Federation, for example, currently is actively monitoring programs affecting the woodpeckers.

It is our hope that managers of the national forests of the southeast will come to view the forests less as sites for growing timber for forest industry and more

as stewards charged with maintaining the natural ecosystems of the region. The first stated purpose of the Endangered Species Act is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved . . ." Until this is done, the Red-cockaded Woodpecker's future as a species will remain precarious.

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VI. LITERATURE CITED AND SELECTED BIBLIOGRAPHY

- BAKER, W. W. 1983. Decline and extirpation of a population of Red-cockaded Woodpeckers in northwest Florida. Pp. 44-45 in *Red-cockaded Woodpecker Symp. II Proc.* (D. A. Wood, Ed.). Florida Game and Freshwater Fish Comm., U.S. Fish Wildl. Serv., and U.S. Forest Serv.
- CARTER, J. H., III, R. T. STAMPS, & P. D. DOERR. 1983. Status of the Red-cockaded Woodpecker in the North Carolina sandhills. Pp. 24-29 in *Red-cockaded Woodpecker Symp. II Proc.* (D. A. Wood, Ed.). Florida Game and Freshwater Fish Comm., U.S. Fish Wildl. Serv., and U.S. Forest Serv.
- CONNER, R. N. 1979a. Effects of a prescribed burn on cavity trees of Red-cockaded Woodpeckers. *Wildl. Soc. Bull.* 7: 291-293.
- . 1979b. Minimum standards and forest wildlife management. *Wildl. Soc. Bull.* 7: 293-296.
- , & B. A. LOCKE. 1982. Fungi and Red-cockaded Woodpecker cavity trees. *Wilson Bull.* 94: 64-70.
- FIELD, R., & B. K. WILLIAMS. 1985. Age of cavity trees and colony stands selected by Red-cockaded Woodpeckers. *Wildl. Soc. Bull.* 13: 92-96.
- FRANKEL, O. H., & M. E. SOULÉ. 1981. Conservation and evolution. Cambridge, England, Cambridge Univ. Press.
- FRANKLIN, I. R. 1980. Evolutionary change in small populations. Pp. 135-149 in *Conservation biology, an evolutionary-ecological perspective* (M. E. Soulé and B. A. Wilcox, Eds.). Sunderland, Massachusetts, Sinauer Assoc. Inc.
- FREEMAN, J. T. 1984. Woodsman, spare that woodpecker! *Defenders* 6: 5-13.
- HARLOW, R. F., R. G. HOOPER, & M. R. LENNARTZ. 1983. Estimating number of Red-cockaded Woodpecker colonies. *Wildl. Soc. Bull.* 11: 360-363.
- HOOPER, R. G., & M. R. LENNARTZ. 1983. Roosting behavior of Red-cockaded Woodpecker clans with insufficient cavities. *J. Field Ornithol.* 54: 72-76.
- , L. J. NILES, R. F. HARLOW, & G. W. WOODS. 1982. Home ranges of Red-cockaded Woodpeckers in coastal South Carolina. *Auk* 99: 675-682.
- JACKSON, J. A. 1971. The evolution, taxonomy, distribution, past populations and current status of the Red-cockaded Woodpecker. Pp. 4-29 in *Ecology and management of the Red-cockaded Woodpecker* (R. L. Thompson, Ed.). Tallahassee, Florida, Bur. Sport Fish. and Wildl. and Tall Timbers Res. Sta.
- . 1974. Gray rat snakes versus Red-cockaded Woodpeckers: predator-prey adaptations. *Auk* 91: 342-347.
- . 1976. Rights-of-way management for an endangered species—the Red-cockaded Woodpecker. Pp. 247-252 in *Proc. 1st Natl. Symp. on Environmental Concerns in Rights-of-way Management* (R. Tillman, Ed.). Mississippi State, Mississippi State Univ.
- . 1978a. Competition for cavities and Red-cockaded Woodpecker management. Pp. 103-112 in *Endangered birds: management techniques for threatened species* (S. A. Temple, Ed.). Madison, Univ. Wisconsin Press.
- . 1978b. Analysis of the distribution and population status of the Red-cockaded Woodpecker. Pp. 101-110 in *Proc. Rare and Endangered Wildl. Symp.* (R. R. Odom and L. Landers, Eds.). Georgia Dept. Nat. Res., Game and Fish Div., Tech. Bull. W44.
- . 1981. An annotated bibliography of the Red-cockaded Woodpecker. Savannah River Natl. Environ. Res. Park, Aiken, South Carolina, Savannah River Ecology Lab.
- . 1984. Red-cockaded Woodpecker studies at the Savannah River Plant, South Carolina: 1976-1984. Final Technical Summary Rept. Prepared for U.S. Dept. Energy.
- . 1986. Why do Red-cockaded Woodpeckers need old trees? *Wildl. Soc. Bull.* 14: 318-322.
- , M. R. LENNARTZ, & R. G. HOOPER. 1979. Tree age and cavity initiation by Red-cockaded Woodpeckers. *J. For.* 77: 102-103.
- , & R. L. THOMPSON. 1971. A glossary of terms used in association with the Red-cockaded Woodpecker. Pp. 187-188 in *Ecology and management of the Red-cockaded Woodpecker* (R. L. Thompson, Ed.). Tallahassee, Florida, Bur. Sport Fish. and Wildl. and Tall Timbers Res. Sta.
- LABISKY, R. F., & M. L. PORTER. 1984. Home range and foraging habitat of Red-cockaded Woodpeckers in north Florida. Unpublished Rept.,

- Dept. Wildl. Range Sci., Sch. Forest Resources and Conservation. Gainesville, Univ. Florida.
- LANYON, W. E., & V. H. LANYON. 1969. A technique for rearing passerine birds from the egg. *Living Bird* 8: 81-93.
- LENNARTZ, M. R. 1983. Sociality and cooperative breeding of Red-cockaded Woodpeckers (*Picoides borealis*). Unpublished Ph.D. dissertation, Clemson, South Carolina, Clemson Univ.
- , P. H. GEISSLER, R. F. HARLOW, R. C. LONG, K. M. CHITWOOD, & J. A. JACKSON. 1983a. Status of Red-cockaded Woodpecker populations on federal lands in the south. Pp. 7-12 in *Red-cockaded Woodpecker Symp. II Proc.* (D. A. Wood, Ed.). Florida Game and Freshwater Fish Comm., U.S. Fish Wildl. Serv., and U.S. Forest Serv.
- , H. A. KNIGHT, J. P. MCCLOURE, & V. A. RUDIS. 1983b. Status of Red-cockaded Woodpecker nesting habitat in the south. Pp. 13-19 in *Red-cockaded Woodpecker Symp. II Proc.* (D. A. Wood, Ed.). Florida Game and Freshwater Fish Comm., U.S. Fish Wildl. Serv., and U.S. Forest Serv.
- LIGON, J. D. 1970. Behavior and breeding biology of the Red-cockaded Woodpecker. *Auk* 87: 255-278.
- ODOM, R. R. 1983. Georgia's Red-cockaded Woodpecker relocation experiment: a 1983 update. Pp. 106-108 in *Red-cockaded Woodpecker Symp. II Proc.* (D. A. Wood, Ed.). Florida Game and Freshwater Fish Comm., U.S. Fish Wildl. Serv., and U.S. Forest Serv.
- , J. RAPPOLE, J. EVANS, D. CHARBONNEAU, & D. PALMER. 1982. Red-cockaded Woodpecker relocation experiment in coastal Georgia. *Wildl. Soc. Bull.* 10: 179-203.
- OOSTING, H. J. 1956. *The study of plant communities*. San Francisco, W. H. Freeman and Co.
- SKORUPA, J. P., & R. W. MCFARLANE. 1976. Seasonal variation in foraging territory of Red-cockaded Woodpeckers. *Wilson Bull.* 88: 662-665.
- THOMPSON, R. L. (Ed.). 1971. *The ecology and management of the Red-cockaded Woodpecker*. Tallahassee, Florida, Bur. Sport Fish. and Wildl. and Tall Timbers Res. Sta.
- U.S. FISH AND WILDLIFE SERVICE. 1979. *Red-cockaded Woodpecker Recovery Plan*. Atlanta, Georgia, U.S. Fish Wildl. Serv.
- . 1984. Technical draft comments and responses to the revised Red-cockaded Woodpecker recovery plan. Atlanta, Georgia, U.S. Fish Wildl. Serv.
- . 1985. *Red-cockaded Woodpecker Recovery Plan*. Atlanta, Georgia, U.S. Fish Wildl. Serv.
- U.S. FOREST SERVICE. 1985. *Wildlife habitat management handbook*. Ch. 400—Management by wildlife species: 420—Red-cockaded Woodpecker. Atlanta, Georgia, U.S. Dept. Agr., Forest Serv.
- WAHLENBERG, W. G. 1946. *Longleaf pine—its use, ecology, regeneration, protection, growth, and management*. Washington, D.C., C. Lathrop Pack. For. Found.
- . 1960. *Loblolly pine—its use, ecology, regeneration, protection, growth, and management*. Durham, North Carolina, Sch. For., Duke Univ.
- WOOD, D. A. (Ed.). 1983. *Red-cockaded Woodpecker Symp. II Proc.* Florida Game and Freshwater Fish Comm., U.S. Fish Wildl. Serv., and U.S. Forest Serv.
- WOOD, G. W., L. J. NILES, R. M. HENDRICK, J. R. DAVIS, & T. L. GRIMES. 1985. Compatibility of even-aged timber management and Red-cockaded Woodpecker conservation. *Wildl. Soc. Bull.* 13: 5-17.
- YAFFEE, S. L. 1982. *Prohibitive Policy: Implementing the Federal Endangered Species Act*. Cambridge, Massachusetts, MIT Press.