PART II. RECOVERY

5. RECOVERY GOAL

The ultimate recovery goal is species viability. This goal is represented by delisting. Once delisting criteria are met, it is believed that the size, number, and distribution of red-cockaded woodpecker populations will be sufficient to counteract threats from demographic, environmental, genetic, and catastrophic stochasticity. Therefore, upon delisting the species will be viable over the long-term, at least under the current understanding of these stochastic processes. An interim goal is downlisting from endangered to threatened status.

6. RECOVERY CRITERIA

Population sizes identified in recovery criteria are measured in the number of potential breeding groups. A potential breeding group is an adult female and adult male that occupy the same cluster, with or without one or more helpers, whether or not they attempt to nest or successfully fledge young. A traditional measure of population size has been number of active clusters. Potential breeding groups is a better measure of population status, because this is the basis of population dynamics in this species, and number of active clusters can include varying proportions of solitary males and captured clusters. Estimates of all three parameters—number of active clusters, proportion of solitary males, and proportion of captured clusters—are required to support estimates of potential breeding groups.

To assist in the transition between these two measures, we have provided a range of numbers of active clusters considered the likely equivalents of the required number of potential breeding groups. Estimated number of active clusters is likely to be at least 1.1 times the number of potential breeding groups, but it is unlikely to be more than 1.4 times this number. Thus, an estimated 400 to 500 active clusters will be necessary to contain 350 potential breeding groups, depending on the proportions of solitary males and captured clusters and also on the estimated error of the sampling scheme. It is expected that all recovery populations will have sampling in place that is adequate to judge potential breeding groups. If this is not the case, only the highest number of active clusters in the range given can be substituted to meet the required population size.

A. DELISTING

Delisting shall occur when each of the following criteria is met. A brief rationale for each criterion is given immediately following this list, and a detailed discussion of species and population viability is presented in 2C.

Criterion 1. There are 10 populations of red-cockaded woodpeckers that each contain at least 350 potential breeding groups (400 to 500 active clusters), from among the 13 designated primary core populations, and these 10 populations exhibit a stable or increasing trend. A population is considered to exhibit a decreasing trend if a 10 percent decline in the number of active clusters is documented from one year to the next, or if for three consecutive years the number of active clusters declines. If a population does not show decreasing trend, it is stable or increasing (see 8A for method to determine increase). All 13 primary core populations should be managed for maximum size that the habitat will allow.

Criterion 2. There are 10 populations of red-cockaded woodpeckers that each contain at least 250 potential breeding groups (275 to 350 active clusters), from among the 12 designated secondary core populations, and these 10 populations exhibit a stable or increasing trend. All 12 secondary core populations should be managed for maximum size that the habitat will allow.

Criterion 3. There are at least 250 potential breeding groups (275 to 350 active clusters) distributed among designated essential support populations in the South/Central Florida Recovery Unit, and six of these populations including either Big Cypress National Preserve or Ocala National Forest exhibit a minimum population size of 40 potential breeding groups and a stable or increasing trend. Essential support populations in this recovery unit should be managed for maximum population size that the habitat will allow.

Criterion 4. There is one stable or increasing population containing at least 100 potential breeding groups (110 to 140 active clusters) in northeastern North Carolina/southeastern Virginia.

Criterion 5. For each of 12 primary core populations and 13 secondary core populations, and for six essential support populations in the South/Central Florida Recovery Unit, responsible management agencies shall provide (1) a habitat management plan that is adequate to sustain the population and emphasizes frequent prescribed burning, and (2) a plan for continued population monitoring.

Rationale for Delisting Criteria

Criterion 1. A population size of 350 potential breeding groups is considered highly robust to threats from environmental stochasticity as well as inbreeding and demographic stochasticity. It is the lowest of current estimated minimum sizes necessary to offset losses of genetic variation through genetic drift (see 2C). Ten of 13 are required for delisting because it is recognized that at any given time, two primary core populations may be suffering hurricane impacts. Thirteen primary core populations are designated because of available habitat and because this number, together with 12 secondary core populations (below), may serve to facilitate natural dispersal among populations and maximize retention of among-population genetic variability. Primary and secondary core populations provide for the conservation of the species within each major physiographic

unit in which it currently exists, with the exception of South/Central Florida. This unit is represented by several, smaller, essential support populations (below).
Criterion 2. A population size of 250 potential breeding groups is the minimum size considered robust to environmental stochasticity, and is far above the size necessary to withstand inbreeding and demographic stochasticity. Ten of 12 designated secondary core populations are required for delisting to allow for hurricane impacts.

Criterion 3. This unique habitat type is represented to the extent that available habitat allows. Unique genetic resources are conserved as much as reasonably possible. Because of small size, some of these populations will remain vulnerable to extinction threats and may eventually be lost. The likelihood of extirpation of small populations can be minimized by territories that are aggregated in space.

Criterion 4. This unique habitat, and genetic resources contained within this population, will be represented at the time of delisting. This population size is midway in estimates of sizes necessary to withstand threats from inbreeding depression and are considered robust to demographic stochasticity if territories are moderately aggregated in space.

Criterion 5. Continued habitat management and population monitoring are necessary to ensure that the species does not again fall to threatened or endangered status.

B. DOWNLISTING

Downlisting shall occur when each of the following criteria is met. Rationale for each criterion is presented immediately following this list.

Criterion 1. There is at least one stable or increasing population containing at least 250 potential breeding groups (275 to 350 active clusters) in each of the following recovery units: Sandhills, Mid-Atlantic Coastal Plain, South Atlantic Coastal Plain, East Gulf Coastal Plain, West Gulf Coastal Plain, Upper West Gulf Coastal Plain, and Upper East Gulf Coastal Plain.

Criterion 2. There is at least one stable or increasing population containing at least 100 potential breeding groups (110 to 140 active clusters) in each of the following recovery units: Mid-Atlantic Coastal Plain, South Atlantic Coastal Plain, and East Gulf Coastal Plain.

Criterion 3. There is at least one stable or increasing population containing at least 70 potential breeding groups (75 to 100 active clusters) in each of the following recovery units: Ouachita Mountains, Cumberlands, and Piedmont. In addition, there is one stable or increasing population containing at least 70 potential breeding groups (75 to 100 active clusters) in northeastern North Carolina/southeastern Virginia.

Criterion 4. There are at least four populations each containing at least 40 potential breeding groups (45 to 60 active clusters) on state and/or federal lands in the South/Central Florida Recovery Unit.

Criterion 5. There are habitat management plans in place in each of the above populations identifying management actions sufficient to increase the populations to recovery levels, with special emphasis on frequent prescribed burning during the growing season.

Rationale for Downlisting Criteria

Criterion 1. This population size, 250 potential breeding groups, is sufficient to withstand extinction threats from environmental uncertainty, demographic uncertainty, and inbreeding depression. These seven populations will represent each major recovery unit.

Criterion 2. A second population in these coastal recovery units will decrease the species' vulnerability to hurricanes. The West Gulf Coastal Plain is excluded because there are no candidate populations there. The lower size, 100 potential breeding groups, is considered sufficient to withstand threats from demographic uncertainty and inbreeding depression, but much more quickly attained than 250 potential breeding groups thought necessary to withstand environmental stochasticity.

Criterion 3. Populations in these special habitats will have a decent foothold on survival at the time of downlisting. This population size is midway in estimates of sizes necessary to withstand threats from inbreeding depression and are considered robust to demographic stochasticity if territories are moderately aggregated in space.

Criterion 4. This unique region will be represented at the time of downlisting. Forty active clusters is at the lower end of estimates of sizes necessary to withstand inbreeding depression and are considered robust to demographic stochasticity if territories are highly aggregated in space.

Criterion 5. These habitat management plans are necessary to ensure progress toward delisting.

7. RECOVERY UNITS

Recovery units are geographic areas containing extant woodpecker populations delineated according to ecoregions (physiographic provinces; see discussion below and map insert). There are eleven designated recovery units for red-cockaded woodpeckers. Each recovery unit (with one exception, below) contains one or more core recovery populations and one or multiple support populations (map insert). Core populations are classified as primary or secondary based on available habitat and population size required for delisting. In addition to primary and secondary core populations, several support

populations are considered essential to species recovery and as such are identified in delisting and downlisting criteria. These essential support populations are not designated primary or secondary cores because of habitat limitations. All other support populations (below) are necessary to protect and maximize genetic and demographic health until the species is delisted. After delisting, core and essential support populations will be sufficient to maintain species viability.

Maintaining viable populations within each recovery unit, to the fullest extent possible, is essential to the recovery and long-term survival of red-cockaded woodpeckers as a species, across their range. Conservation of populations in all habitats, forest community types, and ecoregions in which they currently exist is critical to species recovery primarily because these varied populations have crucial ecological and genetic values. Conservation of populations in all regions in which they currently occur has historical and cultural values as well. Ecological, genetic, historic, and cultural values of the various woodpecker populations are well-served by the recovery unit strategy, because it is based on ecoregional units and identifies the role that populations of all sizes have in the recovery process. Again, the establishment and protection of viable populations (to the fullest extent possible) in each recovery unit is essential to recovery and viability of the species, because the species' inherent ecological and genetic diversity can only be maintained by recovering populations in the major ecoregions and habitats where it currently occurs. Thus, the system of recovery units, with respective primary core, secondary core, and support populations, provides the foundation of the strategy to recover red-cockaded woodpeckers.

Ecoregions

Ecoregions (physiographic provinces; Bailey 1983, Bailey *et al.* 1994) are a system of classification based on physiography, the study of the natural features of the earth's surface. Important to physiography and the designation of ecoregions are characteristics of land formation, climate, air and sea currents, and distribution of flora and fauna. Ecoregions are a more finely grained system of classification than the world biome system (Clements and Shelford 1939), for example, but not as fine as classifications according to ecosystems or communities. Although the natural boundaries of ecoregions are generally gradual rather than distinct, for the purposes of classification distinct boundaries have been delineated.

Ecoregions can be used to represent varying climatic and edaphic factors that have likely influenced species evolution over time. For red-cockaded woodpeckers, ecoregions reflect broad areas within which local adaptations and genetic coadaptation have likely occurred. (Genetic coadaptation is the evolution of gene complexes that together impart greater fitness than the sum of each individual gene's contribution. A coadapted gene's effect depends on the presence of one or more other genes; Templeton *et al.* 1986). Thus, major objectives in the use of ecoregions as a basis for recovery units are to identify likely genetic variation and to assure that this variation is conserved to the fullest extent possible.

Translocation

Translocations between populations (see 3D) will be conducted within recovery units except in rare cases. These rare exceptions include (1) previous agreements between the U.S. Fish and Wildlife Service, private landowners, and state and federal agencies, and (2) no donor population available in the same recovery unit. In such cases, translocation will be conducted between adjacent recovery units. This guideline applies to all translocations, including those intended for population augmentation (3D) and mitigation (4A). The primary objectives, and major benefits, of this guideline are the retention of genetic integrity within recovery units and the protection of each unit's progress toward recovery. Translocation and/or mitigation must not result in genetic pollution or cause a net loss of groups within any given recovery unit. In addition, controlling maximum distances for translocation will minimize cost, logistical difficulties, and the stress on the birds from transport.

Primary and Secondary Core Populations

Primary Core Populations

Primary core populations are those that will hold at least 350 potential breeding groups at the time of and after delisting. Populations of this size are above minimum estimates necessary to withstand threats of extirpation from demographic stochasticity, environmental stochasticity, and inbreeding depression (2C). However, populations of this size are no longer considered capable of retaining sufficient genetic variability for long-term viability in the absence of immigration (Lande 1995; 2C). Because retention of genetic variability is a direct function of population size, these primary core populations will retain more variation than secondary core and support populations. Conservation of within-population genetic diversity is a major function of primary core populations. Although a minimum population size of primary core populations is necessarily identified in delisting criteria, primary core populations should expand to the maximum sizes the habitat base will allow to retain as much genetic variation within the populations as possible (2C).

There are 13 designated primary core populations, located on federal lands including national forests, military installations, and one national wildlife refuge (map insert). Some state properties, such as the Sandhills Game Lands and Holly Shelter Game Lands in North Carolina, support important segments of core populations.

Secondary Core Populations

Secondary core populations are those that will hold at least 250 potential breeding groups at the time of and after delisting. This population size is the minimum estimate considered necessary to withstand threats of extirpation from environmental stochasticity, and is considered highly robust to threats from demographic stochasticity and inbreeding depression. These populations are not large enough to withstand threats to long-term viability from the process of genetic drift unless immigration is maintained. Secondary

core populations should be expanded to maximum population goals based on available habitat to protect genetic resources as much as possible and provide maximum resilience to environmental effects. Habitat limitations for secondary core populations prevent their designation as primary core populations.

There are 12 secondary core populations, located on federal lands including national forests, national wildlife refuges, and Department of Energy lands (see map insert). State lands, such as the Sand Hills State Forest in South Carolina, support important segments of secondary core populations.

Benefits of the Primary and Secondary Core Population Strategy

The 13 primary and 12 secondary core populations of red-cockaded woodpeckers are well distributed throughout the species' range. This widespread distribution serves several critical ecological objectives. First, such a distribution conserves red-cockaded woodpeckers in varied habitats and geographic regions in which they currently exist (above). Second, the wide distribution and relatively high number of populations reduces threat of species extinction from catastrophic events such as hurricanes (see 2C). Finally, secondary and primary core populations together create a network which, when population goals are reached, will facilitate the natural dispersal among populations that is critical to long-term genetic viability (2C).

Red-cockaded woodpeckers are capable of long-distance movements between populations (Walters *et al*. 1988b, Conner *et al*. 1997c, Ferral *et al*. 1997; see 2B), although under present conditions these dispersal events are rare. With increasing population size, natural movements between populations are expected to increase. Primary and secondary core populations at and after delisting will be large and healthy; thus, natural dispersal among recovered core populations may be sufficient to maintain species-wide genetic variability. If not, translocation may have to be conducted to achieve this objective. In the meantime, support populations (below) play a vital role in facilitating gene flow through natural dispersal and translocation.

Primary core, secondary core, and essential support (below) populations are delineated by estimated biological population boundaries. Most of these designated populations are currently functioning, or will function at recovery, as one demographic and genetic unit. If this were not the case, expected resistance to stochastic threats would be compromised. There are four cases, however, in which a defined recovery population may continue to be a composite of relatively isolated subpopulations: (1) NC Sandhills Primary Core, (2) Coastal NC Primary Core, (3) Angelina/Sabine Primary Core, and (4) Northeastern NC/Southeastern VA Essential Support. In the first case, the potential exists to connect the subpopulations with occupied habitat, through various habitat protection initiatives. For the other three cases, it remains to be seen whether, as isolated subpopulations grow in size, these designated populations can begin to function as single biological units.

Support Populations

All populations not designated a primary or secondary core are designated support populations. There are three classifications for support populations:

1. Essential support populations are those populations, identified in recovery criteria, that represent unique habitat types that cannot support a larger, core population. They are located on federal, state, and, in one case, private lands in agreement with the U.S. Fish and Wildlife Service.

2. Significant support populations are populations, not identified in recovery criteria, that contain and/or have a population goal of 10 or more active clusters. (A population size of 10 active clusters, if highly aggregated in space, has a good probability of persistence over a 20-year time period; Crowder *et al*. 1998.) They are located on federal and state lands and on private lands enrolled in agreements with the U.S. Fish and Wildlife Service.

3. Important support populations are populations, not identified in recovery criteria, that contain and have a population goal of less than 10 active clusters. They are located on federal and state lands and on private lands enrolled in agreements with the U.S. Fish and Wildlife Service.

All populations of red-cockaded woodpeckers have intrinsic ecological, cultural, and historical value. In addition to these intrinsic values, support populations aid in the conservation and recovery of the species. Support populations are important reservoirs of genetic resources. They help represent natural variation in habitats occupied by red-cockaded woodpeckers. Support populations are an important source of immigrants for core populations to increase retention of genetic variation and could potentially provide a buffer against stochastic loss of core populations. These functions are especially critical now, because many core populations are currently well below the population sizes necessary to withstand threats of environmental, demographic, and genetic uncertainty. Because of small population size of most support populations, extirpation of some due to stochastic events is expected.

Significant and important support populations identified within this plan are defined by ownership, rather than biological population boundaries. Some of the populations listed below may be functioning as part of larger populations. Recovery populations—primary core, secondary core, and essential supports—are defined by estimated biological boundaries rather than ownership.

Management prescriptions for all support populations on public lands will be the same as those applied in core populations. Managers should increase their populations to the maximum the habitat base will support, using the level of monitoring recommended based on population size (see 8B) and the recovery standard for foraging habitat (8G). Management plans for federal and state lands are approved by the U.S. Fish and Wildlife Service (contact the Recovery Coordinator for further information). Support populations

on private lands will be managed under Memoranda of Agreement, Habitat Conservation Plans, Safe Harbor Agreements or other management instruments approved by the U.S. Fish and Wildlife Service (contact the Recovery Coordinator for further information). Management prescriptions for these populations depend on agreements.

Individual Recovery Units

Cumberlands Recovery Unit

The Cumberlands Recovery Unit (Table 5, map insert) contains one primary core population: Talladega/Shoal Creek Ranger District (Talladega National Forest). This unit also contains one significant support population, the Daniel Boone National Forest.

East Gulf Coastal Plain Recovery Unit

The East Gulf Coastal Plain Recovery Unit (Table 5, map insert) contains two primary core populations: Apalachicola Ranger District (Apalachicola National Forest), and Eglin Air Force Base. This recovery unit also contains five secondary core populations: Wakulla Ranger District (Apalachicola National Forest), Conecuh National Forest, Chickasawhay Ranger District (DeSoto National Forest), Biloxi Ranger District (DeSoto National Forest), and Homochitto National Forest.

Significant support populations in this unit consist of St. Marks National Wildlife Refuge, Blackwater River State Forest, Tate's Hell State Forest, a large population on various private lands in the Red Hills region, and another three on private lands.

Mid-Atlantic Coastal Plain Recovery Unit

The Mid-Atlantic Coastal Plain Recovery Unit (Table 5, map insert) contains two primary core populations: coastal North Carolina, consisting of Marine Corps Base Camp LeJeune, Croatan National Forest, and Holly Shelter Game Lands; and Francis Marion National Forest. It also contains one essential support population: northeastern North Carolina/southeastern Virginia, consisting of Alligator River National Wildlife Refuge, Pocosin Lakes National Wildlife Refuge, Dare County Bombing Range, and Piney Grove Preserve (owned by The Nature Conservancy). Significant support populations in this unit are Lewis Ocean Bay Heritage Preserve, Military Ocean Terminal Sunny Point, Sandy Island, and five on privately owned lands. Important support populations are Bladen Lakes State Forest, Hampton Plantation Park, Longleaf Pine Heritage Preserve, Santee Coastal Reserve, Wedge Plantation, Yawkey Wildlife Center, and two on privately owned lands.

Ouachita Mountains Recovery Unit

The Ouachita Mountains Recovery Unit (Table 5, map insert) contains one secondary core population, Ouachita National Forest, and one significant support population, McCurtain County Wilderness Area.

Piedmont Recovery Unit

The Piedmont Recovery Unit (Table 5, map insert) contains no primary core population and one secondary core population: Oconee National Forest/Piedmont National Wildlife Refuge. Because of limited habitat base, it is unreasonable to expect that this population could consist of 350 potential breeding groups, and so the designation of secondary core population was chosen. This unit also includes one significant support population, the Pee Dee National Wildlife Refuge.

Sandhills Recovery Unit

The Sandhills Recovery Unit (Table 5, map insert) contains two primary core populations: North Carolina Sandhills, consisting of Fort Bragg, the Sandhills Game Lands, Camp Mackall, McCain Tract, Weymouth Woods State Park, and various groups on private lands; and Fort Benning. (Landowners of private properties supporting red-cockaded woodpeckers within the North Carolina Sandhills primary core are not required to manage for increasing numbers, but are encouraged to do so. Nor are they required for recovery.) This unit contains one secondary core population: the South Carolina Sandhills, consisting of Carolina Sandhills National Wildlife Refuge and Sand Hills State Forest. Significant support populations in this unit are Fort Gordon, Fort Jackson, and Poinsett Weapons Range. There are three important support populations, Cheraw State Park, Cheraw State Fish Hatchery, and Manchester State Forest.

South Atlantic Coastal Plain Recovery Unit

The South Atlantic Coastal Plain Recovery Unit (Table 5, map insert) contains two primary core populations: Fort Stewart, and Osceola National Forest/Okefenokee National Wildlife Refuge. This recovery unit contains a single secondary core population, the Savannah River Site. There are five significant support populations, the Webb Wildlife Management Area, Charleston Naval Weapons Station, and three on privately owned lands. There are three important support populations, Laura S. Walker State Park, Persanti Island, and Santee State Park.

South/Central Florida Recovery Unit

The South/Central Florida Recovery Unit (Table 5, map insert) is the only recovery unit that does not contain a primary or secondary core population, because no federal properties in this unit have sufficient land base to support populations of this size. For this reason, the 1985 Recovery Plan (USFWS 1985) did not include south and central Florida in species recovery. However, maintaining populations of red-cockaded woodpeckers in south and central Florida is essential to the recovery of the species. These populations are associated with unique habitat types such as native hydric slash pine (Beever and Dryden 1992) and critically endangered sand ridge communities (USFWS unpublished). South/central Florida populations contain a high degree of among-population genetic variation and at least one unique allele (Haig *et al.* 1996). In addition, south and central Florida served as the source of the longleaf pine/scrub oak

community roughly 5000 to 8000 years ago (Watts 1971, Watts *et al*. 1992). The region was a refuge for red-cockaded woodpeckers during the Wisconsin Glaciation just prior to the longleaf advance, and it is likely that red-cockaded woodpeckers evolved here during a previous glacial event (Jackson 1971, Conner *et al.*, in press). Therefore, red-cockaded woodpeckers in south and central Florida are considered an essential component of the species.

All populations on state and federal lands in this unit are designated essential support populations. Because there are no primary or secondary core populations, these support populations have a much more substantial role in recovery than support populations in other units. Support populations within the South/Central Florida Recovery Unit are included in criteria for delisting (see 6). It is recognized that this recovery unit will not in itself sustain viable populations and that one or more of these populations may be lost to stochastic events. Translocation among populations within this unit is likely to be necessary for long-term maintenance of genetic variation.

Essential support populations within the South/Central Florida Recovery Unit are Avon Park Air Force Range, Big Cypress National Preserve, Ocala National Forest, Three Lakes Wildlife Management Area, Withlacoochee State Forest, Webb Wildlife Management Area, J. W. Corbett Wildlife Management Area, Goethe State Forest, St. Sebastian River State Buffer Preserve, and Howe Scott Preserve. Currently, there are no private lands enrolled in agreements with the U.S. Fish and Wildlife Service in this recovery unit.

Upper East Gulf Coastal Plain Recovery Unit

The Upper East Gulf Coastal Plain (Table 5, map insert) contains one primary core population, Bienville National Forest, and one secondary core population, Talladega National Forest (Oakmulgee Ranger District). There is one significant support population in this unit, Noxubee National Wildlife Refuge.

Upper West Gulf Coastal Plain Recovery Unit

The Upper West Gulf Coastal Plain (Table 5, map insert) contains one primary core population, the Sam Houston National Forest. This unit contains no secondary core populations.

Significant support populations in this unit consist of Felsenthal National Wildlife Refuge, W. G. Jones State Forest, and three populations on private lands. Important support populations in this unit are D'Arbonne National Wildlife Refuge, Upper Ouachita National Wildlife Refuge, and L. D. Fairchild State Forest.

West Gulf Coastal Plain Recovery Unit

The West Gulf Coastal Plain Recovery Unit (Table 5, map insert) contains two primary core populations: (1) the Angelina/Sabine National Forests and (2) Calcasieu

Ranger District (Kisatchie National Forest)/Fort Polk, which also includes some groups on private property. (This private property is not required to manage for increasing numbers, but is encouraged to do so. Nor are they required for recovery.) This recovery unit contains two secondary core populations, Davy Crockett National Forest and Catahoula Ranger District (Kisatchie National Forest). These secondary core populations were chosen from among several federal properties that can hold populations of 250 potential breeding groups, and were selected to create a stepping-stone pattern in the hopes of enhancing natural dispersal.

Significant support populations in this recovery unit are the Kistachie, Evangeline, and Winn Ranger Districts of the Kisatchie National Forest, Peason Ridge, and two on private lands.

Gulf Coast Prairies and Marshes Ecoregion

The Gulf Coast Prairies and Marshes ecoregion (Table 5, map insert) is not considered a recovery unit because there is only a single, small population within it and habitat for red-cockaded woodpeckers is limited. Big Branch National Wildlife Refuge is a significant support population. Because of its unusual habitat type, Big Branch National Wildlife Refuge should be conserved to the fullest extent possible.

TABLE 5. Populations of red-cockaded woodpeckers on publicly owned lands and their designated role in recovery, by recovery unit. Estimated current size, in number of active clusters during the 1999 breeding season (1998 in some cases), is given for all populations and subtotaled by recovery unit. Numbers in parentheses are estimated sizes for populations designated part of a larger recovery population. Population goal, taken from management plans and based on available habitat (81 ha/group; 200 ac/group), is given where available. NA indicates management plans not yet available. For sums of population goals, current size is substituted if population goal is unavailable. Minimum size at delisting (potential breeding groups; pbg) is given for those populations identified in delisting criteria. Potential breeding groups is equivalent to 0.7 to 0.9 times the number of active clusters. Current trend is given where sufficient data exists and is increasing (I), declining (D), or stable (S) depending on definitions given in notes.

Recovery Unit	Population	Recovery Designation	Current Size (#active clusters)	Pop. Goal (#active clusters)	Min. Size at Delisting (pbg)	Current Trend[1]
Cumberlands	Talladega/Shoal Creek RD's	Primary Core	3	413	350	D
	Daniel Boone NF	Significant Support	7	66		I
subtotal			10	479	350	
East Gulf Coastal Plain	Apalachicola RD	Primary Core	486	500	350	S
	Eglin AFB	Primary Core	295	500	350	I
	Biloxi RD	Secondary Core	6	368	250	I
	Chickasawhay RD	Secondary Core	13	502	250	I
	Conecuh NF	Secondary Core	14	309	250	S
	Homochitto NF	Secondary Core	45	254	250	I
	Wakulla RD	Secondary Core	125	500	250	D
	Blackwater River SF	Significant Support	20	30		
	St. Marks NWR	Significant Support	6	71		
	Tate's Hell SF	Significant Support	25	NA		
subtotal			1035	3059	1950	
Mid-Atlantic Coastal Plain	Coastal NC, including:	Primary Core	148	357	350	
	Croatan NF	(part)	(60)	(135)		S
	Holly Shelter Game Lands	(part)	(38)	(38)		S
	MCB Camp LeJeune	(part)	(50)	(184)		
	Francis Marion NF	Primary Core	334	450	350	D

Table continued next page.

TABLE 5 (cont.). Populations of red-cockaded woodpeckers on publicly owned lands and their designated role in recovery, by recovery unit.

Recovery Unit	Population	Recovery Designation	Current Size (#active clusters,)	Pop. Goal (#active clusters)	Min. Size at Delisting (pbg)	Current Trend[1]
Mid-Atlantic Coastal Plain (cont.)	NE NC/SE VA, including:	Essential Support	16	NA	100	
	Alligator River NWR	(part)	(2)	(20)		
	Pocosin Lakes NWR	(part)	(4)	(NA)		
	Dare Co. Bombing Range	(part)	(6)	(46)		
	Piney Grove Nature Preserve[2]	(part)	(4)	(10)		
	Lewis Ocean Bay Heritage Preserve	Significant Support	3	10		
	Military Ocean Terminal Sunny Point	Significant Support	6	17		
	Sandy Island	Significant Support	36	NA		
	Bladen Lakes SF	Important Support	3	NA		
	Hampton Plantation Park	Important Support	1	NA		
	Longleaf Pine Heritage Preserve	Important Support	3	NA		
	Santee Coastal Reserve	Important Support	9	NA		
	Wedge Plantation	Important Support	1	NA		
	Yawkey Wildlife Center	Important Support	8	NA		
subtotal			568	911	800	
Ouachita Mountains	Ouachita NF	Secondary Core	16	400	250	I
	McCurtain Co. Wilderness Area	Significant Support	12	44		
subtotal			28	444	250	
Piedmont	Oconee NF/Piedmont NWR:	Secondary Core	54	346	250	
	Oconee NF	(part)	(17)	(250)		S
	Piedmont NWR	(part)	(37)	(96)		I
	Pee Dee NWR	Significant Support	1	10		S
subtotal			55	356	250	

Table continued next page.

TABLE 5 (cont.). Populations of red-cockaded woodpeckers on publicly owned lands and their designated role in recovery, by recovery units.

Recovery Unit	Population	Recovery Designation	Current Size (#active clusters)	Pop. Goal (#active clusters)	Min. Size at Delisting (pbg)	Current Trend[1]
Sandhills	Fort Benning	Primary Core	186	450	350	I
	NC Sandhills, including:	Primary Core	504+	NA	350	
	Fort Bragg	(part)	(350)	(350)		I
	Sandhills Game Lands	(part)	(132)	(160)		
	Camp Mackall	(part)	(11)	(12)		
	McCain Tract	(part)	(5)	(NA)		
	Weymouth Woods SP	(part)	(6)	(NA)		
	SC Sandhills, including:	Secondary Core	168	345	250	
	Carolina Sandhills NWR	(part)	(118)	(200)		I
	Sand Hills State Forest	(part)	(50)	(145)		
	Fort Gordon	Significant Support	3	25		I
	Fort Jackson	Significant Support	21	126		I
	Poinsett Weapons Range	Significant Support	6	30		
	Cheraw SP	Important Support	7	20		
	Cheraw State Fish Hatchery	Important Support	1	1		
	Manchester SF	Important Support	3	NA		
subtotal			899	1504	950	
South Atlantic Coastal Plain	Fort Stewart	Primary Core	198	500	350	I
	Osceola NF/Okefenokee NWR:	Primary Core	92	589	350	
	Osceola NF	(part)	(63)	(462)		I
	Okefenokee NWR	(part)	(29)	(127)		S
	Savannah River Site	Secondary Core	31	418	350	I
	Charleston Naval Weapons Station	Significant Support	2	12		
	Webb WMA	Significant Support	11	NA		
	Laura S. Walker SP	Important Support	2	NA		
	Persanti Island	Important Support	3	NA		
	Santee SP	Important Support	1	NA		
subtotal			340	1536	1050	

Table continued next page.

TABLE 5 (cont.). Populations of red-cockaded woodpeckers on publicly owned lands and their designated role in recovery, by recovery unit.

Recovery Unit	Population	Recovery Designation	Current Size (#active clusters)	Pop. Goal (#active clusters)	Min. Size at Delisting (pbg)	Current Trend[1]
South/Central Florida	Avon Park Air Force Range	Essential Support	21	50	*	S
	Big Cypress National Preserve	Essential Support	40	73	*	
	Cecil M. Webb WMA	Essential Support	27	NA	*	
	Goethe SF	Essential Support	26	150	*	
	Howe Scott Preserve	Essential Support	1	NA	*	
	J. W. Corbett WMA	Essential Support	8	NA	*	
	Ocala NF	Essential Support	18	179	*	I
	St. Sebastian River State Buffer Preserve	Essential Support	9	NA	*	
	Three Lakes WMA	Essential Support	35	NA	*	
	Withlacoochee SF	Essential Support	50	130	*	
subtotal			235	662	250	
Upper East Gulf Coastal Plain	Bienville NF	Primary Core	106	500	350	S
	Oakmulgee RD	Secondary Core	123	394	250	S
	Noxubee NWR	Significant Support	38	88		S
subtotal			267	982	600	
Upper West Gulf Coastal Plain	Sam Houston NF	Primary Core	168	541	350	S
	Felsenthal NWR	Significant Support	15	47		D
	W. G. Jones SF	Significant Support	14	14		
	D'Arbonne NWR	Important Support	4	5		D
	L. D. Fairchild SF	Important Support	3	7		
	Upper Ouachita NWR	Important Support	1	1		
subtotal			205	615	350	

Table continued next page.

TABLE 5 (cont.). Populations of red-cockaded woodpeckers on publicly owned lands and their designated role in recovery, by recovery unit.

Recovery Unit	Population	Recovery Designation	Current Size (#active clusters)	Pop. Goal (#active clusters)	Min. Size at Delisting (pbg)	Current Trend[1]
West Gulf Coastal Plain	Angelina/Sabine NF's:	Primary Core	55	714	350	
	Angelina NF	(part)	(30)	(252)		S
	Sabine NF	(part)	(25)	(462)		S
	Calcasieu RD/Fort Polk:	Primary Core	190+	500	350	
	Calcasieu RD (formerly Vernon)	(part)	(146)	(302)		D
	Fort Polk	(part)	(44)	(179)		I
	Catahoula RD	Secondary Core	31	328	250	I
	Davy Crockett NF	Secondary Core	51	330	250	I
	Evangeline NF	Significant Support	72	231		S
	Kisatchie RD	Significant Support	38[3]	296		D
	Peason Ridge	Significant Support	27	120		
	Winn RD	Significant Support	16	263		I
	Alexander State Forest	Important Support	5	5		
	Black Bayou NWR	Important Support	1	NA		
subtotal			486	2588	1200	
Gulf Coast Prairies and Marshes ecoregion (not a recovery unit)	Big Branch Marsh NWR	Significant Support	9	NA		
TOTAL			4137	13419	7750	

+ Plus additional groups on private lands.

* Six of these populations will have 40 or more potential breeding groups at delisting.

[1]Population trend is increasing if average annual percent change in number of active clusters, 1995-1999, is $\geq$ 5 percent. Population trend is declining if (1) there was a 10 percent drop in the number of active clusters from one year to the next (within the last 3 years), or (2) if the number of active clusters decreased for 3 consecutive years (within the last 5 years). Population trend is stable if neither increasing nor declining.

[2]Private property owned by The Nature Conservancy.

[3]Maximum number of active clusters from a district-wide comprehensive survey in May 2000 (USFWS unpublished).

8. MANAGEMENT GUIDELINES

A. RECOMMENDED RATE OF INCREASE AND USE OF RECRUITMENT CLUSTERS

Substantial increases in population sizes are required to achieve recovery of red-cockaded woodpeckers. Proper management of the nesting and foraging habitat of existing groups (see 8C, 8D, 8G) is a prerequisite for population increase, but recent research and experience strongly indicate that management of existing groups by itself is not sufficient to bring about the rates of increase necessary for recovery. Because population dynamics of red-cockaded woodpeckers are regulated by the number of potential breeding groups rather than annual variation in reproduction and mortality (see 2B), substantial increases in population size can only be obtained through continued addition of recruitment clusters. Therefore, we have developed the following guidelines for the use of recruitment clusters in all populations being managed for increasing population size. Recruitment clusters are clusters of artificial cavities in habitat containing mature and old pines (greater than 60 years in age), with little or no hardwood midstory and a healthy grass and forb groundcover (see 2D and 8D for discussion of cluster ecology and guidelines).

Guidelines

1. Recommended Rates of Increase: Populations required for recovery are to be increasing at rates of 5 to 10 percent per year or more, until population goals are reached. Rates of increase are calculated by averaging the annual percent change over five years. All other populations on federal and state lands, as well as those being managed for population increases on private lands, should exhibit similar trends.

2. Recommended Supply of Recruitment Clusters: To achieve recommended rates of increase, provide a constant supply of unoccupied recruitment clusters equal to 10 percent of total active clusters in the population. As recruitment clusters become occupied, establish additional recruitment clusters on an annual basis to sustain the required pool of unoccupied recruitment clusters.

3. Management Plan Review: Evaluate the rate of population increase every five years. If recommended rates of increase are not achieved, review the overall management strategy to determine what factors are impeding growth, and improve the management plan accordingly.

4. Placement of Recruitment Clusters: Placement of recruitment clusters is critical to successful use. Place recruitment clusters no closer than 0.4 km (0.25 mi) to existing active clusters, to reduce the likelihood of capture by an existing group. Place recruitment clusters no farther than 3.2 km (2 mi), and preferably no farther than 1.6 km (1 mi), from existing active clusters to facilitate activation and to develop beneficial spatial arrangements and densities within the population (see 2C).

Recent research performed with a spatially explicit, individual based model of population dynamics (see 2C) has indicated that edges of populations are particularly vulnerable to decay from disrupted dispersal (J. Walters *et al.*, unpublished). Maintain group densities as high as possible throughout the population, and pay particular attention to population edges.

5. Translocation: For populations currently less than 30 potential breeding groups, proper management of habitat and addition of recruitment clusters may not be sufficient to bring about required rates of increase. Translocation of birds into these critically small population may be required for increases—but only after the habitat supporting active and recruitment clusters has been restored to good condition (see 8D, 8G). If you are involved in the management of a critically small population, consider developing a comprehensive translocation program (see 8F).

6. Recruitment Cluster Requirements: Provision recruitment clusters with three suitable cavities and two starts, or four suitable cavities, when first installed. Once the cluster is occupied, ensure that a minimum of four suitable cavities is maintained. Preferably, there should be enough cavities for all resident birds (adults and fledglings) post-nesting season. This is particularly important for donor populations and critically small populations (less than 30 potential breeding groups). See 3B and 8C for further details concerning the definition of suitable cavities and the recommended methods for constructing artificial cavities and starts.

B. Population Monitoring

Population monitoring is an essential aspect of red-cockaded woodpecker management and recovery. Only through accurate monitoring can we determine the success and failure of our management actions, and adapt these actions accordingly. Appropriate intensity of monitoring varies with population size, role in recovery, and management objectives. In section 3A we describe four levels of monitoring intensity, give instructions on their use, and discuss their relative usefulness. In this section, we present guidelines for determining recommended monitoring levels for individual populations.

Guidelines

1. Monitor primary core, secondary core, and essential support populations using Level IVa or IVb. Enlist the help of a wildlife statistician if Level IVa is employed.

2. Monitor critically small populations (less than 30 potential breeding groups) on all federal and state lands using Level IVb.

3. Monitor populations undergoing translocation between or within populations (including donor populations) using Level IVa or IVb. If Level IVa is used, monitor donor and recipient neighborhoods within the respective populations intensively.

4. Monitor populations containing mitigation sites using Level IVa or IVb, both before and after the installation of mitigation sites, until successful mitigation is completed.

5. The minimum sample size for all uses of Level IVa monitoring is 25 percent of all active clusters or 30 groups, whichever is greater.

6. Monitor all other populations at Level I, II, III, or IV, depending on landowner or agency objectives.

C. Cavity Management, Artificial Cavities, and Restrictor Plates

Maintaining an adequate number of suitable cavities in each woodpecker cluster is fundamental to the recovery of the species. Loss of cavity trees was a major factor in the species' decline (see 1A), and cavity trees currently limit many populations. This limitation will remain in effect until large old pines are restored throughout the lands managed for red-cockaded woodpeckers. Until large old trees become widely available, artificial cavities and restrictor plates are essential management tools that can bring about population increases, if used carefully and in suitable habitat.

Here we present guidelines for the use of artificial cavities and restrictor plates. The role of cavities in population dynamics and the cooperative breeding system of red-cockaded woodpeckers is discussed in 2B. Further information concerning nesting ecology is provided in 2D. Descriptions of artificial cavity construction techniques and their usefulness are given in 3B. Restrictor plates are also discussed in 3B, and cavity enlargement in general is described in sections 2F and 3B.

Guidelines

1. Maintain the recommended number of suitable cavities in each cluster. A suitable cavity is not enlarged, has a single entrance, and has a solid base. Suitable cavities may be either naturally excavated or artificially constructed.

    a. Maintain at least four suitable cavities in each active cluster.

    b. Maintain at least four suitable cavities, or three suitable cavities and two starts, in each unoccupied recruitment cluster.

2. Use the appropriate method of cavity construction. See 3B for more information.

    a. Use the Copeyon-drilled method when heartwood is sufficient to house the cavity.

    b. Use drilled starts when heartwood is insufficient to house the cavity and cavities are not needed for a year or more. Provide more than one start for each new cavity desired.

c. Use insert cavities when heartwood is insufficient to house a drilled cavity and cavities are needed as soon as possible. Inserts must always be used with full restrictor plates, and all inserts must be coated with a thick layer of Acraglass gel, fiberglass, or acrylic resin. Annual maintenance of cavity inserts prolongs their suitability and minimizes potential injury or mortality to red-cockaded woodpeckers.

d. Avoid using the modified-drilled method (see 3B).

3. Place artificial drilled cavities as high as heartwood diameter of the recipient tree will allow. Do not place cavities above or below the range of natural cavity heights in the surrounding area. Orient entrances so that they are facing west, if possible.

4. Install artificial cavities within 30.5 m (100 ft) of existing cavity trees, if possible. If this is not possible, install them at least within 71 m (200 ft) of the existing cavity trees.

5. Protect the birds from sap leakage. Ensure that no artificial cavity has resin leaking into the chamber or entrance tunnel.

a. Coat all inserts with a thick layer of Acraglass gel, fiberglass, or acrylic resin prior to installation.

b. Screen all drilled starts and drilled cavities with heavy wire mesh (0.64 by 0.64 cm [0.25 by 0.25 in]) for at least four weeks following installation.

c. Inspect cavity interiors when the screens are removed. If resin leaks are detected, keep the screens on and conduct additional checks. Persistent resin leaks into entrance tunnels can be treated with repeated scraping, application of wood putty, replacement of veneer, or redrilling. If severe leaks continue, block the cavity with a wooden plug at least 7.6 cm (3 in) long, and construct a replacement cavity.

d. Construct artificial cavities and starts during the non-growing season to reduce likelihood of leaks.

e. Conduct a second check of all new drilled cavities, inserts, and drilled starts for resin leaks during the first growing season following installation, and screen those found to be leaking.

f. Inspect the interior of all inserts, new and old, at least once each year.

6. Use cavity restrictors judiciously to control cavity enlargement.

a. Use only when necessary on active cavities. Do not restrict all cavities.

b. Use restrictors on a cluster-by-cluster basis to minimize potential damage to any cavity, natural or artificial, by pileated woodpeckers. Only use restrictors if there is a known problem with enlargement by pileated woodpeckers or there is a good possibility, based on past experience, that cavities may be damaged.

c. Use restrictors on all cavity inserts and previously installed modified-drilled cavities.

d. Inspect all restrictors at least once each year and repair if loose or out of place. Do not use restrictors if annual inspections cannot be performed.

e. Do not use on unenlarged cavities for the purpose of excluding cavity kleptoparasites.

D. CLUSTERS AND CAVITY TREES

Conservation and recovery of red-cockaded woodpeckers in today's second- and third-growth forests requires skillful management of their cavity trees and clusters. Successful cluster management has three main parts: (1) protection of existing cavity trees, (2) development and protection of sufficient large, old pines for future cavity trees, and (3) restoration and maintenance of appropriate habitat structure, including sparse and low or no hardwood midstory, low densities of small pines, low to moderate densities of large pines, and abundant native grass and forb groundcovers. We recommend the removal of excessive overstory hardwoods in regions where fire suppression has resulted in the establishment of large hardwood trees. We also recommend that human disturbance within the cluster be minimized.

In this section, we provide guidelines for management of cavity trees and clusters. Information concerning nesting ecology is given in 2D. Any discussion of nesting ecology is not complete without considering fire. The role of fire in the southeastern pine ecosystem, prescribed burning as a management tool, and guidelines for the use of prescribed fire are discussed in sections 2G, 3F, and 8I, respectively.

Guidelines

1. Protect existing cavity trees.

   a. Reduce risk of accidental damage or removal. Mark cavity trees for easy identification.

   b. Protect against fire damage. The application of regular, frequent fire in the clusters is the best method of protecting cavity trees against damage from fires (prescribed or wild) that are too intense. Also, until cavity trees are no longer a limiting resource, use one or more additional methods of protecting individual cavity trees presented in 8I).

c. Protect cavity tree roots. Limit the use of heavy machinery and vehicles within 15.25 m (50 ft) of cavity trees, and do not use at all within 15.25 m (50 ft) of cavity trees in wet areas. Do not establish plow lines within 61 m (200 ft) of cavity trees.

d. Protect against southern pine beetle infestations. Thin dense loblolly and shortleaf pine forests regularly to maintain basal areas of less than 18.4 sq. m per ha (80 sq. ft per acre) or to maintain a minimum average spacing of 7.6 m (25 ft) between trees. Reduce impacts to clusters by removing excessive midstory and overstory hardwoods from outside the cluster, as these serve to funnel the insects toward cavity trees. Minimize physical disturbance to soil and roots during management operations such as thinning, midstory removal, and prescribed burning.

e. Reduce risk of damage from high winds. Retain a 61 m (200 ft) wide barrier of continuous forest around the cluster. Do not provision large numbers of artificial cavities within clusters and do not establish more recruitment clusters than can reasonably be occupied within 1 to 2 years.

Over time, risk of wind damage can be reduced by the development of an open habitat structure that encourages the growth of wind-resistant trees. Conversion to longleaf pine, where appropriate, also can reduce risk from winds.

2. Develop sufficient large and old pines to serve as cavity trees.

a. Retain all potential cavity trees (pines greater than 60 years in age) within clusters, unless pine basal area is above 18.4 sq. m per ha (80 sq. ft per acre) and all trees are above 60 years in age.

b. Supply trees for future cavity trees and clusters in abundance. Grow large, old pines throughout the landscape managed for red-cockaded woodpeckers (see 3E, 8H).

3. Restore and maintain appropriate habitat structure.

a. Control hardwood and pine midstory. Apply prescribed fire to the entire cluster every one to five years, preferably during the growing season. If necessary, remove excessive hardwoods by hand (with chainsaws and brushhooks), mechanical means such as brush-hogging or mulching, one-time application of herbicides to live trees or stumps, or a combination of these methods. Mechanical and chemical methods of control should not be performed when woodpeckers in the cluster are nesting. Recently abandoned clusters should be managed with the same intensity as active clusters. If midstory control throughout the entire cluster is not yet possible, as a minimum remove all midstory vegetation within 16.5 m (50 ft) of each cavity tree.

b. Foster native grasses and forbs. Native grasses and forbs facilitate prescribed burning and are maintained by prescribed burning. Apply frequent growing season fire and avoid soil disturbance that negatively impacts fragile ground covers.

c. Reduce excessive overstory hardwoods. Overstory hardwoods should not total more than 2.3 sq. m per ha [10 sq. ft per acre] of basal area. Retain natural oak inclusions of upland species, such as post, blackjack, turkey, and bluejack oak, if less than the above basal area and if located away from cavity trees. Overstory trees of mesic hardwood species such as sweetgum and maples are generally considered undesirable products of fire suppression and should be removed from red-cockaded woodpecker clusters.

d. Locate recruitment clusters away from stream drainages as often as possible. Although some clusters naturally occur in wetland habitats, use of upland sites as recruitment clusters whenever possible can reduce problems associated with mesic hardwoods.

e. Retain dead and dying cavity trees and other snags.

4. Minimize human disturbance within clusters as much as possible, especially during nesting season.

E. Predators and Cavity Kleptoparasites

Red-cockaded woodpecker populations that are healthy and of medium to large size require no predator control and few measures to combat cavity kleptoparasites. Predators and cavity kleptoparasites were not among the original causes of decline (see 1A), and their removal will not result in population increases. Occasional loss of nests to predators does not affect population size or trend. Maintaining good quality nesting and foraging habitat, and retaining snags throughout the landscape, are the recommended management tools to control kleptoparasitism in all but the smallest populations. Managers of critically small populations of red-cockaded woodpeckers (less than 30 potential breeding groups), especially those in shortleaf and loblolly pine habitats, may choose to use exclusion devices for predator/kleptoparasite control. A less invasive technique, bark-shaving, may be employed in any population to protect newly installed artificial cavities.

We present guidelines for the use of predator and kleptoparasite control below. Research supporting these guidelines is described in detail in 2F. The techniques themselves are described in 3C. Control of cavity enlargement through the use of restrictor plates is required in many populations regardless of population size, and is discussed in 3B and 8C.

Guidelines

1. Use methods of predator control only in small populations (less than 30 potential breeding groups).

2. If snake control measures are considered necessary, use the bark-scraping procedure or metal snake excluder devices. Do not use snake nets—their use is prohibited because of risk to red-cockaded woodpeckers.

3. If squirrel control measures are considered necessary, avoid lethal methods; use squirrel excluder devices.

4. Retain snags in clusters and throughout the landscape, and consider the protection of snags in active clusters during prescribed burns.

5. Consider using nest boxes for species other than red-cockaded woodpeckers.

F. TRANSLOCATION

Translocation is an important management tool for small and/or disjunct populations to be used only in conjunction with aggressive management of nesting and foraging habitat. All translocations should serve to enhance the spatial structure of the population. Potential breeding groups should be developed in locations carefully chosen to link isolated groups or subpopulations and increase territory density. We refer to this critical management concern as strategic recruitment. Strategic recruitment is accomplished by translocating birds from within or outside the population to (1) unoccupied recruitment clusters or (2) clusters containing solitary birds.

Translocation of birds within populations is conducted solely for the purpose of strategic recruitment. Translocation of birds from donor to recipient populations may be used for population augmentation (increasing the size of the recipient population), mitigation (see 4A), and reintroduction (reestablishment of an extirpated population). Again, translocation for population augmentation, mitigation, or reintroduction must also serve to create beneficial spatial arrangements of groups. See 8A for guidelines governing the use of recruitment clusters. See 3D for background information concerning translocation. Because reintroduction is an untested management technique, it is not discussed in detail; contact the Red-cockaded Woodpecker Recovery Coordinator for further information concerning the use of reintroduction. Use of translocation for any purpose requires permits from the U.S. Fish and Wildlife Service as discussed in Appendix 1.

Guidelines

1. Populations Eligible for Within-population Translocation.— Birds can be translocated within a population only if the population meets each of the following requirements:

a. Full administrative support, including valid state and federal permits and staff well-trained in the handling, banding, and transport of birds;

b. A management plan approved by the U.S. Fish and Wildlife Service that includes each of the following.

i. Level IVa or IVb monitoring in place (see 3A, 8B).

ii. A prescribed burning program for both nesting and foraging habitat in place.

iii. Specific identification of objectives and locations of the proposed translocations. Objective of proposed translocations should include definitions of target areas (the area in which birds must be found for the translocation to be judged successful; see 3D).

c. Recipient clusters that are in excellent condition, with a minimum of four suitable cavities per cluster, no or very low midstory within the cluster, and suitable foraging habitat (see 8C, 8D, 8G). Provide no more than two recruitment sites for each potential pair moved.

2. Populations Eligible for Augmentation. A population can receive birds from a donor population (augmentation) only if the receiving population contains fewer than 30 potential breeding groups (or a subpopulation of fewer than 30 potential breeding groups), has a population goal of at least 10 active clusters, and meets criteria a, b, and c listed above.

Not all populations eligible for augmentation will receive birds, because available birds are limited. Whether or not a population receives birds is decided annually based on population need and importance to species recovery.

3. Populations Eligible to Donate Birds. A population may donate birds for translocation only if one of the following conditions is met:

a. Recovery status is recovered, and population trend is stable or increasing,

b. Population goal has been met, and population trend is stable and has been stable for at least 5 years,

c. The population is within 75 percent of its population goal and at least 50 active clusters in size, and population trend is increasing, or

d. Population size is 100 active clusters or greater and population trend is stable or increasing.

Private land populations that do not meet one or more of the criteria identified above may serve as donor populations on a case-by-case basis to be evaluated through consultation with the U.S. Fish and Wildlife Service. Factors considered during the consultation process will include, but not be limited to: (1) benefit to recovery, (2) value to the recipient population, and (3) landowner objectives.

4. Matching Recipient Populations with Appropriate Donors. Recipient and donor populations must be carefully matched to maintain genetic integrity and enhance translocation success by accommodating local adaptations of translocated birds, to the maximum extent possible. Therefore, translocations should be conducted within recovery units whenever possible. Translocations between adjacent recovery units should be conducted if within-unit translocation is not feasible, but must be approved through consultation with the U.S. Fish and Wildlife Service. Translocations between non-adjacent recovery units are prohibited.

5. Recipient Clusters. Translocate birds only to clusters that are:

1. Within 3.2 km (2 mi) of an occupied cluster. This guideline applies to all translocations, whether the translocation is within a population, between populations, to an unoccupied cluster, or to a cluster containing a solitary individual. An exception is made if the translocation is for reintroduction.

2. In excellent condition prior to receiving birds, as stated above. Recipient clusters must have a minimum of four suitable cavities per cluster, no or very low midstory within the cluster, and suitable foraging habitat.

6. Impacts to Donor Neighborhoods. The donor neighborhood is all clusters within 4.8 km (3 mi) of and including the donor cluster(s), based on common dispersal distances of females. Limiting impacts to the donor neighborhood will, in turn, limit negative impacts to the population. For all translocations, minimize impacts to donor neighborhoods by following these guidelines:

a. Establish adequate monitoring of donor neighborhood prior to removing birds.

b. Ensure that donor neighborhood has a minimum average group size of 2.33, as estimated including solitary males. If average group size is below 2.33, do not remove birds from this neighborhood.

c. Ensure that donor neighborhood is not declining in number of active clusters. If decline in number of active clusters is greater than or equal to 5 percent, do not remove birds from this neighborhood.

d. Remove only eligible birds according to the guidelines below.

e. Do not remove excessive numbers of birds. Just how many birds can be removed without excessive impacts to donor neighborhoods and populations is not yet clear. This question requires further research before more specific guidelines can be developed.

7. Birds Eligible for Translocation. Determine which birds may be removed for translocation by following these guidelines:

a. Remove only subadult males or subadult females. A subadult is less than 12 months in age.

b. Remove birds only from their natal territory.

c. Do not remove any males unless there will be at least one male helper or male fledgling remaining in the group after the individual is removed. Do not remove more than two subadult males from any group.

d. Do not remove any females if there is a solitary male within 1.6 km (1 mi) of the natal cluster. Do not remove more than two subadult females from any group.

e. Translocation of any birds not meeting these criteria (above) will be approved on a case-by-case basis through consultation with the Red-cockaded Woodpecker Recovery Coordinator. Moving adult females has been successful but will have detrimental impacts on the donor neighborhood and the population. Translocation of adult males is not allowed, because of its poor likelihood of success and high cost to the donor population.

8. When to Translocate Birds. Translocations can be performed from late September through early March. Translocations early in this period may have lower success, because translocated birds will also experience winter mortality. However, translocations later in this period will have higher impacts on the donor neighborhood and donor populations, because females that have survived the winter have a high likelihood of becoming breeders in their native population. Translocations just before the breeding season are made more difficult by increased movement of birds. More research on the effects of season on translocation is required before more specific recommendations can be made.

9. Procedures for Capture, Transport, and Release. Procedures for the capture, transport, and release of translocated birds are available from the Clemson Field Office of the U.S. Fish and Wildlife Service.

10. Monitoring, Evaluation of Success, and Reporting. Adequate population monitoring, evaluation of success, and reporting are required for regulatory compliance with permits authorizing translocations. Follow these guidelines:

a. Monitor all populations in which translocation is used (including donor populations) at level IVa or IVb (see 3A).

b. Determine success of all translocations by presence or absence of translocated birds within target areas in the following breeding season. Management objectives (identified in management plans) dictate target areas. For example:

i. The objective of mate provisioning is successful only if the translocated bird is found in the target cluster in the following breeding season.

ii. The objective of population augmentation is successful if the translocated bird is found anywhere within the target area in the following breeding season.

c. Report all translocations and translocation attempts, both within and between populations, to the Red-cockaded Woodpecker Recovery Coordinator using the Annual Monitoring Report. Include a description of the management objective, the target area, and the success of the translocation.

G. FORAGING HABITAT

Recent research has expanded our understanding of the foraging ecology of red-cockaded woodpeckers considerably (2E). We know that the structure of foraging habitat is important to fitness of red-cockaded woodpeckers as well as influencing habitat selection. Fitness increases if foraging habitat is burned regularly, has an open character and herbaceous groundcovers, and contains large old trees. Selection of habitat increases with these same characteristics. This structure constitutes good quality foraging habitat for the species. Quality of foraging habitat also affects home range size: as quality increases, the amount of foraging habitat used decreases. We base the following guidelines for the management of foraging habitat on what we now know about both habitat quality and quantity. A general discussion of foraging ecology in presented in 2E, and a detailed rationale for each guideline is given in Table 6 (below).

We present two sets of guidelines. The first set, termed the recovery standard, is to be followed for all populations on federal and state lands. We recommend this standard for those populations on private lands that are being managed for increasing population size. The second set of guidelines, termed the standard for managed stability, is to be followed for populations on private lands being managed for stable rather than increasing population size.

Guidelines

Part A. Recovery Standard.

Follow this standard for all populations on federal and state lands. We recommend this standard for those populations on private lands being managed for increasing population size.

1. Area Provided by Site Productivity.

a. In systems of medium to high site productivity (site index 60 or more), provide each group of woodpeckers 50 ha (125 ac) of good quality habitat as defined below.

b. In systems of low site productivity (site index below 60), provide each group of woodpeckers 80 to 120 ha (200 to 300 ac) of good quality habitat as defined below. (We recognize that some aspects of the following definition of good quality habitat may not be achievable on extremely dry or wet sites. See discussions below on geographic variation in habitat for more information.)

2. Definition of Good Quality Foraging Habitat. Good quality foraging habitat has some large old pines, low densities of small and medium pines, sparse or no hardwood midstory, and a bunchgrass and forb groundcover. Based on results of studies described in 2E and Table 6, good quality habitat has all of the following characteristics:

a. 45 or more pines per ha (18 or more per acre), of pines that are at least 60 years in age *and* at least 35 cm (14 in) dbh. Recommended minimum rotation ages apply to all land managed as foraging habitat.

b. Basal area of all pines 10 cm (4 in) dbh between 9.2 and 13.8 sq. m per ha (40 to 60 sq. ft per acre) for longleaf systems and between 9.2 and 18.4 sq. m per ha (40 and 80 sq. ft per acre) for loblolly and shortleaf forests.

c. Basal area of all pines 10.2 to 25.4 cm (4 to 10 in) dbh less than 2.3 sq. m per ha (10 sq. ft per acre) *and* less than 50 stems per ha (20 per acre).

d. Groundcovers of native bunchgrass and/or other native, fire-tolerant, fire-dependent herbs totaling 40 percent or more of ground and midstory plants and dense enough to carry growing season fire at least once every 5 years.

e. No hardwood midstory or a sparse hardwood midstory that is less than 2.1 m (7 ft) in height.

f. Canopy hardwoods absent or less than 10 percent of canopy trees in longleaf forests and less than 20 percent of canopy trees in loblolly and shortleaf forests.

g. Fifty percent or more of this habitat within 0.4 km (0.25 mi) of the cluster is preferred; all must be within 0.8 km (0.5 mi).

h. Foraging habitat may not be separated by more than 61 m (200 ft) of non-forested land.

3. Discussion of Habitat Types.

a. Longleaf Pine. Longleaf pine communities vary from highly xeric to mesic and seasonally wet (see 2E), and each of these can support red-cockaded woodpeckers if the habitat structure is suitable. Red-cockaded woodpeckers in some highly xeric sites, such as Eglin Air Force Base in Florida, have very large home ranges, and it is thought that these large home ranges may be related to sparse groundcovers and low density of large old trees. Thus, we recommend that between 80 to 120 ha (200 and 300 ac) of good quality foraging habitat in sites of low productivity. Note that these areas do not refer to home range size in this habitat type, but the recommended amount of good quality foraging habitat within the home range. The latter may be much larger, due to unsuitable areas and home range overlap.

Extremely dry and extremely wet longleaf habitats may be unable to support some of the characteristics identified for good quality habitat. Pine sizes, pine density, and groundcover density may be below those specified above. Failure to meet these three criteria in extremely dry and extremely wet sites is understandable, as long as habitats are burned frequently and conscientious restoration is underway. Further research will help determine the extent of the natural ability of these habitats to support longleaf pines, native groundcovers, and red-cockaded woodpeckers at higher densities.

b. Shortleaf Pine. Historically, shortleaf pine communities included those without hardwoods, those with a small hardwood component, and those dominated by hardwoods. For red-cockaded woodpeckers, some shortleaf habitats, especially those on upland areas, should be free or almost free of hardwoods. Other habitats, such as those grading into mesic sites and north facing slopes, may support more hardwood overstory (up to 20 percent) and still be important red-cockaded woodpecker foraging habitat. Overstory hardwoods should not be removed entirely from communities in which they were historically present; however, neither should they be allowed to dominate a historic pine site. Stands with a hardwood component greater than 20 percent are not considered suitable foraging habitat for red-cockaded woodpeckers.

c. South Florida Slash Pine. Foraging ecology of red-cockaded woodpeckers in native slash pine communities in south Florida has received little research attention. It is clear, though, that home ranges of red-cockaded woodpeckers in native slash pines are unusually large. It is also clear that hydric slash pine flatwoods do not support the size of pines, and may not support the pine density,

recommended in the Recovery Standard (above). Until further information is available, we can make only intermediate provisions for these populations. Each group in south Florida slash pine habitat is to be provided at least 80 to 120 ha or more (200 to 300 ac) of good quality foraging habitat containing mature and old pines and healthy native groundcovers that are frequently burned. Again, this is not the home range size but the amount of good quality habitat to be provided. Further research will help determine the density to which south Florida slash pines can be restored, as well as the specific requirements of red-cockaded woodpeckers in this unique habitat type.

d. Pond Pine. Ecology of red-cockaded woodpeckers in pond pine communities is virtually unknown. Catastrophic natural fire regimes of these communities confound red-cockaded woodpecker management. Certainly, reintroduction of fire and restoration of an open habitat structure are important. We recognize that the above definition of good quality habitat may not apply to this habitat type but can offer no alternative at this time. Further research is necessary before more specific recommendations can be made for this habitat type.

e. Non-native Pine Species. Although foraging ecology in sites covered by non-native pines such as loblolly and slash has not been well researched, there is no reason to suspect that the foraging recommendations presented above are not applicable to these populations.

TABLE 6. Rationale for foraging guidelines based on habitat structure[1] (recovery standard).

	Recommendation	Rationale	Source
1a	50 ha (125 ac) good quality habitat	Home range/foraging habitat required decreases with habitat quality.	Walters *et al*. 2000
		51 ha (126 ac) good quality habitat recommended.	James *et al*., in press
		Average home range of groups with access to old-growth foraging (Wade Tract, GA) is 47 ha (116 ac), including overlap.	Engstrom and Sanders 1997
1b	More foraging required for sites of low productivity	Large home ranges in Eglin Air Force Base and South/Central Florida.	DeLotelle *et al*. 1987 Beever and Dryden 1992 Hardesty *et al*. 1977
2a	$\geq$ 45 pines/ha (18/ac) that are at least 35 cm dbh (14 in) and 60 yr.	Group size and reproduction increase with density of large pines; recommended 40 35 cm. pines per ha (16 14 in pines per acre).	James *et al*. in press
		RCW's selected stands with 50 or more pines at least 35 cm in dbh per ha (20 or more pines at least 14 in dbh per ac).	Walters *et al*. 2000
		Group size increases with number of flat-tops per acre.	Walters *et al*. 2000
		Pines and patches of pines selected if over 60 yrs. in age.	Zwicker and Walters 1999 Walters *et al*. 2000
		RCW's select large old pines in greater proportion than their availability.	Hooper and Lennartz 1981 DeLotelle *et al*. 1983, 1987 Hooper and Harlow 1986 Porter and Labisky 1986 Jones 1994 Epting *et al*. 1995 Engstrom and Sanders 1997 Hardesty *et al*. 1997 Bowman *et al*. 1998 Doster and James 1998 Zenitsky 1999 Zwicker and Walters 1999 Walters *et al*. 2000

Table continued next page.

TABLE 5. Rationale for foraging guidelines based on habitat structure[1] (recovery standard).

	Recommendation	Rationale	Source
2b	Basal area of pines ≥ 10 cm (4 in) dbh 9.2-13.8 sq. m/ha (40-60 sq. ft/ac) for longleaf pine, 9.2-18.4 sq. m/ha (40-80 sq. ft/ac) for loblolly/shortleaf pine	Basal areas above these ranges were found to be detrimental to group size and/or productivity.	James *et al.* 1997 Hardesty *et al.* 1997 Walters *et al.* 2000 James *et al.*, in press
		RCW's avoided patches with basal areas below these ranges.	Walters *et al.* 2000
2c	Basal area of pines 10-25 cm (4-10 in) dbh < 2.3 sq. m/ha (10 sq. ft/ac)	Density of small pines negatively affected group size and productivity; recommended this density.	James *et al.* 1997 James *et al.*, in press
		Selection of patches and stands decreased with densities above this level.	Walters *et al.* 2000
		High densities of small pines negatively affect stand use in general.	Porter and Labisky 1986 Bradshaw 1995
2d	Herbaceous groundcovers ≥ 40% of groundcovers	Group size and reproduction increases with herbaceous groundcovers; this level recommended.	Hardesty *et al.* 1997 James *et al.* 1997 James *et al.*, in press
2e	Hardwood midstory below 2.1 m (7ft).	Patches with midstory below 2.1 m (7 ft) were preferred. Stand use decreased with midstory above 2.1 m (7 ft).	Walters *et al.* 2000
		Patch and stand use decreases with midstory in general.	Hooper and Harlow 1986 Jones 1994 Epting *et al.* 1995 Bradshaw 1995 Doster and James 1998
2f	Canopy hardwoods < 20% of canopy trees	Large hardwoods negatively affect habitat selection; Jones (1994) found a negative effect above 10%.	Jones 1994 Bradshaw 1995
2g, 2h	Within 0.8 km (0.5 mi), not separated by more than 61 m (200 ft) non-forested land.	Fragmentation of foraging habitat negatively affects red-cockaded woodpeckers.	Conner and Rudolph 1991b Rudolph and Conner 1994 Conner and Dickson 1997 Ferral 1998

[1]Foraging guidelines are based on structural components rather than total number of pines ≥ than 10 in DBH because of the evidence presented in this table and because no relationship has been found between this variable and group size or reproduction (Hooper and Lennartz 1995, Beyer *et al.* 1996, Wigley *et al.* 1999).

Part B. Standard of Managed Stability.

Some populations on private lands are managed to maintain rather than to increase existing population size. In these situations, it may be unreasonable to expect managers to provide the quantity and quality of foraging habitat that, based on scientific evidence, is likely to support an increasing, managed population and eventually a large, stable, minimally-managed population (i.e., the recovery standard). Therefore, we present an alternative set of foraging guidelines for groups in populations on private lands managed to maintain existing population size. Because our understanding of foraging requirements is not yet sufficient to identify the specific level of foraging resources at which a population changes from stable to increasing (see recovery task 5.9.), these guidelines are based on existing minimum amounts of foraging resources of groups known to be surviving and reproducing at least in the short-term.

Red-cockaded woodpeckers can benefit by the establishment of lower guidelines for populations in which only stability rather than increasing trends is required, because lower guidelines encourage private landowners to enroll in conservation agreements and participate in active management. Flexibility in guidelines, within appropriate boundaries, is an important component of successful conservation on private lands because it fosters cooperation rather than resentment (see 4A). However, these guidelines are presented with a caveat: stability of small populations cannot be attained without additional management (such as use of artificial cavities and/or translocation; see 3B, 3D, 8C, 8F). Thus, we refer to these guidelines as the standard for managed stability. The standard for managed stability is as follows:

1. Provide each group of red-cockaded woodpeckers a minimum of 689 sq. m (3000 sq. ft) of pine basal area, including only pines $\geq$ 25.4 cm (10 in) dbh.

2. Provide the above pine basal area on a minimum of 30.4 ha (75 ac).

3. Count only those pines in suitable habitat that, for this standard only, has each of the following characteristics:

a. Stands that are at least 30 years old and older.

b. An average pine basal area of pines $\geq$ 10 cm (4 in) between 9.2 and 16.1 sq. m per ha (40 and 70 sq. ft per ac).

c. An average pine basal area of pines $\leq$ 25.4 cm (10 in) less than 4.6 sq. m per ha (20 sq. ft per ac).

d. Little or no hardwood midstory (below 7 ft).

e. Total stand basal area, including overstory hardwoods, less than 23.0 sq. m per ha (100 sq. ft per acre).

f. We recommend that all land counted as foraging habitat be within 0.4 km (0.25 mi) of the cluster.

g. Frequent prescribed burning of foraging habitat, especially during the growing season, is strongly recommended. Development and protection of herbaceous groundcovers facilitates prescribed burning and benefits red-cockaded woodpeckers.

As stated above, the standard for managed stability can benefit red-cockaded woodpeckers on ownerships not legally required to recover the species, because it encourages cooperation between landowners and the U.S. Fish and Wildlife Service. Previous guidelines for privately owned lands facilitated the development of successful Safe Harbor Agreements and Memoranda of Agreement (see 4A). Again, research to date does not adequately support the designation of foraging habitat that will result in stable vs. increasing populations, so these guidelines have been developed using minimum observed values for successfully reproducing groups. For the most part, the standard for managed stability reflects previous guidelines for private lands. Changes include requirements of slightly more minimum acreage, lower maximum pine densities, and higher minimum pine densities. These modifications were made based on results of recent research described in detail in 2E.

H. SILVICULTURE

Silviculture is an important tool for conservation, management, and recovery of red-cockaded woodpeckers. We describe silvicultural methods and techniques in 3E. Guidelines for their use are given below.

Guidelines

1. Use two-aged management, uneven-aged management, or low intensity management to manage habitat for red-cockaded woodpecker populations on public lands.

a. If two-aged management is used, then

i. Use rotation intervals not less than 120 years for longleaf and shortleaf pines and 100 years for loblolly, slash, and pond pines.

ii. Limit regeneration areas to less than 10.1 ha (25 ac).

b. If uneven-aged management is used, then

i. In foraging habitat, retain 20 or more trees per acre of pines at least 35 cm (14 in) dbh and 60 years in age.

ii. In active and recruitment clusters, retain 5 or more trees per acre of pines at least 120 years in age for longleaf and shortleaf and 100 years in age for loblolly, slash, and pond pines.

2. Use even-aged, two-aged, and/or uneven-aged management systems to restore off-site pines to native pine species. Limit size of regeneration areas for restoration to 10 ha (25 ac) or less.

3. Retain trees of highest importance to red-cockaded woodpeckers (older, old, and very old pines including flat-tops, potential cavity trees, and scarred old pines), regardless of silvicultural system.

4. Maintain densities of pines 10 cm (4 in) dbh between 9.2 and 13.8 sq. m per ha (40 to 60 sq. ft per acre) for longleaf systems and between 9.2 and 18.4 sq. m per ha (40 and 80 sq. ft per acre) for loblolly and shortleaf forests.

5. Use the least invasive form of site preparation possible given habitat conditions. In most instances, prescribed burning is the preferred method.

I. PRESCRIBED BURNING

Prescribed burning is basic to the management, conservation, and recovery of red-cockaded woodpeckers. In addition, prescribed burning provides benefits for a long list of species associated with southern pine/bunchgrass ecosystems, many of which are rare, threatened, or endangered. Discussions of the integral role of fire in southern pine ecosystems and the use of prescribed fire are given in 2G and 3F. Prescribed burning should mimic natural fire regimes as closely as possible, but must be carefully planned and conducted to reduce the likelihood of damage to nesting and foraging habitat. In general, managers are to work toward a prescribed burning program of early to mid-growing season burns on a 1 to 5 year return interval.

Guidelines

1. Planning a Prescribed Burning Program. In planning a prescribed burning program, follow these guidelines:

a. Prioritize areas of the forest in need of burning.

i. Review the status of red-cockaded woodpeckers throughout the forest, and focus burning effort on sections of the population that are declining due to lack of fire.

ii. Give first priority to active clusters with excessive hardwood midstory.

iii. Give second priority to recently inactive clusters with excessive midstory.

b. As special needs are being addressed, move to implement an effective broad-scale burning program to maintain and enhance quality of nesting and foraging habitat.

2. Burn Prescriptions. Prepare burn prescriptions for each burn unit prior to conducting prescribed burning based on habitat evaluations for individual woodpecker groups. Each prescription should include:

a. The management objective of the burn, such as habitat restoration, habitat maintenance, or fuel reduction.

b. The parameter values necessary to achieve the objective, including season of burn, fuel moisture, wind speed and direction, and relative humidity. Prescribed burns should never be conducted on days when environmental conditions are outside parameter values specified in the prescription.

c. Maps indicating the location of all cavity trees within the burn unit as well as specific directions for protecting each of these cavity trees.

In light of stringent laws regulating smoke management, it is imperative that all prescribed burns comply with state and federal regulations.

3. Season of Prescribed Burning. Determine the appropriate season for prescribed burns based on management objectives. Consider the following guidelines when determining appropriate season:

a. Strive for a program of frequent early to mid-growing season burns to maintain and enhance quality of nesting and foraging habitat.

b. Apply dormant season fire prior to growing season burns when reintroducing fire to fire-suppressed habitats, but be aware that fires conducted during the late growing season and into the fall can greatly increase pine mortality. Growing season burns can be used in habitat restoration in some sites (see 3G and below).

c. Do not rely on dormant season fire. Once hazardous fuel accumulations have been reduced by dormant season burns, place the area on a growing season fire rotation.

d. Bear in mind geographic variation in the timing of the seasons.

e. Remember that regardless of the season, heavy fuels are very dangerous to cavity trees. During dormant season as well as growing season burns, thick duff layers surrounding can result in deadly smolder fires.

4. Size of Burn Units. Size of prescribed burns can vary from single clusters to over a thousand hectares (several thousand acres). In general, larger burns have a lower cost per hectare (acre) and provide the greatest benefit to the ecosystem. However, cost efficiency should not be the sole factor in determining the size of burn units. The prescribed burn should be large enough to accomplish the primary objective of the burn without reducing the burn boss's ability to maintain control of the fire's intensity.

5. Cavity Tree Protection. Protect cavity trees within and in close proximity to the burn unit, following these guidelines:

a. Ensure that all members of the burn crew have maps detailing the location and status of all cavity trees within and in close proximity to the burn unit. Information distributed to each crew member should include activity status, cavity height, and relative amount of resin present, as determined by surveys performed within one year of the burn date.

b. Determine the appropriate level of protection for cavity trees, according to the following:

i. Protect active and inactive cavity trees (excluding starts) within the burn unit if one or more of the following conditions exist: (1) the population consists of 50 active clusters or less; (2) fire intensity of the prescribed burn will likely result in the cavity tree ignition; or (3) potential cavity trees (i.e., pines over 60 years in age) are limited.

ii. Protect active cavity trees within the burn unit if all of the following conditions exist: (1) the population consists of more than 50 active clusters; (2) the area proposed for burning has been burned in recent years and the fuel loads have been reduced to acceptable limits; (3) fire intensity of the prescribed burn will not likely result in the ignition of active cavity trees; and (4) potential cavity trees are not limited.

c. Protect individual cavity trees by reducing fuels at the base of cavity trees for a distance of 1.5 to 15.2 m (5 to 50 ft) from the trunk. The necessary distance varies depending on fuel types, fuel loads, amount of resin present, cavity heights, and firing technique as well as on the objective of the burn. Restoration burns require a greater raking distance than less intense maintenance burns. Use maximum distances during the nesting season and when protecting cavity trees with turpentine scars.

d. Use one or more of the following methods of cavity tree protection:

i. Small preparation burns. Conduct preparation burns of the cluster or areas surrounding individual cavity trees before conducting the larger burn. Preparation burns can be performed immediately before or several weeks ahead of the larger burn. Carefully monitor and extinguish preparation burns to avoid damage to cavity trees or unintentional ignition of the larger burn unit. A strong advantage of this method is that it benefits groundcover plants that are harmed by other methods such as raking and mowing (below).

ii. Raking. Rake fuels far enough from the trunk to prevent cavity tree ignition. Avoid the formation of mounds or rings of concentrated fuels (such as pine straw); such piles of fuels can cause greater mortality than if no action had been taken. Remove small trees and shrubs by hand prior to raking fuels.

iii. Mowing. Mowing is effective, but heavy machinery can compact soils and damage tree roots. To reduce these negative impacts, avoid repeated mowing and use of heavy equipment, and minimize use of machinery in wet sites.

iv. Lightly scraping the bark from ground to breast height improves the effectiveness of other methods such as raking and mowing.

v. Wetting the cavity trees. A solution of water and foaming agent can be used to apply foam to the base of cavity trees. Foam has a greater residence time than water alone and also requires less water for each tree. Foam is especially effective in combination with mowing or raking but care should be taken not to apply too much foam resulting in the buildup of fuels below cavity trees.

vi. Never install circular plow lines around individual cavity trees because such plow lines can cause the death of the tree.

e. Consider a let-burn policy for wildfires. Fires that are ignited naturally or accidentally, but are allowed to continue burning, should be considered prescribed fires and any cavity trees in the fire's path and adjacent areas should be protected accordingly. In addition, emergency fire suppression personnel should be familiar with cavity protection methods and the need to avoid damage to cavity tree roots from firebreaks plowed too closely to cavity trees.

6. Method of Ignition. Apply fire to the landscape using aerial or ground ignition. Ground ignition requires less financial resources and training requirements. Aerial

ignition increases the area burned per unit time, and improves dispersal of smoke. Either technique is suitable, and both are discussed in 3F.

If using aerial ignition, provide a greater degree of cavity tree protection than normally provided for burns ignited on the ground. Rake, mow, or burn for a distance of at least 6.1 m (20 ft) or more from the cavity trees. Even greater protection is necessary if the area has not been burned frequently and the habitat requires restoration. If restoration is required, we recommend a prescribed burn of the cluster ignited on the ground prior to igniting the larger burning unit from the air.

7. Restoration Burning. Restoration burning and the reintroduction of fire can be used to reduce or remove dense hardwood midstories. When applying restoration burns, have fire suppression equipment on site in case the fire crosses control lines. Clusters on deep, sandy soils, with a dense hardwood midstory and a sparse accumulation of ground fuels, can be effectively treated with a restoration burn during the growing season.

Key to success of this management action is a thorough understanding of fire behavior in those fuel types under a variety of weather conditions. The use of fire for restoration purposes often requires burning under very specific weather parameters including those conditions identified as extreme fire weather conditions. Typically, these parameters include modest to high wind speeds, a low relative humidity, and low fuel moistures. Use of prescribed burns under these conditions requires extensive experience in the application of growing season fire and should only be attempted by experienced burners.

9. RECOVERY TASKS

The following recovery tasks are presented as a stepdown outline, a format required by the U.S. Fish and Wildlife Service's recovery planning guidelines. Ecology and management techniques relevant to these tasks are described in the Introduction. Management guidelines are given in detail in previous sections of Recovery. Specific guidelines relevant to tasks are referred to in parentheses.

1. Increase existing populations on all federal lands, and on those state lands identified in recovery criteria, until population objectives are reached.

1.1. Protect existing active clusters.

1.1.1. Apply prescribed burns every 1 to 5 years, preferably during the growing season (included in task 1.7., see 8I).

1.1.2. Provide and maintain four suitable cavities per cluster, if necessary using artificial cavities and/or restrictor plates (8C).

1.1.3. Control midstory and overstory hardwoods using means other than prescribed fire as necessary, but minimize disturbance to soil and native herbaceous groundcovers (8D, 8H).

1.1.4. Retain and protect active and inactive cavity trees and potential cavity trees (8D, 8H).

1.2. Provide and maintain a sufficient number of recruitment clusters to achieve an annual average rate of population increase between 5 and 10 percent (8A).

1.2.1. Choose strategic locations for recruitment clusters, to facilitate occupation and develop beneficial spatial arrangements of groups (8A).

1.2.2. Restore suitable habitat structure prior to the installation of artificial cavities in recruitment clusters, using prescribed fire and other means as necessary to remove midstory and overstory hardwoods. Conduct pine thinning if densities are too high. Minimize disturbance to soils and native herbaceous groundcovers (8D, 8G, 8H, 8I).

1.2.3. Provision a number of recruitment clusters equal to 10 percent of potential breeding groups (or number of active clusters, if potential breeding groups is unknown). For each recruitment cluster, provide 3 artificial cavities and two drilled starts, or four artificial cavities (8A, 8C).

1.2.4. Apply prescribed burns to unoccupied recruitment clusters every 1 to 5 years, preferably during the growing season (8I).

1.2.5. When occupied, manage recruitment clusters as in 1.1 above.

1.3. Provide suitable quality and quantity of foraging habitat for each active and recruitment cluster, following the recovery standard (8G).

1.3.1. Apply prescribed fire to foraging habitat every 1 to 5 years, preferably during the growing season, to protect and restore native herbaceous groundcovers and control densities of midstory hardwoods and pines (8G, 8I).

1.3.2. Use means other than prescribed fire, if necessary, to control densities of midstory and overstory hardwoods and small and medium-sized pines (8G, 8H).

1.3.3. Protect and/or develop an old-growth or mature pine component within the foraging habitat, at recommended densities (8G, 8H).

1.3.4. Provide suitable quantity of good quality foraging habitat (8G).

1.4. Combat effects of fragmentation on demography and genetic resources.

1.4.1. Locate newly developed recruitment clusters of artificial cavities in strategic locations to enhance natural dispersal (same as task 1.2.1).

1.4.2. Use within-population translocation when appropriate to stabilize and increase isolated sub-populations (8F).

1.4.3. Consider population augmentation if your population is less than 30 potential breeding groups, through enrolling in a regional translocation program (8F). Provide excellent nesting and foraging habitat prior to translocation (8C, 8D, 8G).

1.4.4. Avoid further fragmentation of forests managed for red-cockaded woodpeckers (8H).

1.5. Provide additional habitat for population growth to achieve population objectives.

1.5.1. Use appropriate silvicultural techniques to produce suitable foraging and nesting habitat for future population expansion (8H).

1.5.2. Restore historic vegetation type (e.g., longleaf and shortleaf pine communities) where appropriate (8H).

1.6. Monitor woodpecker populations using Level IVa or IVb monitoring systems (8B).

1.7. Apply prescribed fire to all habitat managed for red-cockaded woodpeckers at least every 3 to 5 years (tasks 1.1.1, 1.2.4, and 1.3.1).

2. Maintain and/or increase populations on state lands not identified in recovery criteria.

2.1. Provide regulatory and economic incentives for state managers to participate in recovery efforts.

2.2. Enlist managers in statewide and regional recovery programs and partnerships.

2.3. Protect existing active clusters and encourage population increase (see tasks 1.1-1.7).

3. Maintain and/or increase populations on private lands, and establish new populations.

3.1. Provide regulatory and economic incentives for private landowners to participate in recovery efforts.

3.2. Enroll private landowners in management, conservation, and recovery programs, including Safe Harbor, Habitat Conservation Plans, and Memoranda of Agreement.

3.3. Provide awards to private landowners, both citizens and corporations, for exemplary conservation efforts.

3.4. Protect existing active clusters and encourage population increase (see tasks 1.1-1.7.).

4. Increase awareness of stakeholders and the general public.

4.1. Increase awareness of red-cockaded woodpecker ecology, status, and recovery.

4.2. Increase awareness of the role of fire in southeastern ecosystems and the need for prescribed burning.

4.3. Increase awareness of the need to restore an old-growth pine component to federal, state, and private lands of the south.

5. Conduct research to further our understanding of woodpecker ecology, management, and recovery.

5.1. Explore and evaluate best management practices to increase populations at a rate appropriate for the recovery potential and habitat availability of individual populations.

5.2. Expand current understanding of relationships between condition of foraging habitat (structure, age, and species composition) and measures of group fitness and population health, for various habitat types such as mesic and xeric longleaf pine, south Florida slash pine, pond pine, and shortleaf pine systems.

5.3. Expand current understanding of the relationships between condition of nesting habitat (density of pines, age of cavity trees, and groundcover composition) and measures of group fitness and population health.

5.4. Research conditions and factors that promote territorial budding and pioneering.

5.5. Further evaluate genetic threats.

5.6. Gain a better understanding of effects of cavity kleptoparasitism and predation on population dynamics, for various population sizes and trends.

5.7. Further research juvenile dispersal, especially factors promoting movements between populations.

5.8. Identify the thresholds at which quantity and quality of foraging habitat affect population trends, to better evaluate management of woodpeckers on private lands.

5.9. Further evaluate the relative benefits and drawbacks of artificial cavity installation methods.

6. Explore costs, benefits, and feasibility of moving from management based on single clusters to landscape level management.

6.1. On federal lands.

6.2. On state lands.

6.3. On private lands.

10. IMPLEMENTATION SCHEDULE AND ESTIMATED COSTS

We present several tables in this section. First is the implementation schedule and estimated costs for each recovery task (Table 7). These costs are given per unit (e.g., per active cluster, or per unit area). Next are tables of estimated time to delisting (Table 8) and downlisting (Table 9), as calculated by projecting a 10 percent annual increase up to size 100 active clusters and a 5 percent annual increase thereafter. Finally, there are tables that illustrate estimated costs, by recovery population and responsible agency, for three recovery tasks: cavity maintenance (Table 10), cavity installation in recruitment clusters (Table 11), and frequent prescribed burning of all woodpecker habitat (Table 12).

Key to Implementation Schedule (by Column Headings)

Task: Recovery task from stepdown outline, section 9. See section 8 for guidelines.

Task No.: Task number identified in stepdown outline (see 9).

P: Priority assigned to recovery task, according to the following:

1. Tasks that must be completed to meet delisting criteria (see 6).
2. Tasks that should be done to help meet recovery objective (see 5).
3. Tasks that should be done to enhance management of the species.

D: Duration of recovery task. Two levels are identified here:

C. Continuous, up to and after delisting.

D. Until delisting. Estimated time to delisting is approximately 67 years, assuming a 10 percent growth rate for recovery populations under 100 active clusters and a 5 percent growth rate above that size, until population size required for delisting is met (see Table 8).

Resp. Parties: Agencies and other parties responsible for the completion of task. Abbreviations are as follows:

AF	U.S. Air Force
ARMY	U.S. Army
DOE	U.S. Department of Energy
FS	U.S. Forest Service
FWS	U.S. Fish and Wildlife Service
FDF	Florida Division of Forestry
FFWCC	Florida Fish and Wildlife Conservation Commission
MC	U.S. Marine Corps
NAVY	U.S. Navy
NCWRC	North Carolina Wildlife Resources Commission
SCFC	South Carolina Forestry Commission
STATES	All state agencies with occupied properties
PI	Principal investigators
ALL	All of the above

Cost Estimates: The figures in this column represent the estimated annual cost of each task, to the best of our abilities. Additional tables (Tables 10, 11, and 12) present expanded costs for select tasks.

Other Abbreviations in the Implementation Schedules:

FY	fiscal year
tbd	to be determined

TABLE 7. Implementation schedule and estimated costs by recovery task. See key (previous page) for explanation of abbreviations; see notes (below) for explanation of cost estimates. For more information on select tasks, see Tables 10, 11, and 12.

Task	Task No.	P	D	Resp. Parties	Cost Estimates ($1) FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Increase All Federal and Specific State Populations														
Nesting Habitat, Active Clusters														
Prescribed burning	1.1.1	1	C	AF ARMY DOE FS FWS FDF FFWCC MC NAVY NCWRC SCFC	37/ha (15/ac)[1]	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)
Cavity installation and restriction (see Table 10)	1.1.2	1	R	"	200/ active cluster[2]	200/ active cluster	100/ active cluster	100/ active cluster	100/ active cluster	100/ active cluster	100/ active cluster	100/ active cluster	100/ active cluster	100/ active cluster
Other hardwood control	1.1.3	1	C	"	0-200/ha (0-80/ac)[3]	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)
Protect cavity trees	1.1.4	1	C	"	Included in prescribed burning costs above									
Nesting Habitat, Recruitment Clusters														
Strategic locations	1.2.1	1	R	"	0	0	0	0	0	0	0	0	0	0
Initial habitat restoration	1.2.2	1	R	"	0-200/ha (0-80/ac)[3]	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)
Cavity installation (see Table 11)	1.2.3	1	R	"	800/ cluster[4]	800/ cluster	800/ cluster	800/ cluster	800/ cluster	800/ cluster	800/ cluster	800/ cluster	800/ cluster	800/ cluster
Maintenance burning	1.2.4	1	R	"	37/ha (15/ac)[1]	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)
Appropriate management when occupied (task 1.1)	1.2.5	1	C	"	Included in task 1.1									

Table continued next page.

TABLE 7 (cont.). Implementation schedule and estimated costs by recovery task.

Task	Task No.	P	D	Resp. Parties	Cost Estimates ($1) FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Increase Federal and Specific State Populations (cont.)														
Foraging Habitat														
Prescribed burning	1.3.1	1	C	AF ARMY DOE FS FWS FDF FFWCC MC NAVY NCWRC SCFC	37/ha (15/ac)[1]	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)
Other hardwood or pine control	1.3.2	1	C	"	0-200/ha (0-80/ac)[3]	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)	0-200/ha (0-80/ac)
Develop mature pines	1.3.3	1	C	"	0	0	0	0	0	0	0	0	0	0
Provide suitable quantity	1.3.4	1	C	"	0	0	0	0	0	0	0	0	0	0
Combat Fragmentation				"										
Strategically locate recruitment clusters (same as task 1.2. 1)	1.4.1	1	R	"	0	0	0	0	0	0	0	0	0	0
Within-pop. translocation	1.4.2	2	R	"	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
Population augmentation, pops. < 30 pbg only	1.4.3	2	R	"	2000-6000/ new pbg[5]	2000-6000 /new pbg	2000-6000 /new pbg	2000-6000 /new pbg	2000-6000 /new pbg	2000-6000 /new pbg	2000-6000 /new pbg	2000-6000 /new pbg	2000-6000 /new pbg	2000-6000 /new pbg
Avoid fragmentation	1.4.4	1	C	"	0	0	0	0	0	0	0	0	0	0
Develop Additional Habitat														
Silviculture	1.5.1	1	R	"	0	0	0	0	0	0	0	0	0	0
Habitat restoration	1.5.2	1	R	"	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd

Table continued next page.

TABLE 7 (cont.). Implementation schedule and estimated costs by recovery task.

Task	Task No.	P	D	Resp. Parties	Cost Estimates ($1) FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Increase Federal , Specific State Populations (cont.)														
Monitor at Level IV	1.6	1	C	AF ARMY DOE FS FWS FDF FFWCC MC NAVY NCWRC SCFC	750/ cluster sampled[6]	750/ cluster sampled	750/ cluster sampled	750/ cluster sampled	750/ cluster sampled	750/ cluster sampled	750/ cluster sampled	750/ cluster sampled	750/ cluster sampled	750/ cluster sampled
Burn all habitat in HMA at least every 3-5 yrs. (tasks 1.1.1, 1.2.4, 1.3.1; see Table 12)	1.7	1	C	"	37/ha (15/ac)[1]	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)	37/ha (15/ac)
Maintain and/or increase all other state populations														
Provide incentives	2.1	2	C	STATES USFWS	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
Enlist in programs	2.2	2	R	"	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
Protect existing clusters, encourage increases	2.3	2	C	"	See tasks 1.1 – 1.7									
Maintain and/or increase populations on private lands														
Provide incentives	3.1	2	C	"	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
Enlist in programs	3.2	2	R	"	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
Protect existing clusters, encourage increases	3.3	2	C	"	See tasks 1.1 – 1.7									
Increase public awareness														
Ecology, status, recovery	4.1	2	C	ALL	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
Importance of fire	4.2	2	C	ALL	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
Importance of old pines	4.3	2	C	ALL	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd

Table continued next page.

TABLE 7 (cont.). Implementation schedule and estimated costs by recovery task.

Task	Task No.	P	D	Resp. Parties	Cost Estimates ($1*1000) FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Research needs														
Best management to increase populations	5.1	1	tbd	PI	200	200	200	200	200	200	200	200	200	200
Foraging habitat & fitness, in various habitat types	5.2	1	tbd	PI	200	200	200	200	200	200	100	100	100	100
Nesting habitat & fitness	5.3	1	tbd	PI	100	100	100	100	100	100	0	0	0	0
Budding & pioneering	5.4	2	tbd	PI	100	100	100	100	0	0	0	0	0	0
Genetic threats	5.5	2	tbd	PI	50	50	50	50	50	50	0	0	0	0
Cavity kleptoparasitism & predation	5.6	3	tbd	PI	30	30	30	30	0	0	0	0	0	0
Dispersal	5.7	2	tbd	PI	100	100	100	100	100	100	0	0	0	0
Foraging & private lands	5.8	2	tbd	PI	200	200	200	200	0	0	0	0	0	0
Cavity installation methods	5.9	3	tbd	PI	30	30	30	30	30	30	30	30	0	0

[1]Estimate for prescribed burning is a well-known figure in the field.
[2]Estimate for artificial cavity installation includes salary, equipment, overhead, and associated costs.
[3]Estimate for chemical and mechanical control varies within this range, well-known in the field.
[4]Estimate for cavity installation in recruitment clusters is four times the cost per cavity (4 x $200).
[5]Estimate for translocation for population augmentation is based on price per bird ($1000), success rate (varies between 25 and 50%), and movement of one or two birds; does not include costs of constructing recruitment clusters.
[6]Estimate for monitoring is based on survey of federal properties' annual expenditures.

TABLE 8. Estimated time for each recovery population to attain size required for delisting the species, by recovery unit. Maximum value in last column is the estimated time to delisting the species, assuming a 10 percent annual increase for populations below 100 active clusters, and a 5 percent annual increase for populations equal to and above that size.

Recovery Unit	Population	Recovery Designation	Current Size[1]	Pop. Goal[2]	Size at Delisting[3]	Time to Required Size (yrs)
Cumberlands	Talladega/Shoal Creek RD's	Primary	3	500	500	67
East Gulf CP	Apalachicola RD	Primary	486	500	500	1
	Biloxi RD	Secondary	295	500	500	11
	Chickasawhay RD	Secondary	125	500	350	21
	Conecuh NF	Secondary	14	309	350	45
	Eglin AFB	Primary	13	502	350	45
	Homochitto NF	Secondary	6	368	350	53
	Wakulla RD	Secondary	45	254	350	33
Mid-Atlantic CP	Coastal NC	Primary	148	357	500	24
	Francis Marion NF	Primary	334	450	500	8
	NE NC/SE VA	Ess. Support	16	NA	100	18
Ouachita Mountains	Ouachita NF	Secondary	12	400	350	46
Piedmont	Oconee NF/Piedmont NWR	Secondary	54	346	350	31
Sandhills	Fort Benning	Primary	186	450	500	20
	NC Sandhills	Primary	504	504	500	0
	SC Sandhills	Secondary	168	345	350	15
South Atlantic CP	Fort Stewart	Primary	198	500	500	19
	Osceola NF/Okefenokee NWR	Primary	92	589	500	33
	Savannah River Site	Secondary	31	418	350	37
South/Central Florida	Avon Park AFR	Ess. Support	21	50	*	
	Big Cypress NP	Ess. Support	40	73	*	
	Cecil M. Webb WMA	Ess. Support	27	27	*	
	Goethe SF	Ess. Support	26	150	*	
	J. W. Corbett WMA	Ess. Support	8	8	*	
	Ocala NF	Ess. Support	18	179	*	
	St. Sebastian Buffer Preserve	Ess. Support	9	9	*	
	Three Lakes WMA	Ess. Support	35	35	*	
	Withlacoochee SF	Ess. Support	50	130	(350)*	
Upper East Gulf CP	Bienville NF	Primary	106	500	500	31
	Oakmulgee RD	Secondary	123	394	350	21

Table continued next page.

TABLE 8 (cont.). Estimated time for each recovery population to attain size required for delisting the species, by recovery unit.

Recovery Unit	Population	Recovery Designation	Current Size[1]	Pop. Goal[2]	Size at Delisting[3]	Time to Required Size (yrs)
Upper West Gulf CP	Sam Houston NF	Primary	168	541	500	22
West Gulf CP	Angelina/Sabine NF's	Primary	55	714	500	38
	Calcasieu RD/Fort Polk	Primary	190	500	500	20
	Catahoula RD	Secondary	31	328	350	37
	Davy Crockett	Secondary	51	330	350	32
		TOTAL	3688	11776	11150	MAX 67

[1]Based on 1999 breeding season data or, if unavailable, 1998 data (USFWS unpublished).

[2]Number of active clusters, taken from individual habitat management plans that estimate one active cluster per 81 ha (200 ac) of identified habitat. NA indicates population goals not yet available. Total for this column uses current size if population goal unavailable.

[3]Number of active clusters, maximum of range given in delisting criteria. For this exercise, number of active clusters rather than potential breeding groups is used as the measure of population size because it is the only measure available for many populations at this time. The exercise does not take into account the likelihood that one to several of these populations may be suffering reduced populations due to hurricane impacts.

*For the South/Central Florida Recovery Unit, the populations that will satisfy delisting criteria (250 potential breeding groups, or 275 to 350 active clusters within six populations) have not been specifically identified.

TABLE 9. Estimated time for each recovery population to attain size required for downlisting the species, by recovery unit. Maximum value in last column is the estimated time until downlisting, assuming the largest current populations fulfill downlisting criteria and that there is a 10 percent annual increase for populations below 100 active clusters, and a 5 percent annual increase for populations equal to and above that size.

Recovery Unit	Population	Recovery Designation	Current Size[1] (#active clusters)	Pop. Goal[2]	Size at Down-listing[3]	Time to Required Size (yrs)
Cumberlands	Talladega/Shoal Creek RD's	Primary	3	413	100	35
East Gulf CP	Apalachicola RD	Primary	486	500	350	0
	Eglin AFB	Primary	295	500	140	0
Mid-Atlantic CP	Coastal NC	Primary	148	357	140	0
	Francis Marion	Primary	334	450	350	1
	NE NC/SE VA	Ess. Support	16	NA	100	18
Ouachita Mountains	Ouachita NF	Secondary	12	400	100	21
Piedmont	Oconee NF/Piedmont NWR	Secondary	54	346	100	6
Sandhills	Fort Benning	Primary	186	450	140	0
	NC Sandhills	Primary	504	NA	350	0
South Atlantic CP	Fort Stewart	Primary	198	500	350	11
	Osceola NF/Okefenokee NWR	Primary	92	589	140	8
South/Central Florida	Big Cypress NP	Ess. Support	40	73	60	4
	Goethe SF	Ess. Support	26	NA	60	8
	Three Lakes WMA	Ess. Support	35	NA	60	5
	Withlacoochee SF	Ess. Support	50	130	60	2
Upper East Gulf CP	Oakmulgee RD	Secondary	123	394	350	21
Upper West Gulf CP	Sam Houston NF	Primary	168	541	350	15
West Gulf CP	Calcasieu RD/Fort Polk	Primary	145	500	350	18
		TOTAL	2936	6498		MAX 35

[1]Based on 1999 breeding season data or, if unavailable, 1998 data (USFWS unpublished).

[2]Number of active clusters, taken from individual habitat management plans that estimate one active cluster per 81 ha (200 ac) of identified habitat. NA indicates population goals not yet available. Total for this column uses current size if population goal unavailable.

[3]This is number of active clusters, the maximum of range given in downlisting criteria. For this exercise, number of active clusters rather than potential breeding groups is used as the measure of population size because it is the only measure available for many populations at this time. This exercise does not take into account the likelihood that one to several of these populations may be suffering reduced populations due to hurricane impacts.

TABLE 10. Estimated annual cost and schedule for implementation of recovery task 1.1.2 (*maintain four suitable cavities in each active cluster*), for all federal populations and those state populations identified in recovery criteria. Annual estimated cost = $200 x number of active clusters for the first two years, then $100 x number of active clusters for the remaining time period. Number of active clusters is projected over ten years with an annual population increase of 10 percent for populations less than 100 active clusters and 5 percent for populations equal to and greater than 100 active clusters. Populations that reach their population goal are considered to still require the same level of cavity maintenance until the species is delisted.

Resp. Agency	Population	Current Size[1]	Estimated Annual Cost ($1) for Cavity Maintenance									
			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AF	Avon Park AFR	21	4600	5100	2800	3100	3400	3700	4100	4500	5000	5400
	Dare Co. Bombing Range	6	1300	1500	800	900	1000	1100	1200	1300	1400	1600
	Eglin AFB	295	62200	65300	34300	36000	37800	39700	41700	43700	45900	48200
	Poinsett Weapons Range	6	1300	1500	800	900	1000	1100	1200	1300	1400	1600
	subtotal		69400	73300	38700	40800	43100	45500	48100	50800	53700	56800
ARMY	Camp Mackall	11	2300	2400	1200	1200	1200	1200	1200	1200	1200	1200
	Fort Benning	186	39100	41000	21500	22600	23700	24900	26200	27500	28900	30300
	Fort Bragg	350	73500	77200	35000	35000	35000	35000	35000	35000	35000	35000
	Fort Gordon	3	700	700	400	400	500	500	600	600	700	800
	Fort Jackson	21	4600	5100	2800	3100	3400	3700	4100	4500	5000	5400
	Fort Polk	44	9700	10600	5900	6400	7100	7800	8600	9400	9900	10400
	Fort Stewart	198	41600	43700	22900	24100	25300	26500	27900	29300	30700	32300
	MOT Sunny Point	6	1300	1500	800	800	800	800	800	800	800	800
	Peason Ridge	27	5900	6500	3600	4000	4300	4800	5300	5800	6400	7000
	subtotal		178700	188700	94100	97600	101300	105300	109500	114100	118500	123200
MC	MCB Camp LeJeune	50	11000	12100	6700	7300	8100	8900	9700	10700	11300	11800
	subtotal		11000	12100	6300	7300	8100	8900	9700	10700	11300	11800
FWS	Alligator River NWR	2	400	500	300	300	300	400	400	400	500	500
	Big Branch Marsh NWR	9	2000	2200	1200	1300	1400	1600	1800	1900	2100	2300
	Black Bayou NWR	1	200	200	100	100	200	200	200	200	200	300
	Carolina Sandhills NWR	118	24800	26000	13700	14300	15100	15800	16600	17400	18300	19200
	D'Arbonne NWR	4	1000	1000	500	500	500	500	500	500	500	500

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TABLE 10 (cont.) Estimated annual cost and schedule for implementation of recovery task 1.1.2 (*maintain four suitable cavities in each active cluster*), for all federal populations and those state populations identified in recovery criteria.

Resp. Agency	Population	Current Size[1]	Estimated Annual Cost ($1) for Cavity Maintenance									
			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
FWS (cont.)	Felsenthal NWR	15	3300	3600	2000	2200	2400	2700	2900	3200	3500	3900
	Noxubee NWR	38	8400	9200	5100	5600	6100	6700	7400	8100	9000	8800
	Okefenokee NWR	29	6400	7000	3900	4200	4700	5100	5700	6200	6800	7500
	Pee Dee NWR	1	200	200	100	100	200	200	200	200	200	300
	Piedmont NWR	37	8100	9000	4900	5400	6000	6600	7200	7900	8700	9600
	Pocosin Lakes NWR	4	800	800	400	400	400	400	400	400	400	400
	St. Marks NWR	6	1300	1500	800	900	1000	1100	1200	1300	1400	1600
	Upper Ouachita NWR	1	200	200	100	100	100	100	100	100	100	100
	subtotal		57100	61400	33000	35500	38300	41300	44500	48000	51800	55000
DOE	Savannah River Site	31	6800	7500	4100	4500	5000	5500	6000	6600	7300	8000
	subtotal		6800	7500	4100	4500	5000	5500	6000	6600	7300	8000
NAVY	Charleston Naval Weapons Stn	2	400	500	300	300	300	400	400	400	500	500
	subtotal		400	500	300	300	300	400	400	400	500	500
NPS	Big Cypress NP	40	8800	9700	5300	5900	6400	7100	7300	7300	7300	7300
	subtotal		8800	9700	5300	5900	6400	7100	7300	7300	7300	7300
NCWRC	Holly Shelter Game Lands	38	5800	5800	2900	2900	2900	2900	2900	2900	2900	2900
	Sandhills Game Lands	132	27100	28400	14900	15700	16000	16000	16000	16000	16000	16000
	subtotal		32900	34200	17800	18600	18900	18900	18900	18900	18900	18900
SCFC	Sand Hills SF	50	11000	12100	6700	7300	8100	8900	9700	10700	11300	11800
	subtotal		5500	6100	6700	7300	8100	8900	9700	10700	11300	11800

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TABLE 10 (cont.) Estimated annual cost and schedule for implementation of recovery task 1.1.2 (*maintain four suitable cavities in each active cluster*), for all federal populations and those state populations identified in recovery criteria.

Resp. Agency	Population	Current Size[1]	Estimated Annual Cost ($1) for Cavity Maintenance									
			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
FDF	Goethe SF	26	5700	6300	3500	3800	4200	4600	5100	5600	6100	6700
	Withlacoochee SF	50	11000	12100	6700	7300	8100	8900	9700	10700	11300	11800
	subtotal		16700	18400	10100	11100	12200	13500	14800	16300	17400	18600
FFWCC	Cecil M. Webb WMA	27	5900	6500	3600	4000	4300	4800	5300	5800	6400	7000
	Howe Scott Preserve	1	200	200	100	100	200	200	200	200	200	300
	J. W. Corbett WMA	8	1800	1900	1100	1200	1300	1400	1600	1700	1900	2100
	St. Sebastian Buffer Preserve	9	2000	2200	1200	1300	1400	1600	1800	1900	2100	2300
	Three Lakes WMA	35	7700	8500	4700	5100	5600	6200	6800	7500	8300	9100
	subtotal		17600	19400	10600	11700	12900	14200	15600	17100	18900	20700
FS	Angelina/Sabine NF's	55	12100	13300	7300	8100	8900	9700	10700	11800	12400	13000
	Apalachicola RD	486	100000	100000	50000	50000	50000	50000	50000	50000	50000	50000
	Bienville NF	106	22300	23400	12300	12900	13500	14200	14900	15700	16400	17300
	Biloxi RD	6	1300	1500	800	900	1000	1100	1200	1300	1400	1600
	Calcasieu RD	145	30500	32000	16800	17600	18500	19400	20400	21400	22500	23600
	Catahoula RD	31	6800	7500	4100	4500	5000	5500	6000	6600	7300	8000
	Chickasawhay RD	13	2900	3100	1700	1900	2100	2300	2500	2800	3100	3400
	Conecuh NF	14	3100	3400	1900	2000	2300	2500	2700	3000	3300	3600
	Croatan NF	60	13200	14500	8000	8800	9700	10600	11200	11700	12300	12900
	Daniel Boone NF	7	1500	1700	900	1000	1100	1200	1400	1500	1700	1800
	Davy Crockett NF	51	11200	12300	6800	7500	8200	9000	9900	10900	11500	12100
	Evangeline RD	72	15800	17400	9600	10500	11100	11600	12200	12800	13500	14100
	Francis Marion NF	334	70100	73600	38700	40600	42600	44800	47000	45000	45000	45300
	Homochitto NF	45	9900	10900	6000	6600	7200	7600	8000	8400	8800	9200
	Kisatchie RD	38	8400	9200	5100	5600	6100	6700	7100	7400	7800	8200
	Oakmulgee RD	123	25800	27100	14200	15000	15700	16500	17300	18200	19100	20000
	Ocala NF	18	4000	4400	2400	2600	2900	3200	3500	3900	4200	4700
	Oconee NF	17	3700	4100	2300	2500	2700	3000	3300	3600	4000	4400

Table continued next page.

TABLE 10 (cont.) Estimated annual cost and schedule for implementation of recovery task 1.1.2 , for all federal populations and those state populations identified in recovery criteria.

Resp. Agency	Population	Current Size[1]	Estimated Annual Cost ($1) for Cavity Maintenance									
			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
FS (cont.)	Osceola NF	63	13900	15200	8400	9200	10100	11200	12300	12900	13500	14200
	Ouachita NF	16	3500	3900	2100	2300	2600	2800	3100	3400	3800	4100
	Sam Houston NF	168	35300	37000	19400	20400	21400	22500	23600	24800	26100	27400
	Talladega/Shoal Creek RD's	3	700	700	400	400	500	500	600	600	700	800
	Wakulla RD	125	26300	27600	14500	15200	16000	16800	17600	18500	19400	20400
	Winn RD	16	3500	3900	2100	2300	2600	2800	3100	3400	3800	4100
	subtotal		425700	447800	235800	248500	261800	275700	289700	299700	311500	324300
	TOTAL		830600	879100	462800	489100	516400	545200	574200	600600	628400	656900

[1]Number of active clusters, 1999 breeding season or 1998 breeding season if 1999 data were unavailable (USFWS unpublished).

TABLE 11. Estimated annual cost and schedule for implementation of recovery task 1.2.3 (*provision recruitment clusters equal to 10 percent of population, 4 artificial cavities each*), for all federal populations and those state populations identified in recovery criteria. Annual estimated cost = $800 x (0.10 x number of active clusters). Number of recruitment clusters to be provisioned annually is adjusted at 5-year intervals. For this exercise, population size is estimated by number of active clusters because of currently limited information. Populations that reach their population goal require no more recruitment clusters.

Responsible Agency	Population	Current Size[1]	Annual Cost, 2001-2005	Annual Cost, 2006-2010
AF	Avon Park AFR	21	1680	2700
	Dare Co. Bombing Range	6	480	800
	Eglin AFB	295	23680	30200
	Poinsett Weapons Range	6	480	800
	subtotal		26320	34500
ARMY	Camp Mackall	11	0	0
	Fort Benning	186	14880	19000
	Fort Bragg	350	28000	0
	Fort Gordon	3	240	400
	Fort Jackson	21	1680	2700
	Fort Polk	44	3520	5700
	Fort Stewart	198	15840	20200
	MOT Sunny Point	6	480	0
	Peason Ridge	27	2160	3500
	subtotal		66800	51400
MC	MCB Camp LeJeune	50	4000	6400
	subtotal		4000	6400
FWS	Alligator River NWR	2	160	300
	Big Branch Marsh NWR	9	720	1200
	Black Bayou NWR	1	80	100
	Carolina Sandhills NWR	118	9440	12000
	D'Arbonne NWR	4	0	0
	Felsenthal NWR	15	1200	1900
	Noxubee NWR	38	3040	4900
	Okefenokee NWR	29	2320	3700
	Pee Dee NWR	1	80	100
	Piedmont NWR	37	2960	4800
	Pocosin Lakes NWR	4	800	300
	St. Marks NWR	6	480	800
	Upper Ouachita NWR	1	80	100
	subtotal		21280	30200
DOE	Savannah River Site	31	2480	4000
	subtotal		2480	9300
NAVY	Charleston Naval Weapons Station	2	160	800
	subtotal		160	800

Table continued next page.

TABLE 11 (cont.). Estimated annual cost and schedule for implementation of recovery task 1.2.3.

Responsible Agency	Population	Current Size[1]	Annual Cost, 2001-2005	Annual Cost, 2006-2010
NPS	Big Cypress NP	40	3200	5200
	subtotal		3200	5200
NCWRC	Holly Shelter Game Lands	38	0	0
	Sandhills Game Lands	132	10320	12800
	subtotal		10320	12800
SCFC	Sand Hills SF	50	4000	6400
	subtotal		4000	6400
FDF	Goethe SF	26	2080	3300
	Withlacoochee SF	50	4000	6400
	subtotal		6080	6400
FFWCC	Cecil M. Webb WMA	27	2160	3500
	Howe Scott Preserve	1	80	100
	J. W. Corbett WMA	8	640	1000
	St. Sebastian Buffer Preserve	9	720	1200
	Three Lakes WMA	35	2800	4500
	subtotal		6400	10300
FS	Angelina/Sabine NF's	55	4400	7100
	Apalachicola RD	486	0	0
	Bienville NF	106	8480	10800
	Biloxi RD	6	480	800
	Calcasieu RD	145	11600	14800
	Catahoula RD	31	2480	4000
	Chickasawhay RD	13	1040	1700
	Conecuh NF	14	1120	1800
	Croatan NF	60	4800	7700
	Daniel Boone NF	7	560	900
	Davy Crockett NF	51	4080	6600
	Evangeline RD	72	5760	8900
	Francis Marion NF	334	26720	0
	Homochitto NF	45	3600	5800
	Kisatchie RD	38	3040	4900
	Oakmulgee RD	123	9840	12600
	Ocala NF	18	1440	2300
	Oconee NF	17	1360	2200
	Osceola NF	63	5040	8100
	Ouachita NF	16	1280	2100
	Sam Houston NF	168	13440	17200
	Talladega/Shoal Creek RD's	3	240	400
	Wakulla RD	125	10000	12800
	Winn RD	16	1280	2100
	subtotal		122080	135300
	TOTAL		273120	309000

[1]Number of active clusters, 1999 breeding season or 1998 breeding season if 1999 data were unavailable (USFWS unpublished).

TABLE 12. Estimated annual cost for implementation of recovery task 1.7 (*burn entire area managed for red-cockaded woodpeckers at least every 3 to 5 years*), for all federal populations and those state populations identified in recovery criteria. Annual estimated cost = $37 x (¼ total ha), or $15 x (¼ total ac). This calculation assumes all habitat is burned once every four years.

Responsible Agency	Population		Estimated Available Habitat (ha)	Estimated Annual Cost ($1)
AF	Avon Park AFR		4290	39750
	Dare Co. Bombing Range		40470	375000
	Eglin AFB		3890	36000
	Poinsett Weapons Range		2430	22500
		subtotal	51080	473250
ARMY	Camp Mackall		970	9000
	Fort Benning		2020	18750
	Fort Bragg		28330	262500
	Fort Gordon		10200	94500
	Fort Jackson		40470	375000
	Fort Polk		36420	337500
	Fort Stewart		14490	134250
	MOT Sunny Point		650	6000
	Peason Ridge		9710	90000
		subtotal	143260	1318500
MC	MCB Camp LeJeune		14920	138000
		subtotal	14920	138000
FWS	Alligator River NWR		5750	53250
	Big Branch Marsh NWR		10200	94500
	Black Bayou NWR		80	750
	Carolina Sandhills NWR		15540	144000
	D'Arbonne NWR		400	3750
	Felsenthal NWR		2750	25500
	Noxubee NWR		810	7500
	Okefenokee NWR		810	7500
	Pee Dee NWR		7770	72000
	Piedmont NWR		7120	66000
	Pocosin Lakes NWR		80	750
	St. Marks NWR		320	3000
	Upper Ouachita NWR		1620	15000
		subtotal	53250	493500
DOE	Savannah River Site		32430	300000
		subtotal	32430	300000
NAVY	Charleston Naval Weapons Station		970	9000
		subtotal	970	9000
NPS	Big Cypress NP		5920	54750
		subtotal	5920	54750

Table continued next page.

TABLE 12 (cont.). Estimated annual cost for implementation of recovery task 1.7, for all federal populations and those state populations identified in recovery criteria.

Responsible Agency	Population		Estimated Available Habitat (ha)	Estimated Annual Cost ($1)
NCWRC	Holly Shelter Game Lands		10200	94500
	Sandhills Game Lands		3080	28500
		subtotal	13280	123000
SCFC	Sand Hills SF		11760	108750
		subtotal	11760	108750
FDF	Goethe SF		10520	97500
	Withlacoochee SF		12140	112500
		subtotal	22660	210000
FFWCC	Cecil M. Webb WMA		4050	37500
	Howe Scott Preserve		4050	37500
	J. W. Corbett WMA		4050	37500
	St. Sebastian Buffer Preserve		4050	37500
	Three Lakes WMA		4050	37500
		subtotal	20250	187500
FS	Angelina/Sabine NF's		57790	535500
	Apalachicola RD		40470	375000
	Bienville NF		8660	80250
	Biloxi RD		29790	276000
	Calcasieu RD		5340	49500
	Catahoula RD		24440	226500
	Chickasawhay RD		26550	246000
	Conecuh NF		40630	376500
	Croatan NF		25010	231750
	Daniel Boone NF		10930	101250
	Davy Crockett NF		26710	247500
	Evangeline RD		18700	173250
	Francis Marion		20560	190500
	Homochitto NF		43790	405750
	Kisatchie RD		23960	222000
	Oakmulgee RD		36420	337500
	Ocala NF		31890	295500
	Oconee NF		14490	134250
	Osceola NF		20230	187500
	Ouachita NF		40470	375000
	Sam Houston NF		32380	300000
	Talladega/Shoal Creek RD's		40470	375000
	Wakulla RD		40470	375000
	Winn RD		21290	197250
		subtotal	681440	6314250
		TOTAL	711310	9739500

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GLOSSARY OF TERMS

Adaptive management	The process of implementing flexible management and policy that is responsive to results of continuous biological monitoring and scientific experimentation.
Allozyme	An enzyme that has different forms, resulting from different alleles at the locus encoding the enzyme.
Augmentation	Increasing the size of a population by translocating individuals between populations.
Basal area	The area of a horizontal cross section of a tree's stem, generally measured at breast height.
Breeding dispersal	Movement of individuals between consecutive breeding locations.
Budding	One of two processes of new group formation in red-cockaded woodpeckers (see also pioneering), referring to the splitting of one territory into two.
Canopy	The uppermost layer of foliage in a forest or forest stand.
Catastrophe	A random environmental event of great consequence.
Clayhills	Pine communities on clay soils, especially in northwestern Florida, eastern Alabama, and southwestern Georgia.
Clearcut	An area in which all trees have been removed in one cutting.
Cluster	The aggregation of cavity trees previously and currently used and defended by a group of woodpeckers. For management purposes, the minimum area encompassing the cluster is 4 ha (10 ac). Use of the term cluster is preferred over colony because colony implies more than one nest (as in colonial breeder).
Cooperative breeding.	A breeding system in which one or more adults assist a breeding pair in rearing of young. These extra adults, called helpers, delay their own dispersal and reproduction and are generally related to the offspring of the breeding pair.
Decreasing population trend	A population is decreasing if a 10 percent decline in the number of potential breeding groups is documented from one year to the next, or if for three consecutive years the number of potential breeding groups declines.
Demographic stochasticity	Randomly occurring events affecting individuals.
Demography	Vital rates, including birth, death, and dispersal rates, and the analysis of population size and trend.
Dispersal	Movement of individuals from natal to first breeding location (natal dispersal), or between consecutive breeding locations (breeding dispersal).

Effective population size	The size of the ideal, hypothetical population in which all individuals mate randomly and all contribute equally to reproduction. Variation in reproductive success and other processes in a real population affect how many genes are conserved in subsequent generations. The concept of effective population size is used to control for the effects of such processes when discussing genetic conservation.
Environmental stochasticity	Random changes in environmental conditions and their effects on populations.
Even-aged management	A silvicultural method designed primarily for timber production, in which all trees in a stand are of one age/size class. The forest is regulated by developing equal areas in each age/size class.
Flatwoods	Mesic pine communities on the Gulf and Atlantic coastal plains with a well-developed woody shrub or midstory layer.
Floater	An adult bird not associated with a breeding group.
Forb	A herbaceous plant that has broad leaves, not a grass.
Fragmentation	Habitat loss that results in isolated patches of remaining habitat.
Gene flow	The movement of genetic material among populations or within a population.
Genetic drift	Random sampling of genetic resources within a population from one generation to the next. In populations of finite size, this sampling will always result in loss of variation. In populations of large size, such loss may be offset by new variation arising through mutation.
Genetic stochasticity	Random changes in gene frequencies.
Group	The social unit in red-cockaded woodpeckers, consisting of a breeding pair with one or more helpers, a breeding pair without helpers, or a solitary male.
Habitat selection	Use of a resource above what is expected based on the availability of that resource.
Heartwood	The inner, inactive core of a tree.
Helper	An adult that delays its own reproduction to assist in the rearing of another breeding pair's young. Typically, helpers are related to the breeding pairs that they assist.
Herbs	Grasses and forbs.
Herbaceous	Non-woody.
Heterozygosity	Genetic diversity within an individual or population, as measured by the proportion of loci containing two different alleles.
Home range	The area supporting the daily activities of an animal, generally throughout the year.

Homozygosity	Genetic similarity within an individual or population, as measured by the proportion of loci containing two identical alleles.
Inbreeding	Mating between relatives.
Inbreeding depression	Loss of fitness due to the increase in homozygosity that results from inbreeding.
Increasing population trend	A population is increasing if the average annual rate of change over five years is 5 percent or greater.
Kleptoparasitism	Theft by one species of resources procured by another species, resulting in positive effects for the parasite and negative effects for the species being parasitized. Generally this term is applied to theft of food, but has recently been expanded to include theft of spatial resources.
Metapopulation	A set of interacting populations.
Midstory	A layer of foliage intermediate in height between canopy and groundcover, litter layer, or soil surface.
Mitigation	Reduction of negative impacts.
Natal dispersal	Movement of individuals from their place of birth to their first breeding location.
Pioneering	One of two processes of new group formation in red-cockaded woodpeckers (see also budding), by which a group colonizes previously unoccupied areas. Because of the difficulty of cavity excavation, this process occurs at very low frequencies.
Plate	On a cavity tree, the area surrounding the cavity entrance with bark removed by red-cockaded woodpeckers. Newly formed cavities may not exhibit a well-developed plate.
Pocosin	A wetland dominated by a dense cover of evergreen and deciduous shrubs.
Population dynamics	Properties of the population such as trend and regulation of population size.
Population trend	See increasing population trend, decreasing population trend, and stable population trend.
Potential breeding group	An adult female and adult male that occupy the same cluster, whether or not they are accompanied by a helper, attempt to nest, or successfully fledge young.
Primary cavity nester	Species that nest in cavities they created.
Primary core population	A population identified in recovery criteria that will hold at least 350 potential breeding groups at the time of and after delisting. Defined by biological boundaries.

RAPD	Randomly amplified polymorphic DNA;
Recovery	Species viability.
Recovery population	One of a set of populations considered and designated essential to the recovery of the species.
Recovery unit	One of a set of geographical areas, delineated according to ecoregions, that likely represent broad-scale geographic and genetic variation in red-cockaded woodpeckers. Viable populations in each recovery unit, to the fullest extent that available habitat allows, are considered essential to the recovery of the species.
Recruitment	The addition of individuals into a breeding population through reproduction and/or immigration and attainment of a breeding position.
Recruitment cluster	Clusters of artificial cavities in suitable nesting habitat, located close to existing groups.
Regeneration	A silvicultural method of simultaneously harvesting and establishing reproduction in trees.
Regulation	A silvicultural technique of establishing equal areas of tree size classes, to sustain a given level of timber production over time.
Resin well	A wound in a pine tree's cambium, created and maintained by red-cockaded woodpeckers, for the purpose of resin production.
Rotation	In even-aged management of forests, the number of years between regeneration events.
Sandhills	Xeric and sub-xeric longleaf pine communities on deep sandy soils. Also, the ecoregion encompassing the fall-line sandhills communities, between the mid- and south-Atlantic coastal plains and Piedmont.
Sapwood	The outer, active layer of tissue in a tree, lying just inside the cambium.
Savannah	A mesic and seasonally wet pine community, often transitional between xeric pine systems and wetlands, characterized by diverse grass and forb groundcovers.
Secondary cavity nester	Species that inhabit cavities they did not create.
Secondary core population	A population identified in recovery criteria that will hold at least 250 potential breeding groups at the time of and after delisting. Defined by biological boundaries.
Seed-tree	A method of timber regeneration in which most trees in a site are cut, and tree seedlings become established under remnant large trees. Remnant large trees are retained at lower densities than under the shelterwood method.

Selection cutting	A method of timber regeneration in which single trees or patches of trees (0.8 ha or less, 2 ac or less) are cut.
Shelterwood	A method of timber regeneration in which many but not all trees in a site are cut, and tree seedlings become established under remnant large trees. Remnant large trees are retained at higher densities than under the seed-tree method.
Silviculture	The theory and practice of controlling the establishment, composition, structure, and growth of forests to achieve management objectives. Silviculture was developed primarily for the purpose of timber production, but can be used for other purposes including biological conservation.
Snag	A standing, dead tree.
Solitary male	An unpaired male that is the sole resident of a cluster.
Stable population trend	A population that exhibits neither an increasing or decreasing population trend.
Start	An incomplete cavity.
Strategic recruitment	Placement of recruitment clusters in locations strategically chosen to enhance the spatial arrangement of breeding groups. Breeding groups aggregated in space rather than isolated are beneficial to population dynamics and viability.
Stochasticity	Random events.
Support population	All known populations not designated a primary or secondary core are designated support populations. Support populations (other than essential supports) are defined by ownership rather than biological boundaries. There are three classifications for support populations: 1. Essential support populations are those populations, identified in recovery criteria, that represent unique habitat types that cannot support a larger, core population. They are located on federal and state lands and one private property. 2. Significant support populations are populations, not identified in recovery criteria, that contain and/or have a population goal of 10 or more active clusters. They are located on federal and state lands and on private lands enrolled in agreements with the U.S. Fish and Wildlife Service. 3. Important support populations are populations, not identified in recovery criteria, that contain and have a population goal of less than 10 active clusters. They are located on federal and state lands and on private lands enrolled in agreements with the U.S. Fish and Wildlife Service.
Take	As defined by the Endangered Species Act, take means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (Section 3.18). Habitat

	destruction and alteration are considered forms of take, following a Supreme Court ruling on this issue (Sweet Home vs. Babbitt).
Taxonomy	Hierarchical classification system for all life forms.
Territory	A region within an animal's home range that is defended from conspecifics.
Translocation	The artificial movement of wild organisms between or within populations to achieve management objectives. Originally, translocation referred to the movement of animals from captive to wild populations, but the term has been expanded to include movements (by artificial means) within and between wild populations.
Uneven-aged management	A silvicultural method designed primarily for timber production, in which trees of at least three age classes are present in the same stand. Stands are regulated by size class structure or volume.
Viability	The ability of a population or species to persist over time.

INDEX

APPENDIX 1. PERMITS, TRAINING, AND COMPLIANCE REQUIREMENTS

The objectives of the permitting and compliance program are to: (1) identify, standardize, and, as needed, modify training/certification procedures to ensure the safety of and minimize death and injury to red-cockaded woodpeckers; (2) standardize permit reporting requirements; (3) ensure compliance with all permit requirements, including reporting; (4) ensure that a coordinated specimen disposal program exists, and (5) facilitate distribution of research findings resulting from permit activities. The permit process is an important component of adaptive management. Permitted activities may be modified or eliminated based on research findings and/or an evaluation of their biological costs versus conservation benefits. The primary objective of establishing certification procedures, including "hands-on" protocols, is to minimize the potential for injury or death. Ultimately, it is our responsibility as individuals and as federal and state agency regulators to ensure that biological and ethical protocols are established and followed when conducting activities that have the potential to harm or harass red-cockaded woodpeckers.

The following activities associated with the monitoring and management of red-cockaded woodpeckers require an exemption from the prohibitions of Section 9 of the Endangered Species Act. This exemption is usually authorized via a Section 10(a)(1)(A) permit. The U.S. Fish and Wildlife Service considers that these activities have the potential to harass or result in death or injury to an individual red-cockaded woodpecker or to raise concern about possession of endangered wildlife contrary to laws and regulations.

1. installation and/or modification of artificial nesting cavities.
2. installation of cavity restrictors.
3. manipulation (removal or modification) of red-cockaded woodpecker cavities or cavity trees, including installation of SNED's, SQED's, cameras, etc.
4. capturing and handling (for any purpose, including banding or color marking) nestling and adult birds.
5. placing radiotelemetry devices on red-cockaded woodpeckers.
6. visual examination of active cavities with a mirror and droplight or a video probe ("peeper").
7. salvage of addled eggs, and/or determining viability of eggs.
8. collection and retention of red-cockaded woodpecker specimens or their body parts (including eggs, blood or feathers) for scientific and other purposes consistent with the species' conservation strategy.
9. interstate commerce of dead or living birds or their body parts, including sale or bartering for financial gain.
10. translocation and/or temporary confinement of adults, fledglings, chicks, or eggs.
11. any other activity or practice that may be construed to harm or harass red-cockaded woodpeckers during any life stage.

In addition, the following activities involving red-cockaded woodpeckers are likely to require a Section 10(a)(1)(A) permit unless you are an employee or agent of the

U.S. Fish and Wildlife Service, any other federal land management agency, or a state conservation agency who is designated by his agency for the following purposes:

1. aid to a sick, injured, or orphaned specimen.
2. disposal of a dead specimen.
3. salvage of a dead specimen which may be useful for scientific study.

(Federal or state employees and agents must notify the U.S. Fish and Wildlife Service, Division of Law Enforcement within 5 days of undertaking these activities and must receive concurrence from the U.S. Fish and Wildlife Service on the disposition of these specimens.)

Those individuals placing aluminum bands and/or auxiliary markers (including colored leg bands) on red-cockaded woodpeckers, require a permit (in addition to a U.S. Fish and Wildlife Service Section 10(a)(1)(A) permit) for each of those activities from the U.S. Geological Survey, Biological Resources Division's National Bird Banding Lab, Route 197, Laurel, Maryland 20708; telephone: (301) 498-0428. Most, if not all, states harboring red-cockaded woodpeckers also require permits for some of the activities listed above, including translocating birds from and to their state. Contact state wildlife agencies for endangered/threatened species permit requirements. Each permit has a specific purpose and provides important information to the agency legally responsible for issuing the permit.

Reporting Requirements

Every Section 10(a)(1)(A) permit requires an annual report to the U.S. Fish and Wildlife Service. The Annual Red-cockaded Woodpecker Report fulfills this requirement, and must be completed submitted to the Recovery Coordinator (original) and the U.S. Fish and Wildlife Service's Regional Office (copy) annually by January 31st. Agencies or individuals not submitting completed reports will not have their permits re-authorized. This reporting system ensures that this critical recovery program is evaluated annually for its conservation value, and is modified as needed in response to new information.

Training

Prior to issuing any Section 10(a)(1)(A) permit, the U.S. Fish and Wildlife Service must meet several criteria, including the determination of the applicant's ability to successfully accomplish the authorized activities. Because of the potential for direct injury or death to red-cockaded woodpeckers from the above activities, all individuals involved in any of these activities must be trained and certified for each activity prior to receiving a permit or sub-permit under someone else's permit. Potential applicants must be trained by an individual who has the proper permits for and extensive experience in the activity in question. Several federal and state biologists, consultants, and researchers are considered "trainers" or "certifiers" by the U.S. Fish and Wildlife Service for one or more of the above activities. Upon satisfactory completion of training (as determined by

the trainer and the Service), the trainer certifies in writing to the Service that the individual is competent and qualified to perform the activity or activities in question.

Training for Installation of Artificial Cavities and Restrictors

Training prior to installation of artificial cavities and restrictors is considered adequate if the following criteria are met:

a. A period of apprenticeship is completed under the direction of a person that has held appropriate permits for at least three years.

b. The apprentice has installed at least 10 restrictors, 10 drilled cavities, 10 starts, and 10 inserts under direct supervision of the permit holder.

c. The apprentice has learned the maintenance procedures for cavities and restrictors.

d. The permit holder has certified in writing to the U.S. Fish and Wildlife Service Regional Permits Coordinator and the Red-cockaded Woodpecker Recovery Coordinator that the apprentice completed the required training. If the permit holder determines that additional training of the apprentice is necessary or that the apprentice should not be issued a permit, he or she should certify such in writing to the apprentice and the coordinators listed above.

Training for Monitoring, Capture, Banding, Etc.

Safe and accurate monitoring of red-cockaded woodpeckers requires skill, normally acquired through years of experience with red-cockaded woodpeckers and their habitat. Apprenticeship training by a recognized expert in the biology of red-cockaded woodpeckers can accelerate the acquisition of appropriate monitoring skills. The Red-cockaded Woodpecker Recovery Coordinator maintains a list of recognized experts who are willing to serve as trainers. Persons seeking the endangered species and bird banding permits necessary for red-cockaded woodpecker monitoring will document their *need* in writing to the Red-cockaded Woodpecker Recovery Coordinator and the Regional Permits Coordinator. If both Coordinators concur that the monitoring need is legitimate and that the permit applicant is the appropriate entity to conduct the monitoring, the applicant will be referred to the list of qualified trainers. In reaching the referral decision the Recovery Coordinator or Permits Coordinator may conduct background inquiries as they deem necessary.

The applicant will select a red-cockaded woodpecker trainer from the provided list, contact that person, and arrange for training to occur. The cost of training will be borne by the applicant. The red-cockaded woodpecker expert will personally supervise the training of the applicant. The training period will be at the discretion of the trainer, but will not be less than:

a. 50 cavities correctly assessed for stage and activity,

b. 15 cavity trees climbed and cavity contents checked,

c. 10 adult red-cockaded woodpeckers captured and banded (with appropriate data taken) without injury to the birds,

d. 20 nestlings captured, aged and banded (with appropriate data taken) without injury to the birds,

e. 20 free ranging red-cockaded woodpeckers correctly identified by color bands,

f. 10 sub-adults translocated without injury or mortality (including all associated activities such as feeding during transport, etc.), and

g. 10 red-cockaded woodpeckers treated for any other handling technique (such as bleeding, etc.).

Once at least the minimum amount of training, as described above or as otherwise dictated by the Recovery Coordinator, is accomplished to the satisfaction of the trainer, he or she will certify such in writing to the Recovery Coordinator and the Regional Permits Coordinator. The trainer will only conduct training and certification in areas of expertise in which he or she is certified. The trainer is under no obligation to certify anyone if in his or her opinion the applicant has not completed training adequately. If such is the case, the trainer will document the deficiencies in writing to the applicant, the Recovery Coordinator and the Regional Permits Coordinator, and recommend either more training or permit denial. Certification may be issued for some techniques and withheld for others. A person receiving certification cannot in turn train and certify other individuals until he or she has at least 3 years of experience in the certified techniques, has all required permits in good order and has been placed on the Recovery Coordinator's list of red-cockaded woodpecker trainers.