

**Draft Recovery Plan for the
Ivory-billed Woodpecker
(*Campephilus principalis*)**



Male Ivory-billed Woodpecker leaving nest
Photo by James T. Tanner - 1937

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Bird species names are in accordance with the American Ornithologists Union common names. Scientific names of species in the text are found in Appendix G.

Cover Illustration Credit: James T. Tanner, 1937

ACKNOWLEDGMENTS

Despite having been listed as an endangered species since 1967, no recovery plan was ever prepared for this species. This was in large part due to the lack of any clear evidence of their continued existence for the many decades prior to the passage of the Endangered Species Act.

Perspectives with regard to the need for a plan changed dramatically when evidence supporting the presence of at least one bird in the Bayou de View area of Cache River National Wildlife Refuge became widely known in April 2004. From the outset there was a strong desire to prepare a plan for the many conservation actions needed. Primary needs were to learn more about the bird's occurrence, relocate additional birds, and determine what could be done to improve conditions for long term recovery.

As might be imagined about such a charismatic species, there was widespread interest in assisting with Ivory-billed Woodpecker recovery. A large team of more than 60 technical experts was identified. This list eventually grew to nearly 80 people. A list of team members is provided in Appendix A. All Team members are acknowledged for their expertise, enthusiasm and commitment to the recovery and conservation of the Ivory-billed Woodpecker.

The Nature Conservancy of Arkansas, the Cornell University Laboratory of Ornithology, the Arkansas Game and Fish Commission, the Arkansas Natural Heritage Foundation and Audubon Arkansas contributed greatly during the initial stages of the recovery effort and continued as the plan began to take shape. Especially instrumental in preparing the plan were Scott Henderson and David Goad, Arkansas Game and Fish Commission; Tom Foti, Arkansas Natural Heritage Commission; Robert Cooper, University of Georgia; Kenneth Rosenberg, Cornell Laboratory of Ornithology; and Kenny Ribbeck, Louisiana Department of Wildlife and Fisheries. Martjan Lammertink from Cornell Laboratory of Ornithology and Jerry Jackson from Florida Gulf Coast University contributed written portions of the plan. Among U. S. Fish and Wildlife Service staff, Deborah Fuller, Ralph Costa, Charles Hunter, Erin Clark, Laurie Fenwood, and Robert V. Smith made substantial contributions.

Charles Baxter and Bill Uihlein of the Lower Mississippi Valley Joint Venture Office and their interagency partners at the USGS National Wetlands Research Center in Lafayette, Louisiana, contributed greatly to many technical aspects of the plan.

The following individuals provided summaries of information on the Ivory-billed Woodpecker in their respective state: Dwight Cooley, Alabama; Mike Harris, Georgia; Cliff Shackelford, Texas; Richard Hines, Kentucky; Catherine Rideout, Arkansas; Laurel Barnhill, South Carolina; Erik Baca, Louisiana; Karl Miller, Florida; Nick Winstead, Mississippi; and Bob Ford, Tennessee.

The hard work and dedication of those mentioned above as well as the Recovery Team members listed in Appendix A is gratefully acknowledged. The Recovery Plan is much better for the involvement and collective thinking of such a dedicated and talented group of people.

Lastly, the work of James Tanner must be acknowledged as the basis of much of what we currently understand about this magnificent bird. His early contributions to the conservation of the species through scientific field work have allowed us to sketch a path to recovery. We stand on his shoulders and gratefully acknowledge his contribution.

EXECUTIVE SUMMARY

Current Status

The Ivory-billed Woodpecker (*Campephilus principalis*) belongs to a group of 11 species of large woodpeckers of the genus *Campephilus*, inhabiting the Western Hemisphere—primarily Central and South America. Two groups within the species of Ivory-billed Woodpecker are recognized (American Ornithologists' Union 1998): the *principalis* group of the southeastern United States and the *bairdii* group of Cuba. The Ivory-billed Woodpecker was listed as endangered throughout its range on March 11, 1967, (32 FR 4001) and June 2, 1970 (35 FR 8495). Information on the status of the population is limited and current population size and distribution is not clearly known. Evidence indicating the presence of a small population in central Arkansas exists but confirmation of other populations in the southeastern United States is lacking (Fitzpatrick *et al.* 2005). Many State, Federal and private partners are cooperating to continue searching for evidence of the species' presence (*e.g.*, sightings, nest cavities) some additional evidence is considered interesting. Authorities in Cuba (A. Kirkconnel, pers. comm.) suspect that the species might persist in a few locations in that country. No critical habitat has been designated for this species in the United States. The Recovery Priority Number for the Ivory-billed Woodpecker is 5 indicating a high degree of threat and low recovery potential for this species.

Habitat Requirements

The Ivory-billed Woodpecker is a resident of large, contiguous forests with numerous large trees. A significant portion of the forest must also be in some stage of decay providing a continuous supply of food (Jackson 2002).

Bottomland hardwood forests are frequently noted as important (Jackson 2002, Tanner 1942). It is unclear if this view is biased by the scant information on habitat use having been gathered near the end of a long period of population decline. Habitats occupied at the time most of the studies occurred may not have been typical or preferred by the species. Rather the habitat may have been occupied simply because it was the last suitable habitat available. In Florida, bald cypress was noted as an important component of the forest used by Ivory-billed Woodpeckers, especially in conjunction with an adjacent pine forest (Jackson 2002). In the Texas region of northeastern Louisiana, Tanner (1942) documented use in "upland" sites infrequently flooded and forested primarily with species such as Nuttall Oak, Sweet-gum and Green Ash. Tanner also observed that habitat used by Ivory-billed Woodpeckers was also highly favored by other species of woodpeckers, a high density of other woodpecker species being indicative of good Ivory-billed Woodpecker habitat.

Habitat requirements likely vary seasonally and with habitat conditions, population density, food resources and other factors. None of these influencing factors are understood for this species. It is clear however that the Ivory-bill requires large tracts of forest for foraging and trees large enough for nesting and roosting.

Limiting Factors

The primary reason for the decrease in Ivory-billed Woodpecker numbers throughout its range appears to be a reduction in suitable habitat (and indirect destruction of their food source) due to large scale logging and conversion of forest habitats. Essential features of Ivory-billed Woodpecker habitat include: extensive, continuous forest areas, very large trees, and agents of tree mortality resulting in a continuous supply of recently dead trees or large dead branches in mature trees (Jackson 2002). According to Tanner (1942), "In many cases their [Ivory-billed Woodpeckers] disappearance almost coincided with logging operations. In others, there was no close correlation, but there are no records of Ivory-billed inhabiting areas for any length of time after those have been cut over." Noel Snyder (in prep) argues that the close correlation between timber harvesting activities and the decline of the Ivory-bill may reflect an increased exposure to poaching and collecting rather than food limitation in logged over forests. Specific to the Singer Tract, before large-scale logging had commenced, Tanner (1942) also commented that the reduced occurrence of recently dead and dying wood was probably responsible for declines of woodpeckers there.

Habitat loss has probably affected Ivory-billed Woodpeckers since the original cutting of virgin forest. Some losses were probably gradual while other losses occurred very rapidly. Tanner (1942) reported that by the 1930s only isolated remnants of the original southern forest remained. Forest loss continued with another period of accelerated clearing and conversion to agriculture of bottomland hardwood forests of the Lower Mississippi Valley during the 1960's and 1970's. The combined effect of those losses has resulted in reduction and fragmentation of the remaining forested lands. The conversion rate of forest to agricultural lands has reversed in the past few years. Currently, many public and private agencies are working to protect and restore forest habitat; however, it may be many years before these restored forests mature and provide ideal habitat for the Ivory-billed Woodpecker. Therefore, until more is learned about the Ivory-bill's habitat requirements, the extensive habitat loss and fragmentation and the lack of information on specific habitat requirements remain a threat to this species.

Historical records indicate that Ivory-billed Woodpeckers (bills and the plumage) were collected and used for various purposes by native and colonial Americans. Collection of ivory-bills for scientific purposes has been documented since the 1800's. Jackson (2002) presented data indicating that such collecting resulted in the taking of over 400 specimens, mostly between 1880 and 1910. By itself, overutilization may not have caused the widespread decline of Ivory-bill numbers. However, collecting in combination with the concurrent habitat loss likely hastened the decline of the species. It is possible that local populations could have been extirpated by collecting. For example, Ivory-billed Woodpeckers are believed to have been reduced by excessive collecting, rather than as a result of the conversion of forest habitats in a small area of the Suwannee River region of Florida. In addition, Tanner (1942) indicated that many Ivory-bills were killed merely to satisfy curiosity.

Ivory-billed Woodpecker populations appear to have been in a state of continuous fragmentation and decline since the early 1800's (Jackson 2002, Tanner 1942). Early accounts gave no accurate or definite estimates of abundance, but populations by this time were probably not large and were limited to habitats subject to high tree mortality, e.g., areas that

were regularly flooded or burned (Jackson 2002). The small population size and limited distribution of the Ivory-billed Woodpecker place this species (previously thought by many to be extinct) at risk from naturally occurring events and environmental factors.

Additionally, the exact number and genetic health of remaining birds is unknown. In general, small populations are at risk from genetic and demographic stochastic events (such as normal variations in survival and mortality, genetic drift, inbreeding, etc.).

Recovery Strategy

Our understanding of all aspects of the ecology and biology of the Ivory-billed Woodpecker is limited. Indeed, it has proven extremely difficult to even briefly encounter the species despite extensive survey efforts. Due to its rarity for such a long period of time the literature and previous research for the species is likewise meager. Much of what is known is derived from the landmark studies of James Tanner. The findings of Tanner, knowledge extrapolated from other *Campephilus* species, knowledge of woodpeckers in general, interpretations of photographs, and additional anecdotal information (Gallagher 2005, Jackson 2004) comprise the state of our understanding of the Ivory-bill. Clearly, any strategy aimed at recovery of this species must focus on intensive surveys to document the presence of the species. Much more could be learned about the ecology and biology of the species.

Our poor understanding of the species has largely directed the recovery strategy to one of learning more about the species status and ecology as opposed to developing specific habitat management actions to be taken. Habitat management and land protection efforts are important but, at this early stage of recovery, the current focus is on learning more about where birds persist and then to examine those habitats to reveal ways in which specific conservation actions could be developed.

Spatially explicit population goals have not been identified here but are recognized as a key part of this recovery plan. Recognizing this, modeling of habitats and populations is currently underway. The end result of these efforts will help inform the development of spatially explicit population and habitat goals. When these analyses are completed the plan can be revised to reflect the findings of modeling and research activities.

Recovery Goal

The goal of the Ivory-billed Woodpecker recovery program is to protect and increase existing populations and associated habitat and recover the species to the point at which it can be downlisted from endangered to threatened status, and ultimately to remove it completely from the Federal list of threatened and endangered species when the protections provided by the Endangered Species Act are no longer necessary.

Recovery Objectives

This recovery plan identifies actions needed to achieve long-term viability for the Ivory-billed Woodpecker and accomplish these goals. Recovery of the Ivory-billed Woodpecker focuses on the following objectives:

1. Management to reduce risks to the existing population,
2. Protection and enhancement of suitable habitat, and;
3. Actions to reduce or eliminate threats sufficient to allow successful restoration of additional wild populations.

The emphasis in this recovery plan on the distribution of additional viable populations in the historical range is based upon two widely recognized and scientifically accepted goals for promoting viable populations of listed species. These goals are: 1) the creation of multiple populations so that a single or series of catastrophic events do not result in species extinction; and 2) the increase of population size to a level where the threats from genetic, demographic, and normal environmental uncertainties are diminished (Mangel and Tier 1994, National Research Council 1995, Tear *et al.* 1995, Meffe and Carroll 1997). By maintaining population numbers and viable breeding populations at multiple sites, the species will have a greater likelihood of achieving long term survival and recovery.

Recovery Criteria

At present, the limited knowledge on the population abundance, distribution, habitat requirements, and biology of the Ivory-billed Woodpecker prevents development of more specific recovery criteria. The following interim criteria will lead us to the development of more specific, quantifiable criteria that should be met before considering the delisting of this species:

1. Determine current habitat use and needs of existing populations.
2. Survey potential habitats for new occurrences.
3. Conserve and enhance habitat on public land. Add additional acreage to public habitat inventory via land acquisition from willing sellers.
4. Conserve and enhance habitat on private lands through the use of agreements, conservation easements, habitat conservation plans, and public outreach to facilitate appropriate management actions.
5. Determine viability of existing populations (numbers, breeding success, population genetics, and ecology).

6. Determine the number and geographic distribution of subpopulations needed for a self-sustaining metapopulation and evaluate suitable habitat for species reintroduction.

Recovery Actions Needed

The primary actions needed to accomplish delisting and interim downlisting recovery goals are: (1) population surveys and monitoring with an emphasis on the Cache and White River Basins and additional survey work in other parts of the historical range where habitat and sighting information indicates potential for the presence of the species, (2) habitat inventory and monitoring in the Cache and White River Basins and at larger spatial scales in the historical range of the species, (3) population and habitat modeling at various spatial scales to facilitate survey efforts and to inform potential management actions, (4) assumption-driven research directed at testing the biological assumptions otherwise implicit in modeling and management actions, (5) landscape characterization and assessment of the Mississippi Alluvial Valley and specifically the ability of the Cache and White River Basins to support recovery populations, (6) conservation design aimed at defining the spatially explicit landscape conditions needed to support the species, (7) education and outreach on the conservation of the species, (8) management of public use in areas where the species is known to occur to avoid possible adverse impacts from intense public use, and (9) management of rediscovered populations to protect occupied habitat and individuals, as well as to provide for management of forested habitats to aid in achieving recovery.

Total Estimated Cost of Recovery

Year	Action 1	Action 2	Action 3	Action 4	Action 5	Action 6	Action 7	Action 8	Action 9	Total
2006	1.95M*	1.032M	28K†	355K	446K	70K	0	90K	4.06M	7.977M
2007	845K	806K	0	355K	340K	175K	65K	60K	3.055M	5.652M
2008	810K	550K	0	240K	40K	140K	31.5K	60K	3.055M	4.877M
2009	810K	500K	0	180K	0	90K	33K	60K	3.055M	4.679M
2010	810K	500K	0	150K	0	40K	35K	60K	3.055M	4.600M
Total	5.225M	3.388M	28K	1.28M	826K	515K	164.5K	330K	16.03M	27.785M

*M = million dollars

†K = thousand dollars

Date of Recovery

Delisting should be initiated in 2075, if recovery criteria are met.

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I. BACKGROUND

A. Overview

The Ivory-billed Woodpecker (*Campephilus principalis*), once an inhabitant of forested habitats throughout the Southeastern United States and Cuba, was reduced to very low numbers by the early 20th century (Tanner 1942). Little hope was held for its continued existence, until evidence of the species was documented in 2004 and 2005 (Fitzpatrick *et al.* 2005). Observers reported multiple sightings and recorded audio and video of at least one Ivory-billed Woodpecker within a section of Bayou de View, located in the Cache River National Wildlife Refuge (NWR) in east-central Arkansas.

The Fish and Wildlife Service (We) recommend that the recovery strategy initially focus on completing surveys that help us learn more about the species' status, distribution, ecology and that help us characterize its habitat. Results from these surveys will help us formulate specific conservation actions for the species throughout its range in the United States. Population goals are not identified, but are acknowledged as key to the recovery. Current efforts include development of models and additional research that will generate these spatially-explicit population goals. The recovery strategy contained in this recovery plan pertains to the population of Ivory-billed Woodpeckers in the southeastern United States. However, the U. S. Fish and Wildlife Service and its partners recognize the need to develop cooperation at the international level to address conservation of the species across its entire range (*i.e.*, Cuba) (Thomas Barbour 1923 from Jackson 2004).

B. Species Description and Taxonomy

The Ivory-billed Woodpecker belongs to a group of 11 species of large woodpeckers that form the genus *Campephilus*, the majority of which inhabit Central and South America. Two groups of Ivory-billed Woodpeckers are recognized (American Ornithologists' Union 1998): the Northern Ivory-billed Woodpecker (*principalis* group) with a historic range covering most of the southeastern and a small portion of south-central United States (Figure 1) and the Cuban Ivory-billed Woodpecker (*bairdii* group) which historically ranged throughout Cuba, though a recent publication provides evidence that the Cuban Ivory-billed Woodpecker may be a distinct species (Fleischer *et al.* 2006).

The Ivory-billed Woodpecker is noted for its striking black and white plumage; robust white, chisel-tipped bill; lemon-yellow eye; and pointed crest of feathers. Males are red from the nape to the top of their crest with black outlining the front of the crest. Females have a solid black crest which is somewhat more pointed and slightly recurved to point forward (Figure 1).



**Figure 1 Male Ivory-billed Woodpecker, perched. Female, showing crest
copyright David Allen Sibley**



The bases of the male's red crest feathers are white, which may allow a spot of white to be displayed on the side of the crest when the feathers are fully erect. This was illustrated by Wilson (1811) and shown on a specimen by Jackson (2004). Morphological data from live birds are lacking. The best estimates of size are from measurements given by John J. Audubon (although these lack locality, date, and other data) and ornithologists of the late 19th century, such as Robert Ridgeway, who collected specimens (Ridgeway 1914 from Tanner 1942). The available information from such sources suggests the Ivory-billed Woodpecker has an overall length of approximately 48-51 centimeters (cm), an estimated wingspan of 76-80 cm, and a weight of 454-567 grams (g), based on values of "1 pound"

and “20 ounces” given in the historical records. However, no clearly documented data is available (Jackson 2002). In comparison, the more common Pileated Woodpecker has an overall length of approximately 40-48 cm and a weight of 250-355 g.

Ivory-billed Woodpecker vocalizations are comprised of a nasal “kent” call resembling the sound obtained by blowing on the mouthpiece of a saxophone or clarinet. John J. Audubon likened the sound to that of a toy trumpet. This call and variants of it seem to function as a contact call, a distress call, or as a call given during displays at the nest. Mnemonics for these calls have varied greatly, including such renditions as “kent,” “yent,” “yap,” and “kient.” The notes of these calls are often given singly, doubly, or in a series of three (a single note followed by a double note) such as “yent-yentyent” and were recorded at a nest in 1935 (Allen and Kellogg 1937, Allen 1939). There is also a far-carrying call described as “kient-kient-kient” for which no recording exists. This far-carrying call, often used among group members in chorus prior to a long-distance flight, is reportedly the loudest contact call of the Ivory-billed Woodpecker and can be heard up to a quarter-mile away (Tanner 1942). Non-vocalized sounds made by the bird include a rapid, loud knocking characteristic of most members of the genus. This “rapping” is often described as a “double rap” since it consists of two rapid knocks. Raps may also occur singly. The Ivory-bill is also known— at least in some circumstances— to have noisy wing-beats in flight and a more rapid wing-beat relative to the Pileated Woodpecker (Tanner 1942).

C. Status

The Ivory-billed Woodpecker was listed as endangered throughout its entire range on March 11, 1967, (32 FR 4001) and June 2, 1970 (35 FR 8495). Information on the status of the population is limited and current population size and distribution is not clearly known. On February 11, 2004, kayaker Gene Sparling caught a glimpse of a large woodpecker in the Cache River National Wildlife Refuge of Arkansas. The encounter spurred an extensive scientific search. Additional sightings, observations as well as audio and video recordings from the search have provided evidence that the Ivory-billed Woodpecker still exists. Many State, Federal and private partners will cooperate to continue searching for evidence of the species’ presence (*e.g.*, sightings, nest cavities), promoting habitat protection and management, and supporting necessary research to conserve this species and the ecosystem upon which it depends. Additionally, we recognize that there continues to be debate among ornithologists and birders regarding the evidence that at least one Ivory-billed Woodpecker was found in the Big Woods of eastern Arkansas (Fitzpatrick *et al.* 2005, Fitzpatrick *et al.* 2006, Jackson 2006, Lammertink *et al.* 2006, Sibley *et al.* 2006). The Service recognizes and supports exchanges of views on alternative interpretations as a part of the scientific process. However, it is understood that the U. S. Fish and Wildlife Service is charged to promote conservation and recovery of this species.

Some authorities (Kirkconnel 2005, pers. comm.) suspect the species might persist in a few locations in Cuba (Garrido and KirkConnell 2000).

The Recovery Priority Number for the Ivory-billed Woodpecker is 5 on a scale of 1 to 18, indicating a high degree of threat and a low recovery potential for this species. A Recovery

Priority Number is assigned to every species listed according to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1537 *et seq.*) and is based on the species' recovery potential, degree of threat and its taxonomic designation (U.S. Fish and Wildlife Service 1983a, 1983b). No critical habitat has been designated for this species.

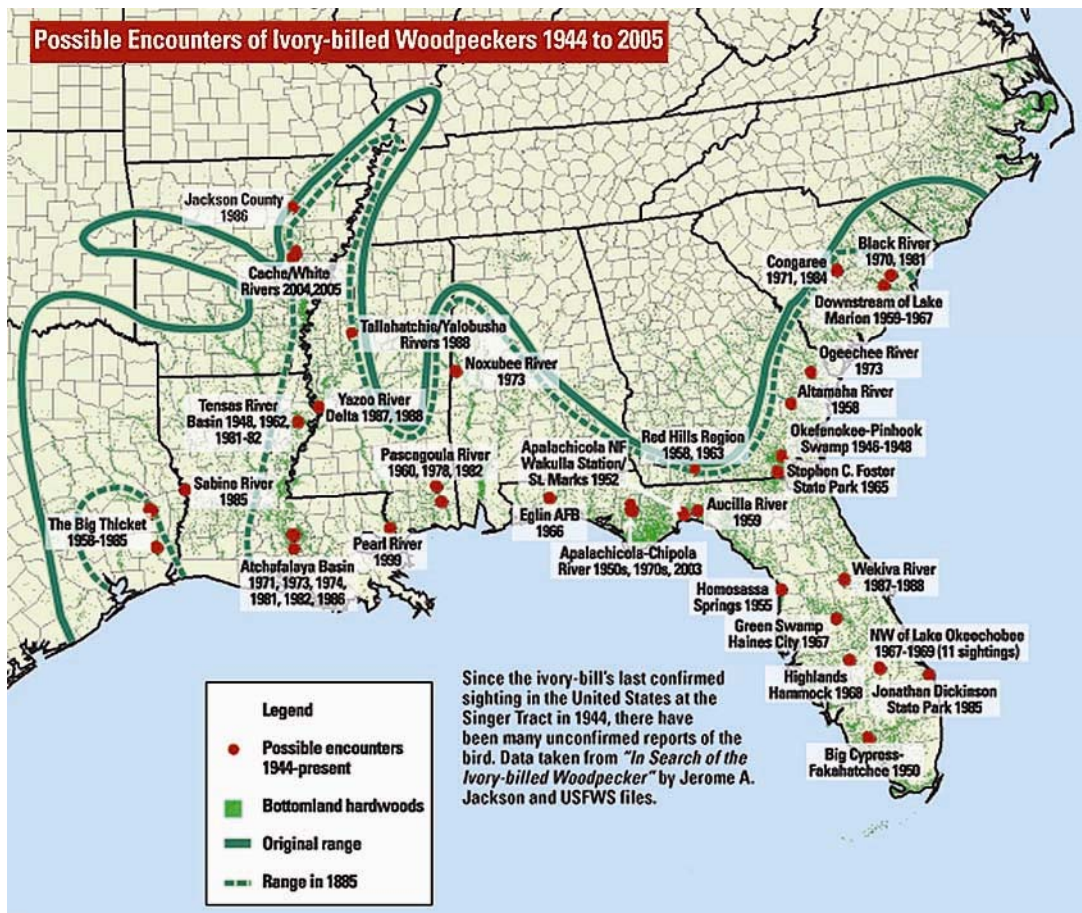
D. Population Trend and Historic Distribution

The extreme rarity of the species for nearly a hundred years has resulted in a lack of population data which could be used to establish a definitive current trend in population size or distribution. It is possible to sketch a distribution of the historic range in the U.S. based on museum records and the observations of early explorers and naturalists. The Ivory-billed Woodpecker appeared to be quite widespread throughout the southeastern United States prior to European settlement (Figure 1). It once roamed forests of the southeastern United States from the coastal plain of Texas and eastern Oklahoma into North Carolina, southward to include all of Florida, and in the Mississippi Alluvial Valley northward to the confluence with the Ohio River and then eastward on the Ohio River bordering Kentucky and Illinois (Hasbrouck 1891 from Jackson 2004). Archaeological evidence indicates that the Ivory-billed Woodpecker may have occurred eastward to southern Ohio at least 300 years prior to European settlement (J. L. Murphy and J. Farrand, Jr. 1979 from Jackson 2004).

Historic population numbers will never be known but based on the extensive habitat available prior to European settlement it is likely that thousands of birds once existed. Declines corresponded closely with European settlement and the clearing and alteration of forest habitats (Appendix B). The long term decline in habitats important to the Ivory-billed Woodpecker began in the early 1800s with essentially all of the historic range impacted in some way by the early 20th century. Through the early 1940s, there was a gradual decrease in the number of collection and sight records that ended with the documented sightings in the Tensas River region of northeastern Louisiana. These records are all that is available to sketch the historic range and decline of this species.

The most recent density estimate we have for Ivory-billed Woodpecker populations are from Tanner's study published in 1942. Based on his reports, Ivory-billed Woodpecker density ranged from 1 breeding pair per 6 square miles (about 4,000 acres of mixed upland pine and bottomland forest in Florida) to 1 breeding pair per 17 square miles (about 11,000 acres of bottomland forest in Louisiana). Based on these estimates, 50 breeding pairs of Ivory-billed Woodpecker in the late 1930s would need 300 square miles (about 200,000 acres) of habitat in Florida or 850 square miles (about 550,000 acres) in Louisiana.

Figure 2. The Historic Range of the Ivory-billed Woodpecker and Locations of Potential Sightings Reported from 1944 to 2005.



Since the last confirmed sightings of the species in Louisiana in the 1940s, there have been numerous reports of possible sightings, photographs, and recordings of Ivory-billed Woodpecker vocalizations or drumming across the historic range of the species. The most significant of these are summarized in Figure 1 and Table 1 and discussed in more detail in Appendix C. Those observations, unfortunately, could not be verified. Convincing evidence of the species' existence was obtained when the Ivory-billed Woodpecker was rediscovered in Arkansas as documented by Fitzpatrick *et al.* (2005). In 2004 and 2005, observers reported multiple sightings and, more importantly, recorded video of an Ivory-billed Woodpecker. Interpretation of the video has been challenged by others (Jackson 2006, Sibley *et al.* 2006). The opposing position is that the recorded bird may be a Pileated Woodpecker. Fitzpatrick *et al.* (2006) provided additional analysis of the Arkansas sightings to answer the opposing claims and to further support the video evidence of Ivory-billed Woodpecker existence.

Table 1. Summary of possible Ivory-billed Woodpecker encounters reported from 1944 to 2005. Most of these are referenced in Jackson (2004). The source for some encounters is an unpublished FWS compilation of reports from the late 1980s. (Appendix C).

STATE	REGION	COMMENTS
South Carolina	Pee Dee and Waccamaw	Sightings from the Black River reported in 1970 and 1981, no independent confirmation.
South Carolina	Santee River	Congaree Swamp National Park to Cape Romain National Wildlife Refuge (FWS)
South Carolina-Georgia	Savannah River from Augusta to Savannah.	No post-1944 reports.
Georgia	Ogeechee River, 25 miles west of Savannah	1973
Georgia	Altamaha River	1958
Georgia-Florida	Okefenokee NWR-Pinhook Swamp-Osceola NF	Reports during 1946-1948
Georgia-Florida	Red Hills	Seen by Stoddard in 1958 and Reynard (1963)
Florida	Apalachicola Drainage Basin	1950's (Stevenson and Anderson 1994)
Florida	Lower Suwannee River (including Big Bend and California Swamp)	No post-1944 reports
Florida	Big Cypress-Fakahatchee	1950
Florida	Eglin Air Force Base	1966, not independently confirmed
Florida	Wekiva River	1987-1988, not independently confirmed
Florida	Homosassa Springs	1955, not independently confirmed
Florida	Green Swamp, Haines City area	1967, credible observer
Florida	Highlands Hammock	1968, not independently confirmed
Florida	Jonathan Dickinson State Park	1985, not independently confirmed
Florida	northwest of Lake Okeechobee	1967-1969
Alabama-Mississippi	Mobile River delta (includes Tensaw, Alabama and Tombigbee river systems)	No post-1944 reports
Mississippi	Pascagoula River	Reports from 1960, 1978, and 1982
Mississippi	Yazoo River Delta (from Mississippi River confluence to vicinity of Greenwood)	
Mississippi	30 miles north of Meridian	1953
Louisiana-Mississippi	Pearl River	1999
Louisiana	Atchafalaya Basin	1970s 1980s
Louisiana	Catahoula NWR east to Cat Island NWR	No post-1944 reports
Louisiana	Tensas River Basin	1940s-1980s
Louisiana-Arkansas	Ouachita River (from Felsenthal NWR to Ouachita WMA)	No post-1944 reports
Arkansas	White-Cache-Lower Arkansas rivers	2004, 2005
Louisiana-Arkansas-Oklahoma-Texas	Red River (including Little River NWR, OK, Caddo Lake NWR, TX, Pond Creek NWR, AR and points south into LA)	1980s
Louisiana-Texas	Sabine River (Toledo Bend Reservoir)	1985
Texas	Big Thicket (Neches-Trinity rivers)	1958 to 1985 (FWS)

The status of the species in each of the states within the historic range is summarized below. Detailed state descriptions are included in Appendix D.

1. Alabama

Data on the historical occurrence, and hence the original range, of the Ivory-billed Woodpecker in Alabama is meager. Based on published records and the historic range of the species in surrounding states, the Ivory-billed Woodpecker probably inhabited areas of suitable habitat in the eastern gulf coastal plain of Alabama south of the fall line (the area where continental bedrock meets coastal plain. When this area intersects a river, falls and rapids are usually present). The most suitable habitat appears to have been in forests along major riverine systems in the west and south and in extensive longleaf pine forests in the southeast. The vast forested wetlands along the Alabama, Tombigbee, Black Warrior, Chattahoochee, Conecuh, and Pea rivers were undoubtedly important.

The relative rarity of the species throughout its range, absence of surveys, and lack of locality data documenting its distribution makes it difficult to draw meaningful conclusions concerning range changes. While the bird undoubtedly occurred in low numbers over large areas of Alabama, available data indicates that by 1850 its main center of distribution in Alabama was severely restricted. Six records for Alabama are from the once vast forested areas drained by the Tombigbee and Alabama Rivers in west Alabama.

There have been at least six reported Ivory-billed Woodpecker sightings from four counties in Alabama (Madison, Sumter, Jefferson, and Tallapoosa) since 1944. Of those encounters, only one sighting along the Noxubee River in 1973 is within the reported historical range of the species.

2. Arkansas

Historically, the Ivory-billed Woodpecker inhabited old-growth bottomland forests in eastern Arkansas (James and Neal 1986). John Audubon saw these woodpeckers regularly during his travels down the Mississippi River near Arkansas Post in 1820 (Audubon 1929). Tanner (1942) presents reports of the species in the 1800s from the northeastern part of the state near Newport along the White River, near Marked Tree (between the St. Francis River and the Mississippi River), Osceola (adjacent to the Mississippi River in far northeast Arkansas), and Helena in eastern Arkansas. Tanner (1942) also reports less specific accounts of sightings in the 1800s along the Canadian and Arkansas rivers and at the confluence of the Ouachita and Saline rivers in the south-central part of Arkansas. (This record is derived from the 1834 record of G.W. Featherstonhaugh, 1935 which should read “Clark County, Caddo River, 2 miles upstream of the junction of the Ouachita River” and is incorrect in Tanner, 1942) (Foti pers. com).

According to Tanner (1942) logging increased rapidly in most of Arkansas between 1890 and 1900. The last Ivory-billed Woodpecker population remaining in the state near the mouth of the Arkansas River disappeared between 1900 and 1915; the last historical report for the bird in Arkansas was about 1910. Tanner (1942) briefly visited what is now the White River NWR

in 1938 and found no evidence of the bird and a lack of habitat to support the species. However, in 2005, published auditory, video and visual evidence in the Cache and White River NWRs indicated the presence of at least one bird in Arkansas.

There have been at least 27 reported Ivory-billed Woodpecker sightings or auditory encounters from 4 counties in Arkansas (Jackson, Little River, Monroe, and Phillips) since 1944. Most notably, the 2004 and 2005 encounters in Bayou de View documented by Fitzpatrick *et al.* (2005) represent the most definitive evidence of the species existence since the 1940s.

3. Florida

The greatest number of historical reports and collected specimens of Ivory-billed Woodpeckers are from Florida, partly owing to Florida's accessibility to the "northeastern establishment ornithologists" of the late 1800s and early 1900s (Jackson 1996:105). Ivory-billed Woodpeckers are known to have existed throughout Florida from the panhandle to the Everglades (Jackson 1996), although records from extreme southern Florida are controversial.

Ivory-billed Woodpeckers were probably most numerous in three regions: (1) riparian systems and associated pine woods in northern Florida; (2) the Big Cypress swamp in southwest Florida; and (3) swamp forests associated with several rivers in central Florida. The salient feature of Ivory-billed Woodpecker habitat in Florida appears to be old-growth forest, including, and perhaps favoring (Jackson 1996), the ecotone (transition zone between two ecological communities) between bottomlands and uplands. Most historical Ivory-billed Woodpecker habitat in Florida can be characterized as river swamp, although stillwater swamps, particularly cypress swamps and cypress strands, were a significant component. A habitat used by Ivory-billed Woodpecker and unique to Florida was the extensive Big Cypress region that occurs on flat, poorly drained limestone topography in the southwestern part of the peninsula (Duever et al. 1986).

Ivory-billed Woodpecker numbers, in decline since the arrival of Europeans in North America, suffered accelerated losses during the last decades of the 1800s and first decades of the 1900s (Jackson 1996). By 1900, they were gone from most parts of northern Florida (Robertson and Woolfenden 1992). Areas such as St. Marks in Wakulla County were thought to have had Ivory-billed Woodpeckers around 1905 (Phillips 1926). By the late 1930s, when Tanner (1942) visited the Gulf Hammock, lower Suwannee River, and California swamp in northern Florida, he found no sign of the species and very little habitat that was not cut over.

As the twentieth century progressed, only small groups persisted, mainly in southern and central Florida (Jackson 2004). By the 1920s, only dedicated field ornithologists could find pairs of birds in remote areas like Taylor Creek in central Florida—and these last pairs were quickly taken as specimens (Allen and Kellogg 1937). The last museum specimens with reliable collection data were a male and female pair taken during 1925 in Osceola County by B.J. Hancock (Florida Museum of Natural History collection; Hahn 1963).

There have been many reports of various types of encounters with this species in Florida since 1944 (Appendix D, Florida table). A series of credible sightings occurred in northern Florida during the 1950s along the Chipola River and in Taylor, Jefferson and Wakulla Counties (Crompton 1950, Eastman 1958, Dennis 1967, Stevenson and Anderson 1994, Jackson 2002). Recent sightings that appear to have the most reliability were reported from Polk/Highlands County during 1967-1969, the lower Apalachicola River in 1984, and Jonathan Dickinson State Park in 1985. Jackson (1996, p.104) referred to winter sightings during 1990-1991 from Fakahatchee Strand (southwest Florida) and from the lower Chipola/Apalachicola swamps (panhandle Florida), which “simply cannot be ruled out as having truly not been of an Ivory-billed Woodpecker.” However, no details regarding Jackson’s references were available.

4. Georgia

The original range of the Ivory-billed Woodpecker in Georgia probably was the extent of the coastal plain up to the fall line, although it is likely that some birds occasionally traveled up some of the major river systems (i.e., Savannah, Oconee, Ocmulgee, Chattahoochee, and Flint) into the Piedmont. As with other parts of its range, the bird probably was primarily associated with major river systems, including the Okefenokee Swamp in extreme southeast Georgia (Tanner 1942, Burleigh 1958, Jackson 2002).

As the coastal plain gave way to agriculture, the species’ range was restricted more and more to floodplain forests associated with the above major river systems, plus those such as the Satilla, wholly contained in the coastal plain (Tanner 1942, Burleigh 1958, Jackson 2002). In addition, areas of mature pine surrounding large expanses of bottomland hardwoods were apparently used for foraging. However, it is unlikely that pine forests would be used in the absence of a core area of large bottomland forests. A possible exception is in the Red Hills region of southwest Georgia-northern Florida, which still retains large patches of mature longleaf forest, some of it virgin (Stoddard 1969).

An area that apparently retained Ivory-billed Woodpeckers well into the twentieth century is the Okefenokee Swamp, an area greater than 150,000 hectares in southeast Georgia with limited drainage by the Suwannee River toward the Gulf and by the St. Mary’s River toward the Atlantic (Greene 1936, Burleigh 1958).

As large forested areas, including many bottomland forests, were cleared for agriculture, replanted for pine silviculture, or otherwise developed, the species range continued to shrink. Today the only locations that retain habitat features favorable to Ivory-billed Woodpeckers over a large enough expanse to be considered possible habitat are sections of the lower Altamaha River floodplain and the Okefenokee Swamp, although there are a couple of other areas that are probably worth searching (see below).

Habitat in the Okefenokee Swamp might be considered somewhat unique. It features large expanses of open shallow marshes or prairies of floating leaved plants and emergents, plus bogs of sphagnum or fern. These are intermixed with (1) wooded swamps or bays supporting stands of pond cypress, water tupelo, red bay, black bay and loblolly bay, (2) hammocks

supporting mixed stands of water oak, loblolly pine, magnolia and sweet-gum, and (3) barrens of moist and dry pineland, mostly containing longleaf and slash pines (Burleigh 1958).

Habitat in the Red Hills region is a mosaic of mature pine forest, agriculture, urban/suburban, and hardwood bottoms. What makes it unique are the relatively large patches of old-growth longleaf-wiregrass habitat that still exist. The overstory of these habitats is typically a well-spaced monoculture of old (>300 years) longleaf pine with an herbaceous ground cover that is very diverse. The system is maintained by frequent fire, which also serves to control the growth of a hardwood understory. Several of these areas border large patches of bottomland hardwoods, and together they might constitute suitable habitat for Ivory-billed Woodpeckers.

Only a handful of encounters have been reported since 1944. Probably the most credible of these were made by the noted ornithologist/naturalist/conservationist Herbert L. Stoddard. Interestingly, Stoddard did not report these immediately, apparently for fear of disturbance of the birds. Several observations were from the Okefenokee Swamp (Suwannee, St. Marys Rivers) including one unknown observer cited by Green 1936, as well as F.V Hebard cited by Burleigh 1958, and Loftin 1991. Stoddard's reports include Thomas County 1952, 1958, and the Lower Altamaha River 1940-1950s. G. Reynard also reported a Thomas County sighting in 1963. Jackson (2004) reported a sighting 25 miles west of Savannah by C.D. Gerow on the Ogeechee River.

5. Kentucky

Modest documentation exists on the historical locations as well as actual population densities of this species in Kentucky. The earliest record for the species, provided by Col. William Fleming in his journal (A. W. Schorger 1949 from Jackson 2004), placed the species in Lincoln County on the foothills of the Knobs Physiographic Region, a distinctive geologic region with higher elevations reaching 1,000 feet (above mean sea level) in forest habitat. The forest in this region is drastically different from most Ivory-billed Woodpecker habitat documented to date. Wharton (1945) described the region's different upland forest types as pine, oak-pine, chestnut oak-scarlet oak, white oak, and mixed mesophytic (not particularly dry or wet) forest. All are primarily determined by slope aspect and/or succession (Muller and McComb 1986).

When viewing these records on a regional scale, it may be entirely plausible that pre-colonial Ivory-billed Woodpecker populations could have extended, not only up the Ohio River, but also into other tributaries of the Ohio River. If so, then another one plausible explanation for the presence of the species in Lincoln County site may be explained by the nearby riverine forests of the Dix River and the nearby source of the Green River, which lies in close proximity to the area mentioned. With major cultivation and land use changes not occurring until the early 1800's, both of the mentioned river systems may have provided connectivity to the Ohio River floodplain forests to the north and west of the Lincoln County site. Since no documentation exists outside the Ohio record, the pre-colonial record from Lincoln County may suggest the species could have been present in many of Kentucky's larger river bottoms.

While the early Kentucky record continues to be rather dubious, the most precise documentation providing a definitive date and reference to the original range in the state appears to be in the 1831 notes of John James Audubon, when he recorded the species at the confluence of the Mississippi and Ohio River (present day Ballard County). In these notes, Audubon only made “oblique reference” to nesting in Kentucky and Indiana (in the Wabash River system) (Mengel 1965). This record would have placed the species near present day Union County, Kentucky. Audubon also made additional reference to nesting at Green River in present day Henderson County, however it appears that the greatest population densities of the species occurred in counties adjacent to the Mississippi River which include: Fulton, Hickman, Carlisle, and Ballard counties.

Due to the lack of documentation of the Ivory-billed Woodpecker in Kentucky, it is impossible to determine any range changes over time. It does appear that by the early 1800’s the Ivory-billed Woodpecker had all but disappeared from the majority of Kentucky’s landscape, with some residual numbers remaining until the early 1870’s in Fulton county, where the last known population of the bird remained (Mengel 1965). No substantive evidence of the species has been reported since the Fulton County report in the 1870s (Palmer-Ball 2003).

Current habitat conditions are thought to be poor due to the clearing of land along the Mississippi River in the early 1800’s and continual logging operations which occur on regular cycles, as well current conditions found in the Mississippi River floodplain.

6. Louisiana

Figure 2 James Tanner in the Singer Tract



Jackson (2002), Oberholser (1938) and Tanner (1942) discussed known Ivory-billed Woodpecker distribution in Louisiana prior to the 1940s which can generally be described as occurring in the bottomland forests along the Mississippi corridor from the Arkansas state line south to the coast. Specimen collections and sightings (as reported by Tanner 1942) date back to the late 1800s and in northern Louisiana came from the general area between the Mississippi River and Ouachita River, south to the area where they are joined by the Red River (Morehouse, West Carroll, East Carroll, Madison, Franklin, Tensas, and Concordia Parishes). South of that area, Ivory-billed Woodpecker specimens and sightings were reported from the bottomland forests along the Mississippi River and Atchafalaya River (West Feliciana, West Baton Rouge, Iberville, St. Martin, and Lafourche Parishes) south to the forested coastal area of Iberia Parish. McIlhenny (1941) recorded his earliest childhood memories of Ivory-billed Woodpeckers being resident in the forested areas of Avery Island and the "great forest" extending east to the Atchafalaya River.

Tanner (1942) noted that logging in the southern part of Louisiana began around 1905 gradually moving north. The last observation of an Ivory-billed Woodpecker in the southern part of the state was by E.A. McIlhenny in 1923 (McIlhenny 1941). Logging began to spread southward into Louisiana from Arkansas about 1910 and met the logging movement from the south in northern Louisiana where it peaked about 1925 and then declined (Tanner 1942). According to Lowery (1974) until 1932, ornithologists had come to believe that the Ivory-

billed Woodpecker no longer existed. As Lowery recounts it "A comment to this effect in the offices of the Louisiana Wildlife and Fisheries Commission prompted a quick denial from Mason Spencer, a resident of Tallulah, who happened to be present. So incredulous was everyone of his assertion that Ivory-bills still lived near Tallulah that a permit was immediately issued to him to shoot one." Apparently, commissioners were certain that he would return with a pileated woodpecker. Mr. Spencer returned with an Ivory-billed Woodpecker. As previously stated in the plan, the Ivory-bills of the Singer Tract in northern Louisiana were the last known United States population to be studied (Allen and Kellogg, 1937 and Tanner, 1942).

There have been at least 10 reported possible sightings of the Ivory-billed Woodpecker in Louisiana since August of 1941.

- 1941 In August, three Ivory-billed Woodpeckers were seen in John's Bayou area of the Singer Tract, LA, by George Bick and Jim Parker, including an apparent female hatch-year young (Bick 1942; J. Tanner pers. comm., Oct 1989, an update and annotation of Tanner 1942).
- 1941 On 21 and 28 of December, Tanner found an adult and juvenile female in a highly cutover area of the Singer Tract.
- 1942 Roger T. Peterson and Bayard Christy observed two females in the same area May 9 (Christy 1943, Peterson 1948, J. Tanner update pers. comm.).
- 1942 In November of 1942, John Baker found a single female in the Singer Tract (Peterson 1948).
- 1943–1944 Richard Pough of National Audubon Society found a single female in the Singer Tract between 4 Dec 1943 and 19 Jan 1944 (Pough 1944).
- 1944 In April of 1944, Don Eckelberry saw and sketched a female in the Singer Tract (Eckelberry 1961; watercolor painting in collection of J. A. Jackson and reproduced in Jackson 2002).
- 1946 A possible sighting occurred in December of 1946. A single Ivory-billed Woodpecker may have remained in the Singer Tract (Peterson 1988), although there is apparently neither identification of the observer nor further record of this report.
- 1971 On 22 of May 1971, an unidentified dog trainer photographed a pair of Ivory-billed Woodpeckers on separate tree trunks in second-growth forest in the Atchafalaya Basin, Louisiana. The photos were given to George Lowery at Louisiana State University (LSU), who followed up with searches in the area. He found no conclusive evidence of Ivory-billeds. Jackson has examined the photos and concurred with Gauthreaux (1971: 827) and Stewart (1971: 868) that they are clearly of one or two Ivory-billed Woodpeckers. However, the photos were shown to ornithologists at the 1971 American Ornithological Union meeting at LSU and met with skepticism, the suggestion being that they might be of a mounted specimen.

1974 November 11, 1974, Robert Bean reported seeing an Ivory-billed Woodpecker from a distance of about 5 m as it flew across Interstate 10 in the Atchafalaya Swamp about 32 km west of Baton Rouge, LA (Dennis 1979). This is near where Robert Hamilton thought he had seen one 2 years earlier (Hamilton 1975).

1999 David Kulivan reported seeing two Ivory-billed Woodpeckers in the Pearl River Swamp of southeast Louisiana April 1 (Williams 2001, Jackson 2002).

7. Mississippi

Ivory-billed Woodpeckers in Mississippi were probably originally distributed essentially statewide in floodplain forests along major river systems. These systems included the Pearl, Wolf, Pascagoula, and Tombigbee rivers; the lower tributaries and main stem of the Big Black River; and the Yazoo and Mississippi River deltas (Turcotte and Watts 1999). Most records for the species are from the Pascagoula, Tombigbee, Yazoo and Mississippi River floodplain forests (Hasbrouck 1891, Tanner 1942). Specimens have been collected from Bolivar and Harrison counties (Hahn 1963). Other counties with apparently acceptable records include Clay, Coahoma, Hancock, Jackson, Monroe, Warren and Yazoo (Jackson 2004). Habitat used by the Ivory-billed Woodpecker in Mississippi is believed to be the same as the habitat described in the life history account of the species in this recovery plan.

Reports of the species in Mississippi were most numerous before 1940 and included 16 of the 27 known records from the state (Appendix D, Mississippi table). Subsequent reports have been made in areas near or within the same river systems as the earlier ones, suggesting that the range of the species did not change over the recorded history of its known and suspected occurrence in the state, but that the abundance within that range declined throughout, presumably as the extant stands of timber were harvested and local populations were extirpated. The most recent specimen records are from 1893.

Several Ivory-billed Woodpecker encounters have been recorded in Mississippi, including 13 unverified reports since 1944 (Appendix D, Mississippi table). Areas with reported encounters since 1944 include the Pearl, Pascagoula, Leaf, Big Black, Noxubee, Yazoo and Mississippi rivers.

8. North Carolina

There have been no recent reliable or confirmed sightings of Ivory-billed Woodpeckers in North Carolina. The one definitive record, from Alexander Wilson, was from the Wilmington area around 1831.

The primary river systems in this southeastern corner of North Carolina, are the Waccamaw, and the Lumber Rivers. The Lumber River flows into the Little Pee Dee River in South Carolina approximately nine miles south the state line. In North Carolina, the Lumber River drainage contains about 85 square miles of potential habitat which includes the bottomland hardwood system and some associated uplands. The Waccamaw River system is about 30 miles to the southeast of the Lumber River, and contains about 45 square miles of potential

habitat. Lastly, the Cape Fear River system has some potential as well, and it includes the Northeast Cape Fear River and the Black River that join the Cape Fear near Wilmington. This group of rivers has about 60 square miles of potential habitat, and is about 20 miles northeast of the Waccamaw River.

9. South Carolina

The original range of Ivory-billed Woodpecker in South Carolina was the extent of the coastal plain bordered to the north by the fall line and extending to the Atlantic coast. This area was comprised of bottomland hardwood riverine systems surrounded by long-leaf pine uplands intermixed with farms and plantations. Tanner (1942) reported suitable Ivory-billed Woodpecker range was decreasing due to logging operations in the Santee River swamp occurring around 1939.

Three major river drainages occur within South Carolina and make up the majority of bottomland hardwood habitat type found. The Congaree and Wateree Rivers converge into the Santee River in the center of the state and the Santee River flows south to the Atlantic Ocean. The Savannah River delineates the border between Georgia and South Carolina, and flows north-south emptying into the Atlantic Ocean at Savannah Georgia. Northeastern coastal South Carolina includes the major drainages and tributaries of the Waccamaw, Lynches, Black, Great Pee Dee, Little Pee Dee, and Lumber Rivers (here referred to as the Waccamaw Complex).

Sprunt and Chamberlain (1949) suggest that the Ivory-billed Woodpecker was formerly common over much of the eastern part of the state but its virtual extinction is due to the encroachment of civilization. Bottomland hardwood habitat is still present along the Congaree-Wateree-Upper Santee Rivers, Savannah River, and Waccamaw Complex.

A number of Ivory-billed Woodpecker encounters in South Carolina have been recorded with the majority of historical sightings around the lower Santee River. A few sightings were also recorded along the Savannah, Pee Dee, and Coosawhatchie Rivers.

There are a number of possible encounters that do not have independent confirmation; six of those have occurred since 1944. All encounters fall within one of the four major bottomland hardwood river systems within the state; however the majority is from the Upper Santee/Congaree/Wateree Rivers, specifically within Congaree National Park.

10. Tennessee

While Ivory-billed Woodpeckers almost certainly occurred in bottomland hardwood forests of Tennessee historically, no definitive records from the state are known. Ivory-bill remains have been found in a few archaeological sites in Tennessee (Jackson 2004). However, since Native Americans traded them widely, the birds may not have originated in Tennessee. Audubon (1929) reported Ivory-billed Woodpeckers, for example, from a flatboat while traveling the Mississippi River during the winter of 1820–1821. Although Audubon reported this species from a stretch of river bordering Tennessee, he did not specifically mention the presence of Ivory-billed Woodpeckers on the Tennessee side of the Mississippi River. At least 2 records of

the bird from the late 1800s occurred in counties bordering Tennessee— Fulton County, Kentucky and Mississippi County, Arkansas.

Historically, the range of Ivory-billed Woodpeckers was very likely limited by the relatively few acres of bottomland hardwood forest in Tennessee when compared to other states within the rest of the species' range. The majority of the state's bottomland forests occur within the floodplain of the Mississippi River and its tributaries, which are relatively narrow in Tennessee. By the end of the 1940s, intensive logging practices further reduced existing possible Ivory-billed Woodpecker habitat in the state.

At least 4 Ivory-billed Woodpecker sightings or auditory encounters have been reported in Tennessee since 1944, all from the same area in the Hatchie River watershed. Three reports came from the same individual, who reported seeing one bird on 3 different occasions between 1996 and 2005, one of which was a female. The fourth report is a series of mostly auditory encounters, with one possible distant visual encounter, near the same location in the Hatchie River watershed during January 2006.

11. Texas

According to Oberholser (1974) the Ivory-billed Woodpecker was never common in Texas. In fact, records exist from only 16 counties in the state. Existing reports suggest that the species was restricted to areas east of the Brazos River. Tanner's (1942) publication indicates breeding records along the Brazos and Neches rivers in the 1880s. Specimens have been collected as far north as Dallas County along the Trinity River and birds were observed farther north along the Red River in Cooke County (Shackelford 1998). Most accounts of Ivory-billed Woodpeckers in Texas provide little or no information about the bird's habitat, but strongly suggest the species resided in mature bottomland forests (Oberholser 1974, Shackelford 1998).

Changes in the Ivory-billed Woodpecker's range are directly associated with changes in the distribution of mature forests. The amount of forests throughout eastern Texas was greatly reduced and fragmented before World War II. Man-made disturbances associated with agriculture, timber cuts and reservoir construction were the main causes. However, some large forested tracts, presumably with acceptable ivory-bill habitat, remained along the river bottoms of eastern Texas until the 1960s when some of the state's largest reservoirs, the Sam Rayburn and Toledo Bend, were constructed. At the time, these areas contained some of the state's best bottomland hardwood forests.

Unconfirmed accounts by J. V. Dennis, G. Reynard, and others persisted from 1956 into the 1970s, mostly along the Neches and Trinity rivers and Village Creek in the region known as the "big thicket." This area should not be confused with the present-day Big Thicket National Preserve, which was established later. A total of 12 unverified Ivory-billed Woodpecker observations, 2 of which were audio recordings, occurred within the counties of Hardin, Jasper, Liberty and Tyler, located within extreme southeastern Texas. All such published accounts are outlined in Shackelford (1998).

12. Cuba

The status of the species in Cuba is also poorly known. The species was known to persist as recently as 1987 but there have been no recent sightings of the species despite efforts to locate them. Despite the lack of clear evidence of their continued existence it is still possible the species is present in Cuba (A. Kirkconnell, pers. comm.) though the extent of suitable habitat is unknown.

12. Summary

In summary, it is clear that the Ivory-billed Woodpecker, once widespread throughout the southeastern forests, has declined dramatically to a small fraction of its historic range. Due to its extreme rarity, a definitive assessment of population size and distribution is not possible at this time. It is likely, however, that the population of remaining birds in Arkansas is extremely small. If the species persists in areas outside of Arkansas it is likely in small numbers as well. Potential remaining habitat for this species has been preliminarily identified and work is underway to refine methods which will aid in identifying potential habitat. In many locations, the forests of the southeastern United States continue to expand in size and age leaving some hope that as habitat conditions improve any remaining birds will increase in number.

E. Life History and Ecology

Our knowledge of the Ivory-billed Woodpecker's life history and ecology is limited and based primarily on just a few studies and information extrapolated from other similar species. The Ivory-billed Woodpecker is over 50% larger than the Pileated Woodpecker (see Section B) and, therefore, should require a greater amount of food to maintain its body mass than a Pileated Woodpecker. This greater food demand could explain why an Ivory-billed Woodpecker must range farther and is more sensitive to habitat alterations than the Pileated Woodpecker. The traits of having large home ranges and sensitivity to habitat alterations in the Ivory-billed Woodpecker are shared with the 3 other very large woodpecker species that weigh over 400 g (Lammertink in prep.). Associated with maintaining large home ranges, the Ivory-billed Woodpecker is known to fly distances of at least several kilometers each day between favored roost sites and feeding areas. Information on daily movements is very limited, however.

The ecology of the species likely includes substantial spatial and temporal flexibility, due to their use of disturbed sites (containing increased volumes of stressed and dead trees). Where these trees are available, they are useful for a limited period, normally when the trees and limbs are freshly dead or damaged after the disturbance. Ivory-billed Woodpeckers are thought to be dependent on extensive forested areas with old-growth characteristics and naturally high volumes of dead and dying wood needed to sustain the species in between disturbance events such as fires, storms, or other phenomena expected to kill or stress trees.

When faced with habitat fragmentation or habitat degradation, other large woodpeckers have been found to adapt by expanding their home range sizes. For example, in southern Sweden, Black Woodpeckers expanded their home ranges four-fold, yet maintained the same breeding

success in forests fragmented by agricultural fields (Fitzpatrick et al. 2005). In Borneo, Great Slaty Woodpeckers maintained similar group sizes in logged and primary forests (Lammertink 2004a) but average densities in commercially logged forests were only 17% of those in primary forests of similar soil type and elevation (Lammertink 2004b). It is likely that Ivory-billed Woodpeckers would expand home range sizes in sub-optimal habitats, such as in the regenerating bottomland forests in the Cache and White National Wildlife Refuges in eastern Arkansas. If Ivory-billed Woodpeckers in eastern Arkansas expanded home ranges and densities five-fold as observed in the Bornean study of Great Slaty Woodpeckers, core home ranges there could be up to 20 square miles and home ranges may occur at densities of only one per 85 square miles. At such densities, encounter rates with Ivory-billed Woodpeckers, even with a large number of observers in the field, can be expected to be very low.

There is no evidence to suggest that the Ivory-billed Woodpecker is migratory (Allen and Kellogg 1937), however Tanner (1942) suspected that the species may become nomadic in response to a fluctuating and undependable food supply.

Diet is poorly understood and based on anecdotal observations and the examination of the stomach contents of six collected birds. Large beetle larvae appear to be an important component of the diet. These are obtained by stripping bark from recently dead or dying tree trunks and branches and by excavating rotted wood. Members of the long-horned beetle family, Cerambycidae, were noted in the stomach of Ivory-billed Woodpecker several times, but many other species of wood-boring beetle larvae have also been documented. The diet may at times include various nuts, such as pecans and acorn, and fruits, including hackberry, persimmon, wild grape, poison ivy and possibly swamp tupelo.

Breeding phenology (annual cycle) is poorly known. Generally, it is thought that breeding occurs between January and April (Tanner 1942). Cavities are excavated in a dead or dying portion of a live tree, although in some cases a dead tree may be used. Nest cavities have ranged from 4.6 m to over 21 m up the nest tree with nests rarely being excavated below 9 m from the tree's base. Nest openings are characteristically oval, with an irregularly shaped rim, and somewhat taller than wide, ranging between 10.2 -14.6 cm wide and 15.2-17.1 cm tall. The size and shape of an Ivory-billed Woodpecker's nest opening is generally distinguishable from those of Pileated Woodpeckers, which typically have a regular oval or round rim and a width under 8.9 cm. The frequently oval-shaped cavity entrance of Ivory-billed Woodpeckers, Pileated Woodpeckers and other crested woodpeckers may be an adaptation to accommodate the bird's crest (Jackson 2004). The inside dimensions of Ivory-billed Woodpecker nest cavities suggest that the diameter of the cavity ranges from 17.8 to 26.7 cm with a possible depth from roof to floor of 44.4 to 63.5 cm. The outside diameter of the limb supporting the cavity can range from 33 to 55.9 cm (Tanner 1942, Allen and Kellogg 1937).

Ivory-billed Woodpeckers excavate and/or use roost cavities. Roost cavities are similar in appearance to nest cavities. In other woodpeckers, the roost cavity of the male often becomes the nest cavity. Observations by Tanner (1942) and Allen and Kellogg (1937) suggest that roost cavities are used by single Ivory-billed Woodpecker individuals, but this may not always be the case. In other large woodpecker species like the Megalanic

Woodpecker, members of a pair sometimes roost together (Ojeda 2004). Tanner (1942) and Allen and Kellogg (1937) found that paired birds or group members often roosted in trees within a few hundred meters of each other. They also reported the Ivory-billed Woodpecker to be a late riser, leaving its roost after sunrise.

Individuals can be faithful to the same roost cavity for at least a year and a half (Tanner 1942). Nest cavities are often constructed in favored roosting areas and may later become roost cavities. Thus, in several respects, the roosting area is the center of activity for an Ivory-billed Woodpecker.

Reported clutch size ranges from 1-5 eggs, but most reports are of clutches of 2 to 4 eggs. Incubation period has never been quantified for an Ivory-billed Woodpecker, but is performed by both sexes and, based on the measured incubation period of the Magellanic Woodpecker and one estimate by Tanner (1942) for an Ivory-billed Woodpecker, takes about 20 days. Both parents feed the young for a period of about 35 days until the young have fledged. The young may be fed by the parents for an additional two months and forage with and roost near the parents into the next breeding season.

The most complete study we have suggests that the Ivory-billed Woodpecker produces very few young compared to other birds (Tanner 1942). By the late 1930s, Tanner had identified up to seven distinct territories under his observation in the approximately 80,000 acres making up the Singer Tract, but only three breeding pairs produced young at least once for the six years of data collected, and young were produced consistently in only two territories.

No incidences of predation on Ivory-billed Woodpecker are known and it is likely that natural predators are few. However, nest predators may have had an impact on the species' decline under certain conditions. Raccoon and rat snakes may prey on nestlings or eggs while Great Horned Owls, Barred Owls, and Red-shouldered Hawks may prey upon recently fledged birds. Birds may also be killed by sudden catastrophic damage to nest or roost trees (*e.g.*, lightning strike, hurricane or tornado winds) and by disease.

Humans have killed the bird for several reasons. Historically the Ivory-billed Woodpecker was valued for its ivory-colored bill which was used as an ornament or collected as a curiosity by both Native and European Americans. The striking black and red crest of males was also used to decorate Native American war pipes (Jackson 2004). Additionally, Ivory-billed Woodpeckers were sometimes eaten by humans in the United States and Cuba. By the late 19th century, the rarity of the species made it desirable to amateur and scientific specimen collectors (Jackson 2004).

F. Habitat Characterization

What is known regarding the habitat requirements of the Ivory-billed Woodpecker comes mostly from the work of James Tanner and observations from current sites where the bird has been seen in eastern Arkansas. These birds have survived under less than optimal conditions, given the general assumptions regarding its needs. Recovery planning will require a comparison and evaluation (against what is understood about habitat requirements) of current

conditions in historically occupied and currently potential range, most notably in the Lower Mississippi Valley. Current forest management practices affecting Ivory-billed Woodpecker habitat should be examined to determine if those practices should be modified to improve those habitat conditions. In the long term, habitat protection, management, and enhancement will be of paramount importance to the recovery of the Ivory-billed Woodpecker.

1. General Observations on Historical Conditions

Literature on habitat characteristics favored by the Ivory-billed Woodpecker creates the impression that this species was associated with expansive patches of "virgin" or uncut forests with a relatively high proportion of very large and old trees that supported a high proportion of dead and dying trees. However, the importance of uncut forests may be only part of the habitat requirements of this species. This species may have sought older forests that had been subject to recent catastrophic events i.e. drought, fire, hurricanes, tornadoes, ice storms, and flooding, leading to the death of large patches of trees. In more modern times, Tanner did document that Ivory-billed Woodpecker occasionally used forests that had undergone some degree of partial logging, as long as many damaged, dying, and stressed trees were left standing and there were nearby remaining large areas of unlogged, older forests. However, these observations do not suggest foraging in logging slash was prevalent for the species. Logging, when followed by conversion of forests to other land uses (mostly agriculture and shorter rotation, plantation forests) likely led to this species overall decline and extirpation throughout much of the historic range (Tanner 1942, Jackson 2004).

Although most reports (both confirmed prior to the 1940s and unconfirmed after the 1940s) have been from bottomland forests, there are suggestions in the literature that the species also made substantial use of mature pine forests, not only in Cuba, but also Florida and elsewhere in the coastal plain (Allen and Kellogg 1937, Jackson 2004). In many cases, occurrences in pines were especially associated with fire-killed trees, often adjacent to bottomland forests, but there were known nesting cavities in pine, and almost all recent nesting cavities in Cuba were in pine (Jackson 2004). The factor in common between hardwood and pine habitat use appears to be disturbance events that led to the availability of many recently dead and dying trees that support the beetle larvae that could be considered essential in successful fledging of young woodpeckers.

Forests in the Southeast today are mostly young (<100 year old) and mid-seral (sequence of plant communities leading to the climax vegetation). If the Ivory-billed Woodpecker has indeed persisted at some minimal population level for the last 60 years, it did so under conditions very unlike those described in the historical literature. There are only a few patches of bottomland forest considered relatively "virgin" or characterized by older-growth conditions (e.g., Congaree National Monument in South Carolina and scattered small patches in the Mississippi Alluvial Valley, most if not all on public lands). In recent years, conditions in many forests, particularly on public lands, have been gradually moving closer toward what is thought to be optimal Ivory-billed Woodpecker habitat requirements as trees age and the forests are being managed to encourage retention of older forest characteristics.

2. James Tanner's Observations on the Singer Tract

James Tanner's 1942 report is based on his observations in the Singer Tract of northeastern Louisiana (now Tensas River National Wildlife Refuge), on his visits to remaining habitat throughout the US range of the species in the 1930s, and on a review of all literature up to time of writing. It is the best available source of historical information. Tanner reported that the sweet-gum-oak association was the primary forest type used by Ivory-bills within the Mississippi Alluvial Valley. Tanner refers to these forests as associated with the higher parts of the "first bottoms," relatively removed from frequent and long-term flooding. According to Tanner, cypress-tupelo forest (the type in which birds have been seen recently in Arkansas) was a rarely used habitat in the Mississippi Alluvial Valley. In Georgia and Florida Ivory-billed Woodpeckers were more frequently associated with cypress swamps, though it is unclear whether birds foraged in such habitats.

Tanner's data suggest that large trees are required for foraging (feeding). Of Tanner's foraging observations, 49% (frequency of feeding) were on trees between 12-24 inches dbh (diameter at breast height). These sizes of trees represented about 18% of forest composition. 35% of the feeding took place on trees that were between 24-36 in dbh. Trees this size made up about 5% of the forest. Based on Tanner's observations on the Singer tract 87% of foraging observations occurred on the largest trees, comprising 25% of the total trees available for foraging. Elsewhere, some observers noted Ivory-billed Woodpecker foraging on "very small" to medium diameter pines, recently killed by fire (from Florida and Cuba; Allen and Kellogg 1937, Dennis 1948, Lamb 1957).

Tanner also found that sweet-gum was the number one tree species that the birds fed on during his 1935-1938 study (43% of foraging observations, while making up about 21% of stand composition). Nuttall oak was the second most used tree by Ivory-bills at 27% of observations compared with about 11% availability in the forest.

Tanner strongly emphasized the need to preserve all "virgin" forests for the benefit of the Ivory-billed Woodpecker, a sensible conclusion from his findings. At the time of his study over 80% of the Singer Tract was "virgin" forest, with no history of logging or clearing. However, 20% (close to 16,000 acres) was not.

Regardless of the various ages of forest stands making up the Singer Tract, it is clear that this forest was within an area containing some of the largest acreage of old growth forest in the Mississippi alluvial valley; 577,600 acres out of 2.68 million acres of forest cover in the North Louisiana Delta were classified as "uncut old growth" (USDA Misc. Pub. No. 309, 1938). Almost everything else in the Mississippi Alluvial Valley, if not within the entire historical range of the Ivory-billed Woodpecker, had been cut-over by the 1930's.

3. History of Habitat in the Area of Rediscovery in Arkansas

The recent observations of the Ivory-billed Woodpecker on Cache River NWR have occurred in the extensive tupelo/baldcypress swamps of Bayou de View. There is also evidence of potential foraging along the hardwood perimeters of the swamps and in other hardwood stands

in the southern parts of the refuge. Almost all of the sightings since 2004 come from a relatively narrow (about one mile wide) forest along Bayou de View in the Cache River NWR, Benson Creek Natural Area, and Dagmar WMA. Historical information has been gathered from the USDA Forest Service, Continuous Forest Inventory (CFI) data and interviews with local residents and managers. The first major human disturbance event in Bayou de View occurred around 1920 to 1940 when the area was first logged. Logging was likely extensive and removed a large amount of old growth baldcypress. However, some baldcypress were left, either because of size, infeasibility of logging, or poor grade. The cutover swamp responded with regeneration and release of tupelo stands beneath the residual trees.

Additionally, during this time period, forests surrounding the Bayou were cleared for agriculture. Forests were likely similar in composition to that of modern day residual stands. These forests located above the normal floodplain were mostly hardwood containing mature sweet-gum, willow oak, water oak, Nuttall oak, sugar-berry, American elm, post oak, white oak, and other common hardwood species, with scattered pockets of saline soils harboring native loblolly pine. As the demand for agricultural land increased more of the surrounding forests were cleared. From approximately 1960 to 1970 the swamps of Bayou de View were extensively logged again; this time removing more tupelo than baldcypress. Logging continued until much of the Bayou was acquired by the U.S. Army Corps of Engineers as mitigation for the Lower Cache River channelization project. The Bayou was posted as federal property at that time, but there was no enforcement to guard against encroachment, poaching, or timber theft, until the mitigation land was transferred to the Cache River NWR in 2000.

The remaining habitat, primarily cypress-tupelo bottoms, had been previously dismissed by many authors describing Ivory-billed Woodpecker habitat requirements. Arkansas was considered one of the least likely states with potential to support this species during the last status survey in 1985 (Endangered Species Technical Bulletin 10, no.5).

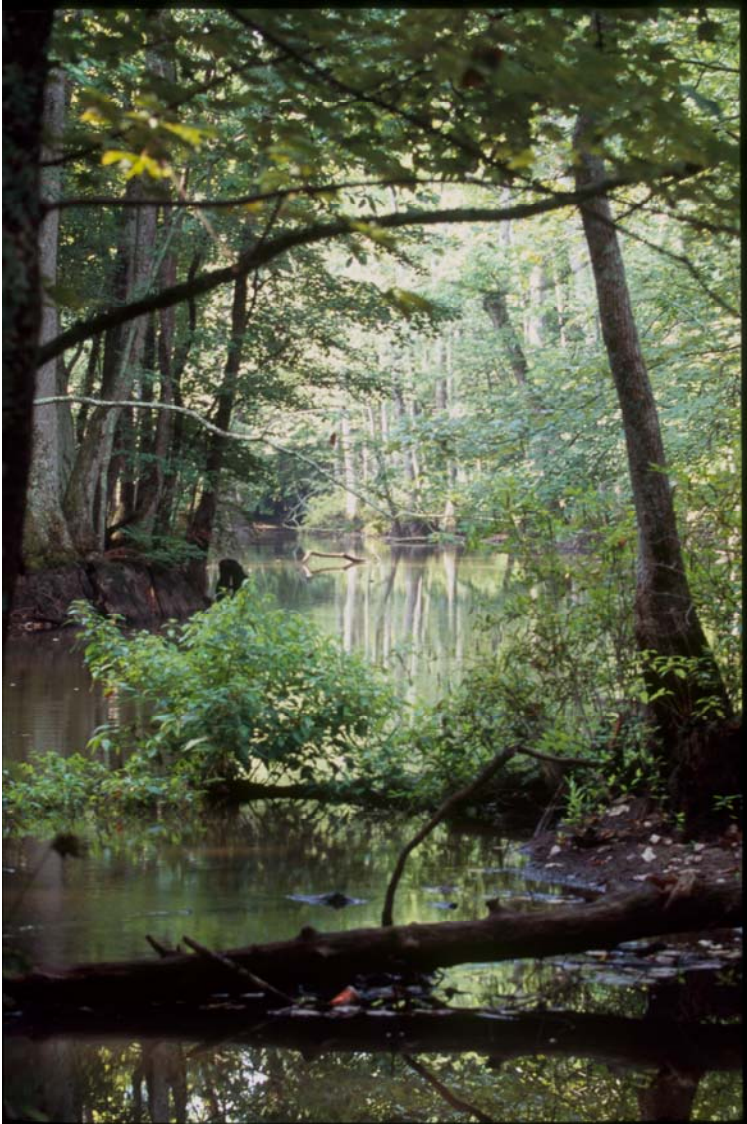


Figure 3 Example of Current Habitat Condition

4. Current Conditions in the Area of Rediscovery in Arkansas

Currently the Bayou de View forest corridor is long and contiguous; the forest block in which the Ivory-billed Woodpecker sightings have occurred stretches from two miles south of Dagmar State Wildlife Management Area (WMA) to six miles above Cotton Plant, Arkansas, an approximate aerial distance of 20 miles. The corridor is fairly narrow, averaging less than 1 mile wide, with the exception of the area at Dagmar WMA.

The Bayou now contains a dense stand of mostly second growth tupelo that range in age from 35 to 135, mixed with occasional large relic baldcypress and tupelo that are several centuries old, with some cypress over 1000 years old. The interconnected channels of Bayou de View, create a broad floodplain or swamp that presents an increased mortality and decline

(senescence) of live trees within its distinct border. The perimeter of the Bayou is lined with hardwood forests that are subject to limited annual flooding but contain a diversity of hardwood species. These perimeter forests are all second or third growth, with prevalent species including sweet-gum, green ash, overcup oak, Nuttall oak, water oak, willow oak, red maple, American elm and locust. The perimeter hardwood forests also exhibit elevated levels of decline and senescence. In proximity to the Bayou de View forest block, but outside of the Bayou corridor, are larger forest blocks of diverse hardwood forests mostly under the ownership of the Cache River NWR or Dagmar WMA. The forest types represented in these outlying blocks are primarily sweet-gum-willow oak, willow oak-water oak-diamond leaf oak, sugar-berry-ash-elm, and overcup oak-bitter pecan. However, caution must be taken in consideration of conditions where the bird has been seen. All observations have been of flying birds; there have been no observations of foraging, roosting, or nesting in the Bayou de View area. There is no certainty that habitat conditions where birds have been observed are preferred or optimal.

In order to document forest habitat conditions in proximity to the Ivory-billed Woodpecker, an extensive habitat survey was undertaken in the fall of 2005 on the Cache River NWR, White River NWR, and state Wildlife Management Areas within a 20-kilometer radius of the concentrated Ivory-billed Woodpecker sightings/recordings. The survey inventoried live trees, recording species, diameter and stress condition, dead tree volume and condition, and other habitat parameters attributed to forest stands (Appendix E). Field work was initially completed on 73,182 acres of White River NWR, 7,547 acres of Cache River NWR, 3,499 acres of Dagmar WMA, 2,091 acres of Henry Gray/Hurricane Lake WMA, 389 acres of Rex Hancock/Black Swamp WMA, 2,540 acres of Bayou Meto WMA, 843 acres of Wattensaw WMA, and 512 acres of Trusten Holder WMA. A total of approximately 90,603 acres was inventoried during September and October, 2005. Subsequently, White River NWR inventoried another 10,000 acres of areas where forest management was either in progress, approved for implementation, or planned.

The habitat survey information was compiled by the Lower Mississippi Valley Joint Venture (LMVJV) Office and utilized for the following: (1) to reveal stands with highest habitat values via GIS related tables to prioritize search efforts in the Cache/Lower White River basin; (2) to calibrate photogrammetry from USGS, NASA, and other partners to prioritize search efforts in the Cache/Lower White River basin and other areas; and (3) to assess habitat conditions of various previous forest management efforts to better ascertain probable effects for enhancement of habitat for Ivory-billed Woodpecker and other wildlife.

5. Current Conditions Within the Historic Range

Thirty sites in 8 states have been identified as areas of possible post-1944 encounters with Ivory-billed Woodpeckers (Figures 1, Table 1, Appendix C). To characterize the area and structural characteristics of forests on private lands and all ownerships that potentially could support Ivory-billed Woodpecker, we summarized USDA Forest Service Forest Inventory and Analysis (FIA) data for counties listed in Appendix F, Table 1. Because forest products companies harvest wood on lands they own and purchase wood from non-industrial private landowners, the characteristics of all private ownerships is particularly relevant to Ivory-billed

Woodpecker recovery. In all listed counties, we totaled the acres of forestland and timberland, number of live trees, and volume of live trees (ft³) by state and ownership for selected forest types and physiographic classes (Appendix F, Tables 2 and 3). For counties in Arkansas, Louisiana, North Carolina, South Carolina, and Texas, we also totaled volume (ft³) of annual net growth, mortality, and removals. Growth, mortality, and removals are available only in these five states. Original sources of data are described in Appendix F, Table 4.

In counties for which FIA data were available, there are more than 20.1 million acres of forestland (land capable of growing trees, 10% area stocked) and 19.8 million acres of timberland (forestland capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands) in the forest types and physiographic classes of interest (Appendix F, Table 5). Approximately 88.6% of all forestland is privately owned. Similarly, 89.9% of all timberland is privately owned, including 93.7% of pine types and 84.3% of hardwood types. Public and private timberlands differ in species composition. Of the 17.8 million acres of privately owned timberland in the counties, 37.6% is in hardwood forest types and 62.4% is in pine types. Of the 2.0 million acres in public timberland, 62.6% is in hardwood types and 37.4% is in pine types.

Area of privately owned pine timberland is approximately equivalent in small-, medium-, and large-diameter size classes (35.4, 32.1, and 32.4% of private pine timberland area, respectively, Appendix F, Table 5). However, area of private hardwood timberland is predominantly in the large-diameter size class (60.2% of private hardwood timberland area) with much less area in medium- (23.4%) and small-diameter (16.4%) size classes. Public timberland area is predominantly in large-diameter-class forests for pine and hardwood types (60.7% and 81.6% of publicly owned pine and hardwood timberland, respectively).

Although the majority of mortality is occurring in the large-diameter classes, the total volume of mortality is relatively low (<1% of total live volume). However mortality of hardwoods on public lands was 50% of net growth in that size class. Public land management appears to be more heavily focused than private lands on large-diameter class removals, especially in hardwoods, yet total removals are still minimal overall. More detailed forest characteristics by state for private and public ownerships are described in Appendix F, Tables 7 through 13.

In summary, approximately 89% of forest cover is privately owned and 11% publicly owned. Of this, approximately 44% of all timberland is in hardwood types. Large-diameter size class forests dominate the hardwood timberland, 63% of total lands, private and public. All ownerships tend to focus more toward development of large-diameter class stems in the hardwood timberland while public ownership focuses more toward larger diameter class stems in pine timberland than private ownership. Overall, the majority of timberland volumes (pine and hardwood) are represented in the large-diameter size classes for all ownerships. Net growth in hardwoods and pines on private timberland was primarily in the large-diameter class, although much more so for hardwoods, and for both hardwood and pine types on public lands.

G. Management Considerations

If density estimates reported by Tanner range from 1 pair per 6 square miles (about 4,000 acres of mixed upland pine and bottomland forest in Florida) to 1 pair per 17 square miles (about 11,000 acres of bottomland forest in Louisiana), it is likely that a patch of contiguous forest must be very large in order to support even small populations. For 50 pairs the former density estimate would translate to needing 300 square miles (about 200,000 acres), while the latter density estimate would translate to needing 850 square miles (about 550,000 acres). Regarding the density estimates based on the Singer Tract, this nearly 80,000 acre contiguous patch of mature forest was apparently not enough habitat to sustain even a small population, so an actual minimal area estimate to support a sustainable population then and possibly now in habitats dominated by only forested wetlands should be substantially higher. That threshold of size is unknown. Accordingly, the extent of a forested area, for Ivory-billed Woodpecker habitat needs, will affect the quality of habitat for the bird and must be considered in any determination of sustainable habitat.

As described in the Life History and Ecology section, when faced with habitat fragmentation or habitat degradation, large woodpeckers have been found to adapt by expanding their home range sizes. It is likely that Ivory-billed Woodpeckers similarly would expand home range sizes in sub-optimal habitats, such as in the regenerating bottomland forests in the Cache River and White River National Wildlife Refuges in eastern Arkansas. If Ivory-billed Woodpeckers in eastern Arkansas expanded home ranges and densities five-fold as observed in the Bornean study of Great Slaty Woodpeckers, core home ranges there could be up to 20 square miles and home ranges may occur at densities of only one per 85 square miles. At such densities, encounter rates with Ivory-billed Woodpeckers, even with a large number of observers in the field, can be expected to be very low. Therefore, study of habitat preferences directly from observations will be difficult.

1. Current Landscape Management in the Lower Mississippi Alluvial Valley (LMAV)

Starting in the early 1990s, a large-scale bird conservation effort was developed for the LMAV that became the prototype physiographic region plan for the bird conservation group Partners in Flight (Bonney et al. 1999). Although it focuses solely on birds, it contains many features of ecosystem approaches to management (e.g., multiple scales, focus on ecosystem integrity, change in administrative structure, focus on research and monitoring; see Grumbine 1994). Briefly, the effort involved (1) inventorying large patches of the priority habitat (bottomland hardwood forest) that was to be promoted, (2) developing a plan to enlarge, connect and enhance those patches so as to provide source populations of priority landbird species, and (3) implementing the plan, primarily through afforestation (planting trees) of priority locations using various landowner incentive programs. Determining priority areas for afforestation has been an evolving process that has used increasingly sophisticated sources of data and algorithms (e.g., Twedt and Uihlein 2005, Twedt et al. 2006).

Currently, the plan calls for creating large patches of mature bottomland forest, with target sizes of at least 10,000, 20,000 and 100,000 acres for different groups of area-sensitive landbirds. Because it is ecosystem based, and emphasizes area-sensitive species, this approach

also developed the template for large-scale management of the Ivory-billed Woodpecker. What is needed are some guidelines on the sorts of land management within those forest patches that are compatible with the objectives of the plan (i.e., to maintain viable populations of priority landbird species). These appear below. Although the Ivory-billed Woodpecker is the focus of this document, the larger plan is ecosystem based, and if followed should provide progress toward developing adequate habitat for all species of wildlife endemic to that system.

2. Bottomland Hardwood Forest Management

Over the last decade, common ground has been reached on many issues regarding the management of bottomland hardwood forests for wildlife. Providing for both a diverse forest structure and composition (including hard mast, soft mast, and light-seeded species) is now widely accepted as critical for covering the needs of all priority wildlife, along the lines of ecosystem management. There is broad recognition that "monocultures" of anything should be avoided, whether large expanses of willow or past afforestation efforts that have led today to 20-30 year old "sterile" oak plantations. Many recent forest plans have emphasized the need for greater structural complexity, "balanced" composition of shade tolerant and shade intolerant species, along with hard-mast and soft-seeded species, and greater amounts of standing dead and dying wood in stands. Tanner provides forest management recommendations that in most ways sound very similar to what is being done now, but there is still a need for consideration as to whether the existence of the Ivory-billed Woodpecker may require some different approaches.

3. Favored Tree Species

Sweet-gum and Nuttall oak were the two species clearly favored by Ivory-billed Woodpeckers in Tanner's study. The role of sweet-gum in future forests should probably be reconsidered. Both of these tree species need openings of several acres (such as from tornadoes, etc.) in size in which to successfully regenerate and produce large diameter trees in the future stand. The general belief has been that this species was less desirable during regeneration than hard mast red oak for promotion of wildlife values. This is understandable from the perspective that sweet-gum is prolific in today's forests. Today's sweet-gum are mostly young and of small diameter that have grown since larger individuals were harvested. Stimulating the growth of large sweet-gum trees such as those that formerly occurred at the Singer Tract (Tensas River NWR) may require freeing up sweet-gum in current forests to foster the growth of emergents, depending on site conditions. This will be a challenge in what is now an overall young (mostly <100 years) forest throughout the Southeast. Even on public land, most of these forests were high-graded before they became public, and frequently afterwards when the previous owner retained timber rights.

There are several significant caveats to the assumption that sweet-gum and Nuttall oak should be management objectives for Ivory-bills. The apparent preference for these trees in Tanner's work could have been due to their greater susceptibility to long gradual decline after an extended drought and subsequent fire that occurred about ten years prior to Tanner's study. Complicating the situation are a photograph of an Ivory-billed Woodpecker on a pine tree in

Florida and the reliance by the species on pine in Cuba, (Jackson 2004) as well as the use of wetter sites with baldcypress in Bayou de View.

4. Impact of Changing Hydrologic regimes on tree species

Changing hydrological regimes are causing deteriorating conditions for many forest communities in the Mississippi Alluvial Valley (MAV). Conditions in Arkansas' portion of the MAV are becoming wetter for longer periods during the growing season to the point that loss of drainage is leading toward a shift in tree species to those more tolerant of wetter conditions. Without correction of this hydrologic regime, most existing sweet-gum and Nuttall oak will not survive into the older age class apparently preferred by the Ivory-billed Woodpecker and subsequent stands will likely be dominated by species such as overcup oak and water hickory, neither considered by Tanner as important foraging trees for Ivory-bills. In even wetter conditions tupelo gum would tend to spread. The importance of this tree for Ivory-billed Woodpeckers remains unclear despite the presence of this species along the Bayou de View portion of the Cache River NWR (tupelo gum was absent from the Singer Tract and still is absent from the Tensas River NWR).

In contrast to conditions in much of eastern Arkansas, much of Louisiana's portion of the LMV is becoming drier. This change is also leading to some dramatic changes in forest condition, with substantial die-offs underway in some areas that are forcing a shift from Nuttall's oak eventually to willow oak stands. Willow oak also was not considered an important foraging tree for the Ivory-billed Woodpecker on the Singer Tract. Nevertheless, such die-offs might be considered beneficial for Ivory-billed Woodpecker, providing a short-term pulse of increasing foraging substrate. However, the apparent shifts in tree species composition calls into question whether older-growth conditions can be achieved without correcting hydrological conditions.

5. The Role of Disturbance

Tanner concluded that Ivory-bills respond positively to disturbances from storms, fire and other disturbances as long as many standing recently dead, stressed, and dying trees remained after the disturbance, with woodpecker activity greatest usually two to three years after disturbance. This response indicates that these disturbances produce the kinds and amounts of boring insect larvae favored by Ivory-billed Woodpecker.

Tanner described in detail the occupation by Ivory-billed Woodpecker of specific areas in the Singer Tract associated with major recent disturbances. He discussed the role of a major fire that passed through the Singer Tract in 1924 and how that may have influenced the abundance of dead and dying trees in the home ranges of several of the most reliably productive pairs he closely studied. In addition, he recounts the observations of J.J. Kuhn (the State Wildlife official, who helped locate birds and assisted James Tanner with his study) that Ivory-billed Woodpecker territories soon expanded to include the area through which a 1931 cyclone had passed where substantial dead and dying wood remained after salvage logging, and to the edge of a 1930-31 timber harvest area where substantial numbers of dead and dying trees occurred also. In both cases, Ivory-bills had been absent according to Kuhn prior to these disturbances, but adults were observed frequently foraging within them during 1933 and 1934.

By the late 1930's, Tanner had identified up to seven distinct territories under his observation in the 80,000 or so acres making up the Singer Tract, but only three pairs produced young at least once for the six years of data collected, and only two territories produced young consistently. Tanner commented that as the amount of dead wood ages or otherwise becomes unavailable that Ivory-billed Woodpecker numbers also decline. This suggests that over 80,000 acres of relatively old forest may not have been enough to support a small but relatively healthy population. Specifically, Tanner (1942) concluded "Decline in the number of Ivory-bills in the Singer Tract within recent years was probably caused by a decrease in the amount of timber death over the entire tract."

It is questionable within today's predominately fragmented forest conditions whether dependence on natural forces to provide these disturbances will be sufficient. Certainly, prior to human influence 20,000 or more years ago, these forces played important roles in shaping forest structure across what is today the Southeast U.S. It can be argued that tornadoes and hurricanes and other natural disturbances are important factors that would (and do) lead to desired conditions, especially in older-growth. Where these natural forces occur, they can be allowed to create the favorable habitat needed for the Ivory-billed Woodpecker. However, the amount of bottomland hardwood forest in the Southeast U.S. has been greatly reduced from its former expanse. The amount of forest in the Mississippi Alluvial Valley has been reduced from some 24 million acres to less than 5 million, and much of this occurs in very small isolated forest fragments. This is problematic in that it reduces the probability that stochastic (random) forces can maintain a sufficient quantity of forest in a desired post-disturbance condition, and that areas where disturbances do occur may not be connected to larger expanses of habitat.

Past storm events, although often locally devastating, have done little regionally to improve structure in today's mostly mid-seral forests. Given the dominance of mid-seral forest conditions, storms are either too weak to break open densely stocked stands to make much difference in forest structure or they are too strong causing stand replacement events. This strongly suggests that we cannot depend at this time only upon storm events to produce enough openings to develop future desired forest conditions (based on current understanding) for supporting more sustainable populations of Ivory-billed Woodpecker. At the other extreme, those rare storm events that do cause catastrophic damage do provide abundant recently dead and dying wood, but only temporarily and likely at the expense of losing many suitable nesting and roosting trees in blow-downs. Food resources under these very severe conditions likely will decline rapidly for Ivory-billed Woodpecker after 3 years and the entire area would no longer be optimal for supporting healthy Ivory-billed Woodpecker populations. Observations along the Pearl River, post-2005 Hurricane Katrina, and along the Trinity, Neches, and Sabine Rivers, post-2005 Hurricane Rita, may provide additional information to determine the validity of these assumptions with respect to forest dynamics and responses to severe storms.

Although managers have no direct influence over storms, forests can be managed in ways that allow for storm damage, when it occurs, to more closely mimic likely pre-European settlement effect patterns. The challenge is how to promote a simulation of large-scale disturbances where needed within these smaller isolated forests while also promoting older-growth conditions emphasizing a high frequency of senescent large limbs and trees. In addition, the size of an appropriately large disturbance patch is unknown.

As for the potential of managed disturbances, the role of managers in using prescribed fire in bottomland forests is at best unclear. Tanner's data strongly suggests that fire was a huge influence on which stands were most productive (in terms of young produced) for Ivory-billed Woodpecker within bottomland hardwood habitat. However, today the policy of many land managers is to suppress fires in bottoms as much as possible. Perhaps aggressive suppression of all fires in the bottoms should be replaced by allowing natural fires to continue through the bottoms to purposefully stress or kill trees.

Another controversial topic is to what extent certain forestry practices might enhance habitat conditions for this species. J.J Kuhn reported to Tanner (1942, p. 46) that about three years after cutting occurred within a private holding in the Singer Tract, Ivory-billed Woodpeckers foraged in dead and stressed timber along the edge of the cutover area. In addition, Tanner wrote to Richard Pough (see Jackson 2004, pp. 147-148) that he himself had observed a similar response from Ivory-billed Woodpecker's in taking advantage of the flush of wood-borers in freshly killed slash, but again along the edges of the cutover area. It must be emphasized, however, that these examples likely were exceptions where Ivory-billed Woodpeckers used cutover areas for only brief periods of time, and only where directly adjacent to extensive older forests at the Singer Tract. In general, Ivory-billed Woodpeckers avoided foraging in extensively cutover areas and did not use the slash and waste on the forest floor in such areas. Tanner (1942, pp. 96-97) suggested that cutover areas did not support wood-boring insects in the same abundance as found in storm-damaged stands. Regardless of the potential for short-term use of slash after harvesting, eventually Ivory-billed Woodpeckers disappeared entirely from areas that had been subjected to extensive timber harvesting.

Tanner did suggest that by "logging slowly and allowing time for the insect population to increase" some harvesting might be more compatible with supporting this species. He recommended the possibility of purposely girdling trees and forest management practices that favored the selective removal of smaller diameter and healthy trees, while leaving the larger diameter trees, especially if showing signs of decline. Today, many more options are used by forest managers than were used in Tanner's day, and some of these, especially on public lands, are similar to his recommendations. At minimum, there is a need to investigate the occurrence and abundance of wood-boring insects after different girdling and harvesting techniques and compare to wood-boring insect occurrence and abundance in unharvested stands.

Beavers (*Castor canadensis*) are presently an important source of disturbance in the MAV. Beavers historically created large patches of dead and dying trees due to prolonged flooding during the growing season (Kellison et al. 1998). Today, aggressive beaver control programs have been implemented on many public lands and private lands in this area as altered hydrology has often led to a disproportionate amount of mature forest loss, given the more fragmented condition of remaining forest patches when compared with historic forest conditions (currently less than six million acres compared to greater than 24 million acres). Nevertheless, beavers could be managed to provide the sort of disturbance suggested above. However, patches of tree mortality created by beavers in the fragmented forest systems today are difficult to predict and are likely to be too large, making it difficult to create a source of newly dead timber that is sustainable.

6. Dead Trees

Strategies should be considered as to how to increase the amount of recently dead and dying wood on a sustainable basis. Promotion of older and larger trees along with larger patches of recently dead and dying trees on a regular basis presents a management challenge, in part because the appropriate quantity of recently dead and dying wood to provide is unknown. Tanner (1942, p. 47) reports that the areas Ivory-billed Woodpecker used for foraging on the Singer tract contained thirteen trees per acre with dead wood (this included live trees with large dead limbs as well as entirely dead small trees). Balancing older forest conditions with frequent development of large disturbance patches will be particularly challenging on smaller forest patches (i.e., <15,000 acres). This illustrates the potential necessity of conserving large tracts of forested land for management of Ivory-billed Woodpeckers, so that individuals have the possibility to find sites with temporary optimal conditions within contiguous habitat.

In many areas there are increasing numbers of dead and dying trees under changing hydrological conditions as well as from factors such as storm damage. However, once it is determined that trees of a particular species are dying and conditions are not conducive to ensuring successful regeneration, the impulse of most managers is to conduct a salvage cut. The general approach in the past was to promote salvage logging operations to stimulate regeneration of more flood-tolerant or drought-tolerant species, without much consideration for the importance of dead and dying trees for many species of wildlife.

The total number of dead and dying trees in bottomland forests today is perhaps less relevant than the size and ages of those trees. Those that are of rather small diameter and that may stand for a decade or more are not what seems to be needed to support Ivory-billed Woodpeckers. Rather, a flow of enough dead and dying wood from large enough stems (including entire trees as well as large branches on still living trees) from one 3-year period to the next is needed to sufficiently support wood-boring beetle larvae.

The peak foraging window is a narrow one compared to other woodpeckers, as they seek beetle larvae associated with "freshly" dead sapwood that is exposed when bark is removed. The beetle larvae found in dead and dying wood become most available when death of the wood is recent (1-3 years) and this is important given the woodpecker's preferred foraging method of pulling off bark that is still well connected to the sapwood. The Ivory-billed Woodpecker is the only one of our woodpeckers that habitually used its bill as a wedge to remove bark from the freshly dead sapwood. So not only is the amount of deadwood available important, the size and time since death of the wood available is also important.

Tanner recognized the importance of providing dead and dying trees. He suggested that for areas to be managed using selection cuts, dead, dying, damaged, and otherwise stressed trees should be retained, with harvests focused on healthy, growing trees. This would maintain and potentially improve the food sources for the Ivory-billed Woodpecker.

The concept of retaining dead and dying wood is not viewed as negatively as it was in the past, and some public land managers are experimenting with ways to artificially provide more dead

and dying wood following some of Tanner's suggestions. The amount of recently dead and dying wood that should be provided for the Ivory-billed Woodpecker is still unclear and may vary among forest types. This change in management paradigm is already occurring in bottomland forest management circles as evidenced in forestry prescriptions involving state and federal wildlife lands, and groups such as the LMVJVs Forest Resource Conservation Working Group (FRCWG). Additional adaptive change may be required as more is learned about the habitat preferences of the Ivory-billed Woodpecker.

7. Current Forest Management

The LMVJV's FRCWG in 2003 specifically started to address issues related to the management of the forest resources within the MAV. Management issues of concern included management of existing bottomland hardwood forest resources within the MAV as well as reforestation of agricultural lands within the MAV and inventory and monitoring of all these resources. Instead of placing restrictions on individual silvicultural practices, FRCWG recommendations target defining certain habitat characteristics or *forest variables* that are necessary to meet the annual requirements of the multitude of wildlife species dependent on these forest resources for sustaining life. How the forest managers obtain and maintain these forest variables is left up to the individual situation with greater controls over practices at the landscape level. This methodology allows the manager to modify the silvicultural practices at the stand level to meet the overriding habitat needs in each situation. This work is ongoing and will be incorporated into planning for habitat protection and enhancement.

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H. Reasons for Listing/Current Threats

The final rule (32 FR 4001 and 35 FR 8495) did not contain an assessment of the primary threats to the Ivory-billed Woodpecker. A description of these threats is presented below; each is classified according to the five listing/ delisting factors identified in section 4 of the Endangered Species Act (“Act”; 16 USC 1531 et seq.)

1. Habitat Loss and Degradation (Factor A)

The primary reason for the decrease in Ivory-billed Woodpecker numbers throughout its range appears to be a reduction in suitable habitat (and indirect destruction of their food source) due to large scale conversion of forest habitats. Essential features of Ivory-billed Woodpecker habitat include: extensive, continuous forest areas, very large trees, and agents of tree mortality resulting in a continuous supply of recently dead trees or large dead branches in mature trees (Jackson 2002). According to Tanner (1942), “In many cases their [Ivory-billed Woodpeckers] disappearance almost coincided with logging operations. In others, there was no close correlation, but there are no records of Ivory-billed inhabiting areas for any length of time after those have been cut over.” Noel Snyder (in prep) argues that the close correlation between timber harvesting activities and the decline of the Ivory-bill may reflect an increased exposure to poaching and collecting rather than food limitation in logged over forests. In addition, specific to the Singer Tract, before large scale logging had commenced, Tanner (1942) also commented that the reduced occurrence of recently dead and dying wood was probably responsible for declines of woodpeckers there. Habitat loss has probably affected Ivory-billed Woodpeckers since the original cutting of virgin forest; with some losses being gradual and others occurring very rapidly. Jackson (1989) estimated that by the 1930s, only isolated remnants of the original southern forest remained. Forest loss continued with another period of accelerated clearing and conversion to agriculture of bottomland hardwood forests of the Lower Mississippi Valley during the 1960s and 1970s. The combined effect of those losses has resulted in reduction and fragmentation of the remaining forested lands. The conversion rate of forest to agricultural lands in some parts of the southeastern United States has reversed in the past few years. Currently, many public and private agencies are working to protect and restore forest habitat. Nevertheless, until more is learned about the Ivory-billed Woodpecker's habitat requirements, the extensive habitat loss and fragmentation and the lack of information on specific habitat requirements remain a threat to this species.

2. Over Utilization for commercial, recreational, scientific, or educational purposes (Factor B)

Historical records indicate that Ivory-billed Woodpeckers (bills and the plumage) were collected and used for various purposes by native and colonial Americans. Collection of ivory-bills for scientific purposes has been documented since the 1800s. Jackson (2002) presented data indicating that such collecting resulted in the taking of over 400 specimens, mostly between 1880 and 1910. By itself, over utilization may not have caused the widespread decline of Ivory-bill numbers. However, collecting in combination with the concurrent habitat loss likely hastened the decline of the species. It is possible that local populations could have been extirpated by collecting. For example, Ivory-billed Woodpeckers are believed to have been reduced by excessive collecting, rather than as a result of the conversion of forest habitats in a small area of the Suwanee River region of Florida. In addition, Tanner (1942) indicated that many Ivory-billed Woodpeckers were killed merely to satisfy curiosity. The direct utilization of Ivory-

billed Woodpeckers for commercial, recreational, scientific or educational purposes is currently not a significant threat.

3. Disease or Predation (Factor C)

Little is known regarding the past or current roles of disease and predation in the decline of the Ivory-billed Woodpecker and as a current threat.

4. The Inadequacy of Existing Regulatory Mechanisms (Factor D)

The lack of adequate regulatory mechanisms may have contributed to the Ivory-billed Woodpecker's decline. Currently, existing regulatory mechanisms appear to be adequate as the Ivory-billed Woodpecker is protected under the ESA and state laws.

5. Other Natural or Manmade Factors Affecting its Continued Existence (Factor E)

Ivory-billed Woodpecker populations appear to have been in a state of continuous fragmentation and decline since the early 1800's (Jackson 2002, Tanner 1942). Early accounts gave no accurate or definite estimates of abundance, but populations were probably never large and were limited to habitats subject to high tree mortality, e.g., areas that were regularly flooded or burned (Jackson 2002). As habitat loss and fragmentation progressed coupled with collection, population numbers dwindled and became isolated; thus contributing to their decline. The small population size and limited distribution of the Ivory-billed Woodpecker continue to place this species (previously thought to be extinct) at risk from naturally occurring events and environmental factors. The Ivory-billed Woodpecker is currently known to occur in only one area in southeastern Arkansas. While a substantial amount of habitat is protected in the area in which the species was rediscovered, threats exist from normal environmental changes. For example, sporadic natural events such as tornados or ice storms could destroy the only remaining nest or roost trees or severe weather conditions could result in nesting or fledging failures. Additionally, the exact number and genetic health of remaining birds is unknown. Ivory-bills in small populations are at risk from genetic and demographic stochastic events (such as normal variations in survival and mortality, genetic drift, inbreeding, etc.).

I. Conservation Efforts

1. Conservation Efforts in the Recent Past

Wherever the Ivory-billed Woodpecker is suspected to still exist it stirs both excitement and action. In the early 1970's Sam Houston National Forest in east Texas proposed to modify timber harvests based on three unconfirmed Ivory-billed Woodpecker sightings by their staff (Ruediger 1971). These and other sightings in east Texas were never widely accepted and, consequently, did not stimulate forest management changes to promote the welfare of the Ivory-billed Woodpecker. Similar stories of unconfirmed sightings have generated no change in land management throughout the southeast.

A well known, but unconfirmed, 1999 sighting in the Pearl River Wildlife Management Area (WMA) in southeast Louisiana did prompt the Louisiana Department of Wildlife and Fisheries (LDWF) to modify

a prescribed harvest in an attempt to improve Ivory-billed Woodpecker foraging habitat and to attract the birds for easier observation. In 2002 at 11 sites, ranging from three to 40 acres, chainsaw felling, selective girdling (25-75 percent), and chemical injection was used to fell, kill or weaken trees in an attempt to establish a concentration of beetle larvae suitable for Ivory-billed Woodpecker feeding. In August of 2005, Hurricane Katrina made landfall near this particular area, severely impacting the study site as well as the entire lower Pearl River drainage basin. No confirmed Ivory-billed Woodpecker sightings have been made in the area.

2. Current Conservation Efforts

Current conservation efforts in Arkansas have focused on learning more about the status and distribution of the species in the Cache River and White River drainages; managing public access to sensitive sites and directing visitors to appropriate areas; protection of land through acquisition of easements or fee interest; forest management, reforestation; and public education. The Cornell Laboratory of Ornithology in cooperation with the Fish and Wildlife Service, the state of Arkansas, the Arkansas Field Office of The Nature Conservancy (TNC), and other partners conducted extensive surveys in the winter of 2004-05 in an attempt to reconfirm the presence of Ivory-billed Woodpeckers in the White River and Cache River basins. These surveys have proven to be extremely arduous and have resulted in a meager number of sightings. Enhanced and refined survey efforts continued in the 2005-06 winter survey season, with additional sound recordings and a few observations.

Habitat improvement and restoration are essential to the eventual recovery of the Ivory-billed Woodpecker. We are at the very early stages of planning what habitat actions are needed. A quantitative delineation of existing potential Ivory-billed Woodpecker habitat throughout the southeast is being developed. In related actions, various quantitative models are under development to identify the amount and quality of habitat needed to support recovery. Before these models are ready for use and while we are learning more about local Ivory-billed Woodpecker life history, National Wildlife Refuge forest management activity is being carefully reviewed for potential impacts on the Ivory-billed Woodpecker.

About 326,000 acres of the Cache River-White River basin is in public ownership as a national wildlife refuge, state natural areas, or state wildlife management area. In addition, private conservation interests, primarily TNC and Ducks Unlimited, hold nearly 20,000 acres. These fee title ownerships are supplemented by approximately 52,882 acres of Wetland Reserve Program easements administered by the Natural Resources Conservation Service. Together these lands total almost 400,000 acres of current and future habitat that is being managed and conserved in the vicinity of the Ivory-billed Woodpecker rediscovery.

Active forest management (thinning and other timber cutting) on Cache River and White River National Wildlife Refuges was temporarily suspended while the existing forest management plans were reviewed to ensure that they created habitat that best meets the requirements of the Ivory-billed Woodpecker. Managers of the adjacent state lands at Dagmar and Rex Hancock/Black Swamp WMAs also established a temporary moratorium on timber harvests. This short term passive management was implemented under the assumption that some birds are present throughout the contiguous block of forested habitat in the lower White River basin. As we learn more about the Ivory-billed Woodpecker's distribution and

revise forest management plans, timber management prescriptions can be modified to provide for the long term habitat needs of the species.

In 2005 limited morticulture (stressing/killing live trees) management was implemented along Bayou de View on the Benson Creek Natural Area, which is jointly owned by TNC and the Arkansas Natural Heritage Commission. Management is similar to what the LDWF did on the Pearl River WMA. Four 4-acre blocks were treated with varying amounts of tree girdling to create Ivory-billed Woodpecker feeding habitat and attract the birds for observation. The results are being monitored and may serve as a pilot for larger studies in the future. Additional modified harvesting practices and morticulture plots have been developed and established by the LDWF on WMAs and Tensas NWR in Louisiana. These activities are part of ongoing research to better understand the dynamics associated with insect colonization of stressed trees in bottomland hardwood forests; essentially the development of Ivory-billed Woodpecker foraging habitat.

An active land acquisition program is underway at Cache River NWR in cooperation with TNC. This refuge has long been a regional priority for land protection primarily driven by North American Waterfowl Management Plan objectives for wintering habitat for the mid-continent mallard population. Since 1995 the Fish and Wildlife Service has purchased 23,456 acres as additions to Cache River NWR. Lands were purchased primarily (74 percent) using revenue from the Migratory Bird Conservation Fund, also known as the Duck Stamp Fund. The remainder of the lands were purchased with appropriations under the Land and Water Conservation Fund. All lands were acquired from willing sellers.

After the rediscovery of the Ivory-billed Woodpecker, TNC focused land acquisition in the Bayou de View area. In 2004 and 2005 they acquired title, options, or easements on approximately 18,500 acres. Reforestation efforts are underway on much of this land.

The Natural Resources Conservation Service has been a leader in restoring potential Ivory-billed Woodpecker habitat in the lower White River basin. Since the rediscovery of the Ivory-billed Woodpecker their Wetland Reserve Program (WRP) has enrolled 3,601 acres, and the Wildlife Habitat Incentives Program has established easements to reforest or enhance existing forests on 5,958 acres of privately owned land. The Wetland Reserve Enhancement Program is committed to supplemental tree planting on 1,000 additional acres of WRP lands that will be signed up in 2006. They are also working with partners to establish a new, but not yet approved, Conservation Reserve Enhancement Program in the Ivory-billed Woodpecker area.

The Fish and Wildlife Service's Partners for Fish and Wildlife Program has committed \$1 million in support of Ivory-billed Woodpecker habitat improvement activities on private lands in Arkansas and Louisiana. In 2005, 996 acres were enrolled in and reforested by this program in and around the Big Woods. In 2006, an additional 1,362 acres will be planted in the same area.

Educational efforts are underway to inform the general public, hunters, anglers, and birders of the potential presence of Ivory-billed Woodpecker in eastern Arkansas and how to report possible sightings. Other potential areas outside of these major bottomland hardwood drainages within the state include the lower Sabine River Basin in the south-western part of the state as well as the Mississippi and Red River convergence areas in the east-central part of the state.

A central database has been established where all Ivory-billed Woodpecker sightings can be reported (<http://www.birds.cornell.edu/ivory/identifying/>). Sightings in Arkansas can also be reported to 1-800-440-1477. In May 2005 three “Town Hall” meetings were held in the communities of Brinkley, Stuttgart, and Augusta to provide information on the rediscovery and the first steps which are expected to be taken towards recovery. Concerns over potential land acquisition plans, impacts on public use, and questions about the natural history of the species were answered. Similar meetings will continue, and the Corridor of Hope component of the recovery team will serve as another important method of communicating with the local community in the lower White River basin. Other outreach efforts include interpretive materials on how to identify an Ivory-billed Woodpecker, where to report sightings, informational signage, and interpretive programs.

The surveys and related research will be adapted as more is learned about the locations and habits of the Ivory-billed Woodpecker. Survey efforts will also begin in other portions of the historic range in east Texas, Louisiana, Mississippi, Alabama, South Carolina, Georgia and Florida.

3. State Priority Search Areas

Alabama

The following seven areas are generally considered to contain the best and most extensive remaining potential Ivory-billed Woodpecker habitat: (1) Mobile-Tensaw River Delta from the confluence of the Alabama and Tombigbee rivers downstream to the forested wetland/marsh interface; (2) Tombigbee River from Coffeville Lock and Dam downstream to its confluence with the Alabama River; (3) Alabama River from Claiborne Lock and Dam downstream to its confluence with the Tombigbee River; (4) Tombigbee River from Braggs Bluff downstream to Coffeville Lock and Dam; (5) Tombigbee River from the Sipse River downstream to Braggs Bluff; (6) Sipse River from U.S. Highway 82 to its confluence with the Tombigbee River; and (7) Buttahatchie River from Henson Springs downstream to its confluence with the Tombigbee River. While these areas should receive priority consideration during the development of any search strategy, identification of any additional potential areas of habitat through the use of aerial photography and satellite imagery should be undertaken

Arkansas

Current searches are focused on the White-Cache-Lower Arkansas river complex. This area encompasses private lands, National Wildlife Refuges, Arkansas Game and Fish Commission Wildlife Management Areas, and land managed by The Nature Conservancy (TNC) of Arkansas and the Arkansas Natural Heritage Commission (ANHC). The search area includes: (1) White River NWR; (2) Cache River NWR; (3) Bayou Meto WMA; (4) Dagmar WMA; (5) Benson Creek Natural Area; (6) Rex Hancock/Black Swamp WMA; (7) Wattensaw WMA; (8) Steve Wilson/Raft Creek Bottoms WMA; (9) Henry Gray/Hurricane Lake WMA; and (10) Bald Knob NWR. Other potential areas outside of these major bottomland hardwood drainages within the state include the Ouachita and Saline river complex in the south-central part of the state and also the Red River in far southwestern Arkansas.

Florida

Jackson (1996, 2004) mentioned the following areas as potential sites for conducting Ivory-billed Woodpecker searches, some of which he searched during the 1980s and 1990s: Apalachicola and Chipola River swamps, Aucilla and Wacissa Rivers, the lower Suwannee River watershed, Wekiva River, Fort Drum Swamp, Fakahatchee Strand, and Big Cypress National Preserve. The Okefenokee / Pinhook Swamp has been identified as another potential area of Ivory-billed Woodpecker habitat (C. Hunter, USFWS, personal communication); although primarily in the state of Georgia, the southern extent of this swamp stretches into Columbia and Baker counties of northern Florida. Recent discussions amongst members of the Ivory-billed Woodpecker Recovery Team have focused on the Apalachicola and Chipola swamps, the Aucilla and Wacissa Rivers, and the lower Suwannee River watershed as the three most significant areas of potential Ivory-billed Woodpecker habitat in Florida, based primarily on the extensive tracts of bottomland forest that remain there.

Georgia

Potential areas to search that are consistent with the believed habitat requirements of the species. Based on the relatively recent sightings and known areas of large expanses of forested wetlands still in existence, the following are potential areas to search in Georgia: (1) the Ogeechee-Savannah River Basin, (2) the Altamaha River Basin, (3) the Okefenokee Swamp, and (4) the Red Hills Region.

Kentucky

It appears that no areas remain in Kentucky that would be suitable for extensive searches.

Louisiana

The Atchafalaya River Basin with primary emphasis on Attakapas Island WMA and state property owned by the Office of State Lands in the central and southern portions of the Atchafalaya River basin and private land holdings near Bayou Sorrel. The Pearl River Basin with emphasis on the Pearl River WMA and the Tensas River Basin with emphasis on Tensas River National Wildlife Refuge and Big Lake WMA. Other potential areas outside of these major bottomland hardwood drainages within the state include the lower Sabine River Basin in the south-western part of the state as well as the Mississippi and Red River convergence areas in the east-central part of the state.

Mississippi

Potential areas to search include the larger forested areas within the lower Mississippi River Alluvial Valley such as Delta National Forest, Panther Swamp National Wildlife Refuge, and forested lands along the Mississippi River. Floodplain forests along the Pascagoula and lower Pearl Rivers should also be included as potential search areas

North Carolina

In North Carolina, the Lumber River drainage contains about 85 square miles of potential habitat which includes the bottomland hardwood system and some associated uplands. The Waccamaw

River system is about 30 miles to the southeast of the Lumber River, and contains about 45 square miles of potential habitat. Lastly, the Cape Fear River system has some potential as well, and it includes the Northeast Cape Fear River and the Black River that join the Cape Fear near Wilmington. This group of rivers has about 60 square miles of potential habitat, and is about 20 miles northeast of the Waccamaw River.

South Carolina

Search efforts in South Carolina should be focused in the following areas: Congaree-Wateree-Upper Santee River region, lower Santee River, Savannah River, and the Waccamaw Complex (a region in northeastern coastal South Carolina that includes the major drainages and tributaries of the Waccamaw, Lynches, Black, Great Pee Dee, Little Pee Dee, and Lumber Rivers)

Tennessee

There are four areas in Tennessee with forests that have the greatest potential for containing Ivory-billed Woodpeckers: (1) Hatchie River between state highway 51 and the Mississippi River (Tipton and Lauderdale County); (2) Chickasaw National Wildlife Refuge, especially in the southern half of the refuge; (3) Meeman Shelby State Park (Shelby County); and (4) Reelfoot Lake (Lake and Obion County)

Texas

The primary areas to search for Ivory-billed Woodpecker today should include the large forest tracts along the lower stretches of the Neches, Sabine, and Trinity rivers and their tributaries. These “lower stretches” are defined as the bottomland areas downstream of the Steinhagen, Toledo Bend, and Livingston dams. Of the rivers, the Neches River drainage contains the largest amount of habitat with the greatest potential to have Ivory-billed Woodpecker in Texas. Other sizeable forest tracts occur farther north along the Neches, Sabine, and Trinity River drainages but most are privately held and are rather isolated.

4. Summary of Conservation Efforts

Conservation efforts to date have been directed towards confirming the existence of the species and taking initial habitat improvement and restoration actions.

The principal conservation actions to be taken include improving and expanding the survey effort in Arkansas, as well as in other formerly occupied locations, and describing the habitat of the species sufficiently, so that the most likely locations for other possible existing populations may be identified and surveyed. Additional efforts include evaluating current management practices and their effects on Ivory-billed Woodpecker, as well as, conducting public outreach and education.

Conservation efforts for this species are just beginning in earnest as a result of the rediscovery and the formation of the recovery team. The rediscovery has ignited significant interest on the part of the public and national and international conservation organizations. There is strong support for taking the

necessary steps to assess population status, delineate habitat, and determine the proper management actions needed for recovery.

Numerous research, modeling, and habitat inventory projects have been undertaken to better understand the distribution and status of the species and enhance the methods used to detect Ivory-billed Woodpeckers. In addition, models focused on foraging energetics, habitat characterization and assessment, and population viability are being developed. The Implementation schedule included in this plan identifies the projects currently underway.

J. Biological Constraints and Needs

The most significant biological constraint to recovery of the species is the apparently very small and difficult to detect population. The species is so rarely encountered that learning more about the species and its habitat requirements and basic aspects of its ecology is a primary conservation action. The rarity of the species and our lack of biological information are therefore the greatest constraints facing recovery.

Although not clearly known, the capacity of such a small population to recover and multiply is limited. Clutch sizes in the Ivory-billed Woodpecker ranges from 1-6 eggs but more typically consist of 2 to 4. Incubation is by both sexes and takes about 20 days. Both adults feed the young for a period of about 35 days and the young may be fed by the parents for an additional two months. Life span has been estimated to be in excess of 10 years although this is also not known for certain. In sum, the relatively low reproductive capacity of the species will require many years for significant population growth, based on our current knowledge of the species.

Knowledge and capabilities for captive breeding, should this become a viable option, are also poorly understood for this species. Significant work with surrogate species (the Magellanic Woodpecker, *Campephilus magellanicus*) has been suggested. This effort would take some time since there is currently no person or institution engaged in the captive breeding of large woodpeckers.

The availability of suitable forest habitat is in all likelihood constraining. The species requires large tracts of forested habitat (several thousand acres per breeding pair) with large portions of the tract containing large trees for feeding, nesting and roosting. On some public lands within the historic range forests are in suitable or close to condition, though still highly fragmented. Conditions continue to improve on many public lands as the forest ages. Most contemporary public forests are only beginning to approach the older forest conditions we think suitable for Ivory-bills, and have insufficient large, dead and stressed trees. Despite improving conditions, the provision of forested habitat attractive to Ivory-billed Woodpeckers in public forests will require increased attention. In addition, recovering this species will not happen on public forests alone. In the southern U.S. 89% of forests in the southern U.S. are privately owned. (Appendix F), Engaging both industrial and non-industrial private landowners in the improvement of conditions for Ivory-billed Woodpecker must be emphasized if recovery of the species is to be realized.

II. RECOVERY

A. Recovery Strategy

Our understanding of all aspects of the ecology and biology of the Ivory-billed Woodpecker is limited. It has proven extremely difficult to even briefly encounter the species despite extensive survey efforts. Due to its rarity, and the belief of its extinction for such a long period of time, the literature and previous research for the species is likewise meager. Much of what is known is derived from the studies of James Tanner. The findings of Tanner, which have been extrapolated using knowledge of other *Campephilus* species, knowledge of woodpeckers in general and interpretations of photographs, and anecdotes gathered by observers (Gallagher 2005, Jackson 2004), comprises the state of our understanding of the Ivory-billed Woodpecker. Clearly, any strategy aimed at recovery of this species must focus on intensive surveys to document the presence of the species. Following delineation of currently used habitat, much more could be learned about the ecology and biology of the species.

Our poor understanding of the species has largely directed the recovery strategy to one of learning more about the species status and ecology as opposed to developing specific, immediate habitat management actions to be taken. This is not to say that habitat management and land protection efforts are not important but, the strategy for conservation of this species, at this early stage of recovery, is focused on learning more about where birds persist and then to examine those habitats to reveal ways in which specific conservation actions could be developed.

Spatially explicit population goals have not been identified here but are recognized as a key part of any recovery plan. Recognizing this, modeling of habitats and populations is currently underway. The end result of these efforts will help inform the development of spatially explicit population and habitat goals. When these analyses are completed the plan will be revised to reflect the findings of modeling and research activities.

B. Recovery Goal

The goal of the Ivory-billed Woodpecker recovery program is to protect and increase existing populations and associated habitat and to recover the species to the point at which it can be downlisted from endangered to threatened status, and ultimately to remove it completely from the Federal list of threatened and endangered species when the protections provided by the Endangered Species Act are no longer necessary. Due to the current status of the species, its low reproductive potential, potential dependence on old growth forest stands and lack of knowledge about what will optimize habitat abundance and appropriate distribution recovery is anticipated to take a long time.

C. Recovery Objectives

This recovery plan identifies actions needed to achieve long-term viability for the Ivory-billed Woodpecker and accomplish these goals. Recovery of the Ivory-billed Woodpecker focuses on the following objectives:

- 1) Management to reduce risks to the existing population;

2) Protection and enhancement of suitable habitat, and;

3) Actions to reduce or eliminate threats sufficient to allow successful restoration of additional wild populations.

The emphasis in this recovery plan on the distribution of additional viable populations in the historical range is based upon two widely recognized and scientifically accepted goals for promoting viable populations of listed species. These goals are: 1) the creation of multiple populations so that a single or series of catastrophic events do not result in species extinction; and 2) the increase of population size to a level where the threats from genetic, demographic, and normal environmental uncertainties are diminished (Mangel and Tier 1994, National Research Council 1995, Tear *et al.* 1995, Meffe and Carroll 1997). By maintaining population numbers and viable breeding populations at multiple sites, the species will have a greater likelihood of achieving long term survival and recovery.

D. Recovery Criteria

At present, the limited knowledge on the population abundance, distribution, habitat requirements, and biology of the Ivory-billed Woodpecker prevents us from developing more specific recovery criteria. The following are interim criteria that would lead us to first obtain data for the development of more specific, quantifiable criteria that should be met before considering the delisting of this species:

1. Determine current habitat use and needs of existing populations.
2. Survey potential habitats for new occurrences.
3. Conserve and enhance habitat on public land. Add additional acreage to public habitat inventory via land acquisition from willing sellers.
4. Conserve and enhance habitat on private lands through the use of agreements, conservation easements, habitat conservation plans, and public outreach to facilitate appropriate management actions.
5. Determine viability of existing populations (numbers, breeding success, population genetics, and ecology).
6. Determine the number and geographic distribution of subpopulations needed for a self-sustaining metapopulation and evaluate suitable habitat for species reintroduction.

E. Narrative Outline of Recovery Actions

1.0 Population Surveys and Monitoring

Additional Ivory-billed survey work focused primarily in the Cache and White River Basins is considered the highest priority short term action in order to protect what birds are still in existence and to prevent the species from continued decline. Additional survey work is needed in other parts of the

historical range where habitat and sighting information indicates potential for presence of the species. Accordingly, there exists a need for survey protocol development, training of surveyors and a repository or data base for all sightings received by the Recovery Team accompanied by a management plan (validation methods, prioritization of validity of reports etc.) for that information. These tasks will coordinate the design and implementation of a multi-scale survey and monitoring program that explicitly addresses biological planning and programmatic decision-making processes.

1.1 Develop protocols to process sightings.

Reports of ivory-bill sightings vary in both their reliability and detectability. Standardization is necessary to assess reliability of data.

1.1.1 Complete and implement protocols and procedures for recording, classifying, and responding to reported Ivory-billed Woodpecker sightings.

1.1.2 Develop teams to rapidly assess the veracity of sightings in other areas.

1.1.3 Develop a repository for all previous sightings.

1.2 Develop survey designs for search efforts throughout the range. The survey design should be adaptive, use ancillary data (*e.g.*, previous sightings, output from biological models, spatial data on distribution of stressed or dying trees) and result in a consistent survey methodology to allow for the comparison of data.

1.3 Determine the probability of species detection based on survey effort, search area and population size.

1.4 Conduct searches throughout the historic range.

1.4.1 Implement searches in the Cache and White River basins.

1.4.2 Implement range-wide searches based on priority areas defined in the habitat tasks (see tasks 3.1, 3.2 and 3.3).

1.4.3 Develop state-based implementation groups.

1.5 Enhance existing and develop new Ivory-billed Woodpecker survey and monitoring technologies.

1.6 Develop monitoring protocols to assess population size and trend.

2.0 Habitat Inventory and Monitoring

Additional Ivory-billed habitat inventory work focused primarily in the Cache and White River Basins is considered a high priority. Additional habitat inventory and monitoring work is needed in other parts of the historical range where habitat and sighting information indicates potential for presence of the

species. Accordingly, there exists a need for inventory protocol development and a habitat database. The purpose of these tasks is to coordinate and implement a multi-scale habitat inventory and monitoring program.

2.1 Develop protocols and techniques for habitat inventory and monitoring program.

2.1.1 Develop ground-based forest inventory protocols which will identify characteristics important to Ivory-billed Woodpecker, including disturbance history.

2.1.2 Conduct remote sense-based (*e.g.*, LiDAR, ASTER) forest inventories to augment ground-based habitat inventories.

2.2 Identify priority search areas.

2.2.1 Prioritize search areas in the Cache and White River basins.

2.2.2. Prioritize search areas throughout the historic range using information from expert opinion and tasks 1.1.3 and 5.4.

2.3 Conduct habitat inventory and monitoring using both ground-based techniques and remote technologies.

2.3.1 Conduct forest inventories in the Cache and White River basins.

2.3.2 Conduct forest inventories in priority areas throughout the range.

2.3.3 Characterize and assess the adequacy of foraging habitat in the Cache and White River basins.

2.4 Develop a web-based, forest inventory geodatabase to consolidate and archive data. This task would allow web-based connection with other bird monitoring databases.

2.5 Assess the efficiency and effectiveness of forest management prescriptions intended to increase foraging habitat.

3.0 Population/Habitat Models

To facilitate survey efforts identified above in Sections 1.0 and 2.0 and to inform potential management actions in the future, there is a need to delineate quantitatively the relationship between Ivory-billed Woodpecker populations and habitat. These tasks are designed to develop population/habitat relationship models that guide and inform conservation planning, assessment, and management at multiple spatial scales (site-scale, Cache/Lower White River basin; Mississippi Alluvial Valley eco-region; historic range across the southeastern United States).

Models will address landscape quality and site quality factors presumed to limit Ivory-billed Woodpecker populations. Model assumptions and risks of uncertainty will be documented as testable hypotheses. Habitat specific parameters will be based on currently available data at the appropriate scale as well as data expected to be available in the near-future.

- 3.1 Express Tanner's Ivory-billed Woodpecker study conclusions for the Singer Tract population as an energetic foraging model.
- 3.2 Develop an adaptive population and habitat model for Ivory-billed Woodpecker in the Cache and White River basins.
 - 3.2.1 Develop a Cache-White River Basin Ivory-billed Woodpecker population-habitat model to guide forest inventory and monitoring programs and to facilitate landscape characterizations and assessments.
- 3.3 Refine the Cache and White River basin Ivory-billed Woodpecker population-habitat model for application at larger spatial scales (*e.g.*, MAV, range-wide). The outputs from this model would be used to: (1) develop a Mississippi Alluvial Valley Ivory-billed Woodpecker population/habitat model; (2) guide the development of forest inventory/monitoring programs; (3) facilitate landscape characterizations and assessments; and (4) determine forest management needed to reach Desired Future Condition (LMVJV's FRCWG is developing these guidelines).
- 3.4 Develop a range-wide potential occupancy model to facilitate search efforts across the southeastern portion of the United States.
- 3.5 Develop estimates of the possible existing population using Life Table methodology and information on available habitat and territory size.
- 3.6 Develop a Population Viability Model.

4.0 Assumption-Driven Research

Given the scarcity of existing research and Ivory-billed Woodpeckers to study, certain assumptions are necessary to establish management guidelines. Research directed at testing the biological assumptions otherwise implicit in management actions is necessary. The following tasks are designed to test the assumptions implicit in biological goals and objectives, as well as, the biological response presumed to occur from on-the-ground management actions.

- 4.1 Summarize and compile the existing literature into a database.
- 4.2 Assess causative agents of tree mortality, decay rates, and stand replacement processes. The assumption is that both cavities and forage may be limiting factors for Ivory-billed Woodpecker and that this can be evaluated by gathering information on tree mortality.

- 4.2.1 Gather information on naturally-occurring tree mortality, snag formation, and decay rates across elevation gradients, hydrologic regimes, and soil classes.
- 4.2.2 Gather information on tree mortality and snag formation as a result of “typical” silvicultural treatments (*e.g.*, thinning) across elevation gradients, hydrologic regimes, and soil classes.
- 4.3 Assess methods for “artificially” increasing forage-base.
 - 4.3.1 Gather information on wood-boring insect populations, life history, natural densities and on factors which contribute to their density, richness and abundance (*e.g.*, tree mortality, decay rates).
 - 4.3.2 Gather data on tree species mortality and decay rates and on beetle densities at different dead and dying tree stand volumes and where “artificial” silvicultural treatments (*e.g.*, girdling, injection) are used. Collect this data across elevation gradients, flooding regimes, and soil classes.
- 4.4 Expand and re-examine research priorities when active nest trees are discovered.
- 4.5 Investigate the ecology of Ivory-billed Woodpecker through detailed investigations of appropriate surrogate species.

5.0 Landscape Characterization and Assessment

The ability of the Mississippi Alluvial Valley and specifically the Cache and White River Basins to support recovery populations is unknown. The capacity of other habitats within the historic range to support recovery populations is also unknown. The following tasks are intended to characterize the ability of the Cache/ Lower White River basin and the Mississippi Alluvial Valley Bird Conservation Region to support Ivory-billed Woodpecker populations based on current and/or projected landscape and site quality conditions. Additionally, these tasks will allow assessment of other parts of the species range in terms of their capability to support Ivory-billed Woodpeckers.

- 5.1 Conduct an assessment of the extent and distribution of foraging habitat (*e.g.*, stressed and dying trees) within the Cache and Lower White River basins based on high resolution, color infrared aerial photography (to be acquired in 2006).
- 5.2 Develop forest type maps of the Cache and Lower White River basins using a Hydro Geomorphic (HGM) model augmented with fall 2004 and 2006 high resolution color infrared aerial photography, ground survey data, multi-spectral satellite data and any other available data.
- 5.3 Analyze 1938 Singer Tract aerial photography for a retrospective look at Tanner’s data using new ancillary data and technologies (*e.g.*, stereoscopic photo interpretation SURRGO soils

data, Saucier geomorphology data) and any other available data. Compare it with 1940 Lower White River basin aerial photography.

- 5.4 Assess “suitable” habitat across the MAV and the historic range based on the application of biological models to currently available data sets (*e.g.*, FIA, NLCD, aerial photography, LIDAR).
- 5.5 Use remote-sensed data (*e.g.*, ASTER, LIDAR) to characterize forested habitat conditions to attract and support Ivory-billed Woodpecker based on population-habitat models and to compare with ground-based methods.
- 5.6 Conduct a hydro-geomorphic assessment of existing and potential wetland and upland habitats of the MAV.

6.0 Conservation Design

Spatially explicit population and habitat objectives are not known for Ivory-billed Woodpecker but are needed to support decision making for conservation and management of the species. These tasks are designed to establish biological objectives (population and habitat) as determined by biological models. This information will be used to develop spatially explicit models that define the landscape conditions believed to support Ivory-billed Woodpecker populations.

- 6.1 Establish population goals, objectives, and timelines.
 - 6.1.1 Establish population goals, objectives and timelines for the Cache and White River Basins.
 - 6.1.2 Establish population goals, objectives and timelines for the MAV.
 - 6.1.3 Establish population goals, objectives and timelines for the species' historic range.
- 6.2 Establish habitat goals, objectives, and timelines to support population goals, objectives, and timelines. Habitat goals at all spatial scales would consider management, protection, and restoration of extant (bottomland) forests.
- 6.3 Develop forest restoration and management guidelines (Desired Forest Conditions) designed to support population goals.
- 6.4 Refine habitat management guidance for Ivory-billed Woodpecker.
- 6.5 Produce maps and technical documents (*e.g.*, management guidelines) that land managers and planners can utilize to implement conservation programs across multiple spatial scales.
- 6.6 Develop decision-support tools based on biological models that facilitate the delivery of conservation programs by maximizing the biological and cost efficiency of management actions.

7.0 Education and Outreach

The rediscovery of the Ivory-billed Woodpecker has generated a substantial amount of interest among the public. There is a need to provide information to the general public and numerous stakeholders involved or concerned with the recovery of the species. There is also a need to develop community based programs and plans to enhance opportunities to learn about and promote the conservation of the species and its habitat. The purpose of these tasks is to convey a consistent message regarding recovery efforts and to facilitate those efforts through public awareness and education.

7.1 Develop a communications plan and strategy.

7.1.1 Develop an outreach plan and strategy which addresses community-based programs that promote conservation of the species and its habitat.

7.1.2 Ensure that the communication plan and strategy addresses the need for information at various levels and for various stakeholders (*e.g.*, birders, local citizens, government agencies, industry).

7.2 Develop outreach tools to help private landowners and land managers.

7.3 Develop and distribute species identification brochures.

7.4. Coordinate and cooperate with the government of Cuba regarding the status and recovery of the Cuban population of Ivory-billed Woodpecker.

8.0 Public Use and Access in Occupied Habitat

Due to the rarity of this species and the potential for adverse impacts resulting from intense public interest, guidelines and policies need to be developed to manage public use.

8.1 Develop guidelines for public use and other activities in Ivory-billed Woodpeckers habitat.

8.1.1 Develop guidelines on the types of use and the timing and amount of activities in the vicinity of roost or nest trees and foraging habitat.

8.2 Develop public access and viewing points such as boardwalks, towers, blinds and platforms.

9.0 Management of Rediscovered Populations

Increased interest on the part of researchers will require the development of research and monitoring protocols to assure that adverse impacts are minimized. Additionally, there is a need to develop management guidelines for forested habitats to avoid adverse impacts and, where applicable, aid in achieving recovery.

- 9.1 Protect occupied habitat.
- 9.2 Develop guidelines for monitoring Ivory-billed Woodpecker nesting, roosting and feeding behavior (*e.g.*, permitting procedures, procedures for researchers).
- 9.3 Assess the need for intervention to enhance reproductive success, productivity and survival.
- 9.4 Determine the genetic health and viability of the population.
- 9.5 Implement reforestation activities and forest management practices which will benefit Ivory-billed Woodpecker and its habitat (see task 5.4).
- 9.6 Use decision-support models and other biological planning tools to determine the need and location of additional land protection measures.
- 9.7 Protect priority lands identified in task 9.6.

III. IMPLEMENTATION SCHEDULE

Recovery plans are intended to assist the U.S. Fish and Wildlife Service and potential Federal, State, and private partners in planning and implementing actions to recover and/or protect endangered and threatened species. The Implementation Schedule that follows lists the actions and estimated costs for the recovery program for the Ivory-billed Woodpecker (*Campephilus principalis*). It is a guide for meeting the recovery goals outlined in this plan. Parties with authority, responsibility, or expressed interest to implement a specific recovery action, are identified in the Implementation Schedule. When more than one party has been identified, the proposed lead party is indicated by an asterisk (*). The listing of a party in the Implementation Schedule does not require, nor imply a requirement, that the identified party has agreed to implement the action(s) or to secure funding for implementing the action(s). However, parties willing to participate may benefit by being able to show in their own budgets that their funding request is for a recovery action identified in an approved recovery plan and is therefore considered a necessary action for the overall coordinated effort to recover the Ivory-billed Woodpecker.

Section 7 (a)(1) of the Endangered Species Act (ESA) directs all federal agencies to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of threatened and endangered species. Several tasks address the monitoring component of the recovery plan to ensure that data will be collected and evaluated in order to estimate the delisting date. The cost estimates provided are based on the Implementation Schedule and identify foreseeable expenditures that could be made to implement the specific recovery tasks during a 5-year period. Actual expenditures by identified agencies/partners will be contingent upon appropriations and other budgetary constraints.

Recovery Action Priorities

Priorities in column 1 of the following Implementation Schedule are assigned as follows:

Priority 1- An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

ABBREVIATIONS, ACRONYMS AND WORD DEFINITIONS USED IN THE IMPLEMENTATION SCHEDULE

A	Factor A of reasons for listing (see Section H)
ACOE	U. S. Army Corps of Engineers
AGFC	Arkansas Game and Fish Commission
AHC	Arkansas Heritage Commission
AMWPT	Arkansas Multi-Agency Wetland Planning Team
CLO	University of Cornell Laboratory of Ornithology
Coop.	USGS cooperative research unit with a university
CSU	Colorado State University
E	Factor E of reasons for listing (see Section H)
EA	FWS, External Affairs
ES	FWS, Field Office
FWS	U. S. Fish and Wildlife Service
FY	Fiscal Year
GOV	Other Local, Commonwealth and Federal agencies
K	Thousand dollars
LDWF	Louisiana Department of Wildlife and Fisheries
M	Million dollars
MAV	Mississippi Alluvial Valley
MB	FWS, Migratory Birds
NASA	National Aeronautics and Space Administration
NGO	Non Governmental Organization

NRCS	USDA, Natural Resources Conservation Service
NWR	FWS, National Wildlife Refuge
NWRC	U. S. Geological Survey, National Wetlands Research Complex
PVT	Private landowners
R2	FWS, Southwest Regional Office, Albuquerque
R4	FWS, Southeast Regional Office, Atlanta
RE	FWS, Realty
RF	FWS, Refuges
RT	Recovery Team
Smith.	Smithsonian Institution, Museum of Natural History, Department of Vertebrate Zoology
States	State wildlife agencies within Ivory-billed Woodpecker historic range
TNC	The Nature Conservancy
UAR	University of Arkansas
UGA	University of Georgia
UID	University of Idaho
UMD	University of Maryland
Unk	Unknown
UNI	University researchers
USDA	U. S. Department of Agriculture
FS	USDA Forest Service
USGS	U. S. Geological Survey

IMPLEMENTATION SCHEDULE

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
1	Complete and implement protocols and procedures for recording, classifying, and responding to reported Ivory-billed Woodpecker sightings.	1.1.1	E	Ongoing	R4, R2, ES	CLO*, States	75K	25K	10K	10K	10K	Initial protocols and procedures are completed. The sightings database is established and will be continually updated by CLO.
2	Develop teams to rapidly assess the veracity of sightings in other areas.	1.1.2	E	Ongoing	R4, R2, ES, RF	CLO, States*	0	0	0	0	0	Costs included in other tasks
3	Develop a repository for all previous sightings.	1.1.3	E	Ongoing	R4, ES	CLO*	§	§	§	§	§	§ Costs are included in Task 1.1.1.
1	Develop survey designs for search efforts throughout the range.	1.2	E	2 years	R4, ES	UGA, USGS-UGA Coop.	20K	20K				
1	Determine the probability of species detection based on survey effort, search area and population size.	1.3	E	1 year	R4, ES	USGS-UID Coop., CLO	5K					

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
1	Implement searches in the Cache and White River basins.	1.4.1	E	Ongoing	R4, ES, RF	See notes	1M	250K	250K	250K	250K	Numerous partners are involved in the search. Costs may change depending on search results.
1	Implement range-wide searches based on priority areas defined in the habitat tasks.	1.4.2	E	Ongoing	R4, R2, ES, RF	States, CLO, NGOs	450K	450K	450K	450K	450K	Costs may change depending on search results.
2	Develop state-based implementation groups.	1.4.3	E	1 year	R4, ES, R2	States, CLO	0					
1	Enhance existing and develop new Ivory-billed Woodpecker survey and monitoring technologies.	1.5	E	5 years	R4, ES	CLO, USGS	400K	100K	100K	100K	100K	Costs associated with this task will be supplemented with funds provided for task 1.4.1.
2	Develop monitoring protocols to assess population size and trend.	1.6	E	1 year	R4, ES	CLO, USGS, UNI	0					Implementation of this task depends on search results. Costs will increase significantly when detection occurs.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
1	Develop ground-based forest inventory protocols which will identify characteristics important to Ivory-billed Woodpecker, including disturbance history.	2.1.1	A	1 year	R4, R2, ES, RF, MB*	States, NGOs	0					Costs are negligible since the task is already a part of staff duties.
2	Conduct remote sense-based (e.g., LiDAR, ASTER) forest inventories to augment ground-based habitat inventories.	2.1.2	A	3 years	R4, R2, ES, MB*, RF	USGS, UMD, NASA, States, NGOs	292K	46K	50K			
1	Prioritize search areas in the Cache and White River basins.	2.2.1	A, E	2 years	R4, ES, RF, MB*	State of Arkansas, CLO, TNC	20K	40K				Costs are low since the task is already a part of staff duties. Costs may increase when additional data is collected in 2007.
2	Prioritize search areas throughout the historic range using information from expert opinion and tasks 1.1.3 and 5.4.	2.2.2	A, E	2 years	R4, R2, ES, RF, MB*	States, CSU, USGS-CSU Coop.	0	0				Costs dependent on completion of other tasks, funds located in 3.4

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
1	Conduct forest inventories in the Cache and White River basins.	2.3.1	A	2 years	R4, ES, RF*, MB*	State of Arkansas	90K	90K				Work started in 2005.
2	Conduct forest inventories in priority areas throughout the range.	2.3.2	A, E	5 years	R4, R2, ES*, MB, RF	States, NGOs, PVT	500K	500K	500K	500K	500K	Costs are difficult to estimate until the extent and location of the priority areas are identified. Private timber industries may be included.
1	Characterize and assess the adequacy of foraging habitat in the Cache and White River Basins.	2.3.3	A	2 years	R4, ES, MB*RF	AGFC, TNC, CLO	50K	50K				Costs depend on the results of tasks 2.1.2, 2.3.1 and 3.1.
3	Develop a web-based, forest inventory geodatabase to consolidate and archive data.	2.4	A	2 years	R4, R2, ES, RF, MB*	USGS, States	80K	80K				
2	Assess the efficiency and effectiveness of forest management prescriptions intended to increase foraging habitat.	2.5	A	5 years	R4, ES, MB*, RF	USGS, USFS, AHC, LDWF, AGFC	†	†	†	†	†	† Tasks 2.5, 4.2.1, 4.2.2, 4.3.1, and 4.3.2 are linked. Work for all these tasks is covered with funds listed for task 4.2.1.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
2	Express Tanner's Ivory-billed Woodpecker study conclusions for the Singer Tract population as an energetic foraging model.	3.1	E	1 year	R4, ES, MB*	UGA, USGS-UGA Coop., USFS, NWRC	19K					
1	Develop a Cache-White River basin Ivory-billed Woodpecker population-habitat model to guide forest inventory and monitoring programs and to facilitate landscape characterizations and assessments.	3.2.1	E	2 years	R4, ES, MB*	RT	0					Costs are negligible since data will be developed in conjunction with other tasks.
2	Refine the Cache and White River basin Ivory-billed Woodpecker population-habitat model for application at larger spatial scales (e.g., MAV, range-wide).	3.3	E	1 year	R4, ES, MB*	RT, CSU, USFS, CSU-Coop.	0					Costs are negligible since data will be developed in conjunction with other tasks.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
2	Develop a range-wide potential occupancy model to facilitate search efforts across the southeastern portion of the United States.	3.4	E	2 years	R4, R2, ES, RF, MB*	States, CSU, USGS-CSU Coop.						RF staff support will be negligible. Costs are already included in tasks 2.2.2 and 5.4.
2	Develop estimates of the possible existing population using Life Table methodology and information on available habitat and territory size.	3.5	E	1 year	R4, ES	UAR	0	Unk.				Associated with task 3.6 since the outcomes overlap, task will be re-evaluated
2	Develop a Population Viability Model.	3.6	E	1 year	R4, ES, MB	UGA*, USGS-UGA Coop.	9K					This task overlaps task 3.5.
3	Summarize and compile the existing literature into a database.	4.1	A, E	1 year	R4, ES, MB	Smith.	0					Complete

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
2	Gather information on naturally-occurring tree mortality, snag formation, and decay rates across elevation gradients, hydrologic regimes, and soil classes.	4.2.1	A	5 years	R4, ES, MB*, RF	USGS, USFS, AHC, LDWF, AGFC	155K	155K	140K	80K	50K	† Tasks 2.5, 4.2.1, 4.2.2, 4.3.1, and 4.3.2 are linked. Work for all these tasks is covered with funds listed for task 4.2.1.
2	Gather information on tree mortality and snag formation as a result of “typical” silvicultural treatments (<i>e.g.</i> , thinning) across elevation gradients, hydrologic regimes, and soil classes.	4.2.2	A	5 years	R4, ES, MB*, RF	USGS, USFS, AHC, LDWF, AGFC	†	†	†	†	†	† Tasks 2.5, 4.2.1, 4.2.2, 4.3.1, and 4.3.2 are linked. Work for all these tasks is covered with funds listed for task 4.2.1.
2	Gather information on wood-boring insect populations, life history, natural densities and on factors which contribute to their density, richness and abundance (<i>e.g.</i> , tree mortality, decay rates).	4.3.1	A	5 years	R4, ES, MB*, RF	USGS, USFS, AHC, LDWF, AGFC	†	†	†	†	†	† Tasks 2.5, 4.2.1, 4.2.2, 4.3.1, and 4.3.2 are linked. Work for all these tasks is covered with funds listed for task 4.2.1.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
2	Gather data on tree species mortality and decay rates and on beetle densities at different dead and dying tree stand volumes and where “artificial” silvicultural treatments (<i>e.g.</i> , girdling, injection) are used. Collect this data across elevation gradients, flooding regimes, and soil classes.	4.3.2	A	5 years	R4, ES, MB*, RF	USGS, USFS, AHC, LDWF, AGFC	†	†	†	†	†	† Tasks 2.5, 4.2.1, 4.2.2, 4.3.1, and 4.3.2 are linked. Work for all these tasks is covered with funds listed for task 4.2.1.
3	Expand and re-examine research priorities when active nest trees are discovered.	4.4	E	Ongoing	R4, ES, MB, RF	RT CLO	0	0	0	0		
2	Investigate the ecology of Ivory-billed Woodpecker through detailed investigations of appropriate surrogate species.	4.5	E	Ongoing	R4, ES	States, UNI, The Walt Disney Co.	200K	200K	100K	100K	100K	

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
1	Conduct an assessment of the extent and distribution of foraging habitat (<i>e.g.</i> , stressed and dying trees) within the Cache and Lower White River basins based on high resolution, color infrared aerial photography.	5.1	A	2 years	R4, ES, MB, RF, AGFC, AHC	NWRC*	29K	85K				
2	Develop forest type maps of the Cache and Lower White River basins using a HGM model augmented with fall 2004 and 2006 high resolution color infrared aerial photography, ground survey data, multi-spectral satellite data and any other available data.	5.2	A	2 years	R4, ES, MB	AHC*, USGS, ACOE, AMWPT	100K	50K				

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
2	Analyze 1938 Singer Tract aerial photography for a retrospective look at Tanner's data using new ancillary data and technologies. Compare it with 1940 Lower White River basin aerial photography.	5.3	A	1 year	R4, ES, MB, RF	NWRC*, LDWF	114K		40K			The 2008 funds will support a correlative analysis to task 5.1. This task may extend to multiple years and other geographic areas based on the results.
1	Assess "suitable" habitat across the MAV and the historic range based on the application of biological models to currently available data sets.	5.4	A	2 years	R4, R2, ES, MB*	CSU*, USFS, RT, ACOE, AHC	45K	45K				Based on outputs from task 3.4 and provides input to 2.2.2.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
3	Use remote-sensed data (e.g., ASTER, LiDAR) to characterize forested habitat conditions to attract and support Ivory-billed Woodpecker based on population-habitat models and to compare with ground-based methods.	5.5	A	2 years	R4, ES, MB*, RF	NWRC*, NASA, UMD	58K	60K				For FY2006, this task will draw from population-habitat model tasks developed under Action 3. Funds are primarily identified for comparative analyses as other costs are associated with existing tasks.
3	Conduct a hydro-geomorphic assessment of existing and potential wetland and upland habitats of the MAV.	5.6	A	2 years	R4, ES, MB, RF	AHC*, USGS, ACOE	100K	100K				
1	Establish population goals, objectives and timelines for the Cache and White River Basins.	6.1.1	E	1 year	R4, R2, ES*, MB, RF	RT, AGFC		25K				Only selected members of the RT will assist. Costs are largely for RT members' time and travel and for workshop development.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
1	Establish population goals, objectives and timelines for the MAV.	6.1.2	E	1 year	R4, R2, ES*, MB, RF	RT, Lower MAV States			25K			Only selected members of the RT will assist. Costs are largely for RT members' time and travel and for workshop development.
1	Establish population goals, objectives and timelines for the species' historic range.	6.1.3	E	1 year	R4, R2, ES*, MB, RF	RT, Other States				25K		This is associated with task 6.1.1. See comments for task 6.1.1.
1	Establish habitat goals, objectives, and timelines to support population goals, objectives, and timelines.	6.2	A, E	3 years	R4, R2, ES*, MB, RF	RT, States		25K	25K	25K		Only selected members of the RT will assist. Costs are largely for RT members' time and travel and for workshop development.
1	Develop forest restoration and management guidelines (Desired Forest Conditions) designed to support population goals.	6.3	A	2 years	R4, R2, ES, MB*, RF	States, USFS, AHC, TNC, USGS, PVT, NRCS	30K	35K				PVT partners include private timber companies. Costs are for staff time and meetings. Bonus costs are not included.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
2	Refine habitat management guidance for Ivory-billed Woodpecker.	6.4	A	2 years	R4, R2, ES, MB*, RF	States, USFS, AHC, TNC, USGS, PVT, NRCS		50K	50K			PVT partners include private timber companies.
2	Produce maps and technical documents (e.g., management guidelines) that land managers and planners can use to implement conservation programs across multiple spatial scales.	6.5	A	Ongoing	R4, ES, MB*	USGS, USFS	20K	20K	20K	20K	20K	Costs for this task will continue until recovery is completed.
2	Develop decision-support tools based on biological models that facilitate the delivery of conservation programs by maximizing the biological and cost efficiency of management actions.	6.6	A	Ongoing	R4, ES, EA, MB*	USGS	20K	20K	20K	20K	20K	Models will be internet-based and refined annually as habitat management and restoration occurs.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
2	Develop an outreach plan and strategy which addresses community-based programs that promote conservation of the species and its habitat.	7.1.1	A	Ongoing	EA*,R4, R2, ES, MB, RF, AFGC	RT-Outreach Team		7K	7.5K	8K	9K	Funding requests are based on potential discoveries in other states, requiring additional outreach.
2	Ensure that the communication plan and strategy addresses the need for information at various levels and for various stakeholders (e.g., birders, local citizens, government agencies, industry).	7.1.2	A, E	4 years	R4, ES, EA	RT-Outreach Team		3K	4K	5K	6K	Funding requests are based on potential discoveries in other states, requiring additional outreach.
2	Develop outreach tools to help private landowners and land managers.	7.2	A	4 years	R4, ES, EA	RT-Outreach Team		30K	10K	10K	10K	Funding requests are based on potential discoveries in other states, requiring additional outreach.
1	Develop and distribute species identification brochures.	7.3	E	Ongoing	R4, R2, ES, RF, MB, EA	RT-Outreach Team, NGOs, States		25K	10K	10K	10K	Funding requests are based on potential discoveries in other states, requiring additional outreach.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
3	Coordinate and cooperate with the government of Cuba regarding the status and recovery of the Cuban population of Ivory-billed Woodpecker.	7.4	E	Ongoing		CLO*						NGO action, cost currently unknown
1	Develop guidelines on the types of use and the timing and amount of activities in the vicinity of roost or nest trees and foraging habitat.	8.1.1	E	Ongoing	R4, R2, ES, RF, MB	CLO, USGS, UNI, States	15K	10K	10K	10K	10K	Guidelines will be assessed continually based on findings and species status.
1	Develop public access and viewing points such as boardwalks, towers, blinds and platforms.	8.2	E	Ongoing	R4, R2, ES, MB, RF	NGOs, States	75K	50K	50K	50K	50K	The focus will be on the Cache and White River NWRs. Costs may vary based on new findings.
1	Protect occupied habitat.	9.1	A	Ongoing	R4, R2, ES, RF	States, NGOs, PVT	30K	30K	30K	30K	30K	The focus will be on the Cache and White River NWRs. Costs may vary based on new findings.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
1	Develop guidelines for monitoring Ivory-billed Woodpecker nesting, roosting and feeding behavior.	9.2	E	Ongoing	R4, R2, ES, RF, MB	States, CLO	10K	5K	5K	5K	5K	Initial protocols are developed and will be reviewed annually or as needed.
2	Assess the need for intervention to enhance reproductive success, productivity and survival.	9.3	E	Ongoing	R4, ES*, MB	CLO, NGOs	Unk.	Unk.	Unk.	Unk.	Unk.	This depends on locating birds for possible captive propagation. Partners such as the San Diego Zoo will be consulted.
2	Determine the genetic health and viability of the population.	9.4	E	1 year	R4, ES	UNI						Costs are unknown and depend on when biological material is acquired.
1	Implement reforestation activities and forest management practices which will benefit Ivory-billed Woodpecker and its habitat.	9.5	A	Ongoing	R4, R2, RF	States, NGOs, NRCS, PVT	1M	1M	1M	1M	1M	Costs include possible land acquisition on private lands.

Task Priority	Task Description	Task Number	Threat	Task Duration	Responsible Organization (*denotes lead agency)		Cost Estimates					Comments
					FWS	Other	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	
2	Use decision-support models and other biological planning tools to determine the need and location of additional land protection measures.	9.6	A, E	Ongoing	R4, ES, MB, RF, RE	States, NGOs	20K	20K	20K	20K	20K	
2	Protect priority lands identified in task 9.6.	9.7	A, E	Ongoing	R4, R2, RF, RE	States, USDA, NGOs, PVT	3M	2M	2M	2M	2M	Some examples for protecting land are fee purchases, easements, USDA agreements, and voluntary landowner agreements.

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Appendix A. Members of the Ivory-billed Woodpecker Recovery Team and their affiliation.

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Appendix B. Extent of Decline

History of Ivory-billed Woodpecker Status in the Southeastern U.S.

The Ivory-billed Woodpecker's decline since the 1800's is well documented in several resources (Allen and Kellogg 1937, Tanner 1942, Jackson 2002, Jackson 2004, Hoose 2004, Gallagher 2005). Ivory-billed Woodpeckers in the United States formerly ranged in the coastal plain stretching from eastern Oklahoma and Texas eastward into North Carolina, southward to include all of Florida, and in the Mississippi Alluvial Valley northward to the confluence with the Ohio River and then eastward on the Ohio River bordering Kentucky and Illinois (with archaeological evidence that Ivory-billed Woodpecker may have occurred eastward to southern Ohio at least 300 years prior to European settlement). The best understood habitat for this species is expansive mature ("old-growth") forested wetlands which persisted in many parts of the Southeast into the early 1900's. However, associations between forested wetland systems and this species may be only part of story leading to the Ivory-billed Woodpeckers demise in the Southeast.

Evidence exists that Ivory-billed Woodpeckers, while primarily associated with expansive forested wetland systems, may have also used the expansive longleaf pine forests with embedded forested wetlands that before European Settlement covered about 90 million acres of the southeastern landscape (see Jackson 2004). If this was so, the relationship with expansive longleaf pine forests would be consistent with habitat used by the Imperial Woodpecker (*Campephilus imperialis*, a very close relative of Ivory-billed Woodpecker and feared extinct) within the pine dominated mountains in the Sierra Madre Occidental of northwestern Mexico and similarly within the pine dominated mountain habitat used by some, but not all, Ivory-billed Woodpeckers in Cuba. If these conclusions are correct, when the longleaf forests were cut over, Ivory-billed Woodpecker populations may have become increasingly

isolated and individual populations restricted to the remaining larger forested wetland systems. The primary Longleaf pine forest was harvested from the 1700's through the early 1900's from east to west in the Southeast. Before European Settlement there was likely frequent interchange between Ivory-billed Woodpecker populations from Texas to Florida and northward to North Carolina. These connections were permanently severed with the loss of intact longleaf pine forests by the early 1900's.

In addition to habitat loss, by the late 1800's the species was already targeted as a valuable commodity for collectors and trophy hunters as something very rare and unusual. This already rare species became even rarer, especially in remaining suitable habitat. By the early 1900's, it was generally thought extinct in continental North America, until Arthur Allen and his wife documented a pair in central Florida in 1924. When that pair was collected by local taxidermists, this species again disappeared from science.

By the time conservationists began to raise the alarm about the future survival of the Ivory-billed Woodpecker in the early 1900's, most remaining populations already were doomed to extirpation from habitat fragmentation, demographic isolation, and collecting. This point was driven home with what was later to be understood as the last known Ivory-billed Woodpecker population in the United States being studied by Allen and Kellogg (1937) and particularly by Tanner (1942). As Allen and Tanner documented behavior and habitat use of the birds at the Singer Tract, the habitat surrounding the study area was disappearing at an alarming rate. These researchers understood that without immediate conservation action this remaining population would be lost.

Based on his study of this small remnant population and a search of other areas likely to support the bird, Tanner was the last to thoroughly document the range of this species. He also documented the reduction of their numbers, by the mid-1940's, to about 20 birds scattered in Louisiana (Singer Tract), the Gulf coast of Florida (from Apalachicola River basin to the Lower Suwannee River basin and adjacent swamps), the Big Cypress region of southwest Florida, and central South Carolina (the "Santee" River region, now fragmented by Lake Marion, and adjacent swamps).

There has not been an undisputed report of Ivory-billed Woodpeckers in the United States since 1944, when the last individual of the small population studied by researchers from the Cornell Laboratory of Ornithology and National Audubon Society at Singer Tract, Louisiana, was last seen. However, reputable sightings of Ivory-billed Woodpeckers continued in and near Singer Tract at least until 1946, and possible encounters continued into the 1980's, but nothing considered definite since 1944.

However, since the end of World War II, numerous reports have surfaced elsewhere across the Southeastern U.S. suggesting the persistence of at least some Ivory-billed Woodpeckers occurred well after the 1940's, including from the Piney Woods of eastern Texas, the Atchafalaya Basin of southern Louisiana, the Delta in Mississippi, the coastal plain of South Carolina, and across Florida. Most of these reports occurred before the 1970's with some having been shown to be more credible than others, but none representing firm documentation that Ivory-billed Woodpeckers still occur in the Southeastern United States today (there is also evidence that some Ivory-billed Woodpeckers may persist in Cuba). Without any additional tangible evidence this essentially remains true today outside of Arkansas.

Post-1944 Potential Encounters

Since the 1940's, Ivory-billed Woodpeckers have existed essentially as ghost birds of the swamps. Reports regularly come in of fleeting glimpses between dense stands of mature or regenerating forests and of mysterious noises sounding like tin horns or loud pounding double-raps on wood emanating from across a bayou. Most of the sightings upon investigation can be quickly assigned to Pileated or Red-headed woodpeckers. The tin-horn sounding "toot" calls possibly could be assigned to Blue Jays that have been observed and taped giving "toots" considered very similar but not identical to known Ivory-billed Woodpecker calls. The source of double-raps may be of any sort in the woods, including other woodpeckers, limbs rubbing against each other under breezy conditions, or even vehicles going over bumps on a distant highway.

Despite all of these potential explanations for what people have seen or heard, there remain a number of reports that are not easily dismissed, but lacking detail to constitute firm evidence that the species persists. This interest generally has been restricted to a few large areas in the Southeast U.S., especially in Louisiana, but also in Florida, South Carolina, and Texas.

After the loss of the Singer Tract, attention in Louisiana shifted to the remote reaches of southern Louisiana, particularly the Atchafalaya Delta south of Interstate 10, where many authorities believe is the most likely place a population of Ivory-billed Woodpeckers could escape notice. Among the most interesting reports, Dr. George Lowry from Louisiana State University in 1971 came into possession of two color photographs of an Ivory-billed Woodpecker perched half-way up the side of two very large trees. These photographs would seem to have provided good evidence that the species persisted at least into the early 1970's. However, critics pointed out that it was not clear that the bird involved was actually alive and not a mounted specimen that had been secured to the tree. The pose is similar on both trees and neither the bill nor feet are visible in either photograph, both of which are also grainy in quality. The photographer was recently revealed to be taken by Mr. Fielding Lewis of Franklin, Louisiana (Gallagher 2005). Both Lowry (now deceased) and Dr. Van Rensen (Lowry's successor at the LSU's Museum of Natural History) treated these photographs as reasonably firm evidence that Ivory-billed Woodpeckers persisted at least into the early 1970's. As is often the case with evidence concerning this bird, however, many ornithologists doubt the authenticity of these photographs. In essence, no evidence since World War II has undisputedly documented that Ivory-billed Woodpeckers persist in Louisiana. However, intriguing very recent sightings are discussed below.

After 1950 and the demise of Louisiana's Singer Tract, Florida became considered by many searchers the most likely State to support this species, due to the extensive amount of remote forested wetlands that persisted, despite most of these areas being cutover at least once. Florida, despite a rapidly growing population, still had large areas of remote swampland and mature forests throughout the State (at least until the 1970's). The most consistent area of observations and credible sightings come from the Apalachicola and Chipola rivers in the Florida Panhandle, at least through the 1950's.

The most intriguing reports after the 1950's are from 1967-1969. These reports involved birds using a cavity in central Florida as a roost site. Although at least one Ivory-billed Woodpecker was seen in the vicinity of this cavity tree on eleven separate days, as well as a bird thought to be calling from within the cavity, no photograph or convincing tape recording was ever produced (a tape was produced that Cornell Laboratory of Ornithology audio experts identified as a call of Pileated Woodpeckers). However, in the

spring of 1968 the tree in question blew over and a feather was found. The feather was subsequently identified by the Smithsonian Institution as that of an Ivory-billed Woodpecker and considered relatively fresh and not worn (see pages 407-410 in Stevenson and Anderson 1994, *The Birdlife of Florida*, University of Florida Press). Despite these reasonably credible reports, no firm documentation has ever been received to confirm that a pair or even an individual bird persisted in Florida after World War II. Reputable observers contend that the species could still exist in Florida and a recent analysis of bill marks (grooves) at the cavity entrance was determined to be in line with bill marks from known Ivory-billed Woodpecker cavities (P. Sykes, USGS, pers. comm.).

In South Carolina, credible reports continued into the 1930's in the vicinity of the Santee River swamp in Georgetown County, but there has been no confirmed report since then. In 1971, Mr. Robert Manns, then with the National Audubon Society, reported a bird calling in response to a tape recording as an Ivory-billed Woodpecker, again along the Santee River but this time near Columbia. However, all followup surveys resulted in no confirmation that Ivory-billed Woodpeckers persisted in the swamps of South Carolina.

Elsewhere in the Southeast U.S., for a period of about a decade between 1965 and 1975, numerous reports of Ivory-billed Woodpeckers emerged from the Piney Woods of eastern Texas, in the vicinity of what is now Big Thicket National Preserve, between the Trinity and Neches rivers. One of the sightings was by Mr. John Dennis (who was principally involved in the rediscovery of Ivory-billed Woodpeckers in Cuba during the late 1940's) and Manuel Armand Yramategui in 1966 along the Neches River. Also along the Neches River, Dennis in 1968 recorded what he believed was an Ivory-billed Woodpecker, which was analyzed by Hardy (1975) who concluded it could have been an Ivory-billed or possibly a Blue Jay. Recent analysis of this tape by the Cornell Laboratory of Ornithology determined that the calls were indeterminate between known Ivory-billed Woodpecker, White-breasted Nuthatch (*Sitta carolinensis*), and Blue Jay. In addition to the Dennis tape, Mr. George Reynard used for his "Bird Songs in Cuba" record, a recording apparently of a "double-knock" attributed to an Ivory-billed Woodpecker he heard from the Big Thicket in 1969. Jackson (2004) asked Tanner to review this tape and he concluded that he did not think the noise recorded is the double rap of the Ivory-billed Woodpecker. So despite the credentials of these two ornithologists making observations in Texas, credible evidence Ivory-billed Woodpeckers at any time during the mid-1900's occurred in the vicinity of Big Thicket remains a hotly debated issue to this day. As of this writing, all reports since the late 1960's have been discredited, or at best, are considered highly questionable, with the possible exception of Dennis' 1968 recording.

In part due the Big Thicket reports, the Southwest Region of the Service during the late 1980's initiated a rangewide status review for the Ivory-billed Woodpecker and contracted Jackson (2004) to conduct the work. Jackson's report provides a thorough review of all past reports and an assessment of whether the Ivory-billed Woodpecker could still persist in the Southeastern U.S. Jackson's findings unfortunately were inconclusive as he found no hard evidence to confirm the species existence, but discussed in some detail his own possible encounters with the species. Jackson provides two accounts of his experiences, one along the Noxubee River in Alabama just across the Mississippi state line from 1973 and the other in Mississippi along the Yazoo River confluence with the Mississippi River. For the Noxubee River account he glimpsed what he thought could have been an Ivory-billed Woodpecker, but no further evidence has emerged since the 1970's in Alabama. For the Yazoo River account, Jackson along with his graduate student, Mr. Malcolm Hodges (who now works for The Nature Conservancy in Georgia),

reported hearing a bird in 1987 that in their view matched closely with the Cornell tape recording of the species. The bird in question apparently was responding to their playing of the Cornell tape, but never came in close enough for a visual contact and Jackson and Hodges had no capability to record what they heard.

The Most Recent Sighting, Prior to Arkansas

In sum, there have been numerous reports of Ivory-billed Woodpeckers since the 1940's, and Jackson's plea for the public to provide information during his status review resulted in hundreds of letters and phone calls to Service biologists. Most of these reports again easily were dismissed as misidentified Pileated Woodpeckers and in some cases Red-headed Woodpeckers. Still, as suggested above, tantalizing reports, including photographs, tape recordings, and a feather suggest that Ivory-billed Woodpeckers could have persisted in very low numbers in highly isolated locations at least till the late 1980's. Nevertheless, near the end of the 20th Century there was absolutely no undisputed evidence acceptable to the scientific community to back up any claim that Ivory-billed Woodpeckers persisted past the 1940's. Thus, after more than a decade of relative silence, it came as a great surprise to many in the conservation community that an apparently solid report of a pair of birds had been observed in late 1990's, this time along the Pearl River on the Louisiana side.

Mr. David Kulivan, a wildlife graduate student at Louisiana State University, waited a couple of weeks after his wild turkey hunting adventure during the spring of 1999 at the Pearl River Wildlife Management Area, but he finally contacted Van Remsen at the Museum of Natural History, Louisiana State University to discuss what he had observed. He claimed to have observed two Ivory-billed Woodpeckers, one adult male and one adult female, foraging together for about 10 minutes. Although he had a camera with him, he claimed he was too much focused on observing the birds to move an inch from his hunting position. Remsen is now one of the very few leading authorities on the status of the Ivory-billed Woodpecker in the United States and chief critic of all reports regarding this species. After several hours of interviews, Remsen concluded that the details in Kulivan's report were the most solid evidence he had heard in 22 years of keeping track of information to suggest Ivory-billed Woodpeckers are still extant.

Once announced to the general public nearly a year later, numerous expeditions were organized to search for Ivory-billed Woodpeckers at Pearl River Wildlife Management Area. Many folks believed they glimpsed Ivory-billed Woodpeckers or heard their calls in the far distance during various searches. Large cavities and stripped bark aroused curiosity as to their makers and occupants. Finally, as a last effort to locate this species, a well-funded corporately-sponsored team of searchers during January-February, 2002, raised everyone's interest when they reported and taped a mysterious rapping sound that could have been a large woodpecker, but upon analysis proved to be semi-automatic pistol fire. Once again, despite this promising lead and very intensive searching no further hard evidence has been discovered to date to document persistence of this most endangered (if not extinct) bird in the United States. Maybe there is in fact a small population of Ivory-billed Woodpeckers persisting on the Pearl River in Louisiana. Even some of those who have raised doubts that Mr. Kulivan's report was "too detailed" admit it is possible, but hard evidence again is lacking. More recently, Hurricane Katrina has produced numerous snags and damaged trees in the Pearl River basin but also toppled over nearly all of the older and larger hardwoods in the area. It remains to be seen whether on balance the quality of

habitat here has improved or decreased for Ivory-billed Woodpecker after Katrina, but continued monitoring of the region is justified.

Conclusion

If we only accept the report from eastern Arkansas as confirmed, then this species has been lost from over 99 percent of its former range. However, if all these potential post-1944 encounters are considered in the realm of what is possible, then the present-day range of the Ivory-billed Woodpecker largely fills out the former known range. Thus, it is possible that the Ivory-billed Woodpecker persists from east Texas, north to central-eastern Arkansas, and east along the coastal plain to include at least South Carolina (and potentially extreme southeastern North Carolina) and south to at least the Florida panhandle. The one exception, until recently, where there has been no hint that this species persisted after the 1800's would be the area often referred to as the New Madrid region, which includes the lower Ohio River and its confluence with the Mississippi mainstem south through Missouri, Kentucky, and Tennessee, north of the confluence with the Arkansas River. However, several recent reports have surfaced from southern Illinois and western Tennessee (additional details should be forthcoming).

Appendix C. Narrative for Possible Post-1944 Ivory-billed Woodpecker Encounters.

Description of post-1944 possible encounters with Ivory-billed Woodpeckers (most are referenced in Jackson 2004, some additional encounters are referred to in FWS compilations of reports from the late 1980's).

South Carolina

Pee Dee and Waccamaw potential search area. Sightings from the Black River reported in 1970 and 1981, no independent confirmation.

Santee River potential search area from Congaree Swamp National Park to Cape Romain National Wildlife Refuge. Last confirmed area outside of Singer Tract supporting Ivory-billed Woodpeckers in the mid-1930's. Reports continue from the late 1950's to the present, both upstream and downstream from Lake Marion. Upstream of Lake Marion, sightings and recording by Manns in 1971 received national attention though most authorities can tell nothing from the very poor quality of the recording (Jackson suggests the call could be from a Wood Duck). Also, a report from 1984 near confluence of Congaree, Wateree, and Santee rivers. Downstream of Lake Marion, reports relayed to Sprunt and/or Dennis (and then reported to FWS) from 1959, 1960 (3 reports), 1962, 1963, and 1967, again no independent confirmation.

South Carolina-Georgia

Savannah River potential search area from Augusta to Savannah. No post-1944 reports, but a number of searchers suspect habitat has good potential.

Georgia

One sight report from the Ogeechee River, 25 miles west of Savannah in 1973, from someone familiar with other *Campephilus* in South America and considered intriguing by Jackson.

Altamaha River potential search area. Stoddard in 1958 reported seeing a bird at distance of 50 meters during an overflight of the river, considered highly credible.

Georgia-Florida

Okefenokee-Pinhook Swamp-Osceola potential search area. Reports during 1946-1948 are not independently confirmed from the Okefenokee Swamp NWR proper. An additional 1965 report from Stephen C. Foster State Park supposedly with photograph (missing?).

Red Hills potential search area (possibly should be combined with Apalachicola in Florida). Two reports from the Red Hills between Thomasville and Florida border by Stoddard (1958) and Reynard (1963). Both records would seem to be considered highly credible based on reputations of observers,

but neither report is mentioned in the Georgia Annotated Checklist (though a 1952 report is mentioned from Thomas County).

Florida

Apalachicola Drainage Basin potential search area. Highly credible sight reports from the 1950's come from around the Apalachicola National Forest including between Wakulla Station and St. Marks (1952 by Grimes) and many sites along the Chipola River (1950-1951 by Whitney, Eastmann, Dennis, and others). Rumors persist that Stevenson knew of an occupied cavity into the 1970's along the Chipola, but kept the specific location secret. Recent searches (2003) in this same area have produced some possible auditory contacts.

Aucilla River. Highly credible report of a lone female in 1959 1 mile east of the river proper by Rhein as reported to Tanner (also follow up interview by Lammertink in 1997).

Lower Suwannee River (including Big Bend and California Swamp) potential search area. No post-1944 reports, but likely supported the species prior to 1930.

Big Cypress-Fakahatchee potential search area. A report from 1950 by highly credible observer (Cruickshank) relayed to another highly respected ornithologist (Robertson). Other more recent (late 1980's to late 1990's) but unconfirmed reports.

Additional reports of some interest from Florida include:

Eglin Air Force Base 1966, not independently confirmed
Wekiva River 1987-1988, not independently confirmed but thought intriguing by Jackson
Homosassa Springs 1955, not independently confirmed
Green Swamp, Haines City area, 1967, credible observer (Lee), foraging sign also present
Highlands Hammock 1968, not independently confirmed
Jonathan Dickinson State Park, 1985, not independently confirmed but thought intriguing by Jackson

One additional intriguing report comes from private land somewhere northwest of Lake Okeechobee from 1967-1969 where 11 separate sightings were reported between 1967-1969. A fallen roost tree from the site that was said to contain a secondary feather, independently identified as that from an ivory-bill and thought to be fresh (not from a museum specimen), now are housed at the Florida Museum of Natural History, Gainesville. Some doubt on the entire set of reports comes from a tape purported to be of the birds under observation identified by Cornell Lab as definitely Pileated Woodpecker.

Alabama-Upper Coastal Plain of Mississippi

Mobile River delta (includes Tensaw, Alabama and Tombigbee river systems) potential search area. No post-1944 reports for the delta proper, however Jackson may have seen a bird in 1973 along the Noxubee River just across state line into Alabama.

Mississippi

Pascagoula River potential search area. Reports from 1960, 1978, and 1982 considered intriguing by Jackson.

Yazoo River Delta (from Mississippi River confluence to vicinity of Greenwood) potential search area. One bird heard by Jackson and Hodges in 1987 (and then another auditory encounter in 1988 by Davis and Sibley) near confluence with Mississippi River considered probable if it weren't for potential of Blue Jay sounding very similar. Another report from the headwaters of the Yazoo (Tallahatchie and Yalobusha rivers) in 1988 considered at best an individual moving through. In the lower Basin, Panther Swamp NWR and Delta National Forest appears worthy of a search.

An additional report from Mississippi comes from about 30 miles north of Meridian in 1953, tantalizing but incomplete details according to Jackson.

Louisiana-Mississippi

Pearl River potential search area. A very detailed report of a pair of birds seen for 10 minutes at close range in 1999 on Pearl River Wildlife Management Area, LA, sparked a four-year search, resulting in no independent confirmation. Still the area, and adjacent Bogue Chitto NWR Stennis Space Center, may be worth an additional search effort (especially after extensive defoliation and tree mortality following Hurricane Katrina).

Louisiana

Atchafalaya Basin potential search area. Most reports (of which there are many) come mostly from the southern portion of the basin to include some areas south of US Highway 90. A pair of photographs surfaced in 1971 of what is undoubtedly a male Ivory-billed Woodpecker perched on two different trees. The photographs were presented to the American Ornithologists' Union by Lowery, but subjected to strong criticism that these photos could have been faked (i.e., unclear given the position of the bird in both photos was whether or not the bird in the photograph was actually alive). The identity of the photographer was not known beyond a small group of Louisiana ornithologists for over 30 years until the 2005 publication of *The Grail Bird* by Tim Gallagher. The photographer, Fielding Lewis, is a life long resident, hunter, and angler from Franklin, LA, where he has been keeping reports of this species from his fellow outdoorsmen in the southern Atchafalaya Basin for over 30 years (last reports he is aware of are from the mid-1980's). In addition to these reports from the local community, other fleeting glimpses from trained ornithologists were in 1973, 1974, 1981, 1982, and 1986. The 1981 report from Michot and Hankla, included another fuzzy photo, in this case of only the top of the bird's head which indicates either a male Ivory-billed Woodpecker or a female Pileated Woodpecker, but accompanied written details supports the former (though there was confusion over calls the bird[s] were giving).

Central Louisiana Delta (from Catahoula NWR east to Cat Island NWR) potential search area. No post-1944 reports, but habitat potentially exists.

Tensas River Basin potential search area. Last absolutely confirmed reports of the species into at least 1944, some say 1948, on what is popularly known as the Singer Tract. Additional auditory encounters

by credentialed ornithologists in 1962 (Binford, Monroe, Berrett, Arnold) and then again 1981-1982 (Heinrich and Welch).

Louisiana-Arkansas

Ouachita River (from Felsenthal NWR to Ouachita WMA) potential search area. No post-1944 reports, but habitat potentially exists.

Arkansas

White-Cache-Lower Arkansas rivers actual search area. In addition to the visual, auditory, and video evidence mounting from the White and Cache Rivers since 2004, there is at least one additional recent report from eastern Arkansas from farther north in Jackson County in 1986. However, there was no independent confirmation.

Louisiana-Arkansas-Oklahoma-Texas

Red River (including Little River NWR, OK, Caddo Lake NWR, TX, Pond Creek NWR, AR and points south into LA) potential search area. Report of a pair of birds in the mid-1980's near Grassy Lake in sw Arkansas, but no independent confirmation.

Louisiana-Texas

Sabine River potential search area. Apparently a family group (4-5 birds, including young) seen in 1985 along Toledo Bend Reservoir shoreline several miles north of Pendelton Bridge in compartment 101 of Sabine National Forest. Observer interviewed by Conner, extensive scaling evident in area, otherwise no independent confirmation.

Texas

The Big Thicket (Neches-Trinity rivers) potential search area. The official Texas Ornithological Society's position is that all the Big Thicket reports since the 1930s are unsubstantiated. Please see Shackelford (1998) for a more detailed list of published accounts of the species in Texas. This includes all the sightings, auditory contacts, two recordings, and a purported photograph that came out of the Big Thicket area between the Trinity and Neches rivers from 1958 to 1985. Although many of the reports involved Dennis, Eastman and Reynard, all who had good Ivory-billed Woodpecker credentials (especially Dennis who was principle in rediscovering the species in Cuba in 1948), there were general doubts widely expressed by Tanner, Sutton, Sykes, and others about the reports. Statements in the literature that Dennis was "overly optimistic," were regularly mentioned in critiques of the Big Thicket reports. However, Dennis was able to record audio of an unseen bird in 1968 that has been subject to thorough review by Hardy. Hardy concluded that the recording was either an Ivory-billed Woodpecker or a Blue Jay, but "throwing caution to the wind," leaned towards Ivory-billed Woodpecker. In addition, Reynard recorded what was described as a "double rap" in 1969 from the Big Thicket which had been spliced into another recording for his record "Birds Songs in Cuba." Tanner did not agree that this was in fact an Ivory-bill. Finally, Reynard purportedly looked at a fuzzy photograph taken by a local woodsman in 1967 and concluded it was a *Campephilus* woodpecker, but the photo has apparently not

been shared with anyone else. The most recent report from the Big Thicket was in 1985 that came from one individual who saw birds in three different areas, including one breeding pair with 2 young. None of the sightings have been independently confirmed, but the Dennis audio recording resurfaced most recently as part of Cornell Laboratory of Ornithology's analysis of recordings from eastern Arkansas since 2004. Currently, the Dennis recording is considered indeterminate and may be an Ivory-bill, Blue Jay, or White-breasted Nuthatch. It should be noted that all indeterminate recordings thought to be possible Ivory-billed Woodpecker from the White and Cache rivers are of poor quality compared with recordings that ordinate clearly with known Ivory-billed Woodpecker notes from the Singer Tract study. Undocumented reports of ivory-bills still come in from the Big Thicket and other parts of eastern Texas. Unfortunately, there have been no confirmed Ivory-billed Woodpecker records in Texas since 1904.

Appendix D Detailed Description of the Current and Historical Ivory-billed Woodpecker Sightings and Habitat for each of the states within the historic range.

These narratives are provided by the States or their representatives and are reproduced in total in this appendix.

ALABAMA

Original Range in Alabama

Data on the historical occurrence, and hence the original range, of the Ivory-billed Woodpecker in Alabama is meager. The first account of the Ivory-billed Woodpecker in Alabama may well have been that of Audubon (1838) who mentions encountering them during an overland trip from Mobile to Charleston in 1837. Writing from Dallas Co., Gosse (1859) did not consider the species rare in 1838 and mentions taking a paired male and female, probably sometime between June 1-10, though no collection data are given. The specimen Hasbrouck (1891) reported as taken in Marengo Co., west of the Tombigbee River in 1865 is problematic because the Tombigbee River forms the western boundary of Marengo Co. Therefore, any specimen taken west of the river would have been in either Sumter or Choctaw Co. Avery (1890) collected a specimen near the Black Warrior River, 10 mi. west of Greensboro, Hale Co., in 1866. G.V. Young observed a nest in a dead pine at Crump Springs on the Buttahatchie River, Lamar Co., in the spring of 1886 and a bird in Wilcox Co., in 1889 (Hasbrouck 1891). The last record reported by Howell (1928), who considered the species “undoubtedly extinct in Alabama”, was of one killed by C.W. Howe “about 1907” along the Conecuh River north of Troy, Pike Co.

Based on published records and the known or surmised range of the species in surrounding states, the Ivory-billed Woodpecker probably inhabited areas of suitable habitat in the eastern gulf coastal plain of Alabama south of the fall line. The most suitable habitat appears to have been in forests along major riverine systems in the west and south and in extensive longleaf pine forests in the southeast. The vast forested wetlands along the Alabama, Tombigbee, Black Warrior, Chattahoochee, Conecuh, and Pea Rivers were undoubtedly important.

Range Changes over Time

The presence of the species in Alabama was linked to the presence of extensive areas of virgin and old growth forests. Its disappearance appears to have resulted from changes in forest composition subsequent to the arrival of European settlers in the early 1800's. The rise of a strong agricultural economy and need for timber products to support development in the early 18th century reduced the state's forests significantly (Alabama Division of Wildlife and Freshwater Fisheries 2005). Expansion of the railway system in the 1850's required vast quantities of wood and opened areas for settlement. The Civil War and depletion of forest resources throughout the 1800's in many areas of the U.S. placed additional pressure on the state's forest resources. As a result, Alabama's old growth forests were gone by 1920 and millions of acres of former forested habitat had been cleared, degraded, or converted to another habitat type.

The relative rarity of the species throughout its range, absence of surveys, and lack of locality data documenting its distribution makes it difficult to draw meaningful conclusions concerning range changes. While it undoubtedly occurred in low population densities over large areas of Alabama, available data indicates that by 1850 its main center of distribution in Alabama was severely restricted. Of the seven records for Alabama, all but one are from the once vast forested areas drained by the Tombigbee and Alabama Rivers in west Alabama.

Locations of Possible Encounters Since 1944

There have been at least six Ivory-billed Woodpecker encounters reported in Alabama since 1944. Of the encounters reported below, only the sighting along the Noxubee River in 1973 is within the reported historical range of the species.

- 1958 One seen in a thick, wooded swamp on Redstone Arsenal, near Huntsville, Madison Co., adjacent to Wheeler NWR. The sighting was not reported at the time and it is not known if attempts were made to follow-up on the sighting. It has only come to light subsequent to the April, 2005 announcement of the rediscovery of the species in Arkansas. Location of this reported encounter is not within the reported historical range of the species.
- 1973 One seen along the Noxubee River, Sumter Co. Jerry Jackson saw what may have been an Ivory-billed Woodpecker just east of the Alabama-Mississippi state line. No additional sightings were subsequently reported.

[NOTE: We should make sure all these recent sightings are in the sightings database and that they are “ranked” accordingly – not sure if we should list some of the the very doubtful records below, given that there were hundreds of such reports subsequent to April 2005 – KVR]

- 2005 One seen along a wooded trail on Wheeler NWR, Morgan Co. The sighting occurred two weeks before the April, 2005 announcement of the rediscovery of the species in Arkansas but was reported subsequent to the April, 2005 announcement of the rediscovery. Repeated attempts by refuge personnel to relocate the bird were unsuccessful. Location of this reported encounter is not within the reported historical range of the species.
- 2005 One reported seen from a secondary road in a wooded area near Wheeler NWR, Morgan Co., subsequent to the April, 2005 announcement of the rediscovery of the species in Arkansas. Location of this reported encounter is not within the reported historical range of the species.
- 2005 One reported seen in a suburban yard in Center Point, Jefferson Co., subsequent to the April, 2005 announcement of the rediscovery of the species in Arkansas. Location of this reported encounter is not within the reported historical range of the species.
- 2005 Several encounters reported north and west of Dadeville, Tallapoosa Co., near Lake Martin, subsequent to the April, 2005 announcement of the rediscovery of the species in Arkansas. Geoff Hill of Auburn University spent parts of several days investigating the reported encounters and habitats associated with the encounters and was unable to relocate the bird or other evidence of its occurrence. Locations of these reported encounters are not within the reported historical range of the species.

Potential Search Areas Consistent with Believed Habitat Requirements

The following potential search areas in Alabama are ones that are generally considered to contain the best and most extensive remaining Ivory-billed Woodpecker habitat. While these areas should receive priority consideration during the development of any search strategy, identification of any additional

potential areas of habitat through the use of aerial photography and satellite imagery should be undertaken.

1. Mobile-Tensaw River Delta from the confluence of Alabama and Tombigbee Rivers downstream to the forested wetland/marsh interface. The Mobile-Tensaw Delta, roughly 300 mi² in size, contains the largest area of potential Ivory-billed Woodpecker habitat in Alabama. Recent acquisition of significant areas within the delta as part of the Mobile-Tensaw WMA and W.L. Holland WMA by the Alabama Division of Wildlife and Freshwater Fisheries and Forever Wild Program lands by the Alabama State Lands Division, have provided a strong measure of protection to a significant portion of the delta. Extensive forested wetlands containing significant areas of cypress and tupelo habitat occur within the area.
2. Tombigbee River from Coffeville Lock and Dam downstream to its confluence with the Alabama River. The Tombigbee River floodplain downstream of the Coffeville Lock and Dam contains significant potential habitat. The lower portion of the floodplain from Jackson, Clarke Co., downstream appears to contain the most suitable habitat.
3. Alabama River from Claiborne Lock and Dam downstream to its confluence with the Tombigbee River. The Alabama River floodplain downstream of the Claiborne Lock and Dam in Clarke, Monroe, and Baldwin Cos., contains significant potential habitat.
4. Tombigbee River from Braggs Bluff downstream to Coffeville Lock and Dam. The Tombigbee River floodplain downstream of Braggs Bluff appears to contain suitable habitat in Choctaw, Marengo, and Clarke Cos. Demopolis WMA is located within the area in Hale and Sumter Cos., and Choctaw NWR is within the area in Choctaw Co.
5. Tombigbee River from the Sipsey River downstream to Braggs Bluff. The Tombigbee River floodplain downstream of the Sipsey River appears to contain suitable habitat in Greene and Sumter Cos.
6. Sipsey River from U.S. 82 to its confluence with the Tombigbee River. The Sipsey River floodplain downstream of U.S. 82 in Tuscaloosa and Pickens Counties appears to contain potential suitable habitat.
7. Buttahatchie River from Henson Springs downstream to its confluence with the Tombigbee River. The Buttahatchie River floodplain from Henson Springs downstream appears to contain suitable habitat. The last accepted record for the Ivory-billed Woodpecker in Alabama in 1907 is from this area.

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ARKANSAS

Catherine Rideout, AGFC
1/30/06

Original range in the state

Historically, the Ivory-billed Woodpecker inhabited old-growth bottomland forests in eastern Arkansas (James and Neal 1986). Audubon saw Ivory-billed Woodpeckers with regularity during his travels down the Mississippi River near Arkansas post in 1820 (Audubon 1929). Tanner (1942) presents reports in the 1800s from the northeastern part of the state near Newport along the White River, near Marked Tree, which lies between the St. Francis River and the Mississippi River, Osceola adjacent to the Mississippi River in far northeast Arkansas, and near Helena in eastern Arkansas. Tanner (1942) reports less specific accounts of the bird along the Canadian River in 1820, the Arkansas River in 1850, and in northeastern Arkansas in 1888. Additionally, Tanner (1942) reports a record at the confluence of the Ouachita and Saline Rivers in the southern central part of Arkansas.

Range changes over time

Tanner suggests that logging increased rapidly in most of Arkansas between 1890 and 1900 and suggests the period during which Ivory-billed Woodpeckers disappeared from the state was 1885-1900. Tanner (1942) suggests that the last Ivory-billed Woodpecker population remaining in the state near the mouth of the Arkansas River disappeared between 1900 and 1915, with the last historical report for the bird in Arkansas in about 1910. However published auditory, video and visual evidence in the Cache and White River NWRs indicate at least one bird in Arkansas. Tanner (1942) visited what is now the White River NWR in 1938 and found no evidence of the bird, nor a great deal of habitat to support the species

Locations of possible encounters

This report includes records of the Ivory-billed Woodpecker in Arkansas including published sight records, auditory encounters by people, and recordings made by Autonomous Recording Units. It also contains some records which remain unpublished and unverified and are reported as 'possible encounters'. Inclusion in this report is not intended to suggest validity. There are five specimens labeled for Arkansas, but none have specific dates or locality information associated with them (Jackson 2002a), so these have not been included in the below table.

Date	County	Location	Observer	Citation	Notes
14 Dec 1820	Arkansas	Near Arkansas Post, one mile below mouth of Arkansas River,	J.J. Audubon	Audubon 1929	Audubon states that he saw five Ivory-billed Woodpeckers

1834	Ashley	Junction of Ouachita and Saline Rivers	G.W. Featherstonaugh	Featherstonaugh 1835	[This record is derived from the 1834 record of G.W. Featherstonhaugh (1935) which should read “Clark County, Caddo River, 2 miles upstream of the junction of the Ouachita River” and is incorrect in Tanner (1942).]
1885	Jackson	Newport, AR	Yell	Yell 1885	Yell states that Ivory-billed Woodpeckers are not rare but are rarely met with near Newport in Jackson County
1888-1889	Poinsett	Valley of the St. Francis River near Marked Tree	Pindar	Pindar 1924	2 single birds seen in the area during the same period of time; one male and one female
1887	Mississippi	Osceola area	Howell	Howell 1911	
	Phillips	Helena	Howell	Howell 1911	Secondhand reports as late as 1910
1912	Phillips	Helena		Stephenson Biol. Survey notes (in Tanner 1942)	
October 1985	Jackson	Near Diaz in the Village Creek floodplain	H. Hagar	J. Neal in litt	Possible visual encounter
Between 1989-1991, specific date not	Little River	Porter Tract near Millwood Lake and Grassy	R. Weaver	Unpublished	Possible visual encounter with pair of birds; reported to Arkansas Game and Fish and The

known		Lake			Nature Conservancy of Arkansas
10 March 2003		White River NWR	M. Scott	Gallagher 2005	Possible visual encounter with a female Ivory-billed Woodpecker
11 Feb 2004	Monroe	Bayou de View, Cache River NWR	G. Sparling	K. Rosenberg et al. 2005	Sight report of single bird
27 Feb 2004	Monroe	Bayou de View, Cache River NWR	B. Harrison and T. Gallagher	K. Rosenberg et al. 2005; Fitzpatrick et al. 2005	Sight report of single bird
5 April 2004	Monroe	Bayou de View at Pawpaw Lake, Cache River NWR	Jim Fitzpatrick	K. Rosenberg et al. 2005	Sight report of single bird
6 April 2004	Monroe	Bayou de View at Pawpaw Lake, Cache River NWR	R. Rohrbaugh and D. Brown	K. Rosenberg et al. 2005	Report of very good candidate for Ivory-billed Woodpecker
10 April 2004	Monroe	Bayou de View at Pawpaw Lake, Cache River NWR	M. LaBranche	K. Rosenberg et al. 2005	Sight report of single bird
11 April 2004	Monroe	Bayou de View at powerline cut north of Pawpaw Lake	M. Driscoll	K. Rosenberg et al. 2005	Sight report of single bird
25 April 2004	Monroe	Bayou de View, Cache River NWR	D. Luneau and R. Henderson	K. Rosenberg et al. 2005	Sight report and video
4 Sept 2004	Monroe	Bayou de View, Cache River NWR	B. Harrison	K. Rosenberg et al. 2005	Possible visual encounter with single bird
7 Sept 2004	Monroe	Bayou de View,	T. Barksdale	K. Rosenberg et al. 2005	Possible auditory encounter; heard

		Cache River NWR			and reported 2 double-raps in response to playbacks of Ivorybill <i>kent</i> calls
9 Nov 2004	Monroe	Blue Hole, Bayou de View, Cache River NWR	M. Iliff	K. Rosenberg et al. 2005	Possible auditory encounter; over 12 min. period heard 20 double-raps consistent with <i>Campephilus</i> woodpeckers
Evening 24 and 26 and morning of 25 Dec 2004	Monroe	Blue Hole, Bayou de View, Cache River NWR	Autonomous Recording Unit	K. Rosenberg et al. 2005	Acoustic signatures of sounds closely matching <i>Campephilus</i> double-rap
8 Jan 2005	Phillips	Prairie Lakes, White River NWR	Autonomous Recording Unit		Double rap recorded
24 Jan 2005	Phillips	Prairie Lakes, White River NWR	Autonomous Recording Unit		Three double raps recorded
25 Jan 2005	Phillips	Prairie Lakes, White River NWR	Autonomous Recording Unit		Single double rap recorded
5 Feb 2005	Phillips	Prairie Lakes, White River NWR	Autonomous Recording Unit		Three double raps recorded
17, 21, 29, 31 Jan 2005	Phillips	Prairie Lakes, White River NWR	Autonomous Recording Unit		<i>Kent</i> -like calls recorded on four different dates
14 Feb 2005	Monroe	Bayou de View at powerline cut north of Pawpaw Lake	C. Taylor	K. Rosenberg et al. 2005	Heard 9 double-raps and reports sighting a single bird
15 Feb 2005	Monroe	Bayou de View at	D. Luneau and T. Spahr	K. Rosenberg et al. 2005	Possible auditory encounter; heard

		powerline cut north of Pawpaw Lake			and recorded <i>kent</i> -like calls
15 Feb 2005	Monroe	Bayou de View at powerline cut north of Pawpaw Lake	E. Swarthout and D. Sarver	K. Rosenberg et al. 2005	Possible auditory encounter; heard <i>kent</i> -like calls
7 March 2005	Monroe	West of Robe Bayou	C. Taylor and M. Sarver	K. Rosenberg et al. 2005	Possible auditory encounter; heard three double-raps
17 March 2005	Monroe	Blue Hole, Bayou de View, Cache River NWR	T. Barksdale	K. Rosenberg et al. 2005	Possible auditory encounter; heard a double-rap response to playbacks of <i>kent</i> calls
Evening 17 March 2005	Monroe	Blue Hole, Bayou de View, Cache River NWR	Autonomous Recording Unit	K. Rosenberg et al. 2005	Records three bird calls consistent with <i>kent</i> call
May 2005?	Monroe	Hwy 17 Bridge, Bayou de View, Cache River NWR	Vic Kauffman	Unpublished	Possible encounter with single bird
28 Dec 2005	Monroe	Bayou de View, Cache River NWR	E. Hendrickson	Unpublished	Possible visual encounter with single bird
		White River NWR	S. Sietler	Unpublished	Possible encounter with single bird

Habitat descriptions if somehow different from the general description in the life history.

Habitat not believed to be different from general description, which is summarized by Jackson (2002b).

Potential areas to search that are consistent with the believed habitat requirements.

Currently, The Cornell Lab of Ornithology is focusing the search effort on the White-Cache-Lower Arkansas Rivers complex. This area encompasses private lands, National Wildlife Refuges (NWRs), Arkansas Game and Fish Commission Wildlife Management Areas (WMAs), and land managed by The Nature Conservancy (TNC) of Arkansas and the Arkansas Natural Heritage Commission (ANHC). This larger region consists of the following areas, which may be visited during the search:

White River National Wildlife Refuge

Cache River National Wildlife Refuge

Bayou Meto Wildlife Management Area

Dagmar Wildlife Management Area

Benson Creek Natural Area

Rex Hancock/Black Swamp Wildlife Management Area

Wattensaw Wildlife Management Area

Steve Wilson/Raft Creek Bottoms Wildlife Management Area

Henry Gray/Hurricane Lake Wildlife Management Area

Bald Knob National Wildlife Refuge

Other potential areas outside of these major bottomland hardwood drainages within the state include the Ouachita and Saline River complex in the south-central part of the state and also the Red River in far southwestern Arkansas. There have been discussions about the potential of searching the Ouachita and Saline Rivers habitat, though there have been no possible encounters reported since 1944. There was one unverified report of a pair of birds near Millwood Lake/Grassy Lake in the late 1980s, but a great deal of habitat loss has occurred in this area since that time.

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FLORIDA

Original range in the state

The greatest number of historical reports and collected specimens of Ivory-billed Woodpeckers are from Florida, partly owing to Florida's accessibility to the "northeastern establishment ornithologists" of the late 1800s and early 1900s (Jackson 1996:105). Ivory-billed Woodpeckers are known to have existed throughout Florida from the panhandle to the Everglades (Jackson 1996). Records from extreme southern Florida are controversial. A park warden in Everglades National Park reported seeing a nest at Royal Palm Hammock in 1917 (Safford 1919, Howell 1921), although this report was later discounted by Bailey (1927) and Tanner (1942) as that of a pileated woodpecker. One Ivory-billed Woodpecker specimen reportedly collected from the Florida Keys on November 29, 1896 (Cornell Museum of Vertebrates collection; Hahn 1963) lacks critical locality and collection data (Charles Dardia, personal communication).

Ivory-billed Woodpeckers were probably most numerous in three regions: 1) riparian systems and associated pine woods in northern Florida; 2) the Big Cypress swamp in southwest Florida; and 3) swamp forests associated with several rivers in central Florida. Riparian systems in northern Florida historically had the most Ivory-billed Woodpeckers (Robertson and Woolfenden 1992), particularly the Chipola and Apalachicola river swamps in the panhandle (Phillips 1926, Crompton 1950, Eastman 1958, Dennis 1967, Dennis 1979, Stevenson and Anderson 1994), the Wacissa and Aucilla river swamps in the Big Bend region (Wayne 1895, Phillips 1926, Tanner 1942), and the lower Suwannee River and adjacent California swamp (Laurent 1887, Brewster and Chapman 1891, Tanner 1942, Austin 1967). Although relative abundance is difficult to discern from historical reports, some reports opine that Ivory-billed Woodpeckers were more abundant in the lower Suwannee River watershed than in any other region in the state. For example, Maynard (1881) considered them "quite numerous" in Gulf Hammock and rare elsewhere. Alternatively, Tanner (1942) used historical data to estimate that Ivory-billed Woodpecker density was higher in the Wacissa swamp (one pair per 6.25 square miles) than in the California swamp along the lower Suwannee River (one pair per 10 square miles). Prominent areas of swamp forest in central Florida include Osceola (Nicholson 1929) and Okeechobee (Allen and Kellogg 1937) counties and swamp forests associated with the Ocklawaha, Wekiva, Withlacoochee, St. Johns, Indian, and Crystal Rivers (Jackson 1996).

Most of the museum specimens collected from Florida (Hahn 1963) were taken between 1875 and 1905, with 50% collected between 1883 and 1903. Jefferson, Lee, Levy, Hillsborough, and Volusia were the five counties with the most specimens collected.

Range changes over time

Ivory-billed Woodpeckers declined continuously since the arrival of Europeans, with accelerated declines during the last decades of the 1800s and first decades of the 1900s (Jackson 1996). By 1900, ivory-bills were gone from most parts of northern Florida (Robertson and Woolfenden 1992). To wit, areas such as St. Marks in Wakulla County were thought to have had ivory-bills until about 1905 (Phillips 1926). Collecting was undoubtedly an important factor in the decline of the species in Florida. For example, A. T. Wayne collected 19 Ivory-billed Woodpeckers along the Wacissa and Aucilla rivers

alone during spring 1894. Timber cutting and habitat loss also were important factors in the continued decline of the species in Florida. By the late 1930s, when Tanner (1942) visited the Gulf Hammock, lower Suwannee River, and California swamp in northern Florida, he found no sign of the species and very little habitat that was not cut over.

As the twentieth century progressed, only small groups persisted mainly in southern and central Florida (Jackson 2004). By the 1920s only dedicated field ornithologists could find pairs of birds in remote areas like Taylor Creek in central Florida and these last pairs were quickly taken as specimens (Allen and Kellogg 1937). The last museum specimens with reliable collection data were a male and female pair taken during 1925 in Osceola County by B.J. Hancock (Florida Museum of Natural History collection; Hahn 1963).

A series of credible sightings occurred in northern Florida during the 1950s along the Chipola River and in Taylor, Jefferson and Wakulla Counties (Crompton 1950, Eastman 1958, Dennis 1967, Stevenson and Anderson 1994, Jackson 2002). Recent sightings that appear to have the most reliability were reported from Polk/Highlands County during 1967-1969, the lower Apalachicola River in 1984, and Jonathan Dickinson State Park in 1985.

Locations of possible encounters

This report includes evidence of the Ivory-billed Woodpecker in Florida including published records of birds seen or heard and a small number of published records of second-hand accounts. It also contains some unpublished records which remain unverified and are reported as “potentially reliable” sightings. Inclusion in this report is not intended to determine validity.

Jackson (1996:104) referred to winter sightings during 1990-1991 from Fakahatchee Strand (southwest Florida) and from the lower Chipola /Apalachicola swamps (panhandle Florida), which “simply cannot be ruled out as having truly not been of an Ivory-billed Woodpecker.” However, no details regarding these reports were available.

Date	County	Location	Observer	Citation	Notes
Ca. 1859	Volusia	Enterprise (now Benson Springs)	H. Bryant	Bryant 1859	
March 5, 1869	Volusia	Enterprise	J.A. Allen	Allen 1871	
1870	Brevard	Merritt Island	S.C. Clarke	Clarke 1885	
1872	Volusia	Turnbull Swamp or Hummock	S.C. Clarke	Tanner 1942	
1873	Unknown	St. John’s and Ocklawaha Rivers	C.H. Merriam	Merriam 1874 (also see Tanner 1942)	
Late 1870s	Levy	Gulf Hammock	C. J. Maynard	Maynard 1881	Described species as “quite numerous” in this region;

Date	County	Location	Observer	Citation	Notes
		region			few details given.
Spring 1876	Sumter	Lake Panasofkee	W.E.D. Scott	Scott 1881	
1879	Levy/Citrus	Mouth of the Withlacoochee River	W.E.D. Scott	Scott 1903 (also see Tanner 1942)	
1880	Pinellas	Clearwater	W.E.D. Scott	Scott 1881	
Ca. 1885	Unknown	Wekiva River	G.A. Boardman	Boardman 1885	
Ca. 1885	Seminole	Sanford	C.D. Barrett	Anonymous 1885 (also see Tanner 1942)	
1886 or 1887	Alachua	Gainesville	T.G. Pearson	Letter from Pearson 1940 (also see Jackson 2004)	
March 16, 1886 and 1887	Levy	Gulf Hammock	P. Laurent and Williams	Laurent 1887, 1917	5 birds collected.
March 1886	Marion	Juniper Creek	E.M. Hasbrouck	Hasbrouck 1891	
April 8, 1886	Wakulla	St. Marks, several miles upstream	H.A. Kline	Kline 1887	Male and female collected; additional female also collected by a local fisherman.
March 17, 1887	Pinellas	Swamp near Tarpon Springs	W.E.D Scott	Scott 1888 (also see Allen and Kellogg 1937)	Nest in cypress tree, 41 feet above ground. Adults and nestling collected.
1889	Lee	Punta Rassa	Mr. Atkins	Scott 1889	
December 1889	Liberty	Bristol	E.M. Hasbrouck	Tanner 1942	
March 24 and 29, 1890	Levy/Dixie	Suwannee River 20 miles inland from the Gulf of Mexico	F.M. Chapman, W. Brewster	Brewster and Chapman 1891, Austin 1967	Adult male collected Mar 24, one bird heard Mar 29 near entrance to Vista Creek.
1891	Unknown	Caloosahatchie region	W.E.D. Scott	Scott 1892	
April 15, 1893	Unknown	Unknown	A. T. Wayne	Bendire 1895	Nestling collected, along with 12 other specimens and 10 additional sight records that month.

Date	County	Location	Observer	Citation	Notes
					Location unclear.
April 19, 1893	Lafayette	Unknown	Unknown	Bendire 1895	Nest in dead bay tree, 30 feet above ground. Adult female and 3 eggs collected. Location unclear.
February 15, 1898	Collier?	Big Cypress	R. Ridgway	Ridgway 1898	
May 1899	Okeechobee	Fort Drum	Hoxie	Unpubl. "Biol. Survey Notes" cited in Tanner 1942	
Ca. 1900	Osceola	Kissimmee	W.B. Hinton	Howe and King 1902	
Ca. 1900	Leon	Unknown	R.W. Williams	Williams 1904	
January 1900	Taylor and Wakulla	Unknown	C.J. Pennock	Pennock 1901	
March 1904	Taylor	Unknown	R.D. Hoyt	Hoyt 1905	
March 1904	Lake	South Clermont and vicinity	R.D. Hoyt	Hoyt 1905	Eggs collected.
Ca. 1905	Levy	Otter Creek, Gulf Hammock	T. Gordon	Gordon 1909	
1905	Wakulla	Oreilla Swamp	J.C. Phillips	Phillips 1926 (also see Jackson 2002)	
1907, 1911	Volusia	Turnbull Swamp or Hummock	Mrs. Sams	Butler 1931	
November 1908	Osceola	Kissimmee River, 50 miles below Kissimmee	T. Murray	Butler 1931, Tanner 1942	Specimen collected.
1909	Alachua	Micanopy	O.E. Baynard	Unpubl. "Biol. Survey Notes" cited in Tanner 1942	
Ca. 1910	Alachua	Unknown	O.E. Baynard	Baynard 1913, Tanner 1942	Nest with young.

Date	County	Location	Observer	Citation	Notes
March 1911	Lee	Big Cypress Swamp	O.E. Baynard	Baynard 1914 (also see Tanner 1942)	Published and personal communication to Tanner.
Spring 1913	Lee	Big Cypress Swamp	F.M. Phelps	Phelps 1914	Seen and heard "Far down in the Big Cypress."
October 1913	Orange	Bear Bay	Unknown	Unpubl. "Biol. Survey Notes" cited in Tanner 1942	
February 1914	Collier	Big Cypress near Deep Lake	F.H. Kennard	Kennard 1915, (also see Tanner 1942)	Female collected.
About 1916	Osceola	Taylor Creek	Nicholson and J. Black	Sighting report to Tanner 1942	Sighting report.
1916	Putnam	Between Welaka and Rodman	O.E. Baynard	Unpubl. "Biol. Survey Notes" cited in Tanner 1942	
May 1917-February 1919	Dade	Royal Palm Hammock	C.A. Mosier (park warden)	Safford 1919, Howell 1921 (but see Bailey 1927, Tanner 1942)	Mosier observed possible nest in 1917 in royal palm, 35 feet above ground, with 3 nestlings peering out. Birds seen 1918-1919, but with no sign of further breeding.
1917	Unknown	Near Everglades	J.B. Ellis	Ellis 1918	
1917	Levy	Suwannee Hammock	C.J. Pennock	Letter from Pennock (also see Tanner 1942)	
May 1917	Wakulla	St. Marks	J. Williams	Williams 1917	Sighting report of a male.
1920s	Osceola	Deer Park	D.J. Nicholson and W.H. Nicholson	Nicholson 1929	Pair of birds sighted.
1920	Unknown	Apalachicola River swamp	A.H. Howell	Howell 1932	
1923	Unknown	Oklawaha River swamp	B.M. Kinser	Howell 1932	

Date	County	Location	Observer	Citation	Notes
1923	Jefferson	Wacissa River swamp	A.H. Howell	Howell 1932	
April 13, 1924	Okeechobee	Taylor Creek	Mr. and Mrs. A.A. Allen and P.P. Kellogg	Allen 1924, Allen and Kellogg 1937, Tanner 1942	Pair roosting in a cypress swamp and feeding in the "great pine woods." Nesting behavior observed in live cypress tree, 30 feet above ground. Photos of birds and habitat in 1937 citation.
Ca. 1925	Levy	Suwannee Hammock	Dr. Turner	Personal communication cited in Tanner 1942	
Ca. 1926	Osceola	Wolf Creek	D.J. Nicholson	Nicholson 1926 (also see Tanner 1942)	
1926	Jefferson and Liberty/Gulf	Near the mouth of the Aucilla River; also along the Apalachicola River	J.C. Phillips	Phillips 1926 (also see Jackson 2002)	
Ca. 1930	Polk	NW of Polk City	O.E. Baynard	Tanner 1942	
Ca. 1930	Polk/Osceola	Reedy Creek	J. Goodman	Tanner 1942	
1932-34	Levy	Sim's Ridge, Gulf Hammock	T. R. Young	Tanner 1942	Letter from Young.
December 15, 1932	Jefferson	Wacissa River	C.R. Aschmeier	Tanner 1942	Letter from A.H. Howell.
Ca. 1935	Monroe	Shark River and Lostman's River	J.M. Roberts and others	Tanner 1942	
1935	Unknown	Apalachicola River swamp	Stensal and others	Tanner 1942	
1936, 1945	Escambia/Santa Rosa	Escambia River and Perdido River	Unknown	Weston 1965	Discussed second-hand report, few details.
December 1936	Orange	Jim Creek	G.E. McCulloch	Tanner 1942	
Prior to	Jefferson	Wacissa River	J.B. Royalls	Tanner 1942	

Date	County	Location	Observer	Citation	Notes
1937		in cypress swamp			
1937	Collier	Big Cypress, East Crossing	Sheriff J. Thorpe	Tanner 1942	Verbal report of ivory-billed sightings.
Late 1937	Highlands	Small swamp adjacent to Highlands Hammock State Park	O.E. Baynard	Baynard 1937, Tanner 1942	
1938	Collier	Big Cypress near East Henson	C. Billie	Tanner 1942	One bird sighted.
1950s	Liberty	Florida River, SE end of Apalachicola National Forest	Caretaker for Judge Callaway	Eastman 1958	Sighting report of a pair.
1950s	Alachua	Gainesville	Mr. Edwards (ranch manager)	Eastman 1958	Sighting report.
April 25-29 1950; February 21, 1951	Gulf/Liberty	Chipola/Apalachicola River swamps	B. Read and Mr. and Mrs. F.E. Stearns	Eastman 1958	Read heard calls of 1 or 2 pairs in 1950; Stearns sighted a pair in 1951.
March 2, 3 and 4, 1950	Calhoun	Chipola River swamp	W. Eastman, E. Rowe, F. Dye, G. Coppedge, M. Kelso	Sighting report by Eastman to USFWS (also see Eastman 1958, Dennis 1979)	Bird heard on Mar 2, sightings on Mar 3 and 4.
April 3, 1950	Calhoun	Chipola River	H.M. Stevenson and R. West	Stevenson and Anderson 1994	Sighting of one bird.
April 10 and 13, 1950	Calhoun	Chipola River swamp?	Mr. and Mrs. M. Farrar and D.H. Crompton	Crompton 1950	Sighting on 4-10 by Farrars; sighting on 4-13 by Crompton. The search occurred in response to Eastman's sighting, but specific location not given in citation.
Ca. 1950	Collier	State Highway 29 in Big	A. Cruickshank	Jackson 2004	Sighting of a single bird flying across road; reported in a letter from Robertson

Date	County	Location	Observer	Citation	Notes
		Cypress			to Jackson
1951	Calhoun	Chipola River	M. Kelso	Stevenson and Anderson 1994	Kelso reported to Stevenson that a pair nested just downstream from Scott's Ferry.
March 4, 1951	Marion	Near Silver Springs	G. Coppedge and several Native Americans	Eastman 1958	Sighting report of a pair.
April 5, 1951	Calhoun or Gulf	Chipola River	J.V. Dennis	Dennis 1967,1979	Bird heard.
October 1952; October 1953	Alachua	Gainesville	Mrs. H. Bennett and caretaker	Eastman 1958	Pair observed at their home (Tung Acres). Caretaker shot and ate one during summer 1953.
July 10, 1952	Wakulla	Near Wakulla Springs, between Wakulla Station and St. Marks	S. Grimes and R. Hallman	Eastman 1958 (also see Stevenson and Anderson 1994, Jackson 1996)	Sighting by Grimes reported by Tanner (personal communication) and cited in Eastman 1958.
1953	Alachua	Gainesville	V. Gouldsby (interview with filling station attendant)	Eastman 1958	Pair observed at close range during hunting season.
March 4, 1954	Polk/ Hillsborough county line	4 miles from Plant City	K. and W. Eastman	Eastman 1958	Sighting record of a male flying over road between Lakeland and Plant City.
April 11, 1955	Unknown	North of Chiefland?	Mr. and Mrs. J.K. Terres	Terres 1986, 1987 (also see Jackson 1989, 1996; Stevenson and Anderson 1994)	Confusing, inaccurate geographical information; subsequent citations contradictory.
June 1957	Volusia	Deland	Dr. H.R. Wilbur	Eastman 1958	Sighting report at 30 yards.
1959	Taylor	1 mile east of the Aucilla River, west of Perry	W. L. Rhein	Jackson 1996	Sighting of a female by Rhein reported to Tanner (personal communication) and cited in Jackson 1996.

Date	County	Location	Observer	Citation	Notes
April 29, 1962	Brevard	Highway A1A, 3 miles north of Indialantic	N. Ranck	Letter from Ranck 1962	Potentially reliable sighting report to U.S.F.W.S.
Late December 1963	Gulf	10 miles west of Apalachicola	J.H. Merritt	Letter from Merritt 1963	Potentially reliable sighting report to U.S.F.W.S.; flew from cut-over slash pine near Indian Pass north towards Lake Wimico.
August 28, 1966	Okaloosa	Swamp near Yellow River (Boiling Creek) at Eglin Air Force Base	B.P. Brown and J.P. Sanders	Sighting report from Brown and Sanders 1966 (also see Dennis 1979)	Sighting of 2 birds on pines, but habitat and human disturbance makes observation questionable. Reported by Dennis as a valid sighting.
Summer 1967	Polk	Green Swamp north of Haines City	D. Lee	Jackson 2004	Sighting of a female flying across the road at close range; reported in a letter from Lee to Jackson
1967-1969	Polk/ Highlands	Undisclosed location in south central Florida	H.N. Agey and G.M. Heinzmann and colleagues	Agey and Heinzmann 1971a, 1971b (also see Dennis 1979, Stevenson and Anderson 1994, Jackson 2004)	At least 11 different sightings or calls reported over a 2-year period. Controversial woodpecker cavity collected from broken tree (now in Florida Museum of Natural History); cavity contained a secondary feather later identified by Wetmore as Ivory-billed Woodpecker.
Fall 1968	Highlands	Highlands Hammock State Park	F. C. Davis	Letter from Davis 1968	Potentially reliable sighting report to U.S.F.W.S.
May 1984	Liberty/ Gulf	Lower Apalachicola River on Pig Island near Everett Slough	J. Stevenson	Letter from Stevenson 1984	Potentially reliable sighting reported in a letter to D. Pashley.
April 30, 1985	Martin	Loxahatchee River bank at Jonathan Dickinson State Park	D.G. Garratt	Letter from Garratt 1985 (also see Jackson 1996)	Sighting report of male in remnant cypress swamp.
May	Gilchrist	Suwannee	M. Rupp	Sighting	Sighting 4 times during

Date	County	Location	Observer	Citation	Notes
1995		River, adjacent to Wannee boat ramp	and E. Rupp	report from Rupp to Florida Museum of Natural History	Memorial Day weekend; potentially reliable.

4. Habitat descriptions if somehow different from the general description in the life history.

Tanner (1942) suggested that “all Ivory-bill records have been located in or very near swamps or Florida hammocks.” However, most of Tanner’s intensive field studies were done in bottomland forests and this may have influenced his perception of ideal Ivory-billed Woodpecker habitat. The salient feature of Ivory-billed Woodpecker habitat appears to be old-growth forest, including, and perhaps favoring (Jackson 1996), the ecotone between bottomlands and uplands.

Most historical Ivory-billed Woodpecker habitat in Florida can be characterized as river swamp, although stillwater swamps, particularly cypress swamps and cypress strands, were a significant component. A habitat unique to Florida was the extensive Big Cypress region that occurs on flat, poorly drained limestone topography in the southwestern part of the peninsula (Duever et al. 1986).

Potential areas to search that are consistent with the believed habitat requirements of the species.

Jackson (1996, 2004) mentioned the following areas as potential sites for Ivory-billed Woodpecker searches, some of which he searched during the 1980s and 1990s: Apalachicola and Chipola River swamps, Aucilla and Wacissa Rivers, the lower Suwannee River watershed, Wekiva River, Fort Drum Swamp, Fakahatchee Strand, and Big Cypress National Preserve. The Okefenokee / Pinhook Swamp has been identified as another potential area of Ivory-billed Woodpecker habitat (C. Hunter, USFWS, personal communication); although primarily in the state of Georgia, the southern extent of this swamp stretches into Columbia and Baker counties of northern Florida. Recent discussions amongst members of the Recovery Team have focused on the Apalachicola and Chipola swamps, the Aucilla and Wacissa Rivers, and the lower Suwannee River watershed as the three most significant areas of potential Ivory-billed Woodpecker habitat in Florida, based primarily on the extensive tracts of bottomland forest that remain there.

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GEORGIA

1. Original range in state

The original range of the Ivory-billed Woodpecker in Georgia probably was the extent of the coastal plain up to the fall line, although it is likely that some birds occasionally traveled up some of the major river systems (i.e., Savannah, Oconee, Ocmulgee, Chattahoochee, and Flint) into the Piedmont. As with other parts of its range, the bird probably was primarily associated with major river systems, including the Okefenokee Swamp in extreme southeast Georgia (Tanner 1942, Burleigh 1958, Jackson 2002).

2. Range changes over time

As the coastal plain gave way to agriculture, the species' range was restricted more and more to floodplain forests associated with the above major river systems, plus those such as the Satilla wholly contained in the coastal plain (Tanner 1942, Burleigh 1958, Jackson 2002). In addition, areas of mature pine surrounding large expanses of bottomland hardwoods were apparently used for foraging. However, it is unlikely that pine forests would be used in the absence of a core area of large bottomland forests. A possible exception is in the Red Hills region of southwest Georgia-northern Florida, which still retains large patches of mature longleaf forest, some of it virgin (Stoddard 1969).

An area that apparently retained Ivory-billed Woodpeckers well into the twentieth century is the Okefenokee Swamp, an area greater than 150,000 hectares in southeast Georgia with limited drainage by the Suwannee River toward the Gulf and by the St. Mary's River toward the Atlantic (Greene 1936, Burleigh 1958).

As large forested areas, including many bottomland forests, were cleared for agriculture, replanted for pine silviculture, or otherwise developed, the species range continued to shrink. Today the only locations that retain habitat features favorable to Ivory-billed Woodpeckers over a large enough expanse to be considered possible habitat are sections of the lower Altamaha River floodplain and the Okefenokee Swamp, although there are a couple of other areas that are probably worth searching (see below).

3. Habitat descriptions if somewhat different from life history account

Habitat in the Okefenokee Swamp might be considered somewhat unique. It features large expanses of open shallow marshes or prairies of floating leaved plants and emergents, plus bogs of sphagnum or fern. These are intermixed with (1) wooded swamps or bays supporting stands of pond cypress, water tupelo, red bay, black bay and loblolly bay, (2) hammocks supporting mixed stands of water oak, loblolly pine, magnolia and sweet-gum, and (3) barrens of moist and dry pineland, mostly containing longleaf and slash pines (Burleigh 1958).

Habitat in the Red Hills region is a mosaic of mature pine forest, agriculture, urban/suburban, and hardwood bottoms. What makes it unique are the relatively large patches of old-growth longleaf-wiregrass habitat that still exist. The overstory of these habitats is typically a well-spaced monoculture of old (>300 years) longleaf pine with an herbaceous ground cover that is very diverse. The system is

maintained by frequent fire, which also serves to control the growth of a hardwood understory. Several of these areas border large patches of bottomland hardwoods, and together they might constitute suitable habitat for Ivory-billed Woodpeckers.

4. Locations of possible encounters (since 1944)

Only a handful of encounters have been reported since 1944. Probably the most credible of these were made by the noted ornithologist/naturalist/conservationist Herbert L. Stoddard. Interestingly, Stoddard did not report these immediately, apparently for fear of disturbance of the birds.

Observer	Location	River	Date	Citation	Comments
Unknown	Okefenokee Swamp	Suwannee, St. Mary's	Unknown	Greene 1936	Reports that locals believed Ivory-billed Woodpeckers still existed in the swamp
F. V. Hebard	Okefeenokee Swamp	Suwannee, St. Mary's	1941-42, 1948	Burleigh 1958, Loftin 1991	Numerous reports not made public until later
H. L. Stoddard	S. Thomas County	None	1952	Crawford 1998	Two female Ivory-billed Woodpeckers were seen together. Follow-up investigations found nothing.
H. L. Stoddard	Not mentioned	Not mentioned	1940s-1950s	Stoddard 1969	Claims to have seen 3 Ivory-billed Woodpeckers in the southeast over the last 15 years
H. L. Stoddard	Lower Altamaha River	Altamaha	Unknown	Dennis 1979	Claims that Stoddard saw 1 Ivory-billed Woodpecker clearly from small plane
H. L. Stoddard	Thomas County	None	1958	Dennis 1979	Observed in beetle-killed spruce pine area
G. Reynard	Thomas County	None	1963	None	
C. D. Gerow	Approx. 25 miles W of Savannah	Ogeechee	1973	Jackson 2004	Jackson believed Gerow to be a competent observer

5. Potential areas to search that are consistent with the believed habitat requirements of the species.

Based on the relatively recent sightings listed above and known areas of large expanses of forested wetlands still in existence, the following are potential areas to search in Georgia: (1) the Ogeechee-Savannah River Basin, (2) the Altamaha River Basin, (3) the Okefenokee Swamp, and (4) the Red Hills Region.

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KENTUCKY

Historical Status of the Ivory-billed Woodpecker in Kentucky

Modest documentation exists on the historical locations as well as actual population densities of the Ivory-billed Woodpecker in Kentucky. The earliest record for the species is provided by Col. William Fleming in his journal, which was printed by Newton Mereness (*Travels in the America Colonies*, Macmillan, N.Y. 1916:632). In the journal Col. Fleming describes collecting one of two individuals observed in 1780, approximately 1 mile west of Logan's Fort, which is the present day city of Stanford in Lincoln County (Schorger 1949). Kentucky authors have accepted this 1780 record even though its authenticity cannot be documented (Brainard Palmer-Ball personal communication). The primary case for questioning this record is the forest habitat; which in this region of Kentucky is drastically different from most Ivory-billed Woodpecker habitat documented to date. The location would have placed the Ivory-billed Woodpecker on the foothills of the Knobs Physiographic Region; a distinctive geologic region with higher elevations reaching 1,000 feet (above msl). This formation supported pre-settlement vegetation such as: *Acer saccharum*, *Tilia*, *Aeculus octandra*, and *Liriodendron tulipifera*, *Quercus spp*, and *Castanea dentata*. (Muller and McComb 1986). Wharton (1945) further described five upland forest types: pine, oak-pine, chestnut oak-scarlet oak, white oak, and mixed mesophytic forest; all of which are primarily determined by slope aspect and/or succession (From Muller and McComb 1986).

With current documentation and the affinity of the species to inhabit bottomland forests, the Lincoln County record may appear improbable, particularly because the only additional records for Kentucky place the species within the Mississippi Embayment Region of the state. McKinley (1958) thought the Lincoln County record indicated a great deal of wandering by the species, which he further supported with Wetmore (1943) in which evidence from an archeological site in Scioto County, Ohio presumed to be from the 15th or 16th centuries, further made early sightings in southeastern Indiana (near the Ohio River) more plausible.

When viewing these records on a regional scale, it may be entirely plausible that pre-colonial populations could have extended, not only up the Ohio River, but also into other tributaries of the Ohio River. If this was in fact the case, another plausible explanation for the presence of the species at the Lincoln County site may be explained by the nearby riverine forests of the Dix River and the nearby source of the Green River, which lies in close proximity to the area mentioned. With major cultivation and land use changes not occurring until the early 1800's, both of the mentioned river systems may have provided connectivity to the Ohio River floodplain forests to the north and west of the Lincoln County site. Since no documentation exists outside the Ohio record, the pre-colonial record from Lincoln County may suggest the species could have been present in many of Kentucky's larger river bottoms.

While the early Kentucky record continues to be rather dubious, the most precise documentation providing a definitive date and reference to the original range in the state appears to be in the 1831 notes of John James Audubon, when he recorded the species at the confluence of the Mississippi and Ohio River (present day Ballard County). In these notes, Audubon only made "oblique reference" to nesting in Kentucky and Indiana (in the Wabash River system) (Mengel 1965). This record would have placed the species near present day Union County, Kentucky. Audubon also made additional reference to nesting at Green River in present day Henderson County, however it appears that the greatest population

densities of the Ivory-billed Woodpecker were found in counties adjacent to the Mississippi River which include: Fulton, Hickman, Carlisle, and Ballard counties.

Range changes over time

Due to the lack of documentation of the Ivory-billed Woodpecker in Kentucky, it is impossible to determine any range changes over time. It does appear that by the early 1800's the Ivory-billed Woodpecker had all but disappeared from the majority of Kentucky's landscape, with some residual numbers remaining until the early 1870's in Fulton county, where the last known population of the bird remained (Mengel 1965).

Potential areas to search that are consistent with the believed habitat requirements

Due to the clearing of land along the Mississippi River in the early 1800's and continual logging operations which occur on regular cycles, as well as the current habitat conditions along the Mississippi River floodplain, it appears that no areas remain in Kentucky that would be suitable for extensive searches. Unfortunately, it appears that no substantive evidence of the species occurrence has been reported since the Fulton County report in the 1870s (Palmer-Ball 2003).

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LOUISIANA

Original Range in Louisiana

Jackson (2002), Oberholser (1938) and Tanner (1942) discussed known Ivory-billed Woodpecker distribution in Louisiana prior to the 1940s which can generally be described as occurring in the bottomland forests along the Mississippi corridor from the Arkansas state line south to the coast. Specimen collections and sightings (as reported by Tanner 1942) date back to the late 1800s and in northern Louisiana came from the general area between the Mississippi River and Ouachita River, south to the area where they are joined by the Red River (Morehouse, West Carroll, East Carroll, Madison, Franklin, Tensas, and Concordia Parishes). South of that area, Ivory-billed Woodpecker specimens and sightings were reported from the bottomland forests along the Mississippi River and Atchafalaya River (West Feliciana, West Baton Rouge, Iberville, St. Martin, and Lafourche Parishes) south to the forested coastal area of Iberia Parish. McIlhenny (1941) recorded his earliest childhood memories of Ivory-billed Woodpeckers being resident in the forested areas of Avery Island and the "great forest" extending east to the Atchafalaya River.

Range Changes Over Time

Tanner (1942) noted that logging in the southern part of Louisiana began around 1905 gradually moving north. The last observation of an Ivory-billed Woodpecker in the southern part of the state was by E.A. McIlhenny in 1923 (McIlhenny 1941). Logging began to spread southward into Louisiana from Arkansas about 1910 and met the logging movement from the south in northern Louisiana where it peaked about 1925 and then declined (Tanner 1942). According to Lowery (1974) until 1932, ornithologists had come to believe that the Ivory-billed Woodpecker no longer existed. As Lowery recounts it "A comment to this effect in the offices of the Louisiana Wildlife and Fisheries Commission prompted a quick denial from Mason Spencer, a resident of Tallulah, who happened to be present. So incredulous was everyone of his assertion that Ivory-bills still lived near Tallulah that a permit was immediately issued to him to shoot one." Apparently, commissioners were certain that he would return with a pileated woodpecker. Mr. Spencer did return and with an Ivory-billed Woodpecker. As has been mentioned elsewhere in the plan, the Ivory-billed Woodpeckers of the Singer Tract in northern Louisiana were the last known United States population to be studied [Allen and Kellogg (1937) and Tanner (1942)].

Locations of Possible Encounters Since 1941:

There have been at least 10 reported possible sightings of the Ivory-billed Woodpecker in Louisiana since August of 1941.

- 1941 In August, three Ivory-billed Woodpeckers were seen in John's Bayou area of the Singer Tract, LA, by George Bick and Jim Parker, including an apparent female hatch-year young (Bick 1942; J. Tanner pers. comm., Oct 1989, an update and annotation of Tanner 1942).
- 1941 On 21 and 28 of December, Tanner found an adult and juvenile female in a highly cutover area of the Singer Tract.

- 1942 Roger T. Peterson and Bayard Christy observed two females in the same area May 9 (Christy 1943, Peterson 1948, J. Tanner update pers. comm.).
- 1942 In November of 1942, John Baker found a single female in the Singer Tract (Peterson 1948).
- 1943–1944 Richard Pough of National Audubon Society found a single female in the Singer Tract between 4 Dec 1943 and 19 Jan 1944 (Pough 1944).
- 1944 In April of 1944, Don Eckelberry saw and sketched a female in the Singer Tract (Eckelberry 1961; watercolor painting in collection of J. A. Jackson and reproduced in Jackson 2002).
- 1946 A possible sighting occurred in December of 1946. A single Ivory-billed Woodpecker may have remained in the Singer Tract (Peterson 1988), although there is apparently neither identification of the observer nor further record of this report.
- 1971 On 22 of May 1971, an unidentified dog trainer photographed a pair of Ivory-billed Woodpeckers on separate tree trunks in second-growth forest in the Atchafalaya Basin, Louisiana. The photos were given to George Lowery at Louisiana State University (LSU), who followed up with searches in the area. He found no conclusive evidence of Ivory-bills. Jackson has examined the photos and concurred with Gauthreaux (1971: 827) and Stewart (1971: 868) that they are clearly of one or two Ivory-billed Woodpeckers. However, the photos were shown to ornithologists at the 1971 American Ornithological Union meeting at LSU and met with skepticism, the suggestion being that they might be of a mounted specimen.
- 1974 November 11, 1974, Robert Bean reported seeing an Ivory-billed Woodpecker from a distance of about 5 m as it flew across Interstate 10 in the Atchafalaya Swamp about 32 km west of Baton Rouge, LA (Dennis 1979). This is near where Robert Hamilton thought he had seen one 2 years earlier (Hamilton 1975).
- 1999 David Kulivan reported seeing two Ivory-billed Woodpeckers in the Pearl River Swamp of southeast Louisiana April 1 (Williams 2001, Jackson 2002).

Potential areas to search that are consistent with the believed habitat requirements

Search efforts in Louisiana should be focused in the following areas (Figure 1).

The Atchafalaya River Basin with primary emphasis on Attakapas Island WMA and state property owned by the Office of State Lands in the central and southern portions of the Atchafalaya River basin and private land holdings near Bayou Sorrel. The Pearl River Basin with emphasis on the Pearl River WMA and the Tensas River Basin with emphasis on Tensas River National Wildlife Refuge and Big Lake WMA.

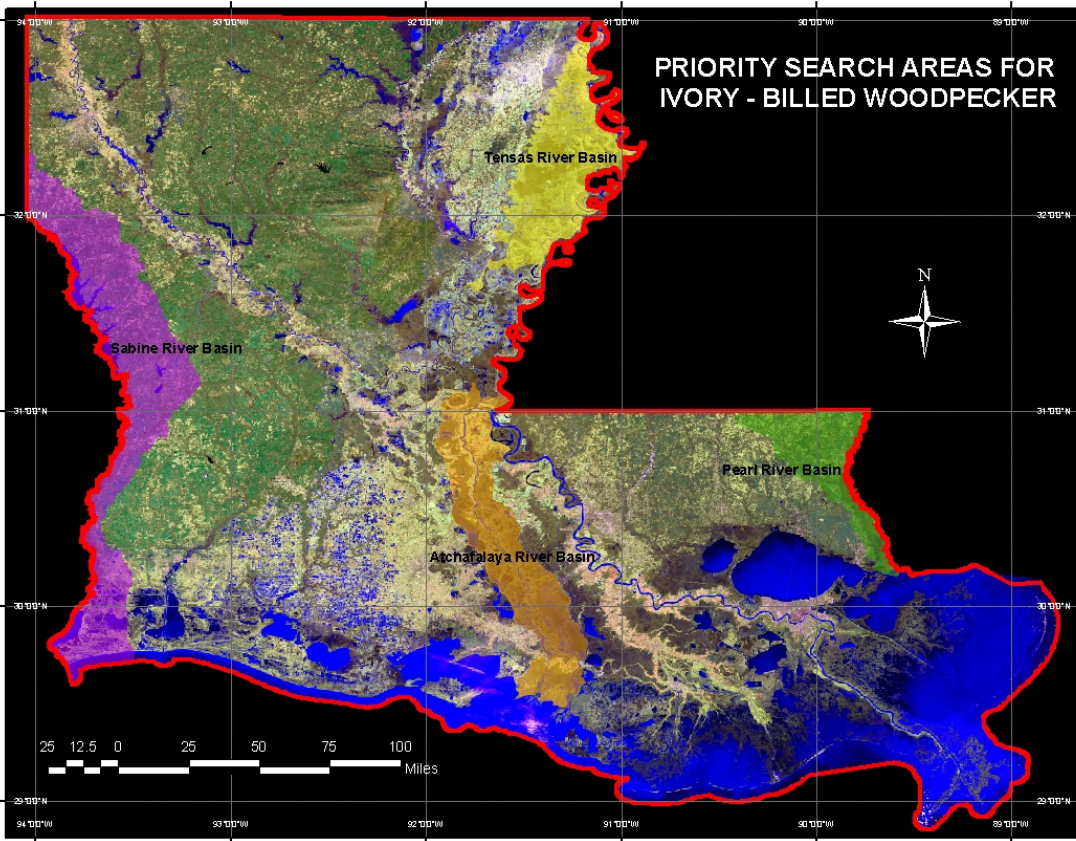


Figure 2. Suggested Ivory-billed Woodpecker search areas in Louisiana based upon historical observations.

Other potential areas outside of these major bottomland hardwood drainages within the state include the lower Sabine River Basin in the south-western part of the state as well as the Mississippi and Red River convergence areas in the east-central part of the state.

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MISSISSIPPI

Table 1. Reports of Ivory-billed Woodpecker encounters in Mississippi as reported by various sources.

Observer	Location	River	Date	Citation	Comments
G. V. Young	Monroe County	Tombigbee	1885	Hasbrouck 1891	Also frequently seen in “flat woods beyond Houston.”
M. Thompson	Bay St. Louis	Unknown	1885	Thompson 1889	Thompson “killed a fine male specimen...but was prevented, by an accident, from preserving it...”
F. G. Dabhey	Unknown	Sunflower	ca. 1888	Coahoma [F. G. Dabhey] 1888	
R. Young	Unknown	Yazoo	1890	Hasbrouck 1891	R. Young of Corinth stated Ivory-billed Woodpecker could still be found in the Yazoo basin.
R. Young	Unknown	Mississippi	1890	Hasbrouck 1891	

G. V. Young	Unknown	Mississippi	ca. 1890	Hasbrouck 1891	Has seen “quite a number recently in the Mississippi bottom.”
G. V. Young	Clay County	Tibbee/Tombigbee	ca. 1890	Hasbrouck 1891	Formerly common, but rare as of 1890.
C. Scott (collector)?	Bolivar County	Unknown	1893	Hahn 1963, Jackson 1988	Male specimen, Academy of Natural Sciences of Philadelphia, PA.
C. Scott (collector)?	Bolivar County	Unknown	1893	Hahn 1963, Jackson 1988	Female specimen, catalogue # 6104, Los Angeles County Museum, Los Angeles, CA.
Unknown	Unknown	Unknown	1893	Hahn 1963, Jackson 1988	Male specimen, catalogue # F349, Royal Ontario Museum, Toronto.
H. W. Davis (collector)?	Unknown	Unknown	1893	Hahn 1963, Jackson 1988	Male specimen, catalogue # 4883, Los Angeles County Museum, Los Angeles, CA.

Observer	Location	River	Date	Citation	Comments
C. K. Worthen	Near Mississippi City, Harrison County	Unknown	1893	Hahn 1963, Jackson 1988	Female specimen, American Museum of Natural History, New York, NY.
Unknown	Near Mississippi City, Harrison County	Unknown	1893	Hahn 1963, Jackson 1988	Male specimen, catalogue # 8528, Peabody Museum of Natural History, Yale University, New Haven, CT.
M. G. Vaiden	Unknown	Big Black	1908	Jackson 2004	Vaiden reported in a letter to James Bond, curator of the Academy of Natural Sciences of Philadelphia, one pair in the Big Black River swamps.
J. D. Corrington	Near Vancleave	Pascagoula	1921	Corrington 1922	Two sightings. Calls of a distant bird were believed to be an Ivory-billed Woodpecker.
M. G. Vaiden	Nine miles south of Rosedale, Allan Grey Estate (Woods), Bolivar Co.	Mississippi, in the Delta on the dry side of the levees	1939	Jackson 1988, M. Bonta, pers. comm.	Vaiden reported in a letter to James Bond, curator of the Academy of Natural Sciences of Philadelphia, six pairs present until World War II when the area was logged for the war effort.
B. Chauncey	About 30 miles north of Meridian	Unknown	1953	Moore 1954	“in a very isolated region”
J. H. Merritt	East side of Pearl River, near Picayune	Pearl	1955	USFWS Files	Saw male Ivory-billed Woodpecker foraging on sweet-gum. Flew off with “loud tinny tootle.”

J. H. Merritt and E. Ivey	Perry County, one mile	Leaf	1960	USFWS Files	Heard report of Ivory-billed Woodpeckers there; went and saw
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Observer	Location	River	Date	Citation	Comments
	north of US Hwy. 98				two. "Loud toots heard for some time after birds out of sight."
J. W. Robinson	Hwy. 12 between McCool and Ethel	Big Black River	1974	USFWS Files	Flew from Big Black River bottoms headed toward Yockanookany River swamp.
J. W. Robinson	West Holmes County, near Coxburg		1976	USFWS Files	
R. Sauey and C. Luthin		Near where Black Creek joins Pascagoula River	1978	Jackson 1988, Jackson 2004	While floating down Black Creek, they heard a bird that "sounded every bit like the historic Ivory-bill recording of Allen and Kellogg."
M. Morris	West side of Pascagoula River, south of Wade-Vancleave Road and east of Old River Road. North of Vancleave	Pascagoula	1982	Jackson 1988, Jackson 2004	Heard and saw two birds in a pine. Sounded like geese "honking" and saw crests pointing forward, white edge on back of perched birds and white trailing edge of wings as they flew away.
J. A. Jackson and M. Hodges	North of Vicksburg	Near where Yazoo River joins Mississippi River	1987	Jackson 1988, Jackson 2004	Heard a bird that possibly responded to a taped Ivory-billed call.
W. E. Davis and F. Sibley	North of Vicksburg	Near where Yazoo River joins Mississippi River	1988	Jackson 2004	Briefly heard a bird near where Jackson and Hodges heard one the previous year.
C. T. Bryson	Northeast of Greenwood	Headwaters of Yazoo River near	1988	Jackson 2004	Saw a large black and white woodpecker that did not sound like a

Observer	Location	River	Date	Citation	Comments
		bottomlands of Yalobusha River			Pileated. Heard a “rhythmic toot, toot, toot.”
M. Collins	Near Stennis Space Center	Pearl	2000, 2005, 2006	http://www.fishcrow.com/winter06.html	Website includes extensive text, video, and some photos purporting to be Ivory-billed Woodpecker

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NORTH CAROLINA

Original range in state

There have been no recent reliable or confirmed sightings of Ivory-billed Woodpeckers in North Carolina. The one definitive record, from Alexander Wilson, was from the Wilmington area around 1831.

Potential areas to search that are consistent with the believed habitat requirements

The primary river systems in this southeastern corner of North Carolina, which might eventually support Ivory-billed Woodpeckers, are the Waccamaw, and the Lumber Rivers. The Lumber River flows into the Little Pee Dee River in South Carolina approximately nine miles south the state line. In North Carolina, the Lumber River drainage contains about 85 square miles of potential habitat. This includes the bottomland hardwood system and some associated uplands. The Waccamaw River system is about 30 miles to the southeast of the Lumber River, and contains about 45 square miles of potential habitat. Lastly, the Cape Fear River system has some potential as well, and it includes the Northeast Cape Fear River and the Black River that join the Cape Fear near Wilmington. This group of rivers has about 60 square miles of potential habitat, and is about 20 miles northeast of the Waccamaw River.

Although logging continues, it has subsided so that much of the river bottom systems in this area have grown into the 60-80 year age classes. Probably because of the relative difficulty in harvesting water tupelo and bald cypress stands, some of these have grown to even older ages, and individual cypress trees that can be found with several hundred years of age.

SOUTH CAROLINA

Original range in state

The original range of Ivory-billed Woodpecker in South Carolina was the extent of the coastal plain bordered to the north by the fall line and extending to the Atlantic coast. This area was comprised of bottomland hardwood riverine systems surrounded by long-leaf pine uplands intermixed with farms and plantations. Rice, indigo and cotton were the primary agricultural crops. The state of South Carolina was extensively logged after three significant historical events, the Civil War, Chicago fire and World War II. Tanner (1942) reported Ivory-billed Woodpecker suitable range was decreasing due to logging operations in the Santee River swamp occurring around 1939.

Three major river drainages occur within South Carolina and make up the majority of bottomland hardwood habitat type found. The Congaree and Wateree Rivers converge into the Santee River in the center of the state and the Santee River flows south to the Atlantic Ocean. The Savannah River delineates the border between Georgia and South Carolina, and flows north-south emptying into the Atlantic Ocean at Savannah Georgia. Northeastern coastal South Carolina includes the major drainages and tributaries of the Waccamaw, Lynches, Black, Great Pee Dee, Little Pee Dee, and Lumber Rivers (here referred to as the Waccamaw Complex).

Range changes over time

Sprunt and Chamberlain (1949) suggest that Ivory-billed Woodpecker was formerly common over much of the eastern part of the state but its virtual extinction is due to the encroachment of civilization. Bottomland hardwood habitat is still present along the Congaree-Wateree-Upper Santee Rivers, Savannah River, and Waccamaw Complex.

The Congaree-Wateree-Upper Santee River Focus Area (220,000 acres) represents the largest, intact expanse of bottomland riverine system remaining within the state. Portions of this area received extensive logging around 1900, while others did not due to poor accessibility and intermittent flooding. Timber prices soared in 1969 and some private landowners resumed logging operations, however some areas were not cut and large, mature cypress and tupelo trees characterize the current habitat. Hurricane Hugo swept across the state in September 1989, leaving a large number of dead and dying trees still present today in this area. The lower Santee River is separated from the upper portions by Lake Marion and Moultrie (156,000 acres) created in 1940 by the Santee Cooper Hydroelectric and Navigation Project, and a number of Tanner's (1942) recorded sightings were located in the area that is now flooded.

The Savannah River and Waccamaw Complex are predominately in private ownership and some of the only remaining mature bottomlands occur on easements and public lands; the exception being large plantations along the Savannah River. The Savannah River swamp system has been impacted to varying degrees by timber harvest since colonial times, with cypress timber being important in the region as early the 1730s (White 2004). As elsewhere, capacity to cut increased dramatically in the 1840s and 50s with the construction of larger, steam-powered sawmills. In the mid 1850s, >2000 ac per year of old growth longleaf pine and bottomland hardwood were probably harvested. Until around 1900, timber

harvest was mostly restricted to areas within one mile of navigable waterways. Logging railways entered the central Savannah River area in the early 1900s and began harvesting the remaining uncut swamp forest but major activities there may not have begun until the late 1920s. Indications are that 6400 ac of the 9400-ac Savannah River swamp on the DOE's Savannah River Site (SRS) in Aiken and Barnwell counties had been disturbed prior to 1950 and some of this harvest most likely included some second growth. Since that time, a few large tracts of bottomland forest (6000-10000 ac) have been protected (e.g., SRS, Webb Wildlife Center, Savannah National Wildlife Refuge, and some private tracts) but some harvest has continued.

Locations of possible encounters (since 1944)

A number of Ivory-billed Woodpecker encounters in South Carolina have been recorded (Table 1). The majority of historical sightings were around the lower Santee River, but a few sightings were also recorded along the Savannah, Pee Dee, and Coosawhatchie Rivers (Figure 1).

The SC Ivory-billed Woodpecker Working Group has compiled a number of possible encounters that do not have independent confirmation. All encounters fall within one of the four major bottomland hardwood river systems within the state; however the majority is from the Upper Santee/Congaree/Wateree Rivers, specifically within Congaree National Park. A number of these encounters have been submitted to the Cornell database. A number of reports have not been published as individuals were contacted and do not wish to submit a formal sighting report for a variety of reasons. A number of these sightings were made prior to the rediscovery in April 2005.

Table 1. Reports of Ivory-billed Woodpecker encounters in South Carolina as reported by various sources.

Observer	Location	River	Date	Citation	Comments
A. Wilson	Between Augusta and Savannah	Savannah River	About 1800	Tanner 1942	Frequently observed
Burnett	Near St. Stephens	Santee River	1854	Tanner 1942	Pine barrens
W. Hoxie	Hunting Island, Beaufort County	Coosawhatchie River system	1870	Tanner 1942	
R. C. Murphy	Cheraw	Pee Dee River	1876	Tanner 1942	
W. Hoxie	Johnson's, Pritchard's, Eddings Islands	Coosawhatchie River system	1880 and before	Tanner 1942	Near Hunting Island
Dr. C. Kollock	Cheraw (near)	Pee Dee River	1889	Tanner 1942	

Observer	Location	River	Date	Citation	Comments
T.M. Ashe	Barnwell County	Savannah River	1898	Tanner 1942	
Unknown	North of Charleston		Unknown	Tanner 1942	Cypress swamp
G.N. Bailie	Allendale County	Savannah River	1907	Tanner 1942	
S. Platt	Georgetown County	Santee River	1925 (about)	Tanner 1942	Near St. Stephens
W.M. Ridgill	Clarendon County, Black Oak Island	Santee River	1930	Tanner 1942	Near St. Stephens
G. Melamphy	Berkley County	Santee River	1930	Tanner 1942	Near Georgetown sites, also cited in Jackson 2004
L. Walsh and A. Sprunt	Georgetown County	Santee River	1935	Tanner 1942	Verified Melamphy report; Wadmacaun Island
H. Shokes	Georgetown County	Santee River	1935-37	Tanner 1942	
Unknown		Santee River	1959-1967	USFWS Files	Downstream of Lake Marion
J. Dennis	Congaree NP	Congaree River	1964	Dennis 1966	Reported to Dennis, pair of birds, near mouth of Cedar Creek
J. Dennis	Congaree NP	Congaree River	1965	Dennis 1966	Reported to Dennis, one bird flying, two miles upstream from mouth of Cedar Creek
J. Dennis	Congaree NP	Congaree River	1966	Dennis 1966	Possible fly over
T. Dabbs	Sumter County	Black River	1969-1970	Jackson 2004	Eastern portion of the county, heard call and observed one bird.
R. Manns	Congaree NP	Congaree River	1971	Jackson 2004	Published in Time Magazine, 1971, "Signal for Wild"
Unknown	Unknown	Black River	1981	Jackson 2004	
Short and Doyle	Unknown	Waccamaw River	Unknown	Jackson 2004	Lower portion of the river
Unknown		Congaree River	1984	USFWS Files	

Habitat descriptions if somehow different from the general description in the life history account.

Habitat not believed to be different from general description.

Potential areas to search that are consistent with the believed habitat requirements

Search efforts in South Carolina should be focused in the following areas: Congaree-Wateree-Upper Santee River region, lower Santee River, Savannah River, and the Waccamaw Complex (a region in northeastern coastal South Carolina that includes the major drainages and tributaries of the Waccamaw, Lynches, Black, Great Pee Dee, Little Pee Dee, and Lumber Rivers) ([Figure 1](#)).

- The Congaree-Wateree-Upper Santee region encompasses private, public and NGO ownerships including Congaree National Park and SC DNR Heritage Preserves (Congaree Creek and Congaree Bluff). The upper portion of this river complex is in the Congaree-Wateree-Upper Santee River Focus Area of the Atlantic Coast Joint Venture.
- The lower Santee River encompasses the Francis Marion National Forest, Santee Coastal Reserve, Santee-Cooper company lands, Santee National Wildlife Refuge, and Wee Tee State Forest. This area is in the Santee Cooper Lakes and Santee River Focus Area.
- The Savannah River area encompasses the following ownerships: Savannah River Site (U. S. Department of Energy), The Webb Wildlife Center (S.C. DNR), Paluahucola Wildlife Management Area (U.S. Army Corps of Engineers), Savannah National Wildlife Refuge, and numerous private plantations. These areas are located in the South Lowcountry Focus Area.
- The Waccamaw River complex encompasses the Great Pee Dee –Lynches River, Little Pee Dee-Lumber River, Upper Waccamaw River, Winyah Bay Focus Areas and Black River. Ownership includes numerous SC DNR Heritage Preserves (Waccamaw River, Lewis Ocean Bay, Little Pee Dee River, Cartwheel Bay), Lee State Natural Area, and numerous forest industry and non-industrial forest landowners.
- Other potential areas outside of these major bottomland hardwood drainages within the state include: Coosawhatchie River and the Francis Beidler Forest (Four Holes Swamp region).

Areas to be searched were determined from historical observations of Ivory-billed Woodpecker in South Carolina as reported by Tanner (1942), Jackson (2004), and the South Carolina Ivory-billed Woodpecker Working Group (2005a, 2005b). These areas are generally the same and coincide with areas identified by Hunter and Holzman (2005).

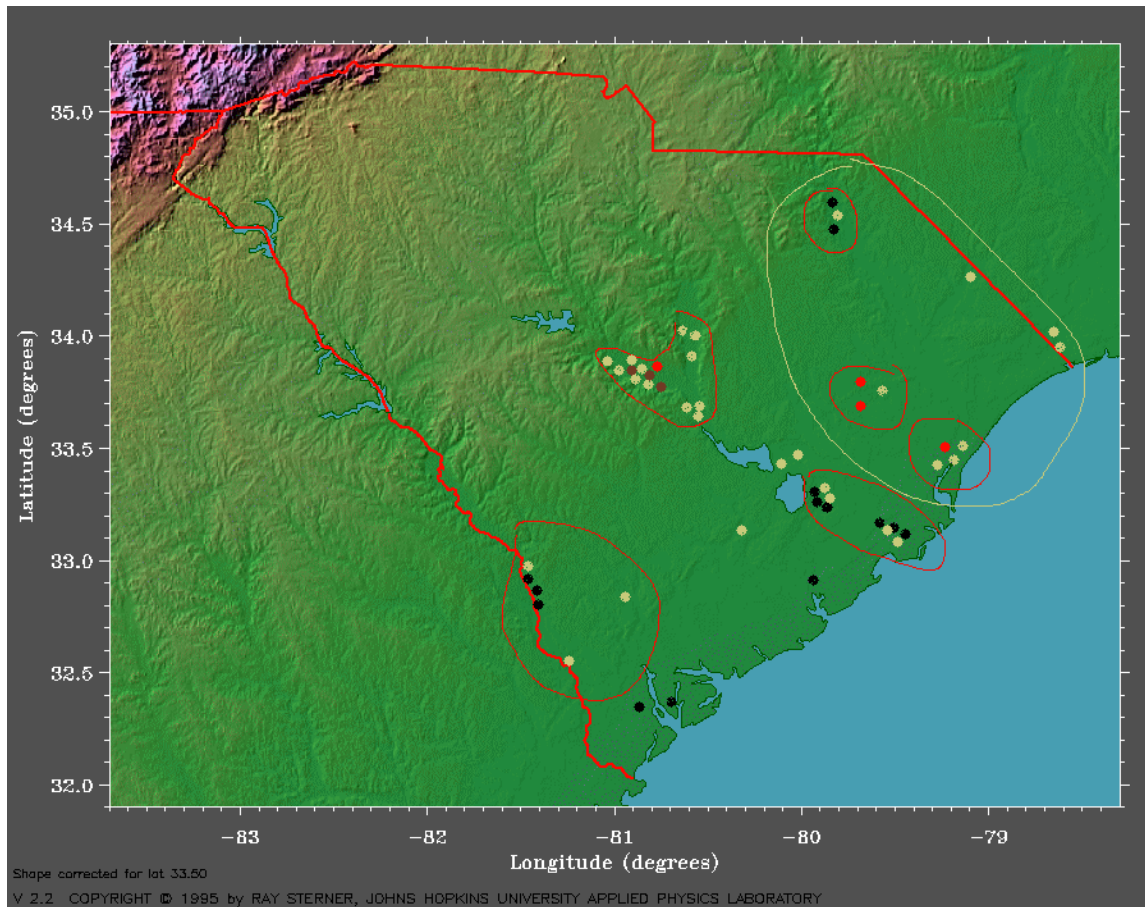


Figure 1. Suggested Ivory-billed Woodpecker search areas in South Carolina based upon historical and current observations (Tanner 1942, Dennis 1966, Jackson 2004, and South Carolina Ivory-billed Woodpecker Working Group 2005). (Tanner 1942 black; Jackson 2004 red; Dennis 1966 purple; SC Ivory-billed Woodpecker 2005 yellow).

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TENNESSEE

Original range in state

There are no reliable reports of wild birds ever being observed in Tennessee. Audubon reported observing ivory-bills from a flatboat while traveling down the Mississippi during the winter of 1820-1821. He reported ivory-bills from the stretch of the river bordering TN, but does not state which side of the river they were on. Remains of ivory-bills have also been found in a few archaeological sites in TN; as native Americans traded them widely, we can't assume they originated in TN.

Potential areas to search that are consistent with the believed habitat requirements

No areas of potential habitat have been designated to date...[but should incorporate recent encounters and insights from Bob Ford – KVR]

TEXAS

See Shackelford (1998) for a compilation and locations of all published accounts of the Ivory-billed Woodpecker in Texas.

Literature Cited

Shackelford, C. E. 1998. A compilation of published records of the Ivory-billed Woodpecker in Texas: voucher specimens versus sight records. *Bulletin of the Texas Ornithological Society* 31(2):34-4.

Appendix E. Ivory-billed Woodpecker Habitat Inventory and Assessment: Public Lands in the Big Woods of Arkansas

**Randy Wilson, Kenny Ribbeck, Jeff Denman, Eric Johnson, and Martin Blaney
with statistical assistance from Ken Reinecke**

INTRODUCTION: In 1942 James Tanner provided the most comprehensive life history account of the Ivory-billed Woodpecker (Ivory-billed Woodpecker) throughout its historic range and the only in-depth, ecological investigation conducted on a population of Ivory-billed Woodpecker. Tanner's observations of the Singer Tract population of Ivory-billed Woodpecker led him to hypothesize that foraging habitat was the limiting factor of habitat occupancy and possibly of population growth. Tanner went on to describe foraging habitat as recently dead trees (<4 years) with 84% of the foraging observations occurring on trees 12-36 inches in diameter. Unfortunately, this is the only published work detailing habitat characteristics associated with the occupancy of Ivory-billed Woodpecker.

Since Tanner's publication, there have been numerous reports of Ivory-billed Woodpecker sightings across the southeast, but none have had the benefit of being confirmed by a series of "re-sightings" or by locating a "base-activity" site (i.e., roost or nest site). The confirmed rediscovery of the Ivory-billed Woodpecker in the Cache/Lower White River basin of Arkansas has set in motion a series of conservation actions. Key among these activities is the continued search effort led by Cornell Lab of Ornithology. As Cornell staff continue to search and document evidence (e.g., sightings and sound recordings), it is imperative that a concurrent habitat inventory and assessment be conducted to facilitate the search efforts, document existing habitat conditions, and to provide land managers with information to facilitate future management decisions.

To accomplish this habitat inventory, the U.S. Fish and Wildlife Service utilized existing infrastructure (e.g. Forest Resource Working Group) within the Lower Mississippi Valley Joint Venture partnership to design, implement, collect, and analyze habitat data within the Cache/Lower White River basin. By utilizing this existing partnership, the U.S. Fish and Wildlife Service and Arkansas Game and Fish Commission were able to lead a multi-agency team representing staff from several National Wildlife Refuges and the Service's Migratory Bird Program, the Arkansas Forestry Commission, Arkansas Game and Fish Commission, Louisiana Department of Wildlife and Fisheries, and the U.S. Geological Survey to complete the habitat inventory.

OBJECTIVES: The purpose of this inventory was to quantify current habitat conditions on public lands within proximity to recent Ivory-billed Woodpecker sightings, audio recordings, and areas perceived to likely harbor Ivory-billed Woodpecker, based on local land manager knowledge. These data will be used to: (1) develop a spatially-explicit decision support model to facilitate search efforts; (2) provide ground-truth data to enhance accuracy of remotely-sensed data; and (3) provide land managers with a basis for making future management decisions. Furthermore, it is hoped that these data will also facilitate and enhance our understanding of Ivory-billed Woodpecker habitat relationships.

STUDY AREAS: The areas inventoried included public lands in proximity to previous sightings and audio recordings in the Big Woods area of eastern Arkansas; which included the Bayou de View area of Cache River National Wildlife Refuge, Jacks Bay and Prairie Lake area of White River National Wildlife Refuge and portions of Dagmar Wildlife Management Area. In addition to these primary locations, additional areas perceived to be "suitable" Ivory-billed Woodpecker habitat were inventoried based on local land manager's knowledge of the existing forest conditions. These locations included:

other areas on White River National Wildlife Refuge and Cache River National Wildlife Refuge, Bayou Meto Wildlife Management Area, Wattensaw Wildlife Management Area, Rex Hancock/Black Swamp Wildlife Management Area, and Henry Gray/Hurricane Wildlife Management Area.

SAMPLING FRAMEWORK: This habitat inventory was conducted in bottomland hardwood forest (excluding reforestation and bodies of water; e.g., oxbow lakes) within the boundaries of the individual Wildlife Management Areas and National Wildlife Refuges previously identified. Within these public lands, the inventory focused primarily on areas with evidence of Ivory-billed Woodpecker existence (e.g., sightings and or auditory recordings): Bayou de View area of Cache River NWR, Jack's Bay and Prairie Lakes region of White River NWR, and a large portion Dagmar WMA. Additional areas were also assessed in a preemptive manner to facilitate search efforts to locate the bird(s).

Due to the large acreage of interest, the inventory was sample-based. That is, sampling effort was allocated and conducted in such a manner to reduce the amount of time, manpower cost, and potential disturbance, all the while maintaining a level of statistical precision in the data. To accomplish this, individual management compartments within the area of interest were broken down into homogenous forest stands approximately 500 acres in size (Fig. 1). Each management compartment and stand was digitized to create a GIS shapefile for use in the allocation process, as well as, in analysis of the data.

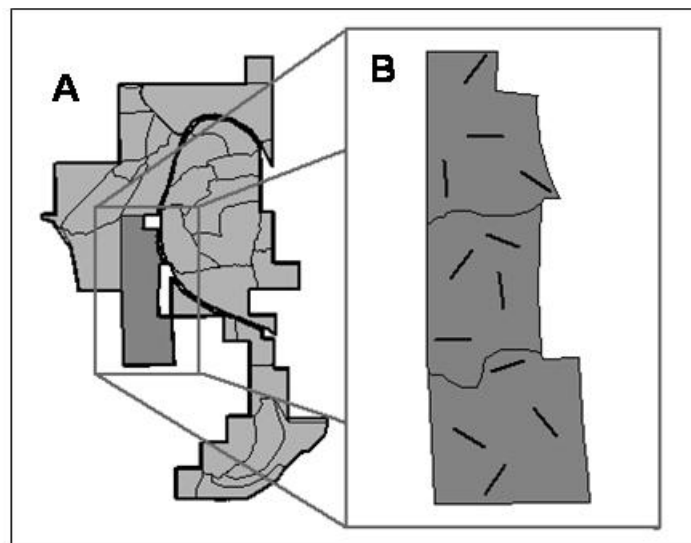


Figure 1. Schematic demonstrating: (A) the delineation of management compartments within a management area; and (B) the delineation and allocation of sampling units within stands across a management compartment.

SAMPLE SIZE DETERMINATION: As with any sampling effort, there are trade-offs in terms of cost (e.g., number of samples and manpower) and the reliability of the data. That is, collect too few samples and the data lack statistical power to provide precise parameter estimates. Whereas, on the other extreme, there is a point where no additional precision can be obtained regardless of the number of samples taken. One means of assessing these trade-offs is to examine pilot data collected from the area of interest to generate summary statistics that provide insight into distributional properties of the data. In particular, the coefficient of variation (CV) is the population quantity on which sample size depends

when one desires to control the relative precision of the data (Thompson 1992; Sampling. John Wiley and Sons Inc. 343pp).

To facilitate the determination of sample size requirements for conducting habitat inventories for Ivory-billed Woodpeckers (e.g., the density of large diameter trees ≥ 24 inches); density of dead/dying trees), pilot data from White River NWR was subjected to sensitivity analyses to assess precision (i.e., stability of coefficient of variation values) under different sample sizes. To accomplish this, we subjected the pilot data ($n=15$ clusters of 5, $1/5^{\text{th}}$ acre plots) to simulation models that randomly selected clusters of points at varying sample sizes and generated summary statistics for the parameter of interest (e.g., density of trees ≥ 24 inches in diameter at breast height [dbh]). In these simulations, CV values were calculated for sample sizes of 2, 3, 4, 5, 6, 8, and 10 clusters by randomly selecting clusters and then replicating the procedure 10 times. Simulations resulted in the calculation of 10 CV values for each sample size (Fig. 2). The simulations revealed great variation in precision estimates (e.g., CV values) for sample sizes of 3; whereas sample sizes ≥ 6 demonstrated little variation in the precision estimates (Fig. 2). Precision estimates calculated for sample sizes of 4 and 5 clusters were similar in the amount of variation expressed in the replicates and also produced acceptable levels of precision (i.e., none exceeded 15%).

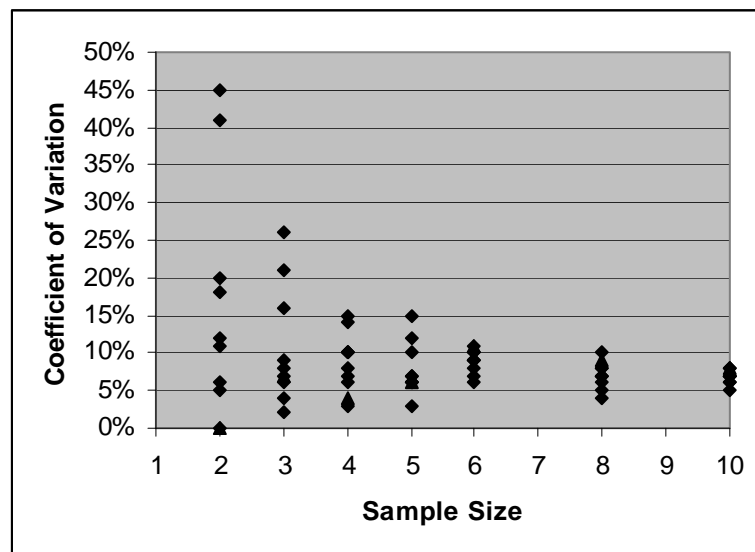


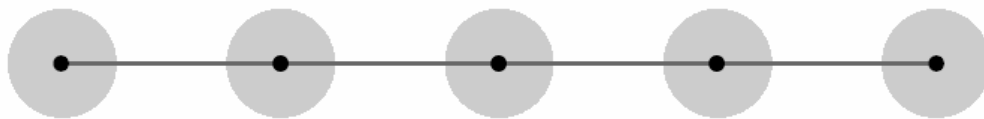
Figure 2. Sensitivity analysis to assess implications of sample size (e.g., number of clusters) on the coefficient of variation for density of large trees (≥ 24 inches dbh) based on pilot data from White River NWR.

Given the current funding constraints, availability of manpower, the large area of interest in the Big Woods of Arkansas (Cache River NWR, White River NWR, and Dagmar WMA) and the desire to maintain an acceptable level of precision (i.e., low CV values) in parameter estimates, a sample size of 4 clusters per sampling unit (e.g., stand) appeared to be the best option. That is, sample sizes of 3 clusters were not sufficient to consistently produce a high level of precision. Whereas, sample sizes ≥ 4 clusters produced precise parameter estimates with sample sizes ≥ 6 clusters being very precise in the parameter estimates. Due to the constraints described above, it seems reasonable to opt for a sample size of 4 or 5 clusters given that both continuously produced acceptable levels of precision (e.g., $CV \leq 15\%$). A

closer examination of CV values for these two sample sizes reveals nearly identical CV values produced during simulation analyses, suggesting that a sample size of four clusters is sufficient to maintain the desired level of precision in parameter estimates.

ALLOCATION OF SAMPLES: From the sensitivity analyses of pilot data, it was determined that cluster sampling yielded equivalent or higher levels of precision in parameter estimates than a simple random sampling scheme. Thus, we allocated samples within a stand using cluster-sampling procedures. For example, plots were allocated using point-transects where each transect contains five, 1/5th acre plots (52.7 ft radius) spaced four chains (264 ft) apart (Fig. 3) and each stand contains four randomly allocated point-transects (Fig. 1B). Additionally, the use of cluster sampling reduced the amount of travel time required to move from point to point, thus increasing the overall cost efficiency of the inventory.

Figure 3.



Schematic of a point-transect depicting a cluster of five, 1/5th acre plots spaced four chains (264 ft) apart upon which habitat metrics were sampled.

PARAMETERS COLLECTED: Based on data provided in Tanner (1942) and discussions with Martjan Lammertink, (Cornell Lab of Ornithology Post-Doctorate Student) whom is leading the Cornell search efforts in Arkansas, it is currently assumed that site-scale Ivory-billed Woodpecker habitat occupancy is influenced by the density of large diameter trees (≥ 24 inches dbh) and the density of recently dead/dying or severely stressed trees. To inventory and assess habitat in the areas of interest (e.g., sightings and/or sound recordings) and other areas perceived to meet these criteria (as noted by local land managers) we collected data on a variety of forest metrics that address forest structure, composition, and health. It is believed that these metrics would provide both a quantitative estimate of parameters of interest, as well as, additional qualitative estimates that would facilitate the characterization of Ivory-billed Woodpecker habitat, based on our limited knowledge. Furthermore, these data were also expected to provide additional benefits in terms of assessing habitat quality for other priority wildlife species (e.g., Swainson's Warbler, black bears, etc..).

SUMMARY OF RESULTS: During the months of September and October, 2005, foresters and biologists spent greater than 1,200 man-hours inventorying over 100,000 acres of potential Ivory-billed Woodpecker habitat (Table 1). Data gathered in the field was sent to the Lower Mississippi Valley Joint Venture Office for entry and analysis. Summary statistics were generated for parameters of interest by forest stand and cross-walked with a Geographic Information System to produce spatially-explicit maps depicting stand conditions. Additionally, these forest stand maps were used in over-layer models to develop preliminary decision support models to facilitate search efforts in the Big Woods area. Currently, plans are being developed to inventory the remaining bottomland forests stands during the summer of 2006. Specifically, the remaining portion of White River NWR, additional acreage on Cache River NWR, Dagmar WMA and other parcels of public land in proximity to Ivory-billed Woodpecker sightings and/or sound recordings will be inventoried.

Table 1. Location, number of forest stands and acreage inventoried in the Big Woods of Arkansas, September-October 2005.

Location	Number of Stands	Total Acreage*
Cache River NWR – Bayou de View	14	7,547
White River NWR – Jacks Bay/Prairie Lakes	113	83,182
Dagmar WMA	8	3,499
Rex Hancock/Black Swamp WMA	1	389
Henry Gray/Hurricane Lake WMA	4	2,091
Trusten Holder WMA	1	512
Wattensaw WMA	3	843
Bayou Meto WMA	5	2,540
Total	149	100,603

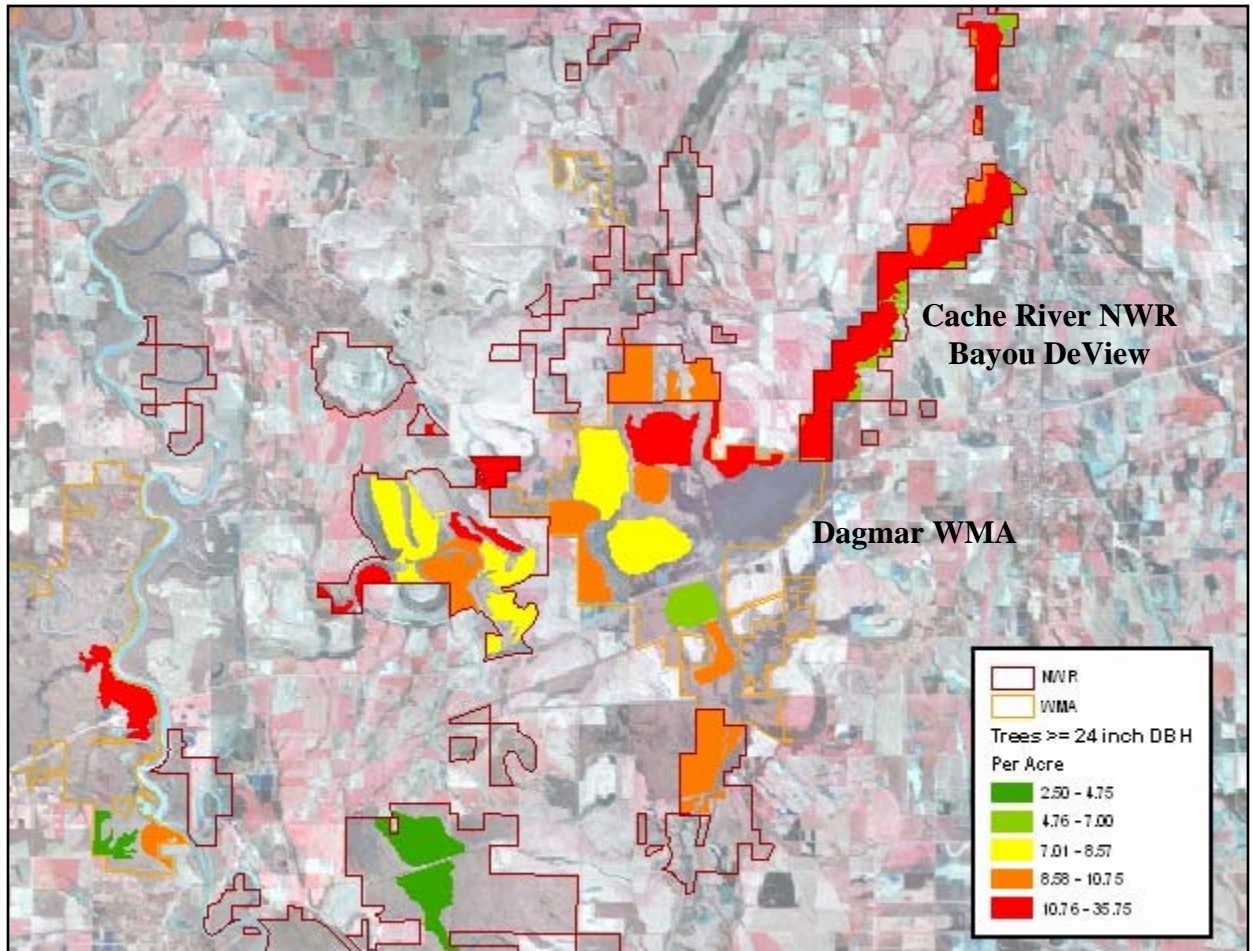
* Represents total acreage within forest stands including bodies of water that were not inventoried.

Appendix 1. Parameters and definitions of metrics collected during the habitat inventory and assessment project in the Big Woods of Arkansas, September-October 2005.

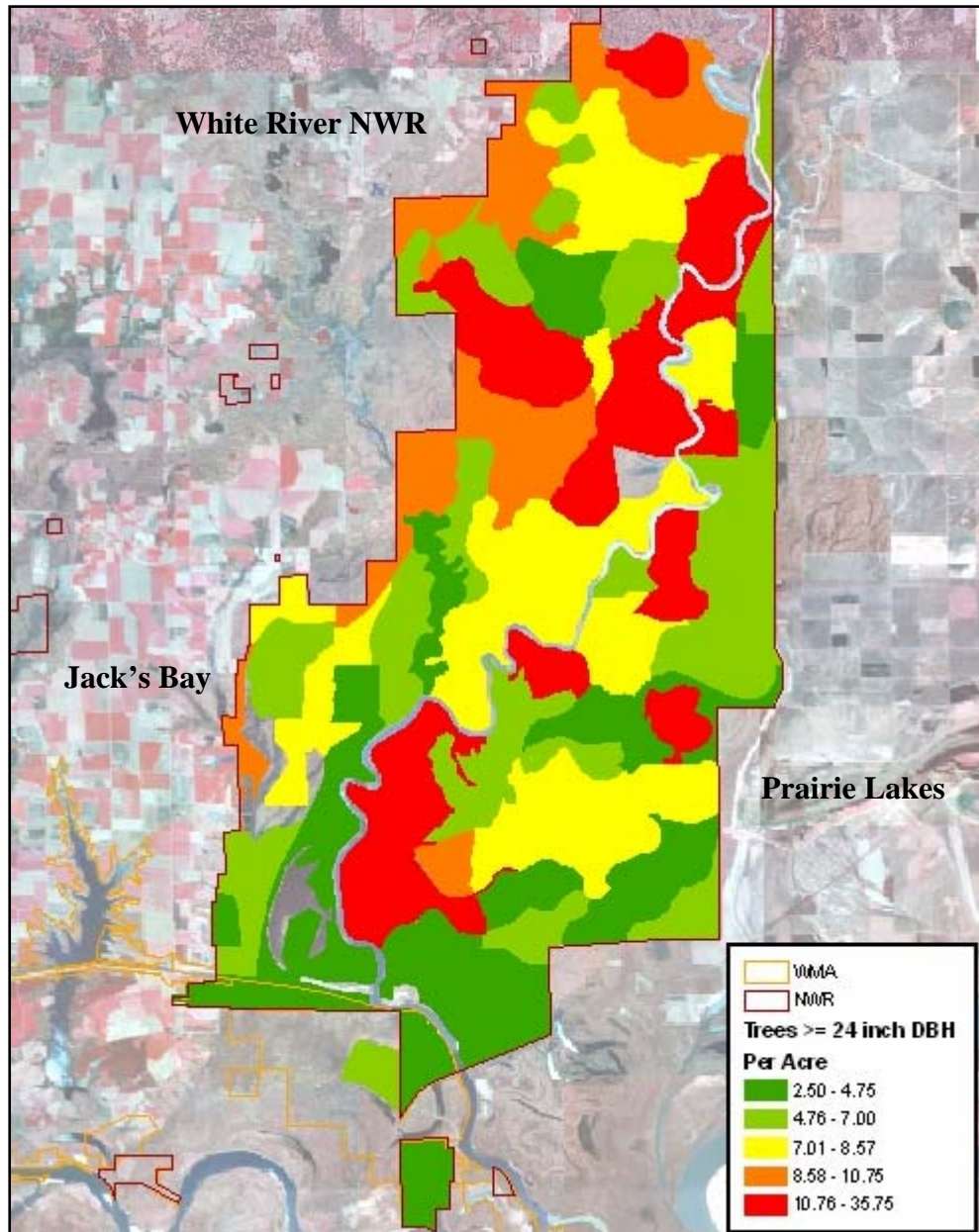
Parameter	Sample Area	Value	Comments
Tree Species	1/5 th Acre	Alpha Code for Tree Species; Appendix 4	All trees $\geq 10''$ dbh
DBH	1/5 th Acre	2'' classes (9.0'' – 10.9'' = 10'')	
Length in feet or # of logs	1/5 th Acre	Dead or down wood: 5' increment. Cruiser option: 1 – 4.5 in half-log increments if sawlog, 5' increment for pulpwood.	Required for dead wood. <i>Cruiser option on # of logs.</i>
Crown Class	1/5 th Acre	D = Dominant C = Co-dominant I = Intermediate S = Suppressed X = Dead	
Tree Condition	1/5 th Acre	1 = No dieback (not very common) 2 = Lower crown dieback, natural pruning 3 = < 1/3 top crown dieback 4 = > 1/3 top crown dieback 5 = Recently dead, retains many twigs 6 = Dead, retains only large limbs 7 = Dead, only bole remains, $\geq 5'$ tall 8 = Down wood $\geq 8''$ @ 3' from base	
<i>Stress Factor:</i> Epicormic Branching	1/5 th Acre	1 = Little to None (<20% of bole) 2 = Moderate (20% - 50% of bole) 3 = Heavy ($\geq 50%$ of bole)	Bole is portion of tree beneath the crown.
<i>Stress Factor:</i> Bark Disfiguration: Ex: bleeds, tannin stains; bug holes; frass, conks	1/5 th Acre	1 = Little to None (<20% of bole) 2 = Moderate (20% - 50% of bole) 3 = Heavy ($\geq 50%$ of bole)	Ex: Red Oak w/ blocky bark; Ash w/ smooth bark; Rot; Bare wood from beaver, skinning, etc.
Overstory Canopy Cover	Visible Range	1 = < 50% 2 = 50% - 80% 3 = > 80%	Vertical sunlight blockage
Midstory Cover	Visible Range	1 = < 25% 2 = 25% - 60% 3 = > 60%	Horizontal vision blockage, 10' – 30' height
Understory Cover	Visible Range	1 = < 25% 2 = 25% - 60% 3 = > 60%	Horizontal vision blockage, < 10' height
Vines	Visible Range	1 = Sparse (<25% [1 of 4 overstory trees]) 2 = Moderate (25-50% [2 of 4 trees]) 3 = Heavy (>50% [3 of 4 overstory trees])	# of dominant or co-dominant trees with vines on the bole &/or canopy

Cane	Visible Range	1 = None 2 = Sparse (1% - 25% area coverage) 3 = Heavy (> 25% area coverage)	
<i>Station Option</i> Intolerant Regeneration	Visible Range	Alpha Code for Tree Species; Appendix 4	Sufficient presence to occur if released
Potential Ivory-billed Woodpecker Cavity	Incidentally on Unlimited Area	A = very large irregular oval or rectangle, 4.5" x 5.5". Record tree species, DBH, height to cavity, face (north, west, etc.) and GPS coordinates (UTM, NAD 83).	Cavity size follows Cornell Lab of Ornithology.
Potential Ivory-billed Woodpecker Bark Scaling	Incidentally on Unlimited Area	Extreme horizontal gouges of tight bark. Record tree species, DBH, height to cavity, face (north, west, etc.) and GPS coordinates (UTM, NAD 83).	
Ivory-billed Woodpecker sighting or hearing of kent calls or double knocks	Incidentally on Unlimited Area	Record GPS coordinates UTM, NAD 83. Also direction and estimated distance to sighting or sound. ASAP contact inventory coordinator	

Appendix 2. Preliminary analysis of Ivory-billed Woodpecker habitat inventory data (i.e. density of trees ≥ 24 inch dbh), Cache River NWR and Dagmar WMA, September-October 2005.



Appendix 3. Preliminary analysis of Ivory-billed Woodpecker habitat inventory data (i.e. density of trees ≥ 24 inch dbh), White River NWR, September-October 2005.



Appendix F. Habitat Conditions across Historic Range

The Forest Products Industry

The forest products industry consists of companies and individuals that operate primary wood-using facilities and/or manage forests they own or control primarily for wood products (Helms 1998). In the United States, the forest products industry directly employs about 1.7 million people in wood and paper production, or about 1.1% of the U.S. workforce (American Forest and Paper Association and Clemson University 2001). For every job that is directly forest-related, another two jobs are related indirectly (e.g., transportation, distribution, sales) meaning about 5.7 million jobs in the U.S. are linked to the forest products industry. This industry can be vital to rural economies, such as in Mississippi where 10% of all jobs in the state are forestry-related and, during 2002, forestry contributed \$11.4 billion dollars to the Mississippi economy (http://www.msforestry.net/pdf/Forest_Facts.pdf).

The considerable complexity of the industry is due to the variable size, character, and objectives of its constituent companies, including ownership (individuals/families vs. stockholders) and source of wood supply (extent to which timber is purchased from public or non-industrial private forests). Companies that require wood for solid products often recommend or manage using uneven-aged systems or even-aged systems with rotations of 30 years or more, using thinnings to remove wood for paper products as part of the silvicultural system to achieve larger, higher quality trees. Companies that primarily require wood for paper products generally favor even-aged systems with short rotations (<15 years in the southern U.S.). Because of variability in management approaches and resulting forest structure, site-specific conditions and habitat opportunities for conservation of Ivory-billed Woodpecker will differ among companies.

Over the last several decades, ownership of industry land has become even more complex as many forest products companies have sold lands to organizations that manage timberlands on behalf of institutional (e.g., pension funds, foundations, endowments) and other type investors. Known as timber investment management organizations (TIMOs) or real estate investment trusts (REITs) (Ravenel et al. 2002, Stanturf et al. 2003), some of these ventures seek to optimize economic return within a much shorter time frame (e.g., 10–15 years) than forest products companies and may include non-timber objectives, such as real estate sales, as a primary motivation. Thus, a growing proportion of the industry no longer owns forest lands. Rather they purchase wood from non-industrial private landowners (NIPFLOs), REITs, TIMOs, and others.

In the United States, over 57% of forests are privately owned with about 26.9 million ha of land owned by forest industry, comprising about 9% of total forest ownership (Smith et al. 2004). About 88.0% of forest land in the South is privately owned (71.3% owned by NIPFLOs, 16.7% owned by industry). Most industry ownership (14.5 million ha) is in the USDA Forest Service's Southern region where industry owns about 3 times the area of national forests and almost 1.5 times that in all public ownerships (Smith et al. 2004). In 2001, the South supplied 58.0% of America's total roundwood production (Smith et al. 2004). That year, industrial forests provided 29% of the Nation's timber harvest and private forests in total provided 92% (Smith et al. 2004). Therefore, the current trend is for increasing wood production from private lands in the southern U.S. (Wear and Greis 2002).

Existing Habitat Conditions for Ivory-billed Woodpecker

To characterize the area and structural characteristics of forests on private lands and all ownerships that potentially could support Ivory-billed Woodpecker, we summarized USDA Forest Service Forest Inventory and Analysis data for counties listed in Table 1. Because forest products companies harvest wood on lands they own and purchase wood from non-industrial private landowners, the characteristics of all private ownerships is particularly relevant to Ivory-billed Woodpecker recovery. In all listed counties, we totaled the acres of forestland and timberland, number of live trees, and volume of live trees (ft³) by state and ownership for selected forest types and physiographic classes (Tables 2 and 3). For counties in Arkansas, Louisiana, North Carolina, South Carolina, and Texas, we also totaled volume (ft³) of annual net growth, mortality, and removals. Growth, mortality, and removals are available only in these five states. Original sources of data are described in Table 4.

In counties for which FIA data were available, there are more than 20.1 million acres of forestland and 19.8 million acres of timberland in the forest types and physiographic classes of interest (Table 5). Approximately 88.6% of all forestland is privately owned. Similarly, 89.9% of all timberland is privately owned, including 93.7% of pine types and 84.3% of hardwood types. Public and private timberlands differ in species composition. Of the 17.8 million acres of privately owned timberland in the counties, 37.6% is in hardwood forest types and 62.4% is in pine types. Of the 2.0 million acres in public timberland, 62.6% is in hardwood types and 37.4% is in pine types.

Area of privately owned pine timberland is approximately equivalent in small-, medium-, and large-diameter size classes (35.4, 32.1, and 32.4% of private pine timberland area, respectively) (Table 5). Area of private hardwood timberland, however, is predominantly in the large-diameter size class (60.2% of private hardwood timberland area) with much less area in medium- (23.4%) and small-diameter (16.4%) size classes. Public timberland area is predominantly in large-diameter-class forests for pine and hardwood types (60.7% and 81.6% of publicly owned pine and hardwood timberland, respectively).

In counties of interest, there are approximately 11.4 billion live stems on private timberland and 1.0 billion on public lands (Table 5). On private timberland, pine stems are most numerous in the medium-diameter class (40.0% of all pine stems) and less abundant in the small- (31.2%) and large-diameter classes (28.8%). Hardwood stems on private timberland are most numerous in the large-diameter class (50.0% of all pine stems) and less abundant in the medium- (29.1%) and small-diameter (20.9%) classes. On public timberland, number of live stems is similar in the medium-diameter class for pine and hardwood timberland (22.8% and 21.1% of all pine and hardwood stems, respectively). However, hardwood timberland on public lands has fewer small-diameter stems than pine timberland (4.4% for hardwood versus 31.2% for pine) and more stems in the large-diameter class (74.5% for hardwood versus 46.0% for pine).

Volume of live trees is approximately 27.4 billion ft³ on private timberland and 4.9 billion ft³ on public timberland (Table 5). On private timberland, this volume is split almost equally between pine and hardwood types (49.6% of total volume in pine versus 50.4% in hardwood). On public timberland, however, volume is predominantly in hardwood forest types (3.5 billion ft³ for hardwood forests versus 1.4 billion ft³ for pine). On private timberland, most volume is in the large-diameter size class for both

pine and hardwood types (61.1% for pine and 80.5% for hardwood), with 33.2% and 16.4% of total pine and hardwood volumes, respectively, in the medium-diameter class. Volume on public lands also is predominantly in the large-diameter class for both forest types (80.3% for pine and 93.2% for hardwood).

Net growth in hardwoods and pines on private timberland was primarily in the large-diameter class (Table 6), although much more so for hardwoods. For hardwoods on private timberland, 71.9% of total volume growth was in the large-diameter class, 19.9% was in the medium-diameter class, and only 8.1% was in the small-diameter class. For pines, however, 46.8% of total volume growth was in the large-diameter class, 37.5% was in the medium-diameter class, and 15.8% was in the small-diameter class. On public lands, net growth was predominantly in the large-diameter class for both pine and hardwood types (76.7% and 87.6% of total net growth, respectively).

Most mortality for both pines and hardwood types was in the large-diameter class for both private (71.8% and 74.5% of total mortality, respectively) and public timberland (76.8% and 95.9%, respectively; Table 6). Total mortality of hardwoods on private timberland was approximately 2.3 times that for pines, while for public lands mortality on hardwoods was 3.7 times as great in hardwood types than in pine types. For large-diameter pines, mortality was approximately 0.5% and 0.6% of live tree volume in that diameter class on private on public timberlands, respectively. Mortality of large-diameter pines was 13.9% of net growth in that diameter class on private timberland and 19.0% on public timberland. For large-diameter hardwoods, mortality was approximately 0.9% of live tree volume on both private and public timberlands. Mortality of large-diameter hardwoods was 50.3% of net growth in that size class on private timberland and 57.2% on public timberland.

For hardwood forests on private timberlands, removals were similar in the small- (44.2%) and large-diameter (39.0%) classes and least in the medium-diameter class (16.8%; Table 6). In contrast, almost all removals (99.4%) on public timberland were in the large-diameter class. Removals for pines on private lands were mostly in the small-diameter class (65.7%), but on public lands were mostly in the large-diameter class (66.9%). On private timberland, volume of large-diameter stems removed was 1.7 times greater for pines than hardwood. On public timberland, however, the trend was reversed with total volume removed 2.3 times greater for hardwoods than for pines. For large-diameter pines, removals were approximately 1.7% and 1.3% of live tree volume in that diameter class on private on public timberlands, respectively. Removals of large-diameter pines were 47.0% of net growth in that diameter class on private timberland and 45.0% on public timberland. For large-diameter hardwoods, removals were approximately 0.8% of live tree volume on private timberlands and 1.0% on public timberland. Removals of large-diameter hardwoods was 42.2% of net growth in that size class on private timberland and 66.4% on public timberland.

Forest characteristics on private and public ownerships are described by state in Tables 7 through 13.

Potential Contributions of the Industry to Recovery

The Endangered Species Act does not require private landowners to contribute to recovery of listed species. Nevertheless, several capacities of the forest products industry could potentially be brought to bear upon issues surrounding recovery of the Ivory-billed Woodpecker. For example, the forest products industry often purchases wood from NIPFLOs, and interacts with them through

landowner assistance programs and other avenues. Personnel that work for forest products companies also commonly interact with adjoining landowners and others interested in the landscape where their lands are located. These contacts offer many opportunities to communicate about silvicultural practices, conservation of rare species such as Ivory-billed Woodpecker, and other topics. The industry also has the capability of altering stand structures through active management without the procedural encumbrances sometimes encountered on public lands or by natural resource agencies. Thus, there may be opportunities for industry to contribute to large-scale management objectives for the Ivory-billed Woodpecker through active management and interactions with NIPFLOs. The potential contributions of industry to recovery of this species will become more evident as Ivory-billed Woodpecker birds and populations are identified and as management guidance is developed and refined.

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Table 1. Counties included in analysis of USDA Forest Service Forest Inventory and Analysis data.	
State	County Name
Alabama	Baldwin, Choctaw, Clarke, Mobile, Monroe, Washington
Arkansas	Arkansas, Ashley, Bradley, Calhoun, Chicot, Clark, Cleveland, Craighead, Crittenden, Cross, Dallas, Desha, Drew, Grant, Hempstead, Hot Spring, Howard, Independence, Jackson, Jefferson, Lafayette, Lawrence, Lee, Lincoln, Little River, Lonoke, Miller, Monroe, Nevada, Ouachita, Phillips, Pike, Poinsett, Prairie, Saline, Sevier, St. Francis, Union, White, Woodruff
Florida	Baker, Bay, Calhoun, Citrus, Columbia, Dixie, Franklin, Gadsden, Gulf, Hamilton, Hernando, Jackson, Jefferson, Lafayette, Leon, Levy, Liberty, Madison, Marion, Nassau, Taylor, Taylor, Wakulla
Georgia	Appling, Brantley, Brooks, Bryan, Bulloch, Burke, Charlton, Chatham, Clinch, Colquitt, Cook, Echols, Effingham, Glynn, Grady, Jeff Davis, Long, Lowndes, McIntosh, Mitchell, Montgomery, Richmond, Screven, Tattnall, Thomas, Toombs, Ware, Wayne, Wheeler
Louisiana	Ascension, Assumption, Avoyelles, Beauregard, Calcasieu, Caldwell, Catahoula, Concordia, East Carroll, Franklin, Iberia, Iberville, La Salle, Livingston, Madison, Morehouse, Ouachita, Pointe Coupee, Rapides, Richland, Sabine, St. James, St. John the Baptist, St. Landry, St. Martin, St. Mary, St. Tammany, Tangipahoa, Tensas, Union, Vernon, Washington, West Baton Rouge, West Feliciana
Mississippi	Adams, Bolivar, Claiborne, Coahoma, Copiah, De Soto, George, Greene, Hancock, Hinds, Humphreys, Issaquena, Jackson, Jefferson, Jefferson Davis, Lawrence, Marion, Pearl River, Perry, Rankin, Sharkey, Simpson, Tunica, Walthall, Warren, Washington, Wilkinson, Yazoo
North Carolina	Brunswick, Columbus, Robeson
Oklahoma	McCurtain
South Carolina	Aiken, Allendale, Barnwell, Beaufort, Berkeley, Calhoun, Charleston, Chesterfield, Clarendon, Darlington, Dillon, Florence, Georgetown, Hampton, Horry, Jasper, Kershaw, Marion, Marlboro, Richland, Sumter, Williamsburg
Texas	Angelina, Bowie, Chambers, Hardin, Jasper, Jefferson, Liberty, Newton, Orange, Polk, San Jacinto, Trinity, Tyler

Table 2. USDA Forest Service Forest Inventory and Analysis physiographic tree species/species group codes used as a filter in the analysis.	
Code	Description
601	Swamp chestnut oak/cherrybark oak
602	Sweet-gum/Nuttall oak/willow oak
605	Overcup oak/water hickory
607	Baldcypress/water tupelo
701	Black ash/American elm/red maple
702	River birch/sycamore
703	Cottonwood
704	Willow
705	Sycamore/pecan/American elm
706	Sugar-berry/hackberry/elm/green ash
708	Red maple/lowland
709	Cottonwood/willow
141	Longleaf pine
142	Slash pine
161	Loblolly pine
403	Longleaf Pine/Oak
406	Loblolly Pine/Hardwood
407	Slash Pine/Hardwood

Table 3. USDA Forest Service Forest Inventory and Analysis physiographic class codes used as a filter in the analysis. Physiographic class is the general effect of land form, topographical position, and soil on moisture available to trees.

Code	Class name	Description
<i>Mesic sites (normally moderate but adequate available moisture)</i>		
21	Flatwoods	Flat or fairly level sites outside of flood plains. Excludes deep sands and wet, swampy sites.
24	Narrow Flood plains/Bottomlands	Flood plains and bottomlands less than 1/4-mile in width along rivers and streams. These sites are normally well drained but are subjected to occasional flooding during periods of heavy or extended precipitation. Includes associated levees, benches, and terraces within a 1 mile limit. Excludes swamps, sloughs, and bogs.
25	Broad Floodplains/Bottomlands	Floodplains and bottomlands less than ¼ mile or wider along rivers and streams. These sites are normally well drained but are subjected to occasional flooding during periods of heavy or extended precipitation. Includes associated levees, benches, and terraces within a ¼ mile limit. Excludes swamps, sloughs, and bogs with year-round water problems within the ¼ mile limit.
29	Other Mesic	All moderately moist physiographic sites not described above.
<i>Hydric sites (normally abundant or overabundant moisture all year)</i>		
31	Swamps/Bogs	Low, wet, flat, forested areas usually quite extensive that are flooded for long periods except during periods of extreme drought. Excludes cypress ponds and small drains.
32	Small Drains	Narrow, stream-like, wet strands of forest land often without a well-defined stream channel. These areas are poorly drained or flooded throughout most of the year and drain the adjacent higher ground.
33	Bays and wet pocosins	Low, wet, boggy sites characterized by peaty or organic soils. May be somewhat dry during periods of extended drought. Examples include sites in the Lake States with lowland swamp conifers.
34	Beaver ponds.	Beaver ponds
35	Cypress ponds.	Cypress ponds
39	Other hydric	All other hydric physiographic sites

Table 4. Sources of USDA Forest Inventory and Analysis data used for this analysis.		
State	Data source	GMR¹ Availability
Alabama	2003 Annual	
Arkansas	2004 Annual	Y
Florida	1995 Periodic	
Georgia	2003 Annual	
Louisiana	2003 Annual	Y
Mississippi	1994 Periodic	
North Carolina	2002 Periodic	Y
Oklahoma	1993 Periodic	
South Carolina	2001 Annual	Y
Texas	2003 Annual	Y
¹ Availability of data for growth, mortality, and removals. Y = Yes, data are available for the state.		

Table 5. Acres of forestland and timberland, and number and volume of live trees by size class in Alabama, Arkansas, Georgia, Louisiana, North Carolina, South Carolina, and Texas.

Variable	Size Class	Public Ownerships			Private Ownerships		
		Pine	Hardwood	Total	Pine	Hardwood	Total
Acres Forestland	Small	132,829	70,390	203,219	3,941,352	1,107,110	5,048,462
	Medium	193,337	206,826	400,163	3,581,273	1,571,284	5,152,557
	Large	528,677	1,170,874	1,699,551	3,614,348	4,051,957	7,666,305
	Total	854,843	1,448,090	2,302,933	11,136,973	6,730,351	17,867,324
Acres Timberland	Small	130,683	43,155	173,838	3,941,352	1,101,864	5,043,216
	Medium	164,085	188,226	352,311	3,575,509	1,571,284	5,146,793
	Large	456,024	1,023,795	1,479,819	3,607,623	4,043,138	7,650,761
	Total	750,792	1,255,176	2,005,968	11,124,484	6,716,286	17,840,770
No. Live Trees	Small	134,813,748	26,288,801	161,102,549	2,370,055,051	793,248,878	3,163,303,929
	Medium	98,408,012	124,450,893	222,858,905	3,037,017,159	1,107,150,711	4,144,167,870
	Large	198,534,365	440,419,011	638,953,376	2,190,384,501	1,902,966,598	4,093,351,099
	Total	431,756,125	591,158,705	1,022,914,830	7,597,456,711	3,803,366,187	11,400,822,898
Vol. Live Trees (ft ³)	Small	52,075,981	12,638,815	64,714,796	770,413,505	427,383,743	1,197,797,248
	Medium	229,375,572	223,401,122	452,776,694	4,508,677,562	2,262,286,839	6,770,964,401
	Large	1,123,160,136	3,240,317,084	4,363,477,220	8,306,398,524	11,090,209,654	19,396,608,178
	Total	1,404,611,689	3,476,357,021	4,880,968,710	13,585,489,591	13,779,880,236	27,365,369,827

Variable	Size Class	Public Ownerships			Private Ownerships		
		Pine	Hardwood	Total	Pine	Hardwood	Total
Net growth (ft ³)	Small	1,963,233	72,173	2,035,406	102,899,014	22,330,079	125,229,093
	Medium	8,142,626	7,156,669	15,299,295	244,978,464	54,765,335	299,743,799
	Large	33,309,907	51,236,605	84,546,512	305,428,197	197,582,342	503,010,539
	Total	43,415,766	58,465,447	101,881,213	653,305,675	274,677,756	927,983,431
Mortality (ft ³)	Small	610,865	171,852	782,717	7,478,633	5,897,618	13,376,251
	Medium	1,305,897	1,067,327	2,373,224	9,100,347	28,134,709	37,235,056
	Large	6,341,342	29,306,732	35,648,074	42,311,763	99,299,409	141,611,172
	Total	8,258,104	30,545,911	38,804,015	58,890,743	133,331,736	192,222,479
Removals (ft ³)	Small	4,017,463	0	4,017,463	380,795,078	94,456,640	475,251,718
	Medium	3,414,295	190,993	3,605,288	54,945,206	35,934,745	90,879,951
	Large	14,987,420	34,050,244	49,037,664	143,624,047	83,417,887	227,041,934
	Total	22,419,178	34,241,237	56,660,415	579,364,331	213,809,272	793,173,603

Table 7. Acres of forestland and timberland, and number and volume of live trees by size class in Alabama (2003 Annual Survey).							
Variable	Size Class	Public Ownerships			Private Ownerships		
		Pine	Hardwood	Total	Pine	Hardwood	Total
Acres Forestland	Small	0	2,593	2,593	124,536	82,009	206,545
	Medium	11,101	0	11,101	137,157	94,227	231,384
	Large	10,319	30,756	41,075	202,774	173,234	376,008
	Total	21,420	33,349	54,769	464,467	349,470	813,937
Acres Timberland	Small	0	2,593	2,593	124,536	82,009	206,545
	Medium	11,101	0	11,101	137,157	94,227	231,384
	Large	0	30,756	30,756	202,774	173,234	376,008
	Total	11,101	33,349	44,450	464,467	349,470	813,937
No. Live Trees	Small	0	2,458,165	2,458,165	89,342,203	23,881,789	113,223,992
	Medium	200,419	0	200,419	89,438,713	64,635,932	154,074,645
	Large	0	17,985,123	17,985,123	121,227,442	71,756,471	192,983,913
	Total	200,419	20,443,288	20,643,707	300,008,358	160,274,192	460,282,550
Vol. Live Trees (ft ³)	Small	0	190,576	190,576	34,220,929	44,199,332	78,420,261
	Medium	334,810	0	334,810	137,929,872	231,325,509	369,255,381
	Large	0	120,446,448	120,446,448	470,911,429	634,729,192	1,105,640,621
	Total	334,810	120,637,024	120,971,834	643,062,230	910,254,033	1,553,316,263

Table 8. Acres of forestland and timberland, number and volume of live trees, net growth, mortality, and removals by size class in Arkansas (2004 Annual Survey).

Variable	Size Class	All Ownerships			Private Ownerships		
		Pine	Hardwood	Total	Pine	Hardwood	Total
Acres Forestland	Small	0	19,241	19,241	732,619	192,583	925,202
	Medium	16,421	39,146	55,567	629,942	389,409	1,019,351
	Large	26,721	363,877	390,598	1,079,064	1,112,315	2,191,379
	Total	43,142	422,264	465,406	2,441,625	1,694,307	4,135,932
Acres Timberland	Small	0	11,235	11,235	732,619	192,583	925,202
	Medium	8,372	39,146	47,518	629,942	389,409	1,019,351
	Large	26,721	335,399	362,120	1,079,064	1,112,315	2,191,379
	Total	35,093	385,780	420,873	2,441,625	1,694,307	4,135,932
No. Live Trees	Small	0	8,046,600	8,046,600	476,018,032	92,527,119	568,545,151
	Medium	7,678,895	24,788,980	32,467,875	636,571,797	231,171,824	867,743,621
	Large	14,616,778	119,670,875	134,287,653	741,864,893	446,278,863	1,188,143,756
	Total	22,295,673	152,506,455	174,802,128	1,854,454,722	769,977,806	2,624,432,528
Vol. Live Trees (ft ³)	Small	0	2,654,730	2,654,730	200,509,772	39,734,505	240,244,277
	Medium	15,087,245	48,750,697	63,837,942	785,722,124	484,346,496	1,270,068,620
	Large	53,289,436	1,204,991,531	1,258,280,967	2,331,886,730	2,892,340,914	5,224,227,644
	Total	68,376,681	1,256,396,958	1,324,773,639	3,318,118,626	3,416,421,915	6,734,540,541
Net growth (ft ³)	Small	0	86,959	86,959	29,895,911	4,762,852	34,658,763
	Medium	695,335	3,266,168	3,961,503	65,215,557	17,825,536	83,041,093
	Large	2,626,962	19,546,012	22,172,974	106,001,203	62,181,891	168,183,094
	Total	3,322,297	22,899,139	26,221,436	201,112,671	84,770,279	285,882,950
Mortality (ft ³)	Small	0	0	0	351,882	1,527,324	1,879,206
	Medium	0	0	0	2,934,382	3,666,691	6,601,073
	Large	450,022	8,124,791	8,574,813	12,123,265	27,120,763	39,244,028
	Total	450,022	8,124,791	8,574,813	15,409,529	32,314,778	47,724,307
Removals (ft ³)	Small	0	0	0	107,062,707	15,146,550	122,209,257
	Medium	921,442	0	921,442	19,057,146	14,705,945	33,763,091
	Large	2,171,207	11,269,939	13,441,146	72,992,097	29,455,288	102,447,385
	Total	3,092,649	11,269,939	14,362,588	199,111,950	59,307,783	258,419,733

Table 9. Acres of forestland and timberland, and number and volume of live trees by size class in Georgia (2003 Annual Survey).							
Variable	Size Class	Public Ownerships			Private Ownerships		
		Pine	Hardwood	Total	Pine	Hardwood	Total
Acres Forestland	Small	33,977	14,069	48,046	1,025,410	162,650	1,188,060
	Medium	47,567	24,195	71,762	1,110,180	151,012	1,261,192
	Large	127,845	27,178	155,023	476,892	260,586	737,478
	Total	209,389	65,442	274,831	2,612,482	574,248	3,186,730
Acres Timberland	Small	33,977	0	33,977	1,025,410	162,650	1,188,060
	Medium	40,232	7,767	47,999	1,110,180	151,012	1,261,192
	Large	102,446	27,178	129,624	475,313	260,586	735,899
	Total	176,655	34,945	211,600	2,610,903	574,248	3,185,151
No. Live Trees	Small	16,338,329	0	16,338,329	510,953,466	146,873,152	657,826,618
	Medium	28,313,098	11,672,196	39,985,294	749,859,890	154,915,398	904,775,288
	Large	41,254,395	10,083,360	51,337,755	251,885,758	134,727,140	386,612,898
	Total	85,905,822	21,755,556	107,661,378	1,512,699,114	436,515,690	1,949,214,804
Vol. Live Trees (ft ³)	Small	5,141,872	0	5,141,872	149,468,857	45,573,377	195,042,234
	Medium	79,491,513	24,860,300	104,351,813	1,469,177,133	241,315,605	1,710,492,738
	Large	278,327,670	89,436,004	367,763,674	1,155,108,662	978,595,831	2,133,704,493
	Total	362,961,055	114,296,304	477,257,359	2,773,754,652	1,265,484,813	4,039,239,465

Table 10. Acres of forestland and timberland, number and volume of live trees, net growth, mortality, and removals by size class in Louisiana (2003 Annual Survey).

Variable	Size Class	Public Ownerships			Private Ownerships		
		Pine	Hardwood	Total	Pine	Hardwood	Total
Acres Forestland	Small	5,038	24,325	29,363	539,045	271,680	810,725
	Medium	25,424	89,667	115,091	473,621	518,452	992,073
	Large	82,627	590,426	673,053	627,583	1,624,244	2,251,827
	Total	113,089	704,418	817,507	1,640,249	2,414,376	4,054,625
Acres Timberland	Small	5,038	24,325	29,363	539,045	266,434	805,479
	Medium	25,424	89,667	115,091	473,621	518,452	992,073
	Large	82,627	541,893	624,520	627,583	1,624,244	2,251,827
	Total	113,089	655,885	768,974	1,640,249	2,409,130	4,049,379
No. Live Trees	Small	3,385,222	12,502,325	15,887,547	261,162,164	147,619,601	408,781,765
	Medium	10,061,234	50,529,840	60,591,074	404,244,553	298,555,337	702,799,890
	Large	33,191,041	237,511,525	270,702,566	308,367,936	740,517,322	1,048,885,258
	Total	46,637,497	300,543,690	347,181,187	973,774,653	1,186,692,260	2,160,466,913
Vol. Live Trees (ft ³)	Small	1,811,628	6,479,326	8,290,954	23,620,772	61,651,843	85,272,615
	Medium	24,482,340	53,322,420	77,804,760	459,042,277	647,187,066	1,106,229,343
	Large	200,693,797	1,499,395,941	1,700,089,738	1,431,910,521	3,936,554,152	5,368,464,673
	Total	226,987,765	1,559,197,687	1,786,185,452	1,914,573,570	4,645,393,061	6,559,966,631
Net growth (ft ³)	Small	0	-58,516	-58,516	19,354,479	5,184,974	24,539,453
	Medium	2,259,333	2,065,145	4,324,478	26,330,562	16,179,225	42,509,787
	Large	8,000,553	24,488,940	32,489,493	63,345,629	79,974,580	143,320,209
	Total	10,259,886	26,495,569	36,755,455	109,030,670	101,338,779	210,369,449
Mortality (ft ³)	Small	0	171,852	171,852	2,413,284	610,718	3,024,002
	Medium	0	555,578	555,578	1,725,218	16,448,954	18,174,172
	Large	1,267,526	16,580,581	17,848,107	9,297,470	49,639,612	58,937,082
	Total	1,267,526	17,308,011	18,575,537	13,435,972	66,699,284	80,135,256
Removals (ft ³)	Small	0	0	0	75,940,948	28,008,326	103,949,274
	Medium	384,995	190,993	575,988	15,352,341	13,749,078	29,101,419
	Large	1,096,239	13,491,464	14,587,703	28,176,218	31,835,313	60,011,531
	Total	1,481,234	13,682,457	15,163,691	119,469,507	73,592,717	193,062,224

Table 11. Acres of forestland and timberland, number and volume of live trees, net growth, mortality, and removals by size class in North Carolina (2002 Periodic Survey).

Variable	Size Class	Public Ownerships			Private Ownerships		
		Pine	Hardwood	Total	Pine	Hardwood	Total
Acres Forestland	Small	0	0	0	269,026	56,364	325,390
	Medium	0	0	0	103,908	17,570	121,478
	Large	6,963	3,924	10,887	165,764	50,119	215,883
	Total	6,963	3,924	10,887	538,698	124,053	662,751
Acres Timberland	Small	0	0	0	269,026	56,364	325,390
	Medium	0	0	0	103,908	17,570	121,478
	Large	5,191	0	5,191	165,764	50,119	215,883
	Total	5,191	0	5,191	538,698	124,053	662,751
No. Live Trees	Small	0	0	0	189,312,013	93,994,009	283,306,022
	Medium	0	0	0	75,103,043	19,510,989	94,614,032
	Large	2,562,006	0	2,562,006	86,418,045	38,472,999	124,891,044
	Total	2,562,006	0	2,562,006	350,833,101	151,977,997	502,811,098
Vol. Live Trees (ft ³)	Small	0	0	0	101,667,967	70,790,979	172,458,946
	Medium	0	0	0	142,536,262	27,785,924	170,322,186
	Large	13,139,059	0	13,139,059	473,216,571	202,033,023	675,249,594
	Total	13,139,059	0	13,139,059	717,420,800	300,609,926	1,018,030,726
Net growth (ft ³)	Small	0	0	0	15,093,147	1,592,130	16,685,277
	Medium	0	0	0	10,851,922	391,042	11,242,964
	Large	319,011	0	319,011	23,703,452	4,614,169	28,317,621
	Total	319,011	0	319,011	49,648,521	6,597,341	56,245,862
Mortality (ft ³)	Small	0	0	0	722,619	500,293	1,222,912
	Medium	0	0	0	625,695	0	625,695
	Large	77,401	0	77,401	2,912,322	1,060,302	3,972,624
	Total	77,401	0	77,401	4,260,636	1,560,595	5,821,231
Removals (ft ³)	Small	0	0	0	47,166,239	3,923,987	51,090,226
	Medium	0	0	0	2,151,275	0	2,151,275
	Large	0	0	0	4,613,716	2,923,402	7,537,118
	Total	0	0	0	53,931,230	6,847,389	60,778,619

Table 12. Acres of forestland and timberland, number and volume of live trees, net growth, mortality, and removals by size class in South Carolina (2001 Annual Survey).

Variable	Size Class	Public Ownerships			Private Ownerships		
		Pine	Hardwood	Total	Pine	Hardwood	Total
Acres Forestland	Small	93,814	5,002	98,816	808,575	247,489	1,056,064
	Medium	68,872	35,221	104,093	780,932	313,429	1,094,361
	Large	205,088	106,477	311,565	612,400	446,173	1,058,573
	Total	367,774	146,700	514,474	2,201,907	1,007,091	3,208,998
Acres Timberland	Small	91,668	5,002	96,670	808,575	247,489	1,056,064
	Medium	67,376	33,049	100,425	780,932	313,429	1,094,361
	Large	188,083	75,880	263,963	612,400	446,173	1,058,573
	Total	347,127	113,931	461,058	2,201,907	1,007,091	3,208,998
No. Live Trees	Small	115,090,197	3,281,711	118,371,908	564,598,954	196,645,563	761,244,517
	Medium	36,292,790	22,559,833	58,852,623	732,854,138	279,267,039	1,012,121,177
	Large	81,106,640	49,710,655	130,817,295	347,369,707	278,423,577	625,793,284
	Total	232,489,627	75,552,199	308,041,826	1,644,822,799	754,336,179	2,399,158,978
Vol. Live Trees (ft ³)	Small	45,122,481	3,314,183	48,436,664	205,018,866	140,258,565	345,277,431
	Medium	99,519,137	76,567,684	176,086,821	1,149,032,060	529,298,027	1,678,330,087
	Large	395,950,357	301,729,220	697,679,577	1,482,909,746	1,574,308,268	3,057,218,014
	Total	540,591,975	381,611,087	922,203,062	2,836,960,672	2,243,864,860	5,080,825,532
Net growth (ft ³)	Small	1,963,233	43,730	2,006,963	24,155,671	8,662,143	32,817,814
	Medium	4,436,631	1,902,121	6,338,752	117,157,850	16,768,069	133,925,919
	Large	15,725,846	5,252,048	20,977,894	78,156,571	28,649,941	106,806,512
	Total	22,125,710	7,197,899	29,323,609	219,470,092	54,080,153	273,550,245
Mortality (ft ³)	Small	610,865	0	610,865	2,868,789	2,792,458	5,661,247
	Medium	823,549	223,776	1,047,325	3,574,344	7,029,237	10,603,581
	Large	3,364,828	4,122,259	7,487,087	12,114,688	12,286,667	24,401,355
	Total	4,799,242	4,346,035	9,145,277	18,557,821	22,108,362	40,666,183
Removals (ft ³)	Small	4,017,463	0	4,017,463	86,984,223	39,582,861	126,567,084
	Medium	966,370	0	966,370	12,589,312	3,752,517	16,341,829
	Large	5,627,617	0	5,627,617	26,475,370	11,459,584	37,934,954
	Total	10,611,450	0	10,611,450	126,048,905	54,794,962	180,843,867

Table 13. Acres of forestland and timberland, number and volume of live trees, net growth, mortality, and removals by size class in Texas (2003 Annual Survey).

Variable	Size Class	Public Ownerships			Private Ownerships		
		Pine	Hardwood	Total	Pine	Hardwood	Total
Acres Forestland	Small	0	5,160	5,160	442,141	94,335	536,476
	Medium	23,952	18,597	42,549	345,533	87,185	432,718
	Large	69,114	48,236	117,350	449,871	385,286	835,157
	Total	93,066	71,993	165,059	1,237,545	566,806	1,804,351
Acres Timberland	Small	0	0	0	442,141	94,335	536,476
	Medium	11,580	18,597	30,177	339,769	87,185	426,954
	Large	50,956	12,689	63,645	444,725	376,467	821,192
	Total	62,536	31,286	93,822	1,226,635	557,987	1,784,622
No. Live Trees	Small	0	0	0	278,668,219	91,707,645	370,375,864
	Medium	15,861,576	14,900,044	30,761,620	348,945,025	59,094,192	408,039,217
	Large	25,803,505	5,457,473	31,260,978	333,250,720	192,790,226	526,040,946
	Total	41,665,081	20,357,517	62,022,598	960,863,964	343,592,063	1,304,456,027
Vol. Live Trees (ft ³)	Small	0	0	0	55,906,342	25,175,142	81,081,484
	Medium	10,460,527	19,900,021	30,360,548	365,237,834	101,028,212	466,266,046
	Large	181,759,817	24,317,940	206,077,757	960,454,865	871,648,274	1,832,103,139
	Total	192,220,344	44,217,961	236,438,305	1,381,599,041	997,851,628	2,379,450,669
Net growth (ft ³)	Small	0	0	0	14,399,806	2,127,980	16,527,786
	Medium	751,327	-76,765	674,562	25,422,573	3,601,463	29,024,036
	Large	6,637,535	1,949,605	8,587,140	34,221,342	22,161,761	56,383,103
	Total	7,388,862	1,872,840	9,261,702	74,043,721	27,891,204	101,934,925
Mortality (ft ³)	Small	0	0	0	1,122,059	466,825	1,588,884
	Medium	482,348	287,973	770,321	240,708	989,827	1,230,535
	Large	1,181,565	479,101	1,660,666	5,864,018	9,192,065	15,056,083
	Total	1,663,913	767,074	2,430,987	7,226,785	10,648,717	17,875,502
Removals (ft ³)	Small	0	0	0	63,640,961	7,794,916	71,435,877
	Medium	1,141,488	0	1,141,488	5,795,132	3,727,205	9,522,337
	Large	6,092,357	9,288,841	15,381,198	11,366,646	7,744,300	19,110,946
	Total	7,233,845	9,288,841	16,522,686	80,802,739	19,266,421	100,069,160

GLOSSARY

Annual mortality—The average annual volume of sound wood in growing-stock trees that died from natural causes during the period between inventories.

Annual removals—The net volume of growingstock trees removed from the inventory during a specified year by harvesting, cultural operations such as timber stand improvement, or land clearing.

Annual growth Net annual sound cubic-foot growth of a live tree on timberland. The net change in cubic-foot volume per year of this tree (for remeasured plots $(V_2 - V_1)/(t_2 - t_1)$). Because this value is net growth, it may be a negative number. Negative growth values are usually due to mortality ($V_2=0$) but can also occur on live trees that have a net loss in volume because of damage, rot, or other causes.

Physiographic class the general effect of land form, topographical position, and soil on moisture available to trees.

Stand-size class—A classification of forest land based on the size class of all live trees in the area. The classes include:

Small diameter Stands with an all live stocking value of at least 10 (base 100) on which at least 50 percent of the stocking is in small diameter trees

Medium diameter Stands with an all live stocking of at least 10 (base 100); with more than 50 percent of the stocking in medium and large diameter trees; and with the stocking of large diameter trees less than the stocking of medium diameter trees.

Large diameter Stands with an all live stocking of at least 10 (base 100); with more than 50 percent of the stocking in medium and large diameter trees²; and with the stocking of large diameter trees equal to or greater than the stocking of medium diameter trees.

NOTE: Size class code, which is derived by an algorithm, is a classification of the predominant (based on stocking) diameter class of live trees within the condition. Size class is assessed at the plot condition level, not the tree level. Large diameter trees are at least 11.0 inches diameter for hardwoods and at least 9.0 inches diameter for softwoods. Medium diameter trees are at least 5.0 inches diameter but not as large as large diameter trees. Small diameter trees are less than 5.0 inches diameter.

Timberland—Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing in excess of 20 cubic feet

per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

Appendix G. Species Names and Acronyms Used in the Recovery Plan.

Plants

American Elm (<i>Ulmus americana</i>)	Poison Ivy (<i>Toxicodendron radicans</i>)
Ash (<i>Fraxinus</i> spp.)	Post Oak (<i>Quercus stellata</i>)
Bald cypress (<i>Taxodium</i> spp.)	Red Maple (<i>Acer rubrum</i>)
Bitter Pecan (<i>Carya aquatica</i>)	Red Oak (<i>Quercus rubra</i>)
Chestnut Oak (<i>Quercus michauxii</i>)	Scarlet Oak (<i>Quercus coccinea</i>)
Cotton (<i>Gossypium</i> spp.)	Sugar-berry (<i>Celtis laevigata</i>)
Diamond Leaf Oak (<i>Quercus laurifolia</i>)	Swamp Tupelo (<i>Nyssa biflora</i>)
Elm (<i>Ulmus</i> spp.)	Swamp-privet (<i>Forestiera</i> spp.)
Green Ash (<i>Fraxinus pennsylvanicus</i>)	Sweet-gum (<i>Liquidambar styraciflua</i>)
Hackberry (<i>Celtis</i> spp.),	Tupelo (<i>Nyssa</i> spp.)
Loblolly Pine (<i>Pinus taeda</i>)	Tupelo Gum (<i>Nyssa aquatica</i>)
Locust (<i>Gleditsia</i> spp.)	Water Elm (<i>Planera aquatica</i>)
Long-leaf Pine (<i>Pinus palustris</i>)	Water Hickory (<i>Carya myristiciformis</i>)
Nuttall Oak (<i>Quercus nuttalli</i>)	Water Oak (<i>Quercus nigra</i>)
Overcup Oak (<i>Quercus lyrata</i>)	White Oak (<i>Quercus alba</i>)
Pecan (<i>Carya illinoensis</i>)	Wild Grape (<i>Vitis</i> spp.),
Persimmon (<i>Diospyros virginiana</i>)	Willow Oak (<i>Quercus phellos</i>)
Pine (<i>Pinus</i> spp.)	

Animals

Barred Owl (<i>Strix varia</i>)
Beaver (<i>Castor canadensis</i>)
Black Woodpecker (<i>Dryocopus martius</i>)
Great Horned Owl (<i>Bubo virginianus</i>)
Great Slaty Woodpecker (<i>Mulleripicus pulverulentus mohun</i>)
Ivory-billed Woodpecker (<i>Campephilus principalis</i>)
Megallanic Woodpecker (<i>Campephilus magellanicus</i>)
Pileated Woodpecker (<i>Dryocopus pileatus</i>)
Raccoon (<i>Procyon lotor</i>)
Rat Snake (<i>Elaphe</i> spp.)
Red-shouldered Hawk (<i>Buteo linneatus</i>)

List of Acronyms

ANHC	Arkansas Natural Heritage Commission
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
CFI	Continuous Forest Inventory
DBH	Diameter at Breast Height
ESA	Endangered Species Act
FIA	Forest Inventory and Analysis
FRWG	Forest Resource Working Group
GIS	Geographic Information System
HGM	Hydro Geomorphic
Ivory-billed Woodpecker	Ivory-billed Woodpecker
LDWF	Louisiana Department of Wildlife and Fisheries
LIDAR	Light Detection and Ranging
LMAV	Lower Mississippi Alluvial Valley
LMVJV	Lower Mississippi Alluvial Valley Joint Venture
MAV	Mississippi Alluvial Valley
NASA	National Aeronautics and Space Administration
NLCD	National Land Cover Data
NWR	National Wildlife Refuge
SAF	Society of American Foresters
SURRGO	Soil Survey Geographic
TNC	The Nature Conservancy
USDA	U. S. Department of Agriculture
USFWS	U. S. Fish and Wildlife
USGS	U. S. Geological Survey
WMA	Wildlife Management Area