U.S. Fish & Wildlife Service

Recovery Plan for the Ivory-billed Woodpecker

(Campephilus principalis)

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April, 2010

U.S. Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

Approved: _____

Regional Director, Southeast Region, U.S. Fish and Wildlife Service

Date: 4/16/2010

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By approving this recovery plan, the Regional Director certifies that the data used in its development represent the best scientific and commercial data available at the time it was written. Copies of all documents reviewed in the development of this plan are available in the administrative record located at the Service Field Office in Lafayette, Louisiana.

Literature Citation Should Read as Follows:

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Additional copies of this Recovery Plan are available on the U.S. Fish and Wildlife Service web site at: http://endangered.fws.gov/RECOVERY/RECPLANS/Index.htm

Common names for birds are in accordance with the American Ornithologists' Union (American Ornithologists' Union 1983). Scientific names of species in the text are found in Appendix G.

Cover Illustration Credit:

A male Ivory-billed Woodpecker at a nest hole. (Photo by Arthur Allen, 1935/Copyright Cornell Lab of Ornithology.)

Acknowledgments

Although the Ivory-billed Woodpecker has been listed as an endangered species since 1967, no recovery plan was ever prepared for the species.

Perspectives with regard to the need for a plan changed dramatically when substantial and compelling evidence suggesting the presence of at least one bird in the Bayou DeView area of Cache River National Wildlife Refuge was announced in April 2005. Primary needs for recovering the Ivory-billed Woodpecker were to learn more about the bird's occurrence, to locate birds, and to determine how 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 team of more than 60 technical experts, scientists, and managers was identified. This list eventually grew to nearly 80 people. A list of team members is provided in Appendix A. All members are acknowledged for their expertise and commitment to the recovery planning effort.

The Nature Conservancy of Arkansas, the Cornell 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 search and recovery effort and 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 Jerome Jackson from Florida Gulf Coast University contributed written portions of the plan. Among U.S. Fish and Wildlife Service staff, Deborah Fuller, Ralph Costa, Chuck Hunter, Erin Rivenbark, 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 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 and Paul Hamel, Mississippi; and Bob Ford and Scott Somershoe, Tennessee.

The hard work and dedication of those mentioned above, as well as the Recovery Team members listed in Appendix A, are gratefully acknowledged. The Recovery Plan is much better for the involvement and critical thinking of this talented group of people. The thoughtful peer review of 7 scientists, led by The Wildlife Society, was essential in making the final recovery plan a better document.

Importantly, 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 allowed us a window into the life history and habitat of the Ivory-billed Woodpecker. We stand on his shoulders and gratefully acknowledge his contributions.

Executive Summary

Current Status

The Ivory-billed Woodpecker (*Campephilus principalis*) belongs to a genus composed of 11 species of woodpeckers inhabiting the Western Hemisphere— primarily Central and South America. Two forms of Ivory-billed Woodpecker have been recognized (American Ornithologists' Union 1983): the North American form with a historical range covering most of the southeastern and a small portion of south-central United States (Figure 1) and the Cuban form with a historical range throughout 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 known. In 2005, information was released on the presence of at least one Ivory-billed Woodpecker in Central Arkansas (Fitzpatrick et al. 2005, see Appendix B). Additionally, the existence of potential habitat and numerous reports from credible sources of Ivory-billed Woodpeckers in recent decades provided motivation to carry out surveys for the species throughout its range. Searches have taken place in Texas, Arkansas, Louisiana, western Tennessee, Mississippi, southern Illinois, Georgia, South Carolina, North Carolina, and Florida. While suggestive evidence has been found in several states, no clear, conclusive photograph or video has been made as of the date of this writing. State, Federal and private partners will continue to search for evidence of the species' presence (e.g., sightings, nest cavities) in order to document an active nest or roost when sufficient additional evidence warrants such a response. The species may also persist in a few locations in Cuba (Garrido and Kirkconnell 2000; Kirkconnell, pers. comm.).

No critical habitat has been designated for this species, and none is required due to the date of listing. The Recovery Priority Number for the Ivory-billed Woodpecker is 5, indicating a high degree of threat and low recovery potential for this species (U.S. Fish and Wildlife Service 2005). When additional compelling evidence exists of a nest or roost, or there are repeated sightings of birds, the actions described in the recovery plan will provide the initial guidance for conservation of the species.

Habitat Requirements

The Ivory-billed Woodpecker was historically described as 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). On the Singer Tract near Tensas in northeastern Louisiana, Tanner (1942) documented use in higher parts of "first bottoms," bottomland forests infrequently flooded and forested primarily with species such as Nuttall oak (*Quercus texana Buckley [syn., Q. nuttallii*]), sweetgum (*Liquidambar styraciflua*), and green ash (*Fraxinus pennsylvanica*). 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 is 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

Two main reasons for the precipitous decrease in Ivory-billed Woodpecker numbers have been proposed. Throughout the species' range, beginning in the early 1800s, there has been a reduction in suitable habitat and potentially a direct impact on suitable nest trees as well as an indirect destruction of their food source due to large scale logging and conversion of forest habitats (Jackson 2002). During this period settlement, logging roads, and slash fires improved access for hunters, trappers, and commercial collectors, increasing the potential for lethal contact. Rather than habitat loss, the direct killing of Ivory-billed Woodpeckers could have been the primary cause for their decline (Snyder 2007). Other factors such as disease or non-human predation are not documented by Tanner or Jackson as important causes.

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 [the Ivory-billed Woodpecker's] 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." Snyder (2007) 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. Nevertheless, it stands to reason that the Ivory-billed Woodpecker, as one of the largest picids, may have particular food demands that are only met in large tracts of mature forest during at least part of its life cycle. 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. He notes that their overall population loss throughout the southeast is probably not directly caused by hunting.

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 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 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 are capable of providing ideal habitat for the Ivory-billed Woodpecker. Therefore, 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 primary 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 1800s. Jackson (2002) presented data indicating that such collecting resulted in the taking of over 400 specimens, mostly between 1880 and 1910. By itself, collecting or hunting 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. 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-billed Woodpeckers 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 1800s (Jackson 2002, Tanner 1942). Early accounts gave no accurate or definite estimates of abundance, but populations by the 1890s 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, where it may occur, at risk from natural events and environmental factors.

Additionally, the exact number and genetic health of any remaining birds are 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, predation, and disease). However, other species, such as the California Condor (*Gymnogyps californianus*) and the Seychelles Warbler (*Acrocephalus sechellensis*) (Komdeur 2002) have survived

narrow genetic bottlenecks. Mattson et al. (2008) applied a stochastic modeling approach to evaluate the potential for persistence under multiple scenarios for large, longer-lived woodpecker species. Their results support the determination that Ivory-billed Woodpeckers could also survive with a very small population size.

Though not a threat directly related to a species' biology or life history, the inability to identify or delineate a population to obtain basic life history information can greatly limit the recovery of that species. Difficulty in confirming and delineating populations and the limited basic biological and ecological information on the Ivory-billed Woodpecker is therefore another primary factor that currently threatens our ability to recover the species.

Recovery Strategy

Our understanding of most aspects of the ecology and biology of the Ivory-billed Woodpecker is limited. It has proven extremely difficult to locate or relocate individuals despite extensive survey efforts. Much of what is known is derived from the studies by James Tanner (1942) on one small population and his rangewide evaluation of reports and habitat availability. Other information comes from knowledge of other Campephilus species, woodpeckers in general, interpretations of photographs, and anecdotes gathered by other observers. The current strategy must focus first on locating and confirming the presence of individuals. Then we can add to our knowledge about the ecology and biology of the species once a population is identified, providing a feasible approach to habitat protection, given its potential presence.

Our poor understanding of the species has largely directed the recovery strategy to one of learning more about the species status and ecology, rather than undertaking specific habitat management actions. Habitat management and land protection efforts are important, but the major focus is learning more about where the birds may persist, then examining those habitats to reveal ways in which specific conservation actions could be developed. Many of the potential recovery actions will be made only where a nest or roost is located or where there are new multiple sightings, video, physical evidence, or a photograph of a bird.

Spatially explicit, objective, and measurable population goals have not been identified. However, those goals are recognized as a key part of future recovery efforts. Habitat modeling and other analysis tools have been completed for Arkansas and other parts of the species' range. These models inform search efforts and broadly identify potential areas for conservation. Population modeling has provided an indication that the persistence of the Ivory-billed Woodpecker in low numbers throughout its range is possible (Mattson et al 2008). These efforts will help inform the development of spatially explicit, objective and measurable population and habitat goals for future recovery plans.

Recovery Goal

The goal of the Ivory-billed Woodpecker recovery program is to locate, 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. This goal is consistent with current requirements for all listed species.

Recovery Objectives

This recovery plan identifies many interim 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. Identify and delineate any existing populations
2. Identify and reduce risks to any existing population,
3. Protect and enhance suitable habitat once populations are identified, and;
4. Reduce or eliminate threats sufficiently to allow successful restoration of multiple populations when those populations are identified.

The emphasis in this recovery plan of documenting and conserving 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 does 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 1994). 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. Potential habitats for any occurrences of the species are surveyed.
2. Current habitat use and needs of any existing populations are determined.
3. Habitat on public land where

Ivory-bills are located is conserved and enhanced. If needed, more acreage is added to public habitat inventory via land acquisition from willing sellers

4. Habitat on private lands is conserved and enhanced through the use of voluntary agreements (e.g., conservation easements, habitat conservation plans) and public outreach to facilitate appropriate management actions.

5. Viability of any existing populations (numbers, breeding success, population genetics, and ecology) is analyzed.

6. The number and geographic distribution of subpopulations needed for a self-sustaining metapopulation and to evaluate suitable habitat for species reintroduction is determined.

Recovery Actions

The primary interim actions needed to accomplish delisting and/or downlisting recovery goals and achieve recovery criteria are:

1. Population surveys and monitoring in the historical range where habitat and sighting information indicate potential for the presence of the species

2. Habitat inventory and monitoring in the historical range of the species

3. Population and habitat modeling to facilitate survey efforts and to inform potential management actions

4. Research directed at testing biological assumptions otherwise implicit in modeling and management actions

5. Landscape characterization and assessment of the Mississippi Alluvial Valley and other areas of the historical range

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

9. Management of rediscovered populations and forested habitats to aid recovery

Total Estimated Cost of Recovery

The total estimated cost of recovering the Ivory-billed Woodpecker is unknown at this time because of our limited knowledge concerning its occurrence, distribution, and long-term actions required. See Appendix C for recovery and other expenditures to the date of drafting the plan.

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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 compelling evidence of the species was obtained in 2004 and announced in 2005 (Fitzpatrick et al. 2005). Observers reported multiple sightings and recorded audio and video interpreted to be an Ivory-billed Woodpecker within a section of Bayou DeView, located in the Cache River National Wildlife Refuge (NWR) in east-central Arkansas. This evidence is not universally accepted (Sibley et al 2006). While there continues to be disagreement as to the validity of this and other reports, the Fish and Wildlife Service has received sufficient information to warrant additional searches and preparation of a recovery plan. Please see Appendix B for a discussion.

The Fish and Wildlife Service recommend that the recovery strategy initially focus on completing surveys and studies to determine the species' status, distribution, ecology, and habitat relationships. Results from these investigations will help us formulate specific conservation actions for the species throughout its range in the United States. Specific population goals are not identified, but they are acknowledged as key to recovery. Recent efforts included development of predictive habitat models and additional research that will generate spatially-explicit population goals in the future, as needed. The recovery strategy contained in this recovery plan pertains only to the population of Ivory-billed Woodpeckers in the United States but could be applied to recovery efforts for the Cuban population of Ivory-billed Woodpecker. 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 (Thomas Barbour 1923 from Jackson 2004).

B. Species Description and Taxonomy

The Ivory-billed Woodpecker (*Campephilus principalis*) belongs to a genus composed of 11 species of woodpeckers inhabiting the Western Hemisphere—primarily Central and South America. Two forms of Ivory-billed Woodpecker have been recognized: the Continental subspecies, with a historical range covering most of the southeastern and a small portion of south-central United States (Figure 1), and the Cuban subspecies with a historical range throughout Cuba. The Cuban form has been recognized by some authors to be a distinct species, *C. bairdii* (American Ornithologists' Union 1983; Fleischer et al. 2006) while others define the 2 forms as subspecies -- *C. p. principalis* and *C. p. bairdii* (e.g., Integrated Taxonomic Information System 2008).

The Ivory-billed Woodpecker is noted for its striking black-and-white plumage; robust white, chisel-tipped bill; lemon-yellow eye; and pointed crest. 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 2).

The bases of the male's red crest feathers are white and may allow a spot of white to be displayed on the side of the crest when the feathers are fully erect. This trait 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 Ridgway, who collected specimens

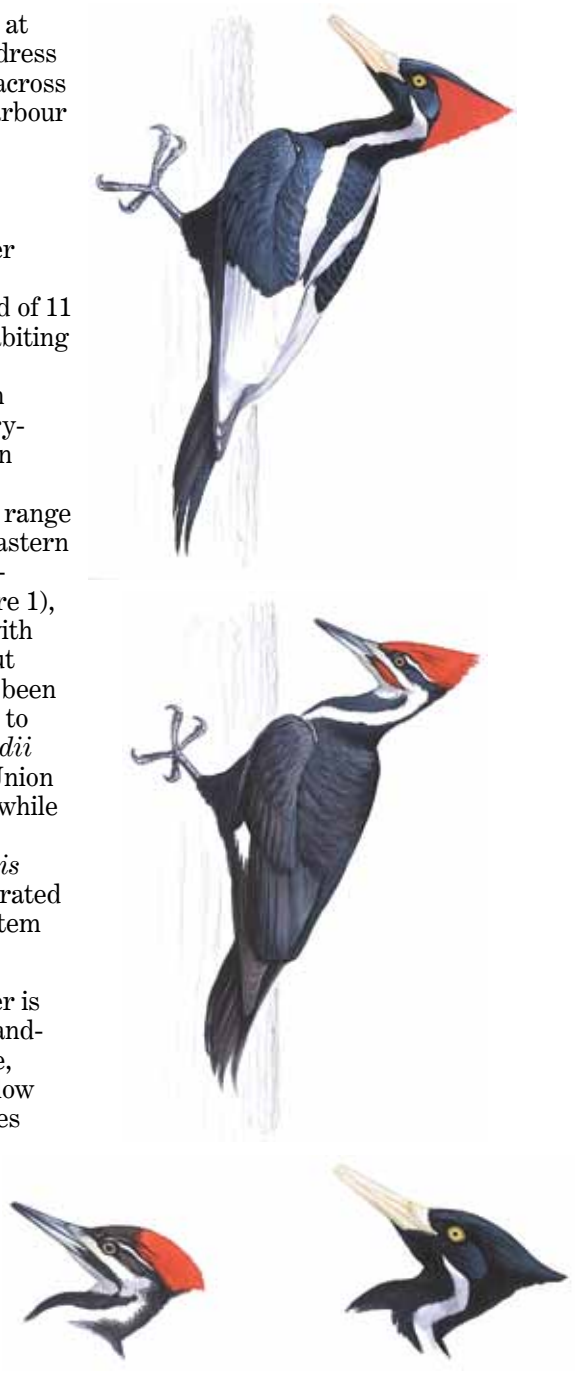

Figure 1. Male Ivory-billed Woodpecker perched (top) and Pileated Woodpecker perched (below). Heads of female Pileated Woodpecker (left) and female Ivory-billed Woodpecker (right). Copyright by David Allen Sibley.

(Ridgway 1914 from Tanner 1942). 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). These figures are based on values

of "1 pound" and "20 ounces" given in the historical records. However, no clearly documented data are 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.

The most commonly described Ivory-billed Woodpecker vocalization is a nasal "kent" call resembling the sound obtained by blowing on the mouthpiece of a saxophone or clarinet. 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-yent-yent" 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 double knocking characteristic of most members of the genus. This "rapping" is often described as a "double rap" or "double knock" since it consists of two rapid knocks. Raps may also occur singly. When taking flight, the Ivory-bill has been described to have noisy wing-beats. In direct flight they are said to have a rapid wing-beat as well as a slender appearance, resembling a Northern Pintail (Tanner 1942).

C. Status

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 current status of the U.S.

Figure 2. Comparison of the Ivory-billed Woodpecker (above) to the Pileated Woodpecker (below), both in flight. Copyright by David Allen Sibley.

population is limited and has been debated for many years. Some authorities suspect the species might persist in a few locations in Cuba (Garrido and Kirkconnell 2000, Kirkconnell, pers. comm.). Potential population size and distribution are not known. Since the last commonly agreed upon sightings of the species in Louisiana in the 1940s, there have been numerous reports of possible sightings and photographs as well as recordings of potential Ivory-billed Woodpecker vocalizations or double-knocks across the historical range of the species. These observations cannot be independently verified, but can be evaluated (Appendix E).

Compelling evidence of the species' existence was obtained when the Ivory-billed Woodpecker was reported in Arkansas and presented by Fitzpatrick et al. (2005). On February 11, 2004, kayaker Gene Sparling observed a large woodpecker with characteristics of an Ivory-billed Woodpecker in Arkansas. The encounter spurred an extensive search led by the Cornell Laboratory of Ornithology and the Arkansas Nature Conservancy. In 2004 and 2005 observers reported multiple sightings and recorded audio and video interpreted to be an Ivory-billed Woodpecker within the same area as Sparling along Bayou DeView, located in the Cache River National Wildlife Refuge (NWR) in east-central Arkansas. Interpretation of the video has been challenged by others (Jackson 2006, Sibley et al. 2006).

An alternative interpretation is that the recorded bird is a Pileated Woodpecker (*Dryocopus pileatus*). In rebuttal Fitzpatrick et al. (2006) provided additional analysis of the Arkansas video. An additional paper supporting Sibley et al. was published by Collinson (2007). Both Sibley et al. and Fitzpatrick et al. recognize that the identity of the woodpecker in question is not inherently obvious as either an Ivory-bill or a Pileated. Taking all information into consideration, the Service concurs with Fitzpatrick et al. (2006) that alternative explanations of the Luneau video are based on misinterpretations of video artifacts and faulty models of bird flight. Dispute in the ornithological community continues to the time of this writing. See Appendix B for additional detail.

Additional sightings and audio and video recordings from the search have suggested that the Ivory-billed Woodpecker may still persist. The Fish and Wildlife Service accepted the initial evidence of the presence of one bird in the Cache River National Wildlife Refuge and on the

basis of all available information believes that it is prudent to plan for the recovery of the species as part of our responsibilities under the ESA. Additionally, the Fish and Wildlife Service, in response to the potential that the species may exist in isolated locations in its former range, initiated region-wide search efforts with state and non-government partners. Initial searches and actions, as well as any others deemed necessary in the future, are consistent with our interpretations of the evidence, our responsibilities under the ESA, and the urgency of the situation.

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 will continue to be debate regarding the evidence. The Service recognizes and supports these exchanges of views on alternative interpretations as a part of the scientific process.

Every federally listed species is assigned a Recovery Priority Number (RPN) on a scale of 1 (indicating highest priority) to 18. The number assigned is based on first, the degree of threat to the entity (either high, moderate or low); second, the species' potential for recovery (either high or low); and, last, the listed entity's taxonomic level (either monotypic genus, species or subspecies) (U.S. Fish and Wildlife Service 1983a, 1983b). This is an internal review process, with the final number representing a set of values that the biologist assigns each of the 3 factors described in the prior sentence. Until 2005, the RPN for the Ivory-billed Woodpecker was 17 (indicating a low degree of threat and a low recovery potential for the species). We believe the more appropriate RPN for the Ivory-bill is currently a 5 (indicating a high degree of threat and a low recovery potential for this species) which more accurately reflects the significant reduction in the species' habitat and the general consensus over 60 years that it was near extinction (some think it is already extinct). Consequently, in November of 2005, the Service changed the RPN to 5; this change was also based on the 2004 sightings reported in Arkansas and a reassessment of the degree of threat to the species (U.S. Fish and Wildlife Service 2005). Specifically, an RPN of 5 means that a species' extinction is almost certain in the immediate future because of rapid population decline or habitat destruction (high degree of threat), and that the biological and ecological limiting factors are poorly understood; the threats to the species' existence are also poorly

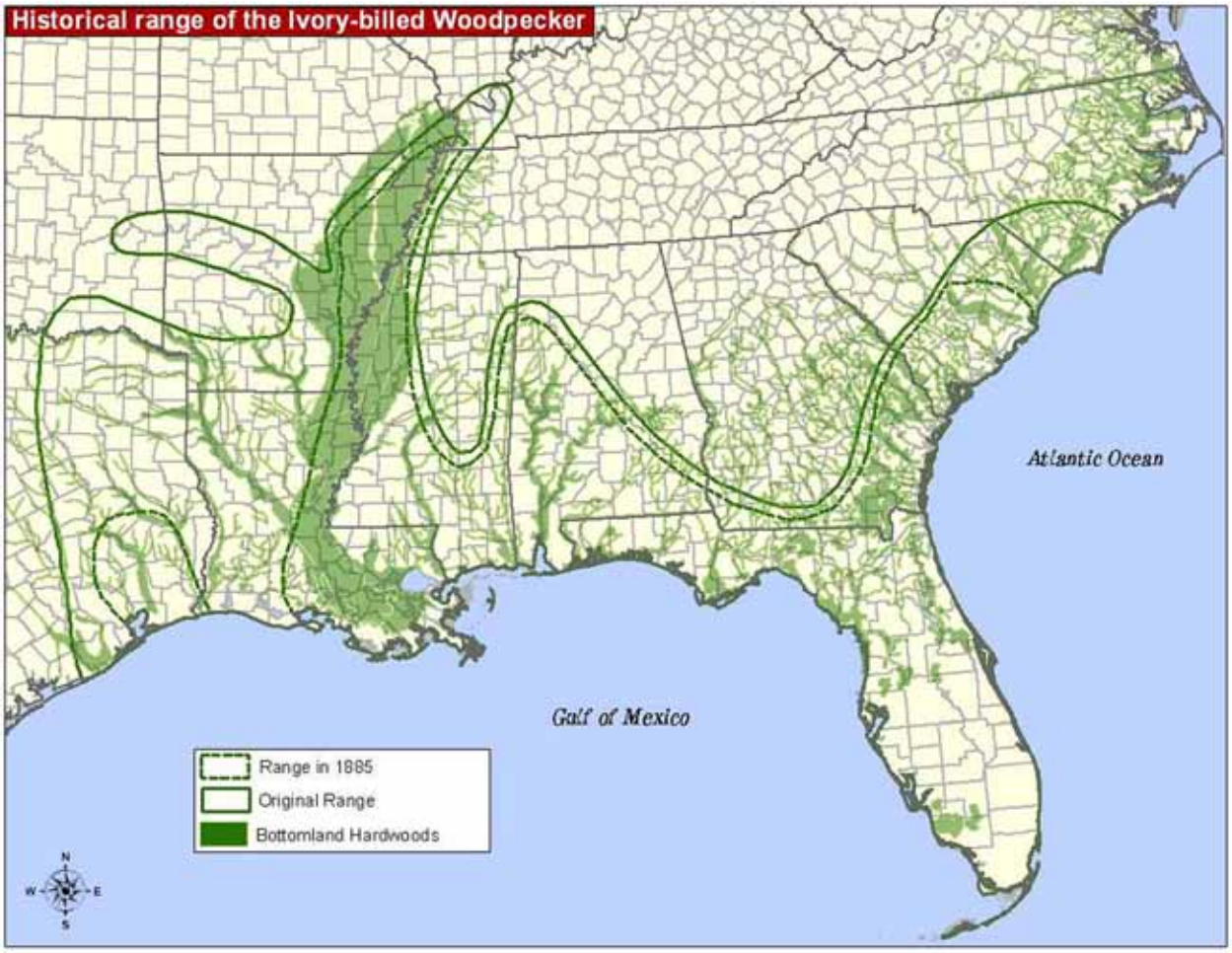

Figure 3. The Historical Range of the Ivory-billed Woodpecker according to Tanner.

understood or pervasive and difficult to alleviate; intensive management is needed, but the probability of success is uncertain; or the techniques needed to recover the species are unknown or experimental (low recovery potential). No critical habitat has been designated for this species and none is required due to the date of listing.

Search results since the original Arkansas report for the species in each of the states within the historical range is summarized below. These data were obtained from the state and university year-end search reports provided to the Service. Analysis of historical state records or sightings is included in Appendix E.

2005-2006

Led by the Cornell Laboratory of Ornithology, The Nature Conservancy, and Audubon Arkansas, the 2005-2006 search season focused on the Big Woods area in eastern Arkansas. Twenty-two full-time searchers, armed with state-of the art audio and video monitoring devices, searched portions of a 550,000-acre area including the Cache River NWR, White River NWR., Dagmar WMA, and other properties. The searchers were aided by volunteers who spent two weeks at a time searching the forest. Scientists from the Cornell Laboratory of Ornithology and researchers from several state and federal agencies have reviewed all evidence that was gathered during the previous winter's search season, including potential sightings, thousands of hours of audio recordings, and examinations of tree cavities, and bark scalings. Although the search resulted in no better documentation than previous searches, four potential sightings based on a single field mark were documented, and additional acoustic evidence was gathered from both the Cache River NWR and White River NWR. While this suggests that Ivory-billed Woodpeckers may be present in the Big Woods, the inability to relocate Ivory-billed Woodpeckers casts doubt on whether there are breeding pairs in the Big Woods.

In addition to Arkansas, state-led searches were conducted during the winter of 2005-2006 in South Carolina primarily at Congaree National Park, in Georgia at Okefenokee National Wildlife Refuge, and along the Louisiana-Mississippi border using ultralight aircraft over the Pearl River. Several other searches were undertaken because of recent possible encounters with Ivory-billed Woodpecker in other states within the species' historical range. No conclusive evidence emerged from these efforts, but information has been gathered that can be used to guide further searches in these states.

The most publicized search independent from state-led efforts was conducted in northwest Florida by Dr. Geoff Hill, Auburn University, and Dr. Daniel Mennill, University of Windsor, Ontario, Canada (Hill et al. 2006). Evidence to date is considered promising; however, the species' presence has not been confirmed.

2006-2007

Arkansas:

Cornell reported 6,033 hours of searches covering about 11,075 hectares. A robotic camera, developed by University of California Berkeley and Texas A&M University, was placed on Bayou DeView (powerline right-of-way between Stab and PawPaw lakes). One million images from 79 Reconyx ® camera deployments captured no potential Ivory-billed Woodpecker images.

The official search team logged 24 (13 acoustic, 11 visual) possible encounters during the five-month field season, none definitive. Six of these encounters were reported by members of the public. This includes two visuals in the Wattensaw WMA from Ross Everett, a duck hunter (12/31/2006, 3/25/2007), and Allan Mueller, retired Field Supervisor US Fish and Wildlife Service Arkansas Ecological Services (5/7/2007). Visual and acoustic encounters took place in both the Cache and White River National Wildlife Refuges as well.

Florida:

Florida Fish and Wildlife Conservation Commission staff and volunteers searched for the Ivory-billed Woodpecker in the Apalachicola and Chipola River Basins from January through early June 2007. They covered 23 2-square km search patches during an effort of approximately 820 hours in the field using 33 volunteers. There were no visual or audio detections of Ivory-billed Woodpeckers.

The Auburn University Search Group spent five months of searching the forested wetlands along the Choctawhatchee River on the Florida panhandle. On seven occasions, searchers saw what they identified as Ivory-billed Woodpeckers. On 47 occasions, searchers heard what they thought were kent calls or double knocks. Listening stations recorded 94 putative kent calls and 58 putative double knocks. These encounters provide additional evidence that Ivory-billed Woodpeckers may persist in the forests along the Choctawhatchee River.

A specific, reported encounter occurred on December 24, 2006, Tyler Hicks, an experienced birdwatcher, reported observing a female Ivory-billed Woodpecker perched on the trunk of a tree at a distance of 15 meters. Hicks stated he clearly saw a black crest, white dorsal stripes, an ivory-colored bill, and a large area of white across the lower portion of the folded wings of the bird. Hicks was drawn to the bird by kent calls, and two other observers heard kent calls and double knocks in the same area just prior to this sighting.

South Carolina:

Searching began on December 7, 2006, and ended on May 13, 2007. The TNC Crew, Cornell Mobile Search Team, the National Park Service and volunteer searchers logged 4190 hours covering Congaree National Park and public areas within the Wambaw Creek and the Pee Dee River system. No definitive encounter with an Ivory-billed Woodpecker was documented. A total of 1.3

million Reconyx® images were recorded. Analysis has provided images of only non-target woodpeckers, raptors, ducks, and mammals. Thirteen autonomous recording units were deployed, recording one kent call and three double knocks that were plausible signs of an Ivory-billed Woodpecker.

The majority of the search effort occurred in Congaree National Park. Thirty-one volunteers were utilized in the search efforts. A total of 15 participants reported 29 acoustic encounters consisting of kent calls or double knocks. Six of these occurred on May 11, 2007. One participant described briefly seeing a large black and white woodpecker with characteristics consistent with Ivory-billed Woodpecker in flight (February 11, 2007).

Tennessee:
Possible visual and auditory encounters in January 2006 on federal and private land led to research into the presence of Ivory-billed Woodpeckers in Tennessee. In addition, a follow-up on records submitted to the Cornell Ivory-billed Woodpecker sighting database has added great interest to two focal search areas in west Tennessee. The Tennessee Wildlife Resources Agency personnel focused their search on Meeman-Shelby Forest State Park and Shelby Forest WMA abutting a heavily forested landscape and the Mississippi River. About 100 hours was spent in the field conducting transects, kayaking, and sitting, watching, and listening in areas of interest. One possible single rap was heard by two observers.

About 102 hours of additional effort were spent searching and cavity monitoring on the Hatchie River, the Lower Hatchie NWR, and Chickasaw NWR. One Reconyx® camera was deployed for 13 days on private land, recording approximately 108,000 images. In the refuges, random GPS points on a 10 square chain spacing were assigned, then priority areas were searched. Cavity trees were monitored. In total, 46 transect days and 15 days of sitting and watching were completed on Lower Hatchie NWR. The crew surveyed 3,560 acres of federal land transects, 2,010 acres at Chickasaw NWR and 1,550 acres at Lower Hatchie NWR. Possible encounters include single and double raps heard on January 8th and 9th, 2007.

Texas:
Randomized patch surveys were completed in the Big Thicket National Preserve, Trinity River National Wildlife Refuge, and the adjacent Wallisville Lake Project. No encounters were recorded.

Cornell Mobile Search Team:
Total field effort was 469 person-days. A total distance of 3,566 km was covered by canoe or on foot during daylight hours. The four main study areas were Congaree National Park, SC (177 person days), Choctawhatchee River, FL (62 person days), Atchafalaya Basin, LA (51 person days) and the Apalachicola River basin, FL (40 person days). Another 10 areas, including Ebenezer Creek, GA, Big Thicket, TX, Santee, Wateree, and PeeDee Rivers, SC, Pearl River, LA, Pascagoula River, MS, and the Appalachicola and Escambia Rivers, FL were searched, consuming 3 to 36 person days each. No sightings of Ivory-billed Woodpeckers were made by the team, and no possible kent calls were heard. There were two incidents of possible double knocks heard by team members, on April 6th and 10th in Congaree National Park.

2007-2008

Arkansas:
The search team employed 6 full time members. The crew imitated double knocks, deployed cameras, walked transects, and did stationary watches. Bayou DeView (Cache River National Wildlife Refuge) and the White River National Wildlife Refuge were surveyed. This effort totaled 852 hours of stationary watches and 31,521 acres of visits. No responses to the double knocks were noted and no sightings were made by team members. On January 27, 2008, 3 sets of double knock sounds were heard on the White River National Wildlife Refuge.

Six days of helicopter surveys in these same areas were completed in cooperation with the USDA Forest Service, The Nature Conservancy, Arkansas Game and Fish Commission, Cornell Lab of Ornithology, and the Arkansas Natural Heritage Commission. These flights covered approximately 152,877 acres. No Ivory-billed Woodpeckers were photographed. Woodpecker flush rates were very low in comparison with known numbers. Although the birds sighted during the flights could be readily identified and photographed, a helicopter survey seems unproductive as a method for documenting an Ivory-bill.

Florida:
The Auburn search continued on the Choctawhatchee River. The search effort totaled 895 hours (149 search days). During this season 3 sightings that the group considers credible were reported. All activity (earlier video, double knock recordings, sound detections, and sightings) occurred in clusters.

South Carolina:
A total of 41 people participated in the 2007/2008 South Carolina Ivory-billed Woodpecker search from 26 November 2007 to 2 May 2008. A four-person full-time field crew, 36 volunteers, and a Student Conservation Association intern with Congaree National Park comprised the participants. The field crew searched a total of 1922.4 hours in Congaree National Park, the Francis Marion National Forest, and other areas of interest in the Lower Pee Dee and Little Pee Dee Basins. A total of 2.3 million Reconyx® camera images were obtained from the cameras during the search season, and review of these images for the presence of Ivory-billed Woodpeckers yielded no positive images. A total of 15 ARUs were deployed and analyzed by Cornell University. Of the 15 units deployed, 3 returned a total of 4 double-knock detection events. No positive encounters were obtained during the search season.

Tennessee:
Observers were in the field from March through mid-May 2008, averaging 2-3 people in the field. There were 4 ARU deployments as well as Reconyx® cameras at 2 locations. These recorded about 150,000 images with no positive results. A total of about 1000 man hours were spent on searches. The Lower Hatchie and 3 WMAs were surveyed. Double knock sounds, kent calls, and brief encounters continued to make this area interesting.

Texas:
Surveys were conducted in the Big Thicket National Preserve, the Trinity River NWR, and the Army Corps of Engineers Wallisville Lake Project, which is adjacent to the refuge on its southern boundary, and that contains 23,000 acres of unsurveyed bottomland forest and swamp. Conditions were moderately difficult due to forest damage from Hurricane Ike in mid September. These surveys will be concluded in March 2009. One possible brief visual encounter was noted in June 2007 at the Trinity River NWR, but no subsequent ones.

Louisiana:
Three sites in the Atchafalaya Basin and the Pearl River WMA were surveyed by helicopter. Approximately 646 miles of transects were completed in the period of January 28 to February 1, 2008. No Ivory-billed Woodpeckers were sighted or photographed. Opportunity for use of helicopters is limited by time, funding, and availability. Large numbers of other species of woodpeckers flushed, and were easily identified in the canopy cover.

The 1200-ha study area in St. Mary Parish, Louisiana was searched during December through May. Cavity and foraging sign inventories were conducted. 120 vegetation plots were also surveyed during this time. A total of 309 large cavities in 155 trees were located and their entrance dimensions estimated. Large cavities were overwhelmingly in cypresses, the vast majority living trees. Double-knock "playback" series were performed with a mechanical device. No Ivory-bills were sighted. No clear double-knocks were heard.

Illinois:
During the January-March season 1160 hours were spent on field surveys. No conclusive evidence was obtained from search effort or Reconyx @ camera deployments.

North Carolina:
The state group led by Audubon North Carolina, continues to follow-up on any credible sightings in the state and is doing surveys in the Juniper Creek area.

Cornell Mobile Search Team:
Areas surveyed included the Atchafalaya, Pascagoula, and Mobile River Basins. The effort totaled 414 person days.

Kentucky, Mississippi, and Georgia:
No searches were conducted in 2007-2008.

2008-9

Arkansas
The search used 4 methods which included 3 full-time paid searchers, volunteer searchers, increased local participation, and remote cameras. The effort took place from December 2008-May 2009 and was a partnership of the Cornell Laboratory of Ornithology, the U.S. Fish and Wildlife Service, Audubon Arkansas, the Arkansas Natural Heritage Commission, and the Arkansas Game and Fish Commission under the leadership of The Nature Conservancy. The three person full-time search crew was in the field daily (except on rainy days) and focused their efforts on following up on leads, searching previously uncovered or poorly searched sites, and visiting "traditional" hot spots. No Ivory-billed Woodpeckers were encountered.

Volunteer searches were designed around five Special Search Areas located in the White River National Wildlife Refuge – Maddox Bay, Mike Freeze/Wattensaw Wildlife Management Area, Cache River National Wildlife Refuge – Bayou DeView, Sheffield Nelson/Dagmar Wildlife Management Area, and White River National Wildlife Refuge - Prairie Lakes. Trained volunteers assigned to each area. A GPS unit was used to record IBWO encounters and cavities. Each volunteer had a high quality camera at all times, and used their own or boats supplied by Cornell and TNC. Untrained supplemental volunteers frequently assisted the trained volunteers.

Despite significant field efforts in past years, local hunters, anglers, and other outdoor recreation participants spent more time in the field than Ivory-billed Woodpecker search groups. The previous $10,000 reward amount did not generate enthusiasm from local users. The reward was increased to $50,000 which greatly increased the number of reports and generated a new wave of press coverage and publicity. The local community was then alerted to the continued interest in the scientific community in the Ivory-billed Woodpeckers. Several reports from the public were of high enough quality that we directed our searches to the areas of their reports, but none resulted in any detections or additional evidence.

During this search season there was no paid, full-time remote camera person. Several experienced partners coordinated this effort. Seventeen cameras were deployed on potential cavities and feeding sign. No Ivory-billed Woodpeckers were recorded.

Florida
A 23 mi^2 (60 km^2) area within the Choctawhatchee River Basin in Holmes, Washington, and Walton counties in Florida. This study site was limited to land owned by the Northwest Florida Water Management District within the Choctawhatchee River Basin. The main search areas included tributaries and distributaries Old Creek, Cypress Slough, Gum Creek, Yates Mill Creek,

Carlisle Lakes, and Bruce Creek, and the East River Island area. Eastern and western boundaries of the study site were defined by Northwest Florida Wildlife Management District property.

The search used a multistrata sampling design to search for Ivory-billed Woodpeckers and all other bird species during the search season from January 4, 2009 to May 1, 2009. To conform to the floodplain of the Choctawhatchee River, the study area was divided into 0.077 mi ^{2} (0.25-km^2) grids. All bird species detected were noted using a checklist of species. Within each search grid we also repeatedly surveyed 100 sites using randomly placed point transects from January 4, 2009 through February 25, 2009. Each point was surveyed using three consecutive 10-min point counts on two different days, totaling six counts. Technicians were ordered to immediately abandon point counts if they heard or saw anything that suggested an Ivory-billed Woodpecker. Each technician set and monitored three Reconyx ® cameras set to record time-lapse surveillance of cavities as well as seismically triggered targets.

Seismically triggered configurations were used on large woodpecker foraging sign that is frequently found on dead trees. After morning point counts, while searching their assigned grid, each technician also searched for potential foraging sites and cavities. From February 26 to March 31, point counts were halted and remaining surveys were 0.77 mi^2 (2-km^2) grids searches and Reconyx ® camera surveillance.

The search team did not detect any Ivory-billed Woodpeckers during search season. Zero sightings and sound detections were recorded. Although our seismically triggered cameras photographed many species of woodpecker, no ivorybill pictures were obtained.

Seismically triggered cameras appear to be a low-cost approach

Figure 4. James T. Tanner, 1935. Photo by Arthur Allen/Copyright Cornell Lab of Ornithology

to obtaining a photograph of an Ivory-billed Woodpecker. This method obtained numerous photographs of Pileated Woodpeckers, Red-bellied Woodpeckers, and Northern Flickers. These cameras are capable of monitoring a foraging site for over two months with no maintenance. The cameras must be set with the appropriate sensitivity. After a period of learning the appropriate settings, the average deployment of two weeks resulted in only about ten photographs of which approximately 30% were woodpeckers. This compares to a burdensome analysis of 20,000 images from a three-day time lapse camera deployment. Images were in 3.1 megapixel color images were sufficient for clear identification of woodpeckers in images.

Future searches could invest in Reconyx ® cameras with more reliable wireless seismic triggers. Such monitoring could be incorporated into any bottomland monitoring projects range wide at low cost compared to the cost of sustaining large scale search efforts.

South Carolina

The Cornell Mobile Search Team (MST) crew arrived on March 23, 2009, and searched through March 25, 2009. During 2009, searches were conducted within the Santee River Basin in the Francis Marion National Forest and adjacent areas along the lower Santee River; within the Congaree River Basin in Congaree National Park; within the Savannah River Basin in the Savannah River National Wildlife Refuge, and on small public and private lands locations along the lower Savannah River. A total of 750 survey hours were dedicated to searches in these three main areas. Active transect surveys, double-knock (DK) trials at a total of 296 stations, and stationary watches of open vistas in high quality habitat, and observation of large cavities were conducted throughout each search area. Autonomous Recording Units (ARUs) and remote cameras were not deployed in South Carolina as part of the Ivory-billed Woodpecker 2009 search effort. On April 4th, a Pileated Woodpecker was observed performing a "double-knock" in Congaree National Park. The observer witnessed it through binoculars from a distance of about 30 yards. It did not appear that the bird was disrupted during the display. There were other calling Pileated Woodpeckers in the area. The double-knock was muffled but could be heard easily at a distance of about 30 yards.

No Ivory-billed Woodpecker detections were made within the Santee River Basin, Congaree National Park, or the Savannah River Basin.

Tennessee

There was a reduced search effort in 2009. Two part-time, contract searchers performed 48 days of field work. Approximately 80 field days from February through April 2009 were completed. Methods included sitting observation periods over a 5 section grid of the area. Searchers attempted to equally divide their effort across sections. No standardized searches for cavities were conducted and no Reconyx ® cameras or Autonomic Recording Units were deployed. Double knock simulations were

conducted on several mornings. On two occasions, suspicious knocks resembling *Campephilus* were encountered. Follow up searching did not yield additional evidence.

The search group still feels confident that an as yet unidentified species of bird that makes *Campephilus* double knocks in isolation from other calls infrequently uses the area. In 2008, there appeared to be more regular use of the site than in 2009.

Texas

A team of two field technicians began work in September 2008. Field work continued, using the habitat model protocols, through February 2009. Vegetation profiles, data entry, and organization of GIS data gathered during the full time field season have continued through 2009. The Trinity River National Wildlife Refuge and two adjoining tracts will have been profiled.

Louisiana

The Pearl and Atchafalaya river basins in Louisiana represent our last large tracts of contiguous bottomland hardwood and cypress-tupelo swamps in Louisiana. The most detailed reported public sightings have come from areas in the Atchafalaya River and Pearl River basins, although an occasional report has come from areas around the confluence of the Mississippi, Red, and Atchafalaya. These reported sightings led to the interest in performing additional surveys of these areas for the Ivory-billed Woodpecker.

Aerial Transects, spaced at 1,500-ft intervals in parallel north/south lines, were surveyed over the Pearl River Wildlife Management Area, 2 sites in the Atchafalaya Basin, and in an area of the confluence of the Pearl, Mississippi, and Red River basins. Surveys were completed using a Bell Jet Ranger helicopter carrying 3 biologists and an experienced pilot. Numbers and species of all birds observed were recorded. Transect were flown at an altitude of 150 feet and at a speed of 40 knots. Observers focused their attention in forested habitats on a narrow swath no more than approximately 100 feet on either side of the helicopter. Approximately 900 miles of transects were flown in 2 areas of the Atchafalaya River Basin (Duck Lake, and Bayou Sorrel), one area in the Pearl River Basin (Pearl River Wildlife Management Area), 2 areas in Three Rivers Wildlife Management Area, and one area in Red River Wildlife Management Area. Flights were conducted January 28 through February 4, 2009.

A total of 6,680 individuals of 43 avian taxa were recorded from 134 transects on 6 sites. No Ivory-billed Woodpeckers were observed. However, 4 other woodpecker species (Northern Flicker, Pileated Woodpecker, Red-bellied Woodpecker, and Red-headed Woodpecker) were readily identified. Individuals were conspicuous and frequently observed, as they flew within the canopy of the cypress-tupelo and bottomland hardwood forest of the study areas. The implication of these observations is that, had an Ivory-billed Woodpecker been flushed below the helicopter, it would have been detected by the crew. Numerous Red-bellied Woodpeckers were observed, a considerably smaller and probably much less detectable species, which lends credibility to the use of helicopters as an investigative tool for an Ivory-billed Woodpecker search.

Illinois

From January through June 2009, totals of 4,200 person-hours in the field and 400 person-hours screening digital images were spent searching for Ivory-billed Woodpeckers in Illinois. The systematic search effort included 10-0.77 mi^2 (2-$km^{2)}$ plots of bottomland forest, 140 winter point-counts across the 10 plots, and deployment of color Reconyx ® cameras to trees with large cavities or bark scaling. In addition, 15 sites in mature bottomland and swamp forest habitat during spring migration and the early breeding season were passively searched. Over 1.2 million Reconyx ® images were screened. No compelling sightings were noted and no evidence of the presence of an Ivory-billed Woodpecker within the areas was found.

North Carolina

Search for evidence of the Ivory-billed Woodpecker (IBWO) along the Waccamaw River and Juniper Creek (Brunswick and Columbus County, NC) began in January 2008. Effort increased in October and continued through May 2009. Daily trips involved canoeing and/or hiking to a gridded, randomly selected GPS point, and conducting a 10-minute point count and 2-hour sit at each waypoint. During this time all birds heard or seen were recorded. After each 2-hour sit, transects were walked through a 40 acre plot, marked by waypoints at each corner. Within each plot, any evidence suggestive of a potential IBWO was photographed and its coordinates were recorded.

After conducting 107 point counts, with nearly as many 2-hour sits and plots searched, there were no visual or auditory detections suggesting the presence of an Ivory-billed Woodpecker within the swamps of the Waccamaw River and Juniper Creek. Less than ten large cavities were documented, but none exemplifying the size and shape associated with the Ivory-billed Woodpecker. Plots surrounding these cavities were canvassed, and point counts/2-hour sits were conducted at surrounding waypoints.

In addition to surveying the habitat, local residents were questioned about the Ivory-billed Woodpecker. All those questioned who had a firm knowledge of the surrounding swamp and had resided in the area for much, if not all, of their lives were able to recognize the Pileated Woodpecker as a bird that they frequently see. Some were familiar with its scaling habits and call. Some individuals distinguished plumage differences between Ivory-

billed Woodpeckers and Pileated Woodpeckers in photographs. All concluded that they had never seen an Ivory-billed Woodpecker.

A portion of the Lumber River was searched by canoe; however this effort did not involve 2-hour sits or area searches. There were no detections.

Mississippi
A 4 person team surveyed the bottomland hardwood forests of the Pascagoula River Basin between January 22 and March 20, 2009 under the coordination and logistic support of the University of Southern Mississippi and the Mississippi Department of Wildlife, Fisheries and Parks. Survey areas included the entire Upper and Lower Pascagoula Wildlife Management Area and parts of the Ward Bayou Wildlife Management Area and The Nature Conservancy's Charles Deaton Preserve and Herman Murrah Preserve. The team spent 1150 hours searching, mostly on foot. Of the 43 patches searched (total area: approx. 14500 ha) 38 were high quality and 5 were low quality patches. 5% search effort was dedicated for the low quality patches. The region was impacted by Hurricane Katrina in 2005 and the resulting damage in the forests still supports an abundant woodpecker community. However, the search produced no evidence that the Ivory-billed Woodpecker.

Cornell Mobile Search Team Search Team:
The Mobile Search Team worked in southern Florida from January 3 through March 16, 2009 with a crew of seven, and in South Carolina from March 23 through April 29 with a crew of four.

In south Florida the team explored areas with Ivory-billed Woodpecker specimen and sighting records, and areas that were remote, had large trees and/or concentrations of dead trees. Many of the search areas were difficult to access but were reached with logistical support from Florida partners. Habitats explored included old-growth mangrove stands, mangrove forests with large numbers of trees killed by hurricanes and lightning strikes, large expanses of recently burnt pine forests, cabbage palm stands, hardwood hammocks with big oaks and maples, and cypress strands with trees up to 59 inches dbh. The congregation of these quality habitats, and its location within large contiguous protected areas, indicates a high potential to support Ivory-billed Woodpecker. Nevertheless, even in areas most difficult to access, such as the Gator Hook and Sig Walker cypress strands, there are old signs of selective logging during ca. the 1920s and 1930s. Access by tram lines was available to collectors and trophy hunters in those years, and cypress were selectively logged. Pine forests in the region offer good habitat now but were intensively logged in the 20th century. Double knock imitations were done at 1,744 stations spaced in distance and time, and no responses of interest were recorded. Several cavities of the appropriate size and shape for Ivory-billed Woodpecker were found, but were not in use, and these cavities can be old, or exceptionally large Pileated Woodpecker cavities, or mammal-enlarged PIWO cavities. The team did not observe Ivory-billed Woodpeckers.

Given the results, it is unlikely an Ivory-billed Woodpecker population of a meaningful size exists in south Florida. The habitat in its current state has a lot of potential and South Florida parks, preserves, agencies, and birders should remain attentive to reports of the species in the region.

In South Carolina, the team worked in the Congaree and lower Santee River basins to follow up on Ivory-billed Woodpecker reports from 2009 and 2007, respectively. The Savannah River was explored because it showed up as potential habitat in the Forest Service model of Forest Inventory and Analysis data.

Kentucky, Georgia
No searches were conducted in 2008-2009

General Observations
During the searches, many large cavities and feeding signs similar to what James Tanner described in Louisiana's Singer Tract were noted. Though some of these observations remain interesting, none of these "signs" can be attributed with certainty to Ivory-billed Woodpecker nesting or feeding activity. This type of information was used to help search groups focus in particular areas or determine remote camera placement. Acoustic encounters were treated in the same manner. Though several recordings are similar to historical recordings of "kent" calls or match the "double knocks" of other *Campephilus* woodpeckers, this information remains useful, but is not a confirmation of the presence of the Ivory-bill.

The results of searches already conducted suggest it is likely that any extant populations of Ivory-bills are extremely small. Potential remaining habitat for this species has been preliminarily identified, and work is underway to refine methods which will aid in identifying what we believe is the best 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 populations, if they are there, will increase in number.

D. Population Trend and Historical Distribution

The extreme rarity of the species for over a hundred years has resulted in a lack of population data which could be used to establish a definitive trend in population size or distribution. It is possible to sketch a distribution of the historic range in the U.S. on the basis of museum records and the observations of early explorers and naturalists. The Ivory-billed Woodpecker appears to have been relatively widespread throughout the southeastern United States prior

to European settlement (Figure 3). 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 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). Archaeological evidence indicates that the Ivory-billed Woodpecker may have occurred eastward to southern Ohio and north along the Mississippi River to the St. Louis, Missouri area at least 300 years prior to European settlement (Warner, pers. comm., J. L. Murphy and J. Farrand, Jr. 1979 from Jackson 2004).

Population numbers prior to European settlement will never be known. According to Warner (pers. comm. Appendix D, p. 85), the common farming practices (e.g., girdling trees to create openings) of Native Americans may have provided a rich food source for woodpeckers along river bottoms. Ivory-billed Woodpecker declines corresponded closely with European settlement and the clearing and alteration of forest habitats (Appendix E). The long-term decline in habitats important to the Ivory-billed Woodpecker began in the early 1800s with essentially all of the historical range affected in some way by the early 20th Century. This impact also increased access for hunting the species for curiosity, food, and collection for private and public museums. Through the early 1940s, there was a gradual decrease in the number of specimen and sight records. The last commonly agreed upon sighting was in the Tensas River region of northeastern Louisiana in April 1944.

Tanner (1942) estimates that Ivory-billed Woodpecker density ranged from 1 breeding pair per 15.5 square kilometers (6 square miles [about 4,000 acres of mixed upland pine and bottomland forest in Florida]) to 1 breeding pair per 44 square kilometers (17 square miles or about 11,000 acres of bottomland forest in Louisiana). Thus, 50 breeding pairs of Ivory-billed Woodpecker in the late 1930s would need 777 square kilometers (300 square miles or about 200,000 acres) of habitat in Florida or 2,201 square kilometers (850 square miles or about 550,000 acres) in Louisiana. Snyder (2007) argues that these estimates are inaccurate. Since Tanner's study in Louisiana was based on very few birds in an altered landscape, it should be used for information and guidance only. If populations persist today, the needs of individuals and family groups could be very different (Tanner 1942, p. XII).

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 larger than a Pileated Woodpecker. Weights are reported at 454 and 567 grams (16 and 20 ounces) in historical records (Jackson 2002). Therefore, an Ivory-bill should require a greater amount of food to maintain its body mass and feed its young than a Pileated Woodpecker. This greater food demand suggests that an Ivory-billed Woodpecker must range farther and may be more sensitive to habitat alterations than the Pileated Woodpecker. That Ivory-bills have relatively large home ranges and a sensitivity to habitat alterations is further supported by the fact that three other very large woodpecker species that weigh over 400 g (13 ounces) (Lammertink 2007) also have large home ranges and are sensitive to habitat alterations. The Ivory-billed Woodpecker was known to fly distances of at least several kilometers each day between favored roost sites and feeding areas. Such movements are associated with maintaining large home ranges. However, information on daily movements is limited to Tanner's study.

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. Such trees 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 (Tanner 1942).

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). Ivory-billed Woodpeckers could have expanded home range sizes in sub-optimal habitats, such as in the regenerating southern forests. If Ivory-billed Woodpeckers reduced densities five-fold as observed in the Bornean study of Great Slaty Woodpeckers, core home ranges of Ivory-billed Woodpeckers could be up to 52 square kilometers (20 square miles) and home range densities might be as low as +one per 220 square kilometers (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 (Scott et al. 2008, Mattson et al. 2008).

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 from eight collected birds (Jackson 2002). Large beetle larvae appear to be an important component of the diet throughout the year, but especially during breeding when feeding young with potentially high energetic demands (at least more so when compared with the young of the smaller Pileated Woodpecker). These beetle larvae are obtained according to Tanner (1942) primarily by stripping large pieces of bark from recently dead or dying tree trunks and branches as well as by the more typical woodpecker approach of excavating rotted wood. Most notable in both the stomachs of collected birds as well as remains in nests were the members of the beetle family *Cerambycidae* (long-horned and roundheaded borers), but many other species of wood-boring larvae also have been documented in the diet. In addition to animal matter, the contents of three stomachs examined in detail from birds collected outside the breeding season (1 during August, 2 during November; described in Tanner 1942, Jackson 2002), illustrated a high percentage and broad range of vegetable matter was also eaten when available. Included in these stomachs, with anecdotal observations from others, were various nuts, such as pecans and acorn, and fruits and seeds, such as from hackberry, persimmon, wild grape, poison ivy, magnolia, black gum, and tupelo. Due to the paucity of data on food items actually consumed by the Ivory-billed Woodpecker, only limited conclusions can be drawn concerning preferences. Current research projects with Pileated Woodpecker and with the community of wood-borers associated with decaying wood in bottomland forests may shed additional light on this issue (see Appendix D).

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 diameters of Ivory-billed Woodpecker nest cavities that have been measured ranged from 17.8 to 26.7 cm with a possible depth from roof to floor of 44.4 to 63.5 cm. The outside diameters of the limb supporting the cavities ranged 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 such as the Megallanic Woodpecker (*Campephilus magellanicus*), members of a pair sometimes roost together (Ojeda 2004). Tanner (1942) and Allen and Kellogg (1937) found that pairs 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 if it parallels the measured incubation period of the Magellanic Woodpecker, it takes about 20 days. This also approximates Tanner's estimate (1942) for the gestation period of an Ivory-billed Woodpecker. Both sexes of the Ivory-bill incubate the eggs, and Tanner documented that 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 only quantified data regarding reproductive success for the Ivory-billed Woodpecker is from Tanner (1942). While he reported little difference between the average number of young fledged per successful nesting effort from 1931-1939 between Ivory-billed Woodpecker and Pileated Woodpecker (Tanner 1942, p. 81), it is important to note that most of the successful nesting efforts were based year-after-year from only one of the seven areas at Singer Tract supporting Ivory-bills (John's Bayou, p. 39), with no more than two successful nests in any one year between 1934 and 1939. While he identified up to seven potential family groups during this six year period, only three of the seven produced young in at least one year. Ultimately during the period of 1934-1939, 9 of the 16 young observed came from one

area (again John's Bayou), and 6 from another area (Mack's Bayou combined with Titepaper), with the other five areas mostly failing to produce any young (the only exception being Bayou Despair in 1937).

No incidences of predation on Ivory-billed Woodpecker are known, and it is likely that natural predators are few. However, nest predators could have had an impact on the species' decline under certain conditions. Typical nest predators, such as squirrels, raccoons and rat snakes could prey on nestlings or eggs while birds, such as Great Horned Owls (*Bubo virginianus*), Barred Owls (*Strix varia*), and Red-shouldered Hawks (*Buteo lineatus*) could prey upon recently fledged birds. Ivory-billed Woodpeckers could also be killed by sudden catastrophic damage to nest or roost trees (e.g., lightning strike, hurricane or tornado winds) and by disease, such as West Nile Virus and Avian flu.

Humans have killed the bird for the usual 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 historical observations, the work of James Tanner, and current reports from sites where observers may have encountered the bird. Any surviving birds may have persisted under less than optimal conditions if historical assumptions—and those of Tanner—regarding the needs of the Ivory-bill are accurate. Therefore any future habitat protection and management will require consideration that much is unknown about the bird's habitat requirements, as well as comparison and evaluation of what is understood.

1. General Observations on Historical Conditions

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 of Tanner's study may not have been typical or preferred by the species. The habitat may have been occupied simply because it was the last suitable habitat available. However, the Lentz (1928) report stated that hardwood and woodland areas accounted for 81 percent of the parish, and of that 67% was classified as virgin timber. Additionally, the specimen record shows that at least in the case of the Tensas basin, Ivory-billed Woodpeckers were known to populate the area long before significant logging and human encroachment was a factor (Roaring Bayou:1899, 3 birds. West Carroll Parish: 1903, 1 bird. Madison Parish: 1908, 1909, 1891, 4 birds, et al.). In 1938, the R. K. Winters report estimated that 2,682,700 acres were hardwood timberlands (69% of the delta), of which 577,600 acres was considered uncut old-growth and was available to wildlife in the north Louisiana delta.

Literature on habitat characteristics favored by the Ivory-billed Woodpecker creates the impression that this species was associated with expansive patches of uncut forests with a relatively high proportion of very large and old trees. These types of forest areas, in general, support a high proportion of dead and dying trees and it stands to reason that the Ivory-billed Woodpecker, as one of the largest picids, may have particular food demands that are only met in large tracts of mature forest during at least part of its life cycle.

However, the importance of uncut forests may be only part of the habitat requirements of this species. Additionally, the species may have sought older forests subjected to recent catastrophic events such as drought, fire, hurricanes, tornadoes, ice storms, and flooding, leading to the death of large patches of trees. In more modern times, Tanner documented that Ivory-billed Woodpeckers used forests that had undergone some 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. These observations do not in any way 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 forests) likely led to this species' overall decline and extirpation throughout much of the historical range (Tanner 1942, Jackson 2004).

Although most records and reports have been from bottomland forests, the literature suggests 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). Observers noted Ivory-billed Woodpeckers foraging on "very small" to medium diameter pines, recently killed by fire (from Florida and Cuba; Allen and Kellogg 1937, Dennis 1948, Lamb 1957).

In many cases, occurrences in pines were associated with fire-killed trees, often adjacent to bottomland forests. 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. These disturbances led to the availability of many recently dead and dying trees, which in turn, supported

the beetle larvae (protein) considered by many to be essential forage for the successful fledging of young woodpeckers.

2. James Tanner's Observations on the Singer Tract

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).

James Tanner's 1942 report is based on his observations in the Singer Tract of northeastern Louisiana (now Tensas River NWR), 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 the time of his writing. It is the best available source of historical information. Tanner reported that the sweetgum/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 was rarely used 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 were preferred 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 trees represented about 18% of forest composition. Thirty-five percent of the feeding took place on trees that were between 24-36 in dbh. Trees this size made up about 5% of the overall forest. Tanner notes that on the Singer Tract 87% of the foraging was observed on the largest trees, comprising 25% of the total trees available for foraging. However, the smallest trees also were utilized. Foraging occurred on trees 3-12" dbh over three times as often as on the largest trees 36+" dbh. Tanner also found that sweetgum was the most common 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 often selected tree by Ivory-bills at 27% of observations compared with about 11% availability in the forest.

While forest inventories in the area during the 1920s and 1930s indicate that the extent of virgin forest specifically on the Singer Tract appears to have been overestimated by Tanner, it is clear that this forest was within an area containing some of the largest acreage of older-growth forest remaining in the Mississippi Alluvial Valley (Lentz 1928, Winters et al. 1938, Pough 1944). Winters et al. (1938) reported in northeast Louisiana that at the time of Tanner's study 577,600 acres out of 2.68 million acres of forest cover were classified as "uncut old growth," but most of this virgin forest was habitat typically not being used by Ivory-billed Woodpecker, including cypress-tupelo and overcup oak-water hickory. Almost all bottomland forest in the Mississippi Alluvial Valley, if not the entire historicl range of the Ivory-billed woodpecker, had been cut over, cleared for agriculture, or otherwise damaged from fire by the 1930s.

3. Ivory-bill Habitat Along Bayou DeView

The forest along Bayou DeView is relatively narrow (about one mile wide) through Cache River NWR and Benson Creek State Natural Area surrounded by agriculture, with the forest along Bayou DeView expanding within Dagmar Wildlife Management Area (WMA). Specifically all of the published sightings of the Ivory-billed Woodpecker and the Luneau video during 2004 and 2005 at Bayou DeView were within Cache River NWR in the tupelo/bald cypress swamps. As described in the previous section, cypress-tupelo swamp was a rarely used habitat according to Tanner (1942). After 2005, additional sightings and auditory evidence came from along the White River from Wattensaw WMA (directly west of Bayou DeView) and at the southern end of the White River NWR where bottomland hardwood forests is more prevalent and more typical of what Tanner described as optimal habitat for this species (see Appendix H).

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 DeView 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 stands now extant. These forests located above the normal floodplain were mostly hardwood containing mature sweetgum, willow oak (*Quercus phellos*), water oak (*Quercus*

nigra), Nuttall oak, sugarberry (*Celtis laevigata*), American elm (*Ulmus americana*), post oak (*Quercus stellata*), white oak (*Quercus alba*), and other common hardwood species, with scattered pockets harboring native loblolly pine (*Pinus taeda*). As the demand for agricultural land increased more of the surrounding forests were cleared. From approximately 1960 to 1970 the swamps of Bayou DeView were extensively logged again; this time removing more tupelo (*Nyssa aquatica*) than baldcypress (*Taxodium distichum*). 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 (U.S. Fish and Wildlife Service 1985).

4. History of Habitat Rangewide (for individual records and sightings see Appendix E)

Alabama

Data on the original range of the Ivory-billed Woodpecker in Alabama is meager. Published records and the historical range of the species in surrounding states would suggest that the suitable habitat was located in the eastern gulf coastal plain of Alabama south of the fall line (the area where continental bedrock meets coastal plain). It was likely found in forests along major riverine systems in the west and south and in extensive longleaf pine (*Pinus palustris*) forests in the southeast. Available data indicates that by 1850 its main center of distribution in Alabama was severely restricted. Six records of the species are from the once vast forested areas drained by the Tombigbee and Alabama Rivers in west Alabama.

Florida

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 of flat, poorly drained limestone topography in the southwestern part of the peninsula (Duever et al. 1986). Tanner (1942) stated 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 appeared to be old-growth forest, including, and perhaps favoring (Jackson 1996), the ecotone between bottomlands and uplands.

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 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 the floodplains of major river systems, including the Okefenokee Swamp in extreme southeast Georgia (Tanner 1942, Burleigh 1958, Jackson 2002). In addition, areas of mature pine surrounding large expanses of bottomland hardwoods were apparently used for foraging. 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.

Illinois

The northern extent of the historical range of the Ivory-billed Woodpecker was thought to include the southern tip of Illinois, particularly along the Mississippi and Ohio Rivers. Audubon noted seeing Ivory-billed Woodpeckers along the Mississippi River from near the confluence of the Ohio and Mississippi Rivers to as far north as the Missouri River, and Robert Ridgway believed that he saw one not far from the confluence of the Wabash and Ohio Rivers in the mid-1800s (Jackson 2004). There is little to no information available on habitat use or historic numbers of birds in these areas, but these birds likely occurred in the once-vast bottomland forests associated with the floodplains of these major river systems. What little old-growth bottomland forest remains in Illinois is moderately to highly fragmented and found primarily in the Cache River watershed in southernmost Illinois. There are presently several thousand acres of old-growth and mature bottomland/swamp forest along the Cache River in Illinois, and an ongoing effort by conservationists has resulted in the conversion of over 15,000 acres of agricultural land to early-successional bottomland forest within the watershed during the past 20 years.

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 (*Pinus spp.*), oak-pine, chestnut oak (*Quercus prinus*), scarlet oak (*Quercus coccinea*), white oak, and mixed mesophytic (not particularly dry or wet)

forest. Pre-colonial Ivory-billed Woodpecker populations could have extended up the Ohio River and its tributaries. Due to the lack of documentation of the Ivory-billed Woodpecker in Kentucky, it is impossible to determine range changes over time. By the early 1800s, the Ivory-billed Woodpecker had all but disappeared from the majority of Kentucky's landscape, with some residual numbers remaining until the early 1870s in Fulton County.

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. Specimens 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. Specimens and sightings were reported from the bottomland forests along the Mississippi River and Atchafalaya River 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 in 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 universally accepted 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).

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 E). 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 E). Areas with reported encounters since 1944 include the Pearl, Pascagoula, Leaf, Big Black, Noxubee, Yazoo and Mississippi rivers.

North Carolina

One definitive record (Jackson 2002), from Alexander Wilson, was from the Wilmington area around 1800. Wilmington is near the primary river system in the southeastern corner of North Carolina, which includes the Waccamaw and the Lumber Rivers.

South Carolina

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 was due to the encroachment of civilization. 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 longleaf 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, the Chicago fire, and World War II. Tanner reported Ivory-billed Woodpecker suitable range was decreasing due to logging operations in the Santee River swamp around 1939.

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-acre 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 NWR, and some private tracts) but some harvest has continued.

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 because of 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 recorded sightings were located in the area that is now flooded.

Bottomland hardwood habitat is still present along the Congaree-Wateree-Upper Santee Rivers, Savannah River, and Waccamaw Complex. The Savannah River and Waccamaw Complex are predominately in private ownership, and much of the remaining mature bottomlands are contained within easements, public lands, and some large plantations along the Savannah River.

Tennessee

While Ivory-billed Woodpeckers almost certainly occurred in bottomland hardwood forests of Tennessee historically, no definitive records from the state are known. Audubon reported Ivory-billed Woodpeckers, for example, from a flatboat while traveling the Mississippi River during the winter of 1820–1821 (Corning 1929). 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.

Habitat was very likely limited to the relatively few acres of bottomland hardwood forest in Tennessee occurring within the floodplain of the Mississippi River and its tributaries. By the end of the 1940s, intensive logging practices further reduced possible Ivory-billed Woodpecker habitat in the state.

Texas

According to Oberholser (1974) the Ivory-billed Woodpecker was never common in Texas. Records exist from only 16 counties in the state restricted to areas east of the Brazos River. Tanner's publication indicates breeding records along the Brazos and Neches rivers in the 1880s. Most accounts 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. Forests throughout eastern Texas were greatly reduced and fragmented before World War II. Agriculture, logging, and reservoir construction were the main causes. However, some large forested tracts remained along the river bottoms of eastern Texas until the 1960s when the Sam Rayburn and Toledo Bend Reservoirs were constructed. Unconfirmed accounts of locations persisted from 1956 into the 1970s, mostly along the Neches and Trinity Rivers and Village Creek in the region known as the "big thicket."

5. Current Conditions in the area of Cache River NWR in Arkansas

Currently the Bayou DeView 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 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 large relic baldcypress and tupelo that are several centuries old, with some cypress over 1000 years old. The interconnected channels of Bayou DeView 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 sweetgum, green ash, overcup oak (*Quercus lyrata*), Nuttall oak, water oak, willow oak, red maple (*Acer rubrum*), American elm and locust (*Gleditsia spp.*). The perimeter hardwood forests also exhibit elevated levels of decline and senescence. In proximity to the Bayou DeView forest block but outside of the Bayou corridor are larger forest blocks of diverse hardwood forests mostly under the management of the Cache River NWR or Dagmar WMA. The forest types represented in these outlying blocks are primarily sweetgum/willow oak, willow oak/water oak/diamond leaf oak, sugarberry/ash-elm, and overcup oak/bitter pecan (*Carya aquatica*). However, caution must be taken in consideration of conditions where the bird was briefly observed. Nearly all sightings have been of flying birds; there were no observations of foraging, roosting, or nesting in the Bayou DeView area. There is no certainty that these habitat conditions are preferred or optimal.

In order to document forest habitat conditions in proximity to the 2004-5 Ivory-billed Woodpecker sightings, an extensive habitat survey was undertaken on the Cache River NWR, White River NWR, and state WMAs surrounding the reported 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 H). Field work was completed on 152,260 acres of White River NWR, 27,515 acres of Cache River NWR, 7,532 acres of Dagmar WMA, 2,091 acres of Henry Gray/Hurricane Lake WMA, 2,698 acres of Rex Hancock/Black Swamp WMA, 5,244 acres of Bayou Meto WMA, 843acres of Wattensaw WMA, and 2,862 acres of Trusten Holder WMA. Foresters and biologists have inventoried a total of approximately 200,000 acres. 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. These forest stand maps were used in overlay models to develop preliminary decision support models to facilitate search efforts in the Big Woods area.

6. Current Regional Forest Conditions Within the Historical Range

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 to be characterized by older-growth conditions (e.g., Congaree National Park 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 suitable Ivory-billed Woodpecker habitat requirements as trees age and the forests are being managed to encourage retention of older forest characteristics. (LMVJV Forest Resource Conservation Working Group 2007)

Thirty sites in 8 states were identified as areas of possible post-1944 encounters with Ivory-billed Woodpeckers. To characterize the area and structure of forests on private lands and all ownerships that could potentially provide Ivory-billed Woodpecker habitat, USDA Forest Service Forest Inventory and Analysis (FIA) data for relevant counties is provided in Appendix I Tables 1-4.

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 I). 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.

The 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 I, Table 17). However, the 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 I, 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, and for both hardwood and pine types on public lands.

G. Management Considerations

Current forest management practices affecting Ivory-billed Woodpecker habitat in the Mississippi Alluvial Valley have been examined in the context of maintaining sustainable landscapes capable of supporting desired forest conditions for a variety of important species. Recommendations have been published by the Lower Mississippi Valley Joint Venture (LMVJV Forest Resource Conservation Working Group 2007). The publication Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat has guidelines which will benefit the full suite of bottomland species, including the Ivory-billed Woodpecker. Application of these recommendations forms the backbone of our approach to the conservation of potential Ivory-billed Woodpecker habitat.

The Singer Tract studied by Tanner apparently did not provide enough habitat to sustain even a small population due to a variety of factors which Tanner discusses. An actual minimum area needed to support a sustainable population may be substantially higher or it may be lower, depending on the actual quantity of preferred food items available. That threshold of size is unknown. The quality of habitat for any given species may affect the quantity of forested acres needed. Even, as proposed in Snyder (2007), if habitat loss were not a major factor in the decline of this species, suitable habitat would be needed for its recovery. Maintaining and enhancing the appropriate quality, quantity, and distribution of habitat is a commonly accepted conservation principle.

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 (Brown 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). 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 land bird 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 land bird conservation 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 land birds. Because it is ecosystem-based, and emphasizes area-sensitive species, this approach also works for large-scale management potentially needed for the Ivory-billed Woodpecker. Guidelines on the sorts of land management within those forest patches, compatible with the objectives of the Joint Venture landbird conservation plan appear in next section and can be found in the publication Restoration, Management, and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat (LMVJV Forest Resource Conservation Group 2007). Although the Ivory-billed Woodpecker is the focus of the recovery plan, the recommended approach is ecosystem-based, and if followed, should begin to develop adequate habitat for all species of wildlife dependent on that system. Any Ivory-billed Woodpecker populations throughout the southeast may benefit from increasing the connectivity and continuity of existing forest patches. Accomplishing this will require detailed, site-specific planning to identify the most beneficial and practical opportunities for connecting and enlarging existing forest patches. Efforts to enhance the connectivity of forests among the Florida panhandle river systems may serve as a possible example.

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. Many recent forest management 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 for the Ivory-billed Woodpecker that in most ways sound very similar to current direction. If additional information is produced by locating or studying birds, or better interpretation of historical data is produced in the future, different approaches can be considered.

3. Favored Tree Species

Sweetgum and Nuttall oak were the two species clearly favored by Ivory-billed Woodpeckers in Tanner's study. Enhancing the amount of sweet gum and Nuttall oak in future forests can be a goal in appropriate forest management prescriptions. Both of these tree species need openings of several acres to regenerate successfully

and produce large-diameter trees. Unless Ivory-billed Woodpeckers are considered, the general belief is that sweetgum is less desirable than hard mast red oak for promotion of wildlife values. This is understandable because small diameter sweetgum is prolific in today's younger forests. Stimulating the growth of large sweetgum trees such as those that formerly occurred at the Singer Tract (Tensas River NWR) may require cutting trees surrounding desired sweetgums in current forests to foster the growth of large, emergent trees on appropriate sites. This will be a challenge, even on public land, where most forests were high-graded before or shortly after (if the previous owner retained timber rights) they came into public ownership. Today, however, there is growing recognition that sweetgum can play an important role in establishing healthy red oak stands that will form mature forests of the future.

More important than merely favoring sweetgum and Nuttall oak is management aimed at producing older forest conditions with adequate dead and dying trees over large enough acreages to allow a more sustainable, functioning forest ecosystem. Gaps created for management purposes or from dying trees will allow development of a diverse forest structure and provide regeneration conditions necessary for a resilient ecosystem. Currently, this should be the appropriate habitat management objective for Ivory-billed Woodpecker. It is possible that the apparent preference for these trees in Tanner's study area 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. To complicate the picture further, a photograph included in Allen and Kellogg (1937) documents an Ivory-billed Woodpecker on a pine tree in Florida, and the species' reliance on pine is well known in Cuba.

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 sweetgum 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 of which is 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 tupelo gum along the Bayou DeView 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 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 foraging opportunity. 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-billed Woodpeckers respond positively to disturbances as long as many standing recently dead, stressed, and dying trees remained after the disturbance. Woodpecker activity was usually greatest two to three years after the disturbance. This response indicates that these disturbances such as fire, wind storms, flooding, and some types of timber removal can 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 ranges soon expanded to include the area through which a 1931 cyclone had passed. This area contained substantial dead and dying wood which remained after salvage logging. A pair also expanded their range to the edge of a 1930-31 timber harvest area with substantial numbers of dead and dying trees. According to Kuhn, Ivory-billed Woodpeckers had been absent prior to these disturbances, but adults were observed frequently foraging within them during 1933 and 1934.

Ice storms, tornadoes, hurricanes, floods, fires, and other natural disturbances are important factors that can lead to favorable conditions, especially in older-growth forests. Where these natural forces occur, they can create the favorable habitat needed for the Ivory-billed Woodpecker as well as providing

for regeneration of shade intolerant species. However, the amount of bottomland hardwood forest in the Southeast U.S. has been greatly reduced from its former expanse. In the Mississippi Alluvial Valley the reduction is staggering, shrinking from about 24 million acres before European colonization to less than 5 million. Today's forest is also predominately fragmented across the landscape. It is debatable whether natural forces alone can provide a sufficient amount or appropriate distribution of disturbance.

Small 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 often 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. Hurricanes or large storms causing catastrophic damage provide abundant recently dead and dying wood, but only temporarily and likely at the expense of losing many suitable nesting and roosting trees. 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. Storms are important, but we have no control over their location or intensity.

Although managers have no direct influence over storms, forests can be managed in ways that allow for storm damage more closely to mimic likely pre-European settlement effect patterns. The challenge lies in producing the effects of large-scale disturbances where needed within these smaller isolated forests while also promoting older-growth conditions, which require an emphasis on large trees, large senescent limbs, and dying wood. The fact that the appropriate size of a disturbance patch is unknown further complicates the issue.

Managers may be able to use prescribed fire in bottomland forests to beneficial effect. Tanner's data strongly suggest that fire was a major influence on which stands were most productive, in terms of young produced, within bottomland hardwood habitat. However, today the practice of many land managers is to suppress fires rapidly in bottomland habitats. Potentially, this practice should be replaced by allowing natural or managed fires to continue through these areas to stress or kill trees purposefully.

Another area of uncertainty 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 (Jackson 2004, pp. 147-148) explaining that he had observed a similar response from Ivory-billed Woodpeckers in taking advantage of the flush of wood-borers in freshly killed slash along the edges of the cutover area. It must be emphasized, however, that these examples likely were exceptions. The Ivory-billed Woodpeckers used cut-over areas for brief periods of time, and only where directly adjacent to extensive older forests in the Singer Tract. In general, Ivory-billed Woodpeckers avoided foraging in extensively cut-over areas and did not use the slash and waste on the forest floor in such areas. Regardless of the potential for short-term use of cut stands, Ivory-billed Woodpeckers disappeared entirely from areas that had been subjected to extensive timber harvesting.

Today, forest managers consider many objectives and use a wide variety of silvicultural methods. Some of these are similar to his recommendations. There are two studies investigating the occurrence and abundance of wood-boring insects after different girdling and harvesting techniques and comparing these to wood-boring insect occurrence and abundance in unharvested stands. These studies can be used to inform future management decisions, as needed (see Appendix D for abstracts).

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 public and private lands in this area. Due to altered hydrology, beavers often lead to an unpredictable and disproportionate amount of mature forest loss, given the smaller amount (5 million acres compared to 24 million acres of estimated pre-European bottomland hardwood) and more fragmented condition of remaining bottom land hardwood forest patches. Potentially, beavers could be managed to provide the sort of disturbance suggested above.

6. Dead Trees

Providing habitats with mostly older and larger trees in addition to 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 (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 appropriately sized disturbance patches will be particularly challenging in today's fragmented forest (i.e., <15,000 acres). Ideally, individuals or pairs of birds will have the possibility to find sites with temporary optimal

conditions within the landscape. If management of larger tracts of forested land to benefit Ivory-billed Woodpeckers is needed, it may require public and private cooperation.

In many areas, there are increasing numbers of dead and dying trees due to changing hydrological conditions as well as storm damage. The general approach in the past was to salvage log the stand in order 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. This practice may need to be reconsidered if Ivory-billed Woodpeckers are present.

The total number of dead and dying trees in bottomland forests today is perhaps less relevant than the size and ages of those trees. Potentially, an adequate flow of dead and dying wood from large stems (including entire trees as well as large branches on still living trees) from one 3-year period to the next will sufficiently support desirable wood-boring beetle larvae. Preliminary data (Hamel et al. and Pearson et al; unpublished presentations) indicate an abundance of large larvae are produced from experimentally wounded trees.

If Cerambycid and other wood-boring insect larvae are a preferred food, the peak foraging window is more narrow than that of other woodpeckers. Ivory-billed Woodpeckers are described as seeking beetle larvae associated with "freshly" dead sapwood (Tanner). The beetle larvae found in dead and dying wood become most available when the death of the wood is recent (1-3 years). The Ivory-billed Woodpecker habitually used its bill as a wedge to remove bark from the freshly dead sapwood. Therefore, the size and time since death of the tree is important as well as the amount of available dead wood. Tanner recognized the importance of providing dead and dying trees. He suggested that areas could be managed using selection cuts. The harvests would be focused on healthy, growing trees and retain dead, dying, damaged, and otherwise stressed trees. This would maintain and potentially improve the food sources for the Ivory-billed Woodpecker.

The practice of retaining dead and dying wood is not viewed as negatively as it was in the past, Some public land managers are experimenting with ways to 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. The publication Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat provides recommended prescriptions (LMVJV Forest Resource Conservation Working Group 2007). Additional adaptive change may be required as more is learned about the habitat preferences of the Ivory-billed Woodpecker.

7. Current Forest Management

In 2003, the Lower Mississippi Joint Venture Forest Resource Conservation Working Group specifically started to address issues related to the management of the forest resources within the Mississippi Alluvial Valley. Management issues of concern included management of existing bottomland hardwood forest resources, reforestation of agricultural lands, and inventory and monitoring of all these resources. Instead of placing restrictions on individual silvicultural practices, recommendations target defining certain habitat characteristics that are necessary to meet the annual requirements of the multitude of wildlife species dependent on these forest resources. How forest managers achieve and maintain these habitat characteristics is determined by the individual situation. Objectives are set at the landscape level, and guidance is provided for how to achieve these objectives with individual stands. This methodology allows the manager to apply appropriate silvicultural practices at the stand level to meet habitat needs in each situation. The publication Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat provides these recommended objectives and guidelines. Application of the recommendations found in the document forms the backbone of our approach to the conservation of potential Ivory-billed Woodpecker habitat. These guidelines should be considered for bottomland systems across the southeast. There are no specific guidelines suggested for other forest types potentially used by Ivory-billed Woodpecker, but focusing on other priority species that depend on mature forests may lead to proper habitat conditions (e.g., open pine forests that are regularly burned).

H. Reasons for Listing/Current Threats

The final listing notice (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 historical decrease in Ivory-billed Woodpecker numbers throughout the range appears to be mainly due to large-scale reduction and conversion of forest habitats, though this is not universally accepted. Essential features of historical Ivory-billed Woodpecker habitat included: 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,

"In many cases [Ivory-billed Woodpeckers'] disappearance almost coincided with logging operations. In others, there was no close correlation, but there are no records of Ivory-billed [sic] inhabiting areas for any length of time after those have been cut over." In addition, before large scale logging had commenced, Tanner also commented that the reduced occurrence of recently dead and dying wood was probably responsible for declines of woodpeckers in the Singer Tract. 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 (LMV) 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 were killed 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. Noel Snyder (2007) concludes that the close correlation between timber harvesting activities and the decline of the Ivory-bill reflected an increased exposure to poaching and collecting rather than food limitation in logged-over forests. He asserts that direct killing of Ivory-billed Woodpeckers was the primary cause for the species' original decline. Collecting, in combination with the concurrent habitat loss likely hastened the decline of the species, and 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 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 due to the current laws protecting the species (see Factor D), and there is no recent evidence of take.

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. No mortality due to disease or predation has been recorded. However, there may be future potential for avian flu, West Nile Virus or other diseases to impact Ivory-billed Woodpeckers. It is unlikely disease or predation was a primary factor in the original decline of the species or in the current status of the species.

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

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

5. Other Natural or Anthropogenic Factors Affecting the Ivory-bill's Continued Existence (Factor E)

Ivory-billed Woodpecker populations appear to have been in a state of continuous fragmentation and decline since the early 1800s (Jackson 2002, Tanner 1942). Early accounts gave no accurate or definite estimates of abundance. As habitat loss progressed, coupled with collection, population numbers dwindled, and fragmentation isolated the species into discrete communities, contributing to the decline. Small population sizes and limited distributions put species at risk from naturally occurring events and environmental factors. While a substantial amount of habitat is protected in Arkansas and other states where recent sightings have been reported, threats exist from continued fragmentation and normal environmental changes. For example, sporadic natural events such as tornadoes or ice storms could destroy the only remaining nest or roost trees, or severe weather conditions could result in nesting or fledging failures. There is no information on the number and genetic health of any remaining birds. Small populations are normally at risk from genetic and demographic stochastic events (such as normal variations in survival and mortality, genetic drift, inbreeding, etc.). Also, difficulty in confirming and delineating populations and the limited basic biological and ecological information on the species is an important factor that currently threatens our ability to recover the species.

I. Conservation Efforts

1. Conservation Efforts in the Recent Past

Wherever the Ivory-billed Woodpecker was reported, both excitement and action followed. In the early 1970s, Sam Houston National Forest in east Texas proposed to modify

timber harvests on the basis 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 widespread forest management changes to promote the welfare of the Ivory-billed Woodpecker. Most stories of unconfirmed sightings have generated no change in land management throughout the southeast, though there have been some local exceptions.

An unconfirmed sighting of Ivory-billed Woodpecker in the White River NWR during the late 1970s by the head forester led to a distinct and repeated emphasis to retain many older-age-class trees. The emphasis on larger trees has continued for 30 years and was adopted upon the purchase of the adjacent Cache River NWR and the subsequent acquisition of about 55,000 acres of former timber company land. The result is that very large trees (>30" dbh) are retained in about 200,000 acres of forest. With staff moves and communication between Service foresters, this practice spread to the South Arkansas Refuge Complex, Holla Bend NWR, Theodore Roosevelt Complex, West Tennessee Complex, Tensas River NWR, and other NWRs (J. Denman, pers. comm.).

A well known, but unconfirmed, 1999 sighting in the Pearl River WMA (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%), 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 potentially sensitive sites and directing visitors to appropriate areas; protection of land through acquisition of easements or fee interest; forest management, reforestation; and public education.

Habitat improvement and restoration may be essential to the future recovery of the Ivory-billed Woodpecker should additional birds or locations of birds be confirmed. In related actions, various quantitative models were developed to identify the amount and quality of habitat needed to support recovery. Additionally, NWR forest management activity was 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 national wildlife refuges, state natural areas, or state WMA. 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.

Active forest management (thinning and other tree cutting) on Cache River and White River National Wildlife Refuges was temporarily suspended (2005-7) 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 harvesting or thinning stands for forest management. This short term passive management was implemented under the assumption that some birds were present throughout the contiguous block of forested habitat in the lower White River basin. Current forest management prescriptions allow the manager to apply appropriate silvicultural practices for individual stands to meet habitat needs for a wide variety of target species. The publication Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat provides these recommended objectives and guidelines (LMVJV Forest Resource Conservation Working Group 2007).

In 2005 limited morticulture (stressing/killing live trees) management was implemented as an experiment along Bayou DeView 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 potential Ivory-billed Woodpecker feeding habitat and to 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 the better to understand dynamics associated with insect colonization of stressed trees in bottomland hardwood forests; potentially informing the development of Ivory-billed Woodpecker foraging habitat.

Land acquisitions at Cache River NWR, in cooperation with TNC, also provide long-term habitat benefits for a multitude of species. This refuge is a regional priority for additional acreage, primarily driven by North American Waterfowl Management Plan objectives 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 using revenue from the Migratory Bird Conservation Fund, also known as the Duck Stamp Fund. The remainder of the lands was purchased with appropriations under the Land and Water Conservation Fund. In 2004 and 2005 they acquired title, options, or easements on approximately 18,500 acres in the Bayou DeView area. Reforestation efforts are underway on much of this land. All lands were acquired from willing sellers.

The Natural Resources Conservation Service has been a leader in restoring bottomland hardwood habitat in the lower White River basin. Since the 2005 announcement of 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.

The Fish and Wildlife Service's Partners for Fish and Wildlife Program committed $1 million in support of 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 were planted in the same area.

A central database has been established where all Ivory-billed Woodpecker sightings can be reported (http://www.birds.cornell.edu/ivory/identifying/). In May 2005 three "Town Hall" meetings were held in the communities of Brinkley, Stuttgart, and Augusta to provide information on the announcement of 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. In Arkansas, the Corridor of Hope serves as an 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. Surveys have been made in other portions of the historical range in east Texas, Louisiana, Mississippi, Alabama, South Carolina, North Carolina, Tennessee, Illinois, Georgia and Florida.

3. Summary of Conservation Efforts

Conservation efforts to date have been directed towards confirming the existence of the species in multiple locations as well as Arkansas and taking initial habitat improvement and restoration actions.

The principal conservation actions included improving and expanding the survey effort in Arkansas, as well as in other formerly occupied locations, and describing potential habitat sufficiently, so that the most likely locations for other possible existing populations may be identified and surveyed. Current management practices were evaluated and modified as needed. Public outreach and education was conducted.

The announcement of rediscovery generated significant interest on the part of the public and national and international conservation organizations. There was strong support for taking the necessary steps to assess population status, delineate habitat, and determine the proper management actions needed for recovery. Subsequent controversy over the evidence supporting the announcement did not reduce the necessity for these initial actions, most of which are complete.

Research, modeling, and habitat inventory projects have been undertaken to understand the distribution of potential habitat better, and to enhance the methods used to detect Ivory-billed Woodpeckers. In addition, models focused on foraging energetics, habitat characterization and assessment, and potential population viability are being developed (see Appendix D for abstracts).

J. Biological Constraints and Needs

The most significant biological constraint to recovery of this species is that the population, where there may be one, is very small, and individuals are extremely difficult to detect with any degree of certainty. The species is so rarely reported that learning more about the species and its habitat requirements and basic aspects of its ecology will be the primary interim conservation action.

The capacity of such a small population to recover and multiply is unknown, though examples of successful increases in numbers exist in other species. (Komdeur 2002).

Clutch sizes in the Ivory-billed Woodpecker range 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, our current knowledge of the species suggests that the relatively low reproductive

capacity of the species may require many years for significant population growth.

Protocols for captive breeding of this species are also poorly understood. Significant work with surrogate species, such as the Magellanic Woodpecker may be needed. This effort would take some time since there is currently no person or institution engaged in the captive breeding of large woodpeckers.

To the best of our knowledge, 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 historical range, forests are in suitable or close to suitable 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 they may have insufficient large, dead, and stressed trees. In addition, major gains in recovering this species potentially require the cooperation of private landowners. In the southern U.S. 89% of the forests are privately owned. (Appendix I).

II. Recovery

A. Recovery Strategy

Our understanding of most aspects of the ecology and biology of the Ivory-billed Woodpecker is limited. It has proven extremely difficult to locate or relocate individuals despite extensive survey efforts. Much of what is known is derived from James Tanner's studies on one small population and Tanner's range-wide evaluation of reports and habitat availability. Other information comes from knowledge of other *Campephilus* species, woodpeckers in general, interpretations of photographs, and anecdotes gathered by other observers. The current strategy must focus first on locating and confirming the presence of individuals. Then we can add to our knowledge about the ecology and biology of the species once a population is identified, providing a feasible approach to habitat protection, given its potential presence.

Our poor understanding of the species has focused the recovery strategy largely on learning more about the species status and ecology rather than undertaking specific habitat management actions. Habitat management and land protection efforts are important, but the major focus is learning more about where the birds may persist, then examining those habitats to reveal ways in which specific conservation actions could be developed. Many of the potential recovery actions will be made only where a nest or roost is located or where there are new multiple sightings, video, physical evidence, or a picture of a bird.

Spatially explicit, objective, and measurable population goals have not been identified. However, those goals are recognized as a key part of future recovery efforts. Habitat modeling and other analysis tools have been completed for Arkansas and other parts of the species' range. These models inform search efforts and broadly identify potential areas for conservation. Population modeling has provided an indication that the persistence of the Ivorybill in low numbers throughout its range is possible (Mattson et al 2008).These efforts will help inform the development of spatially explicit, objective and measurable population and habitat goals for future recovery plans.

B. Recovery Goal

The goal of the Ivory-billed Woodpecker recovery program is to locate, 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. This goal is consistent with current requirements for all listed species.

C. Recovery Objectives

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

1. Identify and delineate any existing populations
2. Identify and reduce risks to any existing population,
3. Protect and enhance suitable habitat once populations are identified, and;
4. Reduce or eliminate threats sufficient to allow successful restoration of multiple populations when those populations are identified.

The emphasis in this recovery plan on documenting and conserving 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 does 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 1994). 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 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. Potential habitats for any occurrences of the species are surveyed.
2. Current habitat use and needs of any existing populations are determined.
3. Habitat on public land where Ivory-bills are located is conserved and enhanced. If needed, additional acreage is acquired from willing sellers and listed in the public habitat inventory.
4. Habitat on private lands is conserved and enhanced through the use of voluntary agreements (e.g., conservation easements, habitat conservation plans) and public outreach.
5. Viability of any existing populations (numbers, breeding success, population genetics, and ecology) is analyzed.
6. The number and geographic distribution of subpopulations needed to create conditions favorable to a self-sustaining metapopulation and to evaluate habitat suitable for species re-introduction is determined.

E. Recovery Actions

The primary interim actions needed to determine explicit recovery criteria and ultimately to achieve recovery criteria and accomplish delisting/downlisting recovery goals are:

1. population surveys and monitoring in the historical range where habitat and sighting information indicate potential for the presence of the species,
2. habitat inventory and monitoring in the historical range of the species,
3. population and habitat modeling to facilitate survey efforts and to inform potential management actions,
4. research directed at testing biological assumptions otherwise implicit in modeling and management actions,
5. landscape characterization and assessment of the Mississippi Alluvial Valley and other areas of the historical range,
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 and forested habitats to aid recovery.

F. Total Estimated Cost of Recovery

Our limited knowledge of the Ivory-billed Woodpecker's occurrence and distribution as well as of necessary long-term actions precludes any informed estimate of recovery costs for the species. See Appendix C for recovery expenditures to date.

G. Narrative Outline of Recovery Actions

1. Population Surveys and Monitoring

a. Ivory-bill surveys were initially focused in the Cache and White river basins. Surveys have been completed there and elsewhere in the historical range. Survey protocols have been developed, and state search groups have been formed. A sightings database is being maintained by Cornell Laboratory of Ornithology. Criteria for evaluating encounters were developed for that information (see Appendix F);

   i. A survey design developed for search efforts throughout the range is adaptive, uses ancillary data (e.g., previous sightings, output from biological models, distribution of stressed or dying trees), and results in consistent survey methodology. Search teams used a sampling design provided by the University of Georgia (see Appendix F). This design, if birds are detected, will allow determination of the probability of species detection based on survey effort, search area, and population size.

   ii. Searches have been conducted throughout many areas in the historical range, including the Cache and White river basins, by state-based groups.

   iii. Ivory-billed Woodpecker survey and monitoring technologies were developed (including the use of helicopter surveys). See Appendix F.

b. If birds are located, develop monitoring protocols to assess population size and trend.

2. Habitat Inventory and Monitoring

   Additional Ivory-bill habitat inventory focused primarily in the Cache and White river basins. Coordination and implementation of a multi-scale habitat inventory and monitoring program are needed in other parts of the historical range where sighting information indicates presence of the species.

   a. Develop additional protocols and techniques, as needed, for habitat inventory and monitoring program.

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

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

   b. Priority search areas were identified by state search groups. Prioritize additional search areas throughout the historical range in cooperation with state search groups.

   c. Conduct habitat inventory and monitoring using both ground-based techniques and remote technologies, as needed. Forest inventories in the Cache and White River basins were completed. As needed, conduct forest inventories in priority areas throughout the range.

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

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

3. Population/Habitat Models

   To facilitate survey efforts and inform potential management actions, there is a need to develop quantitative population and habitat relationship models. These models should address landscape-quality and site-quality factors presumed to limit Ivory-billed Woodpecker populations. Models and risks of uncertainty will be presented as testable hypotheses. Habitat-specific parameters will be based on currently available information, research results, new data, and expert opinion. See Appendix D for description of model development.

   a. As needed, refine the Cache and White river basin Ivory-billed Woodpecker population-habitat model for application at larger spatial scales (e.g., MAV, rangewide). The outputs from this model would be used to:

      1. develop a Mississippi Alluvial Valley population/habitat model;

      2. guide the development of forest inventory/ monitoring programs;

      3. facilitate landscape characterizations and assessments; and

      4. refine forest management to reach Desired Forest Conditions if needed.

   b. Refine, as needed, the range-wide potential occupancy model to facilitate search efforts across the southeastern portion of the United States.

   c. When birds are confirmed, develop estimates of populations using life table methodology and data on available habitat quality and use.

   d. Develop, as needed, a population viability model (currently a theoretical model is available).

4. Assumption-Driven Research

   Given the limited information available, 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 assumptions implicit in biological goals, objectives, and the biological response presumed to occur from management actions.

   a. Compile and summarize additional literature.

   b. Assess causes of tree mortality, decay rates, and stand-replacement processes on the assumption that cavities, foraging habitat, and/or prey may be limiting factors for Ivory-billed Woodpecker and that these can be evaluated by gathering information on tree mortality.

      i. Gather information on naturally-occurring tree mortality, snag formation, and decay rates across elevation gradients, hydrologic regimes, and soil classes.

      ii. 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.

   c. Assess the relationship of tree mortality to forage availability. This is a focus of current studies.

      i. Gather information on wood-boring insect populations, life history, and natural densities and on factors which

contribute to their density, richness and abundance (e.g., tree mortality, decay rates).

ii. 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.

d. Expand and re-examine research priorities when active nest trees are discovered and/or when other appropriate reports occur.

e. Investigate the ecology of Ivory-billed Woodpecker through detailed investigations of appropriate surrogate species.

f. Disseminate research findings via symposia and peer-reviewed publications.

5. Landscape Characterization and Assessment

The ability of the Mississippi Alluvial Valley to support recovery populations is unknown. The capacity of other habitats within the historical 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. Abstracts of these studies are provided in Appendix D.

a. 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.

b. Develop forest type maps of the Cache and Lower White River basins using a hydrogeomorphic (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.

c. 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.

d. Assess "suitable" habitat across the MAV and the historical range based on the application of biological models to currently available data sets (e.g., FIA, NLCD, aerial photography, LIDAR, Cornell mobile search teams)

e. Use data obtained by remote sensing (e.g., ASTER, LiDAR) and population habitat models to identify forested habitat conditions that attract and support Ivory-billed Woodpecker, then ground-proof the results.

f. Conduct a hydrogeomorphic assessment of existing and potential wetland and upland habitats of the MAV.

6. Conservation Design

At this time, spatially explicit, objective and measurable population and habitat objectives cannot be determined for the Ivory-billed Woodpecker but will be 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.

a. Establish population goals and objectives when appropriate information is available.

b. Establish habitat goals and objectives to support population goals and objectives when appropriate information is available. Habitat goals at all spatial scales would consider management, protection, and restoration of extant southern (bottomland) forests.

c. Develop, as needed, any additional forest restoration and management guidelines (Desired Forest Conditions) designed to support population goals.

d. Refine habitat management guidance for Ivory-billed Woodpecker.

e. Produce maps and technical documents (e.g., management guidelines) that land managers and planners can use to implement conservation programs across multiple spatial scales.

f. 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. Education and Outreach

   The 2005 announcement that an Ivory-billed Woodpecker had been encountered in the Big Woods of Arkansas generated a substantial amount of interest among the public. Information for the general public and numerous stakeholders involved or concerned with the recovery of the species have been developed. Community-based programs to enhance opportunities to learn about and promote the conservation of the species and its habitat have been provided in cooperation with partners. The purpose of these tasks is to convey a consistent message regarding recovery efforts and to facilitate those efforts through public awareness and education.

   a. Communication plans and strategies have been developed and implemented. Ensure that continuing communications address the need for information at various levels and for various stakeholders (e.g., birdwatchers, local citizens, government agencies, industry).

   b. Outreach tools to help private landowners and land managers must be developed. See Appendix G.

   c. Species identification brochures have been developed and distributed. Monitor future need for these products and provide them where needed.

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

8. Public Use and Access in Occupied Habitat

   Due to the potential for adverse impacts resulting from intense public interest, guidelines were developed to manage public use where birds are possibly located. Initially, a portion of the Cache River NWR was closed temporarily, then full access was managed via permit. No restrictions currently exist. See Appendix G. These actions should be discussed and applied, as needed, where roosting or nesting birds are documented or a bird is confirmed.

   a. Develop guidelines for public use and other activities in Ivory-billed Woodpecker habitat. Develop additional guidelines, as needed, on the types of use including the timing, amount, and nature of activities near roost or nest trees and foraging habitat.

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

9. Management of Populations

   Increased interest on the part of researchers will require the development of research and monitoring protocols to assure that adverse impacts are minimized.

   a. Protect occupied habitat and priority lands needed for recovery.

      i. Acquire additional acreage from willing sellers and list it in the public habitat inventory, if needed.

      ii. Acquire additional area through voluntary agreements (e.g., conservation easements, habitat conservation plans) and public outreach to facilitate appropriate management actions, if needed.

   b. Develop guidelines for monitoring Ivory-billed Woodpecker nesting, roosting, and feeding behavior (e.g., permitting procedures, procedures for researchers).

   c. Assess the need for intervention to enhance reproductive success, productivity and survival.

   d. Determine the genetic health and viability of the population.

   e. Implement reforestation activities and forest management practices to benefit Ivory-billed Woodpecker habitat.

   f. Use decision-support models and other biological planning tools to determine the need and location of additional land protection measures.

III. Implementation Actions

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 initial recovery actions completed and planned for the Ivory-billed Woodpecker. 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 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. Any expenditures by identified agencies/partners will be contingent upon appropriations and other budgetary constraints. Expenditures for completed tasks and research projects are included in Appendix C.

Abbreviations and Acronyms Used in the Following Table

A	Factor A of reasons for listing (see Section H)
ACOE	U.S. Army Corps of Engineers
AGFC	Arkansas Game and Fish Commission
ANHC	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, state, 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 historical 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

Table 1. Implementation Actions (*denotes lead agency)

Task description	Threat	Responsible Organization FWS	Responsible Organization Other	Status and Comments
Complete and implement protocols and procedures for recording, classifying, and responding to reported Ivory-billed Woodpecker sightings.	E	R4, R2, ES	CLO*, States	Initial protocols and procedures are completed. The sightings database is established and will be updated by CLO.
Develop teams to rapidly assess the veracity of sightings in other areas.	E	R4, R2, ES, RF	CLO*, States	State Search Groups perform this task
Develop a repository for all previous sightings.	E	R4, ES	CLO*	Completed
Develop survey designs for search efforts throughout the range.	E	R4, ES	UGA, USGS-UGA Coop.	Completed
Determine the probability of species detection based on survey effort, search area and population size.	E	R4, ES	USGS-UID Coop., CLO	Completed
Implement searches in the Cache and White River basins.	E	R4, ES, RF	See notes	Numerous partners are involved in the search.
Implement range-wide searches based on priority areas defined in the habitat tasks.	E	R4, R2, ES, RF	States, CLO, NGOs	Completed, additional searches will be completed with partners as necessary
Develop state-based implementation groups.	E	R4, ES, R2	States, CLO	
Enhance existing and develop new Ivory-billed Woodpecker survey and monitoring technologies.	E	R4, ES	CLO, USGS	Complete as needed
Develop monitoring protocols to assess population size and trend.	E	R4, ES	UNI	Implementation of this task depends on search results.
Develop ground-based forest inventory protocols which will identify characteristics important to Ivory-billed Woodpecker, including disturbance history.	A	A,E	States, NGOs	Costs are negligible since the task is already a part of staff duties.
Conduct remote sense-based (e.g., LiDAR, ASTER) forest inventories to augment ground-based habitat inventories.	A	R4, R2, ES, MB*, RF	USGS, UMD, NASA, States, NGOs	Initial inventories are completed
Prioritize search areas in the Cache and White River basins.	A, E	R4, ES, RF, MB*	State of Arkansas, CLO, TNC	Completed
Prioritize search areas throughout the historical range using information from expert opinion and tasks	A, E	R4, R2, ES, RF, MB*	States, CSU, USGS-CSU Coop.	Completed
Conduct forest inventories in the Cache and White River basins.	A	R4, ES, RF*, MB*	State of Arkansas	Completed
Conduct forest inventories in priority areas throughout the range.	A ,E	R4, R2, ES*, MB, RF	States, NGOs, PVT	Perform as needed.
Characterize and assess the adequacy of foraging habitat in the Cache and White River Basins.	A	R4, ES, MB*RF	AGFC, TNC, CLO	Completed
Consolidate and archive data.	A	RF, MB*	States	
Assess the efficiency and effectiveness of forest management prescriptions intended to increase foraging habitat.	A	R4, ES, MB*, RF	USGS, USFS, ANHC, LDWF, AGFC	Complete as needed

(*denotes lead agency)

Task description	Threat	Responsible Organization FWS	Responsible Organization Other	Status and Comments
Express Tanner's Ivory-billed Woodpecker study conclusions for the Singer Tract population as an energetic foraging model.	E	R4, ES, MB*	UGA, USGS-UGA Coop., USFS, NWRC	Study is being completed. See Appendix D
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.	E	R4, ES, MB*	RT	Complete as needed.
Refine the Cache and White River basin Ivory-billed Woodpecker population-habitat model for application at larger spatial scales (e.g., MAV, range-wide).	E	R4, ES, MB*	RT, CSU, USFS, CSU-Coop.	Data have been developed in conjunction with other tasks.
Develop a range-wide potential occupancy model to facilitate search efforts across the southeastern portion of the United States.	E	R4, R2, ES, RF, MB*	States, CSU, USGS-CSU Coop.	Research project is being completed, see Appendix F
Develop estimates of the possible existing population using Life Table methodology and information on available habitat and territory size.	E	R4, ES	UAR	Complete as needed
Develop a Population Viability Model.	E	R4, ES, MB	USGS-UGA Coop.	Appendix D
Summarize and compile the existing literature into a database.	A, E	R4, ES, MB	Smith.	Complete
Gather information on naturally-occurring tree mortality, snag formation, and decay rates across elevation gradients, hydrologic regimes, and soil classes.	A	R4, ES, MB*, RF	USGS, USFS, ANHC, LDWF, AGFC	
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.	A	R4, ES, MB*, RF	USGS, USFS, ANHC, LDWF, AGFC	
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.	A	R4, ES, MB*, RF	USGS, USFS, ANHC, LDWF, AGFC	Experimental treatments completed, data collection and analysis is continuing
Expand and re-examine research priorities when active nest trees are discovered.	E	R4, ES, MB, RF	RT, CLO	Complete as needed
Investigate the ecology of Ivory-billed Woodpecker through detailed investigations of appropriate surrogate species.	E	R4, ES	States, UNI, The Walt Disney Co.	See Appendix D
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.	A	ANHC	NWRC*	Completed

(*denotes lead agency)

Task description	Threat	Responsible FWS	Organization Other	Status and Comments
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.	A	R4, ES, MB	ANHC*, USGS, ACOE, AMWPT	Completed
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.	A	R4, ES, MB, RF	NWRC*, LDWF	Study being completed. Extend to other portions of the historical range as needed to inform habitat management.
Assess "suitable" habitat across the MAV and the historical range based on the application of biological models to currently available data sets.	A	R4, R2, ES, MB*	CSU*, USFS, RT, ACOE, ANHC	Completed
Use data obtained by remote sensing (e.g., ASTER, LiDAR) and population habitat models to identify forested habitat conditions that attract and support Ivory-billed Woodpecker, then ground-proof the results.	A	R4, ES, MB*, RF	NWRC*, NASA, UMD	Basic data gathered
Conduct a hydro-geomorphic assessment of existing and potential wetland and upland habitats of the MAV.	A	R4, ES, MB, RF	ANNHC*, USGS, ACOE	Completed
Establish population goals, objectives and timelines for the species' historical range.	E	RF	States	Complete as needed
Establish habitat goals, objectives, and timelines to support population goals, objectives, and timelines.	A, E	R4, R2, ES*, MB, RF	RT, States	Selected members of the RT will assist. Costs are largely for RT members' time and travel and for workshop development. Complete as needed.
Develop forest restoration and management guidelines (Desired Forest Conditions) designed to support population goals.	A	R4, R2, ES, MB*, RF	States, USFS, ANHC, TNC, USGS, PVT, NRCS	Completed.
Refine habitat management guidance for Ivory-billed Woodpecker.	A	R4, R2, ES, MB*, RF	States, USFS, ANHC, TNC, USGS, PVT, NRCS	PVT partners include private timber companies.
Produce maps and technical documents (e.g., management guidelines) that land managers and planners can use to implement conservation programs across multiple spatial scales.	A	R4, ES, MB*	USGS, USFS	Costs for this task will continue until recovery is completed. These tools are part of larger bird conservation initiative.
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.	A	MB*	USGS	Models will be internet-based and refined annually as habitat management and restoration occurs. These tools are part of larger bird conservation initiative.
Develop an outreach plan and strategy which addresses community-based programs that promote conservation of the species and its habitat.	A	EA*,R4, R2, ES, MB, RF, AFGC	RT-Outreach Team	Tasks and Funding are based on potential discoveries in other states, requiring additional outreach.

(*denotes lead agency)

Task description	Threat	Responsible Organization FWS	Other	Status and Comments
Communication plan and strategy addresses the need for information at various levels and for various stakeholders (e.g., birders, local citizens, government agencies, industry).	A, E	R4, ES, EA	RT-Outreach Team	Tasks and Funding requests are based on potential discoveries in other states, requiring additional outreach.
Develop outreach tools to help private landowners and land managers.	A	R4, ES, EA	RT-Outreach Team	Tasks and Funding requests are based on potential discoveries in other states, requiring additional outreach.
Develop and distribute species identification brochures.	E	R4, R2, ES, RF, MB, EA	RT-Outreach Team, NGOs, States	Tasks and Funding requests are based on potential discoveries in other states, requiring additional outreach.
Coordinate and cooperate with the government of Cuba regarding the status and recovery of the Cuban population of Ivory-billed Woodpecker.	E		CLO*	NGO action
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.	E	RF, MB	UNI, States	Guidelines will be assessed continually based on findings and species status.
Develop public access and viewing points such as boardwalks, towers, blinds and platforms.	E	R4, R2, ES, MB, RF	NGOs, States	The current focus is on the Cache and White River NWRs. Completed
Protect occupied habitat.	A	R4, R2, ES, RF	States, NGOs, PVT	Complete additional land acquisition, protection, and management as needed
Develop guidelines for monitoring Ivory-billed Woodpecker nesting, roosting and feeding behavior.	E	R4, R2, ES, RF, MB	States, CLO	Initial protocols have been developed and will be reviewed annually or as needed.
Assess the need for intervention to enhance reproductive success, productivity and survival.	E	R4, ES*, MB	CLO, NGOs	This depends on locating birds for possible captive propagation. Partners such as the San Diego Zoo will be consulted.
Determine the genetic health and viability of the population.	E	R4, ES	UNI	Costs are unknown and depend on obtaining appropriate biological material.
Implement reforestation activities and forest management practices which will benefit Ivory-billed Woodpecker and its habitat.	A	R4, R2, RF	States, NGOs, NRCS, PVT	Complete where needed or as a part of current bird conservation initiatives.
Use decision-support models and other biological planning tools to determine the need and location of additional land protection measures.	A, E	RE	NGOs	Complete where needed or as a part of current bird conservation initiatives.
Protect priority lands identified in task.	A, E	RE	NGOs, PVT	Some examples for protecting land are fee purchases, easements, USDA agreements, and voluntary landowner agreements. Current conservation initiatives can incorporate this task.

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Appendix A.

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Appendix B.

U.S. Fish and Wildlife Service Statement on Existing Evidence for Ivory-billed Woodpecker (*Campephilus principalis*) Occurrence in the Big Woods of Eastern Arkansas and Elsewhere in the Southeast U.S.

Prepared by William C. Hunter, U.S. Fish and Wildlife Service, Atlanta, GA 30345

The U.S. Fish and Wildlife Service (FWS) recognizes that substantial evidence for the persistence of the Ivory-billed Woodpecker (*Campephilus principalis*) into the 21st Century emerged from recent search efforts that began in eastern Arkansas (hereafter the Big Woods). The presentation of this evidence triggered implementation of conservation provisions as stipulated by the Endangered Species Act of 1973, as amended. In the case of the Ivory-billed Woodpecker, these provisions include the development of a recovery plan, consultation on all Federal actions proposed within the Big Woods, and working with conservation partners further searching both in the Big Woods as well as throughout the historical distribution of the species. The FWS also recognizes that there continues to be scientific debate regarding the interpretation of this evidence. We take seriously our responsibility to promote conservation and potential recovery of this species, while recognizing that this evidence is not universally accepted within the scientific community. With this in mind, we remain committed along with our conservation partners to promoting appropriate habitat protection and management based on an ecosystem approach that includes consideration for this very rare species, and supporting necessary research to conserve this species and the ecosystem it depends upon in the Southeast U.S.

Interpretation of the Evidence: The Debate

One of the most significant, yet controversial, wildlife conservation events during the first decade of the 21st Century was the announcement by Fitzpatrick et al. (2005) that at least one Ivory-billed Woodpecker had been located in the Big Woods within the Mississippi Alluvial Valley. This announcement included the presentation of at least seven detailed first-hand accounts of presumably the same individual male Ivory-billed Woodpecker (Gallagher 2005, Rosenberg et al. 2005). However, it was a four-second video ("Luneau" video) of a large woodpecker flying away from the camera that has been the focus for most of the debate on whether or not this evidence was conclusive (Jackson 2006, Sibley et al. 2006, 2007, Fitzpatrick et al. 2006, 2007, Collinson 2007).

Recorded auditory and repeated detailed sighting evidence contributed to the original conclusion reached by Fitzpatrick et al. (2005), but are not all by themselves considered conclusive. While recorded auditory evidence continues to be suggestive of Ivory-billed Woodpecker (both "kent" calls and *Campephilus*-like double-knocks), careful analyses are necessary to exclude a wide range of other alternative explanations from other plausible sources (see Jones et al. 2007 and http://www.birds.cornell.edu/ivory/multimedia/sounds/index_html/document_view). Sightings not accompanied by diagnostic video or photographs, no matter how detailed or how qualified the observers, are all subject to some level of doubt. While there may be a wide range of remotely possible alternative explanations for sight records, the most likely alternative explanation involves potential confusion with the much more numerous and superficially similar Pileated Woodpecker (*Dryocopus pileatus*). In fact, most reported sightings of Ivory-billed Woodpeckers in the past have turned out to be misidentified Pileated Woodpeckers. Nevertheless, there are a number of sightings before and since 1938 (when the last definitive photo was taken in the U.S.) that cannot be easily dismissed raising the issue of whether all sightings were mistakes in the past and are also mistakes in the present. That is an important issue described elsewhere (see Appendix E). While detailed sightings and auditory evidence remain important in evaluating whether or not Ivory-billed Woodpeckers may persist in an area, it is the Luneau video that is potentially the best hard evidence that at least one Ivory-billed Woodpecker was present in the Cache River National Wildlife Refuge at least in April of 2004.

Both Sibley et al. (2006) and Fitzpatrick et al. (2005, 2006) recognize that the identity of the woodpecker in question is not inherently obvious. While universal agreement on the identity of the woodpecker in the Luneau video may never be possible, both Sibley et al. (2006, 2007) and Fitzpatrick et al. (2006, 2007) remain confident that enough information can be derived from the Luneau video to reach an identification of the woodpecker in question. Sibley et al. (2006, 2007) stated that the video evidence is insufficient to reject the null hypothesis of

a normally plumaged Pileated Woodpecker and that "the evidence firmly supports this hypothesis" in that it "cannot be an ivory-billed woodpecker and is consistent only with a pileated woodpecker." In contrast, Fitzpatrick et al. (2006, 2007) "disagree that Sibley et al. showed that the bird in the Luneau video 'is consistent' only with a pileated woodpecker," "showed their analysis and assumptions to be flawed or lacking on many counts," and "continue to regard all aspects of the Luneau video as fully consistent with ivory-billed woodpecker."

After weighing the various positions, the FWS accepts the interpretation of Fitzpatrick et al. (2005, 2006, 2007). FWS concludes that other published interpretations by Sibley et al. (2006), and by extension Collinson (2007), are based on misinterpretations of video artifacts as plumage, and novel interpretations of typical bird flight. In Collinson's comparison of the Luneau video to videos of known Pileated Woodpeckers in flight, we believe the misinterpretations also include inappropriate comparison of interlaced images of known Pileated Woodpeckers in flight with the de-interlaced images of the woodpecker in the Luneau video. While other interpretations of the Luneau video may yet emerge, to date no video of an actual Pileated Woodpecker exhibits from frame to frame the same plumage characteristics and flight mechanics exhibited by the woodpecker in the Luneau video.

FWS review of the David Luneau Video Evidence

Support for the hypothesis that the Luneau video captures an Ivory-billed Woodpecker is appropriate when possible alternative hypotheses have been reviewed and rejected. The null hypothesis in this case is that the Luneau video captures a Pileated Woodpecker. There are two widely suggested alternatives of this null hypothesis that need to be rejected before it is possible to support the identification of the woodpecker in the Luneau video as an Ivory-billed Woodpecker. These alternatives are: (1) an abnormally white plumaged Pileated Woodpecker, or (2) a normally plumaged Pileated Woodpecker. To date there has been no published detailed analysis describing the bird depicted in the Luneau video as an abnormally white plumaged Pileated Woodpecker. Regardless, the possibility of a white Pileated Woodpecker was addressed thoroughly by Rosenberg et al. (2006) and dismissed. The challenge published by Sibley et al. (2006) focuses on the second alternative by claiming the identity of the woodpecker is obscured due to the angle of the bird relative to the camera along with flight mechanics.

A critical interpretation of the Luneau video hinges on the use of comparative materials. These materials include videos and photographs of Pileated and Ivory-billed Woodpeckers (the latter available only from the archives at the Cornell Laboratory of Ornithology and based on the work of A. A. Allen and colleagues during the 1930s), the use of mounted specimens and museum skins, models, and illustrations. Both Sibley et al. (2006) and Fitzpatrick et al. (2006) used most of these types of comparative materials, but only Fitzpatrick et al. (2005) analyzed the Luneau video using customized "flapping" life-sized models for both Pileated and Ivory-billed Woodpeckers.

Specifically, Fitzpatrick et al. (2006, also see Lammertink et al. 2006) used these flapping models under conditions similar to those when the Luneau video was taken. This allowed an experimental comparison of what should be expected in video images from a normally plumaged Pileated Woodpecker and a normally plumaged Ivory-billed Woodpecker during the wing downstroke. Fitzpatrick et al. (2005, 2006, 2007) concluded, using direct comparisons between models, specimens, and videos of known Pileated Woodpeckers, that the Luneau video point by point does not match any known normal Pileated Woodpecker. They further concluded that there is broad consistency with what would be expected with an Ivory-billed Woodpecker.

Sibley et al. (2006) countered that the flapping models are not realistic portrayals due to "stiff" wings. Instead, Sibley et al. (2006) presented an alternative interpretation using mostly line drawings as support for the alternative that the bird captured on film is a normal Pileated Woodpecker. Since there is extensive video footage available of Pileated Woodpeckers in flight, careful review of this footage (including videos cited by Sibley et al. 2006) is compelling in demonstrating the flaws in the Sibley et al. (2006) interpretation for the extensive amount of white on wings evident on most frames in the Luneau video.

While Sibley et al. (2006) reject the use of flapping models as comparable to flying woodpeckers, it is instructive to note that the Pileated Woodpecker model closely matches actual downstroke video images of Pileated woodpeckers and not the downstroke images of the woodpecker in the Luneau video (Fitzpatrick et al. 2006, Lammertink et al. 2006). The black trailing edges on the underwing are evident in many frames in all these videos of Pileated woodpecker, regardless of the quality of video or the camera angle. Even when the black trailing edge disappears in certain frames, it quickly reappears and is apparent in virtually every wingbeat. This is not the case with the woodpecker captured in the Luneau video. In all the videos of Pileated Woodpeckers, the consistent "twisting" wing flight style as proposed by Sibley et al. (2006) is undetectable. In particular, it is the upperwing, not the underwing, that is most apparent in both upstroke and downstroke when a woodpecker is flying level or rising relative to the line of sight

of the camera (as the woodpecker does in the Luneau video).

However, some key features proposed by Fitzpatrick et al. (2005) as diagnostic are not necessarily so. Specifically, the extrapolated size of the perched bird prior to launching (which if correct would eliminate Pileated Woodpecker as a possibility) could be subject to several differing interpretations, including the possibility that the woodpecker was already in flight when it first appeared in the Luneau video (Sibley et al. 2005, 2007). Nevertheless, once the video artifacts are dismissed, the woodpecker in the Luneau video, when it first becomes visible, still shows characteristics consistent with Ivory-billed Woodpecker and not with Pileated Woodpecker (i.e., lack of any indication of black secondaries), regardless of whether it is the underwing or the upperwing in view (Fitzpatrick et al. 2006, Lammertink et al. 2006). All videos of launching Pileated Woodpeckers at roughly comparable angles invariably exhibit clear evidence of black secondaries.

Conclusion

The FWS has made every effort to objectively review published interpretations of the Luneau video. Our review of the presented arguments leads us to conclude that the alternative interpretations of Sibley et al. (2006) and Collinson (2007) fail to credibly support their assertion that the woodpecker in the Luneau video could reasonably be a Pileated Woodpecker. Subsequent published analyses with additional comparative video footage or the use of improved (including computer generated) models may lead to new insights into the identification of the woodpecker in the Luneau video.

Regardless of the debate over the Luneau video, the lack of more definitive evidence would understandably lead to increasing doubt about the initial reports from 2004 and 2005. The question that must be addressed is whether a large species of woodpecker with a black body and extensive white in the wings (more than is typical for Pileated Woodpecker) could reasonably escape being definitively photographed since 1938 (Tanner 1942, Jackson 2004). This question becomes more important as search efforts over five years, while leading to additional potential encounters, have failed to reliably locate Ivory-billed Woodpeckers in Arkansas. Similar results have occurred with organized searches in Florida, South Carolina, Tennessee, Texas, and Louisiana (USFWS 2006, 2007, Hill et al. 2006), again despite similar increases in the number of potential encounters in several of these states across the historical range of the species (more detail provided in Appendix E.). So while we cannot conclude that a population of Ivory-billed Woodpeckers is established in this region, any declaration proclaiming the Ivory-billed Woodpecker is extinct would be premature.

The FWS recognizes and supports exchanges of views on alternative interpretations as a part of the scientific process, and we understand that the accumulated information in Fitzpatrick et al. (2005) will continue to be questioned as constituting confirmation of the species' persistence in eastern Arkansas. We will review any new published information to ensure that our conclusions and actions supported by the best available information. Although the FWS continues to welcome constructive debate over the interpretation of the Luneau video, the repeated potential visual and auditory encounters alone in the Big Woods of Arkansas and elsewhere within the historical range of the species cumulatively present enough evidence to support the region-wide search effort. In addition, the potential presence of this species justifies continuing habitat conservation and restoration efforts that were already well underway in eastern Arkansas before any recent evidence of the Ivory-billed Woodpecker became known to the FWS.

In conclusion, the FWS accepts the original Fitzpatrick et al. (2005) interpretation of the Luneau video and other evidence gathered during the last five years as the best information available to support the hypothesis that Ivory-billed Woodpecker has persisted into the 21st Century. On the basis of this conclusion, the FWS will continue to appropriately act on behalf of the Ivory-billed Woodpecker under the authority of the Endangered Species Act of 1973, as amended.

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Appendix C. Expenditures and Accomplishments to Date of This Draft Recovery Plan

Table C-1.

ACCOMPLISHMENTS OF ENDANGERED SPECIES RECOVERY (1113) FY 06 FUNDS IVORY-BILLED WOODPECKER					
Received $1,135,945					
		FUNDS	**ORG**		
Recovery Plan, Team	**EXPENDED**	**TARGETED**	**CODE**	**PARTNER/OFFICE**	**ACCOMPLISHMENT**
NWR, RO existing staff/recovery needs, Recovery Plan Draft	$ 83,360	Refuges RO	40130	White River NWR	Planning, inventory, management, support stakeholder and team meetings
	$ 46,168	Refuges RO	40130	Cache River NWR	Planning, inventory, management, support stakeholder and team meetings
	$ 129,528				
Search Teams					State Searches
Georgia	$ 28,312	Athens ESFO	41460	Field Office, GA Dept of Natural Resources	Georgia Search
South Carolina	$ 75,000	Charleston ESFO	42410	Field Office, Nature Conservancy	South Carolina Search
Louisiana and Arkansas	$ 51,108	Lafayette ESFO	43440	Field Office, LA Wildlife Department, Operation Migration	Lousianna Search, Arkansas Search
Louisiana and Arkansas	$ 138,000	Refuges RO	40130	Cornell University Laboratory of Ornithology	Technology support and coordination by Cornell, Arkansas Search
Alabama	$ 50,000	RO	40120	USGeological Survey	Alabama/Florida Search
Texas	$ 100,000	Refuges RO	40130	Gulf Coast Bird Observatory	Texas Search
	$ 442,420				
Biological Planning					
Development of a Population Viability Model P1	$ 9,000.00	LMV JV office	47750	University of Georgia, Athens	Complete-report provided
Development of a Foraging Energetics Model P2	$ 9,000.00	LMV JV office	47750	see above	Work completed-- model assumptions and parameters developed, based on forest habitat inventory
Cache/Lower White Habitat Characterization and Assessment Phase II L1	$15,000.00	Refuges	40130	Arkansas Game and Fish Commission	Work completed--habitat mapping
MAV Habitat Characterization and Decision Support Model L2 and C1	$39,000.00	LMV JV office	47750	Ducks Unlimited	Preliminary layers to search teams, additional field data collection needed, next steps will develop decision support tools. Training on Data Analysis completed, large amount of data to handle, issue with geo-location on field data
Ecological Dynamics of Tree Mortality and Forest Regeneration R1	$ 5,000.00	LMV JV office	47750	US Geological Survey	Completed, FWS contribution to $75,000 project-management scenarios, mortality--2-3 year project
Development of a Range Wide Potential Occupancy Model P5 and L7	$40,000.00	LMV JV office	47750	US Geological Survey	Draft model developed, circulated/revised
Assessment of IBWP and other breeding birds relative to forest structure and composition R5	$30,150.00	LMV JV office	47750	Univ of AR $30,150 401816J047	Point count surveys completed, to be coupled with ground based stand inventory and lidar data
Cache/Lower White Forest Structure Mapping Project L4	$78,570.00	LMV JV office	47750	University of Maryland, NASA	Partnership with NASA, UMD, lidar flights completed, Spatial analysis of existing conditions, support tools will allow better focus of restoration efforts
Development of a Web-enabled Forest Management Geodatabase M3	$79,240.00	LMV JV office	47750	US Geological Survey	Under development--real time tracking of habitat conditions using forest management and inventory data in a user-friendly environment-expertise provided by USGS
Assessment of Attack Rates and Density of Wood-boring Beetles R4	$15,000.00	LMV JV office	47750	US Department of Agriculture	Part of larger Forest Service Project on tree mortality/insects
	$319,960				

Recovery Activities					
Staff time	$72,209	ES RO	40120	Salary, Travel, Printing (includes ClemsonUniversity)	Field and Regional Office staff support--coordinated recovery actions, developed partnerships, assisted search efforts
	$49,904	Lafayette ESFO	43440	Salary, Travel	
	$63,953	Conway ESFO	43421	Salary, Travel	
	$186,066				
TOTAL 1113 FUNDS	$1,077,974				
	TOTAL OBLIGATIONS				
FUNDS REMAINING AT END OF FY $57,971					
The remaining funds noted above have been used for Dec/Jan FY 07 Ivory-billed Woodpecker Recovery Projects					

Table C-2.

ACCOMPLISHMENTS OF ENDANGERED SPECIES RECOVERY (1113) FY 07 FUNDS IVORY-BILLED WOODPECKER					
Received $1,182,000					
		FUNDS	**ORG**		
Recovery Plan, Team	**EXPENDED**	**TARGETED**	**CODE**	**PARTNER/OFFICE**	**ACCOMPLISHMENT**
RO existing staff/recovery actions, technical assistance, Recovery Plan Draft, and search support	$ 58,482	Refuges RO	40130	Regional Office, Refuges	Planning, management, support search and team meetings, technical assistance, and analysis
	$ 146,720	ES RO	40120	Regional Office, Ecological Services	Planning, management, support stakeholder and team meetings, search coordination, agreements, technical assistance, and analysis
Lead Field Office Plan Support	$ 77,916			Lafayette ES Field Office	Manage Public Comment process, draft plan support
Peer Review	$ 18,000	ES RO	40120	The Wildlife Society	Contract for Peer Review Process-completed
	$ 301,118				
Search Teams					State Searches
Georgia	$ -	Athens ESFO	41460	Transferred funds to Charleston	Georgia Search
South Carolina	$ 67,691	Charleston ESFO	42410	Field Office, Nature Conservancy , NPS	South Carolina Search
Arkansas	$ 54,239	WRNWR	43670	White River National Wildlife Refuge	Arkansas Search
Arkansas	$ 39,700	Conway ESFO	43421	TNC, AUD-Arkansas, AFGC	Arkansas Search (Some funds to be used for Helicopter search 2008)
Arkansas	$ 225,000	Lafayette ESFO	43440	Cornell University Laboratory of Ornithology	Technology support and coordination by Cornell, Arkansas Search
Florida	$ 100,000	RO	40120	US Geological Survey-Auburn University	Florida Search (FWC search supported by 2006 carryover funds-$43,000
Texas	$ 16,000	R2	40130	Gulf Coast Bird Observatory	Texas Search
Tennessee	$ 4,000	Cookeville ESFO	4230	TN DNR, Hatchie National Wildlife Refuge	Tennessee Search
Louisiana	$ 50,000	Lafayette ESFO	43440	LA Department of Wildlife and Fisheries	Louisiana Search (Some funds to be used for Helicopter search 2008)
Mississippi	$ 30,000	Jackson ESRO	43910	MS Department of Wildlife, Fisheries, and Parks	Mississippi Search(Some funds to be used for Helicopter search 2008)
Illinois	$ 9,850	R3		Cypress Creek National Wildlife Refuge, IL DNR, IL Natural History Survey	Illinois Reconnaisance Search
North Carolina	$ 71,784	ES RO	40120	Audubon North Carolina	North Carolina Search for 2008 agreement
	$ 668,264				
Biological Planning					
Search Survey Design and Development of Occupancy Model	$ 112,777	USGS	40120	University of Georgia, Athens	Continuing Model development
Surrogate Species Study Pileated Woodpecker Productivity and Ecology	$ 56,500	ES RO	40120	Arkansas State University	First Year of Study completed
	$ 169,277				
Recovery Activities					
Outreach	$17,667	ES RO	40120	Salary, Travel, Printing	recovery actions such as brochures, partnerships, web management
Education	$15,954	Tensas NWR	43690	Salary, Travel	Interpretive Kiosk plus $11,925 with RO for Tensas traveling display design)
Support Refuge Management	$2,975	Loxahatchee NWR		Helicopter Use	
	$36,596				
TOTAL 1113 FUNDS	**$1,175,255**			TOTAL OBLIGATIONS	
FUNDS REMAINING AT END OF FY $6,742					
The remaining funds noted above have been used for Dec/Jan FY 08 Ivory-billed Woodpecker Recovery Projects					

Challenge Cost Share Project	$ 30,000	Refuges		White River NWR, USDA Forest Service	Decay and Beetle infestation study
Lower Mississippi Joint Venture Line Item Projects $396,000 Appropriated					
MAV Habitat Characterization Habitat expanded by Mapping the Potential Natural Vegetation (PNV) of the Tensas Basin and Mississippi River in Northeastern Louisiana.	$100,000	LMV JV office	47750	Contracted with the US Army Corps of Engineers, 5 Oaks Wildlife Services	Development of PNV maps for planning habitat restoration in the region, and specifically for restoration of potential Ivory-billed Woodpecker habitat. This area is additional potential habitat outside of Arkansas, particularly in Louisiana and Mississippi. Study underway.
Development of a Range Wide Potential Habitat Suitability Model	$24,000.00	LMV JV office	47750	US Geological Survey, Colorado State University	Improved model under development
Assessment of IBWP and other breeding birds relative to forest structure and composition R5	$30,150.00	LMV JV office	47750	Univ of AR $30 401816J047	Point count surveys completed, to be coupled with ground based stand inventory and lidar data
Remotely Sensed Data Interpretation, Forest Structure Mapping, Management Decision Support Tool Development, Science Workshop, Historical Habitat Analysis	$ 121,000	LMV JV office	47750	National Wetlands Research Center	Under development--tracking of habitat conditions using forest management and inventory data at the compartment level using remotely sensed data, Forest Composition and stress mapping (AVIRIS), Forest structure mapping (LiDAR) Development of 1-2 workshops for IBWO science updates
Assessment of Attack Rates and Density of Wood-boring Beetles R4	$ 15,000	LMV JV office	47750	US Department of Agriculture	Part of larger Forest Service Project on tree mortality/insects
GIS Product Development and Data Dissemination	$20,000	LMV JV office	47750	The Nature Conservancy	Under development
Project Management Support	$ 95,850	LMV JV office	47750		Development of agreements, Project Officer and management, technology transfer, financial accountability

Table C-3.

ACCOMPISHMENTS OF ENDANGERED SPECIES RECOVERY (1113) FY 08 FUNDS IVORY-BILLED WOODPECKER						
	$1,163,561	Appropriated				
			FUNDS	**ORG**		
	Recovery Plan, Team	**EXPENDED**	**TARGETED**	**CODE**	**PARTNER/OFFICE**	**ACCOMPLISHMENT**
	RO existing staff/recovery actions, technical assistance, Recovery Plan Draft, and search support	$ 55,484	Refuges RO	40130	Regional Office, Refuges	Planning, management, support search and team meetings, technical assistance, and analysis
		$ 152,850	ES RO	40120	Regional Office, Ecological Services	Planning, management, support stakeholder and team meetings, search coordination, agreements, technical assistance, and analysis
	Lead Field Office Plan Support	$ 77,916			Lafayette ES Field Office	Manage Public Comment process, draft plan support
		$ 286,250				
	Search Teams					State Searches
	South Carolina	$ 76,132	Charleston ESFO	42410	Field Office, Nature Conservancy , NPS	South Carolina Search
	Arkansas	$ 5,000	WRNWR	43670	White River National Wildlife Refuge	Arkansas Search
	Arkansas and Regional Search	$ 225,000	ES RO	43440	Cornell University Laboratory of Ornithology	Technology support and coordination by Cornell, Arkansas Search, Mobile Search Team
	Florida	$ 101,932	ES RO	40120	USGeological Survey-Auburn University	Florida Search (FWC search supported by 2006 carryover funds
	Texas	$ 93,000	R2	40130	Gulf Coast Bird Observatory	Texas Search
	Tennessee	$ 18,000	Cookeville ESFO	4230	TN DNR, Hatchie National Wildlife Refuge	Tennessee Search
	Louisiana	$ 66,380	Lafayette ESFO	43440	LA Department of Wildlife and Fisheries	Louisiana Search (Some funds were used for Helicopter search 2008)
	Mississippi		Jackson ESRO	43910	MS Department of Wildlife, Fisheries, and Parks	Mississippi Search $30,000 2007 Funds
	Illinois	$ 30,000	ES RO		Cypress Creek National Wildlife Refuge, IL DNR, IL Natural History Survey	Illinois Reconnaisance Search
	North Carolina		ES RO	40120	Audubon North Carolina	North Carolina Search for 2008 agreement
						$71,784 2007 Funds
		$ 615,444				
	Biological Planning					
	Surrogate Species Study Pileated Woodpecker Productivity and Ecology	$ 56,500	ES RO	40120	Arkansas State University	Second Year of Study completed
		$ 56,500				
	Recovery Activities					
	Outreach		ES RO	40120	Salary, Travel, Printing	Field and Regional Office staff support recovery actions such as brochures, partnerships, web management
	Education		Tensas NWR			Interpretive Kiosk (FY 2007 and $11,925 with RO for Tensas traveling display design)
	Support Refuge Management	$1,500				Hunt Brochures
		$1,500				
	LMJV Projects	$ 200,000				

	TOTAL 1113 FUNDS	**$1,159,694**			TOTAL OBLIGATIONS	
	FUNDS REMAINING AT END OF FY		$3,867			
	The remaining funds noted above have been used for Dec/Jan FY 09 Ivory-billed Woodpecker Recovery Projects					
	Lower Mississippi Joint Venture Projects $200,000 Appropriated					
	MAV Habitat Characterization Habitat expanded by Mapping the Potential Natural Vegetation (PNV) of the Tensas Basin and Mississippi River in Northeastern Louisiana.	$50,000	LMV JV office	47750	Contracted with the US Army Corps of Engineers, 5 Oaks Wildlife Services	Development of PNV maps for planning habitat restoration in the region, and specifically for restoration of potential Ivory-billed Woodpecker habitat. This area is additional potential habitat outside of Arkansas, particularly in Louisiana and Mississippi. Study underway.
	Development of a Range Wide Potential Habitat Suitability Model		LMV JV office	47750	US Geological Survey, Colorado State University	Improved model under development (2007 Funds)
	Assessment of Attack Rates and Density of Wood-boring Beetles R4	$ 15,000	LMV JV office	47750	US Department of Agriculture	Part of larger Forest Service Project on tree mortality/insects
	Cache/Lower White Habitat structure Characterization and Assessment Phase II L1	$ 5,000				
	GIS Product Development and Data Dissemination	$20,000	LMV JV office	47750	The Nature Conservancy	Under development
	Project Management Support	$ 110,000	LMV JV office	47750		Development of agreements, Project Officer and management, technology transfer, financial accountability
		$200,000				

Table C-4.

DRAFT PROPOSED ALLOCATION OF 1113 FY09 FUNDS RECEIVED FOR PREVENTING EXTINCTION OF IVORY-BILLED WOODPECKER						$1,122,836	31-Mar-09 Estimate	September
		FY09	FY09	FUNDS	ORG	$1,163,000	Actual	March
ITEM		AMOUNT	SUBTOTAL	TARGETED	CODE	DESCRIPTION		
IBWO Recovery Salaries	Liason salary, benefits, ov	$110,000			40120			
	ARD salary	$2,000			40120			
	Refuges/RO salary	$50,000			40136	Refuges Planning, Chuck Hunter--salary		
Recovery Team and Plan	team travel and meeting costs	$10,000			40120	support of team meetings, travel associated with meetings, meeting costs		
Field Office Support		$77,916			43440	to Lafayette salaries Lead Field Office		
			$248,916					
Search Efforts								
	Cornell	$225,000			40120	Agreement with Cornell-MST, Database, Tech support, South Florida		
	Arkansas (TNC)	$40,000			43421	to Conway Agreement with TNC or AGFC		
	South Carolina	$0			42410	Charleston/Search Team will use 2008 funds		
	Florida (Hill)	$40,000			40120	to ES RO estimate		
	North Carolina	$0			40210	Audubon NC will use 2008 funds		
	Tennessee	$15,000			42430	to Cookeville		
	Louisiana	$20,000			43440	Lafayette, LA search		
	Texas	$7,220				R2 Gulf Coast Bird Observatory, 2008 funds	93,960	
	Georgia	$0			41460	to Athens, GA search 2007 funds		
	Mississippi	$5,000		additional	43910	to Jackson, MS search 2007 funds	30,000	
	Illinois	$25,000				Illinois University, INHS		
			$377,220					
Biological Planning			$189,000					
Biological and Habitat Modeling		See	Attached					
Occupancy modeling	UGA 2 Years Total Funds $112,778	0			40120	UGA via USGS Coop Unit use 2008 funds		
Research-ASU/telemetry PIWO		$59,500			40120	Agreement Bednarz/ASU 3rd yr tot. $113,000 to date		
			$59,500					
Outreach	Cornell 1935 Expedition exhibit	Complete			43690	for Tensas NWR display--RO contract		
	Brochure, Poster, Reprints, web site management,develop new materials	$10,000	$10,000		40120	reprint of hunt brochure, print recovery plan		
Funding Partnership Projects,	habitat improvement		$120,000	NWR, FS	40120	Pre-commercial thinning reforestation stands, restoration planning AR, LA		
TOTAL 1113			$1,005,636			search, LMVJV, and all other projects		
			Balance	$157,364	(Actual)			

* Actions or items charged to 1113 under this heading must be directly related to recovery of IBWO. We will be held accountable to show the use of these recovery funds specifically for IBWO.

Proposed Projects	Continuation	2006 Funding	2007 Funding Actual	2008 Funding	2009Funding Proposed	Description
Cache/Lower White Habitat structure Characterization and Assessment Phase II L1	n	$ 90,000		$ 5,000	$ -	Data analysis
MAV Habitat Characterization and Decision Support Model L2 and C1	y	$ 39,000	$ 100,000	$ 50,000	$ 40,000	Hydrology, geomorphology characterization, Mapping Communities---ERDC, 5 Oaks--Total request originally 100,000
Development of a Range Wide Potential Occupancy Model P5 and L7	y	$ 40,000	$ 24,000		$ 24,000	CSU, Forest Service
Assessment of IBWP and other breeding birds relative to forest structure and composition R5	y	$ 30,150	$ 30,150		$ -	University of Arkansas
Cache/Lower White Forest Structure Mapping Project L4	y	$ 80,000			$ -	add field data collection, analysis, product development
Assessment of Attack Rates and Density of Wood-boring Beetles R4	y	$ 15,000	$ 15,000	$ 15,000	$ 15,000	Part of larger Forest Service Project on tree mortality/insects
GIS Product Development and Data Dissemination	y		$ 20,000	$ 20,000	$ -	The Nature Conservancy-under development
LMVJV Management Support	y		$ 95,850	$ 110,000	$ 64,000	Development of agreements, Project Officer and management, technology transfer, financial accountability
Remotely Sensed Data Interpretation, Forest Structure Mapping, Management Decision Support Tool Development, Science Workshop, Historic Habitat Analysis	LMV JV office		$ 121,000	$ 200,000	$ 46,000	USGS Historic Habitat Analysis
			$ 406,000			
Technology Transfer and Training	complete				$ 189,000	**Lower Mississippi Valley Joint Venture IBWO Funding**
Habitat Information Synthesis Workshop	complete					

Appendix D

Research Projects Completed or Underway in Response to Recovery Outline/Implementation Actions

The following are abstracts of papers presented at the Ivory-billed Woodpecker Science Symposium on June 10, 11, 12, 2008 at the National Wetlands Research Center in Lafayette, Louisiana. Most of the authors plan to publish their results in the future.

TITLE: Food of Ivory-Billed Woodpecker: Experimental Determination of Attack Rates of Cerambycid Prey on Forest Trees in the Mississippi Alluvial Valley

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ABSTRACT: This is a bundled project including a primary study of attack rates of Cerambycid beetles and other wood boring insects as potential prey organisms of Ivory-billed Woodpeckers, with a growing number of collateral projects made possible by the initial design. The primary study addresses the concern that food availability is a likely limiting factor for the woodpecker. By a carefully controlled experiment using randomly selected trees, we assess the response of wood-boring insects producing medium and large larvae to four treatments involving progressively greater wounds to living trees. Wounded trees will be harvested at two exposure intervals after one wounding and placed into emergence cages. Three samples from each tree will assess emergence of insects over a five-year period to accommodate long-lived larvae. Expected results involve determination of expected biomass, species composition, energy return, and nutritive value of larval wood-boring insects in early stages of infestation after injury, when Ivory-billed Woodpeckers are believed to have a competitive advantage over other woodpeckers in extracting these foods. Generation of large numbers of the supposedly preferred Hardwood stump borer (*Mallodon dasystomus dasystomus*) will demonstrate how food supply for Ivory-billed Woodpeckers can be enhanced by specific tree wounding treatments. To date, approximately 180 of 192 emergence cages have been constructed, and 24 of 96 trees harvested and put into them. Additional work on pheromones of *Mallodon*, and energetic value of this, of the carpenter worm, and other species has been initiated.

TITLE: Searching For Where To Search: Sifting Forest Inventories For Singer Tracts

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ABSTRACT: Rediscovery of once thought extinct species is more common than we may think. Within the last few decades, over 30 species that were once thought vanquished from the biota have been rediscovered. These rediscovered species are often found on islands or are local endemics. The Ivory-billed Woodpecker is an exception to this pattern because it had a widespread historical range that spanned portions of up to 13 states from east Texas to southeastern North Carolina. Monitoring to confirm rediscovery of a wide ranging species would benefit from searches informed by measures of habitat suitability derived from spatially extensive forest inventories. This project developed a range-wide habitat suitability model derived from historical accounts, primarily from the Singer Tract. The model was structured as a decision tree with threshold values for classifying U.S. Forest Service Forest Inventory and Analysis data as "suitable" or "unsuitable" habitat. Because food is the likely limiting factor affecting occupancy, our model focused on attributes of foraging habitat including forest type, tree size distribution, foraging substrate, and landscape context to identify potentially suitable habitat. Uncertainty was incorporated into the model by estimating distributions of threshold values for these attributes based on data from historical accounts. This permitted the mapping of suitable habitat probabilities across the South. Spatially explicit comparisons of model predictions against the Big Woods search area and historical locations provided initial validation of model performance. Probability

maps of suitable habitat were generated for Alabama, South Carolina, Mississippi, and Florida to inform the 2007/2008 mobile search teams.

TITLE: Evaluating Evidence of Persistence for Ivory-billed Woodpecker (Campephilus principalis) in the Southeastern United States From 1900 to the Present.

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ABSTRACT: The persistence of Ivory-billed Woodpecker in the Twentieth Century is firmly documented with many specimens prior to 1920, two specimens and photos in 1924 (of a pair in east-central Florida), and a specimen along with many photos and other documentation (including video and auditory recordings) during the 1930s (of a small population in northeast Louisiana). All other reports prior to 1950 were only of visual encounters (most accepted by Dr. James Tanner) at locations that support the hypothesis that small numbers (populations) of Ivory-billed Woodpeckers persisted across the historical range at least into the 1940s. After 1950, reports of visual encounters from prominent ornithologists are generally accepted from southern Georgia and Florida, but other reports of visual encounters during this decade also come from South Carolina, Alabama, and Texas. Although generally considered inconclusive after 1960, many visual encounters, several photos, feathers, and auditory encounters and recordings were reported from over most of the historical range through to the 1999 report along the Pearl River, Louisiana. During the Twentieth Century (before or after 1950), at no location during any one decade was this species regularly reported year-after-year except at the Singer Tract in Louisiana during the 1930s. Thus, failure to document Ivory-billed Woodpeckers along the Pearl River by organized searches during 2002, though disappointing, was not without precedent. In contrast to all Twentieth Century reports (besides the Singer Tract), initial visual encounters during 2004 in Arkansas were repeated by experienced observers but always with brief glimpses of a flying bird (presumably the same male bird). The public 2005 announcement of Ivory-billed Woodpecker persistence (of at least one male bird) in Arkansas energized searches for this species across the southeastern U.S. from the Carolinas, Georgia, Florida, Mississippi, Louisiana, Texas, Tennessee, Arkansas, and Illinois. Results thus far include many additional potential visual and auditory encounters. To date, none of these reports provide any better evidence than the original Arkansas reports of this species' continued persistence. The lack of any indisputable evidence following the 2005 announcement despite relatively extensive searching raises many questions regarding search strategies for firmly documenting a very rare species, if present. Addressed here specifically is whether the current pattern differs from reports prior to the 1930s, between 1930 and 1960, and between 1960 and 2000. Elsewhere, the history of reports has been presented state-by-state. In this analysis, range-wide reports have been compiled to compare encounters within the last 10 decades and also to compare these records to potential encounters from recent searches. These patterns are discussed to generate alternative hypotheses regarding the detection and documentation of the Ivory-billed Woodpecker since 1940.

TITLE: Morticulture Use for Ivory-Billed Woodpecker Habitat Improvements

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ABSTRACT: The rediscovery of the Ivory-billed Woodpecker in the bottomland hardwood forests of eastern Arkansas prompted a reexamination of management practices and habitat improvement efforts. Lack of suitable foraging sites (near-dead trees inhabited by cerambycid larvae) is often cited as one reason for its initial decline. As part of an effort to increase suitable forage for Ivory-billed Woodpecker, we implemented a morticulture project in which 614 bottomland hardwood trees were treated with girdles or glyphosate injections. Treatments were performed in 2005 and 2006, and trees were monitored annually for signs of impending mortality. An associated monthly Picidae-oriented point count was conducted in four of the treatment areas. After one year, 24.5% of trees showed no signs of decline. However, 18% of treated trees showed complete mortality. Within the first year *Celtis laevigata* and *Ulmus americana* most frequently experienced greater than one-third crown dieback. Preliminary results suggest that greater crown dieback occurs within the second year. Girdling also produces greater crown mortality than herbicide injections. While no Ivory-billed Woodpecker were observed using these treatment areas, seven *Picidae* species were recorded in treatment areas. Many recently dead, treated trees had large amounts of insect frass surrounding them. This work has potential implications in a variety of restoration and improvement projects for the Ivory-billed Woodpecker and other bottomland hardwood species.

TITLE: Acoustic Methods in the Ivory-bill Search and Beyond

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ABSTRACT: Acoustic methods have been an integral part of the search for the Ivory-billed Woodpecker since the Pearl River effort in 2002. The needs of this search have spurred a number of advances in hardware and software technology. We will summarize key components of the evolving acoustic methods, including hardware, software, and data analysis and review protocols. We will discuss lessons learned from the review and analysis of over 36,000 hours of audio recordings from bottomland hardwood forest habitats, including the discovery of unexpected "Ivory-bill impostor" sounds from some common species and the need for caution in interpreting isolated acoustic events. Finally, we will discuss ways in which technology advances resulting from the Ivory-bill search may benefit efforts to apply acoustic monitoring methods to other species of conservation concern.

TITLE: Acoustic and Digital Image Technologies for Detecting and Monitoring Ivory-billed Woodpeckers and Other Avifauna.

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ABSTRACT: Intensive search efforts for the Ivory-billed Woodpecker (*Campephilus principalis*) have resulted in numerous technological advancements related to bird monitoring methodologies. These include autonomous acoustic- and image-recording systems with potential applications for remote detection and constant effort monitoring of avian populations. These devices are important for monitoring endangered species and conducting spatially explicit avian research. Exceedingly rare species, especially those in remote habitats, can go unobserved for long periods of time, making it difficult (or impossible) to determine their status (Scott et al. in press). The human and financial resources required to conduct surveys of sufficient magnitude to assess with confidence that a species is extinct are frequently prohibitive, making autonomous systems an attractive alternative for future endangered species research. Furthermore, these systems, especially when networked to provide real-time data, afford the ability to gather important population and behavioral information on more common species. Some example applications include monitoring migration via nocturnal flight calls, determining volume and composition of raptor migration, and identifying timing and causation of bird strikes at wind turbines. Future successful development and application of these technologies will rely on strong partnerships among biologists, engineers, and information systems specialists.

TITLE: Design for a Region-wide Adaptive Search for the Ivory-billed Woodpecker with the Objective of Estimating Occupancy and Related Parameters.

AUTHORS: Robert J. Cooper, Rua S. Mordecai, Brady J. Mattsson, Univ. of Georgia, Athens; Michael J. Conroy, Krishna Pacifici, James T. Peterson, USGS Georgia Cooperative Fish and Wildlife Research Unit and UGA, Athens; Clinton T. Moore, Patuxent Wildlife Research Center, Athens, GA.

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ABSTRACT: We describe a survey design and field protocol for the Ivory-billed Woodpecker research effort that will: (1) allow estimation of occupancy, use, and detection probability for habitats at two spatial scales within the bird's former range, (2) assess relationships among occupancy, use, and habitat characteristics at those scales, (3) eventually allow the development of a population viability model that depends on patch occupancy instead of difficult-to-measure demographic parameters, and (4) be adaptive, allowing newly collected information to update the above models and search locations. The approach features random selection of patches to be searched from a sampling frame stratified and weighted by patch quality, and it requires multiple visits per patch. It is adaptive within a season in that increased search activity is allowed in and around locations of strong visual and/or aural evidence, and adaptive among seasons in that habitat associations allow modification of stratum weights. This statistically rigorous approach is an improvement over simply visiting the "best" habitat in an ad hoc fashion because we can learn from prior effort and modify the search accordingly. Results from the 2006-07 search season indicate weak relationships between occupancy and habitat (although we suggest modifications of habitat measurement protocols), and a very low detection probability, suggesting more visits per patch are required. Sample size requirements will be discussed.

TITLE: From the Ground Up: Evidence for the Wide Distribution of the IBW in the Southeast in the Archeological and Ethnographic Record

AUTHOR: Richard Warner, Staff Archeologist, Region 4, USFWS, 1875 Century Boulevard, Atlanta, Georgia 30345, 404-679-7110

ABSTRACT: The current scientific and popular literature on the Ivory-billed Woodpecker acknowledges the archeological and ethnographic evidence for a wide distribution of the Ivory-billed Woodpecker, well beyond its known and suspected current range. This presentation will review and evaluate the published archeological evidence from the perspective of an SE

archeologist, and will conclude with a distribution map that may be useful in assisting in the long-term recovery of the species. In addition, this presentation will include a brief overview of the cultural context of the Ivory-billed Wooddpecker and other woodpeckers in the pre-Columbian Southeastern United States, along with a discussion of how Native American populations may have had a significant influence on the distribution of this species over the last thousand years.

TITLE: Historical Ivory-billed Woodpecker Habitat Mapping Within the Tensas National Wildlife Refuge, 1938 and 1998.

AUTHORS: Handley, L.R., C. J. Wells, National Wetlands Research Center, U.S. Geological Survey, Lafayette, LA; J. Dugas, R. Mouton, D. Lichtenberg, National Wetlands Research Center/IAP World Services, Inc., Lafayette, LA

ABSTRACT: The Ivory-billed Woodpecker has always been described as rare, even before the catastrophic loss of habitat between the 1880s and 1930s. The woodpecker's preferred habitat varied by region. In the Mississippi Delta it seems to have preferred temporarily flooded, palustrine, deciduous forest dominated by sweetgum. In the Lower Mississippi Valley area, including the Mississippi-Atchafalaya distributary system, the Ivory-billed Woodpecker foraged in seasonally flooded oak flats and adjacent oak-hickory uplands, and in the lower, permanently flooded cypress-gum swamps. Photography covering the Singer Tract in both 1938 and 1998 were obtained and photointerpreted. Habitat data dating from 1938 were derived from 1:18,000 scale, black and white, aerial photography. The 1938 photography was scanned and rectified using Leica Imagine software. 1998 habitat data were derived from USGS NAPP 1:40,000 scale, color infrared, aerial photography, digital ortho quarter quads. Using this photography, areas of Tensas NWR were photo interpreted using the National Wetlands Inventory mapping conventions. Ancillary data sources utilized include USGS topographic maps, digital NRCS soil surveys, Digital elevation models, and 2004 and 2005 digital Roth quarter quads. Additionally the 1938 imagery was interpreted to create a disturbance, texture, and transportation layer. The photography was interpreted to reveal disturbances of any kind, human related or natural. A texture layer was also created to reveal patterns that would indicate forest growth trends as well as logging areas. A transportation layer was created to document transportation features, including roads and railroad tracts which were indicative of logging activity. Argos software was used to create and maintain topological relationships between features. Habitats were classified and attributed on-screen using Arc Map. 1938 hard copy stereo pairs were viewed under a stereoscope. This allowed for higher resolution, stereo viewing of the project area. Polygonal features begin and end at the same point, contain no overshoots or undershoots, and contain a single label. The 1938 habitat mapping photography will provide additional information in documenting the known historical habitat of this rare bird. The 1998 habitat mapping will allow a comparison with the historical data.

TITLE: Habitat Characteristics of the Ivory-Billed Woodpecker In Louisiana: Analysis of 1938 Aerial Photography

AUTHORS: Christopher Wells*, Larry Handley*, Jason Degas**, Wylie Barrow* PhD, Tommy Michot* PhD, National Wetlands Research Center, * United States Geological Survey, ** IAP World Services, Inc. U. S. Geological Survey, National Wetlands Research Center, Lafayette, Louisiana 70506.

ABSTRACT: The Ivory-billed Woodpecker, long suspected to be extinct, is now known to persist in remnant lowlands of the Cache River, Arkansas. Planning efforts are underway for extensive searches to find more birds in Arkansas and other river bottoms of the southern United States. Anecdotal reports of Ivory-billed Woodpeckers in the southern United States continue to this day. Potential habitat for Ivory-billed Woodpeckers is vast throughout the southeastern US and Gulf of Mexico coastal areas.

The authoritative natural history of the woodpecker is James Tanner's 1942 publication. Accepting that work as complete, accurate, and factual, we searched for historical photography with coverage of approximately the same date as Tanner's field work and at a scale that could demonstrate habitat characteristics that Tanner reported as important to the Ivory-billed Woodpecker. We located a private source of photography (P2Energy, formerly Tobin Aerial Surveys) that was originally taken about August of 1938 at the Singer Tract when Tanner was conducting his field work. Some of the important factors found on the photography included dead and dying vegetation, very large trees, a heterogeneous canopy, forest canopy gaps, and disturbance.

Limitations of the 1938 photography were lack of horizontal control, resulting in no GPS or gyroscopic positioning; monochromatic emulsion (black & white) which makes tree species identification difficult; the low altitude flight required for high resolution, which caused considerable buffeting of the aircraft with resultant camera axis differences from the ground between flight lines and even between individual frames; and extremely problematic ground control points for rectification. Finally, since the 1938 photography was taken during the growing season, we were unable to observe either the middle stories or the ground cover except under the most unusual circumstances.

We developed a statistically valid method of stereo-photographic

analysis that allowed the quantification of many factors of interest in describing the habitat requirements of the Ivory-billed Woodpecker in the early 20th Century. This method required some compromises that we believe are tolerable, especially given the paucity of actual data regarding the habits and habitats of the Ivory-billed Woodpecker.

TITLE: Ivory-Billed Woodpecker Habitat Relations for the Singer Tract, Louisiana: A Retrospective Analysis.

AUTHORS: Wylie C. Barrow, Jr., Christopher P. Wells, Thomas C. Michot, James B. Grace, Larry R. Handley, Heather Q. Baldwin1., Tyson L. Hatch1., and Jason Dugas1., U. S. Geological Survey, National Wetlands Research Center, and 1.IAP World Services, Inc., Lafayette, Louisiana 70506.

ABSTRACT: Currently, there are no known Ivory-billed Woodpecker activity areas that can be carefully delineated and studied to determine habitat relations. Work conducted on the last known populations by James Tanner (Singer Tract, Louisiana; 1930s) and George Lamb (Cuba; 1950's), have provided thirteen known locations of Ivory-billed Woodpecker home ranges. Aerial photographs corresponding to the dates and locations of their studies are known to exist. We created an ArcMap GeoDatabase of the Singer Tract by combining interpreted 1938 aerial photographs (mapped and sampled stereoscopic interpretation) and ancillary historical data (e.g., 1815-55 surveyor's maps, 1830 – 1943 Madison Parish tax records, 1863 confiscated Confederate Army maps, 1935 and 1941 Singer Tract maps created by James Tanner, and 1931-1938 topographical quad maps) to characterize habitat used by Ivory-bills. For the photo-interpretation, we used panchromatic photography of the Singer Tract that was flown in August 1938 at a nominal scale of 1:18,000. All photographs were scanned at high resolution (12 microns) and rectified to the 2004 digital ortho quarter quads of the area using ERDAS Imagine software. A mosaic of the rectified photographs was exported to ArcMap and boundaries were drawn of 7 Ivory-billed Woodpecker home ranges (mean = 871 ha, range = 501 ha – 1369 ha) and 3 "best areas" (Tanner 1942, p. 38 and p. 91; respectively). Boundaries of an additional 7 randomly selected areas were created (each area = 871 ha) to delineate areas not used by Ivory-bills during the breeding seasons 1934-1939. We described categories of dead and dying trees, forest disturbance, canopy texture, canopy gaps, super-emergent trees, and habitat types in areas used and not used by Ivory-bills. Results provide insight into how Ivory-bills used the Singer Tract, and will inform forest restoration/management and searches for potential Ivory-bill habitat.

TITLE: Woodpecker Densities and Habitat Use in the Big Woods of Arkansas.

AUTHORS: David G. Krementz - USGS Arkansas Coop Unit, Dept. Biological Sciences, Univ. Arkansas, Fayetteville, AR, Jason D. Luscier – Dept. Biological Sciences, Univ. Arkansas, Fayetteville, AR

ABSTRACT: To understand the potential habitat use of the Ivory-Billed Woodpecker better, we investigated the habitat use of all woodpeckers in the Big Woods of Arkansas. With the Big Woods Ivory-billed habitat inventory sampling scheme as a sampling frame, we used a stratified sampling approach to select 92 sites across 3 areas (Cache River NWR, White River NWR, AR Game & Fish Comm.). We surveyed each site 5 times during spring 2006 and winter and spring 2007 (15 surveys per site total) for woodpecker use. We estimated density by species using the program DISTANCE. We recorded 3,585 detections across the following species: Pileated Woodpecker, Downy Woodpecker (*Picoides pubescens*), Red-bellied Woodpecker (*Melanerpes carolinus*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Yellow-shafted Flicker (*Colaptes auratus*), Yellow-bellied Sapsucker (*Sphyrapicus varius*), and Hairy Woodpecker (*Picoides villosus*). The effective survey distance varied by species, season and area. Except for the Hairy Woodpecker, we were able at least to estimate 1 season-specific density per species which ranged from a low of 9 (95% CI 4.5 – 18.1) Pileated Woodpeckers/ km2 during winter 2007 to a high of 161 (95% CI 144.2 – 180.6) Red-bellied Woodpeckers/ km2 during spring 2007. Densities of Downy Woodpecker and Red-bellied Woodpecker were about five times greater than Pileated Woodpecker densities across seasons. We were only able to estimates winter densities for Red-bellied Woodpecker, Yellow-bellied Sapsucker and Yellow-shafted Flicker. Our estimated woodpecker densities usually exceeded comparable species-specific densities from other study sites, indicating that the Big Woods may be unique in attracting and/or holding woodpeckers. Our next step will be to relate woodpecker abundance and distributions to habitat variables thought important to woodpeckers.

TITLE: LiDAR "Images" of Forest Structure: Will They Help Us Improve Wildlife Habitat Quality?

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ABSTRACT: Quality wildlife habitat – forested acreage is not enough. To thrive, wildlife requires specific forest structure and other habitat conditions. To improve wildlife habitat quality in these fiscally thin times, managers need to know where to apply management actions to induce optimal wildlife responses.

What is the quality of the existing forest habitat? To answer this question, foresters, wildlife

biologists – land managers – need a scale-relevant, affordable, accurate and robust means of monitoring the vertical structure of the forest over space and time. The hypothesis: large footprint, waveform LiDAR (Light Detection and Ranging) provides an innovative means for these land managers to quantify forest structure and, consequently, evaluate wildlife habitat quality.

To assess this hypothesis NASA – Goddard Space Flight Center, in conjunction with Drs. Dubayah and Hofton, University of Maryland, flew the Region of Rediscovery in June, 2006, collecting large footprint, waveform LiDAR (Light Detection and Ranging) data over 1.2 million acres to map the forest structure of potential Ivory-billed Woodpecker habitat. Direct products from LiDAR data collection (e. g., forest canopy height, percent canopy cover) have already been used to inform Ivory-billed Woodpecker search and planning efforts.

We continue to assess the abilities of LiDAR data to

Quantify forest basal area

Quantify forest biomass

Quantify the vertical structure of the forest

Assist managers to visualize complete forest stands in 3D

Assist managers with land management decisions

Merge with other types of remotely sensed data (e. g., Hyperion, ASTER) and accurately describe forest structure and composition.

Our presentation will illustrate our findings.

TITLE: Are Hurricanes Good for Ivory-bills? Impact of Hurricanes on Woodpecker Populations in the Pearl River Basin, Louisiana

AUTHORS: Martjan Lammertink, Utami Setiorini1, and Alison Styring

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ABSTRACT: Temporary concentrations of dead and dying trees are important as feeding sites for Ivory-billed Woodpecker. Hurricane impact, a major agent of concentrated tree death in the southeastern U.S., is generally expected to benefit the species. In February 2002 we conducted point counts to assess woodpecker densities in mature bottomland forests of the Pearl River basin, Louisiana. In 2005 these forests were severely damaged by the Katrina and Rita hurricanes. We repeated our Pearl River point counts in February 2006, 2007, and 2008 to monitor the hurricane impact on woodpecker populations. No Ivory-billed Woodpeckers were observed. Following Tanner, we used density of Red-bellied Woodpecker and Pileated Woodpecker as a proxy for habitat suitability for Ivory-billed Woodpecker. Densities of these woodpeckers were greatly reduced in all of the three post-hurricane years. Red-headed Woodpecker has disappeared from the area. Standing hurricane-killed trees were in an advanced state of decay as soon as 18 months after the hurricanes. We conclude that bottomland forests in the full impact zone of a hurricane path are too severely damaged to benefit woodpecker populations. Historically, in a contiguously forested landscape, any hurricane left moderately damaged forests peripheral to its pathway that may well have benefited Ivory-billed Woodpeckers. This is no longer the case with the present fragmented distribution of the bottomland forests of the Southeast.

TITLE: Imitation of Double-knock Drums in Ivory-billed Woodpecker Surveys: Tests with Pale-billed Woodpeckers in Costa Rica

AUTHORS: Chris Saker1, Martjan Lammertink2, Theresa Thom3, and Howard Daugherty4

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ABSTRACT: A mechanical device for imitation of double-knock drums of Campephilus woodpeckers was developed at the Cornell Laboratory of Ornithology. Thirty copies of the device have been distributed to aid Ivory-billed Woodpecker surveys across the southeastern U.S. We examined whether use of the double-knocker device improves the detection rate of Campephilus woodpeckers, and whether it causes undue disturbance to these birds, using the Pale-billed Woodpecker (*C. guatemalensis*) as a model. Experiments were conducted between late September 2007 and early February 2008 in the Alexander Skutch Biological Corridor, Southern Pacific Slope of Costa Rica. We conducted 49 tests with the double-knocker, under a variety of conditions, in three Pale-billed Woodpecker home ranges. Responses were detected in 45% of the experiments. Often the first detection cue was the sound of wing beats of a woodpecker coming in to investigate. Responses were most prevalent when the woodpeckers were confirmed to be in the immediate vicinity (<100 m) at the time of the experiment. The device also proved successful in generating responses from birds not confirmed to be in the vicinity prior to the experiment, especially in hours of high bird activity in the early morning and late afternoon. Comparisons

with similar experiments using vocalization and double-knock recording playbacks, showed a greater rate and intensity of response when the double-knocker tool was used. Pale-billed Woodpeckers generally resumed routine activities within 30 minutes after use of the double-knocker, and no birds left territories or roost holes after use of the device. In conclusion the double-knocker proved to be an effective and safe means for improving detection probability of Campephilus woodpeckers, making it a promising tool in the search for Ivory-billed Woodpeckers.

TITLE: Ecology of Pileated Woodpecker (Dryocopus Pileatus) Nesting, Roosting, and Foraging and Saproxylic Beetles in Partial Cut and Uncut Bottomland Hardwood Forests

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ABSTRACT: Relative abundance and species richness of saproxylic beetles and nesting, roosting, and foraging ecology of Pileated Woodpeckers were studied in recent partial cuts and uncut forest during 2006 and 2007. Relative abundance of saproxylic beetles was greater in partial cuts than in uncut forest in both years but species richness was the same. The number of dead trees and period of capture also influenced beetle abundance. Partial cuts and uncut forest provide similar habitat for nesting and roosting Pileated Woodpeckers. Woodpeckers used a variety of species of trees that were between 42 and 150 cm diameter at breast height (dbh) for nesting (n = 24, 60.5 ± 3.02; mean ± SE) and roosting (n = 15, 70.3 ± 7.03). Bald cypress was selected in all treatments. Nests (22 of 24) and roosts (12 of 15) were predominantly in boles of live trees (vigorous to decadent). Nest and roost sites contained more trees >50 cm dbh than did availability plots. Foraging observations were conducted in 31 territories of radio-tagged and non-radio-tagged Pileated Woodpeckers. Pileated Woodpeckers spent the highest proportion of their foraging time excavating (58%), followed by pecking (14%), gleaning (14%), scaling (7%), berry-eating (4%), and probing (3%) on trunks with bark, (41%) dead branches (27%), live branches (13%), trunks without bark (10%), and vines (9%). Woodpeckers preferred bitter pecan, avoided sugarberry, and used overcup oak in proportion to availability. They avoided dbh classes 10-20, selected dbh classes 50-70, and used dbh classes 30-40 in proportion to their availability in most treatments. In partial cuts, extremely large trees (dbh classes 80-90+) were selected. Pileated Woodpeckers either avoided vigorous and decadent trees for foraging or used them in proportion to their availability. Woodpeckers preferred trees in early stages of decay in all treatments, but in two-year-old partial cuts they preferred trees in late stages of decay. The mean proportion of thatching ant individuals was (44 ± 7.1), followed by unknown seeds (26.6 ± 5.4), poison ivy seeds (15.4 ± 2.7), carpenter ants (10.6 ± 3.9), and beetles (4.9 ± 1.4). The proportion of food items in scat did not vary among treatment types.

TITLE: Pileated Woodpecker Nesting Ecology in the Big Woods of Arkansas: Possible Inferences to Limiting Factors Affecting Ivory-billed Woodpecker Population Growth?

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ABSTRACT: One significant obstacle to the recovery of Ivory-billed Woodpeckers is the lack of information about this species' biology and the ecology of large woodpeckers in bottomland hardwood forests in the southeastern U.S. We present preliminary findings on large woodpecker ecology in bottomland hardwood habitats, using Pileated Woodpeckers as our model species. These data suggest that certain characteristics of nest trees, cavity trees, and forage trees selected by large woodpeckers were different between the lower and higher bottomland habitats. Specifically, Pileated Woodpeckers nested in trees that were shorter, had a smaller dbh, and were more advanced in decay than trees they selected as roosts. In 2007, we estimated mean spatial use patterns in 9/13 radio-marked Pikeatd Woodpeckers as 264.4 ha (range = 22.4 – 994.3 ha). In addition, nesting, roosting, and foraging locations were documented for radio-marked and unmarked individuals. Adult Pileated Woodpeckers exhibited smaller home-ranges (= 27.3 ha) than reported in the literature (ca. 53–160 ha), suggesting high-quality habitats. Four of 13 radio-marked individuals were depredated in the lower bottomland habitat: perhaps dispersal or mate searching is very dangerous in this environment. Most recent Ivory-billed Woodpecker sightings occurred in these lower bottomland habitats. Further, we documented nest depredation, which could be another limiting factor affecting Ivory-billed Woodpecker population growth, if extant.

TITLE: Using Hydrogeomorphic Community Maps to Better Understand Potential Ivory-billed Woodpecker Habitat in Arkansas and Louisiana

AUTHORS:Thomas Foti, Charles Klimas, Jody Pagan and Elizabeth Murray

ABSTRACT: Varying flow regimes and depositional environments throughout the Quaternary Period have left a subtly complex landscape of depositional features within the Mississippi Alluvial Valley (MAV). Those variations

produce spatial complexity and diversity, with the distribution of plant communities reflecting abiotic site characteristics such as geomorphology, soil, hydrology and topography. Recent studies have established hydrogeomorphic (HGM) criteria for wetland classification over a large part of the MAV. Detailed, spatially explicit geomorphology and soils data are available over the entire MAV, along with flood frequency maps at varying levels of detail. Therefore the tools exist to apply HGM principles to develop maps of potential plant community distribution based on identifiable combinations of abiotic characteristics of sites, whether they are currently forested or in agriculture or other use. These Potential Natural Vegetation (PNV) maps provide an indication of the multi-scale complexity that once characterized the MAV, and can serve as planning tools for restoration. PNV maps have been completed for most of the MAV in Arkansas; the approach currently is being applied to northeastern Louisiana, and it can be expanded to the entire MAV.

These maps provide insight into the composition and distribution of forests occupied by Ivory-billed Woodpeckers along the Tensas River of Louisiana ca. 1940 and in the area of rediscovery along the White and Cache rivers in Arkansas at present. The maps are particularly useful in the Tensas area since much of the forest there has been cleared or substantially altered since the time of Tanner's studies in the Singer tract. His studies provided considerable detail on habitat relationships of the Ivory-billed Woodpecker at that time, but typically his descriptions were general and his detailed tables of composition and structure cannot be extrapolated to the entire area or to specific sites. Therefore questions remain as to the distribution, composition and structure of the forests at that time. HGM mapping can provide insight into the first two questions. Maps produced through this process can provide valuable insight particularly when used in conjunction with descriptions by scientists such as Tanner, early forest inventories, General Land Office surveys, and other sources. A limitation of the HGM approach is that it is based in part on flood frequency maps that are somewhat uncertain even with modern data; projecting site-specific conditions into the past must be approached with caution.

TITLE: A Stochastic Population Viability Analysis for Rare Large-bodied Woodpeckers, with Implications for the Ivory-billed Woodpecker

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ABSTRACT: Six large-bodied (i.e., ≥120 g) woodpecker species are listed as near threatened to critically endangered by the IUCN. The small population paradigm assumes that these populations are likely to become extinct without an increase in numbers, but the combined influences of initial population size and demographic rates (annual adult survival and fecundity) may drive population persistence for these species. We applied a stochastic, stage-based single-population model to available demographic rates for Dryocopus and Campephilus woodpeckers. In particular, we determined the change in predicted extinction rate (i.e., proportion of simulated populations that went extinct within 100 years) to proportional changes in six input parameters. To our knowledge, this is the first study to evaluate the combined importance of initial population size and demographic rates for the persistence of large-bodied woodpeckers. Under a worse-case scenario, the median time to extinction was 8 years (range: 1-50). Across the combinations of other input values, increasing initial population size by one female induced, on average, 0.4-3.2% (range: 0-28%) reduction in extinction rate. Increasing initial population size from 5-30 drove extinction rate <0.05 under limited conditions: 1) all input values were intermediate, or 2) Allee effect was present and annual adult survival was ≥ 0.8. On the basis of our model, these species can persist as rare (as few as 5 females), and thus difficult-to-detect, populations provided they maintain ≥ 1.1 recruited females annually per adult female and an annual adult survival rate ≥ 0.8. While a demographic-based PVA is useful to predict how extinction rate changes across scenarios for life history attributes, the next step for modeling these populations should incorporate more easily-acquired data on changes in patch occupancy to make predictions about patch colonization and extinction rates.

TITLE: Causes of the Ivory-bill's Decline

AUTHOR: Noel F.R. Snyder

ABSTRACT: In most modern accounts the endangerment of the Ivory-billed Woodpecker has been attributed mainly to (1) feeding specialization leading to a dependency of individuals on huge areas of pristine forest, and (2) the logging of nearly all virgin forests in the species' original range. However, the direct evidence for feeding specialization in the Ivory-bill is weak, and early reports strongly suggest the species was once common in bottomland forests. The Ivory-bill did show evidence of sparse populations and often a close association with remnant virgin forests as it closely approached extinction, but these features may have been caused by factors other than difficulties with food procurement. In particular, human depredations on the species provide a plausible alternative explanation for decline that poses no inconsistencies with early abundance of the species. At the same time, human depredation is as good an explanation for last habitat associations of the species as are

problems with food procurement because remote virgin forests were likely the regions least impacted by depredations. Human depredations also provide a plausible explanation for the disappearance of some populations prior to logging and for long persistence of the last known Cuban population in spite of logging. Better survival of the Pileated Woodpecker to the present may have resulted mainly from lesser vulnerability of this species to human depredations, not to any foraging superiority. Logging's most negative impact on the Ivory-bill may not have been decreases in food supplies but increases in depredations, resulting from enhanced access to, and increased human densities in, forested areas. Under the human depredations hypothesis, there is no reason to assume Ivory-bills were limited to old-growth forests, had huge range requirements, or were a "disaster species" highly dependent on food-enhancing catastrophes such as fire or storm damage of forests, as suggested by some observers. Conservation priorities under a human depredations hypothesis are quite different from conservation priorities under a feeding specialization hypothesis.

TITLE: Spatial and Temporal Dynamics of Tree Growth in Two Floodplain Forests

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ABSTRACT: Hydrologic and geomorphic processes that structure floodplain forests of the Lower Mississippi Alluvial Valley (LMAV) have been altered at the regional, landscape, and local level. Levees, channelization, and other flood control activities have eliminated or altered overbank and backwater flooding in much of the historical floodplain, thus affecting the delivery of water and nutrient-rich sediments. These flood control activities also have altered river stage which can affect the water table at a variety of spatial and temporal scales. The overall goal of this study is to quantify hydrologic and geomorphic processes within and among floodplains and determine their influence on forest community composition and tree growth. The study area is located in NWRs and WMAs in the LMAV. Study sites are uneven-aged forests selected along a flooding gradient and stratified by geomorphic feature (ridge, swale, and flat). We will present initial results from a dendroecological study comparing green ash growth between ridges and swales at White River NWR, Arkansas. We also compare Nuttall oak growth between three ridges, swales, and flats at Bayou Cocodrie NWR, Louisiana. Trees selected for dendrochronological analysis were overstory trees from 30 sample plots per geomorphic feature. Time-series analysis was used to compare tree growth with climate (temperature, precipitation, and Palmer Drought Severity Index) and river stage. Future plans include quantifying fine scale hydrology (surface and subsurface) in monitoring wells across each geomorphic feature and historical flooding regime at water wells extrapolated from nearby gauges.

TITLE: Restoration and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat

LMVJV Forest Resource Consservataion Working Group. 2007:.

AUTHORS: Edited by R. Wilson, K. Ribbeck, S. King, and D. Twedt.

ABSTRACT: The conservation objective in the Mississippi Alluvial Valley is to provide forested habitat capable of supporting sustainable populations of all forest-dependent wildlife species. However, forest loss, fragmentation, and hydrological change have markedly altered habitat conditions within bottomland forests such that some species of concern (e.g., Ivory-billed Woodpecker, Louisiana black bear (*Ursus americanus luteolus*),and some migratory songbirds) have been severely impacted. To provide habitat for these and other priority wildlife species, we advocate forest conditions that are conducive to the continued viability of this suite of priority wildlife species. Forest-dependent (silvicolous) wildlife is responsive to habitat conditions at multiple spatial scales (e.g., landscape quality and site quality).To address this issue, we define Desired Forest Conditions as those forested landscapes that meet both Desired Landscape Conditions and Desired Stand Conditions. Traditional forest management has focused on production of forest products (i.e., lumber or pulp) through silviculture that promotes optimal growth and vigorous health of economically desirable tree species. Often these traditional silvicultural methods are not optimal for silvicolous wildlife. Indeed, quality habitat for priority wildlife species likely requires some sacrifice in timber production and the retention of less healthy trees. Even so, commercially viable, wildlife-oriented silviculture (i.e., wildlife forestry) employing variable retention harvests can be used in conjunction with forest restoration, regeneration, and natural processes to achieve desired forest conditions within bottomland hardwood forests. The recommendations contained within this report were developed specifically to address issues surrounding restoration, management, and monitoring of forest resources in the MAV. However, the working group believes that these recommendations are applicable to other bottomland hardwood systems across the southeastern United States provided users consider differences

in geomorphology, soils, and hydrology where applicable.

This document provides technical guidance for the restoration and management of bottomland hardwood forests where conservation of wildlife resources is a central purpose and objective. As such, the document integrates habitat conditions for priority wildlife with technical recommendations for the restoration and management of bottomland hardwood forests. To achieve these habitat conditions requires managers to reassess traditional methods of silviculture, placing greater emphasis on retaining and promoting forest structure and senescence to benefit priority wildlife. We envision these recommendations will aid on-the-ground managers and program managers responsible for managing forest resources in implementing forest management strategies for wildlife conservation. Furthermore, we anticipate that these recommendations will be instructive to private landowners targeting wildlife conservation as part of their overall land stewardship objectives, especially on lands under conservation easement.

TITLE: Modeling Ivory-billed Woodpecker Habitat Quality to Prioritize Search Areas in Arkansas

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ABSTRACT: Initial searches for the Ivory-billed Woodpecker in the region of rediscovery predominantly focused on locations in the immediate vicinity of previous sightings. In the following years, a concerted effort was made to search the Big Woods more systematically. Although >35,000 hours were logged (at a cost of ~$1.6 million), only 12% of the area was searched. Continued failure to document the bird, high costs associated with systematic sampling, and the acquisition of stand and site-scale habitat data within the region prompted searchers to seek a prioritization tool that could focus search areas on locations with the highest habitat quality. Twenty habitat variables derived from three sources (National Landcover Dataset, field-based sampling, and LiDAR) representing three scales (landscape, stand, and site, respectively) were identified as potential model parameters. We asked six experts to rank these variables and provide threshold values for non-habitat, as well as marginal and suitable habitat quality. We weighed these variables equally within scales and weighed each scale equally to develop a single, preliminary model for review at an August 2007 meeting. Attendees at that meeting dropped consideration of landscape-scale factors due to their inability to inform searches (i.e., there was little variability in landscape-scale factors across the search area). Additionally, they preferred to use the information hierarchically (i.e., individual models for each scale) rather than combine the data into a single model. Five factors were identified for inclusion in the stand-level model: three associated with forage availability (density of trees with moderate to heavy bark disfiguration, density of trees exhibiting crown dieback, and the density of recently dead trees) and one (density of trees >24" dbh) associated with appropriate timber size class. Threshold values for optimal, suitable, and marginal habitat were determined via quantiles for all model parameters related to forage. Stands with >7.5 trees/acre with a dbh <24" were considered marginal habitat. At the site-scale, two variables were used in the model: canopy height and canopy cover. Searchers approached the results with guarded optimism and were initially encouraged by the identification of some stands that had not been searched in previous seasons. Nevertheless, after scouting some areas, searches were discouraged by the lack of conformity of the sites to perceptions of Ivory-bill habitat and the similarity of those locations to marginal and suitable forest stands. Future attempts to develop a search prioritization tool should use biological data to set objective thresholds for marginal, suitable, and optimal habitats to restrict potential search areas more effectively to sites with the best potential habitat.

TITLE: Field-based Forest Structure Mapping Cache Lower White River

AUTHOR: Jeff Denman, USFWS, White River NWR

ABSTRACT: The announcement of rediscovery of the Ivory-billed Woodpecker in the Cache/Lower White River basin of Arkansas set in motion a series of conservation actions. As Cornell and their partners continued to search and document evidence (e.g., sightings and sound recordings), it was imperative that a concurrent habitat inventory and assessment be conducted to facilitate the search efforts and to document existing habitat conditions.

This inventory quantifies current habitat conditions on public lands within proximity to recent Ivory-billed Woodpecker sightings and audio recordings and areas perceived likely to harbor Ivory-billed Woodpecker on the basis of information provided by local land managers. These data were 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 management decisions.

The habitat inventory covered bottomland hardwood forest (excluding reforestation and bodies of water—for example, oxbow lakes—within the

boundaries of the individual WMAs and NWRs. Due to the large acreage of interest, the inventory was sample-based. To accomplish this, individual management compartments within the area of interest were broken down into homogenous stands approximately 500 acres in size. 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. 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. One means of assessing these trade-offs was to examine pilot data collected from the area of interest to generate summary statistics which provided insight into distributional properties of the data. To facilitate the determination of sample size requirements for conducting habitat inventories for Ivory-billed Woodpeckers (e.g., the density of large diameter trees [≥24inches]; density of dead/dying trees), pilot data from White River NWR was subjected to sensitivity analyses to assess precision—that is, stability of the coefficient of variation values—under different sample sizes. To accomplish this, we subjected the pilot data (n=15 clusters of 5, 1/5th acre plots) to simulation models that randomly selected clusters of points at varying sample sizes and generated summary statistics for the parameter of interest, for example, 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 ≤3; whereas sample sizes ≥6 demonstrated little variation in the precision estimates. 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. None exceeded 15%.

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, for example, a stand, appears to be the best option. That is, sample sizes of ≤3 clusters were not sufficient to produce a high level of precision consistently. Sample sizes ≥4 clusters produced precise parameter estimates with sample sizes ≥6 clusters being very precise in the parameter estimates. A closer examination reveals that a sample size of four clusters is sufficient to maintain the desired level of precision in parameter estimates.

Appendix E.

Interpreting Historical Status of the Ivory-billed Woodpecker with Recent Evidence for the Species' Persistence in the Southeastern United States.

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Regardless of the debate over the meaning of evidence for the persistence of the Ivory-billed Woodpecker (*Campephilus principalis*) into the 21st Century as described in Appendix B, was this species difficult to relocate once located through time going back to 1800? Was the Ivory-billed Woodpecker truly resident in local areas or more periodically nomadic than previously realized? Specifically, is there strong evidence in the historical record that once located, this species could be reliably relocated from one year to the next within a decade and across decades, throughout much of its historical distribution? The following sections provide an historical summary of reports and of the species' status.

Historical Summary-1800 to 1944

The Ivory-billed Woodpecker's decline since the 1800s 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 northward to the Missouri River confluence and 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 1900s. However, associations between forested wetland systems and this species may be only part of the story leading to the Ivory-billed Woodpecker's demise in the Southeast.

In addition to habitat loss, by the late 1800s the species was already targeted as a valuable commodity for collectors and trophy hunters as something very rare and unusual (Snyder 2007). This already rare species became even rarer, especially in remaining suitable habitat. By the early 1900s, it was generally thought extinct in continental North America until Dr. 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 1900s, most remaining populations already were doomed to extirpation from habitat fragmentation, demographic isolation, and shooting. 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 Dr. James 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.

With his study of this small remnant population and search of other areas likely to support the bird, Tanner was the last to document thoroughly the range of this species. He also documented the reduction of their numbers, by the mid-1940s, to about 20 birds scattered in Louisiana (the Singer Tract), the Gulf coast of Florida (from Apalachicola River basin to the Lower Suwannee River basin and adjacent swamps), the Highlands Hammock and Big Cypress regions of south 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 an individual of the small population studied at the Singer Tract, Louisiana, was last seen. Reputable sightings of Ivory-billed Woodpeckers continued in and near the Singer Tract at least until 1946, and possible encounters continued into the 1980s, but nothing has been 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 well after the 1940s in areas such as the Piney Woods of eastern Texas, the Atchafalaya Basin of southern Louisiana, the Delta in Mississippi, the coastal plain of South Carolina, and Florida. Most of these reports occurred before the 1970s with some having been shown to be more credible than others, but none represented firm documentation that Ivory-billed Woodpeckers still occur in the Southeastern United States. Without any additional tangible evidence, this essentially remains true today outside of Arkansas.

Potential Encounters-1944 to 1999

Since the 1940s, 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 Woodpeckers (*Dryocopus pileatus*) or Red-headed Woodpeckers (*Melanerpes erythrocephalus*). The tin-horn sounding "toot" calls possibly could be assigned to Blue Jays (*Cyanocitta cristata*) 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, colliding duck wingtips, 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 which lack detail to constitute firm evidence that the species persists. 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, which many authorities believe is the most likely place a population of Ivory-billed Woodpeckers could escape notice. In 1971, Dr. George Lowry from Louisiana State University came into possession of two color photographs of an Ivory-billed Woodpecker perched half-way up the side of two very large trees. However, critics pointed out that it was not clear the bird involved was actually alive and not a mounted specimen secured to each of the two trees. 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 photograph was recently revealed to be taken by Mr. Fielding Lewis of Franklin, Louisiana (Gallagher 2005). Both Lowry and Dr. Van Remsen (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 1970s. 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.

After 1950 and the demise of Louisiana's Singer Tract, many searchers came to consider Florida 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 cut over 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 1970s). The most consistent area of observations and credible sightings come from the Apalachicola and Chipola Rivers in the Florida Panhandle, at least through the 1950s.

The most intriguing reports after the 1950s are from 1967 to 1969 (Agey and Heinzmann 1971). 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 feathers were found. The feather of most interest was a secondary that 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). However intriguing this feather is, its age remains unknown, so it is relatively useless in establishing a date at which the Ivory-bill was extant in central Florida. (A different secondary feather identified as that of an Ivory-billed Woodpecker purportedly from the Appalachicola region found during the 1980s remains mysterious.)

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 where feathers were found in 1968 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 1930s 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 1940s) and Mr. 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 Woodpecker or possibly a Blue Jay. Recent analysis of this tape by the Cornell Laboratory of Ornithology determined that the calls could have been made by an Ivory-billed Woodpecker, a White-breasted Nuthatch (*Sitta carolinensis*), or a 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. Dr. Jerome 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. In addition, Reynard donated copies of two slides to VIREO purporting to show a female Ivory-billed Woodpecker at a cavity that were taken by Mr. Neil Wright during the 1960s (see Collins 1970, also Jackson 2004). So despite the credentials of these two ornithologists making observations in Texas, credible evidence of Ivory-billed Woodpeckers at any time during the mid-1900s in the vicinity of Big Thicket remains a hotly debated issue to this day.

In part due to the Big Thicket reports, the Southwest Region of the Service during the late 1980s initiated a range-wide 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 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 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 in 1973, but no further evidence has emerged since the 1970s in Alabama. For the Yazoo River account, Jackson and 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 closely matched 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.

In sum, there have been numerous reports of Ivory-billed Woodpeckers since the 1940s, 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 were dismissed easily 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 1980s. 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 1940s. 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 the late 1990s, this time along the Pearl River on the Louisiana side.

Mr. David Kulivan, a wildlife 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 WMA, 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. 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 (Williams 2001, Gallagher 2005).

Once Kulivan's sighting was announced to the general public nearly a year later, numerous expeditions were organized to search for Ivory-billed Woodpeckers at Pearl River WMA. Many folks believed they glimpsed Ivory-billed Woodpeckers or heard their calls far in the 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 was produced to

document persistence of this most endangered bird in the United States. Even some of those who have raised doubts, claiming that Mr. Kulivan's report was "too detailed," admit it is possible the Ivory-bill is still extant, 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.

Treatment of Recent along with all Previous Documented and Potential Encounters

After the 2005 Arkansas announcement, organized search efforts were initiated across the historical range to include (in addition to Arkansas) Texas, Louisiana, South Carolina, and Georgia. Additionally, several reports since 2005 surfaced from areas initially not considered from southern Illinois, western Tennessee, southeastern North Carolina, the Florida panhandle, and extreme south Florida. Organized search efforts spread to these locations, along with additional areas included in the Cornell Lab's Mobile Search Team efforts over several years. As of 2009, no better documentation has come forth than what had been announced in 2005, but with this combined effort a relatively high number of credible-sounding reports were compiled compared with any other post-1930s decade.

If any of these potential encounters, added to those between 1944 and 1999, are considered in the realm of what is possible, then it is possible that the Ivory-billed Woodpecker may persist in isolated locations throughout the historical distribution mapped by Tanner (1942). Conducting a decade-by-decade assessment of documented (by specimen and/or universally accepted video or photograph; all prior to 1940) and potential (both prior and post 1940) encounters may reveal important patterns useful for guiding any future organized searches. Perhaps as important, this assessment should generate important research questions that should be considered with respect to searching for any rare, widely occurring, and/or otherwise difficult to detect species requiring conservation attention.

For consistency, Tanner's geographical regions are used for all reports: (1) Carolina, (2) Georgia-northern Florida, (3) southern Florida, (4) Alabama (including the Florida panhandle west of the Apalachicola River and also drainages in Mississippi outside the Delta, (5) lower Mississippi Delta (Louisiana and adjacent Mississippi), (6) upper Mississippi Delta (Arkansas, Missouri, and adjacent Mississippi, Tennessee, Kentucky, and Illinois), (7) Arkansas (west of the Delta)-Oklahoma, and (8) east Texas. Within each region, subregions are identified which are composed of groups of locations and serve again as the basis for comparing patterns of occurrence within each region, each decade, and among regions.

The smallest common unit used in this treatment is location of report(s) within a decade, following and building upon the list of locations provided in Tanner. A data point represents at least one report from a location had occurred during a specified decade. Confirmation of a report is established at locations when a specimen is identified as having been collected from that location during the decade in question. Specimens serving as documentation of occurring at a location during a decade are identified in Tanner (1942), Hahn (1963), and Jackson (2004). An attempt was made here to cross-reference specimens listed with dates and locations of collections presented in these three major references. Most such reports of specimens listed in Tanner were successfully identified in Hahn, but there were some inconsistencies where reports in Tanner lacked references to specimens found in Hahn with the same date and location. Other reports were matched successfully to location, collector, or name of owner (museum, collection, etc.), but were off by year or decade (e.g., 1897 as opposed to 1898, or 1898 versus 1889; one or the other reference apparently contained a typographic error). Since Tanner was the primary reference, his treatment of such reports took precedence, but documentation of discrepancies are provided as appropriate (many of these were in fact corrected by Tanner in his unpublished 1989 update to his report). In addition, multiple specimens often were collected at the same location during the same decade; some are identified by Tanner, but some were revealed only when compared with Hahn. In such cases, notations and treatments are based on a combination of these two primary sources.

All specimens collected were prior to 1940, and Jackson (2004) presents a summary of the number of specimens collected per decade now in museum collections. This information is used to make comparisons between reports accepted, but without specimens, during the decades prior to 1940 with reports after 1940 where no universally accepted documentation exists beyond the reputations of the involved observers. There are two exceptions to this rule where photographs have been widely accepted as documentation. These are also locations where specimens were known to have been taken during the same decade (Taylor Creek, FL, in the 1920s and the Singer Tract, LA, in the 1930s, respectively). All other reports are considered potential encounters of varying quality depending upon the authority of the observer as judged by Tanner, Jackson, and other authoritative ornithologists.

Here, a potential encounter is defined as a report not easily explained as something other than an Ivory-billed Woodpecker

on the basis of description of the bird, the type of habitat in which it was encountered, and distribution. After the Arkansas announcement was made, post-1944 reports were compiled prior to the 2005 announcement of an Ivory-billed Woodpecker being sighted in Arkansas. A map was produced of these potential encounters in Service brochures. These potential encounters were based on those discussed by Jackson (2004) or otherwise in Service files as "probably reliable," defined here as not obviously another species. A review of other published literature and files maintained by some State working groups included other potential encounters that are cited and used in this treatment (both before and after 1950). Excluded from further consideration were reports that likely described other species (especially Pileated, but also Red-headed and sometimes other woodpecker species), as well as those reports outside the historical range of the species (as depicted in Tanner 1942) and in unlikely habitats such as golf courses and backyards. The reports between 1945 and 2005 considered further vary in detail, with some accepted based solely on the credibility and reputation of the observer. Reports since April 2005 (i.e., the Arkansas announcement) are similarly treated, but at least one diagnostic field mark had to be observed (most often the white trailing edges on a flying or perched large woodpecker).

It is important to understand the type and level of documentation accepted for this species' persistence at the time when most collecting of specimens began to trail off (i.e., after 1900) compared with those reports which were accepted without question previously. While most previous treatments break down reports by State, here it is believed that important insights can be made by comparing reports, type and level of documentation, by decade starting with the 1800 and ending with the present. References for those reports besides those of Tanner himself prior to 1940 are provided in Tanner (1942, with cross-reference to location on his maps, his figures 3-10) and are so noted here.

Results and Discussion

The number of locations with Ivory-billed Woodpecker reports peaked between 1880 and 1910, the same period when most specimens were collected (Figures 1, 2). The number of locations with potential reports after 1940 generally dropped below the number of locations with all reports between 1900 and 1940. However, when including only potential encounters between 1900 and 1939, the range in number of locations among decades was roughly similar to the number of locations with potential encounters in the decades between 1940 and 2009, only dropping below 10 locations during the 1990s. The number of locations within each decade with multiple reports among years never exceeded 10 per decade prior to the extensive efforts underway after 2005 to search for this species.

Prior to 1940, only a small percentage of locations from decade to decade provided the source of reports from multiple years within any one decade, ranging from 12 to 28 percent of all locations with birds reported within each decade (Figures 3, 4). After 1940, there was a slight increase in the percentage of locations with multi-year reports in the later decades, ranging from 9 to 51 percent of all locations with birds reported within each decade. Despite this increase in locations with reports from multiple years there was no definitive documentation of persistence at any of these locations. Similarly, a very low percentage of locations with reports spanning more than one decade is documented in the historical record, but again with a slight increase during the latter decades (Figures 5, 6). Reports continue to come from most of Tanner's regions into the present day with an obvious shift from those regions that included Florida to regions elsewhere (Figure 7).

In summary, there is no evidence that the Ivory-billed Woodpecker was ever widely or consistently relocated in the same areas from year to year or from decade to decade prior to 1940, despite the impression one may have about birds at the Singer Tract during the 1930s. Actually, during Tanner's study the chore in locating birds often took days or weeks even where pairs or family groups were known to occur from previous years (and actually only one nesting pair at John's Bayou was consistently relocated during his entire study). Whether the birds were truly more nomadic than previously thought, or whether the low percentage of repeated locations historically has been due to the search patterns of ornithologists and collectors is unclear. What is clear is that the present pattern of reports that do not effectively document occurrence of the species has been repeated from decade to decade for more than a century and that the number of locations with potential encounters within the same decade has varied little since the 1870s.

Whether or not many or all post-1944 reports pertain to actual Ivory-billed Woodpeckers will continue to be debated in some circles, and it also is possible that some of the reports dismissed for purposes of this treatment perhaps should not have been discounted so lightly. However, the pattern of credible-sounding reports accepted for this treatment from locations without firm documentation was from decade to decade slightly lower between 1940 and 2009 than the pattern recorded between 1890 and 1939. Most interestingly, the exceptional increase in locations with potential encounters during the present decade is on the surface similar to what was recorded during the 1930s, given both of these decades experienced a notable increase in amount of effort to firmly document the persistence of this species (with similar results despite substantially fewer observers involved in the 1930s than in the present decade).

Figure E-1. Numerical summary of all locations with Ivory-billed Woodpecker reports.

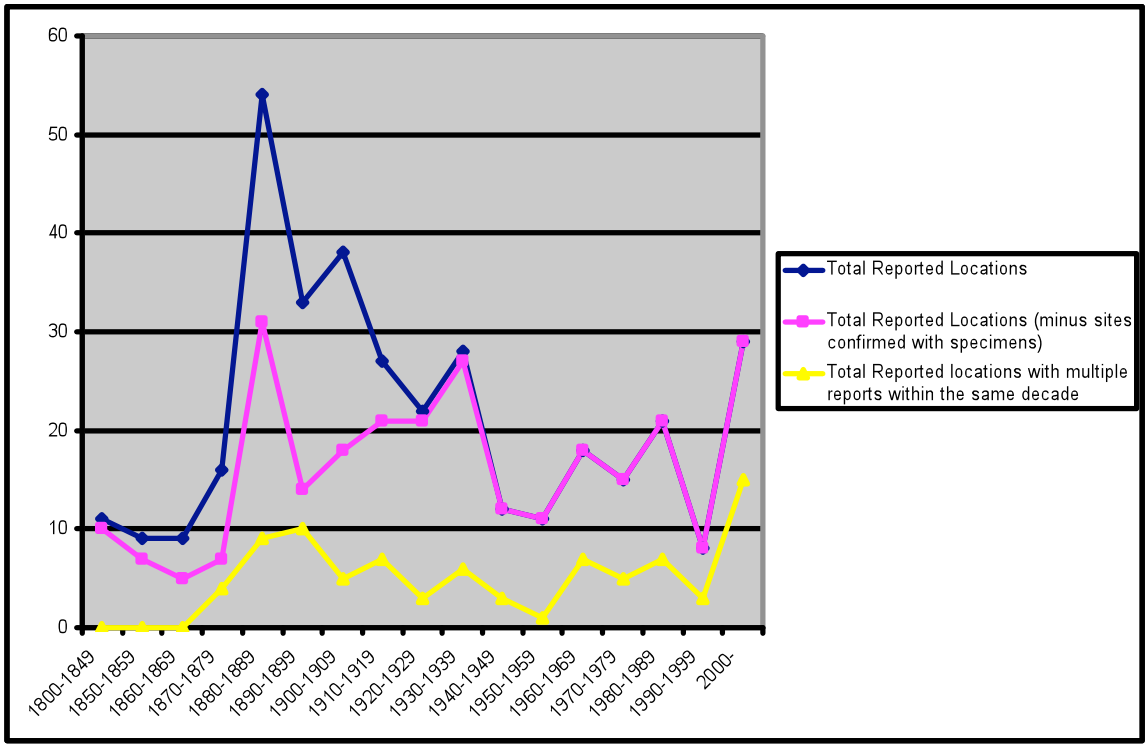


Figure E-2. Total locations with at least one specimen known from that location, that decade, range-wide

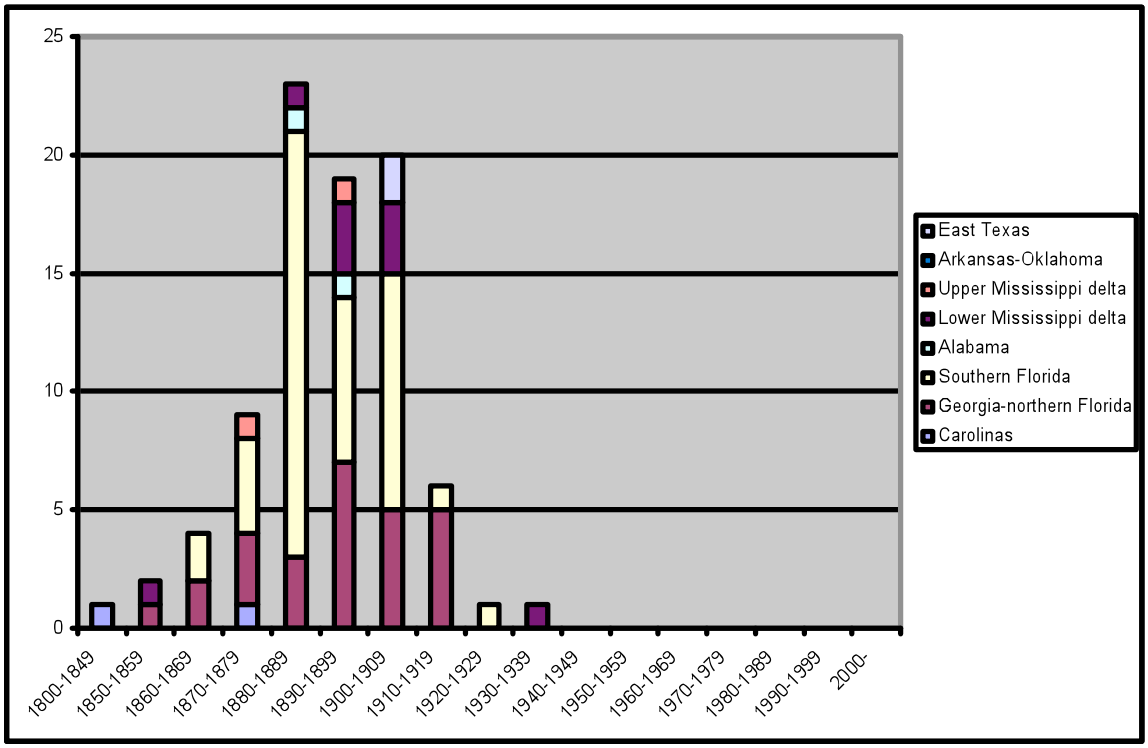


Figure E-3. Percent of reported locations with multiple reports within the same decade.

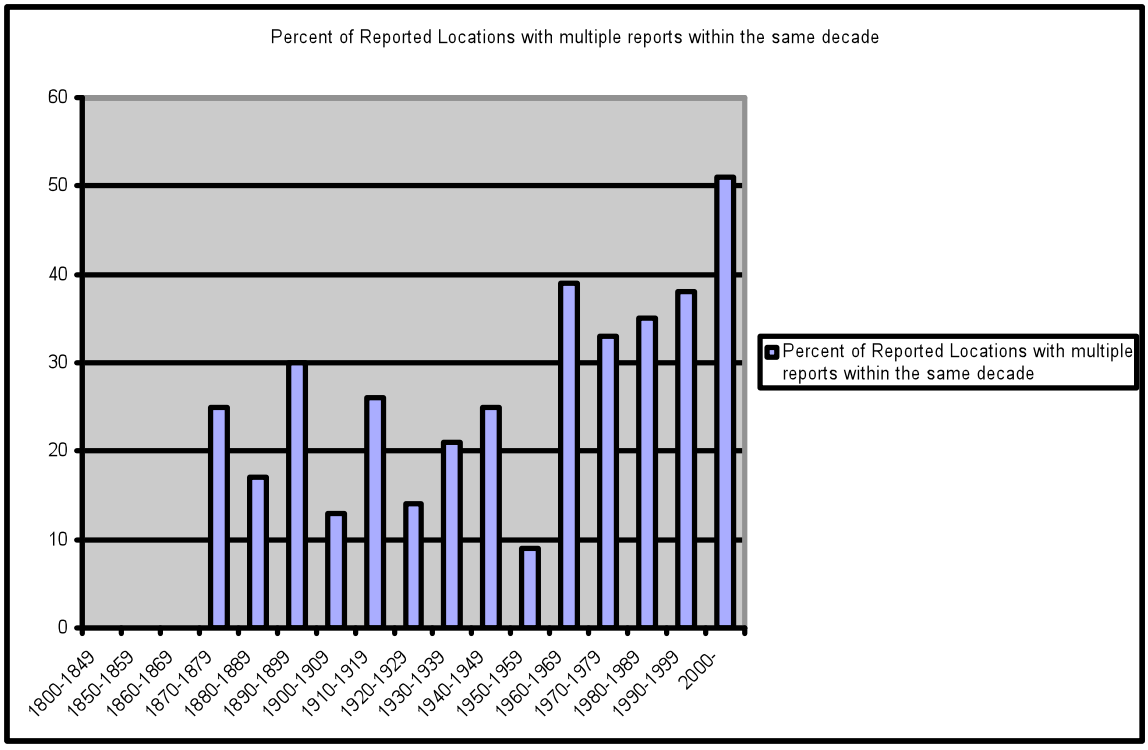


Figure E-4. Percent of locations with multiple reports within one decade during multiple decade time blocks.

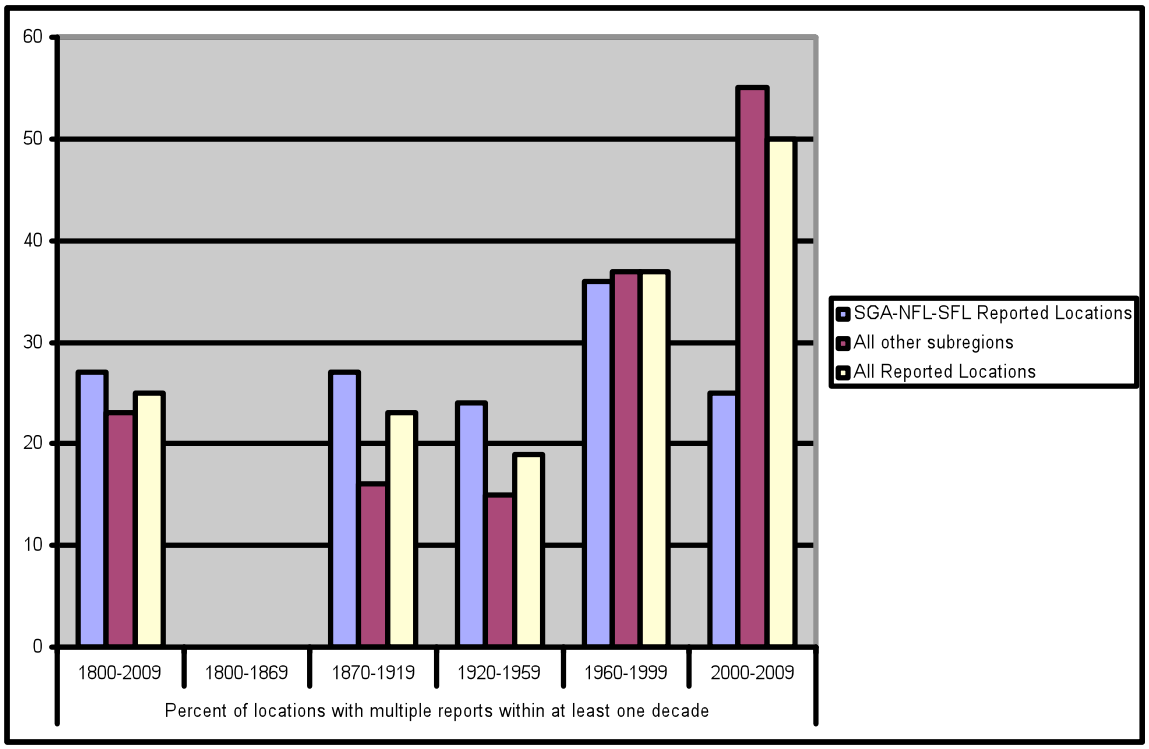


Figure E-5. Number of locations with reports across two decades.

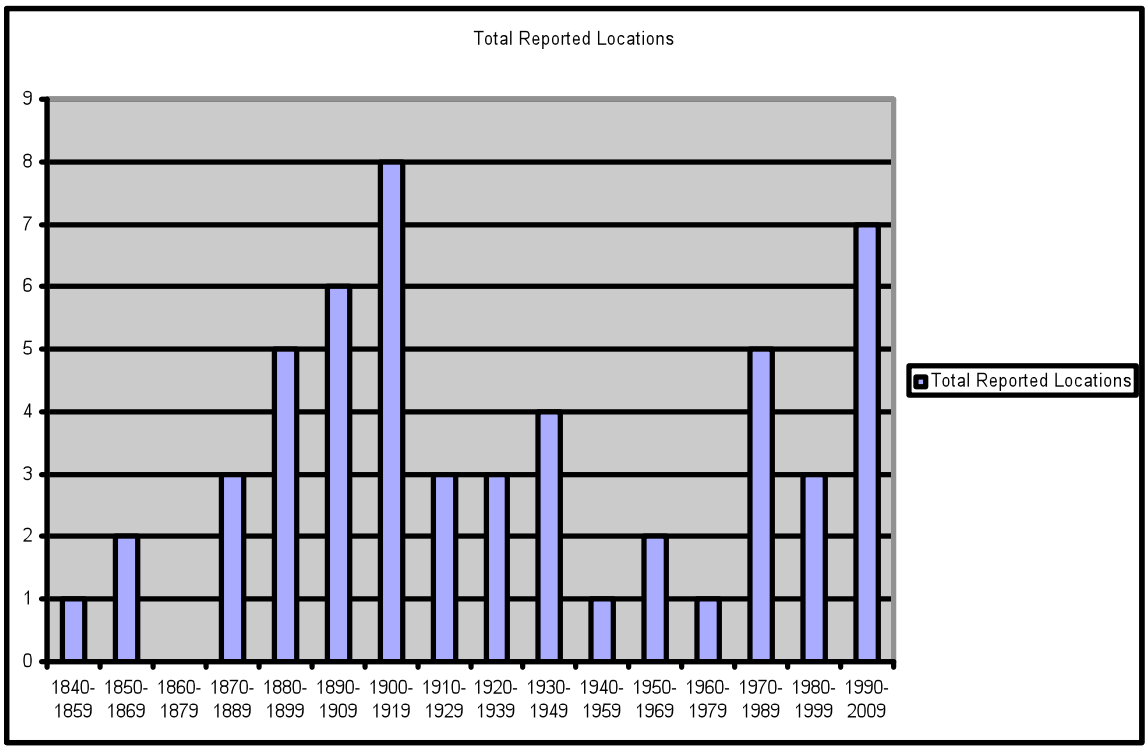


Figure E-6. Percent of locations with reports across two decades during multiple decade time blocks.

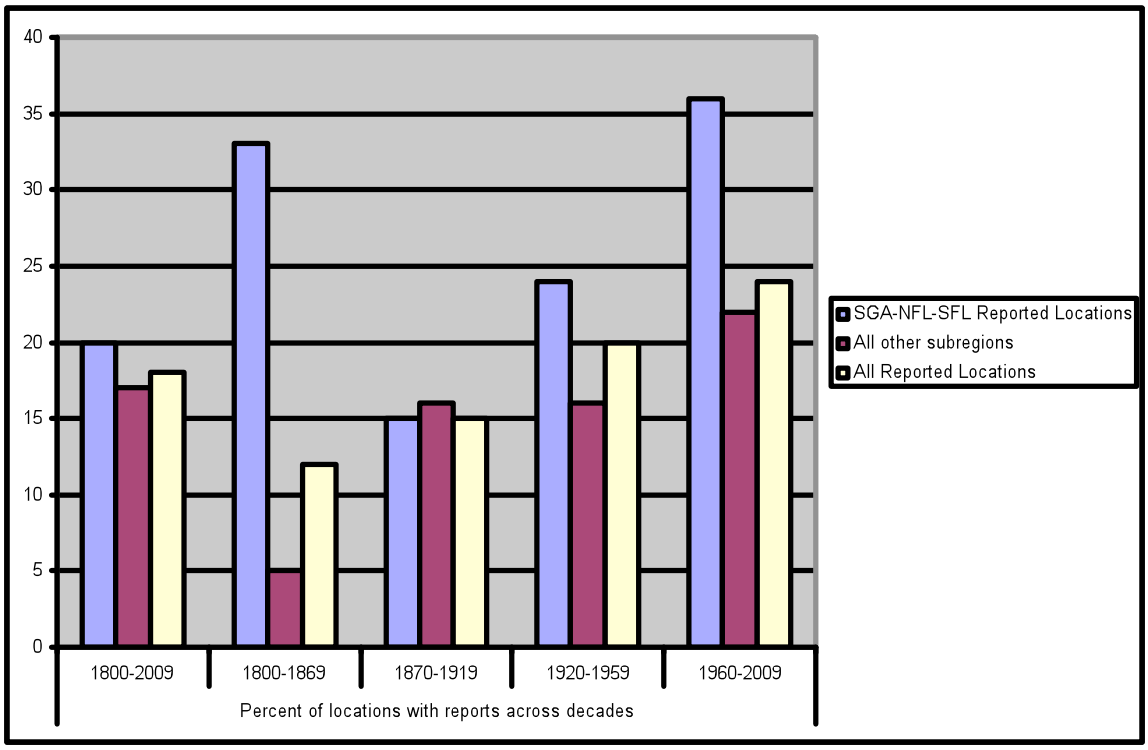
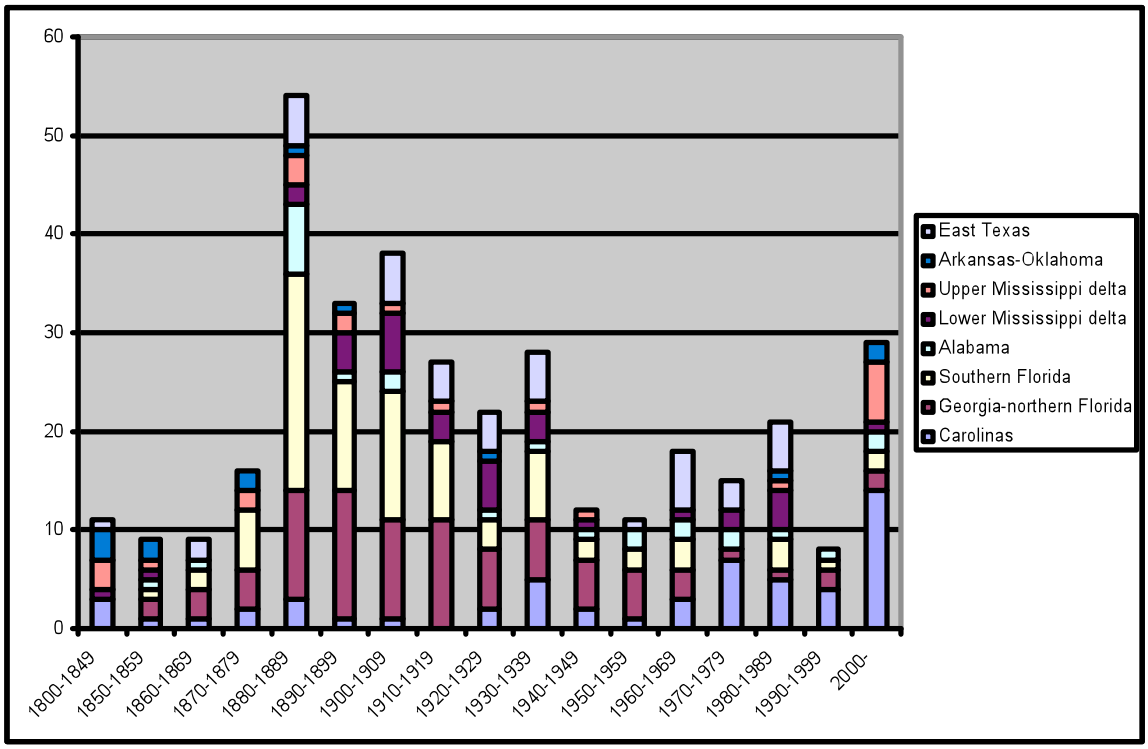


Figure E-7. Total locations with reports in each Tanner region



Reports of Ivory-billed Woodpecker by Geographic Region

(October 10, 2009)

Locations alpha-numeric codes in **green bold type** represent reports from more than one year within the decade; * indicates at least one specimen known from that location during that decade. Unless otherwise indicated, reference to Tanner is for his 1942 report and reference to Hahn is for his 1963 list of specimens and where they were housed.

Carolina Region (#'s where indicated are cross-referenced to Figure 3 in Tanner), subregions: (A) Wilmington, NC, (B) Pee Dee-Waccamaw, SC-NC, (C) Lower Santee (including the Black River which is actually a tributary of the Pee Dee), SC, (D) Upper Santee (including Congaree and Wateree), SC, (E) Edisto, SC, (F) Coosawhatchie-Broad-Mary rivers, SC, (G) Savannah (including Ogeechee and Canochee), SC-GA

1800-1849

(A-1) 12 miles north of Wilmington, NC; about 1800 (#1; specimen at Smithsonian said to be from Wilmington, NC; possibly collected by Wilson who reported taking three in February 1809)

(C-1*) Cypress swamp north of Charleston, SC (spec., presumably same area where two other spec. collected without date, but Hasbrouke 1891 reports that G. N. Lawrence received two specimens from J. G. Bell apparently sometime in the late 1840s or early 1850s); 1840 (#9)

(G-1) Frequently between Augusta and Savannah along the Savannah River; about 1800 (#11; three specimens listed by Hahn are from Georgia and dated 1806, 1807, and 1809; collected by Wilson?)

1850-1859

(C-2) Pine Barrens of SC; about 1850 (#3)

1860-1869

(F-1) Hunting Id., Beaufort County, SC; before 1870 (#12)

1870-1879

(B-1*) Cheraw, SC (spec.; another specimen with unknown date); April 1876 (#2)

(F-2) Johnson's, Pritchard's, and Edding Islands, SC; 1880 and before (#13; Hasbrouke 1891 is more specific in citing a letter from W. Hoxie whereby a specimen was taken, and now unaccounted for, from Johnson's Island in 1879 or 1880)

1880-1889

(B-1) Pee Dee River, near Cheraw, SC; April 1889 (#2)

(F-2) Johnson's, Pritchard's, and Edding Islands, SC; 1880 and before (#13; Hasbrouke 1891 is more specific in citing a letter from W. Hoxie whereby he reports a sighting on Pritchard's Island during the winter of 1886-1887, but Hoxie refers elsewhere that his last report was 1884)

(G-1) Miller's Island, Column lake, 30 miles north of Savannah ("shot" by C. B. Prescott); 1886 (Jackson 2004)

1890-1899
(G-2) Savannah River, Barnwell County, SC; 1898 (#10; Jackson 2004 has as location "near Beldoc, Allendale County" for what appears to be the same report)

1900-1909
(G-2) Savannah River, Allendale County, SC; September 1907 (#10)

1910-1919
None

1920-1929
(C-1) Fairlawn Plantation, Charleston County, SC (two separate reports); 1929 (Sprunt and Chamberlain 1949)

(C-3) Santee Swamp, near St. Stephens, SC; about 1925 (#5)

1930-1939
(C-4) Black Oak Island, near St. Stephens, Clarendon County, SC; about 1930 (#4)

(C-5, C-6, C-7) Santee Swamp, Georgetown and lower Berkeley Counties, SC; 1930-1937 (# 6, 7, and 8; in addition Post and Gauthreaux 1989 state that a report of two birds by Murray and Sanders in 1938 at Wadmacon was the "last official" sighting in SC)

(E-1) Four Holes Swamp, Edisto River, Orangeburg County, SC (SC Audubon); 1930s (SCIBWO Working Group Files 2009)

1940-1949
(C-3 through 7) Santee region, SC (Figure 13 in Tanner; reach between Black Oak Island and Atlantic Ocean; unknown number); 1940s (Tanner)

(C-8) Coastal Highway 17 (Francis Marion National Forest, Berkeley County?), SC (report from Chuck Horn for John Lynes to Cornell); 1945 (SCIBWO Working Group Files 2009)

1950-1959
(C-8) Francis Marion National Forest between Awendaw and Moore's Landing (Bull Island Ferry), Berkeley County, SC (two separate reports: one heard and briefly seen by L. Vaughan, P. W. Smith, and D. Crompton and the other reported by a "game warden," both reported to J. Dennis); 1959 (USFWS 2007)

1960-1969
(C-8) Six reports within the Francis Marion National Forest and Cape Romain National Wildlife Refuge, Berkeley County area:

Bulls Island, Cape Romain NWR, Berkeley County, SC (three separate reports by H. Mills, H. Waller, and a "Brookline, MA, Bird Club member" according to A. Sprunt, L. Vaughan, and D. Crompton in replies to J. Dennis); January to December 1960 (USFWS 2007)

West of Summerville (Great Cypress Swamp?), Dorchester County, SC (sighting by L. Rush according to Sprunt in reply to J. Dennis); spring 1962 (USFWS 2007)

Iron Swamp Road, west of US Highway 17, Cape Romain NWR and Francis Marion National Forest, Berkeley County, SC (one seen flying crossing road by J. Edwards); April 1963 (USFWS 2007)

Near McClellanville ("Buck Hall" area), Francis Marion National Forest, lower Santee River system, Berkeley County, SC (two birds observed on pines by E. DeBold); May 1967 (USFWS 2007)

(D-1) Cedar Creek, Congaree Swamp, Richland County, SC ("aerial sighting…of a bird in flight" by J. Dennis and two additional reports to J. Dennis [one of a pair]; also reported to have nested by T. Dabbs); 1964-1966, 1969 (Dennis 1966, Jackson 2004, USFWS 2007)

1970-1979
(C-9) Lower Santee River, 2 miles south of Greeleyville, Williamsburg County, SC (seen by D. Hill as reported to D. Chamberlain); late 1970s (SCIBWO Working Group Files 2009)

(C-11) Black River, eastern portion of Georgetown County, SC (two heard and silhouettes seen by T. Dabbs, no additional evidence from followup by P. Sykes); 1970 (Jackson 2004)

(D-1) Congaree Swamp, Richland County, SC (reported to have nested by T. Dabbs); 1970 (Jackson 2004)

(D-2) Upper Santee Swamp, vicinity of Broadwater Creek about 40 miles northeast of Francis Beidler Forest in Four Holes Swamp (a response to Singer Tract tape by R. Manns, reportedly recorded but doubts on what was heard by Manns expressed by Jackson; several media references to a report of a pair by Audubon staff and photos implied to be associated with these reports actually pertain to Fielding Lewis's photos from Louisiana during this same year); February 1971 (Jackson 2004, USFWS 2007)

(G-3) Ogeechee River, 25 miles west of Savannah, Chatham County, GA (C. D. Gerow); July 1973 (Jackson 2004)

1980-1989
(B-2) Lower Waccamaw River, Georgetown County, SC (a report from B. Doyle given to L. Short); unclear date perhaps 1980s (Jackson 2004)

(C-11) Black River, eastern portion of Clarendon County, SC (one supposedly seen but observer not named); 1981 (Jackson 2004)

(D-1) Congaree National Park, Richland County, SC (multiple reports); 1982 (near RCW cluster, S. Pfaff), 1987 (W. Sweeny) (SCIBWO Working Group Files 2009)

(D-2) Near confluence of Little Congaree (Wateree?) and Santee River, Sumter County (one heard and seen by J. Williams) another near Camden Kershaw County (one apparent female by Sara Davis-Hyman), SC; September 1984 (USFWS 2007), 1988 (SCIBWO Working Group Files 2009)

1990-1999
(D-1) Congaree National Park, Richland County, SC (seen by L. Askins); May 1998 (SCIBWO Working Group Files 2009)

(D-2) Wateree River, Poinsett State Park, Sumter County, SC (single male seen by park naturalist) and Upper Santee River swamp, Lone Star, Calhoun County, SC (seen by J. Pittard); 1993 and April 1997 (SCIBWO Working Group Files 2009)

2000-

(B-3) Green Swamp, Brunswick County, NC (pair seen by J. Condrey); 2005 (SCIBWO Working Group Files 2007)

(B-4) Little Pee Dee River, Marion County, SC (female seen both times by F. Ervin); September 2004, September 2006 (SCIBWO Working Group Files 2009)

(B-5) Woodbury Tract, Great Pee Dee River, Marion County, SC (female seen by J. Godbold); March 2007 (SCIBWO Working Group Files 2009)

(B-6) Lumber River, Robeson County, NC, north and west of Lumberton (large woodpecker with bold black and white pattern on the wings and white trailing edge seen while conducting a NC Wildlife Resources Commission aerial waterbird survey by A. Houston); April 2008 (reported to W. Golder with Audubon North Carolina 2008)

(C-8) Wabmaw Creek Wilderness, Francis Marion National Forest, Berkeley County, SC (a pair well described in 2007 in comparison with pair of Pileateds by J. Cork); September 2007 (SCIBWO Working Group Files 2009)

(C-10) Near Cross, Lower Santee River, Berkeley County, SC (seen by L. Riney); January 2005 (SCIBWO Working Group Files 2009)

(D-1) Congaree National Park, Richland County, SC (multiple visual reports and recordings); 2005-2009 (SCIBWO Working Group Files 2009)

(D-2) Wateree and Congaree river confluence, Sumter County, SC (several observations by C. Reed) and Upper Santee River swamp, Lone Star, Calhoun County, SC (seen by J. Pittard); 2001, 2002, March 2003 (SCIBWO Working Group Files 2009)

(E-2) Near Four Holes Swamp, Edisto Drainage, Dorchester County, SC (one seen by B. Teagardin); December 2006 (SCIBWO Working Group Files 2007)

(F-3) Near Grays, Coosawhatchie River, Jasper County, SC (three seen by D. Hamilton); June 2005 (SCIBWO Working Group Files 2009)

(F-4) Rosehill Plantation between Mary and Colleton Rivers, Beaufort County, SC (heard and seen by D. Dunlap); October 2006 (SCIBWO Working Group Files 2009)

Georgia-northern Florida Region (#'s where indicated are cross-referenced to Figure 4 in Tanner), subregions: (A) Altamaha, GA, (B) Okefenokee (including Satilla, Pinhook Swamp, Oseola NF), GA-FL, (C) Red Hills, GA-FL, (D) Apalachicola-Chipola (including Chattahoochee), FL-GA-AL, (E) Wakulla-Aucilla, FL, (F) Lower Suwannee, FL, (G) North Peninsula (including lower St. John's River and tributaries, Ocala National Forest), FL

1800-1849

None

1850-1859

(A-1) Altamaha Swamp, GA; after 1853 (#2)

(F-1*) Cedar Key, FL (spec.); January 1859 (#33)

1860-1869

(A-1) Altamaha Swamp, GA; before 1865 (#2)

(B-1*) Okefenokee, GA (spec.); 1860 (#4)

(G-1*) Volusia, FL (three specs.); February 1869 (#45; all three listed in Hahn with possibly an additional specimen listed at University of Michigan Museum of Zoology with same date and location)

1870-1879

(G-2) St. John's and Oklawaha Rivers, FL; 1873 (#41)

(G-3*) Oklawaha River swamp, FL (two specs.); March 1879 (#42)

(G-4*) Lake George, FL (spec.); July 1877 (#44)

(G-10*) Near Palatka, FL (two specs.); March 1878 (Hahn)

1880-1889

(A-3) Frederica River, St. Simons Island, Glynn County, GA (a pair seen in flight by R. Brasher); late 1880s (Jackson 2004)

(B-2) Okefenokee region, GA; 1888 (#6)

(D-1) Chattahoochee River, a day's journey south of Columbus, GA; 1887 (#8)

(D-2) Bristol (Apalachicola River), FL; December 1889 (#9; Hasbrouke 1891 mentions a specimen at the Smithsonian apparently from Bristol taken during this time period, but it is now unaccounted for)

(D-3) Apalachicola River swamp, FL; March 1887 (#10)

(E-1) St. Marks River (several miles upstream), FL; April 1886 (#14; Hasbrouke 1891 states that H. A. Kline killed one in March of 1886, but if so specimen is unaccounted for)

(E-2) St. Marks, FL; March 1885 (#15)

(F-2*) Rosewood, FL (five specs.); 1881-1883 (#32; Hahn also lists specimen taken 1885 included in total here)

(F-3*) Gulf Hammock, Levy County, FL (five specs.); August 1883 and March 1887 (#35; Hahn also lists specimens taken December 1881 included in total here)

(G-5*) St. John's River, north of Green Cove Springs, FL (three specs.); 1887 (#38; appears to be same report listed as 1877 in Hahn, acknowledged later by Tanner as a possibility in an 1989 update to his 1942 report)

(G-6) Juniper Creek, Marion County, FL; March 1886 (#43)

1890-1899

(B-3) Small tributary of the Satilla River, 20 miles southeast Blackshear, GA; about 1895 (#3)

(D-2*) Bristol (Apalachicola River), FL (two specs.); November 1894 (Hahn)

(E-3) Waukeenah River, Jefferson County, FL; April 1894 (#16)

(E-4*) Wacissa River region, Jefferson County, FL (eleven specs.); February to June 1894 (#17; includes two specimens from Cow Creek taken February 1894 listed in Hahn, who also lists a specimen taken April 1896 included in total here; also Hasbrouke 1891 reports that in March 1890 "Captain" Gregg had killed two but these were discarded)

(E-5*) Aucilla River, FL (spec.); March 1894 (#19)

(E-6) Big Muddy swamp, Taylor County, FL; February 1894 (#20)

(F-4*) Pumpkin swamp, Dixie County, FL (spec.); April 1893 (#25; neither Tanner nor Hahn list a specimen with specific location or date for this location, but such a specimen is listed at the Smithsonian collected by H. Parker)

(F-5) California swamp, Dixie County, FL; February 1893 (#26)

(F-6*) California swamp, Lafayette County, FL (two specs.); 1893 (#27; Tanner cites MCZ as having a specimen from 1893, but this was not found in Hahn which lists two specimens from this location during March 1896 housed at Bowling Green State University, OH, included in total here)

(F-7) Branford, FL; April 1892 (#28)

(F-8*) Suwannee River, near Old Town, FL (six specs.); 1890 and 1893 (#29; Hahn 1963 up to fourteen collected according to accounts by Brewster and Chapman [one] in 1890 and Wayne [thirteen] in 1893)

(F-9*) Old Town, FL (four specs.); April 1892 (#30; Hahn lists three specimens dated April 1892, an additional specimen dated February 1897 included in total here)

(F-10) Suwannee Hammock, Levy County, FL; 1893 (#31; Jackson 2004 adds two sight records by F. Chapman at Vista Creek in 1890 and near Fort Fanning in 1891)

1900-1909

(B-4) Minnie's Lake Island, Okefenokee, GA; 1903 (in Tanner's 1989 update, citing Elliott 1932, to his1942 report)

(E-2*) St. Marks, FL (spec.); January 1900 (#15; Tanner does not indicate that a specimen was taken, while Hahn lists one specimen taken in 1901; these likely refer to the same event as the one cited by Tanner from Pennock 1901 entitled "Recent capture of Ivory-billed Woodpeckers in Florida)

(E-4*) Jefferson County (Wacissa region), FL (spec.); June 1905 (Hahn)

(E-7) Leon County, FL; about 1900 (#13)

(E-8) Taylor County, FL; January 1900 (#21)

(E-9*) Taylor County, FL (two specs.); March 1904 (#22; Tanner does not indicate that specimens were taken, while Hahn lists two specimens from January 1904 included in total here)

(F-11*) Stephensville, Taylor County, FL (spec.); January 1901 (#23)

(F-12*) Lafayette or Dixie County, FL (three spec.); 1905 (#24; Hahn also lists specimen taken February 1904 included in total here)

(F-13) Otter Creek, Gulf Hammock, Levy County, FL; about 1905 (#34)

(G-7) Micanopy, FL; 1909 (#40)

1910-1919

(B-1*, B-4, B-5) Okefenokee Swamp (Craven Island, Minnie's Lake Island, Suwannee Canal), GA; 1910-1915 (#4, 5, and 7; apparently a 1912 specimen is from Craven Island in the Philadelphia Academy of Science collection, but not clear in Hahn though cited by Tanner in his 1989 update to his 1942 report)

(B-2*) Waycross (Okefenokee region), GA (spec.); April 1913 (Hahn; specimen is a skeleton; acknowledged by Tanner in his 1989 update to his 1942 report)

(B-7*) Baker County (Okefenokee-Pinhook region), FL (four specs.); February 1914 (#37; Tanner listed this report without dates or references to specimens that are listed in Hahn; acknowledged by Tanner in his 1989 update to his 1942 report)

(E-4*) Jefferson County (Wacissa region), FL (spec.); January 1910 (Hahn)

(E-5*) Aucilla River, FL (spec.); May 1917 (#19)

(E-11) Wakulla Springs, FL (a pair seen by H.L. Beadle; reported by Stoddard to Sprunt); April 1918 (Sprunt 1954; acknowledged by Tanner in his 1989 update to his 1942 report)

(F-10) Suwannee Hammock, Levy County, FL; 1917 (#31)

(G-8) Alachua County, FL; about 1910 (#39)

(G-2) Between Welaka and Rodman, FL; 1916 (#41)

1920-1929

(A-2) Altamaha River, Tattnall County, GA; around 1925 (#1)

(B-4) Okefenokee (Minnie's Island), GA (still nesting according to B. Carter); 1924 (S. Willis, pers. comm., USFWS 2007)

(D-4) Apalachicola River Swamp, FL; 1920 (#11)

(E-10) Wacissa River Swamp, FL; 1923 (#18)

(F-10) Suwannee Hammock, Levy County, FL; about 1925 (#31)

(G-3) Oklawaha River Swamp, FL; 1923 (#42)

1930-1939
(B-4) Okefenokee (Minnie's Lake Island), GA (possible nesting C. Elliot); 1931 (Jackson 2004; various other references during the 1930's give conflicting interpretations but suggesting persistence with Greene 1936 and especially Burleigh 1958 quoting F. Hebard that not until the "great fire" of 1932 was this species noted since 1912, and with Jackson recounting that Tanner had spoken with E. Adams, a technician for the refuge, about his sighting presumably in the mid-1930s, but with Tanner himself treating these as "rumors" and on the basis of what he did observe of the habitat in 1939 he considered to look unsuitable, mostly pond cypress)

(D-4) Apalachicola River Swamp, FL; about 1935 (#11)

(E-11) Wakulla County, FL; June 1936 and January 1937 (#12)

(E-4, E-10) Wacissa River Swamp, FL; December 1932 up to 1937 (#17 and 18)

(F-14) Sim's Ridge, Gulf Hammock, Levy County, FL; 1932-1934 (#36)

1940-1949
(A-2) Altamaha River, GA; 1940s (Stoddard 1969)

(B-5) Suwannee Canal, Okefenokee, GA; 1941-1942, 1946, 1948 (Loftin 1991, Jackson 2004)

(D-2 through D-4) Apalachicola region, FL (Figure 16 in Tanner; reach from Bristol to Apalachicola Bay; 4 individuals estimated on the basis of Tanner's assessment of "carrying capacity of region and reports of natives;" also a pair reported by Eastman in March 1949); 1940s (Tanner)

(F-2 through F-13) Gulf Hammock-Suwannee region, FL (Figure 15 in Tanner; area from Steinhatchie River to Gulf Hammock; 4 individuals estimated on the basis of Tanner's assessment of "carrying capacity of region"); 1940s (Tanner)

(G-9) Silver Spring swamp near Ocala, FL (pair seen by L. L. Henniger); October 1949 (Sprunt 1954; acknowledged by Tanner in his 1989 update to his 1942 report)

1950-1959
(A-2) Altamaha River, Tattnall County, GA (H. Stoddard observed one from plane); 1958? (Stoddard 1969, Jackson 2004, USFWS 2007)

(C-1) Red Hills, Thomas County, GA (H. Stoddard observed two birds feeding in beetle killed spruce pine); Spring 1952 (Stoddard 1969; Crawford 1998, Jackson 2004)

(D-5) Chipola River, Calhoun County, FL (numerous observers, most prominent H. M. Stevenson along with R. West); 1950-1951 (Stevenson and Anderson 1994, J. V. Dennis 1967, 1979, and W. Eastman 1958; the original reports doubted by both Stoddard and Tanner, who were aware at the time, but did not discount, Stevenson's observation during the same time period)

(E-12) Wakulla County, FL (flying across road between Wakulla Station and St. Marks by S. Grimes along with R. Hallman); July 1952 (Stevenson and Anderson 1994; acknowledged by Tanner in his 1989 update to his 1942 report)

(E-5) Taylor County, FL (female 1 mile east of Aucilla River, west of Perry, by W. L. Rhein); 1959 (Jackson 1996)

1960-1969
(B-6) Stephen Foster State Park, Okefenokee Swamp, Charlton County, GA (supposedly photographed by Park Superintendent and Nova Scotia naturalist [names?] relayed to J. J. Shoman and then to L. R. Short); 1965? (USFWS 2007)

(C-1) Red Hills, Thomas County, GA (G. B. Reynard); 1963 (Jackson 2004)

(D-6) West of Apalachicola, FL (bird flew across road near Indian Pass and flew north to Lake Wimico, J. H. Merritt reported to Eastman); December 1963 (USFWS 2007)

1970-1979
(D-3) Apalachicola National Forest, Liberty/Gulf County, FL (pair with female sticking head out of cavity by J. Stevenson); March "late 1970s" (Stevenson 2006, letters between D. Pashley, C. Hunter and H. Stevenson 1990-1991, USFWS 2007 [see 1980s])

1980-1989
(D-3) Apalachicola National Forest, Liberty/Gulf County, FL (J. Stevenson reported finding breast and secondary feathers inside the cavity of the same tree as in previous decade that was blown down November 1985 from Hurricane Kate, [location of feathers are at present known to J. Stevenson and the museum curator who identified them as from Ivory-bill; also in the aforementioned correspondence, H. Stevenson describes a possible sighting in the same general area himself in 1985 or 1986]); Spring 1986 (Stevenson 2006, letters between D. Pashley, C. Hunter and H. Stevenson 1991, USFWS 2007 [see 1970s])

1990-1999
(D-3) Lower Chipola-Apalachicola River (reports given to J. Jackson considered "tantalizing"); 1990-1991 (Jackson 1996)

(F-8) Lower Suwannee River, Gilchrist County, FL (possible multiple sightings by M. Rupp and E. Rupp); May 1995 (USFWS 2007)

2000-
(D-3) Lower Apalachicola River (heard possible kent calls by Spahr); January 2003 (Spahr 2006)

(E-13) Between Aucilla River and Exit 35 (Highway 221 to Greenville) along I-10, Madison County, FL (female fly-over female seen flying across highway in front of vehicle and then briefly from the side of same vehicle, rear of bird, as it entered woods, by S. Willis); April 2007 (USFWS 2007)

Southern Florida (#'s where indicated are cross-referenced to Figure 5 in Tanner), subregions (all restricted to FL): (A) East-Central (including upper St. John's River and tributaries), (B) North-Central (including Orlando, Green Swamp, and upper Kissimmee River), (C) Chassahowitzka to Tampa Bay, (D) Lower Kissimmee-Highlands-Lake Okeechobee, (E) Charlotte Harbor-Fort Myers, (F) Big Cypress-Everglades, (G) Loxahatchee

1800-1849
None

1850-1859
(A-1) Enterprise (now Benson Springs), Volusia County; about 1859 (#5; Hahn lists four specimens from "April" with no year nor collector listed, but in the collection records for MVZ one specimen [107106] has Bryant as the collector whom Tanner references for this report)

1860-1869
(A-1*) Enterprise (now Benson springs), Volusia County (spec.); March 1869 (#5; Tanner did not list a specimen, but Hahn lists a specimen from March 1869 taken by J. Allen whom Tanner references for this report)

(A-2*) Hawkinsville and Lake Jessup (two specs., one each from each location); March and winter 1869 (#6; Hasbrouke 1891 reports from essentially an anonymous author, "W.A.D. of Hawkinsville, that he and his brother collected 20 to 25 for a taxonomist in Palatka, possibly during the 1870s with the last bird seen during May 1885, but no specific locations or dates for any of the specimens)

1870-1879
(A-3*) Wekiva River (twelve specs.); June 1878 (#4; Tanner cites one specimen being at MCZ, but Hahn lists two there with the date of June 1876 with another two specimens with date August 1876; in addition Hahn lists from other collections three specimens dated July 1876, one with date of July 1877, two with dates of August 1877, and two with dates of dated September 1877)

(A-4) Turnbull Swamp or Hammock, Volusia County; 1872 (#8; Hasbrouke 1891 cites this report as from New Smyrna Beach)

(A-5*) Merritt Island (spec.); 1870 (#22; Tanner did not list a specimen, but Hahn lists a specimen from "Brevard" in April 1870, presumably the same report as Merritt Island is within Brevard County)

(B-1*) Panasofkee Lake, Sumter County (spec.); spring 1876 (#3; Tanner did not list a specimen, but Hahn lists a specimen from February 1876)

(C-1) Mouth of Withlacoochee River; 1879-1880 (#1)

(C-2*) Hernando County (two specs.); March 1876 and January 1877 (#10)

1880-1889
(A-2) Sanford; around 1885 (#6)

(A-3*) Wekiva River (three specs.); about 1885 (#4; Tanner did not list any specimens, but Hahn lists two specimens with dates of February 1883 and one March 1883)

(A-6*) Indian River (spec.); February 1885 (#9)

(B-2*) Linden (spec.); March 1886 (#11)

(B-3*) Polk County (spec.); 1889 (#13; Tanner cites the Museum of Comparative Zoology at Harvard College as housing this specimen, possibly from Brewster as cited by Hasbrouke 1891, but Hahn does not list a specimen with either this location or date there, while listing a specimen from Polk County not otherwise cited by Tanner collected by John Lamb on March 28, 1899, not 1889, and housed at the Charleston Museum, Charleston, SC)

(B-4*) Davenport (spec.); June 1889 (#14)

(B-5*) Kissimmee (spec.); 1887 (#17; Tanner cites the Field Museum at Chicago [Hahn refers to this as the Chicago Natural History Museum) as housing this specimen, but Hahn lists as the only specimen from Kissimmee as housed at the Peabody Museum of Natural History at Yale University with date January 15, 1890; however, Hahn does list two specimens from an unknown location at the Field Museum with the year 1887 and the Field Museum itself does list a specimen from Kissimmee dated October 1892)

(B-10*) Near Orlando (two specs.); April 1886 (Hahn)

(C-1) Mouth of Withlacoochee River; 1879-1880 (#1)

(C-3*) Crystal River, Citrus County (spec.); July 1889 (#2)

(C-4*) Cypress swamp near Tarpon Springs (five specs.); March 1887 (#24; Hahn lists three specimens from March 1887, but also one from October 1886 and one from April 1889, included in total here)

(C-5) Clearwater; 1880 (#26)

(C-6*) Tampa (two specs.); September 1883 (#27)

(C-7*) Southeast of Tampa (three specs.); 1883-1889 (#28; Hahn lists specimens dated October 27, 1881, February 10, 1885, and 1885)

(C-8*) Manatee County (four specs.); March 1889 (#30; Hahn lists three specimens collected in March 1889, two specifically listed as collected at Mill Creek; Hahn also lists one taken in May 1885)

(E-1) Punta Rassa; 1889 (#40)

(E-2*) Fort Myers (#38; spec.); winter 1887-1888 (Hahn)

(E-3*) Caloosahatchie River (spec.); 1881 (#39; Hahn)

(E-5*) Desoto County (six specs.); 1886-1887 (#35; Tanner listed no date but cited Hargitt 1890 entitled "Catalogue of birds of the British Museum," and Hahn 1963 lists a total of five specimens from the British Museum at this location with one December 1886, three February 1887, and one May 1887; another specimen is listed at the American Museum dated February 1887)

(F-7*) Big Cypress, Dade County (three specs.); May 1889 (Hahn; there is some confusion over what constitutes the Big Cypress in Dade County as this county overlaps the very peripheral eastern edge of the swamp, perhaps this location is best considered the "eastern" Big Cypress; Hasbrouke 1891 does cite Brewster as the source of this report and specimens)

(F-8*) Everglades, coastal, "Marco" (spec. by W. Calhoon at Smithsonian, presumably Marco Island, presently in Collier County, not listed in Tanner nor Hahn), Chatham Bay (presently Chevalier Bay), Monroe County (spec.); March 1886 and July 1888 (Hahn 1963, Stevenson and Anderson 1994)

(F-9*) Everglades, interior (two specs.); 1884 (Hahn; no mention of these specimens in Tanner and it is unclear what area specifically is being referenced, but it is assumed here that when the "Everglades" is listed as the location it is likely in reference to the forested "keys" in the interior of the Everglades, such as Long Pine Key and Paradise [Royal Palm Hammock] Key)

1890-1899

(A-13) Chuluota, Seminole County; 1896-1899 (Stoddard 1969; between 12 and

15 observed prior to 1900 by Stoddard, who was between seven and ten years old; acknowledged by Tanner in his 1989 update to his 1942 report)

(B-6) Reedy Creek; October 1892 (#16)

(B-10*) Near Orlando (spec.); December 1894 (Hahn)

(C-9*) Eastern Hillsborough County (two specs.); March 1890 and March 1893 (#29; Tanner cited Scott as the collector and the specimen housed at the American Museum of Natural History, where no specific date is listed; two other specimens are listed by Hahn, but no name of the collector: one at Regar Memorial Museum, Anninston, AL, dated March 1890, and the other at Milwaukee Public Museum dated March 1893)

(D-1) Fort Drum; May 1899 (#34)

(D-2*) Lake Okeechobee (three specs.); May 1898 (#36)

(E-2*) Fort Myers (six specs.); November and December 1891 (#38)

(E-3) Caloosahatchie region; 1891 (#39; Stevenson and Anderson 1994 state that Scott's observations spanned from 1891 to 1892)

(F-1*) Big Cypress (three specs.); February 1898 (#43; Tanner cites Ridgway 1898 and states that the U.S. National Museum [Smithsonian] housed the specimen with date of collection February 15, 1898, while Ridgway reported collecting two specimens on successive days; Hahn does not list specimens at the U.S. National Museum specific to Big Cypress, but does list two specimens from "Corbett's" in Florida collected on February 16 and 18, 1898, which appear to be at nearly the time Ridgway's birds were collected but no collector is named in Hahn; further complicating the picture, two skeletons in the same collection are attributed to Ridgway and are both dated February 16, 1898, from "Okalocoochee Slough," Okaloacoochee Slough near Immokalee, Collier County, is indeed within the vicinity of the Big Cypress where Ridgway appears to have been searching, but it remains unclear whether the skeletons and skins are from the same birds and whether "Corbett's" is the same as Okaloacoochee Slough; in addition, Hahn lists one specimen dated January 2, 1899, again with no name given for the collector)

(F-3*) Big Cypress, Lee County (two specs., prior to 1930 Collier and Hendry Counties were part of Lee County and this location is presumably near or in Corkscrew Swamp, now in Collier County); March 1896 (#42, Hahn; not mentioned in Tanner, but two specimens listed from "Lee County")

(F-9*) Everglades, interior (two specs.); 1890 and November 1896 (Hahn; neither mentioned in Tanner with the 1890 report from Wayne of a skeleton and the November 1896 specimen said to be from the "Florida keys;" the latter is housed at Cornell University and is actually dated November 1898 and may not refer to the Florida Keys but to the "keys" from the interior of the Everglades and is treated this way here)

1900-1909

(A-4) Turnbull Swamp or Hammock, Volusia County; 1907 (#8)

(A-7*) Taylor Creek, (three specs.); December 1907 (#20, Hahn lists two specimens housed at the Field Museum taken on December 20, 1907, one specifically lists Orange County, but there is some question whether this and location A-9 [Tanner's #19) were both either in Orange or Osceola County, as raised by Jackson 2004 with the 1924 report by Allen; a third specimen with date March 20, 1907, housed at the Field Museum is listed from "Halfway Cypress, Orlando, Osceola County, but Orlando is in Orange and not particularly close to Osceola County)

(A-8*) Brevard County (two spec., one specifically from Lake Washington); 1901-1902 (#23)

(B-5) Kissimmee; 1900 (#17)

(B-7*) Lake County, various locations including "near Clermont" (two specs., also egg collected); March 1904 and March 1905 (#12; Tanner cites Hoyt 1905 for this report and did not list any specimens, other than the egg, but Hahn lists two specimens with dates of February 1906, with Hoyt named as the collector)

(B-8*) Gotha, Orange County (five specs.); 1906 (#15)

(D-2*) Lake Okeechobee (two specs.); February 1904 (#36)

(D-3) Kissimmee River, 50 miles below Kissimmee; November 1908 (#33)

(E-1*) Punta Rassa (nine specs.); February 1904 (#40)

(E-4*) Punta Gorda (two specs.); January 1904 (#37)

(E-6*) Charlotte Harbor (two specs.); March 1904 (Hahn)

(F-2*) Naples (two specs.); April 1902 (#41)

(F-4*) Big Cypress, Lee County (spec., near Deep Lake, now part of Collier County); February 1908 (Hahn)

1910-1919

(A-4) Turnbull Swamp or Hammock, Volusia County; 1911 (#8)

(A-9) Taylor Creek, Osceola County; about 1916 (#19; north of area visited by Allen in 1924, may be Orange County?)

(B-8) Bear Bay, west Orange County; October 1913 (#15)

(D-4) "Fort Capron" near Kissimmee River (specific location not known); 1916 (Tanner)

(F-3) Big Cypress, Lee County (near or at Corkscrew Swamp, now in Collier County); March 1911 and March 1913 (#42)

(F-4*) Big Cypress near Deep Lake (spec.); February 1914 (#44; Hahn lists Kennard's specimen as taken in March 1914)

(F-5) Near Everglades; 1917 (#45; J. Ellis who reported this location gave his residence as Chokoloskee and Everglades City and his accounts of birds foraging in dead pines and nesting in cypress suggests the specific locations of his reports was somewhere in the vicinity of present-day Collier-Seminole State Park to Everglades City)

(F-9) Royal Palm Park, Paradise Key, Long Pine Key, all Everglades interior (pair with young, other reports); May 1917, 1919 (Howell 1932, Sprunt 1954, Stevenson and Anderson 1994, Jackson 2004; several authorities including later Howell himself doubted the original 1917 report, but Jackson adds the 1919 report from the same area as a potential encounter along with speculation that yet another record of a specimen taken in 1919 reported from "Long Key" was potentially misinterpreted as from Dry Tortugas when it possibly referred to Long Pine Key in the Everglades)

1920-1929

(A-7*) Taylor Creek, (photo and specs. of nesting pair); April 1924 (#20; same general area as #19, but there is confusion on whether reports along Taylor Creek were in Orange or Osceola County, or both; a report of four birds seen by W. H. Mann on Taylor Creek in Osceola County 1923 not mentioned by Tanner, but was by Howell 1932 and Jackson 2004, likely sparked Allen's interest in visiting this area the following year; the whereabouts of the pair collected soon after Allen left Taylor Creek in April 1924 remains a mystery with Jackson suspecting that the pair of birds at the Florida Natural History Museum labeled as being taken at Bull Creek, Osceola County more than 20 miles to the south of Taylor Creek, about June 1925, is in his view likely the Taylor Creek pair; further confusing the issue, Tanner in his 1989 update to his 1942 report added Bull Creek 1925 to his list of Reports, suggesting that he considered these specimens to be separate from Allen's Taylor Creek birds)

(A-10) Wolf Creek, Osceola County; 1920s? (#21)

(A-12) Lake Poinsett, along the St. Johns River, Brevard County (a pair by D. J. Nicholson; Howell 1932); February 1924

1930-1939

(A-11) Jim Creek, Orange County; December 1936 (#18)

(B-3) Northwest of Polk City, Polk County; about 1930 (#13)

(B-6) Reedy Creek, Polk County; about 1930 (#16)

(D-5) Highlands Hammock, Highlands County; 1937 (#32)

(F-4) Deep Lake, Big Cypress 10 miles north of Tamiami Trail (flew over Highway 29 seen by A. Cruickshank; same as the 1950's report mentioned by Robertson to Jackson?); (Sprunt 1954, Jackson 2004); March 1938

(F-6) Big Cypress, East Crossing region; around 1937 (#46)

(F-8) Shark River and Lostman's River; around 1935 (#47)

1940-1949

(D-5) West-central, Highlands County (2 individuals estimated based on Tanner accepting that they were "Known to be there in late 1937 by O. E. Baynard"); 1940s (Tanner)

(F-3 through F-6) Big Cypress area, Collier and Hendry Counties (Figure 14 in Tanner; 6 individuals estimated based on Tanner's assessment of "carrying capacity of region and locations of reports," one report of a female at Deep Lake [F-4] May 1941; Meyer de Schauensee 1941); 1940s (Tanner)

(F-9) 12 miles southwest of Homestead, Dade County (one report of a female apparently near Royal Palm Park today within the Everglades National Park; Meyer de Schauensee 1941); May 1941

1950-1959

(C-9) Polk-Hillsborough County line (male flying across road by W. Eastman); March 1954 (Eastman 1958, USFWS 2007)

(C-10) Eight miles south of Homosassa Springs, near Citrus and Hernando County line (a pair seen flying across US 19 by J. Terres); April 1955 (Terres 1986, Stevenson and Anderson 1994, Jackson 1996)

1960-1969

(B-9) Green Swamp north of Haines City, Polk County (visual of female flying across road at close range by D. Lee); Summer 1967 (Jackson 2004)

(D-5) Highland Hammock State Park (F. C. Davis); fall 1968 (USFWS 2007)

(D-6) South Central, Highlands or Polk County (multiple reports including a cavity that held a secondary identified as "fresh not worn" by Alexander Wetmore,

but not known how old the feather was when found; both now at Florida Museum of Natural History); 1967-1969 (Agey and Heinzmann 1971, Jackson 2004)

1970-1979
None

1980-1989
(A-3) Wekiva River (two independent reports given to J. Jackson); 1987 and 1988 (Jackson 2004)

(F-4) Fakahatchee Strand, Collier County (two independent reports given to J. Jackson); 1980s (Jackson 1996)

(G-1) Loxahatchee River, Jonathan Dickinson State Park (D. G. Garratt); April 1985 (Jackson 2004)

1990-1999
(F-4) Fakahatchee Strand, Collier County (several reports given to J. Jackson considered "tantalizing"); 1990-1991 (Jackson 1996)

2000-
(F-4) Fakahatchee Strand, Collier County (three independent reports given to J. Jackson); since 1999 (Jackson 2004)

(F-8) Shark River, Lostman's River, Whitewater Bay, Monroe County (several reports of large black woodpecker unlike Pileated Woodpecker, including one by W. Hodge with view of underwing which was white along the leading and trailing edge with black band separating the white in 2003 and another seen in 2007 from above with more white on wing tops than a typical Pileated, larger than Pileated, and with a straight flight while conducting an Everglades National Park aerial waterbird survey by L. Oberhofer); February 2003 and January 2007 (reported to S. Snow and S. Bass with Everglades National Park)

Alabama (#'s where indicated are cross-referenced to Figure 6 in Tanner), subregions: (A) FL Panhandle, FL-AL, (B) Lower Tombigbee-Alabama-Mobile rivers, AL, (C) Upper Tombigbee River, AL-MS, (D) Pascagoula River and coastal Mississippi, MS, (E) Pearl River, MS-LA

1850-1859
(B-1) Near the Alabama River and Selma, Dallas County, AL; around 1850 (#6; two specimens now unaccounted for, but two specimens in Hahn dated "abt. 1850" may refer to these at the collection in Kessel, Germany)

1860-1869
(B-2) Tombigbee River, Marengo County, AL (Tanner mistakenly listed MS); 1865 (#5; specimen now unaccounted for)

1870-1879
None

1880-1889
(A-6*) Blackwater River, FL (two specs.); March 1883 (Hahn; Tanner did mention this report but did not know location nor the date)

(B-3) Cypress Slough, 10 miles west of Greensboro, Hale County, AL; 1886 (#4; specimen now unaccounted for)

(B-4) Wilcox County, AL; 1889 (#7)

(C-1) Monroe County, MS; 1885 (#1)

(C-2) Crump Springs, Lamar County, Buttahatchie River, AL; 1886 (#2)

(C-3) Clay County, MS; 1885 (#3)

(E-1) Near Bay St. Louis, MS; 1885 (#9)

1890-1899
(D-1*) Mississippi City, Harrision County, MS (two specs.); March 1893 (#10; Hahn 1963 also lists a specimen taken in April 1893 included in total here)

1900-1909
(A-1) Conecuh Swamps, north of Troy, Pike County AL; 1907 (#8; specimen now unaccounted for)

(D-2) Big Black River, MS (one pair reported by M. Vaiden); 1908 (Jackson 2004, USFWS 2007)

1910-1919
None

1920-1929
(D-3) Pascagoula Swamp, Jackson County; December 1921 (#11)

1930-1939
(A-2) Escambia River, FL; 1936 (Weston 1965, Stevenson and Anderson 1994)

1940-1949
(A-3) Perdido River, FL; 1945 (Weston 1965, Stevenson and Anderson 1994)

1950-1959
(D-4) About 30 miles north of Meridian, MS (B. Chauncey); 1953 (Moore 1954, Jackson 2004)

(E-2) East side of Pearl River, adjacent to lock #1, St. Tammany Parish, LA, Hancock County, MS (one male foraging on sweet-gum, by J. Merritt); October 1955 (USFWS 2007)

1960-1969
(A-4) Eglin Air Force Base near Yellow River, FL (two birds seen Boiling Creek; B. Brown and J. Sanders reported to Dennis); August 1966 (Jackson 2004)

(D-5) Leaf River swamp (1 mile north of US Hwy 98), Perry County, MS (2 seen briefly in "big gum" trees); December 1960 (USFWS 2007)

1970-1979
(C-4) Noxubee River, near junction with Tombigbee River, Sumter County , AL (possible flyby by J. Jackson); March 1973 (Jackson 2004)

(D-6) Near where Black Creek joins Pascagoula River, Jackson County, MS (one possible heard "kenting" but never seen by R. Sauey and C. Luthin); January 1978 (Jackson 2004)

1980-1989
(D-3) West side of Pascagoula River, north of Vancleave, Jackson County, MS (two birds in a pine by M. Morris); February 1982 (Jackson 2004)

(E-2) Pearl River, St. Tammany Parish, LA (a male observed one year, a female the following year, both by N. Higginbotham); 1986, 1987 (Steinberg 2008)

1990-1999
(E-2) Pearl River, St. Tammany Parish, LA (a pair reported seen for 10 minutes by D. Kulivan while turkey hunting; extensive followup searches in subsequent years unsuccessful); April 1999 (Jackson 2004)

2000-
(A-5) Choctawhatchee River, FL (multiple visual and auditory encounters by many observers, including many recordings of putative kents and double-knocks and a very poor video); 2005-2007 (Hill et al. 2006, Hill 2007)

(E-2) Pearl River WMA – Stennis Space Center, St. Tammany Parish, LA, Hancock County, MS (multiple sightings, several very poor but at least one suggestive video in 2006 of a large woodpecker, possibly lacking red in the crest; a more recent video of a woodpecker in flight in 2009 was determined to be a Red-headed woodpecker, a 2008 video is still undergoing review by M. Collins and others); 2000, 2005-2009 (USFWS 2007; Collins 2005-2009)

Lower Mississippi Delta (#'s where indicated are cross-referenced to Figure 7 in Tanner), subregions: (A) Lower Yazoo Basin, MS, (B) Northeast Louisiana (includes Tensas River, lower Red River, and south to Lake Ophelia), LA, (C) Upper Atchafalaya, LA, (D) Lower Atchafalaya_Deltaic (includes coastal forests), LA

1800-1849
(C-1) Bayou Sara, West Feliciana Parish, LA; June 1821 (#13)

1850-1859
(B-1*) Prairie Mer Rouge (spec.), LA; Sept.1853 (#3; Tanner did not list a specimen taken, but it is listed in Hahn)

1860-1869
None

1870-1879
None

1880-1889
(A-1) Sunflower Delta, MS; about 1888 (#1)

(B-8*) Tensas River, East Carroll Parish, LA (spec.); spring 1888 (#6; Tanner did not list a specimen was taken, but one, possibly two, listed in Hahn)

1890-1899
(A-2) Yazoo River Delta, MS; 1890 (#2)

(B-2*) Madison Parish, LA (spec.); 1891 (#8)

(B-3*) Roaring Bayou, Franklin Parish (four specs.), LA; July 1899 (#10; Tanner did not mention a specimen, but it is listed in Hahn along with three additional specimens listed at LSU collected by Beyer 1900, who reported taking seven specimens)

(D-1*) Avery Island, Iberia Parish, LA (two specs.); 1892, 1895 (both specs.) (#17)

1900-1909
(B-2*) Madison Parish (six specs.), LA; December 1908, (#8; specimens and dates listed in Hahn are two taken in December 1908 and four taken in March and April 1909)

(B-4) Bowling Green, West Carroll Parish, LA; August 1903 (#4)

(B-5) Bear Lake, Madison Parish, LA; February 1904 (#7)

(B-10*) Holly Ridge 18 miles north of "station" (?), Richland or West Carroll Parish, LA; 1907 (specimen attributed to E. L. Moseley and housed at the University of Michigan Museum of Zoology, while Tanner in his 1989 update to his 1942 reported it to be from West Carroll Parish and housed at the Smithsonian and acknowledged Hahn [no specific reference was found in Hahn; the specimen appears to have been collected near the Beouf River where the Parish line between Richland and West Carroll is directly north of the town Holly Ridge])

(C-2*) Cow Bayou, Iberville Parish, LA (two specs.); March 1906 (#15)

(D-1) Avery Island, Iberia Parish, LA; 1900-1909 (#17)

1910-1919
(B-4) Boeuf River swamp, West Carroll Parish, LA; about 1912 (#4)

(D-1) Avery Island, Iberia Parish, LA; 1910-1919 (#17)

(D-2) Lafourche Parish, LA; 1918 (#18)

1920-1929
(B-6) Bayou Macon Swamp, West Carroll Parish, LA; 1926 (#5)

(B-7) Tensas Parish, north of St. Joseph, LA; May 1929 (#11; Hasbrouke 1891 referenced a report from G. Marbett from this location with no date, but must have been at least 39 years prior to Tanner's citation)

(C-3) Bayou des Ourses, St. Martin Parish, LA; about 1920 (#14)

(C-4) Catahoula, St. Martin Parish, LA; about 1920 (#16; not Catahoula Lake as listed in Tanner, which is in La Salle Parish)

(D-1) Avery Island, Iberia Parish, LA; 1920-1923 (#17)

1930-1939
(B-5) Near Bear Lake, Madison Parish, LA; September 1937 (#7)

(B-8) Tensas River swamp, East Carroll Parish, LA; about 1930 (#6)

(B-9*) Tensas River Swamp [i.e., Singer Tract], Madison Parish, LA (spec.); 1930-1939 (#9; one spec. collected in 1932, not specifically mentioned by Tanner, was mounted and is now housed at the state Headquarters for LA Dept. of Wildlife and Fisheries; in addition many photos, movie, and recordings)

1940-1949
(B-9) Singer Tract (i.e., Tensas River Swamp), Madison Parish, LA (6 individuals estimated as "five individuals observed and sign of at least one other individual")

In addition to Tanner's report, Jackson (2004) lists other reports (none supported by photographs or other hard evidence) as follows:

R. Peterson (2 females); 1942

R. Pough (1 female); 1943-1944

D. Eckelberry (1 female [sketch made]); 1944, the last generally accepted sighting of the species in the United States

R. Peterson (reported to Peterson that one remained); 1946

A. MacMurray (one or a pair "believed to be in the region," as reported to Tanner); 1948

The draft Recovery Plan (USFWS 2007) adds the following reports, again none confirmed by photographs:

G. Bick and J. Parker (three seen in John's Bayou area, including apparent female hatch-year young; Bick 1942, J. Tanner pers. comm.); August 1941

J. Tanner (an adult and juvenile female on); 21 and 28 December, 1941

J. Baker (single female; Peterson 1948); November 1942

1950-1959
None

1960-1969
(B-9) Singer Tract, Tensas River near Tallulah, Madison County, LA (one possibly heard and glimpsed by L. Binford, B. Monore, D. Berrett, and K. Arnold); March 1962 (Jackson 2004)

1970-1979
(C-5) Atchafalaya Basin, I-10 (flyover, R. Hamilton and flyover, R. Bean); one 1973 and the other November 1974 (Jackson 2004)

(D-3) Atchafalaya Basin, south of US 90 (several sightings, two diagnostic photos by F. Lewis given to G. Lowrey); May 1971 (for photos, some suggest they could have been staged; Jackson 2004, Gallagher 2005); and (J. Maroney and B. Crider following up on report from hunter, heard calls, also one possibly seen from helicopter); March 1978 (Jackson 2004)

1980-1989
(A-3) Yazoo River confluence with Mississippi River, north of Vicksburg, Warren County, MS (one possibly heard for about 20 minutes after playing Singer Tract tape, but never seen, by J. Jackson and M. Hodges); and March 1987 (heard kent calls, but not seen, by W. Davis and F. Sibley); August 1988 (Jackson 2004)

(A-4) Headwaters of Yazoo River near confluence with Yalobusha River, LeFlore County, Mississippi (one possibly seen and heard giving a "rhythmic" tooting by C. Bryson); May 1988 (Jackson 2004)

(B-9) Singer Tract, Madison Parish (G. Heinrich and C. Welch possibly heard on two occasions); November 1981, April 1982 (Jackson 2004)

(D-3) Near Duck Lake, Atchafalaya Basin, St. Martin Parish (T. Michot and D. Hankla); April 1981 and Duck Lake, Atchafalaya Basin, LA (E. Broussard, LWFD); April 1986 (USFWS 2007)

1990-1999
None

2000-
(D-3) Bayou Sorrel and near Patterson, St. Mary Parish, LA (former, one seen from flyover by R. Boustany, latter multiple sightings and auditory encounters); 2005-2006 (Steinberg 2008)

Upper Mississippi Delta (#'s where indicated are cross-referenced to Figure 8 in Tanner), subregions: (A) White-Cache rivers (i.e., Big Woods), AR, (B) Mississippi mainstem from MS-AR-TN north to Reelfoot, (C) Ohio River to confluence with Mississippi south to include Reelfoot, MO-TN-KY-IL

1800-1849
(B-6) Along Mississippi River, north of Fulton, Lauderdale County, TN (reports by Audubon but not clear which side of the river, possibly Mississippi County, AR); November 1820 (Jackson 2004)

(C-1) Junction of Ohio and Mississippi Rivers; about 1825 (#2)

(C-6) Along Mississippi River, either Carlisle or Hickman County, KY (reports by Audubon); early 1800s (Jackson 2004)

1850-1859
(C-2) White County, 40 miles south Mount Carmel, IL; about 1852 (#1)

1860-1869
None

1870-1879
(B-4*) St. Francis River (near Helena?), Phillips County, AR (two specs.); 1870 (Hahn)

(C-3) Fulton County, KY; 1872-1874 (#4)

1880-1889
(A-1) Newport, Jackson County, AR; about 1885 (#6)

(B-1) Osceola, Mississippi County, AR and Northeast AR; 1887 and 1888 (#5)

(B-2) Marked Tree, Poinsett County, AR; March 1889 (#7)

1890-1899
(B-3*) Bolivar County, MS (two specs.); March 1893 (#9)

(C-4) Little River, Stoddard County, MO; November 1895 (#3; Jackson 2004 clarifies that allegedly a bird was shot near Morley, Scott County, then brought to St. Louis from Stoddard County, supposedly mounted but there is no longer any record of the mount ever existing)

1900-1909
(C-5) Ullin, Pulaski County, IL (one possibly heard by B. Gault); 1900 (Jackson 2004)

1910-1919
(B-4) Helena, Phillips County, AR; 1912 (#8)

1920-1929
None

1930-1939
(B-3) Nine miles south of Rosedale, Bolivar County (6 pairs present until World War II until logged over to support war effort); 1930s (Jackson 2004, USFWS 2007)

1940-1949
(B-3) Nine miles south of Rosedale, Bolivar County (6 pairs present until World War II until logged over to support war effort); 1930s (Jackson 2004, USFWS 2007)

1950-1959
None

1960-1969
None

1970-1979
None

1980-1989
(A-1) Near Diaz in Village Creek floodplain, Jackson County, AR (possible visual encounter by H. Hagar); October 1985 (Jackson 2004, USFWS 2007)

1990-1999
None

2000-
(A-2) South end of White River NWR and adjacent properties Desha/Phillips/Arkansas Counties County, AR (visual encounter of female by M. Scott [but not seen by others present]; multiple kents heard and large woodpecker briefly seen by J. and B. Denman; visual encounter of one bird by S. Sietler; multiple recordings of possible vocalizations and double-knocks;) March 2003 (Gallagher 2005; USFWS 2007), 2004 (Refuge Staff), and January-December 2005 (Rosenberg et al. 2005, USFWS 2007) [search through White River refuge files by D. Sharp and interviews of retired staff by J. Denman, Refuge Forester, revealed references to previously unknown reports from the 1920s, May 1952, and 1979]

(A-3) Bayou de View, Cache River NWR, Monroe County, AR (multiple visual reports of male bird, possible vocalizations and double-knocks, and a 4-second, poor, grainy (and controversial) video of woodpecker of unknown sex; many observers); February 2004 to December 2005 (Fitzpatrick et al. 2005, Gallagher 2005, Rosenberg et al. 2005, USFWS 2007)

(A-4) Wattensaw WMA, Prairie County, AR (one 10-minute and one brief sighting by R. Everrett, one brief sighting by A. Mueller, multiple kents [many recorded by hand-held video camera] and double-knocks [several recorded by ARU]); December 2006-May 2007 (USFWS 2007)

(B-5) Hatchie River, Lauderdale and Tipton Counties, TN (followup to reports from the 1990s, numerous auditory encounters, both kents and double-knocks, one visual encounter by R. Ford); January 2006 (continued searching in February resulted in no additional reports, but additional sounds detected in January 2007; USFWS 2007)

(B-7) Moss Island WMA, Dyer County, TN (several brief sightings by multiple observers of large woodpeckers with extensive white in wings, numerous double-knocks, one series recorded thought by some to possibly be a response to distant simulations); 2007-2009 (TN Working Group, Pulliam 2009)

(C-5) Cache River, Pulaski County, IL (several independent visual reports of large black woodpeckers with extensive white trailing wing edges, most notably by J. White in 2005 and by A. Albores in 2008; also inconclusive reconyx images and auditory encounters by G. Erdy; a color photograph by S. Sheridan reportedly taken in June 2007 of an unknown woodpecker, examined and determined unlikely to be of an ivory-billed woodpecker, was latter exposed as a doctored image); 2005-2008 (USFWS 2007)

Arkansas-Oklahoma (#'s where indicated are cross-referenced to Figure 9 in Tanner), subregions: (A) Ouachita and Saline Rivers, AR-LA, (B) Red River, OK-TX, (C) Canadian and Arkansas Rivers, OK-AR, (D) Red and Little Rivers, AR-OK, (E) Red River, LA

1800-1849
(A-1) Ouachita River, near junction of Saline (Tanner said Caddo, but shows Saline River); 1834 (#6)

(B-1) near Gainesville, Cooke County, TX; 1849 (Oberholser 1974, Shackelford 1998; acknowledged by Tanner in his 1989 update to his 1942 report)

(C-1) Near the "falls" of the Canadian River, OK; 1820 (#2)

1850-1859
(B-1) near Gainesville, Cooke County, TX; 1851 (Oberholser 1974, Shackelford 1998; acknowledged by Tanner in his 1989 update to his 1942 report)

(C-2) Timber of the Arkansas River, OK; 1850 (#1)

1860-1869
None

1870-1879
(B-1) Cooke County, TX; about 1875 (#5)

(B-2) Old Boggy Depot, Atkoa County, OK; 1870-1874 (#3)

1880-1889
(B-3) Blue River, near Caddo, OK; 1883-1884 (#4)

1890-1899
(B-4) Bonham area, Fannin County, TX; 1890 (Oberholser 1974, Shackelford 1998; acknowledged by Tanner in his 1989 update to his 1942 report)

1900-1909
None

1910-1919
None

1920-1929
(E-1) Red River Parish (birds seen by S. Christopher whose description convinced J. Jackson that she had observed this species); 1927-1928 (Jackson 2004)

1930-1939
None

1940-1949
None

1950-1959
None

1960-1969
None

1970-1979
None

1980-1989
(D-1) Porter Tract near Millwood Lake and Grassy Lake, Little River County (possible visual encounter with pair by R. Weaver); late 1980s or early1990s (USFWS 2007)

1990-1999
None

2000-
(A-1) Within and near Felsenthal NWR, Ashley County, AR (several visual reports by Refuge staff, the most detailed from the Saline River where refuge forester L. Threet and a private citizen reportedly saw two birds at close range, one with a black crest the other with possibly a small amount of red in the crest, otherwise described as large woodpeckers with extensive white in the wings dorsally and flying like crows); August 2007 (USFWS 2007)

(D-1) Near Pond Creek NWR, Sevier County, AR (visual by B. Petersen, while deer hunting, of large black woodpecker with extensive white trailing edge when the bird swoop up into a cypress stand); October 2007 (USFWS 2007)

East Texas (#'s where indicated are cross-referenced to Figure 10 in Tanner), subregions: (A) Sabine and southwest Louisiana (including Calcasieu River), LA-TX, (B) Neches and Angelina rivers (includes Big Thicket), (C) Trinity and San Jacinto rivers, (D) Brazos River

1800-1849
(C-1) Buffalo Bayou, San Jacinto River, Harris County, TX; around 1840 (#6; Jackson states 1837 and Audubon considered the species abundant there as well as at nearby Ft. Bend County; Shackelford 1998 notes that Audubon secured several specimens but these are now unaccounted for)

1850-1859
None

1860-1869
(C-2) Trinity River, TX; 1864 (#4)

(D-1) Brazos River, TX; May 1864 (#8)

1870-1879
None

1880-1889
(B-1) Neches River, Jasper County, TX; May 1885 (#1)

(B-2) Russell Creek area, Tyler County, TX; about 1880 (Oberholser 1974, Shackelford 1998; acknowledged by Tanner in his 1989 update to his 1942 report)

(C-3) Northern Harris County, TX; about 1880 (#5)

(C-4) Northern Montgomery County, TX; 1880-1881(Oberholser 1974, Shackelford 1998)

(D-2) Brazos River, TX; around 1880 (#7)

1890-1899
None

1900-1909
(B-3) Near Sour Lake, Hardin County (J. H. Gaut); March-April 1905 (Oberholser 1974, Shackelford 1998)

(B-4) Neches River bottoms (R. Gann); pre-1910 (Oberholser 1974, Shackelford 1998; acknowledged by Tanner in his 1989 update to his 1942 report)

(C-5*) Tarkington, Liberty County, TX (2 spec., total of six birds observed); November 1904 (#3)

(C-6*) Bois d'Arc Island, Trinity River bottoms, Dallas Co., (1 spec.; collected by W. A. Mayer, spec. #6216 at Dallas Museum of Natural History); 1900 (Oberholser 1974, Shackelford 1998)

(C-7) Tarkington road, east of Cleveland, Liberty County (J. H. Gaut); April 1905 (Oberholser 1974, Shackelford 1998)

1910-1919
(B-5) Near Lufkin, Angelina County (J. Shotwell); 1910-1915 (Oberholser 1974, Shackelford 1998; acknowledged by Tanner in his 1989 update to his 1942 report)

(B-6) Near Marshall, Harrison County (A. D. Martin); March 1918 (Oberholser 1974, Shackelford 1998; acknowledged by Tanner in his 1989 update to his 1942 report)

(C-6) Boisd'Arc Island, Trinity River bottoms, Dallas Co. (W. A. Mayer); 1910 (Oberholser 1974, Shackelford 1998; acknowledged by Tanner in his 1989 update to his 1942 report)

(C-8) Spring Creek, Harris County (F. Schneider); June 1913 (Oberholser 1974, Shackelford 1998)

1920-1929
(B-7) Tyler County, (B. M. Reid); April 1929 (Oberholser 1974, Shackelford 1998)

(C-6) Bois d'Arc Island, Trinity River bottoms, Dallas or Kaufman County, (collected by J.E. Stillwell, but specimen not located); about 1920 (Oberholser 1974, Shackelford 1998; acknowledged by Tanner in his 1989 update to his 1942 report)

(C-9) Mouth of East Fork, Trinity River, Kaufman County (caught in trap by B. C. Hays, examined by E. R. Huck, specimen not preserved); winter 1927 (Oberholser 1974, Shackelford 1998)

(D-3) Near Brazoria, Brazos County, Brazos River bottoms (one found freshly killed by F. C. Clarkson, specimen not preserved); May 1927 (Oberholser 1974, Shackelford 1998);

1930-1939
(B-8) Junction of Village Creek and Neches River, Hardin County (C. H. Hooks and B. M. Reid); 1933 (Oberholser 1974, Shackelford 1998)

(B-9) Angelina River, Jasper County (B. M. Reid); 1934 (Oberholser 1974, Shackelford 1998)

(B-10) lower Neches River bottoms, Jefferson-Orange county line (B. M. Reid); May 1937 (Oberholser 1974, Shackelford 1998)

(B-11) Orange County (B. M. Reid); 1938 (Oberholser 1974, Shackelford 1998);

(B-12) Bunn Bluff area, Jefferson County (B. M. Reid); prior to October 1938

(Oberholser 1974, Shackelford 1998)

1940-1949
None

1950-1959
(B-4) Big Thicket area (B. M. Reid); March 1956 (Oberholser 1974, Shackelford 1998)

1960-1969
(A-1) Sabine River valley, along State Highway 87 between Evadale and Kirbyville, Newton County (bird flushed off of large rotting log by R. Parker); spring 1968 (USFWS 2007)

(A-2) Navasota River, near Highway 158 bridge (several observations including R. Lys and M. Steward); 1968-1969 (perhaps to 1972; USFWS 2007)

(B-4) Big Thicket area of Tyler and Jasper counties including the following accounts: Neches River bottoms, Dam B Reservoir area, Tyler and Jasper Counties (by J. Dennis and A. Yramatequi); February 1966 (Dennis 1967)

Near Evadale in Neches River bottoms, Tyler and Jasper Counties (followup to initial sighting by O. Lloyd, heard kents on three separate days and poor view of one bird with distinct white trailing edge to wings by J. Dennis and A. Yramatequi); December 1966 (Dennis 1967, 1979, Shackelford 1998, USFWS 2007)

North of Evadale in Neches River bottoms, Jasper County (observed by K. Newsom); April 1967 (Dennis 1967, Shackelford 1998)

Neches River bottoms, Jasper County; February 1967 (Dennis 1967, Shackelford 1998)

Neches River, Tyler and Jasper counties (multiple sightings and kent calls heard by five separate observers interviewed by J. Dennis; three of these observers were also interviewed by P. Sykes, who did not consider these reports reliable); 1967-1969 (USFWS 2007)

Big Thicket National Preserve area (recording of double-knock by G. Reynard); 1969 (Reynard and Garrido 1988 ["Bird Songs of Cuba"], Jackson 2004 [not thought to be Ivory-bill by Tanner], Shackelford 1998)

(B-8) Big Thicket area of Hardin County including the following accounts:

Sternberg Tract on Village Creek in Neches River bottoms, Hardin County (sighting and kent calls heard and recorded by J Dennis, M. Isleib, G. Watson); February 1968 (Hardy 1975 [recording deemed inconclusive but favored Ivory-bill], Dennis 1967, Shackelford 1998)

Village Creek area of Big Thicket National Preserve, Hardin County (J. Dennis); 1968 (Shackelford 1998)

Big Thicket area, presumably near Silsbee, Hardin County (a pair reported and photographed, nesting attempted but unsuccessful each of three years; at least two slides of apparent female protruding from a cavity in hackberry by N. Wright [one of the observers interviewed in previous accountby P. Sykes, but he was not made aware of these slides at the time] copied by G. Reynard who donated them to VIREO); 1967-1969 (Collins 1970, Jackson 2004, Hunter et al. in prep.)

(B-13) Between Trinity and Neches rivers (2 pairs, one lone female, and others noted by W. Eastman); 1960-1963 (Oberholser 1974, Shackelford 1998)

(B-14) Pine Island Bayou, Hardin County (G. Watson and D. Watson); December 1968 (USFWS 2007)

1970-1979
(B-15) Near Wolf Creek by Steinhagen Reservoir, Jasper County (two sightings by W. Mounsey and students from "The University of the Wilderness"); May 1976 (Dennis 1979, Shackelford 1998)

(C-10) Raven District, Sam Houston National Forest, San Jacinto County (up to four sightings and calls heard on two of them by collectively W. Ruediger, F. Wojcik, B. Ruediger, and T. Davis; led to development of forest management plan for the District); December 1970-February 1971 (USFWS 2007)

(C-11) Tanner Bayou of lower Trinity River bottoms, Liberty County (flyover by L. Risner); July 1972 (Fisher et al. 1972, Shackelford 1998)

1980-1989
(A-3) Toledo Bend Reservoir, Sabine River, north of Pendleton Bridge, compartment 101 of Sabine National Forest, Sabine County (family group [4-5 birds], at least one bird observed for more than 10 minutes, bill gray-ivory, trailing edge of wing white both above and below, observer familiar with Pileateds, J. Hyde); summer 1985 (USFWS 2007)

(A-4) Calcasieu River, LA (H. Ardoin, heard notes like child's tricycle horn); May (?) 1986 (USFWS 2007)

(B-8) Silsbee, Big Thicket area, Hardin County (pair of birds seen twice, presumably same, first time feeding on loblolly pines killed by pine beetles and in direct comparison with many Pileateds in view by A. McKinnon); July and October 1981 (USFWS 2007)

(B-15) Multiple locations including Big Thicket, Steinhagen Lake, (reports in all areas with observer searching in "old-growth areas" located from soil conservation service maps, including a pair with 2 young [which location?] by E. Allen); May, June, and November 1985 (USFWS 2007)

(B-16) Chireno, southeast Nacogdoches County (5-7 minute observation, extensive white in wings and bill dirty white otherwise similar to Pileateds, with 1-note calls given by W. Whitehead); February 1985 (USFWS 2007)

1990-1999
None

2000-
None

Extralimital (with respect to Tanner's 1942 range map) published reports of Ivory-billed Woodpeckers in the United States

Historic documented locations north or west of distribution as defined by Tanner (1942) along Atlantic seaboard:
Fort Macon, near Morehead City, NC ; 1878 (Hasbrouke 1891, Jackson 2004; single sighting reported to Coues and Yarrow by "an apparently respectable source…the statement given for what it is worth, no specimen…")

Fairchance, Moundsville, Marshall County, WV (two lower bill sections recovered in midden debris, not a burial site, suggesting it could be either discarded trade item or locally acquired); 0-200 A.D. (Parmalee 1967, Jackson 2002)

Between Martinsburg, WV, and Winchester, VA (one reported collected by A. Wilson); prior to 1810? (Hall 1983, Jackson 2004)

Doddridge County, WV; about 1900 (Hall 1983, Jackson 2004)

Maryland (statement attributed to Audubon from Audubon and Chevalier, The Birds of America, Volume 4, that "now and then an individual may be accidentally found in Maryland); prior to 1844 (Jackson 2004)

Reedy River, Greenville County, SC (in the Piedmont, to the west of Tanner's boundary, nest with eggs collected by E.J. DeCamps, later lost); May 1896 (listed by Sprunt and Chamberlain 1949, as only known "definitive" nesting in South Carolina)

Etowah Mounds, near Cartersville, Bartow County, GA (in the Ridge and Valley of northern Georgia, well north and west of Tanner's boundary, archeological specimens at Smithsonian Institution, presumably considered not to be a trade item, but requires further discussion); pre-Columbian (Richard Warner, USFWS, pers. comm.).

Historic locations north, east, and west of distribution as defined by Tanner (1942) along the Mississippi and Ohio drainages:
Near Stanford, Lincoln County, KY (two observed, one of these collected, by Col. W. Fleming); March 1780 (Schorger 1949, McKinley 1958, Jackson 2004; acknowledged by Tanner in his unpublished 1989 update to his 1942 report)

Ross, Scioto, and Muskingum county, OH (tarsometatarsi found from an excavated archaeological sites and argued likely to have not been trade items); dated from 1100s to 1500s (Wetmore 1943, Peterjohn 2001, Jackson 2004; acknowledged by Tanner in his unpublished 1989 update to his 1942 report)

Franklin and Monroe counties, IN (reported to have occurred, a specimen from Franklin County is mentioned but not now known to exist); prior to 1869 and possibly during the 1890s (Jackson 2004)

Along the Mississippi River north to near the confluence with the Missouri, MO and IL (reported by Audubon); early 1800s (Jackson 2004)

Cahokia, Madison County near East St. Louis, IL (tarsometatarsus found from excavated site, not part of the skull suggesting it was locally acquired and not a trade item); 1500s or earlier (Parmalee 1958, Jackson 2004; acknowledged by Tanner in his unpublished 1989 update to his 1942 report)

Near the confluence of the Missouri and Mississippi rivers at Forest Park (spec. near St. Louis), MO, May 8, 1886 (Hahn 1963, Jackson 2004; acknowledged by Tanner in his unpublished 1989 update to his 1942 report)

Along the Missouri River from at Fayette and Kansas City, central to western MO (scattered reports); late 1800s and early 1900s (Cooke 1888, Jackson 2004)

Reports from southern Missouri; into the 1930s and as late as 1949 (AOU 1931, Jackson 2002, Moore 1949 [G. E. Moore, Elusive Ivory-bills. Bluebird 16(12):1])

Historic locations west or north of distribution as defined by Tanner (1942) in Oklahoma:
Alluwee, along the Verdigris River, Nowata County, OK (stated by G. Sutton as northward range limit); (Sutton 1967, Jackson 2004)

House Creek, Pawnee County, OK (one seen by S. W. Woodhouse); October 1849 (Jackson 2004; Sutton apparently thought Woodhouse collected the bird he saw, but Jackson could not find a tagged specimen Sutton thought was at the Academy of Natural Sciences in Philadelphia)

Historic locations west or south of distribution as defined by Tanner (1942) in east Texas:
San Marco and Guadalupe rivers and from New Braunfels, Comal County, all south-central TX (multiple reports including a bird killed but not preserved); around 1900 (at least for one of these reports; Shackelford 1998, Jackson 2004)

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Appendix F.

Protocol to Estimate Occupancy and Related Parameters for the Region-wide Search for the Ivory-billed Woodpecker

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Objective Statement:

The purpose of this document is to describe a survey design and field protocol for the Ivory-billed Woodpecker search effort that will: (1) allow estimation of occupancy, use, and detection probability for habitats at two spatial scales within its former range, (2) assess relationships between occupancy, use, and habitat characteristics at those scales, (3) allow the development of a population viability model that depends on patch occupancy instead of difficult-to-measure demographic parameters, and (4) be adaptive, allowing newly collected information to update the above models and search locations. A more statistically detailed version of this document will undergo peer review by the USGS.

Background

The Ivory-billed Woodpecker was once relatively abundant in floodplain forests of the southeastern U.S. By 1900, its range and numbers had declined precipitously due to habitat loss and various types of maltreatment. The last known population was studied in a remnant patch of old-growth forest known as the Singer Tract in northeast Louisiana in the late 1930s by Tanner (1942). The tract was subsequently logged, and since that time, numerous individual sightings have occurred, mostly in and near the few remaining large patches of contiguous bottomland forest (Figure 1). Also since that time, however, a number of bottomland forest patches have come under public protection and have grown to mature forests, and others have been reforested under several large-scale conservation efforts (e.g., Twedt et al. 2006).

The stunning rediscovery of the Ivory-billed Woodpecker in the Cache-lower White River Basins initiated a new search effort. The primary objective of the search has been to find the bird and document its existence, searching mostly those locations that were believed—mainly on the basis of the limited data provided by Tanner—to be optimal. Meanwhile, other searches were initiated in other locations within the former range where unsubstantiated sightings have been reported in recent decades, again focusing on places that were believed to have the best chance of being occupied. Some observations and other promising data have been collected in these places, but many other observations were made in areas that were not consistent with prior expectations (i.e., smaller tracts, few large trees and snags). It is apparent that we have much to learn about the ecology of this species. To this point, significant money and effort have been spent on searching. Although great advances have been made on search techniques and associated technology, little information useful to management and recovery has been obtained.

An Ivory-billed Woodpecker recovery team has been formed and a recovery plan has been written. Among the recovery actions in that plan are at least a dozen that pertain to developing an adaptive search design, estimating occupancy and detection probability, assessing habitat associations, and modeling population viability. The approach we advocate will begin to address all of these actions.

Justification for the Occupancy Estimation Approach

There are several problems with searching only in what are believed to be the best places. For example, (1) optimal sites have not been confirmed, so that it is not known what and where those places are, (2) searching only in the "best" places does not permit inferences about places not searched; that is, one cannot make an inference about the larger population because the selection of search locations lacks randomization, (3) one cannot estimate occupancy, use, detection probability, or the sampling effort required to estimate those parameters, (4) in order to understand habitat associations, a range of habitat values needs to be represented in the sample being analyzed, and until this happens (5) it is not possible to build predictive habitat and population models, or to learn in a systematic, repeatable way from the data collected how to improve the search.

Rather than focus solely on finding the bird, we advocate a primary focus of estimating occupancy and use, from which many other useful parameters and products can be obtained, and in the process of conducting the surveys with that paramount objective, follow good leads and find the bird.

Occupancy is the actual occurrence of an animal at a site of interest, as opposed to its detection or non-detection, and is defined as the probability that a randomly selected site is occupied; alternatively, it is the proportion of sites in an area of interest that are occupied by a species (MacKenzie et al. 2006). It is possible (arguably likely) that one can visit a site that is occupied and not detect a bird on a given occasion (a false negative). Thus, one does not know if an "absence" (i.e., non-detection) is actually due to non-occurrence, or rather the failure to detect the species when it is in fact present. This problem is addressed by multiple visits to a site, which allows estimation of detection probability, which is then used to "adjust" occupancy estimates. If an animal is likely to move in and out of the surveyed area, and that movement is random, it is also possible to apply the same methodology used to estimate occupancy, only in this case it will estimate the probability of use (MacKenzie et al. 2006). Habitat variables are also measured in each site. Occupancy can be related to habitat variables using a variation of typical logistic regression corrected for detection probability.

In order to develop occupancy models, sites must be randomly chosen to make inferences that can be generalized to the entire population. Inaccessible sites and sites that are judged to be entirely unsuitable for woodpeckers (e.g., non-forested sites) can be eliminated from the sampling frame (the list of sample units in the population that could potentially be included in the sample). Further, selection of patches can be weighted by prior belief of their suitability and results from existing searches; so that most but not all effort is still expended in the "best" locations (see below).

This approach is substantially different from what is being done now, although the field methodology is not. Field methodology can include any of the major techniques now being used (e.g., ground surveys for birds, cavities or feeding sign, recording devices, aerial surveys). Costs may be slightly higher (see below), but the benefits in terms of the quality of information obtained will be a substantial improvement over current approaches. We believe that the additional costs will be more than justified by the gain in the quality of inference obtained under this approach. The approach does not detract from efforts to document the bird's existence; indeed, we suggest that our approach may even increase the likelihood of finding birds at multiple locations.

Approach

The following represents our thinking now, after one search season (2006-07) and could be modified in the future; however, data collected under this plan will be useful under future variations of this design. Survey sites will be defined and selected at two levels or spatial scales, the primary level (river basins) and secondary level (patches within river basin).

Primary level. The primary site will be a river basin within the former range of the Ivory-billed Woodpecker (Figure 2). Many of those can be eliminated from further consideration due to their (believed) complete lack of suitability. Culling unsuitable sites will help to create a defined sampling frame. River basins with consistent sightings and/or sound recordings (i.e., high quality evidence) will always be selected to survey. At this point those would be the Cache/lower White in Arkansas, the Choctawhatchie in Florida, and the Congaree/Wateree in South Carolina. Other river basins may also be selected non-randomly on the basis of recent historical sightings. Remaining basins in the sampling frame should be randomly selected with weights based on the subjective probability of Ivory-billed Woodpeckers occurring in the area. This process will yield many basins with high occupancy probability and few with low occupancy probability. Eventually, exact criteria for selection will be developed jointly by experts in order to gain consensus. A step towards this consensus was attained at the recent Congaree meeting.

Secondary level. Within selected river basins, sampling units in the secondary level will be defined as approximately 2km2 patches of land. As individual birds are almost certain to use areas greater than 2km2, the secondary level will be estimating probability of a unit being used. These patches can be a consistent square or some other shape in a grid as in Figure 3, or a variable shape and, to some extent, size in order to follow existing features of the landscape such as water features or management compartments. Squares can be problematic if, for example, they include both sides of a watercourse large enough to prevent easy crossing. The 2km2 size was chosen because it seems functional, and it is currently in use as part of the Lower Mississippi Valley Joint Venture habitat survey (LMVJV refers to these patches as stands, which are subunits of management compartments on public land in the survey). Feedback from most groups that used this sampling design in the 2006-07 search season supports this patch size.

Again, patches that are inaccessible due to logistics or landowner permission can be omitted from the sampling frame, as will completely unsuitable patches; the resulting system of patches constitutes the sampling frame at the secondary level. Selection of patches will occur in a similar fashion to the primary level except no patches in the sampling frame will be

guaranteed selection. Patches will be randomly selected with weights based on the probability of Ivory-billed Woodpecker use. Exact criteria for selection eventually will be developed by expert consensus.

Note that an investigator in a particular area can survey additional patches not selected in the sample. However, because of the need for randomization, in our approach only the patches selected in the sample will be included in the analysis. As an approximate rule of thumb, about 90% of overall search effort should be done in randomly selected patches. If new information is obtained, such as a hunter reporting a bird in a patch that is not in the sample, then the design can and should be modified on the basis of the new information. Eventually, a formal set of protocols will be developed that will allow searchers this flexibility in a truly adaptive search design. For now, if this situation (i.e., new or 'found' data) should arise, then the search team should consult with the UGA team as to how the design might be altered.

Field Procedures

Searches

Again, field methodology can include any of the major techniques now being used (e.g., ground or canoe/kayak surveys for birds, cavities or feeding sign, recording devices, aerial surveys). However, in order to develop models that use and learn from data collected from multiple river basins, it would be better to have comparable field methods to help build more rigorous detection models. We suggest that active ground surveys for birds and sign should be the standard approach that all surveys use. In the 2007-08 search season, this design may be altered to include active double-raps using sticks and a resonating wooden box.

Standard survey units can also be developed for techniques such as autonomous recording units (ARUs), but it is likely that only a few sites will use ARUs in quantities large enough to use in models that involve multiple river basins (i.e., the primary level). Investigators that make extensive use of ARUs or other methods unique to particular river basins can use those data to develop basin-specific models, but results may not be comparable with other sites unless those areas also used similar survey methods.

Habitat surveys

The habitat protocol stems from the LMVJV habitat measurement protocol, which involves taking many measurements on 4 "transects" of 5 plots each, or n=20 plots per patch. Circular plots are 0.2 acres (0.08 ha) in size, with a 52.7' radius. However, this level of time commitment may not be within the means of all investigators. In this case, a reduced number of measurements can be taken on these plots. We suggest that, as a minimum, density of large (>24" dbh and >36" dbh) trees, density of snags, and dominant tree species should be recorded. Based on feedback from searchers in the 2006-07 season, we believe that most of the data on dominant tree species can be obtained using remotely sensed data, so tree species does not need to be recorded.

However, two additional measurements requiring more precision must be made. Rather than measuring all trees, only trees >24" dbh and >36" dbh and all snags >10" dbh are counted, using one or several 52.7' sections of cord to ascertain the plot boundary, and a Biltmore stick to assess dbh class quickly. We estimate that, with a little practice, a plot such as this should take < 5 minutes to complete by one person.

The 20 plots per patch should be randomly located and established using a GPS unit. They can be located using simple random sampling or systematic random sampling. The latter is likely to be more practical if double-rapping is to be done systematically throughout the patch anyway. Alternatively, habitat surveys can all be done in the middle of the day at random locations. Once habitat surveys are done for a patch, they do not need to be done again, unless additional or different data are required, or the patch has undergone significant change since the last survey.

Database and Data Entry

All data should be entered into the centralized database within two months of the end of the field season. Long-term data storage options are currently being discussed with a strong possibility that data for the 2007/8 field season will be entered into the USGS point count database (http://www.pwrc.usgs.gov/point/)

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Figure F-1. Possible encounters since 1944 are primarily in large patches of contiguous bottomland forest.

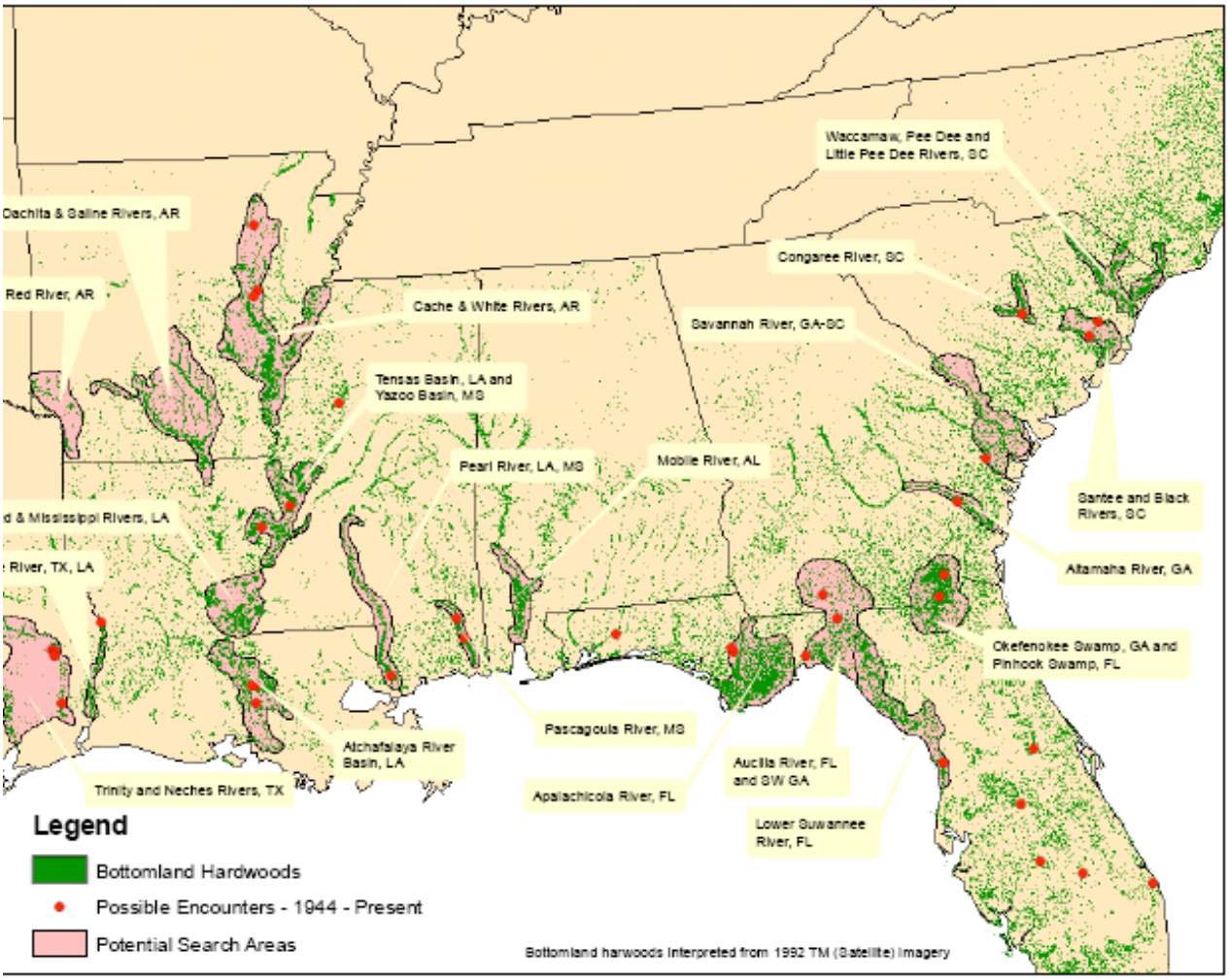


Figure F-2. River basins within the former range of the Ivory-billed Woodpecker

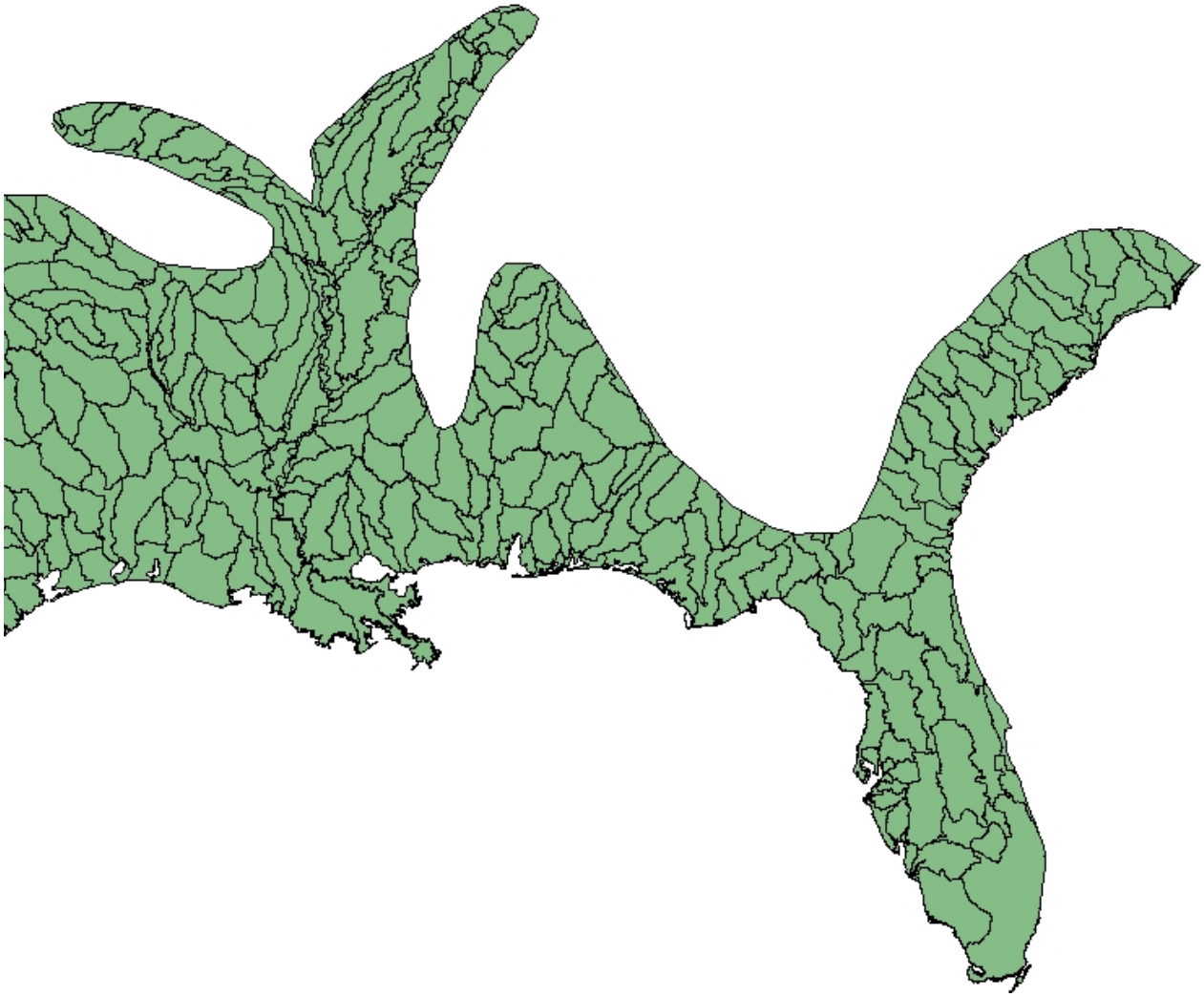
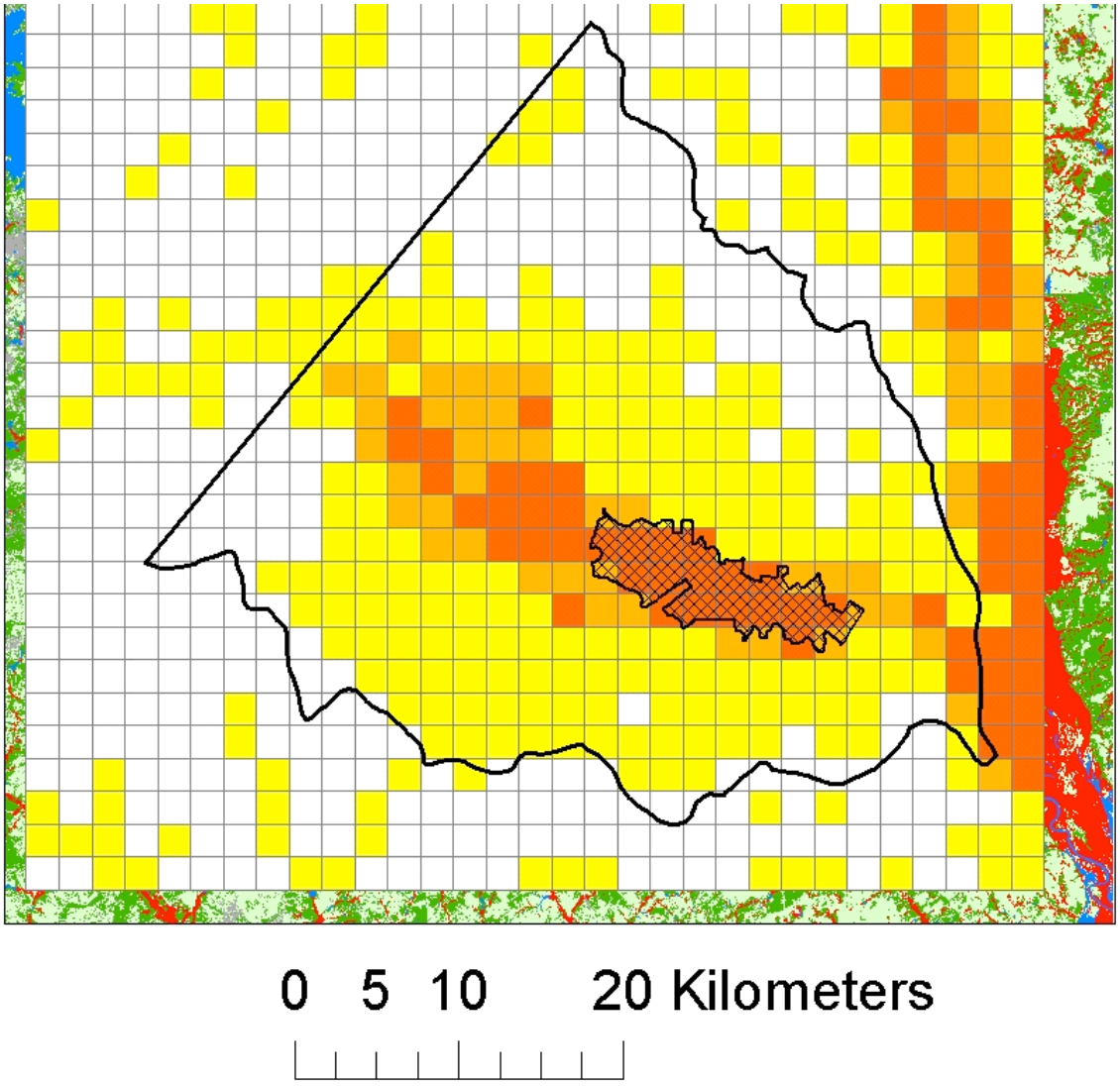


Figure F-3. Example grid of survey units for basin surrounding Congaree National Park. Boundaries shown as crosshatched area. Colors represent percent of square classified as swamp and/or bottomland hardwood (0-10%: white, 10-40%: yellow, 40-70%: orange, 70-100%: red) by the 2001 National Landcover Dataset (NLCD).



ADDENDUM. Implementation of Adaptive Design for Ivory-billed Woodpecker Occupancy Protocol

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Objective:

As we originally intended for the survey design and field protocol for the Ivory-billed Woodpecker to be adaptive, we have augmented the current protocol to incorporate newly collected information. In response to feedback from search teams regarding search behavior and specific concerns about effort, we have also updated our survey design in an attempt to increase the chance of finding the bird while maintaining the current probabilistic framework and scientific rigor. This document provides the minor modifications to the survey design and field protocol.

Justification:

We have modified the survey design to allow for additional information coming from outside sources, e.g. hunter sightings, which potentially would not be from areas surveyed originally. We have also updated the protocol to allow for more effort in areas with defensible detections of Ivory-billed Woodpeckers. The allocation of more effort is two-fold, 1) we have allocated more patches, specifically, adjacent patches to be searched when a high-quality detection has been made or confirmed, and 2) we have allocated an increase in repeat visits in those patches with a high-quality detection and in the adjacent patches. We believe these modifications increase our overall flexibility and ultimately our probability of observing a bird.

Approach:

The original approach will stay intact at both the primary and secondary level.

The survey design will change only when a specific type of encounter is confirmed. This specific encounter will be called a trigger. A trigger can be of several forms: visual detection, auditory detection, or detection from helicopter survey.

Visual Detections:

A visual detection trigger is any visual detection of category 1, category 2, or category 3 on the CLO visual encounter ranking system (see below and pages 21 and 31 of RFP). These visual detection triggers can come from the following sources:

1. a randomly selected patch within secondary level sampling frame,
2. a patch searched during the 25% allocated free time in either primary or secondary sampling frame, or outside of the primary sampling frame or,
3. an outsider's report (e.g. a hunter) and potentially in a patch not in primary or secondary level sampling frame and not originally intended to be surveyed.

Visual Encounter Ranking System

Any large woodpecker falling into either of the following categories:

Category 1—an encounter with documentation that can be repeatedly interpreted the same way by independent observers, such as where definitive photographic evidence is collected by the field observer.

Category 2 - an encounter with at least two diagnostic field marks clearly observed and described, and the bird remaining in view long enough for the observer to reconfirm the observed field marks, but no independently verifiable evidence such as a photograph. Diagnostic field marks include:

a. White trailing edge of wing on either the dorsal or ventral surface.

b. White 'shield' formed by folded wings over the lower back of a perched bird.

c. White lines starting behind the eye, continuing down the neck and onto the back of the bird.

d. Black chin

e. Large woodpecker with one of the above diagnostic field marks and clearly heard giving 'kent' calls or double knocks.

Category 3—an encounter that includes the description of one definitive or several partial or poorly observed field marks.

Auditory Detections:

An auditory detection can be used as a trigger only if it meets the following criteria:

1. It is a clear double-knock or kent call, and
2. It was made by personnel with extensive experience and training (i.e. member of the search team).
3. Does not displace more than 25% of the search time for the original occupancy protocol.

Auditory detections can be followed at any time during the search period regardless of whether it originates in a selected

sample plot or in a plot within the sampling frame, given that it meets the above criteria.

Helicopter Survey Detections

At this time we are not addressing the sampling procedure and/or approach for helicopter surveys. We can however give procedures for the incorporation of high-quality detections (CLO visual encounter category 1, 2, or 3) from a helicopter survey. The high-quality detections will be used in the same manner as found data from an outside source (e.g. a hunter) to reallocate the sampling effort. This can be done for helicopter detections in any area regardless of whether it is in the primary or secondary sampling frame. The site of the detection (gps units) will be used to determine the appropriate initial trigger plot. The protocol will then follow the steps outlined below.

Adaptive Field Procedure

Once a detection trigger has been confirmed the protocol will change in the following fashion.

1. The patch containing the trigger and the four adjacent patches in the cardinal directions (North, East, South, and West) will be searched. If the patches are not square, but are of some other shape dictated by landscape features, then the adjoining or most adjacent patch in each of the four cardinal directions should be surveyed (Figures 1 and 2).
2. These five patches (trigger patch plus four adjacent patches) will be visited a total of five times instead of the original three visits.
3. Any new trigger detections in the adjacent patches will constitute a new trigger and the three adjacent patches of the new trigger patch will be surveyed a total of five times (Figure 3).
4. If at least one more trigger follows the initial trigger, reallocation of search effort will be left up to each search team with the provision that the adaptive protocol is followed. If no additional triggers are found, return to the random patches originally selected for the occupancy model.
5. Continue process to create network of patches until no new triggers have been found. This will result in edge patches (Figure 3).
6. Follow the normal occupancy protocol for all other detections.

Time Allocation

The adaptive augmentation described here will not come out of allocated free time and will be considered as part of the directed occupancy protocol (75% of the total time spent searching). If Category 3 visual detections become abundant and are requiring a significant amount of the search team's time (> 25%) the search team should consult with the University of Georgia Research Team to modify the protocol as needed.

Figure F-4. Initial detection trigger identified and confirmed.

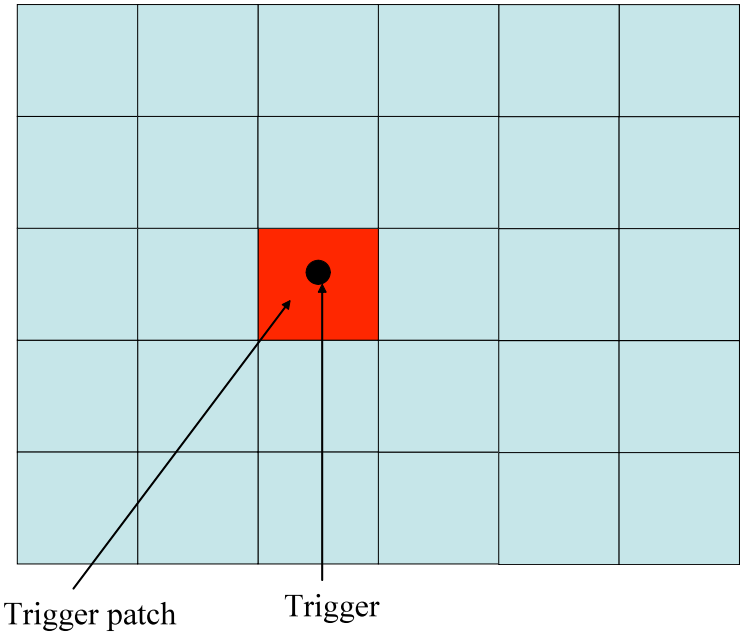


Figure F-5. Four adjacent patches plus initial trigger patch searched five times.

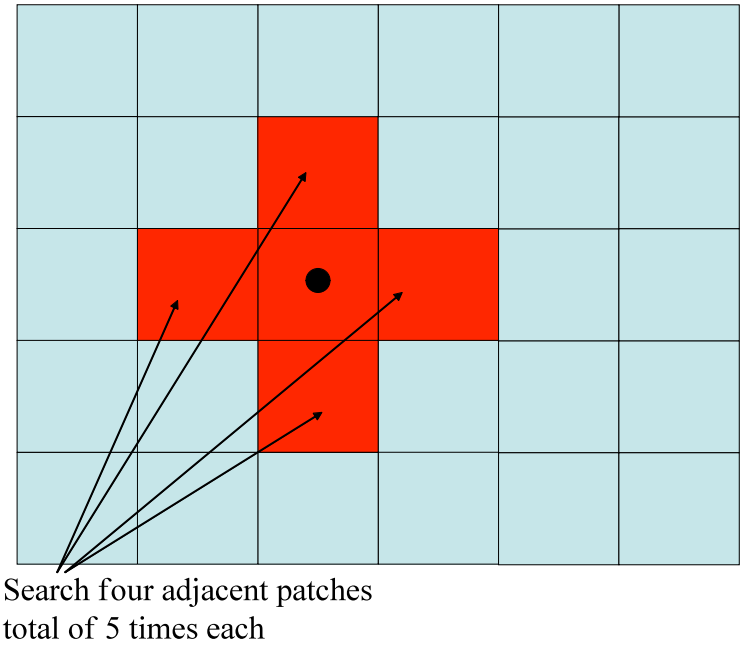
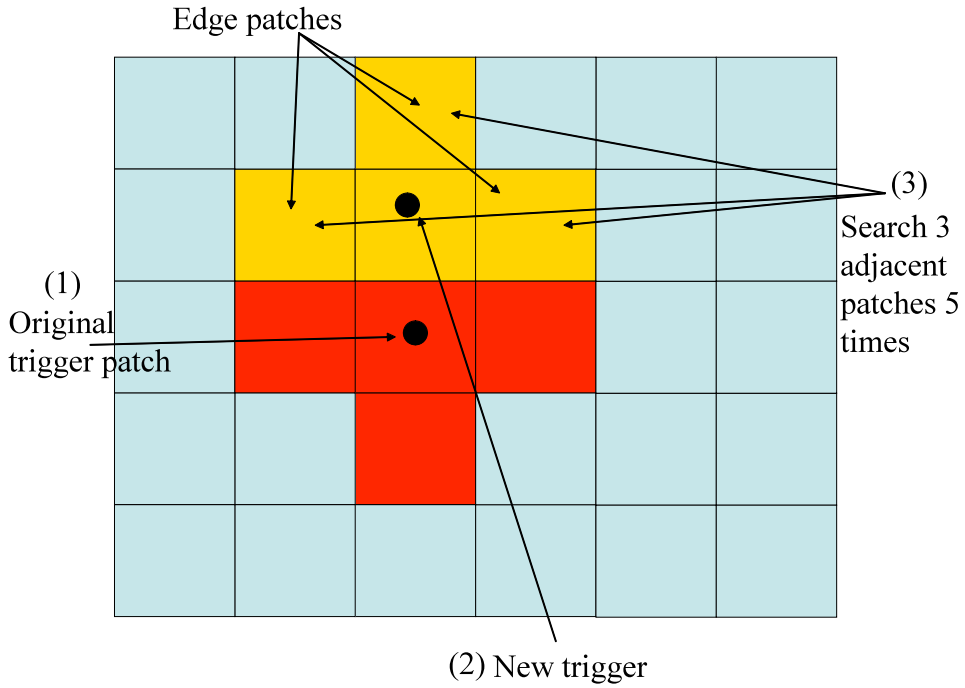


Figure F-6. New trigger found during visit to adjacent patch. Three patches adjacent to new trigger patch searched five times. Process continues until no new triggers are found. This will result in edge patches.



Guidelines for Ivory-billed Woodpecker Searches in the 2007-2008 Season

Recommendations from Cornell Lab of Ornithology

Double Knock Imitations and the Double Knocker Loan Program

For the 2007-08 search season no large-group searches are planned as in previous years in Arkansas and Florida. Instead, small teams of searchers will explore priority areas. Although areas cannot be searched exhaustively with a small team, broadcasting of double knock playbacks can increase the effective area searched. Tanner (1942) reported a higher response rate of Ivory-billed Woodpeckers to double- or single-knock imitations than to kent-call imitations. Other Campephilus species generally also readily respond to double-knock imitations. Because of a large carrying distance, double-knock imitations sample a larger search area than kent-call or double knock playbacks through a speaker system. For these reasons, double-knock imitations appear a more suitable technique than playbacks.

During the 2006-2007 season, the Mobile Search Team of the Cornell Laboratory of Ornithology (CLO) in cooperation with D. Martin developed and tested a mechanical device designed to imitate double knocks. It consists of a wooden box, open on two sides, which is strapped to a tree trunk and rapped upon with a hand-held tool consisting of two wooden dowels that are attached in such a way as permits them to pivot independently of each other. The angle and length difference of the dowels causes them to strike the box in succession, producing a signal with the sound quality, spacing, and amplitude ratio of a large *Campephilus* woodpecker double knock. The signal carries 400-600 m in denser woods with foliage, and up to 1.4 km in more sparse winter woods and under ideal weather conditions. In collaboration with C. Saker of York University, Toronto, a double knocker of CLO design is being tested with Pale-billed Woodpeckers (*Campephilus guatemalensis*) from September-December 2007, to assess response patterns. First results indicate that the Pale-bill is highly responsive to these imitated sounds, much more so than to Pale-bill calls or double knocks played through a speaker from a recording.

During the summer of 2007, the carpentry shop at Congaree National Park produced 30 double knocker (DK) tool sets after the CLO design. These double knockers are now available as part of the equipment loan program for Ivory-billed Woodpecker searches in the 2007-08 season and can be requested by sending an e-mail to Marty Piorkowski <mp362@cornell.edu>. Instructions for using the DK tool set will be distributed with each loan.

Double Knocker Use Protocol

We recommend using double-knock imitations frequently to try to elicit a response when exploring areas with suitable habitat and/or recent reports of Ivory-bills. If an Ivory-bill is confirmed or strongly suspected to be present, double knock imitations should be avoided or used very rarely to avoid potential harassment.

The DK tool set can be carried in a small day backpack, permitting each member of a field team to have a DK tool set with them. DK sessions should be conducted along the searcher's route of travel and are best done in areas of good visibility, such as open forest. Working from a lightly elevated location (i.e. a hill or high river bank or fallen tree) will help facilitate sound travel and permit a better line of sight [this is said again below]. If an unprovoked double knock is heard during the course of regular searching and attempts to see the bird fail, then a DK series should be conducted immediately. In Pale-billed Woodpeckers it has been found that birds already engaged in drumming are especially responsive to DK imitations. DK imitations should be concentrated at times of day with high bird activity, typically early or late in the day, but on crisp, clear winter days bird activity can remain high, permitting DK sessions to be conducted throughout the day. If a searcher plans to be at one spot for an extended period (i.e., a stationary watch, lunch break, vegetation sampling) it is recommended that a DK session be initiated at the beginning of this period.

A DK session consists of a bout of seven double knocks spaced 10 seconds apart, a 4-minute pause, and another bout of seven double knocks at 10 second intervals. This temporal spacing of double knocks is modeled after recordings of other Campephilus drum signals. The spacing is on the high end of the range observed in recordings, aiming to arouse the attention of a bird if present. If working in a team, and if the team uses Garmin GPS units with radio function, several minutes in advance of a DK session a searcher should send out the coordinates and timing of the session so that co-searchers are aware of the upcoming imitations and can listen for responses. Sessions should start at the top of a minute according to standardized, satellite-corrected time on a GPS unit. A log must be kept of all imitated double knocks, so that if members of the public or team members who are beyond radio reach report double knocks, these can be compared with the log of broadcasts. The log should contain GPS coordinates of the broadcast site and exact time of the onset of the two one-minute imitation bouts of a session. It is recommended that each searcher perform between 3 and 6 DK sessions per day.

If a double knock or kent call is heard, or an Ivory-billed Woodpecker flies in: (1) prepare your camera, (2) if the sound or bird is close and the forest navigable, leave your double knocker box strapped to the tree and carefully approach the bird, (3) take the picture or video, (4) clean up your pants; alternatively, if the source cannot be found, or if

the landscape prevents approach, try bringing the bird closer with occasional double knocks, each separate by about one minute. To avoid harassment, interactions should preferably remain under 30 minutes, and should never extend beyond 60 minutes.

Keeping a List of Bird Observations

In the 2007-2008 season, each searcher is asked to keep a daily record of the number of individuals of each bird species seen for entry into the eBird project database (http://ebird.org). Special emphasis is on the keeping of records on species of conservation concern, i.e. Rusty Blackbird, Swallow-tailed Kite, and Swainson's Warbler, as well as on woodpeckers, because woodpecker abundance can be used as a measure of habitat suitability for Ivory-billed Woodpecker. If two searchers travel together, for instance in a shared canoe, only one list should be kept. Along with the daily checklist of birds the following data should be recorded:

(1) length of the day's route by non-motorized means, during daylight hours, according to your GPS track,

(2) the coordinates of the central (mid-way) point of the track (in decimal degrees, not UTMs – to get these, temporarily switch the coordinate format in your GPS settings at the end of the day),

(3) start time of the survey,

(4) duration of the survey in hours,

(5) main observer and co-observers,

(6) mode of transportation (walking, canoe, etc),

(7) name of the general area and state (e.g., Congaree NP, SC),

(8) specific location of the searched area (e.g., Boggy Gut).

If the day's efforts include exploration of a 200-ha patch for the Occupancy Model, a separate track and list must be kept for the part of the search route that falls within the boundaries of the patch, and the name of the specific locality must match the name of the patch. After November 15, 2007, an electronic file from which a data sheet can be printed for daily bird data, consisting of a species checklist and the required data fields, can be requested from Marty Piorkowski <mp362@cornell.edu>.

What to Do in Case of an Ivory-billed Woodpecker Find

If an Ivory-billed Woodpecker is convincingly seen in a search area (with two or more diagnostic characters reported) but not documented with an image (i.e., a Category 2 sighting), the dilemma arises whether continued search effort should continue with a small team or whether a larger team should be formed. A small team minimizes the risk of disturbance but undermines the chances for repeated encounters and documentation. Conversely, a large team brings risks of disturbance but increases the chances for documentation. As a compromise, it was decided during the July 2007 Atlanta meeting of Ivory-bill searchers that in case of an undocumented, plausible find, both methods will be tried, in sequence. A small team of 4-6 people, typically the team that made the original find, will try daily for up to 4 weeks after the initial sighting to obtain an image of the bird. If that fails, additional teams that are active with searches in other states should be called in to assist. The contact persons to discuss expansion of search effort towards the end of the initial 4-week small team effort are Laurie Fenwood <Laurie_Fenwood@fws.gov> and Ron Rohrbaugh <rwr8@cornell.edu>. Developments will be treated with appropriate discretion. Credits for the original discovery, and decisions how and when to release the discovery information, remain with the original finders.

Conducting Helicopter Searches for the Ivory-billed Woodpecker

Background

In April 2005, rediscovery of the endangered Ivory-billed Woodpecker on Cache River NWR in Monroe County, east-central Arkansas was announced. In September 2006, additional evidence for the persistence of the Ivory-bill in Florida was presented by a group of researchers from Auburn University.

Thousands of hours of intensive searching using a variety of techniques (boats, walking, blinds, cameras, sound recording units) during the 2004-05 and 2005-06 field seasons produced only six additional observations in Arkansas. Intriguing sound recordings and a number of possible sightings were also documented, but this massive search effort with few positive results demonstrates the difficulty of finding this charismatic and elusive bird.

No state search group is compelled or required to perform helicopter surveys. The following guidelines are the result of several conference calls and review by a sub-set of the search groups' membership with interest and expertise in aerial surveys. These guidelines may be used to help formulate an appropriate, consistent strategy if helicopters are used at some point during the 2007 search season.

Rationale

Adding aerial helicopter searches can make the total regional, multi-state effort more efficient, by systematically covering a larger area, and/or accessing areas inaccessible via ground techniques (due to hurricane damage, lack of roads, lack of flooding for water access, no public right of way, etc.), thereby increasing the chance of locating a center of activity for the Ivory-bill.

The feasibility of using fixed-wing ultra-light aircraft for Ivory-billed Woodpecker aerial searches was tested on a portion of the White

River NWR in the winter of 2006. From this slow aircraft, common forest birds could be identified and video imagery collected; however, the ultra-light aircraft were unstable at low altitudes with even slight winds produced over the forest. This finding led to the recommendation to use the more powerful and stable helicopter. Other commonly available fixed-wing options do not maximize the ability to fly close to the canopy at lower airspeeds to enable identification and photo-documentation of flushed birds.

Helicopter searches and surveys are an accepted, cost effective means for locating and counting wildlife or finding habitat features. Though population estimates derived from this type of aerial survey frequently underestimate the actual number of individuals present due to visibility bias (i.e., not all animals are sighted), helicopter searches can be used to document the presence of at least one individual. This can be followed up with a thorough ground search of areas where the Ivory-billed Woodpecker is documented.

The first objective of a helicopter search is to locate and capture definitive still camera or video imagery of an Ivory-bill. Widely accepted proof would be invaluable in resolving differences of opinion within the scientific community over the rediscovery of this species as well as in promoting appropriate, effective, on-going conservation efforts.

If Ivory-billed Woodpeckers are located during the aerial search, ground crews can be deployed to a much smaller area to focus on roosting or nest cavity location. Locating these important habitat elements will enable researchers to gather information that could make significant contributions to the knowledge and recovery of the species. This sharper focus can be expected to be much more efficient and likely to yield results, since searching habitat on the ground is difficult and time-consuming. Smaller areas can be searched more intensively.

Safety

Aircraft are mechanical devices that can malfunction or be affected by wind, weather, and earth-based objects such as trees and hills; therefore, safety must be the number one priority. Our decision-makers for this will be the helicopter pilots. Additionally, Federal and state resources are bound by strict requirements, and acceptable contractors will be required to meet these standards as determined by the hiring/acquisition agency. Occupants of the helicopter must adhere to all required safety rules and respective agency requirements while conducting the surveys.

Search Areas

Each state search group will determine geographic priorities using historical information, recent and reliable reports of sightings, and habitat information (see Request for Proposals Criteria). Additionally, selection of areas will depend on several variables including the type of helicopter as well as its cost and availability, logistics for aerial and ground crews, local weather conditions, issues associated with public lands management or private lands, season of search, and accessibility. Randomization can be included for development of the occupancy model.

Search Guidelines

Observers and Cameras

If searches involve low altitude helicopter flights, a total of 3-4 observers including the pilot should be used, depending on the type and capacity of the aircraft and pilot discretion. Pilot observations will be subordinate to flight operations. Safety will be the first priority for all of the flights. In addition to looking actively for flushed Ivory-bill, the port side cockpit observer can help coordinate the operation, and monitor on-board or handheld GPS equipment. Ideally, there will be two observers positioned in the back seat of the ship with doors removed. These observers will be tethered to the ship with safety harnesses. In addition to scanning constantly for flushed Iviroy-bills, each of the back-seat observers should have a high quality SLR camera pre-set/focused and ready to point and shoot still images of flushed Ivory-bills. Observations will likely be brief, no more that two-three seconds, and the observers will have to be familiar and very proficient with SLR use. Additionally, there should be a high-definition video camera mounted to the helicopter. Preferably, the camera will be fitted with a wide angle lens directed down and forward of the flight path, capturing constant video footage of the area immediately in front of the ship. In addition to documenting Ivory-billed Woodpecker sightings, the video imagery will be a way to record and later to assess habitat characteristics in inaccessible areas.

Transects

The pilot will fly previously defined transects downloaded into GPS units monitored by the pilot and cockpit observer. Transects will be defined using landform characteristics and shape of the survey area with consideration for making the most efficient use of available flight time on individual flights. Individual flights should last no more than 2 to 2.5 hours in order to minimize observer and pilot fatigue. Flights can be planned to take place during the hours 0900 through 1600, to take advantage of maximum sunlight. Additional flights can be scheduled in early or later daylight hours depending on effective times for flushing and observing birds. Flight times and duration can be varied according to local needs and issues. Adaptive changes are expected as the crew learns from initial efforts.

Transect spacing can be varied to allow adequate observation of flushed birds. Airspeed should be consistently maintained, if possible. Depending on the ship used, slower airspeeds (40 miles per hour) will aid observers. Altitudes will depend on local issues and safety concerns. The pilot can adjust flight parameters and transect orientation to

maximize viewing ability and adapt to local conditions and safety considerations.

Preliminary test flights can help determine what will work, adapting for optimum results, then maintaining a flight pattern, speed, and altitude that are as consistent as possible. These test flights would ideally use a ground crew making simultaneous observations of flushed and/or hiding birds during the helicopter run.

Crew and Pilot

Onboard GPS units monitored by the pilot and cockpit observer will record waypoints of Ivory-bill sightings, waypoints of habitats of interest, and track logs of all flights.

Crew members may come from partner agencies. Completion of AMD Basic Aviation Safety (B-3) online training is mandatory for all Federal flight crew members. All personnel should wear an approved flight helmet, nomex clothing and gloves, and leather boots during the flight. If flights are to be made over water, an aircraft, approved, personal flotation device will be worn by all occupants when flying beyond the glide slope of the land. During all surveys the two observers positioned in the back seat of the ship will remain tethered to the ship with approved safety harnesses. On-board radio communication between the pilot and flight crew will be maintained via flight helmet voice activated microphones. Air-to-ground communication between the helicopter search team and ground search teams will be established via cell phone after Ivory-bill encounters. If needed, additional air-to-ground communication capability will be maintained between the helicopter search team and ground search team via programmable handheld radio.

All project flights will file flight plans using the FAA Flight Service or Agency Flight Dispatch Offices. The pilot is responsible for the accurate performance, and weight and balance calculations for each flight. An analysis of aerial hazards will be done prior to searches, and maps displaying aerial hazards will be provided to the pilot.

Timeline

Air searches are best conducted during leaf-off condition in order to have the greatest chance of detecting and capturing still or video imagery of a flushed Ivory-bill. Due to the high costs of ferry time the helicopter searches should be completed in blocks of use. Late January, February, and March are expected to be the most effective months.

Issues

Waterfowl

The primary purpose for much of the NWR lands to be searched is to provide habitat and protection for wintering waterfowl. Conducting the flights at any time during the leaf-off period will temporarily disturb and displace waterfowl in the specific area where the flights take place. The disturbance will be a short-duration, single-day event and should not offer significant impacts to wintering waterfowl. For example, January through mid-February are the peak months of wintering waterfowl use on the Arkansas refuges; scheduling after this time period would offer the least disturbance to wintering waterfowl.

Local managers have a good understanding of how seasonality, weather, and water levels concentrate wintering waterfowl. Where wintering waterfowl concentration has been identified as an issue, input from local managers should be used to modify flight plans and avoid areas of waterfowl concentration.

Ivory-billed Woodpecker

Helicopter Ivory-bill sightings would enable immediate redirection of searchers to areas of Ivory-bill encounters. Accurately located sightings will help search teams dramatically increase chances of locating an active roost or nest cavity. This means the bird(s) will be flushed. Flushing an animal to flight does cause energy expenditure and stress. Again, the trade-off is explicit between the management/conservation need to find and document the bird, then reliably locate a roost or nest cavity and a temporary disturbance of extremely short duration. Under the Endangered Species Act, harm or "take" of a listed species without a permit is expressly prohibited. In this case, the "take" potentially occurring is harassment via disturbance of whatever activity the bird was engaged in prior to flushing.

The 2007 helicopter searches will be performed by state search groups in cooperation with the Fish and Wildlife Service. Barring an aerial strike, which will be avoided by the pilot for obvious reasons, the only disturbance that will occur is flushing one or more birds to flight. Currently, all search and monitoring activities which may potentially harass a bird are permitted via the Service's own Section 10(a)1(a) permit or the Cornell Laboratory of Ornithology permit. Location of ground searchers in response to a helicopter sighting may allow the location of a nest or active roost which can result in additional disturbance/harassment. The unlikely worst case scenario would include nest abandonment, although this is extremely unlikely. Additional minor impacts would include flushing the bird(s) repeatedly. Given the habitat conditions and results of the last two years of intensive searching, birds will likely temporarily leave the immediate area. Care will be required in the observation, monitoring, and photography of a cavity believed to be a roost or nest. Requirements are documented in the current region-wide Cornell permit and should be adhered to for follow-up, focused, ground searches. The intra-service Section 7 consultation for this permit resulted in a Not Likely to Adversely Affect determination by the Regional Office and was concurred with by three Ecological Services Field Offices (Conway, Panama

City, Lafayette). Copies of the permit are held by the Fish and Wildlife Service and Cornell Laboratory of Ornithology, with specific requirement information available from Ron Rorbaugh, Cornell University and Laurie Fenwood, US Fish and Wildlife Service.

Other Wildlife

If extensive areas are flooded, some unsubmerged lands may harbor wildlife concentrations which could be disturbed by a low-flying helicopter. This disturbance will be of short duration, and if large concentrations of sensitive species are noted by local officials/ coordinators, these areas could be avoided. Most migratory, non-waterfowl species will not have arrived in the bottomland hardwood habitats. Resident species will, however, be in a relatively stressful period of the year. Recognition of these trade offs should be made. Where compatible with the primary objective, efforts to minimize disturbance and fulfill additional objectives, such as eagle surveys, can be accomplished.

Hunting

Dates chosen for the flights will have an impact on whether this disturbance is an issue. Any disturbance will be of short duration, though flushing waterfowl from the immediate area can affect the availability of animals to shoot. Depending on the closeness of hunters or hunting blinds to the flight path, impact varies from none (similar to crop dusting/seeding) to significant (ducks gone for the day). No impact is anticipated if hunting seasons are closed.

Private Lands

Efforts to locate the Ivory-billed Woodpecker ideally would include all lands within what is now (to the best of current understanding) considered suitable habitat. However, in many areas observing private lands via low altitude helicopter flights might generate negative reactions from landowners or those who worry about landowner rights. Suspicion about government intrusion, lack of confidence in assurances that no trespassing will occur, and fear of potential regulation associated with owning habitat used by endangered species make this a sensitive issue. Some over-flight of private lands will be unavoidable as the helicopter makes turns to follow transects determined for surveys focused only on public land. Potential negative reactions to this can be managed by assuring adjacent landowners that public lands are the focus of the flights. Over-flights on private lands are not illegal and are largely constrained only by safety concerns (via FAA regulations and advisories). However, good sense and gauging local reactions must prevail in each case in order to promote the long-term conservation of this species, which will depend on appropriate private land management. A public outreach effort should be undertaken where needed.

Appendix G.

Example of Action Plan and Private Lands Considerations for the Ivory-billed Woodpecker

Action Plan In the Event of Definitive Information of the Presence of the Ivory-billed Woodpecker In Arkansas

Need for Action Plan

The search for the Ivory-billed Woodpecker is on-going in Arkansas, with intensive search efforts occurring from December through April. Search activities continue to be more specific and highly targeted with each search season as search areas incorporate several years of sighting data, search experience and narrowing of the field of search, as well as investigations in previously untargeted areas through use of occupancy model protocols. Search activity is significantly enhanced annually and more focused on the basis of information gained from the each previous field season. Searches are conducted by professional employees from several organizations, as well as volunteers. Cornell Laboratory of Ornithology (CLO), Audubon Arkansas (AA), The Nature Conservancy of Arkansas (TNCA) and Arkansas Game & Fish Commission (AGFC) are participators in the organized search effort. All search efforts are unified under the field coordination and permits of CLO. It is anticipated that there will continue to be a great number of birders and curiosity seekers in the field, as has occurred in previous years. Traditional users such hunters and anglers will also be in the field and are aware of the search for the Ivory-billed Woodpecker. Additionally, a cash reward (initially $10,000 and currently $50,000 for leading an official to an Ivory-billed Woodpecker) has been offered to the public for locating the bird, and this incentive has raised both public awareness and participation. It is therefore more likely than ever that additional evidence of the species will be forthcoming.

Sighting information collected in association with the winter search effort could significantly inform species management and any associated public use. There is a need to describe how this information is handled in the short term, including how and when to convey the information to the general public and the media.

This brief action plan is an attempt to map out a sequence of events that should take place if significant information on the status of the species is obtained.

Definition of Events

It is considered likely that information on the rediscovery will result from the efforts of the search teams under permit. It is, however, quite possible that significant information could be obtained from independent parties. To maintain awareness of possible independent sightings the various list serves used by the birding public will be monitored daily. Management of the response in these cases is dependent on obtaining information from parties who may or may not be willing to share it. Given the high degree of interest, it is likely that any significant information will come to the attention of the search teams or government officials in a matter of days or less. Therefore, we will consider the sequence of events to be the same regardless of the source of information, with the response dependent on the quality of the information received.

Ivory-billed Woodpecker sighting reports are no longer infrequent in the Big Woods of Arkansas. Reports vary tremendously in credibility due to differences such as observer experience, field marks observed, length and clarity of the observation, and context of the sighting (habitat type, location, observer credibility). Several years of experience have provided an education in assessing the significance of reported encounters, and such is done routinely by Service and Cornell personnel.

This Action Plan is in effect to streamline a swift and effective response to the identification of the location of Ivory-billed Woodpecker(s) by Service and ESA permittee decision-makers. It is not valuable or effective to respond to each and every Ivory-bill sighting report according to the Response Sequence laid out in this document, but rather to those judged to be actual observations of the species and with significant behavioral components likely to lead to further observations. Therefore sightings which are judged to be 'Confirmed Encounter with Documentation' or 'Probable Encounter' will initiate the Action Plan Response Sequence. Less definitive sighting reports ('Possible Encounter', 'Putative Encounter') will be shared among primary agency and permittee representatives, but will not initiate the Response Sequence. Particular attention will be given to this shared information if the sighting report investigator is inclined to believe that the report is likely to lead to 'Confirmed' or 'Probable' encounters, given further investigation. The Response Sequence is, in effect, the equivalent of calling 'the red phone' to notify the Incident Response Team of a significant event which will require team decision-making.

Possible Significant Events

Significant events could take several forms. For purposes of developing appropriate responses

the following scenarios are considered here:

1. Fly-by Ivory-bill - Credible sighting reports of a bird flying by a location with no known focus of activity.
2. Foraging Ivory-bill - Documentation is received of IBWO feeding in a specific area, possibly on an identified food resource. Flood killed trees or possibly one of the "morticulture" sites could result in attracting a bird or birds on a regular basis.
3. Roosting Ivory-bill - A bird or birds are documented frequenting a roost tree.
4. Nesting Ivory-bill - A bird or birds are observed exhibiting nesting behavior at a cavity tree.
5. Dead or Injured Ivory-bill - The remains of a bird are recovered or an injured bird is recovered.

There are of course other possible scenarios or combinations but these five likely encompass most of the general types of situations which could be encountered.

Encounter Classifications:
Each sighting will undergo an assessment led by CLO personnel to determine the degree of confirmation of the particular encounter. The review will result in a classification of the encounter into one of four categories:

Category 1
An encounter with documentation that can be repeatedly interpreted the same way by independent observers, such as where definitive photographic evidence is collected by the field observer.

Category 2
An encounter with at least two diagnostic field marks clearly observed and described, and the bird remaining in view long enough for the observer to reconfirm the observed field marks, but no independently verifiable evidence such as a photograph. Diagnostic field marks include:

e. White trailing edge of wing on either the dorsal or ventral surface.

f. White 'shield' formed by folded wings over the lower back of a perched bird.

g. White lines starting behind the eye, continuing down the neck and onto the back of the bird.

h. Black chin

e. Large woodpecker with one of the above diagnostic field marks and clearly heard giving 'kent' calls or double knocks.

Category 3
An encounter that includes the description of one definitive or several partial or poorly observed field marks.

Category 4
An encounter based solely on the observer's impression of the bird with no identifiable field marks unambiguously observed; encounter lacks sufficient information to make qualitative assessment about the identity of the bird.

In conveying information on sightings use should be made of the categories above so all team members are aware of the degree of confirmation with regard to the sighting.

Response Sequence (Attachment 1.):
For confirmed Ivory-bills fly-bys or probable encounters, notification of the Initial Response Team members should be made, and the need for any management action should be assessed via a conference call or meeting.

The following numbers may be used at any time to convene a conference call:

Phone number = ?????

Passcode = ?????

For all other definitive sightings information (e.g., confirmed or probable nesting, roosting, feeding, dead or injured) the following actions should be taken:

Action 1—Communicate Information to Initial Response Team (Attachment 2):
The below persons will be considered members of the Initial Response Team. This group is kept to a minimal size to facilitate quick response and decisions. Membership is dictated primarily by legal requirements (access and permits) and those in the lead on conducting the search. Team members will be responsible for informing other personnel within their program/agency as appropriate.

All the members of the Initial Response Team will be informed of the information as soon as possible regardless of where the definitive record occurs in Arkansas. Contact should be made by phone if possible and backed up by e-mail. Emphasis in order of contact should be based on the location of the sighting, e.g., on Cache River NWR priority should go to contacting Jonathan Windley first.

U.S. Fish and Wildlife Service

Primary Contacts:

?????

Arkansas Game and Fish Commission

Primary Contacts:

?????

Arkansas Natural Heritage Commission

Primary Contact:

?????

Cornell Laboratory of Ornithology

Primary Contacts:

?????

Action 2: Convene Initial Response Team
An Initial Response Team Meeting will be convened. It is expected that this meeting will be convened within hours of the information becoming available. Representatives of the following shall be present if feasible: FWS-Refuges, Ecological Services and External Affairs programs,

State of Arkansas (individuals to be identified by State of Arkansas), the Cornell Search Team leaders or their designees, and the person(s) providing the information or sightings.

The purpose of the meetings will be quickly to review the information received, confirm the validity, and determine the initial steps which would need to be taken to assure protection of the bird or birds being observed.

If the sighting occurs on public lands, such protective measures may include cessation or modification of public use activities, management programs, search effort, or any other activity that may be deemed to have an adverse impact on the birds.

If the definitive sighting information is on private land, a meeting of the Initial Response Team should still be convened as soon as possible and should include the land owner if the person is willing and circumstances allow. The presence of Ivory-billed Woodpecker on private lands will obviously create a different scenario in terms of protective measures that can be implemented. Involvement of members of the Corridor of Hope Team should be considered depending on the circumstances. Special consideration should be given to the desires of the private land owner to maintain privacy and protect his/her property and activities from birders or others.

An assessment of the methods for monitoring activity will be necessary. In general, the least obtrusive methods should be used. Remote cameras or blinds should be considered. The need for predator control devices such as snake guards should be assessed. Deployment will depend on the location of the nest and time of year, among other factors.

If a dead bird or parts of a bird are recovered, the events above should still take place, but the Office of Law Enforcement and the refuge officers for the area in question should be included in the initial response meeting. Likewise, State of Arkansas Law Enforcement personnel should be offered the opportunity to attend the meeting.

If an injured bird or abandoned nestling (e.g., from a fallen nest tree) is encountered, speedy assessment will provide the best chance for recovery. The welfare of the bird should be the primary concern, but notify the Initial Response Team and law enforcement officials as soon as possible–preferably before transport of the bird. If the nature of the injuries bird warrant it, e.g., gun shot wounds, notify State and Federal law enforcement officials immediately and be careful to preserve any evidence of a crime. The bird should be conveyed to the facility identified in Attachment 1 as soon as practicable.

Contact information for injured birds or nestlings:

The initial response meetings will continue at least once per day or as agreed to until no longer needed. Involvement of other conservation partners in these meetings may be expanded following the initial response and placement of protective measures should an y be needed.

Concurrent with the convening of the Initial Response Team, bird list serves such as Bird Chat and Rare Bird Alerts such as Birdingonthe.net will be monitored to evaluate awareness in the birding community.

Action 3: Implement Protective Measures

Put protective measures in place. This may require tasking enforcement personnel, signage or other measures. In some cases there may be minimal need for these actions. The response will be tailored to fit the particular situation. It is not possible to identify the combination of protective measures that may or may not be needed until the specific location of the activity is known. In the case of a nest or roost tree it is likely a buffer zone approach will be used that is similar to that employed for Bald Eagles. Management actions and permitted activities in the vicinity of the nest tree will be limited to those necessary to assure the well being of the bird or birds present. Research methods will be non-invasive in nature.

Public use and viewing should be discouraged in the initial response. Once the behavior of the birds and the terrain surrounding the sighting are more clearly known, options for some type of public viewing could be evaluated.

In the event the birds are using private lands, discussion with the land owner on how best to provide protection for the bird(s) as well as the interests of the land owner will be necessary. Involvement of the Corridor of Hope Conservation Team should be considered when dealing with private land owners. Their involvement will be somewhat dependent on the circumstances, e.g., the desires of the private land owner. In addition, should trespass issues develop, Federal or State law enforcement could assist with this to assure thatdisturbance to the bird(s) does not occur and that the private property owner is not adversely impacted. Discussions with the private landowner regarding future management and liability avoidance as well as incentives for management and protection of his/her land will be required.

Action 4: Review Permit Requirements and Issue Permits as Appropriate

Permits (ESA and refuge/ State) for work proposed by researchers or other personnel will be evaluated and permits issued as appropriate. A separate ESA permit may be required for work in association with a nest or roosting bird(s), although this is dependent on the nature of the anticipated activity. In addition, if the event occurs on State or Federal land there may be a need for an additional permit from the land-managing entity.

Action 5: Notify Public of Significant Information

Once protective measures are in place, notify the public. External Affairs personnel of the FWS and the State will have the lead with coordinating media/public outreach in consultation with members of the Initial Response Team. The Outreach and Communications Committee formed under the Recovery Team could serve as an appropriate vehicle for disseminating information over the longer term.

Action 6: Monitor Response of Birds and Public and Adjust as Necessary

Action 5 will complete the initial response. This does not mean that the events which follow the initial response will be predictable or manageable. It will be necessary to monitor and evaluate the situation continuously as it develops and to adjust permitting, protection, and communication as needed.

Long-Term Management

Longer term management of the birds and the habitat used will require additional discussion and review. The following factors should be considered with regard to the longer-term management approach:

1. Long-term public use management—this will evolve as we learn more about the habits and behavior of the bird(s). Management actions considered necessary as an initial response may not be needed later in the process. Conversely, there may be a need to expand protective measures.

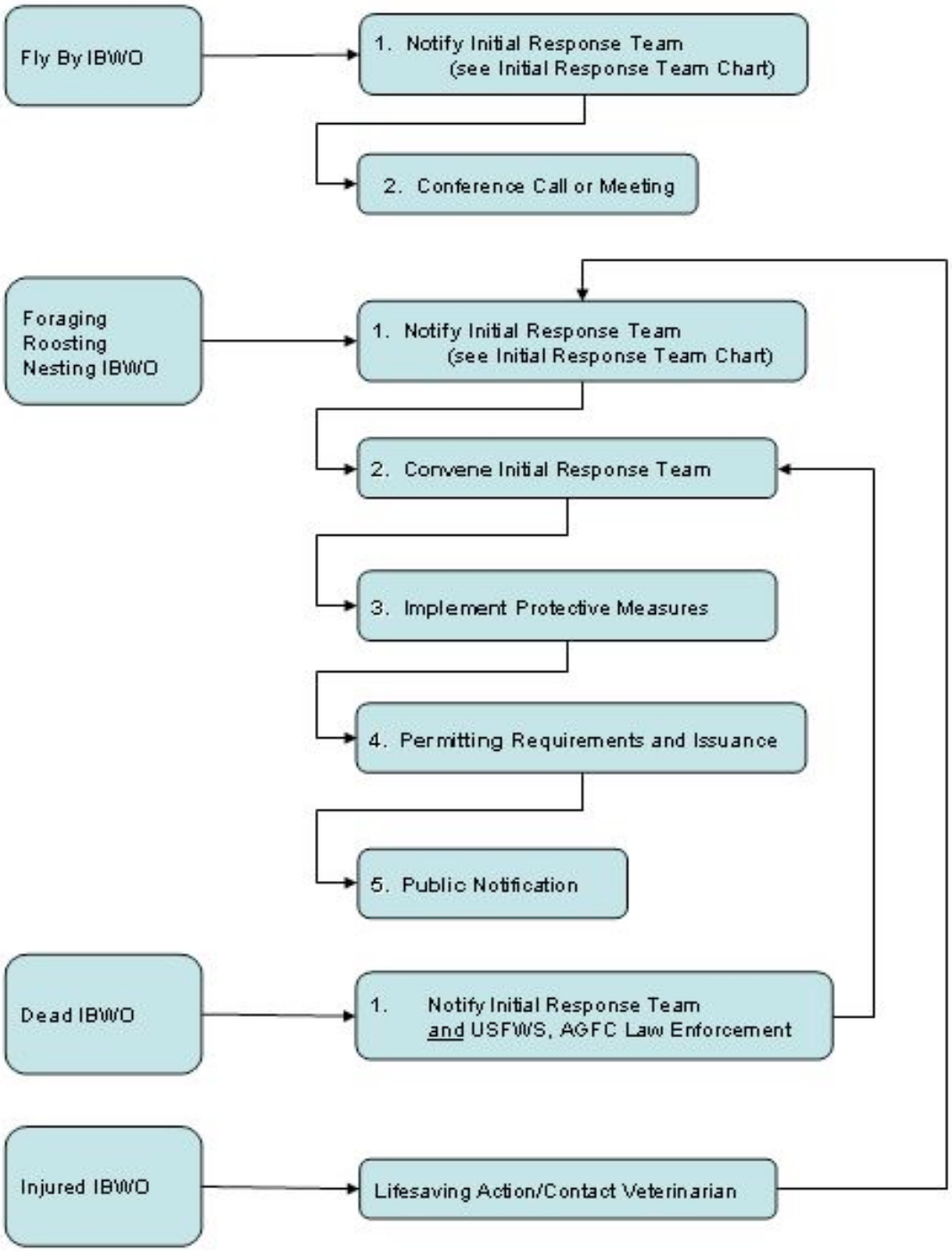
2. Research needs will be an important consideration, but they must be balanced against the welfare of the bird(s). Learning more about the ecology, habitats and behavior of the species would greatly benefit recovery efforts and search methodologies.

3. Some means of providing access for viewing should be considered for nests or roost trees. This will be influenced greatly by the specific characteristics of the individual case. It may be necessary to deploy remote cameras. Some type of monitoring will probably be needed for research and protection purposes.

4. Development/revision of Section 7 guidelines and all other ESA compliance may be necessary.

5. Compatibility determinations and refuge step down plans for public use, forestry management, and other management will need review to assure they are consistent with the recovery and management of Ivory-billed Woodpeckers.

Figure G-1. Functional chart for Initial Response for Action Plan: In the Event of Definitive Information of the Presence of the Ivory billed Woodpecker in Arkansas.



Living With the Ivory-billed Woodpecker: Private Landowner Considerations

"The plain lesson is that to be a practitioner of conservation on a piece of land takes more brains, and a wider range of sympathy, forethought, and experience, than to be a specialized forester, game manager, range manager, or erosion expert in a college or a conservation bureau."
- Aldo Leopold, 1934

Background

The announcement of the rediscovery of the Ivory-billed Woodpecker on Cache River NWR was made on April 28, 2005. This was the first scientifically documented sighting of a magnificent bird that had not been seen for almost 60 years. The Recovery Team was established; the Corridor of Hope Conservation Team was convened; Town Hall meetings were held to involve public citizens. Additionally, there has been consultation with ornithological experts, an assessment of habitat in the Big Woods, communication exchanges among scientists about the Ivory-billed Woodpecker, and discussions about survey and land acquisition needs.

The most important conservation discussion continues. How can we manage for the needs of this species? While the Recovery Plan is still undergoing review, the reality is that we all have the opportunity to work together towards recovery. The Ivory-billed Woodpecker presents all of us with real challenges, mainly because there is so little biological information about its ecology, life history, nutritional requirements, habitat preferences, and current threats. James Tanner's 1942 work provides us with perhaps the best information we currently have.

As Jerome Jackson writes in the ending of his book on the Ivory-billed Woodpecker "If there is habitat, there is hope. If there are Ivory-bills out there, there is hope" (Jackson, 2004). We all now know there is hope.

Recent Surveys

Efforts to document the presence of Ivory-billed Woodpeckers have been underway since late winter of 2004. Additional surveys have taken place in 2005, 2006, 2007, and 2008. Since much of the best remaining forested habitat is found on public lands, search efforts have been focused in areas such as Cache and White River NWRs, and State lands on Dagmar and Rex Hancock/ Black Swamp WMAs in Arkansas, Congaree National Park in South Carolina, Municipal Water District land on the Choctawhatchee River in Florida, the Big Thicket areas in Texas, Pearl River in Mississippi and Louisiana and the Atchafalaya River Basin in Louisiana, as well as the Okefenokee Swamp in Georgia. While some of these areas have yielded intriguing sightings and vocalizations, no additional photographic or videographic evidence has been obtained. Debate in the scientific community continues regarding if and where Ivory-billed Woodpeckers exist.

Rediscovery of an Ivory-billed Woodpecker on Private Land

A significant amount of private land could support the Ivory-billed Woodpecker. Some of this land is intermixed with public land or adjacent to it. It is possible that use of private lands by Ivory-bills could be occurring and the search team or private landowners may find evidence of such activity. Increased search intensity during 2006 and 2007 added to the general awareness of the possible presence of the Ivory-bill and improved the likelihood of its discovery on private lands.

Rediscovery could take several forms. A landowner sees a bird feeding on private forest land. A roost tree or even nesting of a pair of Ivory-bills could also be documented. Evidence of past nesting could be discovered. The characteristic call of the Ivory-billed Woodpecker, which resembles the "toot-toot" of a toy tin horn, could be detected. Potentially, a bird could be seen flying through private property with little or no information on the focal point of activity. In any of these cases, the immediate question will be "What should the landowner do?"

Private landowners who believe they may have Ivory-billed Woodpeckers on their land should be encouraged to share such information with the Fish and Wildlife Service or the appropriate state fish and game agency (contacts are listed at the end of this paper). The following concepts help assure that landowner interests will be protected and that the bird is conserved:

1. Don't kill, harm, wound, or harass a listed species such as the Ivory-billed Woodpecker. Such things are prohibited under the Endangered Species Act (ESA). Habitat destruction or removal may constitute a violation of the ESA. Cooperation and seeking opportunities for partnership are the best approach to conserving listed species, which is the real purpose of the law. Through cooperation, potential concerns can be addressed, and the habitat conditions supporting this rare and elusive bird can be maintained and improved.

2. Existence of a resident bird is a good indicator that the landowner's current use, management, and protection of the land has offered something attractive to the Ivory-billed Woodpecker. The Fish and Wildlife Service, other Federal and state agencies, and private conservation organizations will be interested in providing financial and technical assistance to the landowner aimed at continuing these benefits.

3. Providing information about a bird passing through the area may mean that the larger landscape is still capable of supporting Ivory-billed Woodpeckers. This information will assist ongoing search and location efforts, lending to the recovery of this species.

4. The U. S. Fish and Wildlife Service's goal is to find ways for you to maintain your traditional use of the property while protecting this species. Hunting, fishing, and other recreational activities are unlikely to present a problem and timber management activities may be compatible as well. It is impossible to predict in advance the exact situation or circumstances that may arise on any particular piece of property, so we cannot make blanket promises about a particular land use activity. However, no private lands have been taken or condemned by any government agency to protect this species, and we have no intention of doing so. Our goal is to work cooperatively with private landowners to meet their needs and the needs of the bird.

The following website provides identification tips. (http://www.fws.gov/ivorybill/seenone.html)

To report a sighting, visit http://www.birds.cornell.edu/ivory/identifying

Conservation Options

Private lands are vitally important to the future of endangered, threatened and other at-risk species in the United States. For example, approximately half of all Federally listed endangered species depend on private lands for 80 percent of their habitat needs (Clark and Downes, 1995). Private lands, at the same time, are under tremendous pressures for development, and fragmentation of habitat is a major conservation issue. Local conservation groups as well as Federal and state agencies recognize that they cannot and should not rely solely on land acquisition for conservation. Many new incentives have been established for private landowners that desire to undertake actions to help improve conservation for imperiled species.

There are two major points that all landowners should know:

1. As with any endangered species, there are obligations to avoid "take" which is defined in the Federal Endangered Species Act as follows: "….to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Frequently, existing land use activities can be continued with little or no change. The Fish and Wildlife Service is ready to work with landowners to help avoid "take" and to continue their current land use to the greatest extent practicable.

2. Because the rediscovery of this bird is so spectacular and such an exciting conservation opportunity, conservation groups will be very interested in assisting any private landowner who has an Ivory-billed Woodpecker regularly using their property. Federal, state and private conservationists will be anxious to work with these landowners to assure that conservation opportunities are implemented to protect the bird. The landowner may have a potential entrepreneurial enterprise providing viewing opportunities of the Ivory-billed Woodpecker, with the requirement that the bird be fully protected. There are many direct assistance programs available to fund conservation activities, purchase easements, and provide other financial incentives for conservation to the landowner. Some of these are described below.

Federal Programs Available for Endangered Species Conservation

U.S. Fish and Wildlife Service

1. Landowner Incentive Program

The Landowner Incentive Program (LIP) program provides financial assistance to states and tribes to establish or implement programs that protect and restore habitat on privately-owned lands to benefit federally listed endangered and threatened species, proposed, candidate or other at-risk species. It is designed as a program whereby states can provide technical and financial assistance to private landowners who desire to undertake habitat management or restoration for federally listed endangered, threatened and other at-risk species. The Service administers this program; funds are competitively awarded to the states and tribes to establish a LIP program as well as for implementing an LIP program. State agencies with primary responsibility for fish and wildlife may submit proposals, although other agencies or organizations may partner with or serve as a sub-grantee of the fish and wildlife agency. The States must provide a minimum of 25 percent non-federal matching funds; applications that propose a higher matching amount will score better, since matching funds beyond the required amount is one of the ranking criteria.

Arkansas received an LIP grant in FY 2005 to initiate an on-the-ground Landowner Incentive Program. Rare plants and animals (birds, fish, mammals, insects, and crustaceans) that are identified by each state include state and federally listed species, and other species with small and/or declining numbers in the state. These species may be prevented from becoming "listed" as endangered or threatened under the Endangered Species Act by timely habitat or population enhancement on private lands. It is expected that LIP funds will be used in conjunction with other conservation efforts such as Federal farm program conservation initiatives and non-governmental organization funding.

This program helps to:

- Encourage private landowners to conserve and manage important habitat

- Protect habitat through conservation easements
- Prevent rare or declining species from being "listed"

For more information: http://Federalasst.fws.gov/lip/lip.htm

2. Partners for Fish and Wildlife Program

The Partners for Fish and Wildlife (Partners) Program, established in 1987, restores, improves, and protects fish and wildlife habitat on private lands through voluntary partnerships between the Service, other agencies and organizations, and private landowners, while leaving the land in private ownership. The Partners Program operates in every state and can assist with habitat projects in all habitat types where trust resources are involved. The Partners' Program works with private landowners by providing technical and financial assistance with a flexible goal of achieving 50% of the total project costs from partners.

Partners' projects include those on private and non-Federal lands that conserve native vegetation, hydrology and soils associated with imperiled ecosystems such as bottomland forest wetlands, longleaf pine, native prairies, marshes, rivers and streams, or otherwise provide an important life requisite for a rare, declining or protected species. Typical projects include: planting of bottomland hardwood wetlands and other wetland restoration; site preparation and planting of longleaf pine and subsequent prescribed burning; fencing cattle out of streams; in-stream habitat re-establishment; planting of riparian vegetation; and many other projects that result in the restoration and enhancement of important fish and wildlife habitat. Interested landowners should contact their local Fish and Wildlife Service Ecological Service's Office. Projects must benefit federally protected or candidate species, migratory birds, or other trust resources, such as wetlands and stream habitats. Applications are received continuously.

In Fiscal Year 2005 (from October 1, 2004 through September 30, 2005), approximately $2.3 million was available for habitat improvement projects in the Southeast Region. Detailed information can be found on the Internet Site at: http://www.fws.gov/southeast/partners

3. Conservation Banks

Conservation banking is a relatively new practice that is becoming more attractive to private landowners and developers who are interested in protecting endangered and threatened species and their habitat to achieve a market enterprise. A conservation bank is basically a tract of land that the landowner has decided to protect for the benefit of a particular species; in return for protecting the land in perpetuity, the landowner achieves "credits" that can be sold to others who need to off-set the environmental impacts of their development projects. However, conservation banks are not appropriate when the lands in question are already protected for conservation; conservation banks may also not be effective if they are small in size and neglect landscape-level planning. It is often quite costly to restore and protect conservation bank lands; and long-term management needs sometimes are difficult to address. On the other hand, a conservation bank provides needed or improved habitat for the species in question; it reduces risks for developers by providing regulatory avenues for mitigation; it can simplify Federal and State permitting, thus improving efficiency; and it can provide economic return for the owner of the bank. Conservation banking is a new tool that is appropriate in certain situations and can serve a valuable role in the recovery of endangered and threatened species. For more information about such an opportunity, discuss plans with the local Fish and Wildlife Service office.

4. North American Wetlands Conservation Act (NAWCA)

The North American Wetlands Conservation Act is a Federal grants program that funds partnership projects for wetland restoration, wetland management or acquisition for waterfowl throughout North America. There are two major types of NAWCA grants, standard grants ($50,000 - $1,000,000) and small grants (<$50,000), and the grant requests for proposals are generally open twice a year. Competition for these grants is keen; potential applicants are strongly encouraged to coordinate with the "Joint Venture" contact for their area (http://www.fws.gov/birdhabitat/NAWCA/jvdir.htm). Specific criteria apply, and a minimum of a 1:1 non-Federal to Federal match is required. The Service administers this program, but the North American Wetlands Conservation Council establishes the policies that govern the grant selection process. For more information visit: http://www.fws.gov/birdhabitat/NAWCA/grants.htm

5. Willing Seller Purchase of Easement or Fee Title

Should a landowner be interested in sale of his/her property, two sources of Federal funding are available. The Land and Water Conservation Fund (LWCF) can be used to purchase land for addition to the National Wildlife Refuge System. Approximately one- quarter of Cache River NWR has been acquired using these funds. It is also possible to purchase easements with these funds although the cost of easements often approaches the value

of purchase in fee title and is, therefore, infrequently used.

The Migratory Bird Conservation Fund (Duck Stamp Fund) has been used to purchase about 75 percent of Cache River NWR. Funds are generated through the purchase, primarily by waterfowl hunters, of the Federal Duck Stamp. Purchases made with these funds are generally focused on lands and waters of value to waterfowl.

Some landowners may not want to sell their land. In these instances it may be possible for private landowners to work with conservation organizations on easements or other ways to facilitate achievement of protecting or conserving Ivory-billed Woodpeckers and their habitat.

U.S. Department of Agriculture

A number of Department of Agriculture programs provide funding that can be used to improve wildlife habitat on private lands. The Conservation Reserve Program, Wetlands Reserve Program and Conservation Enhancement Program are all set-aside programs while other programs are designed to address on-the-ground habitat improvements. Short summaries are provided below, but for further information about each of these programs we urge private landowners to contact their local NRCS representative.

1. Conservation Reserve Program

   The Conservation Reserve Program (CRP) is administered by the Commodity Credit Corporation working with the Department of Agriculture's Farm Service Agency. This program is designed to provide cost-share assistance and annual rental payments to private agricultural landowners who voluntarily wish to establish long-term cover on their lands. Criteria apply and the program focuses on enrolling croplands where soils are highly erodible, cropped wetlands, or on other lands with high environmental values (e.g., riparian corridors; wetland protection areas). Contracts may be for 10 – 15 years. For more information, contact: http://www.fsa.usda.gov/dafp/cepd/crp.htm

2. Wetlands Reserve Program

   The Wetlands Reserve Program (WRP) is a voluntary landowner program administered by the Natural Resources Conservation Service that offers financial and technical assistance to those interested in restoring, protecting and enhancing wetlands on their property that were converted to cropland or pasture prior to December 23, 1985. Landowners restore the wetlands and may develop wildlife recreation on the lands. In return, NRCS may provide easement payments, cost-share financial assistance for wetland restoration, and technical assistance. Three types of agreements are available: 10 year restoration cost-share agreements, 30 year easements, and permanent easements. For more information, contact: http://www.nrcs.usda.gov/programs/wrp/

3. Wildlife Habitat Incentives Program (WHIP)

   The Wildlife Habitat Incentive Program (WHIP) provides financial and technical assistance to private landowners who voluntarily desire to improve or restore their lands for fish and wildlife habitat. The program is administered by the Natural Resources Conservation Service's district offices, and funding is provided by the Commodity Credit Corporation. The State Conservationist in each State seeks input from the State Technical Committee during the development of the State WHIP Plan. The ranking criteria for applications to this program are derived from the State WHIP Plan, and thus, the program works towards addressing State wildlife habitat priorities. Landowners may apply at any time to this program. The NRCS will work with the landowner to develop a wildlife habitat development plan, and this is used in the development of the cost-share agreement. Agreements typically run from 5 – 10 years. The NRCS reimburses up to 75 percent of the wildlife restoration costs, but cost-share approval may not exceed $10,000 per contract. For more information: http://www.nrcs.usda.gov/programs/whip/

4. NRCS Environmental Quality Incentives Program (EQIP)

   The Environmental Quality Incentives Program (EQIP), also administered by the Natural Resources Conservation Service, and is designed to address a variety of conservation issues including air quality, water quality, soil health, and at-risk wildlife habitat. The EQIP program pays up to 75 percent of the project costs (more in some cases) and is competitive at the State level. Applications can be filed at any time; upon selection, NRCS will work with the landowner to develop the conservation practices. This program has funded important conservation projects such as fencing cattle out of streams, prescribed burning, wetland habitat restoration, and stream habitat improvement. For more information, contact: http://www.nrcs.usda.gov/programs/equp/

5. Conservation Reserve Enhancement Program.

   In 2001, the Department of Agriculture and Arkansas initiated a $10 million Conservation Reserve Enhancement Program (CREP) to benefit the Bayou Meto Watershed in five counties in central Arkansas, including Arkansas, Jefferson, Lonoke, Prairie and Pulaski Counties. Two of these

counties are located within the Big Woods, Arkansas and Prairie. The CREP provides landowners with the option of removing land from agricultural production and planting trees or other vegetation to improve soil conditions, water quality and wildlife habitat. In return, the landowners receive rental payments and other financial incentives. The program is administered by the Farm Service Agency. For more information, contact: http://www.fsa.usda.gov/pas/publications/facts/html/crepar01.htm

6. Healthy Forests Reserve Program

   The Healthy Forests Reserve Program was established to help restore forest ecosystems. Its focus is on restoring or enhancing habitat for endangered, threatened and rare species, increasing biodiversity in our nation's forests, and serving as an incentive for carbon sequestration. The program is open to private landowners who voluntarily desire to implement conservation practices and place an easement on their forest lands. Easement options include 10 year agreements, 30 year agreements, and 99 year agreements. For more information, contact: http://www.nrcs.usda.gov/programs

Private Incentives Available for Endangered Species Conservation

In addition to Federal and State programs, there are a number of private organizations that are engaged in conservation of endangered species, protection of biological diversity, and land protection efforts. These offer more alternatives for private landowners to consider.

The Nature Conservancy

Private lands conservation is an innovative tactic that leverages the increasing interest of the private sector to take part in conservation. The Conservancy works with landowners, communities, cooperatives and businesses to establish local groups that can protect land. Some of the main tools used to achieve these goals include land trusts, conservation easements, private reserves and incentives. In addition, a Private Lands Program was developed by The Nature Conservancy to use our experience in the United States in developing land conservation tools internationally.

Acquiring Land

In the United States, The Nature Conservancy uses land acquisition as a principal tool of its conservation effort. The Conservancy helps to protect approximately 15 million acres in the United States. Outside the U.S., the Conservancy does not generally acquire land for its own protection but instead works with local communities and national governments to encourage the protection of ecologically sensitive land.

Conservation Easements

Conservation easements are one of the most powerful, effective tools available for the permanent conservation of private lands. Their use has successfully protected millions of acres of land while keeping it in private hands and generating significant public benefits.

A conservation easement is a restriction placed on a piece of property to protect its associated resources. The easement is either voluntarily donated or sold by the landowner and constitutes a legally binding agreement that limits certain types of uses or prevents development from taking place on the land in perpetuity while the land remains in private hands. Conservation easements protect land for future generations while allowing owners to retain many private property rights and to live on and use their land, at the same time potentially providing them with tax benefits.

Conservation Buyer Projects

In recent years, the Conservancy has begun working with private, conservation-minded individuals, or "conservation buyers," interested in acquiring and protecting ecologically-valuable lands. Through this program, the Conservancy identifies and purchases target properties within priority conservation areas, or in zones that buffer and surround core natural areas. The Conservancy then widely and publicly markets the property, seeking a buyer committed to protecting the property's important natural values and willing to ensure the land's long-term conservation by placing a conservation easement on the land. The value of the land before and after the conservation easement restrictions is established by professional, independent appraisals. The Conservancy prohibits sales of conservation lands to any related parties.

National Fish and Wildlife Foundation

The National Fish and Wildlife Foundation (NFWF), a non-profit tax-exempt organization, established by Congress in 1984 to assist the Fish and Wildlife Service in the development of partnerships with others for the conservation of fish and wildlife and plants. The Foundation has worked with many different partners over the years, as demonstrated by the fact that it has awarded over 7,000 grants to 2,600 organizations and has leveraged over $300 million in Federal funds into more than $1 billion dollars worth of conservation projects (NFWF, 2005).

The NFWF issues general requests for proposals three times per year and has numerous special grant opportunities, ranging from Refuge Friends Group opportunities to grants that enhance carbon sequestration efforts. They prefer on-the-ground conservation projects, and most grantees provide a 2:1 (two private dollars to every Federal dollar) matching fund ratio. Project criteria depend on the type of grant one is seeking. The NFWF does not fund advocacy, litigation, shortfalls in

government budgets, overhead and indirect costs, multi-year projects or research. They do, however, provide funding for land acquisition, conservation, restoration and creative new approaches that could serve to stimulate similar environmental projects in other areas. Their contribution to the conservation of fish and wildlife resources has been remarkable.

Contact Information

Private landowners are encouraged to explore the options in this paper and contact the organizations below if they desire more information or are interested in supporting conservation of the Ivory-billed Woodpecker or other fish and wildlife.

Regional Contacts

U.S. Fish and Wildlife Service
Recovery Coordinator
Refuges and Wildlife Management
1875 Century Blvd, Suite 420
Atlanta, GA 30345
Phone: 404/679 4016

U.S. Fish and Wildlife Service
Assistant Regional Director – Ecological Services
1875 Century Blvd, Suite 200
Atlanta, GA 30345
Phone: 404/679 7085

Arkansas

Arkansas Fish and Game Commission
Endangered and Threatened Species
2 Natural Resources Drive
Little Rock, AR 72205
Phone: 501/223 6300
Or 800/364 4263
http://www.agfc.com

U.S. Fish and Wildlife Service
Ecological Services Arkansas Field Office
110 South Amity Road, Suite 300
Conway, AR 72032
Phone: 501/513 4470
http://www.fws.gov/arkansas%2Des/

Florida

Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, FL 32399-1600
850/488 5460
http://myfwc.com

U.S. Fish and Wildlife Service
Ecological Services
Panama City Field Office
1601 Balboa Avenue
Panama City, FL 32405-3721
850/769 0552

Louisiana

Department of Wildlife and Fisheries
2000 Quail Drive
Baton Rouge, LA 70808
225/765 2800
http://www.wlf.louisiana.gov

U.S. Fish and Wildlife Service
Ecological Services
Lafayette Field Office
646 Cajundome Boulevard
Suite 400
Lafayette, LA 70506
Phone: 337/291 3100

Mississippi

Mississippi Wildlife, Fish, and Parks
1505 Eastover Drive
Jackson, MS 39211-6374
Phone: 601/432 2400
http://www.mdwfp.com

U.S. Fish and Wildlife Service
Ecological Services
Jackson Field Office
6578 Dogwood View Parkway
Suite A
Jackson, MS 39213
601/321 1122

South Carolina

South Carolina Department of Natural Resources
Rembert C. Dennis Building
1000 Assembly Street
Columbia, SC 29201
Phone: 803/734 3886
http://www.dnr.sc.gov

U.S. Fish and Wildlife Service
Ecological Services
Charleston Field Office
176 Croghan Spur Road Suite 200
Charleston, SC 29407
843/727 4707

National Park Service
Congaree National Park
100 National Park Road
Hopkins, SC 29061
803/776 4396, ext. 0
http://www.nps.gov/cosw/

Non-Government Contacts:

The Nature Conservancy
South Central Division Office
601 N. University Avenue
Little Rock, AR 72205
Phone: 501/663 6699

National Fish and Wildlife Foundation
1120 Connecticut Ave NW
Suite 900
Washington, DC 20036
Phone: 202/857 0166
Fax: 202/857 0162

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Clark, Dana and David Downes. What Price Biodiversity? Economic Incentives and Biodiversity Conservation in the United States. Center for International Environmental Law, July, 1995 *In* Noah, Emily and YinLan Zhang. 2001. Compendium of State Landowner Incentive Programs for the Conservation of Biological Diversity, Yale University Environmental Protection Clinic, Yale University, Connecticut.

Jackson, Jerome A. 2004. In Search of the Ivory-Billed Woodpecker. Smithsonian Institution, Smithsonian Books, Washington, D.C. 294pp.

Meine, Curt. 1988. Aldo Leopold: His Life and Work. University of Wisconsin Press, Madison, Wisconsin. 638pp.

National Fish and Wildlife Foundation. 2005. Website Information.

Tanner, James T. 1942. The Ivory-Billed Woodpecker. Research Report #1, National Audubon Society, Dover Publications, Inc., Mineola, New York. 111pp.

Appendix H.

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 throughout its historical range and the only in-depth, ecological investigation conducted on a population of Ivory-billed Woodpecker. Tanner's observations of the Singer Tract population 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 NWRs 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 likely to harbor Ivory-billed Woodpecker on the basis of 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 DeView area of Cache River National Wildlife Refuge, Jacks Bay and Prairie Lake area of White River National Wildlife Refuge and portions of Dagmar WMA. In addition to these primary locations, additional areas perceived by local land managers well-acquainted with existing forest conditions to be "suitable" Ivory-billed Woodpecker habitat were inventoried. These locations included other areas on White River and Cache River NWRs, Bayou Meto WMA, Wattensaw WMA, Rex Hancock/Black Swamp WMA, and Henry Gray/Hurricane WMA.

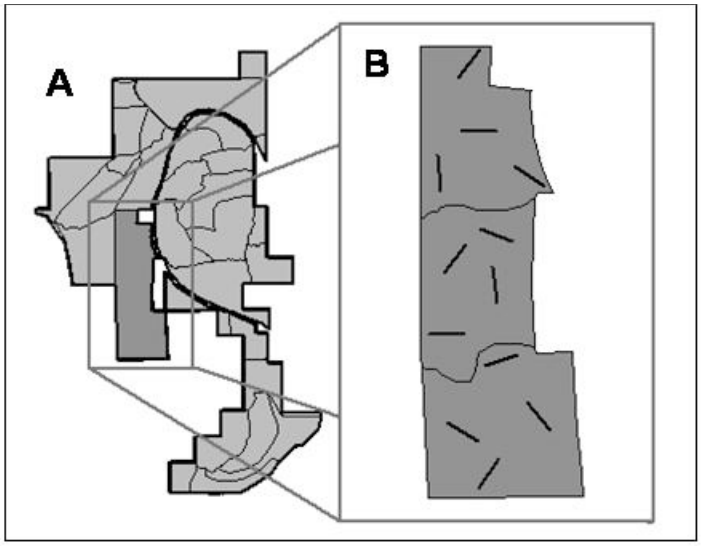
Sampling Framework

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 WMAs and NWRs 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 DeView 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 as 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 H-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. 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 [>24inches]; 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, 1/5th 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%).

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 produce a high level of precision consistently. However, 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 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.

Parameters Collected

The data provided by Tanner and discussions with Martjan Lammertink, (Cornell Lab of Ornithology Post-Doctorate Student), who is leading the Cornell search efforts in Arkansas, support the assumption 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. Though our knowledge is limited in this area, we believe that these metrics 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. Furthermore, these data are 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.).

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

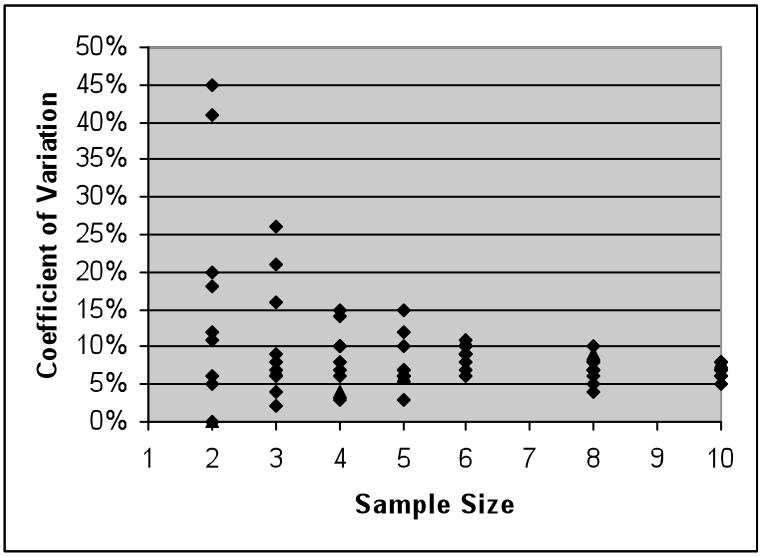


Figure H-3. Schematic of a point-transect depicting a cluster of five, 1/5th acre plots spaced four chains (264 ft) apart upon which habitat metrics were sampled

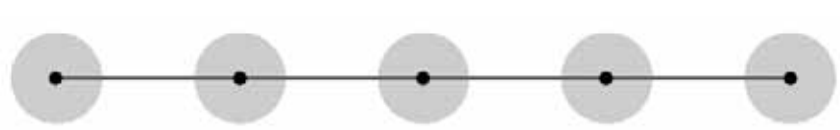


Table H-1. Location, number of forest stands and acreage inventoried in the Big Woods of Arkansas (through 2006).

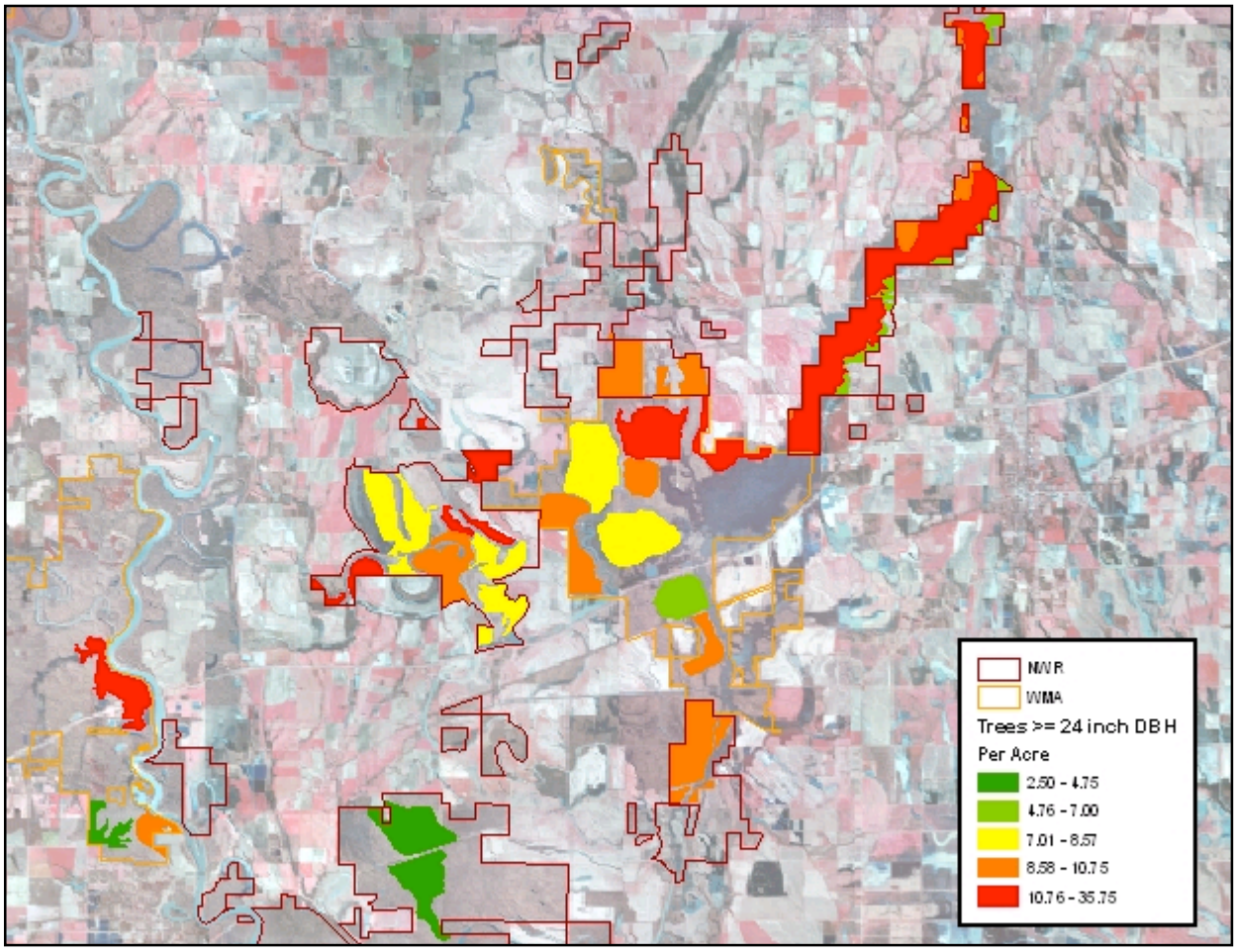
Location	Number of Stands	Total Acreage*
Cache River NWR – Bayou DeView	43	27,515
White River NWR – Jacks Bay/Prairie Lakes	241	152,260
Dagmar WMA	14	7,532
Rex Hancock/Black Swamp WMA	6	2,698
Henry Gray/Hurricane Lake WMA	4	2,091
Trusten Holder WMA	6	2,862
Wattensaw WMA	3	843
Bayou Meto WMA	10	5,244
Total	327	201,045

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

Table H-2. 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	1/5th Acre	Alpha Code for Tree Species; Appendix 4	All trees ≥ 10" dbh
DBH	1/5th Acre	2" classes (9.0" – 10.9" = 10")	
Length in feet or # of logs	1/5th 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. Cruiser option on # of logs.
Crown Class	1/5th Acre	D = Dominant C = Co-dominant I = Intermediate S = Suppressed X = Dead	
Tree Condition	1/5th 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, ≥ 5' tall 8 = Down wood ≥ 8" @ 3' from base	
Stress Factor: Epicormic Branching	1/5th Acre	1 = Little to None (<20% of bole) 2 = Moderate (20% - 50% of bole) 3 = Heavy (≥ 50% of bole)	Bole is portion of tree beneath the crown.
Stress Factor: Bark Disfiguration: Ex: bleeds, tannin stains; bug holes; frass, conks	1/5th Acre	1 = Little to None (<20% of bole) 2 = Moderate (20% - 50% of bole) 3 = Heavy (≥ 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)	
Station Option Intolerant Regeneration	Visible Range	Alpha Code for Tree Species; Appendix 4	Sufficient presence to occur if released
Potential IBW 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 IBW 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).	
IBW 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	

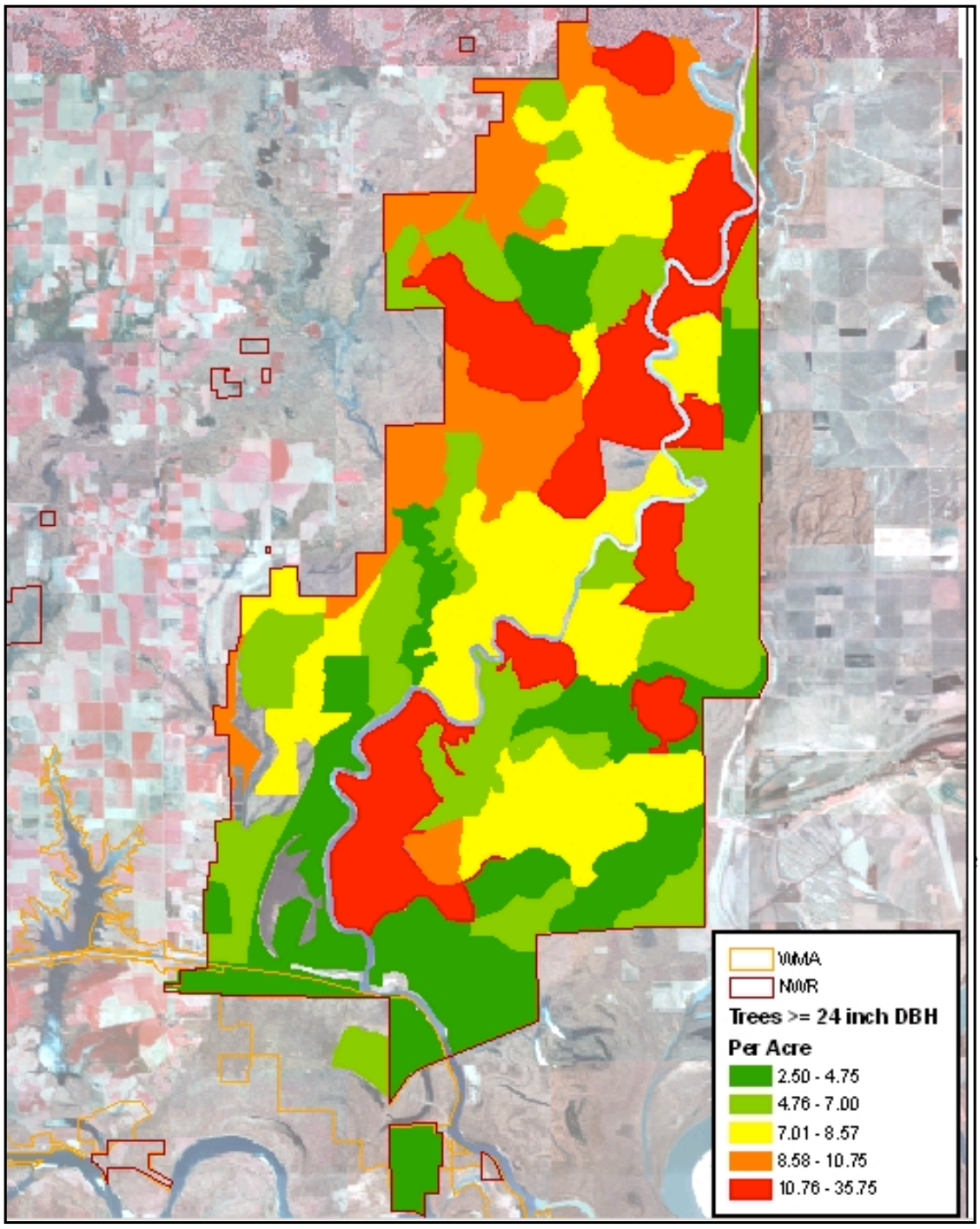
Figure H-4. Preliminary analysis of Ivory-billed Woodpecker habitat inventory data (i.e. density of trees ≥24inch dbh), Cache River NWR and Dagmar WMA, September-October 2005.



Summary of Results

During the months of September and October in 2005, foresters and biologists spent greater than 1,200 man-hours inventorying over 1200,000 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 then entered into a geographic information system to produce spatially explicit maps depicting stand conditions. Additionally, these forest stand maps were used in overlay 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 forest 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.

Figure H-5. Preliminary analysis of Ivory-billed Woodpecker habitat inventory data (i.e. density of trees ≥24inch dbh), White River NWR, September-October 2005.



Appendix I.

Habitat Conditions across the Historical Range of the Ivory-billed Woodpecker

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 (Society of American Foresters, 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); thus, 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 Mississippi where 8.5% of all jobs in the state are forestry-related, and during 2006 forestry contributed 17.4 billion dollars to the Mississippi economy.

(http://www.msforestry.net/pdf/forestryfactsflyer.pdf).

The considerable complexity of the industry is due to the variable size, character, and objectives of its constituent companies, including ownership (individuals/families or 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 (<20 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 types of 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 number of companies no longer own 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 the forest industry, comprising about 9% of total forest ownership (Smith et al. 2003). 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. 2003). In 2001, the South supplied 58.0% of America's total roundwood production (Smith et al. 2003). That year, industrial forests provided 29% of the Nation's timber harvest and private forests in total provided 92% (Smith et al. 2003). 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.

The 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 as over against 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); this was most especially true 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 who work for land-owning forest products companies 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 has the capability of recommending and implementing alterations in stand structure through active forest 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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The following Data Tables reflect analysis completed in 2005.
Table I-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 I-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	Bald cypress/water tupelo
701	Black ash/American elm/red maple
702	River birch/sycamore
703	Cottonwood
704	Willow
705	Sycamore/pecan/American elm
706	Sugarberry/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 I-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
Mesic sites (normally moderate but adequate available moisture)		
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.
Hydric sites (normally abundant or overabundant moisture all year)		
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 I-4. Sources of USDA Forest Inventory and Analysis data used for this analysis.

State	Data source	GMR[1] 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 I-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.

		Public Ownerships			Private Ownerships		
Variable	Size Class	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

Table I-6. Net growth, mortality, and removals by size class in Arkansas, Louisiana, North Carolina, South Carolina, and Texas.

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 I-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 I-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).

		All Ownerships			Private Ownerships		
Variable	**Size Class**	**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

Table I-9. Acres of forestland and timberland, and number and volume of live trees by size class in Georgia (2003 Annual Survey).

		Public Ownerships			Private Ownerships		
Variable	**Size Class**	**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 I-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).

		Public Ownerships			Private Ownerships		
Variable	**Size Class**	**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 I-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).

		Public Ownerships			Private Ownerships		
Variable	**Size Class**	**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 I-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).

		Public Ownerships			Private Ownerships		
Variable	**Size Class**	**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 I-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).

		Public Ownerships			Private Ownerships		
Variable	**Size Class**	**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

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 growing-stock 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 (V2-V1)/(t2-t1)). Because this value is net growth, it may be a negative number. Negative growth values are usually due to mortality (V2=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 use 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 J.
Species Names and Acronyms Used in the Recovery Plan.

Plants

American Elm (*Ulmus americana*)

Ash (*Fraxinus* spp.)

Baldcypress (*Taxodium* spp.)

Bitter Pecan (*Carya aquatica*)

Chestnut Oak (*Quercus michauxii*)

Cotton (*Gossypium* spp.)

Diamond Leaf Oak (*Quercus laurifolia*)

Elm (*Ulmus* spp.)

Green Ash (*Fraxinus pennsylvanicus*)

Hackberry (*Celtis* spp.)

Loblolly Pine (*Pinus taeda*)

Locust (*Gleditsia* spp.)

Longleaf Pine (*Pinus palustris*)

Nuttall Oak (*Quercus nuttalli*)

Overcup Oak (*Quercus lyrata*)

Pecan (*Carya illinoinensis*)

Persimmon (*Diospyros virginiana*)

Pine (*Pinus* spp.)

Poison Ivy (*Toxicodendron radicans*)

Post Oak (*Quercus stellata*)

Red Maple (*Acer rubrum*)

Red Oak (*Quercus rubra*)

Scarlet Oak (*Quercus coccinea*)

Sugarberry (*Celtis laevigata*)

Swamp Tupelo (*Nyssa biflora*)

Swamp-privet (*Forestiera spp.*)

Sweetgum (*Liquidambar styraciflua*)

Tupelo (*Nyssa* spp.)

Tupelo Gum (*Nyssa aquatica*)

Water Elm (*Planera aquatica*)

Water Hickory (*Carya myristiciformis*)

Water Oak (*Quercus nigra*)

White Oak (*Quercus alba*)

Wild Grape (*Vitis* spp.)

Willow Oak (*Quercus phellos*)

Animals

Barred Owl (*Strix varia*)

Beaver (*Castor canadensis*)

Black Woodpecker (*Dryocopus martius*)

Great Horned Owl (*Bubo virginianus*)

Great Slaty Woodpecker (*Mulleripicus pulverulentus mohun*)

Ivory-billed Woodpecker (*Campephilus principalis*)

Megallanic Woodpecker (*Campephilus magellanicus*)

Pileated Woodpecker (*Dryocopus pileatus*)

Raccoon (*Procyon lotor*)

Rat Snake (*Elaphe spp.*)

Red-shouldered Hawk (*Buteo lineatus*)

Squirrel (*Sciuridae* family)

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

IBWO
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 Service

USGS
U.S. Geological Survey

WMA
WMA

Appendix K.

Service Response to Public Comments on the Ivory-billed Woodpecker Recovery Plan

Comment 1

[Opposition to plan and recovery efforts] Approximately 56 comments (including one letter with 70 signatories) did not support the draft recovery plan development or implementation of recovery efforts because: (1) they believed the evidence for the Ivory-billed Woodpecker's existence wasn't strong enough to justify those activities; (2) the estimated costs for those tasks ($27 million) was too high or could be better spent on other species; and/or (3) the Ivory-billed Woodpecker's decline is part of the natural selection process. Some commenters provided specific information and references that dispute or provide alternative explanations for recent Ivory-billed Woodpecker evidence. Two commenters stated ancillary benefits received by other species during the Ivory-billed Woodpecker recovery effort were not sufficient justification for using poor evidence for Ivory-billed Woodpecker persistence.

Response 1

Although the Ivory-billed Woodpecker has been listed as an endangered species since 1967, no recovery plan was ever prepared for the species. The Fish and Wildlife Service reconsidered the need for a plan in 2005 when information was released suggesting the presence of at least one bird in the Bayou DeView area of Cache River National Wildlife Refuge. Observers reported multiple sightings and recorded audio and video of what was interpreted to be an Ivory-billed Woodpecker. This evidence is not universally accepted. While there continues to be disagreement as to the validity of this and other reports, the Fish and Wildlife Service has received sufficient information to warrant additional searches and preparation of a recovery plan. Dispute over the potential cost reflects both philosophical and fiscal concerns. The estimated costs include all funds, including non-federal and non-governmental, that could be considered for expenditure to assist with recovering the species. It is not a request for, or commitment of, funding. This estimate is no longer in the recovery plan, it is replaced with actual expenditures found in Appendix C.

The Fish and Wildlife Service accepted the initial evidence of the presence of one bird in the Cache River National Wildlife Refuge and on the basis of all available information believes that it is prudent to plan for the recovery of the species as part of our responsibilities under the ESA. Additionally, the Fish and Wildlife Service, in response to the potential that the species may exist in isolated locations in its former range, initiated region-wide search efforts with state and non-government partners. Initial searches and actions, as well as any others deemed necessary in the future, are consistent with our interpretations of the evidence, our responsibilities under the ESA, and the urgency of the situation. See Appendix B of the final version of the plan for a discussion of recent Ivory-billed Woodpecker evidence.

Comment 2

[Discussion of controversy] Approximately 10 commenters felt that the recovery plan did not provide a balanced discussion of the controversy among ornithologists and the scientific community regarding the evidence supporting the Ivory-bill's existence.

Response 2

Additional discussion of the controversy has been added to the Recovery Plan in Appendix B.

Comment 3

[Support for plan and recovery efforts] Approximately 40 commenters supported the search effort and/or recovery plan but provided little, if any, comments to the plan itself. One comment from an organization stated that we should increase the funding for Ivory-billed Woodpecker search and recovery efforts. Some simply reported their own sightings or other evidence of Ivory-billed Woodpeckers while others hypothesized ways the bird could still persist and why it may be difficult to document the species properly.

Response 3

The Fish and Wildlife Service appreciated the information concerning sightings and followed up on this information as appropriate. Funding decisions take the needs of all listed species into consideration, as well as the fact that much has been accomplished to date concerning Recovery Outline and Plan tasks. The Service acknowledges the difficulty of documenting the species.

Comment 4

[Habitat Management] Many commenters provided a variety of habitat protection and management recommendations. Eight simply stated they support land protection efforts specific for the Ivory-billed Woodpecker. Five recommended that land acquisition and conservation be given greater priority or the highest priority in the recovery plan, and one pointed out that any conservation easements used to help recover the Ivory-billed Woodpecker must be held by a non-political public interest conservation organization that is a 501(c) 3. Three commenters provided specific management actions to improve Ivory-billed Woodpecker habitat (i.e., modify

linear rights-of-way maintenance activities to promote food supplies; decrease habitat impacts and disruption by adjusting work procedures; install nest boxes in forests, such as the Okefenokee Swamp, to improve nesting habitat for the Ivory-billed Woodpecker). One commenter opposed all development within areas occupied by Ivory-billed Woodpeckers, including public access and viewing points.

Response 4
The focus on habitat management is appropriate; however, what is known regarding the habitat requirements of the Ivory-billed Woodpecker comes mostly from historical observations, the work of James Tanner and current reports from sites, where observers have potentially encountered the bird. Any surviving birds may have persisted under less than optimal conditions, given the historical assumptions of Tanner and others regarding its needs. Therefore any future habitat protection and management will require comparison and evaluation against what is unknown as well as what is understood about its habitat requirements. Specific habitat prescriptions for the species will be dependent upon additional knowledge of a specific population's limiting factors. Impacts to the species from potential development or other management actions permitted, funded, or conducted by a federal agency can be evaluated according to the Endangered Species Act's Section 7 consultation process. The need for access restrictions may be evaluated when it is determined that Ivory-billed Woodpeckers actively occupy an area.

Currently, the Lower Mississippi Partners in Flight Landbird Conservation 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 works for large-scale management potentially needed for the Ivory-billed Woodpecker. Guidelines on the sorts of land management within those forest patches can be found in the publication Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat (LMVJV Forest Resource Conservation Group 2007). These guidelines are in use on National Wildlife Refuges and other public lands. Other Fish and Wildlife Programs encourage bottomland hardwood restoration and management on private lands.

Comment 5
[Species Management] Six commenters identified a variety of protection, recovery, and management recommendations for the Ivory-billed Woodpecker. Such recommendations included: (1) keeping all sighting reports confidential to ensure protection and scientific study; (2) increasing fines, jail sentences, and penalties under the ESA for crimes against the species and its habitat; (3) cloning Ivory-billed Woodpeckers using museum specimens as source genetic material and pileated woodpeckers as surrogates; (4) including capture protocols in the recovery plan and establishing a high priority on captive-breeding Ivory-billed Woodpeckers; (5) initiating efforts to net and tag Ivory-billed Woodpeckers with radio transmitters to obtain the appropriate data needed for recovering the species; and (6) practicing trapping and tracking skills on Pileated Woodpeckers.

Response 5
The most significant constraint to recovery of this species is that the population, where there may be one, is very small; therefore, individuals are extremely difficult to detect reliably. The species is so rarely reported that learning more about the species and its habitat requirements and basic aspects of its ecology will be the primary interim conservation action. Conservation efforts to date have been directed towards confirming the existence of the species in multiple locations as well as Arkansas and taking initial habitat improvement and restoration actions. Subsequent controversy over the evidence supporting the 2005 announcement did not reduce the necessity for these initial actions, most of which are complete.

Research, modeling, and habitat inventory projects have been undertaken to better understand the distribution of potential habitat, and enhance the methods used to detect Ivory-billed Woodpeckers. In addition, models focused on foraging energetics, habitat characterization and assessment, and potential population viability were developed.

Knowledge and capabilities for captive breeding are poorly understood for this species. Significant work with surrogate species, such as the Magellanic Woodpecker, may be needed. There is currently no person or institution engaged in the captive breeding of large woodpeckers. Additionally, it is not appropriate at this time, since capturing an Ivory-billed Woodpecker is not readily accomplished. Surrogate ecological studies have been done on the Pileated Woodpecker.

The Ivory-billed Woodpecker is currently protected under the ESA and is afforded the same level of protection as other federally listed species. See Appendix F for a description of the protocol used to protect potential Ivory-billed Woodpecker sighting locations. Specific species management actions, such as those received during the public comment period, are only possible when Ivory-billed Woodpecker populations are identified. These management options may be evaluated if and when such information is available.

Comment 6
[Information Updates] Eight commenters recommended various updates to the plan. Specifically, these included: (1) additional reports of sightings

and other evidence gathered by Dr. Geoff Hill and his associates from Auburn University in the Choctawhatchee basin, Florida; (2) observations reported in 2005 and 2006 from Tennessee; and (3) Mexico observations previously investigated by Dr. James Tanner. One commenter suggested that the plan include the results of the recent federally-funded search efforts from 2005 to present. Two commenters stated that the costs as reflected in the Implementation Schedule should be updated to exclude past fiscal years (i.e., 2006 – 2008).

Response 6
The plan has been updated and revised, as appropriate, providing a response to these comments. James Tanner's Mexico observations were descriptions of the Imperial Woodpecker, a species related to the Ivory-billed Woodpecker.

Comment 7
[Oversight of Plan and Recovery] Three commenters expressed concern regarding the oversight and management of the recovery effort and review of the plan's creation. One recommendation was to appoint a person from the academic community to oversee all search and recovery efforts for the Ivory-billed Woodpecker. Another recommended we appoint Ivory-billed Woodpecker "ambassadors" for every state in which search and recovery efforts take place to coordinate all such activity in that state. One commenter requested that electric generating companies be represented in the Recovery Team since their activities could impact large portions of potential Ivory-billed Woodpecker habitat.

Response 7
Many partners and cooperators assist with Ivory-billed Woodpecker searches, research, and recovery planning. A team of more than 60 technical experts, scientists, and managers was originally identified. This list eventually grew to nearly 80 people. A list of team members is provided in Appendix A of the Recovery Plan. The Fish and Wildlife Service cooperates with all states within the historical range. State Search Groups independently run their efforts (searches, outreach, and state management). This effort is partially funded and coordinated by the Fish and Wildlife Service.

Forest industry, academia, federal and state government, non-government organizations, and other private business representatives are on the Recovery Team.

Comment 8
[Editorial and Grammatical] Six commenters provided editorial and grammatical comments on the plan.

Response 8
The plan has been edited and revised by a technical editor.

Comment 9
[Recovery Priority Number] Three commenters requested further explanation of the Ivorybill's Recovery Priority Number (RPN) and the process and justification for assigning that number.

Response 9
The plan has been edited to respond appropriately to this comment

Comment 10
[Funding] Two commenters supported the recent Ivory-billed Woodpecker search efforts, but not recovery plan development. They stated that more funds should be dedicated to obtaining better evidence of the species' existence. Another believed the method for ranking search and study areas now and in the future for receiving recovery funds should be more clearly defined in the recovery plan.

Response 10
Balancing the funding between research, habitat analysis, habitat management, search effort, and recovery planning was a decision of the Recovery Team and the Fish and Wildlife Service. Initial funding from multiple programs also focused $3.3 million on planned refuge land acquisitions, $1 million for habitat acquisition by the State of Arkansas, and $3 million on private lands habitat restoration. Search effort funding totaled $2.1 million from Fiscal Years 2006 through 2009. These funds were a portion of the $4.6 million in total recovery funds allocated for Ivory-billed Woodpecker from Fiscal Year 2006 through 2009. State search groups decided which areas should be priority for searches using agreed upon criteria. These criteria included recent reports, current and historical habitat condition, historical records, size of habitat area, history of disturbances, and professional judgment. Selections were also assisted by modeled habitat maps. Additional search effort will be at the discretion of state search groups or private organizations.

The ESA requires that every listed species is to have a recovery plan unless having one would decrease its chances for recovery. This is not the case for Ivory-billed Woodpecker. Many Recovery tasks and actions are centered on obtaining more evidence and locations of the species. During 2006-8 these surveys were guided by the study design and methodology found in Appendix F.

Comment 11
[Habitat] One commenter requested the plan specify those responsible for identifying potential remaining habitat and refining the methods used to identify that habitat.

Response 11
The plan identifies current research efforts aimed at identifying potential habitat in Appendix D.

Comment 12
[Adverse Effects] Three commenters requested greater detail in the definition and discussion of actions that could adversely (or beneficially) impact Ivory-billed Woodpeckers and their habitat. One commenter stated that the plan should identify the types of actions that would be considered to impact the hydrology of that area adversely. The same commenter requested a discussion of the potential

impacts to land-use practices, such as hunting and the "taking" or acquisition of land, caused by land-management requirements in Ivory-billed Woodpecker habitat. One commenter asked that the plan address the effects to Ivory-billed Woodpeckers from increased human utilization of public areas. Another commenter asked that the plan identify ways to alleviate the adverse impacts to Ivory-billed Woodpecker habitat from hydrological changes.

Response 12
More information related to current habitat needs of the Ivory-billed Woodpecker is needed prior to conducting a more thorough threats assessment for the species. No private lands have been taken or condemned by any government agency to protect this species. The U.S. Fish and Wildlife Service's goal is to maintain traditional use of public lands and private property while protecting this species. Hunting, fishing, and other recreational activities are unlikely to present a problem, and most timber management activities may be compatible as well. It is impossible to predict in advance the exact situation or circumstances that may arise on any particular piece of property; therefore, the Fish and Wildlife Service cannot make blanket promises about a particular land use activity.

Human alteration of hydrology in the landscapes of the southeast has a long history. Changing hydrological regimes cause deteriorating conditions (e.g., species mortality) in many forest communities in the Mississippi Alluvial Valley. In Eastern Arkansas conditions are becoming wetter, while much of Louisiana's portion of the Mississippi Alluvial Valley is becoming drier. These tree die-offs might be considered beneficial for Ivory-billed Woodpecker, providing a short-term pulse of foraging opportunity. However, these apparent shifts in tree species composition make it difficult to determine whether old forest conditions can be restored and maintained without correcting hydrological conditions. These questions are a focus of studies unrelated to the Ivory-billed Woodpecker, but as knowledge is gained the plan as well as management approaches can be updated.

Comment 13
[Organization] One commenter stated that to eliminate duplication, all Ivory-billed Woodpecker sightings data (recent and historical) should be located in one section of the plan. This commenter suggested that discussions of all potential Ivory-billed Woodpecker sightings in Arkansas be included in a new appendix that combines the information found in the draft plan's Appendices B, C and D, and that the intended purpose of Appendix C should be explained at the beginning of the appendix.

Response 13
Sections were relocated and revised; however, recent search data is still included in the body of the plan. Appendix E now contains historical information and an analysis of sighting data.

Comment 14
[Animal behavior] One commenter stated that the draft plan erroneously claims past observers, including James Tanner, described Ivory-billed Woodpeckers as having "a more rapid wing-beat relative to pileated."

Response 14
That statement has been modified in the final plan to the following: "When taking flight, the Ivory-bill has been described to have noisy wing-beats. In direct flight they are said to have a rapid wing-beat as well as a slender appearance, resembling a Northern Pintail (Tanner 1942)."

Comment 15
[Threats discussion]: We received several comments regarding our discussion of threats to the Ivory-billed Woodpecker and its habitat. One commenter felt that the recovery plan and its recovery actions retain an inappropriate emphasis on food supplies as a factor contributing to the species' imperilment. The same commenter also did not support the hypothesis that poaching and collecting were the main cause of the Ivory-billed Woodpecker's decline. One commenter stated that disease (Avian flu and West Nile virus) and parasites (Trichonomas, mites, and lice) may pose a current threat to the species and should be addressed in the plan. Another commenter stated that the plan should acknowledge at the beginning of the Reasons for Listing/ Current Threats section (Section H) that the cause of the Ivory-billed Woodpecker's decline is unknown. The same commenter stated that the discussion on Ivory-billed Woodpecker predation should be limited to the beginning sentence, "No incidences of predation on Ivory-billed Woodpeckers are known", as any further discussion on the subject would be speculative. The commenter also stated that the plan should include recovery actions to identify the Ivory-billed Woodpecker's threats, prey distribution, the role of disease, and the sources and significance of predation.

Response 15
The Fish and Wildlife Service agrees that much is unknown and often information is conflicting about the Ivory-billed Woodpecker. However, in the interest of balance and completeness, discussion of all possible threats and causes of decline are included with appropriate caveats. The ability to "address" threats such as disease is extremely limited at this time. Additional information regarding the species will be needed to assess current threats to the species appropriately.

Comment 16
[Diet]: One commenter felt that the recovery plan and its recovery actions incorrectly emphasized a narrow diet (e.g., wood-boring beetles, longhorn beetles, bark-stripping behavior) for the Ivory-billed Woodpecker. The same commenter provided information about the biology

of the longhorned beetle, one of the bird's main food sources, and felt that this material should be included in the recovery plan.

Response 16
Research is underway concerning potential prey species ecology and biology. Information on completed and current research is found in Appendix D. The primary reference for food habits and feeding is James Tanner's study on the Singer Tract, and that is discussed with appropriate caveats in the plan. The Ivory-billed Woodpecker feeds on vegetable and animal matter, but the importance of beetle larvae found under the bark of newly dead wood is emphasized. This is the literature that we must use and consider for the recovery plan.

Comment 17
[Critical Habitat] Two organizations stated the Service should immediately designate critical habitat for the Ivory-billed Woodpecker and direct a "no net loss" of that critical habitat.

Response 17
No critical habitat has been designated for this species, nor is this required due to the date of listing. However, the Secretary of the Interior may choose to designate critical habitat for the species in the future when more data is available for such an evaluation.

Comment 18
[Management tools] One organization stated that Habitat Conservation Plans (HCPs), Safe Harbor Agreements (SHAs) and species take permits (ITPs) issued under Sect 7, 10, and 4(d) of the ESA, should be amended and revoked while the Service evaluates critical habitat and recovery planning areas. Further, the organization stated that the Service cannot use HCPs/ITPs and SHAs as a method for recovering the Ivorybill or any other listed species, according to a recent case finding (Spirit of the Sage Council vs. Secretary Kempthorne et al. (U.S. D.C. Civil Action No. 98-1873(EGS)). They also provided specific ways for implementing Recovery Objectives 1, 2 and 3 of the draft recovery plan, which are all related to quantifying Ivory-billed Woodpecker habitat and the impacts of HCPs, ITPs, and SFAs.

Response 18
Comment on these policies and programs is appreciated; however, they will not be addressed in the Recovery Plan for the Ivory-billed Woodpecker. Recovery Objectives 1,2, and 3 are generally accepted tenets of basic conservation. Additional detailed objectives will be developed as we learn more about the species and locate nesting pairs. Such recommendations may be included in future revisions of the plan when additional information on the species' current distribution and biological requirements are identified.

Comment 19
[Policy]: One commenter stated that the recovery plan appears more like a species status report, and that the plan does not meet Service policies and guidelines for planning and coordinating the recovery of listed species. Specifically, the plan does not include management actions necessary to achieve down-listing or a realistic time frame and cost estimate required for accomplishing recovery that is supported by analyses and discussion. Further, it does not set forth ". . . precise, measurable criteria and/or identify research needs that will allow the Service and others to objectively determine when recovery has been achieved when it is, in fact, achievable." Also, the commenter stated that the plan does not follow Service policy in that the recovery tasks designated as Priority 1 in the Implementation Schedule are not justified in the Narrative Outline as necessary to prevent extinction, and that none of the tasks appear to be necessary to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Response 19
The Fish and Wildlife Service has produced this Recovery Plan with the assistance and input of a large Recovery Team. Required elements are included and discussed in the amount of detail that current data and knowledge permit. Precision can only match what we know at this time. The plan and current management approaches can be modified as we learn more about the current status of the species and locate individuals. Service policies and guidelines for formulating recovery plans allow for modifications of a recovery plan to fit current knowledge and needs of a species.

Comment 20
[Cuba] One commenter expressed concern that the recovery plan and its actions are too focused on Cuba. The commenter felt that the statement about the need for international cooperation with Cuba in the Overview (Section A, page 1) is inappropriate and premature given that problems of recovering the species in the United States have not been resolved. This person further commented that the statement would be appropriate only when international cooperation would be valuable to recovering the species. Finally, the commenter stated that there is no evidence that the species is observable in Cuba; therefore, the Cuban population should not be included in the plan, and the Ivory-billed Woodpecker's status in Cuba is irrelevant because ESA recovery efforts must be focused solely in the U.S.

Response 20
Cuba is mentioned for information purposes and to be complete in describing the range of the species and potential actions for recovery. No federal intervention or management is contemplated there. Any cooperation or coordination would come from private entities. Fish and Wildlife Service policy states that recovery plans include a species' status and background throughout its entire range

(including other countries). When possible or appropriate, the Service does work with other countries to recover and protect listed species. A recovery plan is a planning document only. Foreign countries choose to implement recovery actions at their discretion.

Comment 21

[Citations] One commenter noted that some discussions in the plan were too speculative and did not provide enough cited material, particularly regarding discussions of the life history, ecology and habitat characterization of the Ivory-billed Woodpecker. This person commented that the second paragraph of Section D, page 4, should end after the statement "Historic population numbers will never be known" because the remainder of that sentence and paragraph is pure speculation that can not be supported with citations. Further, the commenter stated that there are no citable data to support the contention that Ivory-billed Woodpeckers have to range farther and are more sensitive to habitat alterations than Pileated Woodpeckers because of greater food demand (Section E, first paragraph, page 17). The writer also requested that the Service provide citations to support the statement that Ivory-billed Woodpeckers were known to fly several kilometers each day.

Response 21

Additional citations have been added to the text including support for the contention that large woodpeckers (and perhaps, therefore, the Ivory-bill) are capable of expanding their home ranges. Some extrapolations, based upon use of existing data for other species, are made in the recovery plan to identify potential areas of research, draw some conclusions about tentative management direction, and apply biological principles where there are substantial data gaps.

Comment 22

[Recovery method] One commenter recommended that an alternative method of recovering the species would be to do nothing, reasoning that if past unconfirmed sightings are valid and small, difficult to detect populations are scattered throughout eight states, they have survived without intervention. The writer commented that this method may be the only reasonable approach, especially since it is unlikely we will ever gather the information needed to develop effective management plans resulting in some form of measurable recovery.

Response 22

The Fish and Wildlife Service completed the Recovery Plan and many tasks recommended by the Recovery Team. Initial searches and actions as well as any others deemed necessary in the future are consistent with our responsibilities under the ESA. If additional information is acquired, appropriate plan revisions and management changes will be made.

Comment 23

[Focus] Five commenters felt that the draft plan is too focused on observations in Arkansas and ignores observations from other areas within the bird's historical range, such as Louisiana and Mississippi. At least one felt that the plan relies too heavily upon Dr. James Tanner's study (1942) when describing the species' biology and ecology.

Response 23

Dr. James Tanner's study is the most complete work we have concerning this species; our legal requirements and policy dictate that we use this data. The plan has been edited to provide a more balanced dicsussion of the Arkansas observations as well as new information from other states.

Comment 24

[Funding] One commenter recommended the Service improve communication with the public regarding the justification for spending the resources and funds that have been used or allocated, and that the ancillary benefits (e.g., economic, recreational, environmental,and spiritual) received during the Ivory-billed Woodpecker recovery effort be included in those communications. Two commenters felt that an explanation should be provided for the cost estimates presented in the Implementation Schedule.

Response 24

Implementation Cost Estimates are not included in this version. Many tasks are completed; therefore, actual expenditures and actions which provide more useful information are included in Appendix C. Cost estimates for additional activities that are not planned at this time would be speculative, given the lack of information on the species' current status.

Comment 25

[Search locations] One commenter requested that we search for Ivory-billed Woodpeckers in the Pinhook Swamp, Osceola National Forest, and Okefenokee Swamp of northern Florida and southern Georgia.

Response 25

Coordinated searches have been made in suitable habitat prioritized by State Search Groups, Fish and Wildlife Service, Forest Service, and Cornell Laboratory of Ornithology. The commenter's suggested search areas have or will be considered.

Comment 26

[Adverse projects] Two commenters identified construction projects in or near potential Ivory-billed Woodpecker habitat that they deemed would have an adverse impact to the species and requested the Service take action to prevent those activities.

Response 26

The Recovery Plan addresses threats but not specific projects that may pose a threat. Our Endangered Species Act Section 7 Consultation process provides a means to disclose effects and identify requirements for projects with a federal agency component. Private persons or businesses are also required not to "take" (harm, harass, or kill) species listed

as threatened or endangered without authorization from the Fish and Wildlife Service.

Comment 27

[Peer review] Two commenters (one representing members of an organization) asserted that additional outside peer review was needed for the plan. Approximately 70 members of an organization stated that an independent review panel should be established to evaluate the current Ivory-billed Woodpecker data and to publish findings for the Service to consider prior to implementing any aspect of the recovery plan. They recommended that members of the American Ornithologists' Union North American Check-list Committee and the American Birding Association's Checklist Committee be considered for such a review panel.

Response 27

Many partners and cooperators assist with Ivory-billed Woodpecker searches, research, and recovery planning. A team of more than 60 technical experts, scientists, and managers was originally identified. This list eventually grew to nearly 80 people. Representatives from the forest industry, academia, federal and state government, non-government organizations, and other private businesses are on the Recovery Team. A list of team members is provided in Appendix A of the Recovery Plan. The Fish and Wildlife Service cooperates with all state wildlife agencies within the historical range.

The Wildlife Society managed the peer review of the draft plan. It was reviewed by seven independent reviewers representing a variety of backgrounds, including wildlife biologists, avian ecologists, and environmental scientists. The reviewers are employed in academia, state or federal government, and non-government organizations. Additional review of recovery plan revisions can be considered when needed.

Comment 28

[Public participation] One person believes the recovery actions of the plan should reflect the need for more public participation, especially of the youth.

Response 28

The 2005 announcement that an Ivory-billed Woodpecker had been located in the Big Woods of Arkansas generated a substantial amount of interest among the public. Informational materials for the general public and numerous stakeholders involved or concerned with the recovery of the species have been developed. Community-based programs to enhance opportunities to learn about and promote the conservation of the species have been provided in cooperation with partners. Communication plans and strategies have been developed and implemented. Continuing communications address the need for information at various levels and for various stakeholders (e.g., birdwatchers, local citizens, government agencies, industry). Outreach tools to help private landowners and land managers were cooperatively developed by the Nature Conservancy for Arkansas. Youth programs have been implemented, and special materials such as coloring books, activities, and costumes are available for use with younger audiences. The purpose of all communication efforts is to convey a consistent message regarding recovery efforts and to facilitate those efforts through public awareness and education.

Comment 29

[Methods] One commenter stated that the recovery plan should be reorganized into tiers that include first confirming the species and implementing specific recovery actions only after the species' presence is confirmed. Two commenters stated the recovery plan should provide criteria for evaluating reported Ivory-billed Woodpecker sightings and thresholds for determining when federally-funded searches should be stopped and the species declared extinct.

Response 29

Criteria for evaluating reports of Ivory-billed Woodpeckers are included in Appendix F. The plan follows current organization guidance. The list of completed implementation tasks is included and triggers for any future actions is included in the Executive Summary and the body of the plan. Many of the Recovery Actions identified in the final plan will occur only after additional data on the species' current status, location, and biological requirements are gathered. Much of the habitat identified by our partners has been surveyed by the date of publication. Additional effort may be triggered by new information. Fish and Wildlife Service policy sets protocol for declaring a species extinct, which is beyond the scope of a recovery plan.

Comment 30

[Search Methods] Four commenters recommended specific search methods be included in the recovery plan. One recommendation was to fund 2-man stealth audio and video teams to monitor "hotspots" or areas with recent reports of Ivory-billed Woodpeckers within its historical range, such as North and South Carolina. Another commenter advocated using acoustical attraction methods during surveys. Others cautioned against extensive search activities because they felt such activities may disturb the species enough to cause irreparable harm.

Response 30

A balance of conducting a thorough search and producing potential disturbance is difficult, especially when the birds are difficult to locate. Searchers employed a variety of methods, including imitation of double knocks and audio playbacks. During 2 years of data collection we employed an occupancy model survey designed to improve our chances of detecting and drawing conclusions about this hard to detect species. Search models used allowed for surveyors to visit areas of recent reports of Ivory-billed Woodpeckers. This is explained in Appendix F.

Peer Review Comments and Responses

The Fish and Wildlife Service contracted with The Wildlife Society to conduct a peer review of the 2007 Draft Recovery Plan. Seven natural resource professionals performed the independent review representing a variety of backgrounds, including wildlife biologists, avian ecologists, and environmental scientists. The reviewers have experience in or are employed in academia, state or federal government, and non government organizations. The seven individual reviewers made individual reports;a consensus report was not produced. Comments are grouped for response, where appropriate.

Comment 1

Three reviewers commented that the plan was a good summary of current information about the Ivory-billed Woodpecker, better than many other plans for poorly known species, with well-expressed goals and objectives. Two reviewers supported the current research direction. However, three reviewers expressed their dissatisfaction with the plan as a whole, noting the Ivory-billed Woodpecker's debatable existence and subsequently questioning the drafting of a Recovery Plan and the spending of limited resources on a species that may or may not exist. Two reviewers recommended additional discussion of the controversy over the continued existence of the Ivory-billed Woodpecker.

Response 1

Although the Ivory-billed Woodpecker has been listed as an endangered species since 1967, no recovery plan was ever prepared for the species. The Fish and Wildlife Service reconsidered the need for a plan in 2005 when information was released on the presence of at least one bird in the Bayou DeView area of Cache River National Wildlife Refuge. Observers reported multiple sightings and recorded audio and video of what was interpreted to be an Ivory-billed Woodpecker. This evidence is not universally accepted. While there continues to be disagreement as to the validity of this and other reports, the Fish and Wildlife Service has received sufficient information to warrant additional searches and preparation of a recovery plan. The current version contains additional discussion concerning the debate over evidence of the species in Appendix B.

Comment 2

One reviewer felt that the plan is simplistic and does not sufficiently increase the probability of recovery, while another reviewer saw the plan as incomplete and suggested that it be regarded as a first step of a work in progress. Two recommended rejection of the plan as written.

Response 2

The Fish and Wildlife Service has produced this Recovery Plan with the assistance and input of a large Recovery Team. Required elements are included and discussed in the amount of detail that current data and knowledge permit. Precision can only match what we know at this time. Appendices D and F have been augmented to reflect additional historical information and current research projects. Additional search data have been included. However, limited knowledge concerning this species constrains the discussion of many aspects of recovery. The plan and current management approaches can be modified as we locate individuals and learn more about the current status of the species.

Comment 3

Reviewers suggested a number of ways to strengthen the plan. Two reviewers felt that the Service should ensure that the goals and recovery actions are practical and concise and should be streamlined and combined into fewer comprehensive, habitat-centered recovery actions that are flexible enough to adapt constantly and incorporate new findings. Reviewers noted the need to develop measurable results or specific timeframes to determine if goals have been met. One reviewer felt that the Service's priority should focus primarily on locating and confirming the existence of Ivory-billed Woodpecker.

Response 3

The Goals and Recovery Actions were recommended by the Recovery Team. As much as possible, these reflect a balance adopted by the Fish and Wildlife Service of habitat inventory and analysis, habitat conservation, search efforts, research, and public engagement. These efforts all have federal, state, and non-government partners. Many of the initial actions are completed. Some of the actions cannot be characterized more specifically now because information about the current locations and conservation needs of the species is limited.

Habitat guidelines for management of National Wildlife Refuge lands have been adopted. These guidelines serve as the framework for conserving the habitat characteristics believed to be needed for Ivory-billed Woodpeckers as well as many other bottomland hardwood species.

Searches have been conducted throughout the historical range in 2006-7, 2007-8, and 2008-9. The locations searched by state groups reflect a combination of criteria, including likely old forest habitat, recent reports, historical records, tree mortality, and patch size. The main focus for the interim Recovery Actions is locating and delineating Ivory-billed Woodpecker populations.

Comment 4

Reviewers encouraged both diversifying the recovery team to include more members outside the federal agencies and utilizing the expertise of experts who are knowledgeable about woodpecker management and avian population viability.

Response 4

The Recovery Team included over 70 members representing a diverse set of scientists, managers, biologists, foresters, and technical experts. A full

list of members can be found at http://www.fws.gov/ivorybill/recoveryteam.html

Comment 5

Data used should reference other sources to reduce reliance on Tanner's data, as he studied a small, isolated, and stressed Ivory-billed Woodpecker population almost 70 years ago. Six reviewers were particularly concerned about the validity of his data on Ivory-billed Woodpecker tree preference and his predictions of maximum population densities.

Response 5

This is a valuable and valid comment. However, Tanner's publication is the major reference concerning the ecology and life history of this species. Reliance on this publication is, of necessity, evident in the recovery plan. Caveats have been added concerning Tanner's data, and recommendations have been added to this version of the plan in response to these concerns.

Comment 6

It was noted that some references mentioned in the text were not included in the literature cited. Also, five reviewers pointed out that relevant literature that has been published since plan development began should be incorporated and cited in the draft plan. Additionally, one reviewer pointed out that there is redundant historical information.

Response 6

The plan has been edited and revised to include new information and delete redundant sections,as appropriate. Recent or new publications are cited, providing a response to this comment.

Comment 7

Five reviewers suggested that protocols be developed (or provided in the plan, if already developed) for surveying Ivory-billed Woodpecker populations including methods for sampling distribution, abundance, population size, density, and habitat use. Three recommended developing protocols for and implementing captive breeding, and/or translocation of individuals. Two reviewers thought that chain-of-custody, evidentiary, and interview (of people reporting encounters) protocols were very important; one reviewer emphasized rapid-response, emergency protection of roost trees and other sensitive sites. It was noted that adequate statistical reliability should be assured for all protocols.

Response 7

The USGS Cooperative Research Unit at the University of Georgia and University of Georgia professors and graduate students developed a protocol for the region-wide search for the Ivory-billed Woodpecker. This survey design and field protocol for the Ivory-billed Woodpecker search effort was aimed at collecting data that would: (1) allow estimation of occupancy, use, and detection probability for habitats at two spatial scales within its former range, (2) assess relationships between occupancy, use, and habitat characteristics at those scales, (3) allow the development of a population viability model that depends on patch occupancy instead of difficult-to-measure demographic parameters, and (4) be adaptive, updating the above models and search locations with newly collected information. Several years of data were collected in different locations using this protocol. The lack of indisputable positive detections hampered a full interpretation of the data. However, any new locations of possible populations will have this sampling protocol applied in order to draw scientifically supportable conclusions about occupancy.

Copies of search protocols and methodologies, a rating system of sighting reports, and action plans are included in Appendix F of the Recovery Plan.

Chain of custody protocols are included in the action plan found in the appendices of the Recovery Plan. It is worth noting that any evidence of Ivory-billed Woodpeckers, including sighting reports, sound recordings, photographs, and videos, are subject to intense scrutiny by the recovery team and the Fish and Wildlife Service. Analyses and vigorous discussions take place in the birdwatching and ornithological communities of any information regarding this species. Any new photographs submitted to the recovery team will be subjected to forensic analysis for potential fraud.

The action plan, found in Appendix G of the recovery plan, outlines the potential protective measures to be taken if an Ivory-billed Woodpecker roost cavity or nest is located. Initial efforts on the Cache River National Wildlife Refuge (location of the Luneau video) included a limited access area managed via permit. No extensive closures were deemed necessary. Normal uses of the refuge continued. Protective measures will be applied as the situation requires.

Comment 8

Reviewers questioned the proposed recovery date of 2075, noting that there was no explanation why that particular date was chosen. Some reviewers suggested not choosing a target recovery date until more information has been gathered and the plan is revised to reflect the additional information. One reviewer requested an explanation of the recovery number.

Response 8

The recovery date is a common feature of recovery plans and provides a goal that guides recovery efforts, but it is not required. In response to this comment and the current lack of additional information to evaluate the usefulness or accuracy of a recovery date for the Ivory-billed Woodpecker it has been deleted. The recovery priority number has been given additional explanation in this version of the recovery plan.

Comment 9

Five reviewers mentioned the need to expand the search area and include in the plan more information about sightings and

possible remnant populations in Florida, southern Louisiana, and Cuba.

Response 9
Search areas have included habitat throughout the species' historical range in the U.S. This information is included in the current version of the plan, as well as additional information on sightings and historical information. The recovery strategy contained in this recovery plan pertains only to the population of Ivory-billed Woodpeckers in the United States, but it could also be applied to recovery efforts for the Cuban population. 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, but currently this is not feasible for legal and diplomatic reasons.

Comment 10
One reviewer commented on the issue of size comparison between the Pileated Woodpecker and the Ivory-billed Woodpecker.

Response 10
This statement has been clarified in the current version of the recovery plan.

Comment 11
Four reviewers suggested expanding the discussion of necessary changes in forest management to include which current practices should change and which new practices should be implemented. Stressing the use of multiple data sources in decision-making, they also pressed for clarification of habitat management goals as well as specification regarding the size and species of trees that are prime habitat for the Ivory-billed Woodpecker. Additionally, three reviewers suggested that there was not a good connection between loss of food resources and endangerment of the Ivory-billed Woodpecker. Two pointed out that there is no strong evidence of niche specialization, such as dependence on Cerembycid larvae as a primary food source.

Response 11
In 2003, the Lower Mississippi Joint Venture Forest Resource Conservation Working Group specifically started to address issues related to the management of the forest resources within the Mississippi Alluvial Valley. Management issues of concern included management of existing bottomland hardwood forest resources, reforestation of agricultural lands, and inventory and monitoring of all these resources. Instead of placing restrictions on individual silvicultural practices, recommendations target defining certain habitat characteristics that are necessary to meet the annual requirements of the multitude of wildlife species dependent on these forest resources. How forest managers achieve and maintain these habitat characteristics is determined by the individual situation. Objectives are set at the landscape level, and guidance is provided for how to achieve these objectives at the stand level.

Current forest management practices affecting Ivory-billed Woodpecker habitat in the Mississippi Alluvial Valley have been examined in the context of maintaining sustainable landscapes capable of supporting desired forest conditions for a variety of important species. Recommendations have been published by the Lower Mississippi Valley Joint Venture (LMVJV Forest Resource Conservation Working Group 2007). The publication Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat has guidelines which will benefit the full suite of bottomland species, including the Ivory-billed Woodpecker. Application of these recommendations forms the backbone of our approach to the conservation of potential Ivory-billed Woodpecker habitat. However, additional adaptive change may be required as more is learned about the habitat preferences of the Ivory-billed Woodpecker.

The practice of retaining dead and dying wood is not viewed as negatively as it was in the past. Some public land managers are experimenting with ways to 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.

Sweetgum and Nuttall oak were two species clearly favored by Ivory-billed Woodpeckers in Tanner's study. Increasing the amount of sweetgum and Nuttall oak in future forests can be a goal in appropriate forest management prescriptions. Both of these tree species need openings of several acres to regenerate successfully and to produce large diameter trees. There is growing recognition that sweet gum can play an important role in establishing healthy red oak stands that in the future will dominate the mature forest. It must be noted that it is possible the apparent preference for these trees in Tanner's study area could have been due to their greater susceptibility to gradual decline after an extended drought and subsequent fire that occurred about ten years prior to Tanner's study. A photograph documenting an Ivory-billed Woodpecker on a pine tree in Florida suggests some variety of preference in trees; the species' reliance on pine in Cuba is well known.

Important as favoring sweetgum and Nuttall oak may be, management's larger aim will be to produce older forest conditions with adequate dead and dying trees over large enough acreages to allow a more sustainable, functioning forest ecosystem. Gaps created from dying trees or management practices will allow development of a diverse forest structure and provide conditions for the regeneration necessary for a resilient ecosystem.

Tanner's description of food habits remains the most complete documentation of diet. On the basis of anecdotal observations and the examination of the stomach contents of eight collected birds, large beetle larvae appear to be an important component of the diet. 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 also included various nuts such as pecans and acorn as well as fruits, including hackberry, persimmon, wild grape, poison ivy and possibly swamp tupelo. Due to the paucity of data on food items actually consumed by the Ivory-billed Woodpecker, limited conclusions can be drawn concerning preferences. Current research with Pileated Woodpeckers may shed additional light on this issue. This discussion is found in Section G, Management Considerations.

The current version of the recovery plan explores direct killing as a cause of the Ivory-billed Woodpecker decline and endangerment. Please see responses to public comments 15 and 16 for additional information.

Comment 12

One reviewer encouraged caution in acquiring land solely on the assumption that the Ivory-billed Woodpecker is present.

Response 12

The State of Arkansas was awarded Recovery Land Acquisition Funds in 2005 to purchase lands in the Big Woods area. In 2005, 2006, and 2007 priority land acquisitions were completed for the Cache River National Wildlife Refuge. National Wildlife Refuge land acquisitions were planned before the 2005 announcement of the Ivory-billed Woodpecker's rediscovery, and according to system and regional priorities, the focus on the Ivory-billed Woodpecker helped to accelerate the additions to the refuge. Additional suitable habitat reduces fragmentation by enlarging blocks of bottomland hardwood and providing wildlife corridors between areas of suitable habitat. These acquisitions and all our restoration programs benefit waterfowl, songbirds, bear, deer, turkey, and a host of priority species. The landscape goals for these habitats coincide with what we interpret as good management of the ecosystem. Any additional land acquisitions would be evaluated for their benefit to an identified area used by an Ivory-billed Woodpecker as a potential foraging, nest, or roost site.

Comment 13

Three reviewers noted that the lack of previous captive breeding and reintroduction programs for large woodpeckers is a critical data gap and encouraged further exploration of an experimental captive breeding program.

Response 13

Knowledge and capabilities for captive breeding, are poorly understood for this species. Significant work with surrogate species, such as the Magellanic Woodpecker may be needed. This effort would take some time since there is currently no person or institution engaged in the captive breeding of large woodpeckers. At this time, no appropriate source population of Ivory-billed Woodpeckers is available to consider for capture and breeding.

Comment 14

Additional research topics were suggested, including roost tree availability, surrogate studies on Pileated Woodpecker ecology, the effects of climate change on the Ivory-billed Woodpecker, and hydrological changes or stress effects. Two reviewers recommended a retrospective population viability analysis to ascertain the possible effects of a genetic bottleneck.

Response 14

The current version of the recovery plan contains abstracts of current and completed research projects (Appendix D). These have been published already or will be available in scientific journals. "A Stochastic Population Viability Analysis for Rare Large-bodied Woodpeckers, with Implications for the Ivory-billed Woodpecker" by Mattson, et al. applied a stochastic, stage-based, single-population model to available demographic rates for *Dryocopus* and *Campephilus* woodpeckers. This study evaluated the combined importance of initial population size and demographic rates for the persistence of large-bodied woodpeckers. Matson et al.'s model suggests that these species can persist as rare (as few as 5 females), and thus difficult-to-detect, populations provided they maintain ≥ 1.1 recruited females annually per adult female and an annual adult survival rate ≥ 0.8.

Noel, et al. entitle their study "Pileated Woodpecker Nesting Ecology in the Big Woods of Arkansas." Their preliminary findings on large woodpecker ecology in bottomland hardwood habitats, using Pileated Woodpeckers as a model species, suggest that certain characteristics of nest trees, cavity trees, and forage trees selected by large woodpeckers were different between the lower and higher bottomland habitats. The fact that adults exhibited smaller home-ranges than reported in the literature suggests that the species' currently occupied habitats are rich in food resources. The authors also documented nest depredation on the Pileated Woodpeckers studied.

Newell and King's paper, "The Ecology of Pileated Woodpecker Nesting, Roosting, and Foraging and Saproxylic Beetles in Partial Cut and Uncut Bottomland Hardwood Forests,"studies relative abundance and species richness of saproxylic beetles and nesting, roosting, and foraging ecology of Pileated Woodpeckers in recent partial cuts and uncut forest during 2006 and 2007. This study provides a wealth of information concerning nesting, roosting and feeding preferences.

Preferred tree species and sizes, as well as food items are documented.

Hamel et al are continuing a study that is part of a bundled project which includes a primary study of attack rates of Cerambycid beetles and other wood boring insects as potential prey organisms of Ivory-billed Woodpeckers, with a growing number of collateral projects made possible by the initial design. The primary study addresses the concern that food availability is a likely limiting factor for the woodpecker. By a carefully controlled experiment using randomly selected trees, Hamel et al. assess the response of wood-boring insects producing medium and large larvae to four treatments involving progressively greater wounds to living trees.

"Spatial and Temporal Dynamics of Tree Growth in Two Floodplain Forests" is being studied by Gee and King. Hydrologic and geomorphic processes that structure floodplain forests of the Lower Mississippi Alluvial Valley (LMAV) have been altered at the regional, landscape, and local level. Levees, channelization, and other flood control activities have eliminated or altered overbank and backwater flooding in much of the historical floodplain, thus affecting the delivery of water and nutrient-rich sediments. These flood control activities also have altered river stage which can affect the water table at a variety of spatial and temporal scales. This study aims to quantify hydrologic and geomorphic processes within and among floodplains and to determine their influence on forest community composition and tree growth. The study area is located in National Wildlife Refuges (NWR) and Wildlife Management Areas in the LMAV. Study sites are uneven-aged forests selected along a flooding gradient and stratified by geomorphic feature (ridge, swale, and flat). A time-series analysis was used to compare tree growth with climate (temperature, precipitation, and Palmer Drought Severity Index) and river stage. Future portions of the study include quantifying fine scale hydrology (surface and subsurface) in monitoring wells across each geomorphic feature and historical flooding regime at water wells extrapolated from nearby gauges.

Additional government studies that focus on the interactions of hydrologic modification and climate change not specifically concerned with Ivory-billed Woodpeckers may reveal important information needed to manage Ivory-billed Woodpecker habitat in the future. This information can be analyzed and incorporated into the plan as needed.