Waterbirds on Working Lands in Mississippi

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Summary

Mississippi is rich in watery places and birds dependent upon them. The great American nature artist and pioneer, John James Audubon, encountered his first Double-crested Cormorants in 1820 at the mouth of the Yazoo River near Vicksburg. Later at Natchez, Audubon would report seeing millions of cormorants flying along the river. Today, fractional populations of cormorants and other fish-eating waterbirds bedevil fish farmers and create seemingly intractable conflicts. Of all the states bordering the Mississippi River, Mississippi has the most miles of river shoreline. For millennia, birds such as Great Egrets, Wood Storks and Roseate Spoonbills have dispersed northward in great numbers in late summer, some leaving breeding grounds as far away as Central America to feed in the shallow backwaters along the Mississippi River that are chocked full of small fish and other prey. The Pascagoula River, bordered by tens of thousands of acres of protected swamps and wetland forests, is the only large unimpeded river – having nearly all of its natural hydrology – in the lower 48 United States. The Pearl, Big Black and other river systems also are focal areas for wetlands and waterbirds.

The state's most productive farming region, the griddle-flat counties of northwestern Mississippi between Memphis and Vicksburg, is a place residents call "The Delta." It was once part of one of the world's greatest freshwater wetland systems, one that covered 25 million acres along the lower Mississippi River before hundreds of miles of government levees isolated more than 90 percent of the river's floodplain from seasonal overflows. For decades and to this day, farmers and conservationists have battled over government-sponsored water projects that enhance cropping opportunities while greatly altering wetland habitats.

The National Audubon Society was formed more than a century ago mainly to counter the gross, unregulated, and short-sighted slaughter of all wildlife, including Great Egrets and Snowy Egrets that were being hunted nearly to extinction so women could wear their lavish breeding plumes on hats. While the plume hunting has been stopped in Mississippi and all states, we know embarrassingly little about current populations of birds we worked so hard to protect. Fish farmers in Mississippi were reported to have shot and killed, under federally issued permits, up to half of the state's known breeding population of Snowy Egrets for several years as recently as the 1990s. In fairness, the finger should point at all of us for having no earthly idea what the true population status of Snowy Egrets – and many other species – is in Mississippi. Audubon wants to do its part to help resolve conflicts between farmers and wildlife and to provide constructive suggestions for sustaining viable populations of game and non-game birds, other wildlife, and their habitats. As early as 1993, for example, Audubon co-sponsored a national symposium in New Orleans with the National Aquaculture Association on the management of fish-eating birds at fish farms. Here in Mississippi, Audubon is a major partner in a broad-based organization to promote the exchange of information between conservation and agricultural interests who share a common goal to promote environmental education. It was formed in 1991 and is called the Southeast Mississippi Environmental and

Agricultural Coordination Organization. We look forward to much more work of this type with private landowners and government and non-government partners.

In the report that follows, the authors have attempted to compile and synthesize a large amount of information on all types of water-dependent birds in Mississippi, how these birds interface with agricultural lands, and opportunities for voluntary and collaborative conservation with private landowners, particularly around sites identified as part of the global network of Important Bird Areas. The report targets 110 focal species that use agricultural lands for migration, wintering or breeding in six groups – waterfowl, waders, shorebirds, marshbirds, landbirds and other waterbirds. In research for and preparation of this report, the authors identified distinct opportunities for improving our understanding of waterbird populations and enhancing waterbird conservation in agricultural landscapes.

Here are a few of them:

- Mississippi recently embarked on scientifically valid surveys of waterfowl (mainly ducks), and experts consider the survey methods to be among the best in the country. The state and its conservation partners must, however, adopt more rigorous systematic surveys for breeding colonial waterbirds, secretive marsh birds and other bird groups, using aerial and ground-based methods, if it is ever to get a firm handle on the status and trends of certain waterbirds.
- Landowners appear ready to explore demonstration projects that could benefit waterbirds. Resources should be directed at implementing such projects and compiling good information on their results that can be shared widely. The National Wildlife Refuge Association recently received private funding to identify and promote conservation and restoration activities on private lands around federal wildlife refuges along the lower Mississippi River, often the very lands discussed in this report.
- Agencies offering incentives to farmers to promote conservation practices should explore ways of accounting for benefits to priority waterbird species and waterbird-focused Important Bird Areas. Four IBAs (Tara Wildlife, Inc., White's Lane, Panther Swamp and Yazoo National Wildlife Refuges) have potential for pilot projects on the IBAs and private lands surrounding them such as colonial waterbird surveys, demonstration ponds and educational programs.
- We relied heavily on the Mississippi list of Species of Greatest Conservation Need in preparing this report and will continue to work to advance the recommendations of the state wildlife conservation strategy and other regional bird plans.
- In simple, understandable formats, people want to know what they can do on their land to help birds and wildlife. Audubon and its partners stand ready to work with universities, agricultural and natural resource agencies, and producer organizations to develop technical guidance for enhancing, creating and restoring habitat for all focal waterbirds on both agricultural lands and natural areas. Audubon is already a national partner with the U.S. Natural Resources Conservation Service on its Audubon at Home program, and its conservation

tenets are adaptable to properties large and small across Mississippi and the nation.

- Waterbirds, particularly egrets and other long-legged wading birds, migratory shorebirds, and ducks and geese, often are the most visible and impressive components of wildlife-viewing experiences. Mississippi should use its waterbird-rich environments to enhance nature tourism and, consequently, the state's tourism economy. All of Mississippi's most cherished outdoor pursuits, hunting, fishing and wildlife-viewing, depend on healthy habitats.

Waterbirds on Working Lands in Mississippi
Introduction and Purpose

As part of the National Audubon Society's nationwide *Waterbirds and Working Lands (WWL) program*, Audubon Mississippi aims to identify and promote practical agricultural practices that will maintain the economic viability of farms while improving wildlife habitat values and environmental health on private lands. Its initial focus is on waterbirds that have great potential to be indicators of environmental health. Audubon's goal for this project is to encourage agricultural producers in Mississippi to protect wetlands and increase waterbird use on private lands. This project will:

1- Identify and encourage adoption of agricultural management practices that support conservation of self-sustaining populations of waterbirds.
2- Build public appreciation and understanding of waterbirds as barometers of aquatic ecosystem health.
3- Communicate findings in Mississippi and nationally.
4- Work with conservation partners to further the North American Waterbird Conservation Plan (NAWCP) as well as other continental, regional and state bird conservation plans.

Audubon is targeting Important Birds Areas (IBAs) and the working (agricultural) landscapes surrounding them as focal points for this effort in Mississippi. Of the 11.1 million acres of farmland in the state, 5.82 million acres are in cropland and approximately 100,000 water surface acres are in aquaculture production. Audubon recognizes that these working lands can provide larger areas of healthy habitat for birds and other wildlife beyond public lands. Thus Audubon is actively seeking input, guidance and collaboration with agricultural producers and organizations, conservation organizations, natural resource managers on public and private lands and scientists to improve management of these lands.

IBAs in Mississippi - IBAs are sites that provide essential habitat for one or more bird species and include sites for breeding, wintering, and/or migrating birds. They range from a few acres to thousands of acres in size, but usually they are discrete sites that stand out from the surrounding landscape. IBAs may include public or private lands, or both, and they may be protected or unprotected. The IBA program is the first statewide bird conservation effort that considers all birds and habitats, regardless of ownership. To date, Audubon and its collaborators have identified 35 IBAs around Mississippi. Of those, 24 IBAs include wetland types that are important to waterbirds and 16 of those are embedded in agricultural landscapes. Most IBAs important to WWL species are in public ownership -- one is a national forest, seven are national wildlife refuges, four are state wildlife management areas and four are in private ownership.

Wetlands in Mississippi. Before the 1800s, Mississippi had nearly 10 million acres of wetlands. Today, almost 60 percent of those wetlands have been lost from conversion to agriculture and in more recent years to residential and commercial development. Wetlands provide many benefits to fish and wildlife, help control erosion, provide natural

flood control, and improve water quality. Natural wetlands in Mississippi that are important to waterbirds include mudflats, sandbars, oxbows, sloughs, marshes, shrub/scrub swamps and flooded forestlands.

Waterbirds? Those birds associated with wetlands in Mississippi for any portion of their life cycle including waterfowl, waders, shorebirds, marshbirds, other waterbirds and certain landbirds. There are 141 waterbird species (including two distinct Sandhill Crane subspecies, two distinct Snowy Plover subspecies and two distinct Least Tern subspecies) from these six groups that migrate, winter or breed in Mississippi, and 110 of those are known to use agricultural wetlands (aquaculture ponds, rice and soybean fields, etc) as well as natural wetlands in agricultural landscapes .

One facet of Audubon's pilot program is the development of this *Mississippi Waterbirds on Working Lands* technical report that discusses the conservation status and population trends of all waterbirds that migrate, winter or breed in the state, describes those birds that use agricultural or aquaculture landscapes and how, and discusses opportunities for conservation particularly around IBAs that occur in agricultural landscapes.

Conservation Status and Population Trends for Mississippi Waterbirds

Mississippi Waterbirds

Waterbirds are defined by different organizations and institutions in many ways. The National Audubon Society defines waterbirds as "all birds predominantly associated with water either ecologically or taxonomically." Their definition includes loons, grebes, pelicans, cormorants, bitterns, egrets, herons, ibises, rails, coots, gulls, terns and skimmers as well as ducks and geese, oystercatchers, stilts, plovers, sandpipers, phalaropes and seabirds. They also include birds affiliated with water and wetland habitats, such as ospreys, kingfishers and several kinds of passerines (National Audubon Society 2006).

For the Mississippi Waterbirds on Working Lands (WWL) Initiative, State Ornithologist Nick Winstead and Audubon Mississippi Conservation Director Bruce Reid developed a list using data from the Mississippi Ornithological Society of 169 waterbird species ever found in Mississippi including 6 distinct subspecies (2 Sandhill Cranes, 2 Snowy Plovers and 2 Least Terns) highlighted because of unique conservation concern. Of those, 141 species and 6 distinct subspecies normally breed, winter or migrate through the state and 110 species plus 2 Sandhill Crane subspecies are regularly found in Mississippi agricultural landscapes (Mississippi Museum of Natural Science 2006). Those 110 waterbird species that use agricultural landscapes are the focal species for Audubon's WWL initiative in Mississippi and are listed on the following pages and discussed throughout this report.

Mississippi WWL Focal Species

Black-bellied Whistling-Duck
Greater White-fronted Goose
Snow Goose
Ross's Goose
Cackling Goose
Canada Goose
Tundra Swan
Wood Duck
Gadwall
American Wigeon
American Black Duck
Mallard
Mottled Duck
Blue-winged Teal
Northern Shoveler
Northern Pintail
Green-winged Teal
Canvasback
Redhead
Ring-necked Duck
Greater Scaup
Lesser Scaup
Bufflehead
Common Goldeneye
Hooded Merganser
Ruddy Duck
Pied-billed Grebe
American White Pelican
Double-crested Cormorant
Anhinga
American Bittern
Least Bittern
Great Blue Heron
Great Egret
Snowy Egret
Little Blue Heron
Tricolored Heron
Cattle Egret
Green Heron
Black-crowned Night-Heron
Yellow-crowned Night-Heron
White Ibis
Glossy Ibis
White-faced Ibis
Roseate Spoonbill
Wood Stork
Osprey
Bald Eagle
Yellow Rail
Black Rail
King Rail
Virginia Rail
Sora
Purple Gallinule
Common Moorhen
American Coot
Sandhill Crane
Mississippi Sandhill Crane
Black-bellied Plover
American Golden-Plover
Killdeer
Black-necked Stilt
American Avocet
Spotted Sandpiper
Solitary Sandpiper
Greater Yellowlegs
Lesser Yellowlegs
Upland Sandpiper
Ruddy Turnstone
Red Knot
Sanderling
Semipalmated Sandpiper
Western Sandpiper
Least Sandpiper
White-rumped Sandpiper
Baird's Sandpiper
Pectoral Sandpiper
Dunlin
Stilt Sandpiper
Buff-breasted Sandpiper
Short-billed Dowitcher
Long-billed Dowitcher
Wilson's Snipe
American Woodcock
Wilson's Phalarope
Bonaparte's Gull
Ring-billed Gull
Herring Gull
Least Tern
Interior Least Tern
Black Tern
Forster's Tern
Belted Kingfisher
Alder Flycatcher
Eastern Phoebe
Fish Crow
Purple Martin
Tree Swallow
Northern Rough-winged Swallow
Bank Swallow
Sedge Wren
Marsh Wren
Palm Warbler
Prothonotary Warbler
Northern Waterthrush
Louisiana Waterthrush
Common Yellowthroat
Le Conte's Sparrow
Lincoln's Sparrow
Swamp Sparrow
Red-winged Blackbird
Rusty Blackbird

While this report focuses on waterbirds that use agricultural landscapes, a general overview of the conservation status and population trends for all Mississippi waterbirds is provided by taxonomic group. The remainder of this report following this section is devoted to the focal WWL species.

Conservation Status Overview

Of the 141 species found in the state, all but five are considered globally secure (G5), or secure but with some long-term conservation concern (G4). However, 51 species are ranked in Mississippi as S1 (critically imperiled), S2 (imperiled) or S3 (vulnerable). Three species (Mississippi Sandhill Crane, Interior Least Tern and Brown Pelican) are federally endangered and two species (Bald Eagle and Piping Plover) are federally threatened (on their wintering grounds). Seven species are on the state endangered species list (NatureServe 2006, Mississippi Museum of Natural Science 2006; Table 1).

Conservation status and population trends for every North American bird species are addressed in one of the four major bird conservation plans (North American Waterbird Conservation Plan, North American Waterfowl Management Plan, U.S. Shorebird Conservation Plan, and the Partners in Flight North American Landbird Conservation Plan) that fall under the umbrella of the North American Bird Conservation Initiative (NABCI). NABCI has divided North America into Bird Conservation Regions (BCRs), which are ecologically distinct regions in North America with similar bird communities, habitats and resource management issues. Two BCRs cover most of the state and are referenced herein as BCR 26 (Mississippi Alluvial Valley) and BCR 27 (Southeastern Coastal Plain). The conservation plans have also been broken down by BCR to address more specific concerns on a regional level. Similarly, various conservation organizations and agencies have addressed conservation status and population trends as part of planning efforts aimed at protecting, restoring, enhancing and conserving habitat for birds. Each of these plans note conservation status of birds and recommend actions for conservation and are excerpted throughout this report.

The **Audubon WatchList 2002** identifies U.S. bird species facing population declines and/or threats such as habitat loss on their breeding and wintering grounds, or with limited geographic ranges. The WatchList is a science-based system that focuses attention on at-risk bird species so that limited resources are spent where they are most needed. Sixteen waterbird species in Mississippi are yellow Audubon WatchList species, signifying they are declining and of national conservation concern, and four species are on the red WatchList, meaning they are rapidly declining and of global conservation concern (National Audubon Society 2002).

Fifty-four waterbird species are designated as Mississippi's Species of Greatest Conservation Need (SGCN), a list of 297 declining wildlife species defined by the **Mississippi Comprehensive Wildlife Conservation Strategy (CWCS).** This list includes most bird species and other wildlife that are designated by state or federal statute

as endangered or threatened, those that are ranked by the Mississippi Natural Heritage Program as S1, S2 or S3 species, species with low population density, low reproductive potential, narrow geographic distribution, or species that are identified as conservation priorities under national plans and peer reviewed publications (Mississippi Museum of Natural Science 2005).

The **North American Waterbird Conservation Plan (NAWCP), Version 1** identifies species in 5 categories of continental conservation concern for 210 species in 29 nations in North and Central America including seabirds, coastal waterbirds, wading birds and marshbirds. These categories are based on population trend, population size, breeding, and non-breeding threats and breeding and non-breeding distribution. In Mississippi one species, Black Rail, is of highest concern – a category formerly called "highly imperiled" that includes species with significant population declines, low populations or other risk factors. Fifteen species are of high concern – which includes species known or thought to be declining, or have some other known or potential threat. Eighteen are of moderate concern – those species that are either declining with moderate threats or distributions or are stable with known or potential threats and moderate distributions, or have relatively small populations with relatively restricted distributions. Another eight species are of low concern indicating that they are either stable with moderate threats and distributions, or are increasing but with known or potential threats and moderate to restricted distributions or moderate population size with known or potential threats and moderate to restricted distributions. Seven species are of lowest concern (Kushlan et al. 2002).

The **U.S. Shorebird Conservation Plan (USSCP) High Priority Shorebirds – 2004** identifies 53 species of shorebirds in the U.S. and uses the same categorization scheme as the NAWCP. Of the shorebirds found in Mississippi, 2 species are highly imperiled, 15 are of high concern, 11 are of moderate concern and 7 are of low concern (U.S. Shorebird Conservation Plan 2004).

The **North American Waterfowl Management Plan (NAWMP) 2004 Implementation Framework** specifies continental conservation priorities for ducks, geese and swans that are based on two factors: continental population trend and combined continental harvest data. Continental prioritization for swans and geese are based on a matrix of population trend and deviation from NAWMP population objectives. In Mississippi, 5 species have a high priority, 9 species are moderately high, 8 species are moderate, 7 species are moderately low and 3 species are above objective (North American Waterfowl Management Plan 2004).

Partners in Flight (PIF), in the **North American Landbird Conservation Plan (NALCP),** provides a continental synthesis of priorities and objectives for 448 native landbirds that breed in the U.S. and Canada including a continental Watch List and a Stewardship List. For the WWL initiative, this discussion is limited to wetland-dependent landbird species. Four landbird species in Mississippi (Prothonotary Warbler, Rusty Blackbird, Seaside Sparrow and Nelson's Sharp-tailed Sparrow) are on the PIF Watch List as moderately abundant or widespread species with declines or high threats, or as species with restricted distribution or low population size. Six species (Bald Eagle,

Alder Flycatcher, Louisiana Waterthrush, Palm Warbler, Lincoln's Sparrow and Swamp Sparrow) are listed as Stewardship species because a high percent of their global population is in a single biome (Rich et al. 2004).

Population Trends Overview

Population trends are difficult to reliably estimate for many waterbirds because widely implemented monitoring programs like the Breeding Bird Survey (BBS) and Christmas Bird Count (CBC) either are not structured to adequately survey waterbirds or obtain data during a time of year when some birds of conservation concern are not present. Though not yet in widespread use, standardized survey techniques targeting certain waterbird groups have been developed in recent years (Howe et al 2000, Steinkamp et al 2003, Conway 2004). However, until those programs are more widely used, BBS and CBC data are the best available for estimating trends, along with local and species-specific databases and expert opinion.

The BBS was developed in the 1960s as a continental monitoring program for all breeding birds. Today there are approximately 3700 active BBS routes across the continental U.S. and Canada, of which nearly 2900 are surveyed annually (Sauer et al. 1997). While the Breeding Bird Survey (BBS) provides data about regional population changes for many species, problems such as small sample sizes, low relative abundances on survey routes, imprecise trends and missing data can compromise results. In Mississippi, data are regularly collected on only approximately half of the routes (BBS 1966-2005; Sauer et al. 2005). The BBS yields very small sample sizes for waterbirds because it does not adequately sample wetlands. Also, many of the birds are relatively non-vocal and rarely detected unless using a survey protocol that uses call-broadcasts or surveys nesting colonies (N. Winstead, MDWFP/MMNS *pers. comm*.).

The CBC was initiated in 1900 to monitor the status and distribution of bird populations across the Western Hemisphere. More than 50,000 observers participate each year in this all-day census of early-winter bird populations. The results of their efforts are compiled into the longest running database in ornithology, representing over a century of unbroken data on trends of early-winter bird populations across the Americas (National Audubon Society 2005). Waterbird population trends are covered by the CBC, but poorly covered by the BBS which does not pick up coastal birds at all (G. Butcher *pers. comm*.). Nationally, 35 waterbirds are typically found in the BBS and CBC databases and a comparison of the two databases indicates that 12 of the species show very similar trends, 15 show somewhat similar trends and 8 species show divergent trends (Butcher et al. 2006).

Table 2 includes trend data from several bird plans for waterbirds that migrate, breed or winter in the state at either the global, continental, regional or state level, continental, state and MAV BBS trends, and continental and MAV CBC trends (Brown et al. 2000, Kushlan et al. 2002, PIF 2004, North American Waterfowl Management Plan, 2004a Niven et al. 2006).

Audubon classifies waterbirds into six taxonomic and ecological groups which will be used for this report: **waterfowl, waders, shorebirds, marshbirds, other waterbirds and landbirds.** The conservation status for birds in each group is discussed below, followed by a summary of known population trends.

Waterfowl (Ducks, Geese and Swans)

Conservation Status

There are 32 species of waterfowl found in Mississippi including 26 species of ducks, five geese and one swan. All species are globally secure. Of those, only six species (Canada Goose, Wood Duck, Mallard, Mottled Duck, Blue-winged Teal and Hooded Merganser) breed in the state (NatureServe 2006). The rest are found during winter or migration (Mississippi Ornithological Society 2004 Turcotte and Watts 1999). Two species, American Black Duck and Mottled Duck, are on the yellow Audubon WatchList (National Audubon Society 2002) and are SGCN along with Northern Pintail and Lesser Scaup (Mississippi Museum of Natural Science 2005).

The Cackling Goose, American Black Duck, Mallard, Northern Pintail and Lesser Scaup are high priority continental species in the North American Waterfowl Management Plan (NAWMP). The Wood Duck, American Black Duck, Mallard, Northern Pintail and Lesser Scaup are also considered high regional priority species in at least one of three regions within Mississippi: Lower Mississippi Alluvial Valley (LMAV), East Gulf Coastal Plain (EGCP) or Southeastern Coastal Plain (SCP) (North American Waterfowl Management Plan 2004b; Table 1).

Population Trends

For 2004 - 2006, the Mississippi Department of Wildlife, Fisheries and Parks (MDWFP) in cooperation with Delta Wildlife (a conservation organization) conducted aerial waterfowl surveys on specific transects through the Mississippi Delta (MDWFP 2006). Prior to this time, data were based on agency estimates, estimates derived from other states and estimates based on the average change during previous years in surveyed regions. Thus, estimates in Mississippi for recent years are not comparable with other years for most species observed in the midwinter waterfowl survey in the Mississippi Flyway. According to the mid-winter survey, recent state duck populations are higher than during1955, but have been highly variable from year to year and trending downward overall from 1966 – 2005 (Fronczak 2006).

On a continental scale, 15 of the 32 waterfowl species have been increasing, while 7 species (American Black Duck, Northern Pintail, Lesser Scaup, Surf Scoter, White-winged Scoter, Black Scoter and Long-tailed Duck) have declined. Northern Pintail populations have decreased consistently across geographic scales (NAWMP 2004a; Table 2).

CBC and annual winter population counts of light geese, including Snow Goose, Blue Goose and Ross's Goose, indicate these species' continental populations may have tripled in the past 30 years (Table 2). The U.S. Fish and Wildlife Service (USFWS) issued a conservation order liberalizing the hunting of light geese in Mississippi and other states to help reduce the populations of these species that may "be contributing to the decline of breeding populations of other migratory bird species that share breeding grounds" in the Canadian arctic (USFWS 2006).

The BBS data are limited for many waterfowl species. State BBS data and CBC data for the MAV show a possible increase in breeding populations of Wood Duck. The continental BBS data indicate that populations of Black-bellied Whistling Duck, Canada Goose, Wood Duck, Gadwall, Mallard and Northern Shoveler may be increasing, but state data are unavailable or unspecified (Sauer et al. 2005, Butcher 2006; Table 2).

Waterfowl that Use Working Lands

Twenty-six species use agriculture lands in Mississippi - Black-bellied Whistling-Duck, Greater White-fronted Goose, Snow Goose, Ross's Goose, Cackling Goose, Canada Goose, Tundra Swan, Wood Duck, Gadwall, American Wigeon, American Black Duck, Mallard, Mottled Duck, Blue-winged Teal, Northern Shoveler, Northern Pintail, Green-winged Teal, Canvasback, Redhead, Ring-necked Duck, Greater Scaup, Lesser Scaup, Bufflehead, Common Goldeneye, Hooded Merganser and Ruddy Duck (Table 1).

Wading Birds (Storks, Ibises, Herons, Egrets and Spoonbills)

Conservation Status

There are 15 species of wading birds in Mississippi. Fourteen are globally secure (NatureServe 2006; Table 1). Two species (Reddish Egret and Wood Stork) are globally secure, with cause for long-term conservation concern. Eleven species (Great Blue Heron, Great Egret, Snowy Egret, Little Blue Heron, Tricolored Heron, Cattle Egret, Green Heron, Black-crowned Night-Heron, Yellow-crowned Night-Heron, White Ibis and Roseate Spoonbill) are confirmed breeders in Mississippi (Mississippi Ornithological Society 2004) and the Roseate Spoonbill is a critically imperiled state breeder. The Little Blue Heron, Tricolored Heron and White Ibis are imperiled state breeders and the Black-crowned Night-Heron and Yellow-crowned Night-Heron are vulnerable breeders (NatureServe 2006).

Two separate Wood Stork breeding populations disperse into Mississippi after the breeding season, including individuals from the federally endangered population. Although the USFWS does not consider Mississippi Wood Storks as endangered, they are listed on Mississippi's endangered species list. Wood Storks do not overwinter in the state (NatureServe 2006). In September, 2006 the USFWS initiated a five year review of the accuracy of the Wood Stork's listing status (Federal Register 2006). One possible

conclusion from this review may be to broaden the area of occurrence for the listed Wood Stork population (B. Brooks, USFWS, *pers. comm.*).

Nine species are imperiled or vulnerable during the non-breeding season in the state (Snowy Egret, Little Blue Heron, Tricolored Heron, Reddish Egret, Black-crowned Night-Heron, Yellow-crowned Night-Heron, White Ibis, Roseate Spoonbill and Wood Stork) and are also classified as SGCN (MMNS 2005). Four species (Snowy Egret, Little Blue Heron, Tricolored Heron and Wood Stork) are of high continental conservation concern (Kushlan et al. 2002). The Reddish Egret is also a yellow WatchList species (National Audubon Society 2002; Table 1). Information on nesting colonial waterbirds in Mississippi in many cases is lacking, outdated or maintained in uncoordinated, decentralized databases (Lower Mississippi Valley Joint Venture Bird Science Team 2002).

Population Trends

Great Blue Heron, Great Egret and Cattle Egret are permanent residents that are increasing regionally and statewide according to the BBS and CBC. CBC and BBS data suggest Snowy Egret and White Ibis also are possibly increasing (Butcher 2006; Sauer et al. 2005). State BBS data are unclear for Little Blue Heron, Green Heron, Black-crowned Night-Heron and Wood Stork, but long-term BBS trends show these populations are decreasing on a continental and regional scale (Sauer et al. 2005, Kushlan 2002; Table 2).

Tricolored Heron and Reddish Egret populations also appear to be declining on a continental and regional scale, but state BBS and CBC data are uncertain. Glossy Ibis, White-faced Ibis and Roseate Spoonbill populations have continental increases (Sauer et al. 2005, Kushlan 2002, Butcher et al. 2006; Table 2).

Wading Birds that use Working Lands

Fourteen species of wading birds use agricultural lands in Mississippi - Great Blue Heron, Great Egret, Snowy Egret, Little Blue Heron, Tricolored Heron, Cattle Egret, Green Heron, Black-crowned Night-Heron, Yellow-crowned Night-Heron, White Ibis, Glossy Ibis, White-faced Ibis, Roseate Spoonbill and Wood Stork (Table 1).

Marshbirds (Cranes, Rails, Gallinules, Coots and Bitterns)

Conservation Status

Twelve species of marshbirds (including two distinct subspecies of Sandhill Crane) occur in Mississippi and all except the Clapper Rail use agricultural landscapes (Table 1). Eight species are globally secure; three species, American Bittern, Black Rail and King Rail, are globally secure, but with cause for long-term conservation concern (NatureServe 2006; Table 1). The Least Bittern, Clapper Rail, King Rail, Purple Gallinule, Common Moorhen, American Coot and Mississippi Sandhill Crane are confirmed breeders

(Mississippi Ornithological Society 2004). The Least Bittern, King Rail and Purple Gallinule are vulnerable state breeders (NatureServe 2006)

The Sandhill Crane's state status is critically imperiled. Two migrant races of Sandhill Cranes have been found in Mississippi (Turcotte and Watts 1999). The non-migratory Mississippi Sandhill Crane is a federally and state listed endangered species and is a critically imperiled state breeder (NatureServe 2006).

The Yellow Rail and Black Rail are imperiled in the state during the non-breeding season; the King Rail and American Bittern are vulnerable and the Clapper Rail is secure, but with cause for long-term conservation concern in the state (NatureServe 2006). The NAWCP classifies Black Rail as a species of highest continental concern and is targeted for immediate action in the Southeast, MAV and SCP regional plans. The American Bittern, Least Bittern, Yellow Rail, King Rail, Sora and Purple Gallinule are of high continental concern (Kushlan et al. 2002; Table 1).

American Bittern, Least Bittern, Yellow Rail, Black Rail, King Rail, Purple Gallinule and Mississippi Sandhill Crane are SGCN (Mississippi Museum of Natural Science 2005). Yellow Rail is a yellow Audubon WatchList species and Black Rail is a red WatchList species (National Audubon Society 2002).

Population Trends

There are no actual population estimates for marshbirds, but an attempt to develop population estimates was made using data from BBS routes using the PIF approach for the Southeast U.S. Regional Waterbird Plan for the various bird conservation regions. While not ideal, these data represent the best available information for producing population estimates for many of these species. Estimates for some species such as Mississippi Sandhill Cranes, however, come from direct count data available due to the intense management of these very small populations (Hunter et al. 2006). It is important to note that a standardized survey methodology has been developed for a continental marshbird monitoring program and is being used on a pilot basis on some national wildlife refuges and other protected wetlands (Conway 2004).

State-level BBS data are uncertain for all marshbirds (Sauer et al. 2005). There are approximately 100 individuals and 20 breeding pairs of Mississippi Sandhill Cranes in Mississippi on, and adjacent to the Mississippi Sandhill Crane NWR; their population declined significantly throughout the 1990s but has gradually increased in recent years because of intensive population and habitat management (USFWS 2006). Little is known about the distribution and abundance of most other marshbirds (Conway 2004).

According to the BBS, American Bittern, Sora and Purple Gallinule may be declining in Mississippi, and the Virginia Rail appears to be increasing continentally, but decreasing in the MAV (Sauer et al. 2005, Butcher 2006). The Common Moorhen is showing some declines in the Southeastern Coastal Plain and East Gulf Coastal Plain. There is little state

level information on Yellow Rail or Clapper Rail, but the former appears to be decreasing in the Southeast and the latter may be increasing (Kushlan 2002, Sauer et al. 2005).

Black Rail and King Rail populations are decreasing in the MAV and Southeast. The American Coot is also showing declines across the Southeast, and the Common Moorhen is showing declines in the SCP and EGCP, but appears to be increasing elsewhere in the Southeast (Kushlan 2002, Sauer et al. 2005, Butcher et al. 2006; Table 2).

Marshbirds that use Working Lands

Eleven species (including two distinct Sandhill Crane subspecies) use agricultural lands in Mississippi -- American Bittern, Least Bittern, Yellow Rail, Black Rail, King Rail, Virginia Rail, Sora, Purple Gallinule, Common Moorhen, American Coot and Sandhill Crane.

Shorebirds (Plovers, Oystercatchers, Stilts, Avocets, Sandpipers and Phalaropes)

Conservation Status

Thirty-five species of shorebirds (including two distinct subspecies of Snowy Plover) occur in Mississippi, and 33 are globally secure. The Piping Plover is globally vulnerable and the Snowy Plover, Southeastern Snowy Plover and Buff Breasted Sandpiper are globally secure, but with long-term cause for conservation concern (NatureServe 2006). Only seven shorebird species breed in the state: Southeastern Snowy Plover, Wilson's Plover, Killdeer, American Oystercatcher, Black-necked Stilt (a vulnerable state breeder), Willet (secure breeder, but with cause for concern and American Woodcock (Mississippi Ornithological Society 2004, NatureServe 2006). Wilson's Plover and American Oystercatcher are critically imperiled in Mississippi, and the Snowy Plover, Southeastern Snowy Plover, Piping Plover, Marbled Godwit and Red Knot are imperiled in the state (NatureServe 2006; Table 1).

The Piping Plover is federally threatened and state endangered. The Snowy Plover and Southeastern Snowy Plover are state endangered species (NatureServe 2006).

The USSCP identifies 3 species found in Mississippi (Snowy Plover, Piping Plover and Buff-breasted Sandpiper) as highly imperiled and 14 (American Golden Plover, Wilson's Plover, American Oystercatcher, Solitary Sandpiper, Upland Sandpiper, Whimbrel, Marbled Godwit, Ruddy Turnstone, Red Knot, Sanderling, Western Sandpiper, Shortbilled Dowitcher, American Woodcock andWilson's Phalarope) are of high concern. Another 11 are of moderate concern and 7 are of low concern (U.S. Shorebird Conservation Plan 2004; Table 1).

Eighteen shorebird species are SGCN either individually or as in a group of migrant shorebirds of concern: American Golden Plover, Southeastern Snowy Plover, Wilson's Plover, Piping Plover, American Oystercatcher, Solitary Sandpiper, Upland Sandpiper,

Whimbrel, Marbled Godwit, Ruddy Turnstone, Red Knot, Sanderling, Western Sandpiper, Dunlin, Buff-breasted Sandpiper, Short-billed Dowitcher, American Woodcock and Wilson's Phalarope (MMNS 2005). Snowy Plover and Piping Plover are red Audubon WatchList species and nine species are on the yellow Audubon WatchList (American Golden Plover, Wilson's Plover, American Oystercatcher, Whimbrel, Marbled Godwit, Red Knot, Short-billed Dowitcher, American Woodcock and Wilson's Phalarope) (National Audubon Society 2002; Table 1).

Population Trends

Killdeer, the only species with state-level BBS data, may be stable in Mississippi, but it appears to be decreasing regionally and on a broader geographic scale (Sauer et al. 2005, Butcher et al. 2006, Brown et al. 2000).

BBS data show in the MAV that 18 species appear to be declining, and trends are unclear for 14 others. Upland Sandpiper shows a possible increase or stable population in the MAV according to BBS (Sauer et al. 2005). In the Southeastern Coastal Plain, 21 species appear to be declining. The Short-billed Dowitcher population is stable, but trends are uncertain for 14 other species in the SECP. The same patterns are reflected in continental population trends (Brown et al. 2000, Butcher et al. 2006; Table 2). CBC data indicate increases in Greater and Lesser Yellowlegs and decreases in American Woodcock and Wilson's Phalarope in the MAV. Spotted Sandpiper shows a possible increase and Western and Least Sandpiper a possible decrease in the MAV (Butcher et al. 2006).

Shorebirds that use Working Lands

Twenty-seven shorebirds use agricultural lands in Mississippi -- Black-bellied Plover, American Golden-Plover, Killdeer, Black-necked Stilt, American Avocet, Spotted Sandpiper, Solitary Sandpiper, Greater Yellowlegs, Lesser Yellowlegs, Upland Sandpiper, Ruddy Turnstone, Red Knot, Sanderling, Semipalmated Sandpiper, Western Sandpiper, Least Sandpiper, White-rumped Sandpiper, Baird's Sandpiper, Pectoral Sandpiper, Dunlin, Stilt Sandpiper, Buff-breasted Sandpiper, Short-billed Dowitcher, Long-billed Dowitcher, Wilson's Snipe, American Woodcock and Wilson's Phalarope (Table 1).

Other Waterbirds (Loons, Grebes, Pelicans, Cormorants, Gulls, Terns, and Skimmers)

Conservation Status

Twenty-two species occurring in Mississippi are classified as other waterbirds, including gulls, terns and grebes (Table 1). The Brown Pelican, Least Tern, Franklin's Gull and Black Tern are globally secure, but with cause for long-term concern. The rest are globally secure. Eleven species breed in Mississippi (Pied-billed Grebe, Double-crested Cormorant, Anhinga, Laughing Gull, Least Tern, Gull-billed Tern, Caspian Tern,

Common Tern, Royal Tern, Sandwich Tern and Black Skimmer) and the remainder migrate or winter (Mississippi Ornithological Society 2004). The American White Pelican is globally vulnerable. The Interior Least Tern is endangered in Mississippi and is an imperiled state breeder. The Laughing Gull, Gull-billed Tern, Common Tern, Royal Tern and Sandwich Tern are critically imperiled state breeders. The Anhinga, Least Tern and Black Skimmer are classified as vulnerable state breeders (NatureServe 2006; Table 1).

The Least Tern, Gull-billed Tern and Black Skimmer are of high continental conservation concern according to the NAWCP (Kushlan et al. 2002). The Common Tern is targeted for Immediate Management in the Southeast region (Hunter, et al. 2005). Six species are Mississippi SGCN (Anhinga, Least Tern, Least Tern – both subspecies, Gull-billed Tern, Royal Tern, Sandwich Tern and Black Skimmer) (MMNS 2005). None of these species are on Audubon's WatchList (National Audubon Society 2002; Table 1).

Population Trends

Pied-billed Grebe breeding populations may be declining, but CBC data show increases in the MAV (Kushlan 2002, Butcher 2006; Table 2). Horned Grebe has shown consistent declines on a continental, regional and state scale. American White Pelican and Brown Pelican appear to be increasing on a continental, regional and state level, but it is important to note that neither breed in Mississippi. Double-crested Cormorant populations show consistent increases across geographic scales and seasons (Kushlan 2002, Sauer et al. 2005).

Wintering and migrant Herring Gull and Common Tern populations are showing some declines on a continental and regional scale. Laughing Gull and Ring-billed Gull show increases across the Southeast. Black Tern has declined across the Southeast and throughout the U.S. (Kushlan 2002, Sauer et al. 2005, Butcher 2006; Table 2). Least Terns nest along the Mississippi River, and surveys indicate increases along the Mississippi River, though immigration from Gulf Coast populations may contribute to the increase (Thompson 1997, Kirsch and Sidle 1999, Lott 2006). CBC data denote an increase in Forster's Tern in the MAV. CBC and BBS data for the MAV show a possible increase in Anhinga populations (Butcher 2006; Table 2)

Population trends for other gulls, terns and skimmers are less certain due to sample size (Table 2).

Other Waterbirds that Use Working Lands

Ten species in the "Other Waterbird" list use agriculture lands in Mississippi - Pied-billed Grebe, American White Pelican, Double-crested Cormorant, Anhinga, Bonaparte's Gull, Ring-billed Gull, Herring Gull, Least Tern (Interior subspecies), Black Tern and Forster's Tern (Table 1).

Landbirds (Ospreys, Eagles, Kingfishers, Flycatchers, Crows, Swallows, Wrens, Warblers, Sparrows and Blackbirds)

Conservation Status

All 25 species of landbirds in Mississippi that are water-dependent, primarily raptors and passerines, are globally secure. The Bald Eagle is a federally threatened and state endangered species (NatureServe 2006; Table 1).

Fifteen breed or are suspected to breed in Mississippi (Osprey, Bald Eagle, Belted Kingfisher, Eastern Phoebe, Fish Crow, Purple Martin, Tree Swallow, Bank Swallow, Marsh Wren, Prothonotary Warbler, Louisiana Waterthrush, Common Yellowthroat, Seaside Sparrow, Red-winged Blackbird, Boat-tailed Grackle) (Mississippi Ornithological Society 2004, Turcotte and Watts 1999). The Bank Swallow is critically imperiled during the breeding season in Mississippi. The Bald Eagle is an imperiled state breeder and the Osprey is a vulnerable state breeder (NatureServe 2006). The remaining species migrate through or winter in Mississippi (Mississippi Ornithological Society 2004).

Nelson's Sharp-tailed Sparrow is on the red Audubon WatchList, and three species (Prothonotary Warbler, Seaside Sparrow and Rusty Blackbird) are on the yellow Audubon WatchList (National Audubon Society 2002).

Eight species, the Osprey, Bald Eagle, Prothonotary Warbler, Louisiana Waterthrush, LeConte's Sparrow, Nelson's Sharp-tailed Sparrow, Seaside Sparrow and Rusty Blackbird, are classified as Mississippi SGCN (MMNS 2005).

PIF lists four Species of Continental Importance as Watch List Species: Prothonotary Warbler, Nelson's Sharp-tailed Sparrow, Seaside Sparrow, Rusty Blackbird and six species as Stewardship Species: Bald Eagle, Alder Flycatcher, Palm Warbler, Louisiana Waterthrush, Lincoln's Sparrow and Swamp Sparrow (Rich et al. 2004; Table 1).

Population Trends

Unlike waterbirds, BBS data are available for most focal landbirds. Osprey and Bald Eagle populations are increasing on a continental scale, but local trend data are uncertain. BBS data show a possible decrease in the Belted Kingfisher population, but CBC data show an increase in the MAV (Sauer et al. 2005, Butcher et al. 2006). Red-winged Blackbird populations are decreasing (Rich et al. 2004, Sauer et al. 2005). The Rusty Blackbird is notable for its apparent long-term, range-wide decline of over 90 percent during the last several decades (Greenberg and Droege 1999; Table 2).

Alder Flycatcher, Eastern Phoebe, Fish Crow, Northern Rough-winged Swallow, Marsh Wren, Lincoln's Sparrow, Swamp Sparrow and Boat-tailed Grackle populations appear to have increased or are stable on a continental scale. Trend data for Purple Martin show declines on a continental scale and state scale, and a definite decrease in the EGCP. Bank

Swallow, Northern Waterthrush, LeConte's Sparrow and Seaside Sparrow populations indicate possible continental declines. Sedge Wren appears to be increasing continent-wide, but declining or stable in the MAV. Louisiana Waterthrush appears to be stable region-wide, but possibly declining in Mississippi. Prothonotary Warbler is showing definite continental and regional declines, but state data are less clear. Data on Nelson's Sharp-tailed Sparrow are unclear; Lincoln's and Swamp Sparrow show a stable continental population, but may be decreasing in the MAV (Rich et al. 2004, Sauer et al. 2005, Butcher et al. 2006; Table 2).

Landbirds that use Working Lands

Twenty-two of these species use agricultural lands in Mississippi -- Osprey, Bald Eagle, Belted Kingfisher, Alder Flycatcher, Eastern Phoebe, Fish Crow, Purple Martin, Tree Swallow, Northern Rough-winged Swallow, Bank Swallow, Sedge Wren, Marsh Wren, Palm Warbler, Prothonotary Warbler, Northern Waterthrush, Louisiana Waterthrush, Common Yellowthroat, Le Conte's Sparrow, Lincoln's Sparrow, Swamp Sparrow, Red-winged Blackbird and Rusty Blackbird (Table 1).

Wetlands, Working Lands and How Waterbirds Use Them in Mississippi

Wetlands

Mississippi has a total surface area (land and water) of 30.5 million acres. In the 1780s, approximately 32.3 percent of the state was covered by wetlands (approximately 9.87 million acres) (Dahl 1990). Estuarine marshes, mudflats, sandbars, oxbow lakes, sloughs, freshwater marshes, islands, bays and streams provided most waterbird habitat (Elliot and McKnight 2000). Emergent wetlands support nearly all species of waterbirds in the Southeastern U.S. at some stage of their annual cycle. These highly productive habitats are critical to rails (breeding and non-breeding) as well as other marshbirds throughout the year, provide nesting habitat for some species of wading birds and Forster's Terns, foraging habitat for nearly all waterbird species in the region, and serve as vital nurseries for most prey species consumed by waterbirds, among other values (Hunter et al. 2006).

By the 1980s, only 4.07 million acres of wetlands remained in Mississippi representing a loss of 59 percent (Dahl 1990). During that period, wetlands losses were attributable primarily to agricultural conversion. However, since then losses have been distributed nearly evenly between agriculture and "other land" such as forests and barren lands. Urban development has also generated conversion in recent years in the region and state. Natural wetlands have been replaced in Mississippi by agricultural lands, particularly in the MAV, and urban development in some areas (Hefner et al. 1994).

In the MAV and other regions, flooded agricultural lands do provide migration, wintering or breeding habitat for waterbirds. These lands may not be specifically managed as wetlands, and may include ephemerally or perpetually flooded cropfields, irrigation or drainage ditches and flooded field buffer habitats. They may also include more "natural" wetland remnants (emergent marsh, shrubland or woodland) (Hands et al. 1991, Twedt et al. 1998).

Working Lands – Row Crops and Aquaculture in Mississippi

For the purposes of Mississippi's WWL initiative, "working lands" are defined as those lands used for production of row crops and lands used for aquaculture ponds. Of the 30.5 million acres in the state, there are 11.1 million acres of farmland including approximately 5.8 million acres of crops and almost 100,000 surface acres in aquaculture production (NASS 2002, 2006). Table 3 shows acreages by product and land use.

Table 3: Agricultural acreages from the 2002 Census of Agriculture in Mississippi (NASS, 2002) and Mississippi County Catfish Estimates, 2006.

Type	Acres
Total acres in Mississippi	30.5 million
Land in Farms	11,050,000
Cropland	5,820,000
Soybeans	1,610,000
Hay	730,000
Corn	380,000
Wheat	70,000
Cotton	1,210,000
Sorghum	25,000
Rice	265,000
Other Crops	1,523,275
Pastureland	1,400,000
Land enrolled in WRP and CRP*	810,000
Aquaculture (total surface acres)	99,000

**Wetland Reserve Program and Conservation Reserve Program*

Soybeans comprise the largest percentage of total crop area (27 percent), with cotton close behind at 20 percent. Corn, rice, sorghum and winter wheat combined total less than 12 percent of crops (NASS 2002). The following are recent trends in production of major row crops in Mississippi used by waterbirds and a discussion of how waterbirds use these crops. According to the 2002 Census of Agriculture, 20 percent of cropland in Mississippi is irrigated, but the amount inundated and functioning as potential waterbird habitat is unknown (NASS 2002). Table 4 shows approximate planting, harvesting, pesticide application and, where applicable, flooding dates for the following crops.

This discussion includes excerpts from the synthesis of each row crop discussed in the August 2006 draft *Waterbird Use of Working Lands Project* report prepared by Oriane Taft for the National Audubon Society and information gleaned from other sources. Included for each crop discussed is a general overview of major themes relating to waterbird use, resources generally found by crop, positive and negative effects of production practices and gaps in knowledge. Though little is known about focal waterbird species' use of agricultural crops in the Mississippi (except waterfowl), these agricultural lands can provide foraging, breeding and resting habitat year-round. This synthesis was compiled to define the challenges faced by wildlife managers in these different agricultural systems in various BCRs primarily in North America and to identify future research needs to address those challenges. A similar discussion of aquaculture follows.

Because little documentation of waterbird use on working lands in Mississippi exists, most of the discussion below refers to waterbird use of agricultural lands in the MAV, or general statements from studies in other regions.

Rice

About 240,000 acres of **rice** are typically planted in Mississippi annually. The acreage can vary based on the market as well as other commodity markets. Depending on environmental conditions, rice may be planted any time from early April to mid June (MSU Cooperative Extension Service 2006). Most of the rice is dry-seeded and is not flooded until after planting. Harvest is typically from mid August to late October by stripping the head or cutting close to the base of the plant. Some farmers flood their fields again after harvest and maintain water throughout the winter to attract waterfowl. Optimal flooding times in Mississippi are mid-October to mid-March (Elphick and Oring 2003; S. Baker, MDWFP *pers. comm.*). To combat pests, farmers may rotate crops every fourth year. Herbicides are applied during seedbed preparation and after seeding, and insecticides may be used throughout the growing season (Shipp 2002; Table 4).

Waterbird Use

Rice fields are used by many waterbird species in the state and region, and ricelands provide extremely valuable habitat to waterbirds, particularly in regions where wetlands have been significantly reduced (Remsen et al. 1991, Elphick and Oring 1998, Twedt et al. 1998, Elphick and Oring 2003, Elphick 2004). Most waterbirds use rice fields for foraging during nonbreeding periods. Among waterbird groups, use of rice fields by waterfowl is best documented, with large numbers of birds observed foraging in fields during migration and winter, and some species nesting and rearing broods in rice habitats in spring and summer. There is also strong evidence that various shorebirds, wading birds, marshbirds, other waterbirds and landbirds also rely heavily on rice fields for a number of resources. Shorebirds use rice fields as foraging habitat primarily in winter and during migration, sometimes in numbers similar to waterfowl. Although less abundant, wading birds and some other waterbird species (mostly coots, rails, and gulls) maintain a constant presence throughout the year, using rice habitats for both foraging and nesting. Landbird use has been documented primarily during nonbreeding periods, but some species also breed in rice fields (Taft 2006 draft; N. Winstead, *pers. comm*.).

In the MAV, only 23 of the WWL focal species identified for this region have been documented using rice fields - all 23 during winter or migration, and only two species (King Rail and Red-winged Blackbird) during the breeding season. This low number can be attributed to a general lack of available documentation of use of MAV rice fields by species other than waterfowl.

Rice Resources

Foraging resources provided to waterbirds by rice fields include rice and moist soil (including weed) seed (van Groenigen et al. 2003, Reinecke et al. 1989, McAbee 1994, Hohman et al. 1996), green forage (Leslie and Chabreck 1984, Alisauskas et al. 1988, Beedy and Hamilton 1999), aquatic invertebrates (McAbee 1994, Hohman et al. 1996, Huner et al. 2002), and aquatic vertebrates (Fasola and Ruiz 1997, Lane and Fujioka

1998). The caloric value of rice seed ranks moderately high compared to other cereals and moist-soil seeds (Reinecke et al. 1989, Petrie et al. 1998). Little is known about variation in the abundance of aquatic invertebrates across rice-growing regions, but densities appear to be comparable to those typically found in some highly-productive moist-soil impoundments. Dabbling ducks and geese rely on some mixture of moist-soil and weed seeds, green forage, and invertebrates; shorebirds feed heavily on invertebrates; and wading birds and other waterbirds obtain a mixed diet including vertebrate prey such as amphibians and fish available in rice habitats. For a smaller subset of waterbird species, breeding resources provided by ricelands include nesting habitat (including vegetation for nest construction), and brood-rearing habitat where fields and associated habitats are flooded (Yarris 1995, McLandress et al. 1996, Hohman et al. 1994, Pierluissi 2006). In North America, species associated with rice habitats during the breeding season (either foraging or nesting) include representatives from all waterbird groups, although waterfowl, wading birds, marshbirds (rails in particular) and some other waterbirds have been most frequently studied. Flooded rice fields also provide resting habitat for virtually all waterbird species studied during nonbreeding periods (Rave and Cordes 1993, Cox and Afton 1998, Elphick 2000). The food value of waste rice for waterfowl is maximized when foraging occurs in winter or shortly after fields are flooded, but the nutritional value decreases within 30 days of flooding (Rutka 2004).

Practices Benefiting Waterbirds

Waterbirds benefit from many practices and at all phases of rice production. Practices that positively influence the suitability of fields for many waterbirds include some residual straw management techniques, shallow winter flooding, lessened use of harmful pesticides, and fallow and secondary crop rotations.

Although the relative values of different straw management methods remain somewhat unclear (Elphick and Oring 2003, Elphick et al. *in press*), there is some evidence that incorporating straw by plowing might favor invertebrate reproduction and therefore the waterfowl and shorebird species that forage heavily on invertebrates in rice fields. Winter flooding boosts invertebrate productivity (Frederickson and Taylor 1982), and where fields are managed at shallow average depths (10-20 cm), a diversity of waterbirds are guaranteed access to available invertebrates and seed resources (Elphick and Oring 1998, 2003). Promising alternatives to lethal pesticides used extensively in the past include use of less dangerous chemicals, delayed spring flooding, early planting, and management to encourage waterfowl to forage on weed seeds (Fontenot 1973, Smith and Sullivan 1980, Eadie et al. *in prep*). Rotation of rice fields with alternative crops such as soybeans and catfish in Mississippi may benefit waterbirds by providing important interim foraging habitats and by increasing rice seed yields available to birds after future harvests (e.g., Hobaugh et al. 1989, Twedt et al. 1998, Huner et al. 2002). Periodic fallowing of habitat can dramatically boost green forage and moist-soil resources for waterfowl and other granivores (Horn and Glasgow 1964, Hobaugh et al. 1989). Finally, research suggests that by attracting waterbirds to flooded rice fields, rice growers will in turn benefit from enhanced straw decomposition, reduced weed pressure, and a decreased need for herbicides (Bird et al. 2000). However, in the MAV only about 10 percent of

rice acreage is managed to provide winter wetlands for migratory birds (Forest and Wildlife Research Center 2002).

Practices Negatively Affecting Waterbirds

Despite the benefits of rice farming, some practices may adversely affect waterbirds and present future obstacles towards maximizing the conservation value of ricelands. Potentially negative practices include improper management of water depth, straw incorporation methods that eliminate cover and decrease access to waste grain, continued pesticide use, early harvests and new mechanical harvest methods that may reduce food availability to waterbirds.

Post-harvest straw management practices such as disking, rolling, chopping and burning all eliminate cover habitat for migrating marshbirds and potentially decrease the availability of waste grain and other foods to waterbirds (Nelms and Twedt 1996). Complete removal of straw for other uses (construction, ethanol production), a new straw management practice gaining some attention in the rice industry, would make flooding rice fields to enhance decomposition unnecessary and ultimately diminish their value to waterbirds (Eadie et al. *in prep*). For many rice fields, water depths are typically managed deeper than the average 10-20 cm (4-8 in)depth expected to provide access to the greatest diversity of foraging waterbirds (Elphick and Oring 2003). Shallow flooding should be promoted not only to benefit the most species, but also because it reduces water costs to growers and is unlikely to compromise yields (Elphick and Oring 1998, 2003). Maintaining shallow depths in the face of evaporative water loss may be achieved by reserving water (blocking field drainage outlets and retaining any rainwater) in select fields (Eadie et al. *in prep*). Until safer pesticides or alternative control measures are widely established across rice-growing regions, sporadic crisis use of more harmful pesticides will continue to pose a threat to waterbirds using rice fields (Eadie et al. *in prep*). In the MAV where quick-maturing rice varieties allow for early harvests, loss of waste rice due to germination, decomposition and other foraging wildlife may be substantial before the arrival of wintering waterfowl (Manley 1999). Early harvests may also remove nesting cover during a critical time for waterbirds that nest in rice. Strip harvesting method further reduces the amount of waste grain available to waterbirds (Miller and Wylie 1996, Day and Colwell 1998, Shimada 2002).

Knowledge Gaps and Research Needs

Waterbird Use

Among the three major rice-growing regions in North America, the least is known about waterbird use of rice fields in the MAV, especially for shorebird, marshbird, wading bird and WWL landbird species that regularly occur in the region. Also, much waterbird use occurs at night while the few waterfowl surveys conducted in Mississippi have been during the day. There are large gaps in our knowledge of the ecology of waterbirds that use rice habitats for nesting, brood-rearing, and foraging during the breeding season, especially species other than waterfowl and rails. Understanding how priority species use ricelands throughout the year will be vital. There is little information on how WWL

landbirds use and benefit from rice habitats. Finally, there is relatively little information on the use and value of ancillary habitats associated with rice fields, in particular the drainage ditches that deliver water to fields, and which might provide important habitat for some species during both the breeding and nonbreeding seasons (Taft 2006 draft).

Resources

Understanding the carrying capacity of rice-growing regions to support wintering and migratory waterbird populations will require greater information on the abundance and availability of rice resources (rice, moist-soil seeds, green forage, and invertebrates) and their consumption by waterbirds. There is some evidence that the biomass available from waste rice for waterfowl foraging may be overestimated in the MAV, which may cause planning by entities such as the LMVJV to recalculate its foraging habitat goals (Rutka 2004).

Little is known about the abundance of rice and moist soil seeds (including weed seeds) and their importance to nesting species during the breeding season. Documentation of breeding success in rice habitats would be valuable, particularly how success relates to availability of food resources, management practices, and predator activity. Reliance of wading birds on vertebrate prey and the abundance of these foods in various rice habitats, particularly irrigation ditches, have not been evaluated in rice fields in North America, but have been found to be important elsewhere in the world. Factors limiting populations of waterbirds that use rice fields are generally not known, thus it is difficult to fully assess how changing management practices will affect species abundance (Taft 2006 draft).

Effects of Crop Production Methods

How harvest (timing and harvester type) and straw incorporation (burning, rolling, plowing, chopping) methods impact availability of cover and food resources and waterbird use of rice fields remains uncertain, and requires further research. Better documentation of the phenology and intensity of use by some species in the MAV is needed. From the farmer's perspective, studies that examine the economic trade-offs involved in winter-flooding would be valuable, especially assessing the consequences of hunting (which provides increased income through leasing fees) versus no-hunting (which might provide benefits in the form of increased straw decomposition, weed seed control, etc). Since so many species use rice fields, and different species require different conditions, no single set of management practices will benefit all species that use the crop. In order to maximize the benefits that waterbirds as a group can gain from using rice fields during nonbreeding periods, research to examine the trade-offs between different waterbird species needs to be examined. In particular, studies that examine the costs and benefits of different strategies for managing water depth, timing and duration of winter-flooding, and alternative uses of fields such as waterfowl hunting would be helpful. Continued research on alternatives to pesticide use including use of low toxicity chemicals or crop management practices that reduce the need for chemical control would be valuable (Taft 2006 draft).

Soybeans

Mississippi farmers plant approximately 2.0 million acres of **soybeans** each year. This acreage fluctuates some from year to year, but that depends mainly on commodity markets and the impact of weather on other acreage. The all time high acreage was 4.0 million acres in 1979. In recent years, the demand for and production of soybean-based fuel mixed with petroleum-based fuel (biodiesel) has increased in the state among non-farm customers. Experts predict an upsurge in the demand for soybean oil by the biodiesel industry in the coming years (Ratliff 2006).

Soybeans are usually planted in the spring from mid-April to mid May and harvested in the late summer (August through November) (MSU Cooperative Extension Service 2006; Table 4). The new paradigm for soybean production in the midsouthern states including Mississippi is the Early Soybean Production System (ESPS), which involves planting early-maturing cultivars in April. The seeds benefit from water provided by higher rainfall during the reproductive stage, instead of having to develop pods and seeds during the hot, dry months when water is scarce. This system allows the farmer to avoid drought, harvest earlier and increase yields and profit (Heatherly and Tyler 1999). Soybeans are sometimes flooded in late November through early January for waterfowl hunting (S. Baker MDWFP *pers. comm*.).

Waterbird Use

Habitat and resources provided by Mississippi soybean fields may be fairly important to some waterbirds. Greatest waterbird abundances have been observed in soybean fields during nonbreeding periods, particularly winter, with large numbers of ducks, shorebirds, and cranes seen foraging in dry (for geese, cranes) or flooded (ducks, shorebirds) fields at any given time (Jarvis 1976, Lovvorn and Kirkpatrick 1982a, Kahl and Samson 1984, Harvey et al. 1988, Twedt et al. 1998, Twedt and Nelms 1999, Gates et al. 2001). Flooded soybean fields, especially, draw large numbers of various waterbird species (Twedt et al. 1998, Twedt and Nelms 1999). Other species, such as swallows and blackbirds, use soybean fields throughout the year, but typically in relatively low numbers (Boutin et al. 1999a, b; Dolbeer et al. 1978). During the breeding season, soybean fields are used to only a limited extent for nesting or as foraging habitat (e.g., Phillips 1959, Johnson and Dinsmore 1985, Basore et al. 1986, Zwank et al. 1989, Castrale 1995, Boutin et al. 1999a, b; Linz et al. 2003, 2004).

Thirty-four WWL focal species have been observed in soybean fields in the MAV. Of these species, 16 use soybean fields during winter and migration.

Soybean Field Resources

The foraging resources provided to waterbirds by fields planted to soybeans include waste soybeans (e.g., Jarvis 1976, Lovvorn and Kirkpatrick 1982a, b; Gates 1984, Hobaugh 1984, Delnicki and Reinecke 1986, Alisauskas et al. 1988, Krapu et al. 1995),

new shoots and seeds from weed species growing in soybean fields (Dolbeer et al. 1978, Hobaugh 1984, Leslie and Chabreck 1984), and terrestrial invertebrates (Mackay and Kladivko 1985, Braile 1999, Boutin et al. 1999a); aquatic invertebrates are also available to birds in flooded fields (Twedt et al. 1998, Twedt and Nelms 1999). Waste soybeans become available after fall harvest, and quickly decline in abundance and availability towards late winter (Hobaugh 1984, Leslie and Chabreck 1984, Warner et al. 1985). Soybeans usually account for only a minor portion of the diet of those species that forage in soybean fields (e.g., Wright 1959, Alisauskas et al. 1988, Alisauskas and Ankney 1992, Gates et al. 2001). Soybeans are high in protein and fiber content (e.g., Baldassarre et al. 1983, Ensminger et al. 1990), but caloric value and digestibility of soybeans rank fairly low compared to waste grain from cereal crops (e.g., Joyner et al. 1987). Although some researchers suggest that the protein provided by soybeans render this row crop valuable to nonbreeding waterbirds such as geese, ducks, and cranes (e.g., Leslie and Chabreck 1984), others question this idea, maintaining that low digestibility of soybeans can lead to significant deterioration in physiological condition of waterbirds, especially if soybeans are consumed in large quantities (e.g., Delnicki and Reinecke 1986, Loesch and Kaminski 1989). New shoots and seeds of weed species in winter and early spring are an additional resource of importance in soybean fields for grazing species such as geese, particularly after peak availability of waste soybeans has passed (Hobaugh 1984, Leslie and Chabreck 1984, Krapu et al. 2004). Terrestrial invertebrates such as earthworms and insect pests may be important to some waterbirds such as shorebirds, other waterbirds, and landbirds throughout the year, but little research has been conducted with respect to their abundances in fields and their relative importance to waterbirds. For soybean fields that are flooded, available aquatic invertebrates are a food resource of immense value to nonbreeding waterbirds, especially dabbling ducks and shorebirds (Twedt et al. 1998, Twedt and Nelms 1999). Soybeans appear to provide limited resources for waterbirds during the breeding period, as soybean nesting has been confirmed for only one WWL species (Killdeer) (Phillips 1959, Basore et al. 1986), and anecdotal observations of birds present in soybean fields post-breeding only suggest the possibility of brood-rearing in this habitat (Johnson and Dinsmore 1985, Zwank et al. 1989). Use of soybean fields for resting has only been observed for migrating American Golden-Plovers (Braile 1999), but in regions where soybean fields are intentionally flooded, some non-hunted fields may provide important resting areas for local waterbird communities.

Practices Benefiting Waterbirds

Several methods commonly used by soybean growers clearly benefit waterbirds using soybean fields. Practices positively influencing the suitability of fields for many waterbirds include some conservation or 'no-till' practices, winter field flooding, biological insect pest control, and the fallowing of soybean fields. No-till practices are associated with greater abundance and availability of waste soybeans and earthworms (Mackay and Kladivko 1985, Warner et al. 1985). Winter field flooding has the potential not only to benefit farmers by increasing decomposition of soybean residues (e.g., Wright 1959, Nelms and Twedt 1996) but also to provide abundant aquatic invertebrate resources for waterfowl and shorebirds (Twedt et al. 1998, Twedt and Nelms 1999), provided the vegetation and soil conditions are suitable for invertebrate recruitment, and

water depths are appropriately managed (e.g., Elphick and Oring 1998, Taft et al. 2002). Use of uncultivated corridors (strips of unfarmed land running through fields) to achieve biological control of soybean insect pests has been established as a promising alternative to pesticide use in soybean fields (Kemp and Barrett 1989). Fallowing of soybean fields may benefit some waterbirds such as geese by providing green forage from weed species in late winter when soybeans and other waste grains are diminishing in availability across the landscape (Hobaugh 1984).

Practices Negatively Affecting Waterbirds

Some soybean farming practices potentially affect waterbirds, or the suitability of soybean fields for waterbirds, in adverse ways, and these conflicts represent challenges towards maximizing the conservation value of soybean habitat. Potentially harmful production practices include conventional tillage that decreases the abundance and availability of food resources, and continued use of some pesticides (Taft 2006 draft).

Soybean residue plowing has been demonstrated to diminish waste soybean abundance for waterbirds by plowing soybeans under so that they are not accessible to foraging birds (Warner et al. 1985). Documented earthworm abundances are also low on fields that have been plowed due to a lack of surface residues that can decompose over the long-term and provide resources for soil invertebrates (Mackay and Kladivko 1985). With nesting cover fairly low in conventionally tilled soybean fields, nest success of the few soybean-nesting waterbirds may be low (Basore et al. 1986). Herbicide use on soybean fields will substantially diminish important goose foraging resources provided by the new shoots and seeds of weed species (Dolbeer et al. 1978, Hobaugh 1984, Leslie and Chabreck 1984, Boutin et al. 1999b, Krapu et al. 2004). For the few shorebird and landbird species that may forage or initiate nests in soybean fields coincident with timing of pesticide application, exposure to "restricted-use" but still moderately toxic pesticides, or damage to nests from farm machinery applications are significant potential threats (Boutin et al. 1999b).

Knowledge Gaps and Research Needs

Waterbird Use

Few studies have attempted to document the full range of species that use soybean fields which might indicate a shortcoming in our understanding of the value of this habitat or might simply reflect the limited value of this habitat in many areas. One efficient approach to distinguishing these alternatives would be to initiate a volunteer-based, citizen science project centered around the goal of collecting comprehensive information on the numbers and species of birds using agricultural fields containing focal crops such as soybeans. Also, estimating the cumulative use of fields by certain species that are widespread in their use of soybeans but which occur in small numbers in any particular field (e.g., Killdeer) would provide a valuable landscape perspective on the overall importance of soybean habitats (Taft 2006 draft).

Resources

More recent assessments of the amount of waste soybeans typically left in fields would be helpful, as existing estimates are potentially outdated, and amount of waste soybeans may be different today given the changes to harvester efficiency that have potentially occurred in the last two decades. Aside from the few studies on earthworm densities in Indiana soybean fields, there has been no assessment of the abundance of terrestrial invertebrate resources, such as insect pests that may be important foraging resources for waterbirds, or of their consumption by waterbirds at various times of the year. Further work in this area would contribute to our understanding of the overall importance of soybean fields, and towards advancing biological control methods and lessening dependence on pesticide use. Likewise, in flooded soybean fields, quantification of the densities, biomass and timing of availability of aquatic invertebrates important to shorebirds and waterfowl will aid in evaluating and fine-tuning use of winter flooding as a crop management technique that augments the conservation value of soybean fields. For Killdeer, Red-winged Blackbirds, and any other species potentially nesting in soybean fields, assessments of nest densities and success rates on tilled and non-tilled lands will add to a more complete understanding of the importance of soybean nesting resources to waterbirds. Finally, it would be helpful to understand the use and importance of flooded soybean fields as resting and refuge habitat for waterbirds subjected to recreational hunting pressure.

Effects of Soybean Production Methods

There are many gaps in our knowledge of the impacts of soybean production methods on waterbirds. To resolve which tillage methods will most benefit waterbirds, it will be crucial to understand the effects of tillage on terrestrial and aquatic invertebrate resources, on associated foraging waterbird use, and on nest densities and reproductive success of the few waterbird species nesting in soybeans. Where retention of water is feasible in winter, quantifying the efficacy of soybean field flooding to break down crop residues, and of optimal flooding regimes for invertebrate productivity and waterbird use, should help in evaluating the economic and conservation costs and benefits of adopting winter flooding as a widespread soybean management tool. Although these questions have been addressed to some extent for soybean fields in the MAV, we need to assess whether flooding methods (primarily flooding regimes and water depth management) could be more efficient in the MAV. Damage to nests from sowing operations has not been quantified for land planted to soybeans, and thus it would be valuable to quantify the degree of damage to nests from sowing operations, and to investigate whether variation in sowing methods could be used to reduce the number of nests that are destroyed. Effects of pesticides on waterbirds foraging or nesting in soybeans also have not been studied, and the effects of insecticides on invertebrate food resources important to waterbirds have yet to be documented. Quantifying the benefits of organic farming and further evaluating the effects of biological control (including the role of field size and the benefits of corridor strips) would contribute greatly towards lessening dependence on pesticide use. Understanding the extent and impact of recreational waterfowl hunting activities in soybean fields would aid in assessing the degree of disturbance and impact on waterbird body condition and potentially subsequent reproductive success of some waterbirds, particularly geese (Taft 2006 draft). The ESPS should be evaluated to

determine if earlier harvest further limit resources available, particularly to migrating birds.

Corn

Corn growers planted an estimated 380,000 acres of corn and produced an estimated 129 bushels per acre yield level and 47.1 million bushels in Mississippi in 2005. In 2004, growers planted 460,000 acres of corn and produced a record 136 bushels per acre yield level and 59.8 million bushels. Corn production declined about 20 percent in 2006 because wet spring conditions and high fertilizer prices discouraged growers from planting as much corn acreage as during recent seasons. Mississippi corn yields have more than tripled in the past 30 years and are increasing faster than any other crop grown in Mississippi. According to the MSU Cooperative Extension Service, the number of corn acres is expected to rise in 2007, partly because of the anticipated increase in ethanol production (an alternative fuel made from ground corn) in the region (E. Larson, *pers. comm.*). The 2005 Energy Bill created new incentives and programs that will likely increase the demand and production of ethanol. With the rise in ethanol production in the U.S. and the establishment of new ethanol plants in the state such as the new Ergon and Bunge plant to be built in Vicksburg, and those proposed from Amory, Greenville and Rosedale, production of corn grain increased from 1997 to 2004 and is likely to continue (Ibendahl 2005; E. Larson, *pers. comm*.). Corn must be planted in early March through April and is harvested in mid to late July through late October. Some farmers flood corn fields for waterfowl hunting from early November to mid-March (S. Baker, *pers. comm.;* Table 4).

Waterbird Use

Cornfields are used by a moderate number of waterbird species, but may be particularly vital to migrating and wintering geese (e.g., Frederick and Klaas 1982, Craven and Hunt 1984, Davis et al. 1989, Alisauskas and Ankney 1992, Krapu et al. 1995, Havera 1998, Gates et al. 2001). Cornfields are used by the greatest numbers of birds during nonbreeding periods, and thousands of waterfowl and cranes have been observed foraging in cornfields during winter, spring and fall migrations (Petrie et al. 2002). Various other granivorous and/or ground-foraging shorebirds, wading bird and landbird species also use cornfield habitats during the breeding season and migration, but in much lower numbers (e.g., Dolbeer et al. 1978, Castrale 1985, 1999b, Kirk et al. 2001, Beecher et al. 2002). Shorebird species using cornfield habitats are primarily associated with more terrestrial habitats (e.g., Upland Sandpiper, Wilson's Snipe, American Woodcock), and many are visual foragers (i.e., plovers). Landbirds using cornfields are primarily aerial insectivores that forage over the fields (e.g., swallows), ground foragers (e.g., sparrows) or generalist species (e.g., blackbirds).

Corn Resources

The foraging resources provided to waterbirds by cornfields include corn kernels (e.g., Baldassarre et al. 1983, Baldassarre and Bolen 1984, Warner et al. 1985, Krapu et al. 1995), weed seeds (Robertson et al. 1978), new shoots of corn vegetation (Rogers and

Linehan 1977), and terrestrial invertebrates (Robertson et al. 1978, McNicol et al. 1982, Warburton and Klimstra 1984, Bollinger and Caslick 1985, Mackay and Kladivko 1985, Dolbeer 1990, Best 2001). Caloric value of corn ranks the highest among cereal crops and moist-soil seeds (Joyner et al. 1987, Reinecke et al. 1989, Petrie et al. 1998). Corn pest insects, earthworms, and arthropods are among the terrestrial invertebrates that are eaten by some waterbird species. These invertebrates are most accessible to birds in winter, spring and early in the breeding season before growth of the corn crop. Waterfowl rely heavily on waste corn (e.g., Iverson et al. 1982, Alisauskas and Ankney 1992, Krapu et al. 1995, Havera 1998); terrestrial invertebrates are likely to be important to shorebirds (Skagen and Oman 1996) and some landbirds (e.g., Bollinger and Caslick 1985, Dolbeer 1990, Boutin et al. 1999a, Beecher et al. 2002); and other landbirds such as blackbirds obtain a mixed diet of corn (in milk stage from ripening ears) and invertebrates (Bird and Smith 1964, Dolbeer et al. 1978, Best 2001). For a few ground- or shrub-nesting species frequenting cornfields during the breeding season, cornfield habitats (including edges) can provide nesting habitat (Basore et al. 1986, Best 2001). Among WWL species, Killdeer and Red-winged Blackbird are most likely to be found nesting in cornfields.

Practices Benefiting Waterbirds

Some methods involved in producing corn both directly and indirectly benefit the waterbird species using cornfields. Practices that positively influence the suitability of fields for many waterbirds during all phases of the annual cycle include some conventional tillage and some 'no-till' practices for different species, lessened use of harmful pesticides, and organic farming (Taft 2006 draft).

Conventional and no-till practices have different effects on different species. Fall plowing activities associated with conventional tillage potentially increase access to terrestrial invertebrates important to some waterbirds such as shorebirds and landbirds (O'Connor and Shrubb 1986). Likewise, fall burning conventionally practiced in lieu of plowing may increase access to waste corn resources by removing cornstalk residue without destroying ears and kernels (Baldassarre et al. 1983). In contrast, no-till practices improve waterbird access to waste corn by leaving it on the surface rather than plowing it under (Frederick and Klaas 1982, Baldassarre and Bolen 1984, Warner et al. 1985), and decomposing residues contribute to increased earthworm and other invertebrate abundances in spring and summer (Warburton and Klimstra 1984, Mackay and Kladivko 1985). Moreover, no-till practices are associated with better conditions for nest concealment and lower nest failure rates by breeding birds (Basore et al. 1986, Best 1986). The potential to control corn crop pests using other non-pest insects or insect-eating birds may be a promising measure to reduce reliance on pesticides (Dix et al. 1995, Barbosa 1998). Finally, organic farming practices may strongly benefit migrant and breeding waterbirds by increasing the quality and quantity of invertebrate and plant food resources both within cornfields and in cornfield margins (Beecher et al. 2002).

Practices Negatively Affecting Waterbirds

Compared to the positive effects of corn agriculture, there appear to be more practices that adversely impact waterbirds and that present future obstacles and challenges towards improving the wildlife conservation value of cornfields. These negative effects have far-reaching implications towards sustaining some waterbird populations that have become dependent on cornfield resources for survival and reproduction. Cornfield management practices with negative effects include some conventional tillage practices, some no-till practices, timing of sowing, pesticide use, measures used to control bird pests, late harvests, increased harvest efficiency, increased field size, and disturbance from hunting on agricultural land (Taft 2006 draft).

There are more negative effects associated with conventional tillage practices than with no-till practices, and while the negative effects of no-till influence nonbreeding birds, the negative effects of conventional tillage impact waterbirds during both nonbreeding and breeding periods. Although lack of plowing or burning in no-till fields may not increase fall and winter access to invertebrates and waste corn, respectively, fall plowing activities associated with conventional tillage can severely bury waste corn, making it unavailable to foraging waterbirds such as geese (e.g., Frederick and Klaas 1982, Baldassarre and Bolen 1984, Warner et al. 1985, Krapu et al. 1995), and the long-term abundance of invertebrates important to shorebirds and landbirds during spring and summer may be lower in conventionally tilled fields than in no-till fields (Warburton and Klimstra 1984, Mackay and Kladivko 1985). Further, because there are more passes by farm machinery during spring and summer in conventionally-managed fields, more waterbird nests are likely destroyed in tilled fields (Best 1986). Finally, nest concealment resources are fairly low in fields that have been disked and harrowed (Warburton and Klimstra 1984, Castrale 1985, Basore et al. 1986, Best 1986).

Because corn is planted in Mississippi in March and April around the time many nests are initiated, sowing poses a risk to the few nesting waterbirds (and many other non-waterbirds), regardless of tillage method (Basore et al. 1986, Best 1986). For waterbirds using cornfields during the breeding season, the “restricted-use” insecticides applied to cornfields present considerable mortality risk to waterbirds, either from direct ingestion or from nest destruction by farm machinery used to apply chemicals to fields (e.g., Best 1992, Best and Fischer 1992, Stinson et al. 1994, Stafford et al. 1996, Boutin et al. 1999b, Beecher et al. 2002). Pesticides can also reduce weed seeds and invertebrate food resources for breeding or migrating birds (e.g., Flickinger et al. 1986, Osten et al. 2005, Freemark and Boutin 1995, Beecher et al. 2002). Late corn harvests during dry years are known to cause geese to forage on dry soybeans as an alternative food source to delayed waste corn. This diet-switching can be harmful as the consumption of dry soybeans can result in esophageal impaction and death (Durant 1956, Wise 1967, Jarvis 1976). Moreover, the trend towards increased harvester efficiency in some locales appears to be substantially reducing waste corn resources for wintering and migrant geese and cranes adversely impacting fat storage capabilities and potentially lowering reproductive fitness of these species (Krapu et al. 2004). Similarly, the disturbance associated with cornfields hunting activities can adversely affect goose foraging efficiency, fat storage rates and ensuing reproductive success (Bechet et al. 2004).

Knowledge Gaps and Research Needs

Waterbird Use

Many of the observations of species using cornfields come from research conducted outside the MAV in corn-growing regions of southeastern Canada, southwestern North America, and the western U.S. Species reported from these regions include waterfowl (Tundra Swan, Ross' Goose, Blue-winged Teal), shorebirds (Black-bellied Plover, Lesser Yellowlegs, Pectoral Sandpiper, American Woodcock), wading birds (Great Blue Heron, Black-crowned Night-Heron), and landbirds (Purple Martin, Tree Swallow, Bank Swallow, Palm Warbler, Northern Waterthrush, Lincoln's Sparrow). Whether these species also use cornfields in the MAV is unclear. For species such as Ross's Goose, Blue-winged Teal, American Woodcock, Great Blue Heron, and Purple Martin, the lack of reported cornfield use in the MAV and other BCRs may represent a lack of published research from these regions. Estimating the cumulative use of fields by certain species that are widespread in their use of corn but which occur in small numbers in any particular field (e.g., Killdeer) would provide a valuable landscape perspective on the overall importance of cornfield habitats (Taft 2006 draft).

Resources

Uncertainty remains regarding how a continued increase in harvest efficiency may affect waterbird populations. Additional studies that document the waste grain densities at which foraging birds abandon fields (the "giving-up density"), or that link the abundance of waste corn to waterbird survival and reproductive success, would be valuable. Better quantification of terrestrial invertebrate resources such as pest insects, earthworms and arthropods in cornfields and their consumption both by breeding species and nonbreeders (perhaps especially shorebirds) would further our understanding of the importance and sustainability of these resources for waterbirds. Moreover, further work in this area would allow us to better assess the role that waterbirds can play in biological control, and thus the potential to lessen the dependence on pesticide use (Taft 2006 draft).

For those species documented as nesting in cornfields, there is little published information on their breeding success in this habitat. Documentation of nesting success in cornfields and post-nesting habitat use by young birds would further our understanding of the overall importance of cornfield nesting resources to waterbirds. Studies of particular value would include assessing how nest success relates to increased residues in no-till fields, and patterns (e.g., timing, number of field passes) of in-field machinery use. Comparisons of nesting productivity in cornfields to other natural and agricultural habitats would also be worthwhile (Taft 2006 draft).

Effects of Corn Production Methods

The known and potential effects of most corn production practices are based on research conducted on a small number of WWL species, primarily waterfowl. To resolve whether conventional or conservation tillage most benefits waterbird communities using cornfields, we need to evaluate the positive and negative effects of all phases of both practices on more species during all phases of the annual cycle, with an ultimate decision weighted by the overall diversity, abundance, and perceived conservation value of the

species that are affected by each. Continued research on alternatives to pesticide use, including use of low toxicity chemicals or crop management practices (organic farming, biological control) that reduce the need for chemicals, would be immensely valuable. In particular, parsing out the organic farming practices that benefit high priority waterbird species would be a helpful step towards identifying aspects of organic farming that could be incorporated into conventional farming.

Sorghum

Growers planted 25,000 acres of grain **sorghum** in producing an estimated 80 bushels per acre and 1.84 million bushels in 2005. Mississippi's grain sorghum acreage has dropped from an average of 100,000 acres to less than 50,000 acres in recent years because of environmental, production and herbicide drift problems which have severely limited profitability. Sorghum growers in the south Delta suffered severe head sprouting in 2001 and growers in the north Delta experienced experienced sorghum injury from off-target glyphosate herbicide drift in 2003. Since most of the sorghum crop is produced in the MAV, many growers switched to other crops such as corn and soybeans because of these problems. New planting systems for soybeans like the ESPS appear to be more productive and profitable and are displacing many acres where sorghum is well adapted (MSU Cooperative Extension Service 2006; Heatherly and Tyler 1999; E. Larson, *pers. comm*.). Sorghum is usually planted from mid-April to mid-June and harvested from late August to late October (Table 4). Sorghum can be flooded from mid-November to mid-March for birds (S. Baker MDWFP *pers. comm*.). Non-bird resistant, dwarf varieties such as Milo are often planted in well-drained, heavy clay soils by landowners to attract waterfowl as well as dove, turkey and quail (West 2004).

Waterbird Use

Habitat and resources provided by sorghum agriculture in North America are important to many waterbirds, primarily granivorous species such as waterfowl, cranes and blackbirds. Highest abundances of these species have been observed in sorghum fields during fall migration and winter, with large numbers of geese and cranes observed foraging in fields at any one time, and shorebirds, wading birds and landbirds in relatively low abundances. Sorghum fields are used by very few waterbird species during the breeding season either as foraging or nesting habitat (Taft 2006 draft).

Sorghum Resources

Sorghum seed and the green forage of weed species are widely available to waterbirds foraging in sorghum fields; terrestrial invertebrates are another probable but undocumented food resource. Waste sorghum becomes available after mid-summer harvest, but quickly dissipates in availability by late winter. Although most waterbird species consume modest amounts of waste sorghum during fall and winter, seed has been documented to account for a significant proportion of the diets of some species, particularly breeding Black-bellied Whistling Duck and wintering Red-winged Blackbird. Sorghum seed is easily digested and high in caloric value, comparable to corn. New shoots of weed species in winter and early spring may be additional resources of importance in sorghum fields for grazing species such as geese, particularly after peak availability of waste sorghum. Terrestrial invertebrates of sorghum fields such as earthworms and insect pests may be important to some waterbirds such as shorebirds, other waterbirds, and landbirds throughout the year, but their abundances in fields and their relative importance to waterbirds has not been studied. Literature suggests that sorghum fields provide limited resources for waterbirds during the breeding period and a

few observations of birds present in fields post-breeding suggest little use of sorghum fields for brood-rearing (Taft 2006 draft*)*.

Practices Benefiting Waterbirds

There are only a few sorghum crop production practices known to benefit waterbirds using sorghum fields including conservation tillage practices and fallowing of sorghum fields. Reduced or no-till practices are associated with greater fall and winter abundance and availability of waste sorghum, and potentially of terrestrial invertebrates, although the latter has not been confirmed explicitly for sorghum fields. Waterbird use of sorghum fields is generally much greater on fields with minimal tillage than those conventionally managed for minimal crop residues. Fallowing of sorghum fields may benefit some waterbirds such as geese by providing green forage of weed species in late winter when sorghum seed and other waste grains have diminished in availability across the landscape (Taft 2006 draft).

Practices Negatively Affecting Waterbirds

The only sorghum production practice that has been documented to adversely affect waterbirds is that of conventional plowing burying sorghum waste grain. The plowing under of sorghum residue has been demonstrated to virtually eliminate access to sorghum waste seed and foraging waterbirds have been know to respond by evacuating fields after plowing (Taft 2006 draft*)*.

Knowledge Gaps and Research Needs

Waterbird Use
Knowledge of waterbird use of sorghum fields in Mississippi is minimal. For most of the species, observations of sorghum use are from research conducted in other North American BCRs outside the Southeast. This list of species includes many waterfowl (Ross's Goose, Black-bellied Whistling Duck, Northern Pintail, Blue-winged Teal, Gadwall, American Wigeon, Mottled Duck), shorebirds (Black-bellied Plover, Wilson's Snipe, Upland Sandpiper, Spotted Sandpiper, Western Sandpiper), wading birds (Cattle Egret, Great Egret Snowy Egret, Little Blue Heron, Tricolored Heron, White Ibis), marshbirds (Sora), and WWL landbirds (Purple Martin, Northern Rough-winged Swallow, Sedge Wren, Lincoln's Sparrow). Including Mississippi in an effort to document waterbird use of sorghum fields throughout the region would enable more comprehensive evaluation of the importance of North American sorghum habitat to waterbirds.

Resources
Although various shorebird and landbird species have been observed in sorghum, there have been no assessments of the abundances, life history traits, or consumption of terrestrial invertebrate resources such as earthworms or insect pests present in sorghum fields that are likely important foraging resources for these waterbirds. Research in this

area would not only contribute to our understanding of the overall importance of sorghum fields to waterbirds, but would also help to advance biological control methods lessening any dependence on pesticide use. Moreover, although the green forage of weed species appears to be abundant in sorghum fields in fall and winter, the degree to which waterbirds rely on this resource is unknown. With sorghum use studies potentially biased towards nonbreeding periods when sorghum seed is most available to foraging birds, there may be more to learn about the degree to which waterbirds nest in sorghum. Growing sorghum fields likely provide similar nesting resources for breeding waterfowl as that found in wheat fields, and thus it is possible that dabbling ducks nest in sorghum more than has been documented. Further, for any species nesting in sorghum, quantifying nest densities and success rates on tilled and non-tilled lands will add to a more complete understanding of the importance of sorghum nesting resources to waterbirds (Taft 2006 draft).

Effects of Sorghum Production Methods

We know very little about how sorghum production methods impact waterbirds. To date, all research on the effects of tillage practices has been conducted in Texas. To fully understand the impact of sorghum tillage methods on waterbirds will require examining on a larger geographic scale the effects of plowing and residue management on terrestrial invertebrate abundance and availability, associated foraging waterbird use, and nest densities and reproduction success. Similarly, the direct and indirect effects of pesticide use on sorghum fields have not been documented. For those waterbirds occurring in sorghum fields in spring coincident with timing of pesticide application, it would be helpful to evaluate exposure to “restricted-use” but moderately toxic pesticides, and the typical damage to nests from farm machinery passes. The extent to which herbicides affect amount of green forage for grazing species and insecticides diminish important terrestrial invertebrate resources is also in need of documentation for sorghum fields. Impact of summertime harvest operations on nest success of the few waterbirds nesting in sorghum would be valuable to examine.

Wheat

Mississippi growers planted an estimated 110,000 acres of **wheat** in 2004-2005, a 50,000 acre or 31 percent decline from the previous year. Wet fall weather delayed and restricted wheat planting intentions. The recent success and profitability of the ESPS coupled with high nitrogen prices has also reduced wheat planting intentions for Mississippi growers, compared to the state's long term average (MSU Cooperative Extension Service 2006). Unlike other major row crops in the state, wheat is planted early October through late November and is harvested from late May to early July (MSU Cooperative Extension Service 2006; Table 4). Winter wheat is also commonly planted in Mississippi for waterfowl and other wildlife to forage on seeds (West 2004).

Waterbird Use

In North America, winter wheat fields are important to a fairly limited group of waterbirds, but they are highly valuable to swans, geese, and cranes during the nonbreeding season (e.g., Iverson et al. 1982, Alisauskas et al. 1988, Alisauskas and Ankney 1992, Krapu et al. 1995, Gates et al. 2001), and to nesting dabbling ducks in summer (e.g., Krapu 1974, Swanson et al. 1985). The greatest waterbird abundances have been observed in winter wheat fields during nonbreeding periods, where swans, geese, and cranes have been seen foraging in fields at a time (Harvey et al. 1988, Petrie et al. 2002). Various other waterbird species use winter wheat fields throughout the year, but in low numbers. A few shorebirds use wheat fields for nesting or brood-rearing (Higgins 1975, Pampush 1980), and a few generalist landbird species (blackbirds) use wheat fields in winter and spring (Mott et al. 1972, Dolbeer et al. 1978) and during the breeding season (Meanley 1961, Flickinger and Pendleton 1994). Compared to winter wheat, use of spring wheat by waterbirds is minimal. Only a handful of species have been documented using spring wheat fields (e.g., Bird and Smith 1964, Clark et al. 1986, Johns et al. 1997), and use occurs during a relatively short period from late spring to early fall.

Wheat Resources

The foraging resources provided to waterbirds by fields planted to winter wheat include wheat seed (e.g., Mott et al. 1972, Krapu 1974, Dolbeer et al. 1978, Iverson et al. 1982, Lovvorn and Kirkpatrick 1982, Kahl and Samson 1984, Swanson et al. 1985, Alisauskas and Ankney 1992, Davis 2003), and the new leaves/shoots or 'green forage' of growing wheat (e.g., Gates 1965, Tate and Tate 1966, Alisauskas et al. 1988, Krapu et al. 1995). Caloric value for wheat seed ranks moderately high compared to other cereal grains (Sugden 1971, Joyner et al. 1987, Reinecke et al. 1989). The green forage of wheat, although fairly low in caloric value (Buchsbaum et al. 1986, Petrie et al. 1998), is high in protein and fiber (McLandress and Raveling 1981) and therefore of great importance to grazing swans and geese in preparation for egg-laying (Alisauskas and Ankney 1992). The abundance and importance of weed seeds and terrestrial invertebrate resources in wheat fields have not been evaluated. Geese, dabbling ducks, cranes, and blackbirds forage on maturing or waste wheat seed available in fields shortly before and after

harvest, and swans and geese additionally graze on the green forage of winter wheat. It is likely that shorebirds forage on invertebrates when in wheat fields, but no studies document this activity. For some ground- or shrub-nesting species such as dabbling ducks, shorebirds, and Red-winged Blackbird, wheat fields appear to provide potentially valuable nesting habitat (e.g., Higgins 1974, 1975, Ducey and Miller 1980, Cowan 1982, Duebbert and Kantrud 1987, Lokemoen et al. 1990).

Practices Benefiting Waterbirds

Some methods to produce wheat are more beneficial to waterbirds that use wheat fields than others. Waterbirds generally benefit from conservation or 'no-till' practices, and when harvest and planting are timed to provide waste grain or new shoots, respectively, during periods of peak migratory waterbird movements. No-till practices are associated with higher nest densities and lower nest failure rates, most likely due to greater nest concealment and fewer farm machinery passes compared to tilled lands (Higgins 1977, Cowan 1982, Duebbert and Kantrud 1987).

Practices Negatively Affecting Waterbirds

Several wheat production practices potentially impact waterbirds in negative ways, representing challenges to improving the wildlife conservation value of wheat fields. These negative effects may have far-reaching implications for some waterbird species currently dependent on the agricultural resources of wheat fields for survival and reproduction. Practices that can be harmful include conventional tillage, sowing when waterbird nests are active, continued use of some pesticides and continuous cropping practices (Taft 2006 draft*)*.

Due to disking and harrowing activities, there is relatively little vegetation in which birds can conceal their nests in conventionally tilled wheat fields, and this is thought to reduce nest success (Macaulay 1981, Cowan 1982, Duebbert and Kantrud 1987). In winter wheat fields, farm machinery passes for tillage operations coincide with nest initiation and incubation in wheat-nesting waterbirds, and associated low nest success and high risk of mortality have been reported for some species (e.g., Higgins 1975, 1977, Cowan 1982, Duebbert and Kantrud 1987). For waterbirds occurring in wheat fields during the breeding season, application of "restricted-use" insecticides present considerable mortality risk to waterbirds, either from direct exposure (e.g., Graber et al. 1965, White et al. 1982, Flickinger et al. 1991), or potentially from nest destruction by farm machinery used to apply chemicals to fields. Continuous cropping practices may greatly impact the reproductive success of waterbird species that tend to nest in wheat stubble or fallow wheat fields (Podruzny et al. 2002).

Knowledge Gaps and Research Needs

Waterbird Use
Some WWL species have only been observed using wheat fields in areas outside Mississippi (e.g., Tundra Swan, Ross' Goose, Cackling Goose, American Woodcock,

Common Yellowthroat). Some of these species may not have been observed in wheat fields in the state simply because they are rare or only present briefly during migration in those areas (e.g., Tundra Swan). The lack of documentation of WWL species use of wheat may represent the lack of research, or a shortcoming in our understanding of the value of this habitat, or that the habitat is of limited value. One efficient approach to distinguish these alternatives would be to initiate a volunteer-based, citizen science project centered around the goal of collecting comprehensive information on the numbers and species of birds using fields containing focal crops such as wheat (Taft 2006 draft).

Resources

There has been no quantification of the potential value to waterbirds of the terrestrial invertebrates (pest insects, earthworms, etc) found in wheat fields, or of their consumption by waterbirds, particularly shorebirds and passerines on the WWL list. Knowledge of these resources and their use would further our understanding of the importance of wheat field resources for waterbirds. Moreover, further work in this area could contribute to advancing the techniques of biological control and lessen dependence on pesticide use (Taft 2006 draft).

Effects of Wheat Production Methods

There are a number of gaps in current knowledge regarding the effects of wheat production methods on waterbirds. Even for those practices that have been studied, research has focused on only a limited number of species. Influence of tillage methods on the abundance and availability of waterbird food resources throughout the year (e.g., plowing influencing access to waste grain, crop residues influencing invertebrate productivity) has not been evaluated for agricultural land planted to wheat. Where waterbirds nest in spring wheat, it would be valuable to quantify the degree of damage to nests from sowing operations, and to investigate whether variation in sowing methods could be used to reduce the number of nests that are destroyed. If nest destruction cannot be prevented, the development of methods that discourage birds from nesting in these fields might reduce the crop's potential to act as sink habitat that contributes to population declines. Effects of pesticides on waterbirds foraging or nesting in wheat have been little studied, and the indirect impacts of insecticides on wheat-related food resources (invertebrates, forbs, weed seeds) have yet to be documented. Potential benefits to waterbirds of alternatives to chemical use, such as organic farming and biological pest control have not been evaluated for wheat fields or margins.

Cotton

Cotton is a major crop in the state and ranks third behind poultry and forestry in state commodities. Mississippi producers plant approximately 1.1 million acres of cotton each year. This number seems to fluctuate every year depending on weather, cost of production and current commodity markets. The highest acreage recorded in Mississippi was in 1930 when 4.163 million acres were planted to cotton (MSU Cooperative Extension Service 2006). Cotton is also planted in late April and May and typically harvested in September and October (Table 4).

Waterbird Use

Habitat and resources provide by North American cotton fields is of little value to waterbirds. Few waterbird species have been documented in cotton fields at any time of year, and assessments of use relative to availability indicate an active avoidance of cotton fields by most species (e.g., Ballard 1993, Iverson et al. 1992, Iverson et al. 1985a, b; Dolbeer et al. 1978). The few accounts of high use of cotton fields by waterbirds appear to be cases of sporadic intense use by opportunistic species such as Cattle Egrets and Laughing Gulls in association with brief periods of insect outbreaks during the growing season (e.g., Mora 1997, White et al. 1979). Taking into account the risks of pesticide exposure during such events, cotton fields have the potential to act as population sinks if such brief but intense use is the norm under which cotton fields are typically visited by waterbirds. All use accounts have been of waterbirds foraging in cotton fields; no waterbird species has been documented nesting in cotton.

There is almost no documented use of WWL species in winter or migration for the MAV or other BCRs where cotton is grown in North America. These low numbers represent a true low use of cotton fields in these regions (Taft 2006 draft*)*.

Cotton Resources

The potential foraging resources available to waterbirds in cotton fields include cotton seed (Iverson et al. 1982), new shoots and seeds of weed plants (Fleskes et al. 2003), and terrestrial invertebrates (e.g., Bottrell and Adkisson 1977, Mora 1997, Fleskes et al. 2003, Cederbaum et al. 2004). The energy content of cotton seed has not been evaluated, but the cotton seed available in fields after harvest appears to be consumed only rarely. It is unknown to what extent weed plants may be an important resource for birds, especially in organically farmed cotton fields. Terrestrial invertebrates are likely the most valuable foraging resource to be found in cotton fields, especially if managed using conservation tillage, stripcover cropping, or organic farming practices (e.g., Mora 1997, Cederbaum et al. 2004). Cotton fields do not typically provide nesting habitat for waterbirds, but the use of clover stripcover cropping may offer hope for providing suitable nesting cover for some species (Cedarbaum et al. 2004). The value of cotton fields for resting birds is relatively unknown.

Practices Benefiting Waterbirds

Most cotton production practices will not likely directly benefit waterbirds using cotton fields. Those practices that contribute anything to the value of cotton fields include conservation tillage, surface irrigation (although only on a short-term, within-field scale) and stripcover cropping. Conservation tillage on cotton fields, namely the practice of leaving crop residues in fields after harvest, has been shown to increase the productivity of terrestrial invertebrate foods of potential value to waterbirds, including non-pest arthropods useful in the biological control of crop pests (Cederbaum et al. 2004). Surface irrigation may act to temporarily attract terrestrial invertebrates (Mora 1997) and concentrate potentially valuable food resources for waterbirds (S. Baker, MDWFP *pers. comm*.). Strip cover cropping facilitates the production of terrestrial invertebrate food resources and reduces the need for pesticides (Bugg et al. 1990,1991), and is likely the most promising crop production method to increase the value of cotton to wildlife (Cederbaum et al. 2004), including waterbirds.

Practices Negatively Affecting Waterbirds

Although cotton fields are of low intrinsic value to waterbirds, a number of crop production practices act to degrade their worth even further. Heavy pesticide use (Luttrell 1994) and conventional methods of tillage on cotton fields significantly discourage the presence of any terrestrial invertebrates of potential importance as a food source for some waterbirds (Cederbaum et al. 2004). Moreover, herbicides further preclude the presence of weed plant species which provide habitat for arthropods and whose seeds could be an important food resource for waterbirds (e.g., Freemark and Boutin 1995, Gibbons et al. 2006). Given the heavy reliance on pesticides in cotton production, insecticide use is likely to incur mortalities from a local to a landscape scale. Cotton fields themselves pose a significant risk of mortality to any bird species that may use them during the spring and summer months when most chemicals are applied (e.g., El Sayed et al. 1967, White et al. 1979). However, the risks of waterbird exposure to any toxic chemicals applied to cotton fields may extend well beyond field boundaries as most insecticides used within fields infiltrate via runoff and soil erosion into neighboring habitats, particularly rivers and wetlands.

Knowledge Gaps and Research Needs

Resources

While it is clear that both pest and non-pest arthropods can be abundant in cotton fields, the extent to which these are typically consumed and of any importance to the few waterbird species observed in cotton fields has not been studied. Further work in this area would help to assess whether the value of cotton fields could be enhanced via the management of terrestrial invertebrates, as well as how waterbird use may interact with methods of biological control. Knowledge of the extent to which the new shoots and seeds of weed species are an important resource for waterbirds in cotton fields would also be helpful (Taft 2006 draft*)*.

Effects of Cotton Production Methods

Few crop production practices warrant further research as to how they affect waterbirds. In terms of working towards enhancing the low value of cotton for all wildlife, however, research goals of highest priority should be to further quantify how tillage methods impact terrestrial invertebrate food resources (including soil fauna such as earthworms) and associated waterbird use, and to further evaluate the efficacy and wildlife value of the various organic farming or integrated pest management options such as adopting cotton cultivars that are resistant to pests, altering the timing of sowing and harvest to minimize exposure to pests, manually removing weeds (cultivating with rotary hoe), use of pheromones to trap pests, and crop rotation and stripcover cropping. Focusing on these questions should help towards alleviating the many negative impacts of cotton agriculture on wildlife (Taft 2006 draft).

Research Needs for all Crops

Beyond waterfowl, ittle is known about waterbird use of rice, corn, soybean, sorghum, wheat and cotton in Mississippi. Some research needs common to all crops discussed in this report include the following: A greater understanding of field size and landscape context to waterbirds using crop fields should enable the development of more comprehensive landscape management strategies for Mississippi. Valuable future research questions should involve evaluating how to balance the economic viability of crop production practices in the state with the efficient use and allocation of water and the management of agricultural habitats in ways that simultaneously benefit farmers and multiple waterbird species. Also, investigating the trade-offs between the benefits and costs of various farming methods to the conservation of waterbirds and the economics of crop production should be a vital focus for future research, as it will enable the ultimate design of sustainable conservation-oriented agronomic practices (Taft 2006 draft).

Aquaculture

Mississippi has approximately 99,000 water acres in catfish ponds, down from an all-time high of 113,000 water acres in 2001 (NASS 2006, Phillips 2004). The state ranks number one in the nation in production of farm-raised catfish, and approximately 70 percent of all U.S. acreage devoted to catfish production is in Mississippi. The MAV and a less well-defined area of east-central Mississippi are the two major catfish-producing areas in the state. Farms in the MAV account for 86 percent of the total land area in the state devoted to catfish production (MSU Cooperative Extension Service 2006; USDA 2000). Most catfish is produced in Humphreys, Issaquena, Leflore, Sharkey, Sunflower, Washington, Yazoo, Chickasaw, Lowndes, and Noxubee counties (NASS 2004).

In recent years, the number of catfish growers and acres in production have decreased due to an oversupply of domestically harvested catfish and large amounts of inexpensive imports. As a result, some growers have abandoned their facilities and others are attempting or considering alternative aquaculture enterprises such as freshwater prawns, tilapia, hybrid striped bass and red swamp crayfish (Phillips 2004). Acreages devoted to production of alternative species including sportfish and baitfish are difficult to quantify because of lack of documentation for these smaller ventures. Mississippi has at least six alligator farms, less than 300 acres of surface water acres in crayfish production (compared to Louisiana that has over 100,000 surface acres) and approximately 1,000 acres in ponds for hybrid striped bass. Crayfish was grown in rice fields in the early 1980s, but in recent years a new system for growing red swamp crayfish in open ponds has been developed, allowing faster and improved production. There are about 20 Tilapia growers in south Mississippi, but the acreage in production for Tilapia, freshwater prawns and baitfish is unknown (Phillips 2004, MSU Cooperative Extension Service 2006).

Waterbird Use and Resources

Like flooded crops, aquaculture ponds in Mississippi also provide open water habitat and food resources (Elliot and McKnight 2000). Mississippi waterbird species that have been observed at freshwater aquaculture facilities in North America include American White Pelican, Anhinga, Black-crowned Night-Heron, Bonaparte's Gull, Brown Pelican, Caspian Tern, Cattle Egret, Common Tern, Double-crested Cormorant, Forster's Tern, Great Blue Heron, Great Egret, Green Heron, Herring Gull, Little Blue Heron, Ring-billed Gull, Roseate Spoonbill, Snowy Egret, Tricolored Heron, White Ibis, Wood Stork and Yellow-crowned Night-Heron. Published research has documented negative impacts associated with some of these birds (American White Pelican, Double-crested Cormorant, Black-crowned Night-Heron, Yellow-crowned Night-Heron, Great Blue Heron, Great Egret, Green Heron, Little Blue Heron, Snowy Egret, Tricolored Heron and White Ibis) such as the consumption of fish at aquaculture facilities (Werner 2000). Herons, gulls, egrets, mergansers, Mallards, American Black Ducks, blackbirds and kingfishers also use and may cause damage to ponds. Less reported species include grebes, Osprey and dabbling ducks (Hygnstrom et al. 1994).

Wading birds such as Great Blue Heron and Great Egret select sick commercial fish and wild fish that invade ponds, helping to reduce the spread of disease and lessen populations of "trash" fish that compete with commercial species for resources (Glahn and King 2004). Large numbers of waders indicate to farmers that there is a problem with a pond (Stickley 1990). Bald Eagles also can help reduce the spread of disease by removing dead fish from the surface (Buehler 2000). In crayfish ponds, stunting and a lack of storage are caused by overstocking. Wading birds prefer crayfish that are below marketable size (Martin and Hamilton 1985). Allowing waders to forage can help remove excess crayfish.

Most research has focused on species thought to cause significant economic loss through predation. Aquaculture facilities are ideal feeding sites for fish-eating birds but also cause an estimated $5 million in losses annually to the Mississippi aquaculture industry (Hygnstrom et al. 1994, USDA APHIS 2004).

While most **waterfowl** are likely to use aquaculture ponds, diving ducks have been studied because of their fish-eating diet (Stickley 1990). Mergansers, Mallards and American Black Duck feed on fish fry and fingerlings (Hygnstrom et al. 1994).

Other Waterbirds – The Double-crested Cormorant is the main predator of farm-raised catfish (Glahn and King 2004). Cormorants arrive in late September and depart in March and April (Turcotte and Watts 1999) although increasing numbers are present year round. Birds travel up to 19 km or 11.8 miles (16 km average or about 10 miles) from night roosts to forage on catfish causing farms near roosts to experience higher depredation rates (Dorr et al. 2004). However, shifting roost sites makes depredation widespread. Estimated catfish consumption and cost of lost fish varies depending on estimation methods and assumptions, but could be as high as nine catfish/bird/day, with 70 percent fish of stocker size (10-20 cm or 4 to 8 in); a flock of 30 cormorants feeding for 100 days could consume 6,800 kg of fish valued at $10,500 on a single commercial farm, resulting in a cost of $25 million across a region (Glahn et al. 2000).

The American White Pelican is present primarily during November-May. The shallow water and high stocking density of catfish ponds make them ideal foraging habitat, although pelicans spend more time resting on nearby flooded agricultural fields than foraging on ponds (Glahn and King 2004). Pelicans forage in the upper 1.25 m (4 ft) of the water column and feed more often at night (Werner 2004). Their diet can consist of 99.6 percent catfish by weight, with a mean fish size of 26 cm or over 10 in (Glahn and King 2004). Pelicans are not widespread and only a small percentage of producers have reported pelican problems. However, pelicans often travel in large flocks of >300 birds (average = 250, max = 2,000) when flying to, foraging on, and departing from catfish ponds. An average-sized flock is estimated to consume $2,900 of fish from one day of foraging (Glahn and King 2004). Thus, economic costs are small at a regional scale but highly significant at the scale of a farm. American White Pelicans also have the potential to transmit trematode parasites among catfish ponds (Breazeale 2006).

While the American White Pelican and Double-crested Cormorant population numbers have increased over the last two decades as the catfish industry has expanded (Hygnstrom et al. 1994, USDA APHIS 2004), the populations are still below historical populations.

Other species may be only a minor nuisance. Stickley (1990) lists Pied-billed Grebe, gulls, and terns as minor predators, taking mostly small, sick, or dead fish. Where crayfish are the primary crop, cormorants, pelicans, gulls, and terns may be a problem (Huner et al. 2002).

The Great Blue Heron and Great Egret are the primary **wading bird** predators at catfish facilities (Dorr and Taylor 2003). Heron numbers peak in mid-winter with the addition of migrants, whereas egret numbers are highest during the breeding season (Glahn et al. 1999). During the breeding season, depredation pressure may be greater on farms closer to rookeries (Gibbs 1991). Estimates for Great Blue Herons range up to 44 percent live catfish in the diet of an average length of 15 cm at a cost of $11,400/year (Glahn and King 2004). Great Egrets, on the other hand, have lower energy requirements and are estimated to consume 8 percent live catfish averaging 10 cm in length at a cost of $3,700/year (Glahn and King 2004). However, the costs do not account for the fact that many of the live fish eaten would have died anyway from disease (Glahn et al. 1999). Great Blue Herons and Great Egrets primarily forage on diseased catfish or species of wild fish that have invaded ponds (Glahn et al. 2002). Healthy catfish are consumed when they come to the surface to feed, but <1 percent of the total healthy stock is consumed. Therefore the economic effect of these two wading birds at catfish ponds may be negligible.

Little Blue Herons, Snowy Egrets, Tricolored Herons, Green Herons, Yellow-crowned Night-Herons, Black-crowned Night-Herons, and Wood Storks have been observed on catfish farms but there is little evidence to suggest they cause significant economic loss (Stickley 1990, Layher 1993, Dorr and Taylor 2003). Cattle Egrets are commonly found at aquaculture farms but do not eat fish (Glahn and King 2004). However, their presence may attract other waders (Stickley 1990).

White Ibis and Yellow-crowned Night-Heron are considered threats to crayfish production (Martin and Hamilton 1985, Stickley 1990). Crayfish becomes a major component of the diet during the flooded period when other prey items in the pond (e.g. fish, tadpoles, insects) become less available and young crayfish become more available (Martin and Hamilton 1985). However, Martin and Hamilton (1985) estimated that only 9 percent of all crayfish consumed were of harvestable size (7.6 cm) so <2 percent of the total commercial harvest was eaten. Wading birds and other focal species eat seeds and insects in ponds and thus compete for food with crayfish, but this has not been quantified. Birds also may be a nuisance by destroying the vegetated substrate of crayfish ponds and dislodging and stealing bait from traps (Huner et al. 2002).

Availability of foraging habitat for **shorebirds** depends on timing of drawdowns during late summer and fall. An estimated 531,000 shorebirds used aquaculture ponds during fall migration in the MAV in 1995 and 1996. A snapshot survey conducted in late

August 1999, a drought year, found that 29 percent of birds were counted at aquaculture ponds (Elliot and McKnight 2000).

Least Bitterns, Purple Gallinules, and Common Moorhens have nested in the marshy edges of aquaculture ponds in Arkansas (Meanley and Neff 1953). Little documentation is available for **marshbird** or **landbird** use of aquaculture facilities in Mississippi. Stickley (1990) lists Belted Kingfisher as a common predator on small fish, and Osprey as an uncommon predator on market-sized fish. Bald Eagles are limited to foraging near the surface; benthic species such as catfish become prey only when dead and floating (Buehler 2000), or perhaps when feeding.

Practices Negatively Affecting Waterbirds

Waders and other waterbirds are harassed as predators at aquaculture facilities. Stickley and Andrews (1989) surveyed 281 catfish farmers and found that 87 percent believed fish-eating birds to be a problem. The researchers ascertained that farmers were spending $7,400 annually harassing birds, primarily cormorants in their ponds. Where non-lethal harassment techniques alone are not effective, reinforcement with limited lethal control has been suggested (Glahn and King 2004). The costs to government agencies such as USDA's Wildlife Services to aid in the control of bird pests is unknown.

Concern over fish depredation has led USFWS to issue permits to take fish-eating birds when non-lethal techniques alone have proven ineffective. In Mississippi, authorized take of Great Blue Heron and Great Egrets exceeded 5 percent each of the estimated breeding population annually from 1995 to 2002, but reported take never exceeded 5 percent. For Snowy Egret, authorized take exceeded 5 percent each year, but dropped below 5 percent since 1999. For three years the take was one-third to one-half of the estimated breeding population, but has dropped to near zero since 1999 (Hunter and Patrick 2003).

An unlimited number of Double-crested Cormorants within the vicinity of an aquaculture facility may be taken without a permit under a Depredation Order (50 CFR Part 21) issued by the USFWS for the Southeast Region (Hunter et al. 2005). Despite rangewide control efforts, populations continue to increase due to a variety of factors, some of which influence birds beyond the Southeast (Glahn and King 2004).

Knowledge Gaps and Research Needs

USDA Wildlife Services (WS) conducts aerial surveys of Double-crested Cormorant roosts in the Delta every two weeks from October through April, and have recently begun aerial and ground surveys of American White Pelicans to note heavy concentrations and to aid producers in planning harassment activities. Aquaculture depredation orders allow WS to lethally control cormorants on winter roost sites (USDA APHIS 2004). More study is needed to determine what effects lethal controls of waterbirds have on aquaculture production and on the population of waterbirds. Research should include accurate identification of bird species, food habits of depredating birds, numbers of birds

using ponds, alternative control methods and the cost-benefit analyses of these methods. More research is also needed on whether wading birds are vectors of fish diseases and parasites (Dorr and Taylor 2003, Glahn and King 2004). Reported take should also continue to be monitored and its effect on population size evaluated (Scheiman 2006). However, in order to evaluate the effects of reported take, monitoring programs specific to waterbirds need to be implemented to adequately estimate populations.

Further assessment of shorebird use of aquaculture ponds and realistic opportunities for management are needed (Elliot and McKnight 2000). Developing GIS layers that depict potential shorebird habitat, including catfish ponds would also aid in depicting the availability and distribution of shorebird habitat across the landscape (LMVJV 2002).

Summary of Management of Working Lands for Waterbirds

Some of the following summary of recommendations were adapted from the Arkansas Waterbirds on Working Lands Initiative Technical Report (Scheiman 2006).

Managing Rice for Waterbird Habitat

Practices at each stage of rice farming can affect waterbird presence, abundance, or reproduction. Fields that were flooded during the winter should be drawn down beginning late February to provide habitat for late wintering waterfowl, early migrating shorebirds, and early migrating wading birds (Helmers 1992; Table 4). Drawdowns should be gradual or partial to continually expose new habitat throughout migration and to concentrate invertebrate prey (Rundle and Fredrickson 1981, Eddleman et al. 1988, Hands et al. 1991). Although seeding method (wet vs. dry) may not influence nest density, nest density of some species may be higher where stem density is high (Hohman et al. 1994). Later-maturing rice varieties allow more time for rice-nesting birds to finish nesting before harvest (Eddleman et al. 1988). Areas of natural vegetation in close proximity to rice fields, or unharvested sections in field corners or edges provide escape cover from combines (Eddleman et al. 1988). Vegetated drainage ditches may also provide cover during critical times when rice fields are not vegetated. Although a second rice crop within a season is often not profitable to harvest, ratoon rice provides seeds and cover for birds (Manley et al. 2004; N. Winstead, *pers. comm.*). A conventional harvester generally results in higher waterbird diversity and abundance than a strip harvester because a conventional harvester leaves shorter stubble and more waste grain (Day and Colwell 1998). Following harvest, several methods to enhance residual straw decomposition may benefit birds including flooding, burning, rolling, chopping, and plowing (Helmers 1992, Day and Colwell 1998, Elphick and Oring 1998, Twedt et al. 1998). However, results have varied by study and species, and more study is needed.

Winter flooding generally is beneficial for waterbirds and has positive impacts on soil and water conservation and agricultural practices. Experiments conducted in four rice growing counties in Mississippi (Bolivar, Leflore, Sunflower and Washington Counties) by MSU indicated that winter flooding conserved soil and increased the quality of water runoff, especially where fields were not disked in the fall. It also inhibited growth of cool season grasses and weeds, reducing the need for herbicides. The flooded fields support winter populations of aquatic invertebrates, which are critically important because of the decrease in availability of waste from the harvest in August to the arrival of waterfowl in the Delta in early December (Forest and Wildlife Research Center 2002).

Different species prefer different water depth ranges (Elphick and Oring 1998). A water depth range of 10-20 cm across a field may favor the greatest number of species (Elphick and Oring 1998, 2003). Staggering water depths among levees within a field or among adjacent fields also will provide for a variety of species (Hands et al. 1991, Helmers 1992, Elliot and McKnight 2000).

Managing Other Row Crops for Waterbird Habitat

Among all row crops, practicing no-till after harvest maintains waste grain availability (Keppie and Whiting 1994, Braile 1999). Except for wheat, where possible, flood fields in late summer/early fall to encourage aquatic invertebrates and provide habitat when conditions are typically dry (Elliot and McKnight 2000, S. Baker MDWFP *pers. comm*.). Flooding will be easiest where crops are grown in rotation with rice. Water should be held as long as possible before preparing the field for other crop types (Helmers 1992). Fields that will remain fallow during the growing season should not be drawn down until late May to provide habitat for late migrating shorebirds (Elliot and McKnight 2000).

For shorebirds, agricultural fields can be dewatered at a rate of one inch per week beginning in late February or early March. The types of crops, planting dates and harvest dates determine drawdown rates and how long fields are flooded (Plauny 2000; Table 4).

Lessening the use of pesticides on all crops, and fallow and secondary crop rotations can improve the suitability of fields for waterbirds. Use of uncultivated corridors (strips of unfarmed land running through fields) to achieve biological control of pests is a promising alternative to pesticide use. Sowing crops such as wheat while waterbirds nests are active and harvesting methods that further reduce waste grains or plow under seeds should be avoided.

Beyond efforts to improve management of existing agricultural lands in the state for waterbird use, it will also be important to monitor areas of agricultural intensification. The MAV in Mississippi includes lands cleared, drained and leveed during the 20th century for agricultural intensification. Areas like the Yazoo Backwater Area historically functioned as a natural flood water storage area for the Mississippi and Yazoo Rivers, but was isolated from those rivers by a complex levee system. These hydrologic alterations stimulated clearing and farming of the wettest areas, which met with limited success. Since 1985, over 50,000 acres of these “high risk”, cleared wetlands have been restored through various federal, state and private conservation initiatives. Despite the focus on restoration, flood control projects that prioritize agricultural intensification of areas like the Yazoo Backwater Area are still being considered (USFWS 2001).

Managing Aquaculture for Waterbird Habitat and Reducing Conflict

Conflict management is of primary concern for **wading birds** and other **waterbirds**. Management techniques should be cost effective and have lasting effects with minimal lethal control. However, no one technique is completely successful at minimizing predation. The combination of frightening techniques (e.g. propane exploders, pyrotechnics, live ammunition, effigies, distress calls), harassment patrols (surveillance of ponds and chasing birds), and limited lethal control for reinforcement is recommended (Littauer et al. 1997, Barras and Godwin 2005). Vigilance is required at night where pelicans are a nuisance (Werner 2004). Harassment should be intensified at times when fish are most vulnerable to predation, e.g. when they surface to feed (Glahn and King

2004). Near-farm management is recommended too. For Double-crested Cormorants, night roost harassment coordinated simultaneously over a region is effective at dispersing birds (Glahn et al. 2000) as long as some unharassed roosts far from aquaculture facilities are left as refugia (Dorr et al. 2004). Early detection and dispersal of heron rookeries also will minimize later conflict (Telfair 1994). Draining agricultural fields adjacent to ponds will remove resting areas for American White Pelicans (Glahn and King 2004). Preserving and restoring extensive natural wetlands will provide alternative locations for wading birds and waterbirds to feed (Glahn and King 2004).

Alterations to commercial fish production practices may reduce predation. Suggested practices include: 1) delay stocking fingerlings until after the peak season of a particular waterbird species (e.g. after mid-April for cormorants), 2) increase stocking rates, 3) use buffer prey in the same or separate ponds, 4) dye the water to reduce visibility, 5) maintain water depth >1 m to limit available feeding area, 6) vary feeding schedules to reduce bird habituation, 7) temporarily use sinking feed instead of floating feed to reduce vulnerability, 8) keep the most vulnerable or valuable fish in ponds closest to centers of human activity, 9) for crayfish, flood and drain ponds rapidly to reduce the time of vulnerability, and 10) provide vegetative cover along edges to protect adults while they burrow (Martin and Hamilton 1985, Cezilly 1992, Dorr and Taylor 2003, Glahn and King 2004). Each method has pros and cons that should be evaluated before instituting. New pond construction should consider: 1) smaller ponds that are easier to protect, 2) designing facilities to make use of deterrent devices more economically feasible, 3) planting trees around ponds to interfere with flight, and 4) locating facilities away from major flyways and concentrations of other facilities where bird densities are high (Wires et al. 2001).

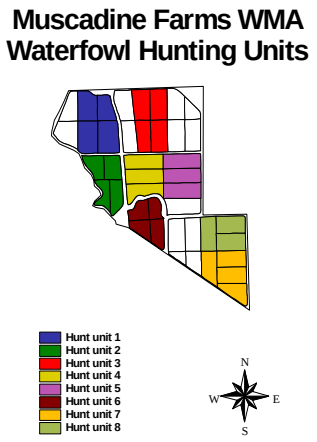
Ponds are periodically drawn down for maintenance and disease prevention. Shallow water and mudflat habitat for **shorebirds** can be provided during spring and fall migration by leaving water control structures closed after draining to hold rainwater in idle basins (Elliot and McKnight 2000). **Marshbird** habitat can be provided by allowing marsh vegetation to grow along edges or corners of ponds. This will provide cover for fish and crayfish as well.

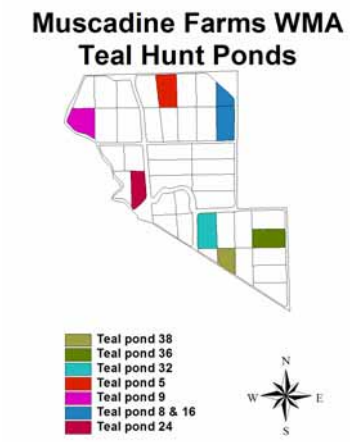
Aquaculture farmers may realize economic benefits of **wildlife-related recreation.** For example, some private fish farms near Belzoni and rehabilitated catfish ponds on public lands such as Morgan Brake and Yazoo NWR are popular bird watching locations (Stevens 2006). In the future, bird watchers may be willing to pay a nominal fee to access farms that hold a diversity of birds, but it is likely that more interest and income may be generated from fee waterfowl hunting.

The National Audubon Society sponsored a joint symposium in 1993 with the National Aquaculture Association which demonstrates a commitment to work with producers and landowners to help resolve conflicts, an effort which should continue and grow (B. Reid NAS *pers. comm*.).

Abandoned Catfish Ponds as Moist Soil Impoundments

The decline in the number of surface acres in catfish production in Mississippi in the past decade has resulted in a number of abandoned impoundments available for potential moist-soil management for waterbirds and other wetland dependent wildlife in the MAV. Moist-soil management is a wetland management technique that uses manipulation of water levels and periodic vegetation disturbance to provide food and other habitat resources for birds in seasonally flooded herbaceous wetlands. This technique is an important alternative to crop production as a method of providing foraging habitat for waterfowl. Abandoned catfish ponds are especially suited to wetland management because each pond or unit can be drained and flooded independently (Reinecke et al. 2006 *in prep).* In Mississippi, abandoned catfish ponds are being managed for waterbirds on federal and state wildlife areas. The USFWS purchased 240 abandoned catfish ponds known as Cox Ponds for the Yazoo NWR for intensive moist soil management. The ponds were reshaped to provide optimal bottom and side slopes, and each pond has its own water control structure and drain. Irrigation wells provide permanent water sources for each pond, allowing for several management options and a rotating management cycle provides habitat for waterfowl, waders, marshbirds, shorebirds and other waterbirds. Fifty-five former catfish ponds totaling 850 acres are also managed at Morgan Brake NWR under a similar management plan (USFWS 2006). Muscadine Farms was a 700-acre catfish farm in Washington County acquired by the U.S. Army Corps of Engineers and managed by MDWFP for waterfowl and shorebird habitat. Ponds are managed on a rotational basis and water levels are maintained at 6 inches for Blue-winged Teal in September, and some ponds are allowed to dry slightly for migrating shorebirds. Others are planted in millet and corn in the summer, or managed for moist soil plants (Wilf 2005). These rehabilitated ponds on public lands provide good demonstrations for abandoned ponds on private lands.





Aquaculture ponds managed as impoundments and other moist soil impoundments that have independent water management capabilities can provide the manager with the luxury of implementing strategies that accommodate a variety of vegetation, water regimes and waterbird guilds in the same year. Stoplog water-control structures provide

more control over water-level manipulations by allowing incremental changes in water-levels suitable to the greatest variety of waterbirds. Slight variations in management can provide benefits to different species. Shorebirds migrate through Mississippi in the fall from July to October and their habitat is considered very limited during fall migration because of drought conditions. Matching drawdown on these impoundments (such as < 4 inches of water in varying size from pools to larger sights) can provide suitable foraging and roosting habitat.

Slow drawdowns of these impoundments are best for concentrating food for wading birds for an extended period. Standing water under bird rookeries is critical to limiting predation and enhancing nest success. Thus draining impoundments while birds are actively nesting is discouraged.

Managing some units for tall emergent vegetation will support habitat for secretive marsh birds, wood duck broods and amphibians and reptiles (N. Winstead, *pers. comm*., Strader and Stinson 2005).

Important Bird Areas in Mississippi for Waterbirds and Opportunities for Increasing Waterbird Use

BirdLife International is a global partnership of conservation organizations that strives to conserve birds, their habitats and global biodiversity, working with people towards sustainability in the use of natural resources. Audubon, as the Birdlife International Partner for the U.S., is responsible for identifying and conserving a network of globally important IBAs in the U.S. IBAs are sites that provide essential habitat for one or more bird species and include sites for breeding, wintering, and/or migrating birds. They range from a few acres to thousands of acres in size, but usually they are discrete areas that stand out from the surrounding landscape. IBAs may include public or private lands, or both, and they may be protected or unprotected. As of March 2006, over 8,000 IBAs have been identified, mapped and documented in 178 countries and at sea. The U.S. is unique among BirdLife partners in that the IBA program is implemented on a state-by-state basis with coordination at the national level. The IBA program is the first statewide bird conservation effort that considers all birds and habitats, regardless of ownership. The goal of the IBA program is to recognize sites that consistently harbor a significant abundance of birds, especially birds of concern, or those vulnerable because they congregate in large numbers such as wintering waterfowl and colonial waterbirds. These areas serve as focal areas for Audubon bird conservation projects such as population monitoring, habitat restoration and environmental education (National Audubon Society 2006b).

To date, Audubon and its collaborators have identified 35 IBAs around Mississippi. Of those, 24 IBAs include wetland types that are important to waterbirds and 16 of those are embedded in agricultural landscapes. All Mississippi IBAs have been entered into National Audubon Society's IBA database and the data are being prepared for public web access as well (Reid et al 2004; Table 5).

Table 5 includes a list of all IBAs in the state that are used extensively by waterbirds by county, IBA and BCR, and denotes notable occurrences of species and those IBAs that are primarily within agriculture landscapes. Most IBAs in Mississippi that are important to WWL species are in public ownership -- one is a national forest, seven are national wildlife refuges, four are state wildlife management areas and four are in private ownership. They are located primarily in 12 counties in BCR 26 (Adams, Holmes, Issaquena, Quitman, Lafayette, Leflore, Sharkey, Tallahatchie, Warren, Washington, Yazoo and Wilkinson Counties) and within 3 counties in BCR 27 (Madison, Panola and Lafayette counties). Threats to habitats within and around the IBAs vary by site, but include over-extraction of groundwater, recreation development/overuse, pollution,

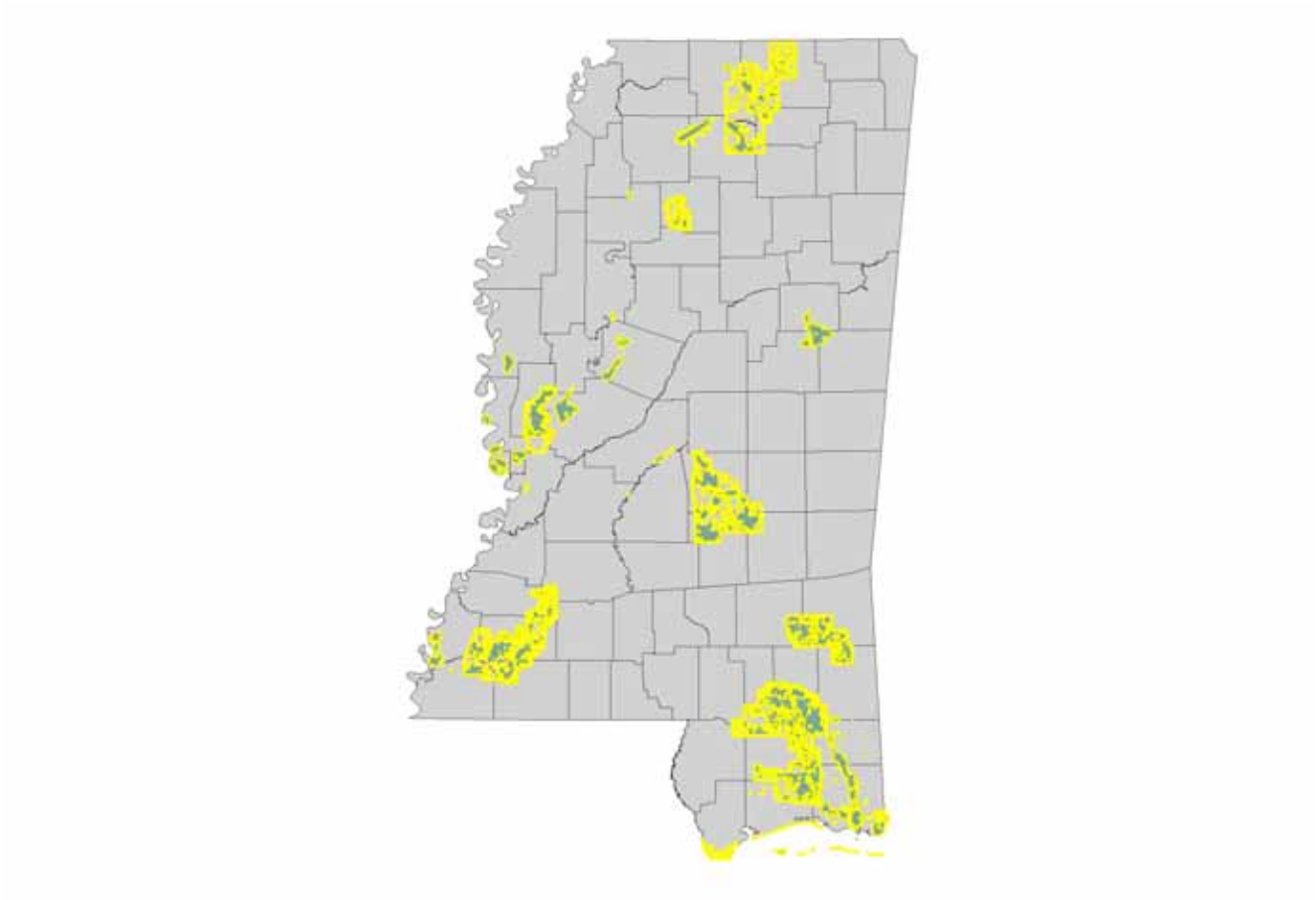
residential development, non-native flora/fauna, pollution and hydrologic changes (Reid et al 2004).

It is noteworthy that Audubon may review a nomination for Muscadine Farms, a new state wildlife management area that is used by waterfowl and shorebirds, as another Mississippi IBA, but must first re-establish a technical committee to review and consider this and other nominations.

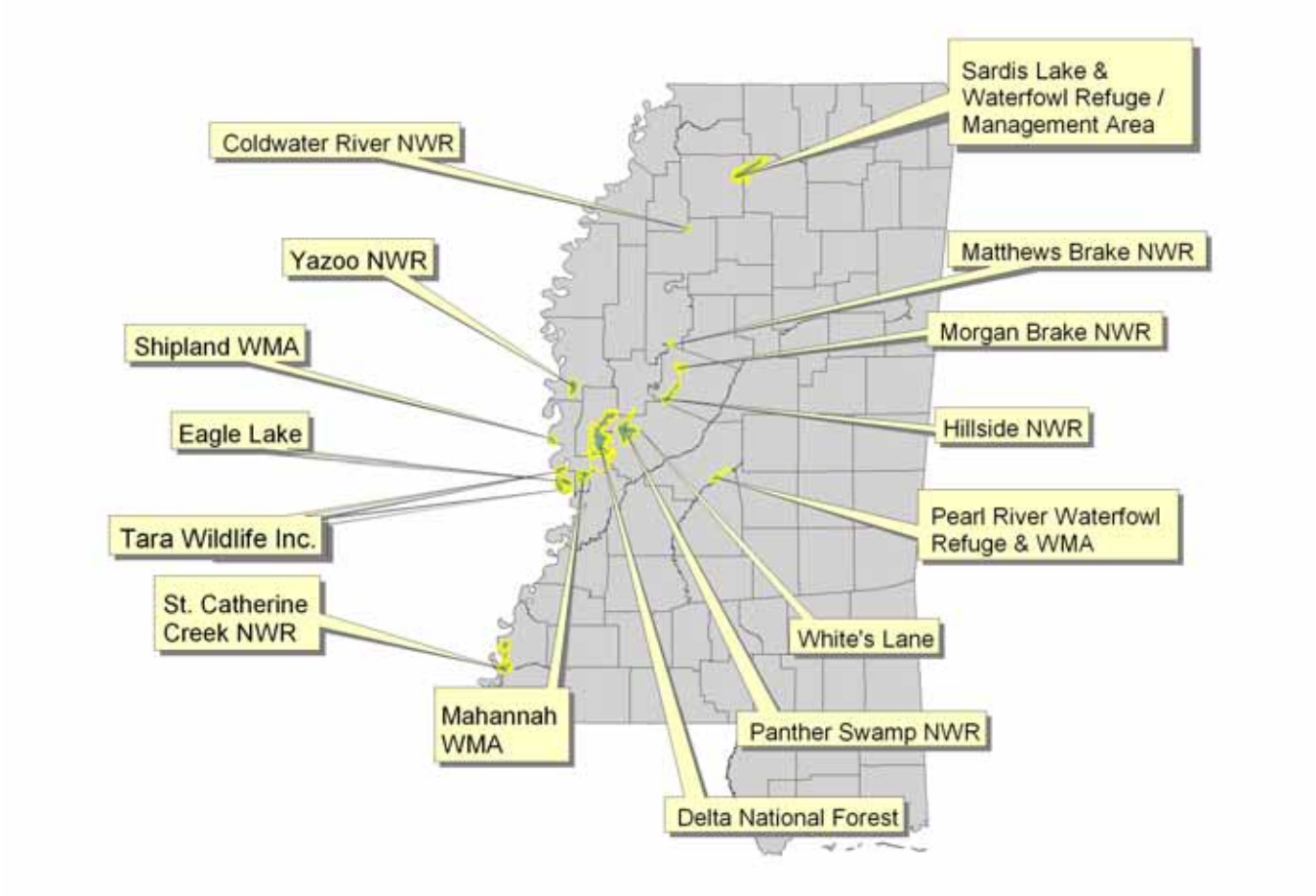
The following pages include maps of IBAs in the state and those important to WWL species, followed by a short description of each IBA by ownership. Four IBAs stand out as potential targets for Audubon's WWL initiative in Mississippi: Panther Swamp NWR and White's Lane (a private tract adjacent to Panther Swamp) in Yazoo County, Yazoo NWR in Washington County and Tara Wildlife, Inc. in Warren County. Audubon staff members in Mississippi have established working relationships with the managers/owners of these four IBAs which will aid in initiating pilot projects and programs on and around these tracts.

White's Lane and Panther Swamp NWR are embedded in a region with significant acreage in cotton, soybean, wheat, corn and catfish production. These neighboring IBAs support substantial numbers of nesting pairs of herons and egrets, and White's Lane is one of four known sites for nesting Double-crested cormorants in the state. Together, they present Audubon with an opportunity to initiate a systematic monitoring system for colonial waterbirds that use both IBAs and the other private lands around them. Yazoo NWR in Washington County is surrounded by rice, cotton, soybean, wheat and corn acreage and catfish farms. Within this refuge, Swan Lake supports a multi-species heronry. Cox Pond, former catfish ponds converted to moist-soil/shorebird management areas on Yazoo NWR, provide much-needed stopover habitat for migrating shorebirds. Yazoo NWR may provide Audubon with another site for groundtruthing a colonial waterbird survey, and its well-managed cultivated fields and moist soil areas can serve as a demonstration and education area for private lands in the region.

Tara Wildlife, Inc. in Warren County is the largest private IBA in the state and is managed as an outdoor recreation and meeting facility fronting the Mississippi River. Surrounding lands are farmed for cotton, soybeans and corn. In 2006 Tara managers constructed a 200-acre shallow water area with wildlife viewing platforms. This new area has potential for Audubon as a demonstration facility for attracting, feeding and studying waterbirds in a mixed agricultural/forested/riverfront landscape. Tara actively cooperates with Audubon on several existing educational outreach efforts such as the annual Stork and Cork event, and is home to Audubon's newly established Mississippi River Field Institute making it an obvious IBA for focused WWL initiative demonstration and pilot projects in the future.



Important Bird Areas in Mississippi (Source: MDWFP/MMNS and National Audubon Society)



IBAs in Mississippi important to WWL Species (Source: MDWFP/MMNS and National Audubon Society)

IBAS in Mississippi Important to WWL Species by Ownership or Management

US Fish and Wildlife Service

Seven national wildlife refuges have been identified as important for the WWL focal species in Mississippi.

Teddy Roosevelt National Wildlife Refuge Complex

Five refuges in Mississippi are part of this 90,000-acre, seven-refuge Complex in seven counties in the MAV. **Hillside, Mathews Brake, Morgan Brake, Panther Swamp and Yazoo NWR** were established to provide important resting, feeding and breeding needs for waterfowl and other birds. More than 225 species of migratory birds use the complex. Mallard is the most abundant wintering waterfowl species followed by Gadwall, Greenwing Teal, pintails and shovelers. Snow Geese occupy Morgan Brake and Yazoo NWRs in large numbers during the winter. Wood Ducks and Hooded Mergansers are common nesters in the spring and summer, depending on the size of the nest box program on each refuge. Wading bird rookeries exists on Yazoo, Hillside and Morgan Brake NWRs. Nesting species include Great Blue Heron, Great Egret, Snowy Egret, Little Blue Heron, Cattle Egret, Black-crowned Night-Heron, Anhinga, Tricolored Heron and Double-crested Cormorant. White Ibis has occupied rookeries on Morgan Brake in the past, but currently are the dominant species using a large rookery adjacent to Panther Swamp. About 20 species of shorebirds (e.g. Least Sandpiper, Lesser Yellowlegs, Stilt Sandpiper) use the Complex, especially Yazoo and Morgan Brake NWRs, where moist-soil habitat is managed extensively.

Yazoo NWR covers 13,706 acres and is located four miles east of the Mississippi River in Washington County. The primary habitat feature is Swan Lake, a 4,000 acre oxbow lake divided into four management compartments by levees and water control structures. The NWR has 65 impoundments, 650 acres of moist soil management and 1,350 acres of bottomland hardwood forest that are flooded in winter for waterfowl.

Panther Swamp covers 38,697 acres between the Yazoo River and Silver Creek in Yazoo County. Lake George WMA, a mitigation project, borders the refuge on the south and southwest. Because of the low elevation, management is challenged by regular flood events and the expansive beaver population. This refuge includes 2,350 acres of cropland/moist soil units and 5,212 acres of wetlands/swamps. It is adjacent to a privately-owned IBA called White's Lane.

Hillside NWR occupies 15,572 acres on the eastern edge of the lower Delta in Holmes and Yazoo Counties between the loessal bluffs and the Corps of Engineers levee. These lands were purchased by the Corps for the Yazoo Basin Headwater Project, and the Corps transformed most of the land into a silt collection sump via a cutoff levee. The project

allows silt to settle out of the water before reaching the Yazoo and Mississippi Rivers to prevent costly dredging projects, and today the Corps retains the right to manipulate water and ditches. The dominant habitat type was bottomland hardwood before the Corps project, but today cottonwood and willow grow in areas affected by the silt. Hillside NWR also includes 1,448 acres of cropland, 374 acres of sloughs and streams and 285 acres of borrow ponds. In addition to the siltation, threats include succession, commercial and residential development, infrastructure development and recreational overuse (USFWS 2006; Reid et. al. 2004).

Morgan Brake NWR is located three miles north of Hillside NWR and includes 7,383 acres. It is on the eastern edge of the Delta adjacent to the loess bluff. The main wetland feature consists of three brakes. The refuge also includes 489 acres of former catfish ponds and 860 acres of cropland.

Mathews Brake NWR covers 2,418 acres and is located seven miles north of Morgan Brake. The primary habitat feature is a shallow, 1,810 acre baldcypress/tupelo brake with expansive open water. The majority of the refuge is only accessible by boat, and portions are privately owned.

All of these refuges except Hillside have legislated purposes that set higher priorities for migratory birds than all other wildlife species. Management actions include providing 9,600 acres of agricultural "hot foods" such as rice, corn, milo and millet, and managing and maintaining moist-soil areas and forested wetlands to meet the feeding, resting and breeding needs of migratory and resident waterfowl. Farming operations are conducted cooperatively with local farmers under certain guidelines and restrictions. In their Comprehensive Conservation Plan (CCP) for the Complex, the USFWS noted the lack of baseline information gathered by comprehensive or standardized surveys on all bird groups throughout the Complex. Also, while spring migration for shorebirds in the MAV is adequate, there is a lack of shallow-flooded or mud-flat habitats in late summer and fall.

The Complex supports 20 species of colonial waterbirds and wading birds, and 65 percent breed on refuge lands. Yazoo, Hillside and Morgan Brake have been used as rookeries. Concern has arisen recently about the Double-crested Cormorants nesting in the Swan Lake rookery on Yazoo NWR and in the White's Lane rookery, an IBA on private land adjacent to Panther Swamp. Other concerns include preservation of appropriate vegetation, maintenance of appropriate water levels during nesting season and protecting rookeries from disturbance. (Rookery die-offs in 1990 and 1991 were attributed to deliberate aerial spraying, which is unlikely to recur; but rookeries are still vulnerable to unintentional aerial spraying and drifts from chemicals used on crops).

The Complex refuges are surrounded by extensive agricultural row crop production, and contaminants and sedimentation from past agricultural practices have impact every refuge. Organochlorine pesticides were commonly used in farming practices in the 1970s, and continue to contaminate fish-eating birds and wood ducks. These refuges are dependent on water from surrounding contaminated watersheds, streams and rivers, many

of which are listed on the states 303(d) list of impaired water bodies because of chemical or fecal coliform bacteria contamination. Runoff from agricultural fields has also caused excessive siltation and turbidity in waterbodies throughout the Complex.

The new CCP for the Complex includes diverse and aggressive management goals for many focal WWL species such as providing 60 acres of marsh bird habitat for nesting and migration, 700 acres of shallow water habitat for nesting and post-nesting long-legged waders, habitat for five colonial waterbird rookeries within five years, and 435 acres of shallow-water habitat for fall migrating shorebirds as well as goals to expand survey work and to provide technical assistance through the Partners for Fish and Wildlife Program on 2,000 acres of private lands in a nine county focus area among all the Complex refuges (USFWS 2006).

The recent approval of this new CCP provides Audubon an opportunity to support the goals and objectives expressed in the plan and to participate in the development of habitat restoration and re-establishment on private lands in the focus areas through involvement in the Partners for Fish and Wildlife program, active participation in the Lower Mississippi Valley Joint Venture and through the NRCS State Technical Committee. **Panther Swamp, because of its proximity to a privately-owned IBA called White's Lane, may present an excellent opportunity for Audubon to establish systematic monitoring of colonial waterbirds that use both IBAs. Yazoo NWR may also provide an excellent site for groundtruthing for this survey (USFWS 2006).**

St. Catherine's Creek NWR is a relatively new refuge covering 24,125 acres in Adams and Wilkinson Counties. It is the only refuge bordering the Mississippi River and includes a loess hill forests, shallow water impoundments, riverine/lacustrine habitats, bottomland hardwood forests and cultivated fields. The impoundments are used by post-breeding waterbirds like Wood Storks, White Ibis and Roseate Spoonbills as well as wintering waterfowl and migrating shorebirds. Two rookeries of herons and egrets and two or to three Bald Eagle nesting territories exist. Threats include non-native flora and fauna such as Common Salvinia, nutria and feral hogs, hydrologic alterations and infrastructure development. Continued management of water impoundments on the refuge is critical to maintaining optimum habitat for waterbirds. This refuge provides good opportunities for education, and the USFWS has indicated in their CCP that they wish to identify a Conservation Partners Focus Area in Adams and Wilkinson Counties to establish a conservation corridor between this refuge and Homochitto National Forest (Reid et. al. 2004, USFWS 2005).

Coldwater River NWR covers 2,508 acres in Tallahatchie and Quitman Counties and is part of the North Mississippi Refuges Complex. This refuge was agricultural lands that are being reforested, but some areas have met with limited success because of the extensive winter flooding and lack of water control capability. There are 25 catfish ponds now managed for waterfowl, shorebirds and wading birds. During post-breeding migration, this NWR hosts concentrations of Wood Storks, Great Egrets, Great Blue Herons, Snowy Egrets, Little Blue Herons and Roseate Spoonbills. Mallards, Northern Pintails, Northern Shoveler, Gadwalls, American Wigeon, teal, Canvasbacks, scaup and

Ring-necked Ducks winter there. Threats include continued channelization within the Yazoo River watershed, levee construction on private lands south of the refuge which impacts flooding, heavy hunting pressure on lands around the refuge (refuge is closed to public use) and aquifer reduction from groundwater irrigation (Reid et. al. 2004, USFWS 2006).

USDA Forest Service

The **Delta National Forest** comprises 60,000 acres of contiguous bottomland hardwoods embedded in a larger agricultural landscape, and represents the once vast network of swamps, bayous and bottomland forests that covered the MAV. The bottomland hardwoods provide important habitat for waterfowl, colonial waterbirds and summer neotropical migrants such as Prothonotary Warblers. The greentree reservoirs and slough control structures allow managers to mimic natural backwater flooding conditions for wintering waterfowl (Reid et. al. 2004). Improving management of agricultural lands adjacent to the national forest would extend available habitat for some WWL focal species.

Mississippi Department of Wildlife Fisheries and Parks (MDWFP)

Four state Wildlife Management Areas (WMAs) are IBAs important to WWL species. It is important to note that the MDWFP is currently developing a new strategic plan for their waterfowl program (S. Baker, MDWFP *pers. comm*.). Audubon should fully participate in the development of this plan in an effort to encourage management for additional focal waterbird species on these sites and to aid MDWFP in promoting management of adjacent private lands for waterbirds.

Mahannah WMA covers 12,675 acres in Issaquena and Warren Counties that was purchased by the Corps of Engineers as mitigation for damages caused by the construction of the Tennessee-Tombigbee Waterway. The area includes bottomland hardwood forests, cultivated fields and reforested areas. The areas farmed and flooded on the WMA provide waterfowl habitat, and about half of these areas are subject to uncontrolled flooding. Wintering Mallards, Gadwall, American Wigeon, Canvasback, Lesser Scaup, Blue-winged Teal, Green-winged Teal, Northern Shoveler, Wood Duck, Canada Goose and Northern Pintail can all be found at Mahannah (Reid et al. 2004, N. Winstead, *pers. comm*.).

Pearl River Waterfowl Refuge and WMA is a 6,925 acre refuge in Madison County located at the upper end of the Ross Barnett Reservoir. It includes 13 miles of frontage along the Pearl River, and several natural oxbows, as well as bottomland hardwoods. Moist-soil impoundments cover 150 acres, and 1,500 acres are in a waterfowl refuge. Levees and water control structures allow for water management throughout the year. Managers flood 900 acres of bottomland hardwoods in October and drain them in March for waterfowl, and to allow shorebirds and other waterbirds to use mudflats and shallow areas during spring and fall migration. The oxbow lakes support permanent residents such as herons, egrets, Bald Eagle, Wood Duck, various waterfowl, shorebirds and

warblers. Marsh habitat along the river also supports Least Bittern, King Rail, Purple Gallinule and Common Moorhen. A large heronry supports 200 nesting pairs of Anhingas, Great Blue Herons and Great Egrets. Threats include non-native flora and fauna proliferation, commercial development and some forestry practices (Reid et. al. 2004, N. Winstead, *pers. comm*.). This is another high profile site near the Jackson metropolitan area that provides an excellent opportunity for demonstration and educational outreach. While land uses around this WMA are more varied than those within BCR 26, there is still significant agricultural land use in proximity to the WMA.

Sardis Lake and Waterfowl Management Area includes a 58,000 acre lake and 3,000 acre waterfowl refuge. The lake is owned and managed by the Corps of Engineers and the refuge is owned by the Corps, but managed by MDWFP. The refuge includes managed impoundments to provide food and low-water habitat for waterfowl. The lake provides winter habitat for Bald Eagles, White Pelicans and several waterfowl species, as well as concentrations of Bonaparte's, Ring-billed and Herring Gulls. The Corps begins drawing down water near the end of December in the lake because it is a flood control reservoir. This results in low water conditions not favorable for wintering waterfowl on the refuge. Other threats are recreational development and overuse (Reid et. al. 2006).

Shipland WMA is a 3,462 acre IBA in Issaquena County. It is one of the few IBAs that provide public access to the Mississippi River. The Ajax Bar complex of sandbars harbors nesting Interior Least Terns. Migrating shorebirds and other waterbirds rest and feed on mudflats associated with sandbars. Navigation traffic on the river, recreation development and overuse are threats to WMA habitats. Tern colonies should be protected from human disturbance during nesting season, thus an investigation of the level of disturbance on the Ajax Bar complex is warranted (Reid et. al. 2004).

Private Lands (list does not include one un-named IBA)

Four IBAs are in private ownership, including one 55 acre unnamed site in Warren County. These private lands IBAs present excellent opportunities for surveys, demonstrations and educational outreach.

Eagle Lake is a 4,700 acre lake in Warren County. Significant numbers of ducks, geese, White Pelicans, Double-crested Cormorants and other waterbirds use the lake for resting and feeding during the winter. Six to ten Bald Eagles can be seen roosting along the shore in winter, and the site once harbored concentrations of Bald Eagles. Because the lake receives little use by sportsmen in the winter it serves as an open-water refuge for waterfowl. This lake is managed primarily for sportfishing and the water level is controlled by a structure on Muddy Bayou. Threats include pollution, residential/waterfront development, recreational development and overuse (Reid et. al. 2004).

Tara Wildlife Inc., located in Warren County in the south Delta, is the largest private IBA in the state with 17,200 acres managed for recreation. This private hunting and

outdoor recreation facility includes extensive bottomland hardwoods, lacustrine/riverine habitats and agricultural fields and harbors significant concentrations of post-breeding waders and species of concern such as Wood Storks, Roseate Spoonbills, White Ibis and Little Blue Herons. Large numbers of other waterfowl, including Mallard, Northern Pintail, and Ring-necked Duck winter on managed impoundments, oxbow lakes and borrow pits. Osprey and Eagles nest at Tara. Though management is focused on providing habitats for game species, Tara serves as a convention facility and hosts many diverse meetings for various conservation organizations, businesses, professional natural resource organizations and the Stork and Cork birding festival. They have recently entered into a partnership with Audubon Mississippi to house the Mississippi River Field Institute. In 2006, Tara managers also constructed a 200 acre waterbird impoundment. **Audubon staff and volunteers have an excellent working relationship with the owners and managers of this facility which presents an opportunity to use this facility and areas such as the new impoundment as a demonstration site for attracting, feeding and studying waterbirds in a mixed agricultural/forested/riverfront landscape.**

White's Lane is a 960-acre natural area in private ownership, adjacent to Panther Swamp NWR and several commercial catfish ponds in Yazoo County. This is a large heronry that supports 1,400 to 5,000 nesting pairs of herons and egrets, and significant breeding populations of White Ibises, Great Egrets, Snowy Egrets, Little Blue Herons and Cattle Egrets. It holds the largest concentration of nesting White Ibis in Mississippi and is one of only four known sites in Mississippi for nesting Double-crested Cormorants. There are no major threats identified. The property is a proposed site for inclusion into the refuge system (Reid et al. 2004). **Its proximity next to Panther Swamp and catfish ponds and its significant use by many focal WWL species make this IBA another excellent potential site for future waterbird surveys by Audubon and partners.**

Because all of these IBAs provide significant habitat for high concentrations of birds, they should be priority areas for management, restoration and conservation (Hunter et al. 2005). Identification of land uses around IBAs and targeted management of those surrounding agricultural lands through new and existing conservation programs, educational outreach and reducing agricultural practices harmful to waterbirds should provide additional habitat for waterbirds across the landscape. Complexes of public and private habitat are critically important on a statewide and regional scale, and efforts to maintain and enhance management on public lands and expand incentives and innovative programs on private lands are recommended (Reinecke 1989).

Partnership Opportunities for Increasing Waterbird Use on Working Lands near Mississippi's IBAs

Several existing private land conservation programs through federal, state and non-profit organizations offer financial assistance and technical support to landowners and have been effective in protecting, restoring and enhancing wetlands and wildlife habitat on private lands in the state. To make the most efficient use of limited funding for these and other programs, more emphasis should be placed on SGCN (C. Knight, MDWFP *pers. comm*.) and species of concern identified by other conservation planning efforts.

Farm Service Agency (FSA)

The **Conservation Reserve Program (CRP)** is a voluntary program available to agricultural producers to help them safeguard environmentally sensitive land. Producers enrolled in CRP plant long-term, resource-conserving covers such as trees and grasses to improve the quality of water, control soil erosion and enhance wildlife habitat. In return, FSA provides participants with rental payments and cost-share assistance. Contract duration is between 10 and 15 years for eligible lands that are croplands (including field margins) that are planted or considered planted to an agricultural commodity during four of the previous six crop years, and which are physically and legally capable of being planted in a normal manner to an agricultural commodity or certain marginal pastureland that is enrolled in the Water Bank Program or suitable for use as a riparian buffer or for similar water quality purposes. Preference is given to lands within Conservation Priority Areas (CPAs), selected by state and federal agencies and state technical committees as being particularly environmentally sensitive. In its 20th year, Mississippi has over 940,000 acres in CRP. A new offspring of CRP is the **Conservation Reserve Enhancement Program (CREP)**. CREP is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat and safeguard ground and surface water.
Continuous Conservation Reserve Program is an addition to CRP that allows producers to enroll on a continuous basis, rather than through the general CRP sign-up process. High-priority practices eligible under this program that may benefit waterbirds include: grassed waterways (CP8), shallow-water areas for wildlife (CP9), contour grass strips (CP15), shelterbelts (CP16), herbaceous filter strips (CP21), riparian buffers (CP22), wetland restoration (CP23), wildlife habitat buffers (CP29), wetland buffers (CP30), and bottomland hardwoods (CP31). Plantings are generally small in area and concentrated along waterways on highly erodible lands. Contracts are 10-15 years and provide up to 50 percent cost-share.
http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp

Natural Resources Conservation Service (NRCS)

The **Conservation Security Program (CSP**) supports ongoing stewardship of private agricultural lands by providing payments for maintaining and enhancing natural

resources. It identifies and rewards those farmers who are meeting the highest standards of conservation and environmental management on their operations. Farmers within selected watersheds submit a self-assessment of their conservation practices. Applicants are placed in one of three tiers. Depending on the tier, contracts are for 5 to 10 years. Each state develops a list of conservation practices for which producers can receive payments. The state then sets a per-acre payment or a fixed payment amount per activity. These payments are made each year for the life of the contract. Wildlife practices help meet Tier III eligibility requirements. Farmers who are not in a selected watershed in a given year can begin the assessment process and enroll in other conservation programs that will help them meet higher eligibility requirements when their watershed is selected. http://www.nrcs.usda.gov/Programs/csp/

In 2005, Mississippi's CSP program focused on the Lower Big Black, Pascagoula and Coastal streams watersheds and paid $536,855 for 34 contracts in Tier I and II. No projects were funded in Tier III. In 2006, Tibbee Creek was the focal watershed. http://www.ms.nrcs.usda.gov/programs/MissCSP.html

Environmental Quality Incentives Program (EQIP) supports reduction of non-point source pollution, emission, soil erosion and sedimentation and promotion of at-risk species habitat conservation on working lands. The program is focused on livestock-related conservation practices. Benefits are not necessarily a direct focus of this program, but wildlife benefit from the soil and water conservation practices. EQIP is targeted to areas where the most environmental benefit will be obtained by the designation of CPAs. Each year, CPAs are established within watersheds by the State Conservationist based on recommendations of local work groups and the State Technical Committee. Technical assistance to landowners is provided with 5 to 10 year contracts. NRCS will work with landowners to prepare a complete conservation plan. Cost-sharing is available for actual costs incurred, up to 75 percent of the costs of conservation practices such as pest management and erosion control.

Resource Conservation and Development Program (RC&D) is designed to encourage and improve the capability of volunteer local elected and civic leaders in designated RC&D areas to plan and carry out "quality of life" projects for resource conservation and community development. RC&D Councils obtain the assistance of local, state, and federal agencies, private organizations, and foundations to carry out their projects. Project categories include natural resource improvement, community improvement, forestry, education, economic development, water quantity and quality, recreation and tourism, marketing and merchandising, fish and wildlife habitat enhancement, and waste management and utilization. http://www.nrcs.usda.gov/programs/rcd/

Watershed Protection and Flood Prevention Program (PL-566) is implemented by NRCS through three watershed programs: surveys and planning, protection and flood prevention operations, and rehabilitation. Program components include conservation practices, sediment control, fish and wildlife enhancement, and wetlands and wetland function creation and restoration. Landowners in watershed projects receive technical and sometimes financial assistance in applying conservation practices

The **Wetlands Reserve Program (WRP)** was established to restore wetland functions and values to land altered for agriculture and contribute to the national goal of no net loss of wetlands. Previously converted or farmed wetlands are eligible if restoration to a functional wetland is possible. Forestland that was formerly wetland is eligible where the hydrology has been altered. Landowners sell a permanent easement or a 30-year easement to NRCS. A new option is a 10-year Restoration Cost-Share Agreement that does not require an easement. Participating landowners agree to maintain or restore the wetland as directed by a WRP Plan of Operations (WRPO) prepared by the NRCS and approved by the USFWS. The landowner receives payment for the easement as well as cost-share assistance for approved projects. NRCS reserves the right to modify a particular use if conditions of the easement area change, and considers the management plan a living document that can be updated over time. In Mississippi there have been approximately 430 WRP easements filed that protect over 150,000 acres of wetlands. These easements are located in 26 counties, most of which are in the Delta. http://www.ms.nrcs.usda.gov/programs/MSWetlandsReserveProgram.html

Wildlife Habitat Incentives Program (WHIP) provides technical advice and cost-share assistance for improvement of wildlife habitat on private lands that focus on national and state priorities such as longleaf pine ecosystems and aquatic habitat restoration. Landowners desiring to participate create a Wildlife Habitat Development Plan (WHDP) with the help of the local conservation district and NRCS staff. Cooperating state wildlife agencies and private organizations may give technical assistance or additional funding for certain projects if the landowner agrees. Because WHIP is focused purely on wildlife benefits, it is applicable to any landowner, tenant, organization, club or business with land suitable for wildlife. The landowner must have a minimum of five acres with at least one acre to be managed under WHIP for wildlife habitat improvements. Agreement periods can be for five to ten years.

U.S. Fish and Wildlife Service

Landowner Incentive Program (LIP) is a new USFWS initiative coordinated by the MDWFP in conjunction with the non-profit conservation organization, Wildlife Mississippi, using federal funds to enhance, restore and protect imperiled habitats and benefit at-risk wildlife on private lands. Priorities in Mississippi are longleaf pine ecosystems in the southeast part of the state, blackland prairie in the northeast and central sections and bottomland hardwoods in the Delta. LIP will confer funds to landowners in these priority areas to cost-share practices such as site preparation, prescribed burning, tree and native warm season grass plantings and herbicide applications. Biologists provide technical guidance to all interested landowners and projects are reviewed and ranked by a team to determine eligibility
http://www.mdwfp.com/Level2/Wildlife/Lip/Introduction.asp

North American Wetland Conservation Act Grants (NAWCA) provide matching grants to organizations and individuals who have developed partnerships to carry out

wetlands conservation projects for the long-term benefit of wetland-associated migratory birds and other wildlife. There is a Standard and a Small Grants Program. Cost-share is 50 percent. Nine projects have been funded in Mississippi under the Standards Grants Program. The most recent project underway involves enhancement of over 1,000 acres of forested wetlands and improved management of 243 acres of moist soil units in Malmaison WMA. http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm

Mississippi Partners for Fish and Wildlife Program (MPFW) is a voluntary program administered by the USFWS with 20 federal, state, corporate and non-profit partners which provides technical and financial assistance to landowners who want to restore, improve and protect fish and wildlife habitats on their property. Priority habitats in Mississippi are wetlands, uplands, aquatics, native prairie and longleaf pine ecosystems and the emphasis for this program is habitat restoration. Projects with private landowners must secure a 10-year cooperative agreement and the maximum amount spent per landowner is $25,000. The overarching goal is to leverage resources of government agencies, organizations, corporations and private individuals to restore, improve and protect fish and wildlife habitats on private lands in the state. http://www.fws.gov/southeast/pubs/facts/mspcon.pdf

Through the **Private Stewardship Grant Program (PSG)** the USFWS provides grants and other assistance on a competitive basis to individuals and groups engaged in local, private, and voluntary conservation efforts that benefit federally listed, proposed, or candidate species, or other at-risk species. A 10 percent match of cash or through in-kind contributions is required. The program is available to private landowners and their partners. Only four proposals have been awarded in Mississippi since 2003 and none appear to have a focus on waterbirds or wetlands in agricultural systems. http://www.fws.gov/endangered/grants/private_stewardship/index.html

Ducks Unlimited (DU)

Mississippi Partners Project is a cooperative effort among DU, USFWS, MDWFP and NRCS. The objective of the program is to return waterfowl to the breeding grounds physically conditioned for maximum reproductive success. Managing off-season agricultural fields as waterfowl habitat offers good food resources for migrating and wintering birds with direct benefits to landowners, The program formerly offered water control structures and technical assistance to private landowners interested in restoring wetlands and managing existing wetlands, idle areas, and agricultural fields after harvest as shallow wetland habitat. Since 1991, DU and its partners have restored and enhanced over 65,000 acres of waterfowl habitat in Mississippi in Bolivar, Coahoma, Grenada, Holmes, Humphreys, Issaquena, Leflore, Panola, Quitman, Sharkey, Sunflower, Tallahatchie, Tunica, Warren, Washington, and Yazoo Counties. Most of this acreage is in agriculture, with the remainder consisting of green tree reservoirs and moist soil units. More emphasis will be placed on the latter two habitat types in the future and on technical assistance. (T. Moorman, DU, *pers. comm.*).

http://www.ducks.org/Mississippi/MississippiConservation/1456/MississippiPartnersProject.html

National Wildlife Refuge Association

The National Wildlife Refuge Association, a conservation organization whose mission is to protect, enhance and expand the National Wildlife Refuge System, launched a "Beyond the Boundaries" initiative last year aimed at protecting vital unprotected buffers and corridors adjacent to national wildlife refuges nationwide. One of their focus areas is the Lower Mississippi River. Over the next year they will be working to assess and develop specific habitat restoration projects on, or adjacent to, nearly 35 National Wildlife Refuges on the Lower Mississippi River (southern Illinois to Louisiana). NWRA will focus much of their work on lands in Arkansas and Louisiana, specifically in connection with White River and Cache River refuges in Arkansas, focal points for ivory-billed woodpecker conservation, and Tensas River NWR in Louisiana, which offers the potential of linking together large forested tracts. They note there is an opportunity to restore up to 70,000 acres of Mississippi River bottomlands from non-productive agricultural lands, located mainly within refuges themselves, to cypress swamps and hardwood forests teeming with oak, gum, ash, and cottonwood, not only benefiting wildlife, but also greatly increasing water quality in the lower river and Delta. http://www.refugenet.org/

Potential Partners and Projects

Agencies and organizations in Mississippi that may be able to assist Audubon Mississippi in accomplishing the WWL goals and objectives through their own programs or new partnerships or demonstration programs include:

Federal Agencies

Agricultural Research Service (ARS)
Environmental Protection Agency (EPA)
U.S. Army Corps of Engineers (USACOE)
U.S.D.A. Farm Services Agency (FSA)
U.S.D.A. Natural Resources Conservation Service (NRCS)
U.S.D.A. Animal and Plant Health Insurance Wildlife Services (WS)
U.S. Fish and Wildlife Service (USFWS)
U.S. Geological Survey (USGS)

For example, Audubon should participate in the State Technical Committee coordinated by the State Conservationist to increase awareness among NRCS and FSA staff and partner organizations about the WWL initiative, IBAs important to waterbirds in Mississippi and focal WWL species and collectively seek ways to direct incentives in conservation programs (CRP, WRP, WHIP, EQIP and others) toward improving habitat for waterbirds on agricultural lands. NRCS's Agricultural Wildlife Conservation Center or AWRC (formerly the Wildlife Habitat Management Institute) develops and

disseminates scientifically based technical materials to assist NRCS field staff and others in conservation and management efforts nationwide. The AWCC has developed some materials such as their "Shorebirds" management leaflet that provide excellent technical guidance on the management of shorebirds in agricultural landscapes and could be expanded or used as a model for similar technical guidance on management for other waterbirds (Plauny 2000). Audubon is already a national partner with the NRCS on its Audubon at Home program, and its conservation tenets are adaptable to agricultural lands in Mississippi.

In March, 2006 Audubon entered into a Memorandum of Understanding (MOU) with the U.S. Army Corps of Engineers that seeks "to provide a foundation for collaboration related to protection, restoration and/or management of natural resources of mutual interest…" (National Audubon Society 2006c). The MOU's objectives include encouraging water management measures that benefit migratory and resident birds and natural communities, fostering wetland protection and restoration projects to improve habitat, fostering demonstration projects, gathering and sharing scientific data and cooperating in public education and information efforts. Audubon should use this new agreement with the USACOE to identify specific educational, habitat protection and restoration projects that focus on IBAs where the Corps has some ownership such as Mahannah WMA and those where the Corps water management influences habitat management such as Hillside NWR.

The USFWS in their CCP for the Theodore Roosevelt NWR Complex identified a large Conservation Partners Focus Area covering nine counties among the five refuges and Delta National Forest where they want to provide technical and financial assistance to landowners through the Partners for Fish and Wildlife Program for enhancement of croplands for migratory birds and reforestation of converted wetlands (USFWS 2006). Audubon should become a partner in this endeavor and should also participate as partners in NAWCA and PSG grant projects targeted toward private lands in the MAV and within this Focus Area. Audubon should continue and increase its participation in the Mississippi River Alluvial Valley Joint Venture and the newly formed East Gulf Coastal Plain Joint Venture to help facilitate integrated bird and habitat conservation across these large regional scales.

Audubon should encourage Wildlife Services and the USFWS to seek ways to ensure accurate reporting and monitoring of cormorant and other migratory bird take under the depredation permit and to work together with industry representatives and other partners on strategies to improve knowledge of population status and trends.

State Agencies

Mississippi Association of Conservation Districts/Soil and Water Conservation Commission (MACD/SWCD)
Mississippi Department of Agriculture and Commerce (MDAC)
Mississippi Department of Environmental Quality (MDEQ)
Mississippi Department of Wildlife, Fisheries and Parks (MDWFP)
Mississippi Forestry Commission (MFC)

As new technical guidance and refined incentive programs are developed in the future that focus on additional waterbirds species and habitats, the MACD/SWCD will be an important component in delivering technical assistance and programs to private landowners. The MDWFP is currently developing a new strategic plan for their waterfowl and wetlands program. Audubon should volunteer to assist in this statewide planning effort and encourage practices and programs that also benefit other waterbird species, and should work with MDWFP's Mississippi Museum of Natural Science and other conservation partners to adopt more rigorous systematic surveys for breeding colonial waterbirds, secretive marsh birds and other bird groups using aerial and ground-based methods, especially at sites with consistent heavy use such as IBAs. Audbon and MDWFP should also work to advance the recommendations from the state's Comprehensive Wildlife Conservation Strategy that will benefit WWL species.

MDEQ manages its water programs on a basin-wide scale. Most of the IBAs important to waterbirds are in the Yazoo River Basin, an area with numerous water quality problems such as excessive concentrations of nutrients, siltation, pathogens and organic enrichment from non-point source pollution. The effects of past use of banned pesticides (DDT and Toxaphene) continue to be an issue. The high priority issues identified by this Basin Management Approach include impacts of turbidity/suspended sediments on water quality, habitat loss, effective drainage from agricultural fields, management of erosion, sediment and nutrient control and impacts of pesticides. Audubon should participate as a stakeholder in this basin management effort and share with MDEQ and other stakeholders' information about the WWL initiative. Audubon may also consider seeking Section 319 Nonpoint Source grant funding for a WWL demonstration project (MDEQ 2000).

Corporations

The Monsanto Fund, the philanthropic arm of the Monsanto Corporation, funded the development of this WWL report and the initiative in Mississippi and other state, as well as other efforts to bring attention to the IBAs in the state. This partnership has and will continue to advance the science of waterbird use of working lands in the state and region, and Audubon will continue to collaborate with the Monsanto Fund on improving habitat for waterbirds on private lands, particularly near IBAs.

Tara Wildlife, Inc. is not only the largest private IBA in the state, but also represents a very active Audubon partner in the south Delta and is aggressively managing its property for multiple uses and habitats that benefit many WWL focal species. In the summer of 2006, the Tara staff designed and installed a 200-acre impoundment to attract waterbirds for viewing. Their goal is to provide a stable feeding area for wading birds such as Wood Storks and Roseate Spoonbills as well as waterfowl (Reid 2006). Because Tara is used extensively for both hunting and as a corporate retreat and meeting facility, it provides an excellent opportunity for demonstration, research and viewing. Tara is also home to the new Mississippi River Field Institute established by Audubon, making it an obvious IBA for several WWL education initiatives in the state.

Universities

Mississippi Cooperative Fish and Wildlife Research Unit – Mississippi State University (MSU)
MSU Cooperative Extension Service (MSU CES)
MSU Natural Resources Enterprises MSU NRE

MSU has three entities that should play an integral role in helping with the WWL initiative in Mississippi. This report has identified many data gaps that could be addressed by researchers at MSU. Most of the research on winter flooded agricultural fields (particularly rice fields) and on waterbird use of aquaculture facilities has been conducted through the Department of Wildlife and Fisheries through the Forest and Wildlife Research Center at MSU. Because of their location in a land grant university with emphasis on agriculture, they are uniquely qualified and positioned to further knowledge of waterbird use of other crops in the state.

The MSU Cooperative Extension Service provides the link between the information developed by sound research and the ultimate end-users such as landowners who will use that information in the management of their property for crops, aquaculture, recreation and habitat. The Extension Service has offices in all 82 of Mississippi's counties, an extensive outreach website (www.msucares.com) and the extension staff are proficient in developing outreach materials, training and technical assistance to landowners. As Audubon progresses in the development of prescriptions for enhancing agricultural landscapes for waterbird use, the MSU CES can play a vital role in helping develop outreach materials, communication and training for resource professionals and landowners.

The MSU Natural Resources Enterprises (NRE) program provides landowners with training and resources to add natural resource businesses to their existing farm and timber operations. This is another potential partner for demonstration projects such as enhanced habitat for wildlife viewing on working lands that have potential to increase ecotourism.

Professional Societies

The Wildlife Society

Mississippi has an active professional association of wildlife biologists that can help disseminate new technical information regarding management of waterbirds species on agricultural lands.

Conservation, Environmental and Sportsmen's' Organizations

Delta Wildlife (DW)
Ducks Unlimited (DU)
Lower Delta Partnership (LDP)
National Fish and Wildlife Foundation (NFWF)
Mississippi Fish and Wildlife Foundation (MFWF)
Mississippi Ornithological Society (MOS)
Mississippi Wildlife Federation (MWF)

South Mississippi Environmental and Agricultural Coordination Organization (SMEACO)
The Nature Conservancy (TNC)
National Wildlife Refuge Association (NWRA)

Some examples may include collaborating with traditional private lands partner organizations such as DU on regional planning efforts through the two major joint ventures, identifying potential grant funding sources such as NFWF, NAWCA and PSG for projects of mutual interests and providing matching funds for those projects. DU has already developed excellent resources for other waterbird species ("Shorebird Migrations: Fundamentals for Land Managers in the United States" and "South Atlantic Coastal Wetlands for Waterfowl and Other Wildlife") that may serve as templates for other outreach materials specific to Mississippi. Audubon and other advocacy organizations such as MWF should monitor changes in Farm Bill conservation programs, advocate for additional incentives focused on waterbird species of concern and their habitats, and work collaboratively with others to prevent rollbacks in existing programs. Audubon may also work with MOS in the future on colonial waterbird surveys on updating and institutionalizing a statewide colonial waterbird survey. The NRWA recently received funding to identify and promote conservation and restoration activities on private lands around federal wildlife refuges along the lower Mississippi River, and should be encouraged to target IBAs such as those in the Theodore Roosevelt Refuge Complex.

Agribusiness

Catfish Farmers of America
Mississippi Corn Growers Association
Mississippi Farm Bureau Federation
Mississippi Rice Producers Association
Mississippi Soybean Association
National Aquaculture Association
USA Rice Federation

Some examples may include working with agribusiness leaders and boards to fund additional research on the impacts of waterbirds on specific crops and aquaculture, identifying educational and information opportunities for farm managers and landowners, and collaborating on improving waterbird population surveys.

Summary of WWL Initiative Priorities in Mississippi

In addition to those items identified in the *Knowledge Gaps and Research Needs* section of each crop and aquaculture discussion, there are several areas where Audubon in collaboration with resource agencies, conservation and commodity organizations could advance the conservation of waterbirds in Mississippi. The following is a brief summary of major priority actions that should be pursued in the state and region.

- Work with NRCS and other partners to characterize land uses and land ownership around all IBAs important to waterbirds, and identify priority areas in private ownership where incentive programs and management assistance can be directed.

- Increase general knowledge about populations and occurrences of waterbirds through use of annual colonial waterbird aerial surveys and participation in future continental marshbird monitoring programs and increase data gathering of BBS routes in the state to 100 percent.

- Document how priority waterfowl, wading bird, shorebird, marshbird, landbird and other waterbird species use agricultural lands and aquaculture ponds throughout the year. More is known about waterfowl use of some crops, particularly rice. Further investigation of breeding, nesting, foraging and migration use of all crops and ancillary habitats is needed.

- Work with USDA NRCS, FSA and the State Technical Committee to identify land uses and ownership around each IBA important to WWL species and strategically focus existing and future Farm Bill incentives programs and other conservation programs on those targeted private lands. Audubon should initially target four IBAs (Tara, Inc., White's Lane, Panther Swamp NWR and Yazoo NWR) where they have existing relationships with managers and landowners and great potential for successful demonstration projects and survey efforts.

- Advocate for improving conservation programs and incentives in the Farm Bill that benefit waterbird species and prevent the rollback of existing programs such as CRP.

- Collaborate with producer organizations and agricultural agencies to encourage practices that benefit waterbirds such as "no-till", winter field flooding, fallowing, biological insect pest control, reduction of pesticide use, harvesting efficiency, methods and timing.

- Develop in partnership with university, agency and other organizations, technical guidance for resource managers and landowners on enhancing,

creating and restoring habitat for all focal waterbirds on both agricultural lands and natural areas.

- Pursue additional study of effects of lethal control on aquaculture production and on the population of waterbirds.

- Seek conservation partners (organizations, agencies, private landowners) to design and implement projects on private working lands near target IBAs that will advance understanding of how and when birds use well-managed agricultural habitats and demonstrate practices that benefit waterbirds.

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Tables

TABLE 1: WATERBIRD CONSERVATION RANKINGS FOR BIRDS THAT MIGRATE, WINTER OR BREED IN MISSISSIPPI (WWL species are highlighted in yellow).

Scientific Name	Common Name	Abundance and Seasonal Occurrence (a)	Federal Status (b)	State Status (c)	GRank (d)	SRank (e)	NAWCP - Continental (f)	NAWCP - Southeast (g)	NAWCP - MAV (h)	NAWCP - Southeastern Coastal Plain (i)	USSCP - Continental (j)	USSCP - MAV (k)	USSCP - Southeastern Coastal Plain (l)	NAWMP - Continental (m)	NAWMP - MAV (n)	NAWMP - Southeastern Coastal Plain (o)	NAWMP - East Gulf Coast (p)	PIF - Continental (q)	PIF - MAV (r)	PIF - EGCP (s)	MS CWCS Tier (t)	Audubon WatchList (u)
Dendrocygna autumnalis	Black-bellied Whistling-Duck	A			G5	SNA								Mod Low								
Anser albifrons	Greater White-fronted Goose	Fw			G5	SNA								Mod Low								
Chen caerulescens	Snow Goose	Cw			G5	SNA								Ab Obj	Mod							
Chen rossii	Ross's Goose	Rw			G4	SNA								Ab Obj								
Branta hutchinsii	Cackling Goose	R			G5	SNRN								High								
Branta canadensis	Canada Goose	Cp			G5	SNA,S4N								Mod /Ab Obj*	Mod Low							
Cygnus columbianus	Tundra Swan	Rw			G5	SNA								Mod Low								
Aix sponsa	Wood Duck	Cp			G5	S4B,S4N								Mod	High/ Mod High*	Mod High	Mod High					
Anas strepera	Gadwall	Cw			G5	S4N								Mod	Mod High	Mod Low	Mod High					
Anas americana	American Wigeon	Cw			G5	SNA,S4N								Mod High	Mod High	Mod Low	Mod High					
Anas rubripes	American Black Duck	Uw			G5	S2N								High		High				Ib	3	Y
Anas platyrhynchos	Mallard	Cp			G5	SNA,S5N								High	Highest	High	Mod					
Anas fulvigula	Mottled Duck	GUp			G4	S2B,S4N								Mod	Mod Low		Mod Low				2	Y
Anas discors	Blue-winged Teal	RsCtUw			G5	SNA,S4N								Mod High	Mod High		Mod High					

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Anas clypeata	Northern Shoveler	Cw			G5	S4N								Mod	Mod High		Mod High					
Anas acuta	Northern Pintail	Cw			G5	S4N								High	High		Mod				3	
Anas crecca	Green-winged Teal	Cw			G5	S4N								Mod	Mod High		Mod High					
Aythya valisineria	Canvasback	Fw			G5	S3S4N								Mod High	Mod High	Mod Low	Mod High			II		
Aythya americana	Redhead	Uw			G5	S4N								Mod High	Mod Low	Mod Low	High			Ib		
Aythya collaris	Ring-necked Duck	Cw			G5	S5N								Mod	Mod High	Mod High	Mod High					
Aythya marila	Greater Scaup	Uw			G5	S5N								Mod	Mod High	Mod High	Mod High					
Aythya affinis	Lesser Scaup	Cw			G5	S4N								High	High	High	High est				3	
Melanitta perspicillata	Surf Scoter	Rw			G5	SNA								Mod High								
Melanitta fusca	White-winged Scoter	Rw			G5	SNA								Mod High								
Melanitta nigra	Black Scoter	Rw			G5	SNA								Mod High								
Clangula hyemalis	Long-tailed Duck	Rw			G5	SNA								Mod High								
Bucephala albeola	Bufflehead	Cw			G5	S4N								Mod	Mod Low	Mod High	Mod High					
Bucephala clangula	Common Goldeneye	Fw			G5	S4N								Mod High	Mod Low	Mod High	Mod Low					
Lophodytes cucullatus	Hooded Merganser	Cw			G5	S2?B,S5N								Mod Low			Mod					
Mergus merganser	Common Merganser	Rw			G5	SNA								Mod Low								
Mergus serrator	Red-breasted Merganser	Cw			G5	S5N								Mod Low			Mod					

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Oxyura jamaicensis	Ruddy Duck	Cw			G5	SNA								Mod Low	Mod	Mod	Mod					
Gavia immer	Common Loon	GC w; IFt Uw			G5	SNA	Mod	MA		MA										II		
Podilymbus podiceps	Pied-billed Grebe	Us Cw			G5	S5N	High	MA(b),PR (nb)	MA(b)	MA(b)											3	
Podiceps auritus	Horned Grebe	Fw			G5	S5N	High	MA	MA	MA												
Podiceps nigricollis	Eared Grebe	Uw			G5	SNA	Mod	PR														
Pelecanus erythrorhynchos	American White Pelican	Fw			G3	S3N	Mod	PR(b),MA (nb)	MA,P C	MA											3	
Pelecanus occidentalis carolinensis	Brown Pelican	GC p; IA	PS:LE	LE	G4T U	S1N	Mod*	PR		PR										Ib	2	
Phalacrocorax auritus	Double-crested Cormorant	Rs Cw			G5	S4N	Lowest	PC(b,nb), PR(nb)	PR(b), PC(nb)	PR(b),PC(nb)												
Anhinga anhinga	Anhinga	Us Rw			G5	S3B,S1N	Mod	PR	PR	PR											3	
Botaurus lentiginosus	American Bittern	GU w; IUt			G4	S3N	High	MA	MA	MA										II	3	
Ixobrychus exilis	Least Bittern	Us			G5	S3B	High	MA	MA	MA											3	
Ardea herodias	Great Blue Heron	Cp			G5	S5B	Lowest	PR	PC	PR												

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Ardea alba	Great Egret	Cp			G5	S5B	Lowest	PR	PC	PR												
Egretta thula	Snowy Egret	Cp			G5	S4B,S1N	High	PR	PC	MA											3	
Egretta caerulea	Little Blue Heron	Cp			G5	S2B	High	IM	MA,PC	MA											2	
Egretta tricolor	Tricolored Heron	Fp			G5	S2B,S1N	High	PR	PR	MA											3	
Egretta rufescens	Reddish Egret	GRp; IA			G4	S2N	Mod	IM		PR										Ib	2	Y
Bubulcus ibis	Cattle Egret	Cs Uw			G5	S5B,S5N	Lowest	PC	PC	PC												
Butorides virescens	Green Heron	Cs Rw			G5	S5B	Low	MA	PR	MA												
Nycticorax nycticorax	Black-crowned Night-Heron	Up			G5	S3B,S4N	Mod	MA	PR	MA											3	
Nyctanassa violaceus	Yellow-crowned Night-Heron	FsRw			G5	S3B,S1N	Mod	MA	MA	MA											3	
Eudocimus albus	White Ibis	Fp			G5	S2B,S3N	Mod	MA	MA	MA											2	
Plegadis falcinellus	Glossy Ibis	R			G5	SNA	Low	PR	PR	MA												
Plegadis chihi	White-faced Ibis	R			G5	SNA	Low	PR	PR													
Platalea ajaja	Roseate Spoonbill	Ca			G5	S1B,S2N	Mod	PR	PR													
Mycteria americana	Wood Stork	Us	PS*	LE	G4	S2N	High	CR(b),MA(nb)	MA	CR(b),MA(nb)										VII	2	
Pandion haliaetus	Osprey	GUp; IRsFt			G5	S3B,S1S2N															3	

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Haliaeetus leucocephalus	Bald Eagle	RsFw	PS:LT	LE	G5	S2B,S2N												PR	VI	VI	2	
Coturnicops noveboracensis	Yellow Rail	Ca			G4	S2N	High	MA	MA	MA										Ib	1	Y
Laterallus jamaicensis	Black Rail	A			G4	S2N	Highest	IM	IM	IM										Ia	1	R
Rallus longirostris	Clapper Rail	GCp	PS		G5	S4	Mod	PR		PR										Ib		
Rallus elegans	King Rail	Up			G4	S3B,S3N	High	IM	IM	MA										II	2	
Rallus limicola	Virginia Rail	GUw; IUtRw			G5	SNA	Mod	PR	PR	PR												
Porzana carolina	Sora	GFw; IUtRw			G5	S5N	High	PR	PR	PR												
Porphyrio martinica	Purple Gallinule	Us			G5	S3B	High	MA	MA	IM											3	
Gallinula chloropus	Common Moorhen	Cp	PS		G5	S5B,S5N	Mod	PR	PR	MA												
Fulica americana	American Coot	RsCw			G5	S5B,S5N	Low	MA	MA(nb)	IM(b),MA(nb)												
Grus canadensis	Sandhill Crane	GRp; ICa	PS:LE		G5	S1	Low	PR	PR	PR												
Grus canadensis pulla	Mississippi Sandhill Crane	GRp	LE	LE	G5T1	S1	*	CR		CR										Ia	1	
Pluvialis squatarola	Black-bellied Plover	GFw; IUt			G5	S4N					Mod	Mod	Mod									

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Pluvialis dominica	American Golden-Plover	Ft			G5	SNA					High	High	Mod								1**	Y
Charadrius alexandrinus nivosus	Snowy Plover	GRp	PS	LE	G4	S2					HI	NAR*	Ex High							Ib		R
Charadrius alexandrinus tenuirostris	Southeastern Snowy Plover	GRp		LE	G4T3Q	S2					HI		Ex High							Ib	1	
Charadrius wilsonia	Wilson's Plover	GUs			G5	S1					High	Low	High							Ib	1	Y
Charadrius semipalmatus	Semi palmated Plover	GFw; IFt			G5	SNA					Low	Low										
Charadrius melodus	Piping Plover	GUw; IRt	LE, LT	LE	G3	S2N					HI	HI	Ex High							Ia	2	R
Charadrius vociferus	Killdeer	Cp			G5	S5B					Mod	Mod										
Haematopus palliatus	American Oyster catcher	GUp			G5	S1					High		Ex High							Ib	1	Y
Himantopus mexicanus	Black-necked Stilt	GUp; IRs	PS		G5	S3B					Low	Low										
Recurvirostra americana	American Avocet	GUp; IRt			G5	SNA					Mod	Low	Mod									
Actitis macularia	Spotted Sandpiper	CtUw			G5	SNA					Low	Low										
Tringa solitaria	Solitary Sandpiper	Ct			G5	SNA					High	Mod	High								1**	
Tringa melanoleuca	Greater Yellowlegs	FtUw			G5	SNA					Mod	Mod	Mod									

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Tringa semipalmatus	Willet	GFp; IRt			G5	S4B,S4N					Mod	Low	Mod							Ib		
Tringa flavipes	Lesser Yellowlegs	CtUw			G5	SNA					Mod	Low	Mod									
Bartramia longicauda	Upland Sandpiper	Ut			G5	SNA					High	Low	High								1**	
Numenius phaeopus	Whimbrel	Rt			G5	SNA					High	NAR*	High								1**	Y
Limosa fedoa	Marbled Godwit	GRw; ICa			G5	S2N					High	High	High							Ib	2	Y
Arenaria interpres	Ruddy Turnstone	GFw; IRt			G5	S5N					High	High	Mod								1**	
Calidris canutus	Red Knot	GUw; IA			G5	S2N					High	High	Ex High							Ib	2	Y
Calidris alba	Sanderling	GCw; IUt			G5	S5N					High	High	Mod							II	1**	
Calidris pusilla	Semipalmated Sandpiper	Ct			G5	SNA					Mod	Mod	High							II		
Calidris mauri	Western Sandpiper	GCw; IFtRw			G5	S4N					High	Mod	Mod								3	
Calidris minutilla	Least Sandpiper	GCw; ICtUw			G5	S5N					Mod	Mod	Mod									
Calidris fuscicollis	White-rumped Sandpiper	Ut			G5	SNA					Low	Low										
Calidris bairdii	Baird's Sandpiper	Ut			G5	SNA					Low	Low										

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Calidris melanotos	Pectoral Sandpiper	Ct			G5	SNA					Low	Low	Mod									
Calidris alpina	Dunlin	GCw; IFtRw			G5	S4N					Mod	Mod	Mod							II	3	
Calidris himantopus	Stilt Sandpiper	Ft			G5	SNA					Mod	Mod	High							Ib		
Tryngites subruficollis	Buff-breasted Sandpiper	Ut			G4	SNA					High	High	High							Ib	1**	
Limnodromus griseus	Short-billed Dowitcher	GFw; IUt			G5	S5N					High	Mod	High							Ib	1**	Y
Limnodromus scolopaceus	Long-billed Dowitcher	GFw; IUt			G5	S5N					Low	Low										
Gallinago delicata	Wilson's Snipe	Cw			G5	S5N					Mod	Mod	Mod									
Scolopax minor	American Woodcock	Up			G5	S?					High	High	High							Ib	3	Y
Phalaropus tricolor	Wilson's Phalarope	GUt; IRt			G5	SNA					High	High	Mod								1**	Y
Larus atricilla	Laughing Gull	GCp; IR			G5	S1B,S5N	Lowest	PR		PC												
Larus pipixcan	Franklin's Gull	Rt			G4G5	SNA	Mod	PR														
Larus philadelphia	Bonaparte's Gull	Cw			G5	S4N	Mod	PR		PR												
Larus delawarensis	Ring-billed Gull	Cw			G5	S4N	Lowest	PC														
Larus argentatus	Herring Gull	Uw			G5	S4N	Low	PC		PC(b)												
Sternula antillarum antillarum	Least Tern (coastal)	GCs			G4	S3B	High*	MA		MA										II	2	

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Sternula antillarum athalassos	Interior Least Tern	ILUs	LE	LE	G4T2Q	S2B	High*	MA	MA	MA											2	
Gelochelidon nilotica	Gull-billed Tern	GUs; IA			G5	S1B,S3S4N	High	MA	PR	MA										II	2	
Hydroprogne caspia	Caspian Tern	GFp; IUt			G5	SNA,S4N	Low	PR		PR(b)												
Chlidonias niger	Black Tern	Ct			G4	SNA	Mod	MA	MA	MA										Ib		
Sterna hirundo	Common Tern	GUs; IRt			G5	S1B	Low	IM(b),MA(t)	MA	IM(b),MA(t)												
Sterna forsteri	Forster's Tern	GCp; IFtUw			G5	SNA,S5N	Mod	PR		PR												
Thalasseus maximus	Royal Tern	GCp; IA			G5	S1B,S4N	Mod	PR		PR										II	2	
Thalasseus sandvicensis	Sandwich Tern	GUs; IA			G5	S1B,S4N	Lowest	MA		MA										II	2	
Rynchops niger	Black Skimmer	GFp; IA			G5	S3B,S3N	High	MA	MA	MA										II	2	
Ceryle alcyon	Belted Kingfisher	Fp			G5	S5																
Empidonax alnorum	Alder Flycatcher	Rt			G5	SNA												PR				
Sayornis phoebe	Eastern Phoebe	Cp			G5	S5B,S5N																
Corvus ossifragus	Fish Crow	Cp			G5	S5B														V		

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Progne subis	Purple Martin	Cs			G5	S5B													V	II		
Tachycineta bicolor	Tree Swallow	As Ct			G5	SNA																
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Fs			G5	S5B																
Riparia riparia	Bank Swallow	LRs Ut			G5	S1?B																
Cistothorus platensis	Sedge Wren	Uw			G5	S5N														Ib		
Cistothorus palustris	Marsh Wren	GUp; IUt Rw			G5	S3S4B,S4N																
Dendroica palmarum	Palm Warbler	GFw; IFt Rw			G5	SNA												PR		Ib		
Protonotaria citrea	Prothonotary Warbler	Cs			G5	S5B												MA	Ib	Ib	3	Y
Seiurus noveboracensis	Northern Waterthrush	Ut			G5	SNA																
Seiurus motacilla	Louisiana Waterthrush	Fs			G5	S3B												PR		III	3	
Geothlypis trichas	Common Yellowthroat	Cs Uw			G5	S5B																
Ammodramus leconteii	Le Conte's Sparrow	Uw			G4	S3N															2	
Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	GUw; ICa			G5	S3N												PR		Ia	2	R

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Ammodramus maritimus	Seaside Sparrow	GUp	PS		G4	S3												PR		Ib	2	Y
Melospiza lincolnii	Lincoln's Sparrow	UtRw			G5	SNA												PR				
Melospiza georgiana	Swamp Sparrow	Cw			G5	SNA												PR				
Agelaius phoeniceus	Red-winged Blackbird	Cp			G5	S5B,S5N																
Euphagus carolinus	Rusty Blackbird	Fw			G4	S2N												MA		II	2	Y
Quiscalus major	Boat-tailed Grackle	GCp			G5	S4B																

Sources and Explanations for Table 1:

(a) C = common or abundant; F = fairly common; U = uncommon; R = rare, present singly or in small numbers annually; Ca = casual, generally occurring in four to eight years during a ten year period; A = accidental, generally occurring three or fewer years during a ten year period; L = local, generally occurs in a small area of the state; G = Gulf Coast; I = inland; Ext = extirpated, no longer occurs in Mississippi; p = permanent resident; s = summer resident; w = winter resident; t = transient. Source: Mississippi Ornithological Society's Checklist of Birds of Mississippi, September, 2004.

(b) LE = listed as endangered throughout range; LT = listed as threatened throughout range; LE, LT = listed as endangered or threatened throughout range; PS = listed only in portion(s) of range, not including Mississippi; PS:LE = listed as endangered in portion(s) of range, including Mississippi; PS:LT = listed as threatened in portion(s) of range, including Mississippi; PS:LE, LT = listed as endangered or threatened in portion(s) of range, including Mississippi. Source: Endangered Species Act of 1973.

* Mississippi's Wood Storks consist of birds from the population listed as endangered and the non-listed population, however the U.S. Fish and Wildlife Service does not consider birds in Mississippi to be endangered.

(c) LE = listed as endangered. Source: Nongame and Endangered Species Conservation Act of 1974.

(d) See http://www.natureserve.org/explorer/ranking.htm for global rank explanations. Source: NatureServe.

(e) See http://www.natureserve.org/explorer/ranking.htm for state rank explanations. Source: Mississippi Natural Heritage Program.

(f) Continental conservation concern categories. Source: North American Waterbird Conservation Plan, Version 1 and http://www.fws.gov/birds/waterbirds/statusassessment/assessment.html. Highest Concern = Highest, High Concern = Hi, Moderate Concern = Mod, Low Concern = Low, Lowest Concern = Lowest. "Lowest Concern" was formerly "Not Currently at Risk", and "Highest Concern" was formerly "Highly Imperiled".

* Conservation ranks are presented for full species.

(g) Southeastern conservation need categories; CR = Critical Recovery; IM = Immediate Management; MA = Management Attention; PR = Planning and Responsibility; PC = Population Control. Ranks followed by (b) apply only to breeding populations, (nb) to non-breeding populations and (t) to transients. Source: Draft Southeast U.S. Regional Waterbird Conservation Plan.

(h) Mississippi Alluvial Valley conservation need categories; CR = Critical Recovery; IM = Immediate Management; MA = Management Attention; PR = Planning and Responsibility; PC = Population Control. Ranks followed by (b) apply only to breeding populations and (nb) to non-breeding populations. Source: Draft Southeast U.S. Regional Waterbird Conservation Plan.

(i) Southeastern Coastal Plain conservation need categories; CR = Critical Recovery; IM = Immediate Management; MA = Management Attention; PR = Planning and Responsibility; PC = Population Control. Ranks followed by (b) apply only to breeding populations, (nb) to non-breeding populations and (t) to transients. Source: Draft Southeast U.S. Regional Waterbird Conservation Plan.

(j) Continental conservation ranks. Source: U.S. Shorebird Conservation Plan, Second Edition. Highly Imperiled = HI, High Concern = High, Moderate Concern = Mod, Low Concern = Low, NAR = Not at Risk

(k) Regional conservation ranks within the Mississippi Alluvial Valley. Source: U.S. Shorebird Conservation Plan, Lower Mississippi Valley/Western Gulf Coastal Plain regional plan.

* Low regional priority due to its relatively low occurrence in the region.

(l) Regional conservation priorities within the Southeastern Coastal Plain. Source: U.S. Shorebird Conservation Plan, Southeastern Coastal Plains-Caribbean Region report. Extremely High Priority - Ex High, High Priority = High, Moderate Priority = Mod, Low Priority = Low

(m) Continental conservation priorities. Source: North American Waterfowl Management Plan 2004 Implementation Framework. High, Moderately High = Mod High, Moderate = Mod, Moderately Low = Mod Low, Low, Above Objective = Ab Obj

* Mississippi Flyway Giant Canada Geese are Above Objective.

(n) Regional conservation need within the Mississippi Alluvial Valley. Source: North American Waterfowl Management Plan 2004 Implementation Framework.

* Wood Ducks are High Conservation Need during the breeding season and Moderately High during the non-breeding season.

(o) Regional conservation need within the Southeastern Coastal Plain. Source: North American Waterfowl Management Plan 2004 Implementation Framework.

(p) Regional conservation need within the East Gulf Coast. Source: North American Waterfowl Management Plan 2004 Implementation Framework.

(q) Suggested continental conservation actions; IM = Immediate Action; MA = Management; PR = Long-term Planning & Responsibility. Source: Partners In Flight North American Landbird Conservation Plan, 2004.

(r) Conservation priority list; Ia = Highest overall priority; Ib = High overall priority; II = Physiographic area priority species; III = Additional species - global priority; IV = Additional species - abundant and declining in physiographic area; V = Additional species - responsibility for monitoring (>5% BBS population estimate); VI = Federal listed species; VII = Local, state, or regional interest species. Source: Partners in Flight Bird Conservation Plan for the Mississippi Alluvial Valley, Version 1.0, September 1999.

(s) Conservation priority list; Ia = Highest overall priority; Ib = High overall priority; II = Physiographic area priority species; III = Additional species - global priority; IV = Additional species - abundant and declining in physiographic area; V = Additional species - responsibility for monitoring (>10% BBS population estimate); VI = Federal listed species; VII = Local, state, or regional interest species. Source: Partners in Flight Bird Conservation Plan for the East Gulf Coastal Plain.

(t) Conservation Tiers. Source Mississippi's Comprehensive Wildlife Conservation Strategy, 2005-2015.
* Pelagic species included as a group rather than individually.

** Shorebird species included as a group rather than individually.

*** Neotropical migrant songbirds included as a group rather than individually.

(u) National Audubon Society's WatchList ranks. Source: http://www.audubon.org/bird/watchlist/bs-bc-what_is_the_watchlist.html. Red = R, Yellow = Y.

TABLE 2: POPULATION TRENDS FOR 141 WATERBIRD SPECIES IN MISSISSIPPI. Population trend estimate headings are the species group (if specific), geographic extent and source of the estimate. Estimates are I= Definite increase, i = possible increase or stable, u = trend uncertain or no data, d = possible decrease, D = definite decrease. NAWMP (2004) trends were given and interpreted as I = increasing, i= no trend, and D = decreasing. CBC trends were given as I = definite increase, i= possible increase, S= stable, d = possible decrease, D = definite decrease. Yellow highlight indicates WWL species.

Order	Family	Common Name	NAWCP - Continental (a)	Southeast Waterbird Plan - Southeast Region (b)	Southeast Waterbird Plan - MAV (c)	Southeast Waterbird Plan - Southeastern Coastal Plain (d)	Southeast Waterbird Plan - EGCP (e)	USSCP - Continental (f)	USSCP - MAV (g)	USSCP - Southeastern Coastal Plain (h)	NAWMP - Continental (i)	PIF - Continental (j)	PIF - MAV (j)	PIF - EGCP (l)	BBS - Continental (m)	BBS - Mississippi (n)	BBS-MAV (0)	CBC - Continental(p)	CBC- MAV(q)
ANSERIFORMES																			
	ANATIDAE																		
		Black-bellied Whistling-Duck									I				I	u			
		Greater White-fronted Goose									i				u	u		I	I
		Snow Goose									i				u	u		I	I
		Ross's Goose									I				u	u			
		Cackling Goose									i				I	u	i	I	I
		Canada Goose									I/i				I	i	i	I	I
		Tundra Swan									I				u	u			
		Wood Duck									I				I	I	i	I	i
		Gadwall									I				I	u		I	I
		American Wigeon									i				d	u		S	d
		American Black Duck									D				d	u		i	D
		Mallard									i				i	i	i	I	i
		Mottled Duck									i				d	u		i	I
		Blue-winged Teal									i				d	u		I	i
		Northern Shoveler									I				I	u		i	I
		Northern Pintail									D				D	u		D	S
		Green-winged Teal									I				i	u		S	i
		Canvasback									i				d	u		D	d
		Redhead									i				i	u			
		Ring-necked Duck									I				i	u		I	S
		Greater Scaup									i				u	u			
		Lesser Scaup									D				d	u		S	i
		Surf Scoter									D				u	u			
		White-winged Scoter									D				u	u			
		Black Scoter									D				u	u			
		Long-tailed Duck									D				u	u		d	U
		Bufflehead									I				i	u		I	i

Order	Family	Common Name	NAWCP - Continental (a)	Southeast Waterbird Plan - Southeast Region (b)	Southeast Waterbird Plan - MAV (c)	Southeast Waterbird Plan - Southeastern Coastal Plain (d)	Southeast Waterbird Plan - EGCP (e)	USSCP - Continental (f)	USSCP - MAV (g)	USSCP - Southeastern Coastal Plain (h)	NAWMP - Continental (i)	PIF - Continental (j)	PIF - MAV (j)	PIF - EGCP (l)	BBS - Continental (m)	BBS - Mississippi (n)	BBS-MAV (0)	CBC - Continental(p)	CBC- MAV(q)
		Common Goldeneye									i				i	u			
		Hooded Merganser									I				i	u		I	i
		Common Merganser									I				d	u			
		Red-breasted Merganser									I				d	u			
		Ruddy Duck									I				i	u		S	d
GAVIIFORMES																			
	GAVIIDAE																		
		Common Loon	i	I	I	I	I								I	u			
PODICIPEDIFORMES																			
	PODICIPEDIDAE																		
		Pied-billed Grebe	d?	d, b; i, nb	d, b; i, nb	d, b; i, nb	u, b; i, nb								i	u	i	I	I
		Horned Grebe	d	D	D	D	D								D	u		S	i
		Eared Grebe	i	I	I	I	I								I	u			
PELECANIFORMES																			
	PELECANIDAE																		
		American White Pelican	i	i, b; i, nb	i, nb	i, nb	i, nb								I	u		I	I
		Brown Pelican	i	I		I	i								i	u			
	PHALACROCORACIDAE																		
		Double-crested Cormorant	I	I, b; I, nb	I, b; I, nb	i, b; I, nb	u, b; I, nb								I	u	i	I	I
	ANHINGIDAE																		
		Anhinga	i	i	u	u	u								i	d	i	I	I
CICONIIFORMES																			
	ARDEIDAE																		
		American Bittern	d	d	d	d	d								d	u			
		Least Bittern	d	d	d	d	d								d	u			
		Great Blue Heron	I	I	I	I	I								I	I	i	I	I
		Great Egret	I	u	i	i	I								I	I	i	I	I
		Snowy Egret	d	I	I	d	u								I	i	I	I	I
		Little Blue Heron	d	D	d	d	D								D	i	D	S	d
		Tricolored Heron	d	i	u	d	d								S	u	i	S	i
		Reddish Egret	i	D		u	u								u	u			
		Cattle Egret	i	i	i	u	I								S	I	I	d	i

Order	Family	Common Name	NAWCP - Continental (a)	Southeast Waterbird Plan - Southeast Region (b)	Southeast Waterbird Plan - MAV (c)	Southeast Waterbird Plan - Southeastern Coastal Plain (d)	Southeast Waterbird Plan - EGCP (e)	USSCP - Continental (f)	USSCP - MAV (g)	USSCP - Southeastern Coastal Plain (h)	NAWMP - Continental (i)	PIF - Continental (j)	PIF - MAV (j)	PIF - EGCP (l)	BBS - Continental (m)	BBS - Mississippi (n)	BBS-MAV (0)	CBC - Continental(p)	CBC- MAV(q)
		Green Heron	i	d	i	d	d								d	i	i		
		Black-crowned Night-Heron	d	D	i	D	D								i	u	i	I	I
		Yellow-crowned Night-Heron	i	u	u	u	u								d	i	i		
	THRESKIORNITHIDAE																		
		White Ibis	i	i	i	i	u								I	i	i	I	I
		Glossy Ibis	I	i	u	d	u								i	u			
		White-faced Ibis	i	I	u										I	u			
		Roseate Spoonbill	i	i	u										I	u			
	CICONIIDAE																		
		Wood Stork	d	D, b; d, nb	d, nb	u, b; d, nb	d, nb								d	u			
FALCONIFORMES																			
	ACCIPITRIDAE																		
		Osprey										I			I	u		I	I
		Bald Eagle										I	u	u	I	u		I	I
GRUIFORMES																			
	RALLIDAE																		
		Yellow Rail	d	d	d	d	d								u	u			
		Black Rail	D	D, b; D, nb	D, nb	D, b; D nb	u, b; D, nb								u	u			
		Clapper Rail	i	u		u	u								i	u			
		King Rail	D	D	D	d	d								D	u		d	D
		Virginia Rail	i	I	I	I	I								i	u		I	D
		Sora	d	u	u	u	u								d	u		S	D
		Purple Gallinule	d	d	u	D	u								d	u			
		Common Moorhen	i	I	u	D	D								i	u		I	I
		American Coot	i	D, b; d, nb	u, b; d, nb	D, b; d, nb	u, b; d, nb								d	u		d	d
	ARAMIDAE																		
	GRUIDAE																		
		Sandhill Crane	i	I	I	I	I								I	i			
		Mississippi Sandhill Crane	*	D		D	D								*	*			

Order	Family	Common Name	NAWCP - Continental (a)	Southeast Waterbird Plan - Southeast Region (b)	Southeast Waterbird Plan - MAV (c)	Southeast Waterbird Plan - Southeastern Coastal Plain (d)	Southeast Waterbird Plan - EGCP (e)	USSCP - Continental (f)	USSCP - MAV (g)	USSCP - Southeastern Coastal Plain (h)	NAWMP - Continental (i)	PIF - Continental (j)	PIF - MAV (j)	PIF - EGCP (l)	BBS - Continental (m)	BBS - Mississippi (n)	BBS-MAV (0)	CBC - Continental(p)	CBC- MAV(q)
CHARADRIIFORMES																			
	CHARADRIIDAE																		
		Black-bellied Plover						u	D	D					u	u			
		American Golden-Plover						D	d	D					u	u			
		Snowy Plover						D	D	D					u	u			
		Southeastern Snowy Plover								D					*	*			
		Wilson's Plover						u	u	u					u	u			
		Semipalmated Plover						u	u	u					u	u			
		Piping Plover						D	D	D					u	u			
		Killdeer						d	D	u					S	i	i	S	d
	HAEMATOPODIDAE																		
		American Oystercatcher						u		u					u	u			
	RECURVIROSTRIDAE																		
		Black-necked Stilt						u	u	u					i	u		I	I
		American Avocet						u	u	u					i	u			
	SCOLOPACIDAE																		
		Spotted Sandpiper						u	u	u					d	u		i	i
		Solitary Sandpiper						d	u	u					d	u			
		Greater Yellowlegs						u	u	u					I	u		I	I
		Willet						u	u	u					D	u			
		Lesser Yellowlegs						D	u	D					D	u		S	I
		Upland Sandpiper						D	i	D					i	u			
		Whimbrel						d	D	D					u	u			
		Marbled Godwit						d	d	d					d	u			
		Ruddy Turnstone						d	d	d					u	u			
		Red Knot						D	D	D					u	u			
		Sanderling						D	D	D					u	u			
		Semipalmated Sandpiper						D	D	D					u	u			
		Western Sandpiper						D	u	D					u	u		d	d
		Least Sandpiper						D	D	D					u	u		S	d
		White-rumped Sandpiper						u	u	u					u	u			
		Baird's Sandpiper						u	u	u					u	u			
		Pectoral Sandpiper						u	u	u					u	u			

Order	Family	Common Name	NAWCP - Continental (a)	Southeast Waterbird Plan - Southeast Region (b)	Southeast Waterbird Plan - MAV (c)	Southeast Waterbird Plan - Southeastern Coastal Plain (d)	Southeast Waterbird Plan - EGCP (e)	USSCP - Continental (f)	USSCP - MAV (g)	USSCP - Southeastern Coastal Plain (h)	NAWMP - Continental (i)	PIF - Continental (j)	PIF - MAV (j)	PIF - EGCP (l)	BBS - Continental (m)	BBS - Mississippi (n)	BBS-MAV (0)	CBC - Continental(p)	CBC- MAV(q)
		Dunlin						d	D	D					u	u			
		Stilt Sandpiper						u	u	u					u	u			
		Buff-breasted Sandpiper						D	d	d					u	u			
		Short-billed Dowitcher						D	D	D					u	u			
		Long-billed Dowitcher						i	D	i					u	u			
		Wilson's Snipe						D	D	D					d	u		d	D
		American Woodcock						D	D	D					i	u		d	D
		Wilson's Phalarope						D	d	D					i	u		d	D
	LARIDAE																		
		Laughing Gull	i	I		I	u								I	u		I	I
		Franklin's Gull	i	i	i	i	i								i	u			
		Bonaparte's Gull	u	u	u	u	u								u	u		I	i
		Ring-billed Gull	I	I	I	I	I								i	u		i	I
		Herring Gull	i	i, b; D, nb	D, nb	i, b; D, nb	D, nb								D	u		d	i
		Least Tern (coastal)	*	d		u	d								*	*			
		Interior Least Tern	*	i	i	i	i								*	*	i		
		Gull-billed Tern	d	d	u	d	u								i	u			
		Caspian Tern	i	u, b; I, nb	I, nb	i, b	u, b								i	u		S	I
		Black Tern	i	d	d	d	d								d	u			
		Common Tern	i	D, b; D, nb	D, nb	D, b; D, nb	i, b; D, nb								D	u			
		Forster's Tern	d	u, b; i, nb	i, nb	u, b; i, nb	i, nb								i	u		I	I
		Royal Tern	i	u		u	u								i	u		i	I
		Sandwich Tern	i	d		d	d								u	u			
		Black Skimmer	d	d	i	d	u								d	u			
CORACIIFORMES																			
	ALCEDINIDAE																		
		Belted Kingfisher										d			d	d	d	i	I
PASSERIFORMES																			
	TYRANNIDAE																		
		Alder Flycatcher										i			u	u			
		Eastern Phoebe										i			i	i		I	d
	CORVIDAE																		

Order	Family	Common Name	NAWCP - Continental (a)	Southeast Waterbird Plan - Southeast Region (b)	Southeast Waterbird Plan - MAV (c)	Southeast Waterbird Plan - Southeastern Coastal Plain (d)	Southeast Waterbird Plan - EGCP (e)	USSCP - Continental (f)	USSCP - MAV (g)	USSCP - Southeastern Coastal Plain (h)	NAWMP - Continental (i)	PIF - Continental (j)	PIF - MAV (j)	PIF - EGCP (l)	BBS - Continental (m)	BBS - Mississippi (n)	BBS-MAV (0)	CBC - Continental(p)	CBC- MAV(q)
		Fish Crow										I		u	i	I	i	i	d
	HIRUNDINIDAE																		
		Purple Martin										i	i	D	S	d	i		
		Tree Swallow										i			S	u	I	d	i
		Northern Rough-winged Swallow										u			I	i	i		
		Bank Swallow										u			d	u			
	TROGLODYTIDAE																		
		Sedge Wren										I		D	I	u		i	S
		Marsh Wren										I			I	u		i	S
	PARULIDAE																		
		Palm Warbler										I		D	I	u			
		Prothonotary Warbler										d	i	D	d	i	d		
		Northern Waterthrush										u			d	u			
		Louisiana Waterthrush										i		i	I	d			
		Common Yellowthroat										i			D	d	D	S	d
	EMBERIZIDAE																		
		Le Conte's Sparrow										u			d	u		d	S
		Nelson's Sharp-tailed Sparrow										i		u	i	u		d	S
		Seaside Sparrow										u			d	u		D	i
		Lincoln's Sparrow										I			i	u		S	D
		Swamp Sparrow										I		u	I	u		S	d
	ICTERIDAE																		
		Red-winged Blackbird										d			d	D	i	S	d
		Rusty Blackbird										D		D	D	u		D	d
		Boat-tailed Grackle										I			I	u	i	i	I

SOURCES :

(a) Population trends. Source: North American Waterbird Conservation Plan, Version 1 and http://www.fws.gov/birds/waterbirds/statusassessment/assessment.html.

* Population trends are presented for full species.

(b) Population trends. Source: Southeast Waterbird Conservation Plan - Southeast Region

(c) Population trends. Source:Southeast Waterbird Conservation Plin - Mississippi Alluvial Valley
(d) Population trends. Source: Southeast Waterbird Conservation Plan - Southeastern Coastal Plain
(e) Population trends. Soucre Southeast Waterbird Conservation Plan - East Gulf Coastal Plain.
(f) Population trends. Source: U.S. Shorebird Conservation Plan, Second Edition.
(g) Population trends. Source: U.S. Shorebird Conservation Plan, Lower Mississippi Valley/Western Gulf Coastal Plain regional plan.
(h) Population trends. Source: U.S. Shorebird Conservation Plan, Southeastern Coastal Plains-Caribbean Region report.
(i) Population trends. Source: North American Waterfowl Management Plan 2004 Implementation Framework.
(j) Population trends. Source: Partners In Flight North American Landbird Conservation Plan, 2004.
(k) Population trends. Source: Partners in Flight Bird Conservation Plan for the Mississippi Alluvial Valley, Version 1.0, September 1999.
(l) Population trends. Source: Partners in Flight Bird Conservation Plan for the East Gulf Coastal Plain.
(m) Continental population trends, 1966-2005. Source: Breeding Bird Survey.
* Trends not assessed at subspecies level.
(n) Mississippi population trends, 1966-2005. Source: Breeding Bird Survey.
* Trends not assessed at subspecies level.
(o) Mississippi Alluvial Valley population trends. Source: Breeding Bird Survey –Daniel Niven.
(p) Continental population trends, 39 years. Source: Christmas Bird Count Data - Greg Butcher.
(q) Mississippi Alluvial Valley population trends, 39 years. Source: Christmas Bird Count Data - Greg Butcher.

TABLE 3: AGRICULTURAL ACREAGES FROM THE 2002 CENSUS OF AGRICULTURE IN MISSISSIPPI (NASS, 2002) AND MISSISSIPPI COUNTY CATFISH ESTIMATES, 2006.

Type	Acres
Total acres in Mississippi	30.5 million
Land in Farms	11,050,000
Cropland	5,820,000
Soybeans	1,610,000
Hay	730,000
Corn	380,000
Wheat	70,000
Cotton	1,210,000
Sorghum	25,000
Rice	265,000
Other Crops	1,523,275
Pastureland	1,400,000
Land enrolled in WRP and CRP*	810,000
Aquaculture (total surface acres)	99,000

**Wetland Reserve Program and Conservation Reserve Program*

TABLE 4. MISSISSIPPI ROW CROP CALENDAR. Calendar is approximate and varies each year depending on climatic conditions. Darker bars for crop flooding indicate optional flooding after harvest, typically for waterfowl.

Month	J				F				M				A				M				J				J				A				S				O				N				D			
Week	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
RICE																																															
Seedbed preparation																																															
Planting																																															
Flooding																																															
Fertilizing																																															
Pesticide application																																															
Harvest																																															
SOYBEAN																																															
Planting																																															
Flooding																																															
Harvest																																															
Pesticide application																																															
CORN																																															
Planting																																															
Flooding																																															
Harvest																																															
Pesticide application																																															
COTTON																																															
Planting																																															
Harvest																																															
Pesticide application																																															
SORGHUM																																															
Planting																																															
Flooding																																															
Harvest																																															
Pesticide application																																															
WINTER WHEAT																																															
Planting																																															
Harvest																																															
Pesticide application																																															

SOURCES: Tom Barber, Mississippi State Extension Service, *pers. comm*. September 19, 2006, Nathan Buehring, Mississippi State Extension Service, *pers.comm*., Bill Maily, Mississippi State Extension Service, *pers. comm.*, National Agricultural Statistical Service, 2002, Scott Baker, Mississippi Department of Wildlife, Fisheries and Parks, October 11, 2006, pers. comm. Mississippi Agricultural Statistics. Supplement 35, Highlights and Economic Statistics. http://www.nass.usda.gov/ms/economic.pdf.

TABLE 5: MISSISSIPPI IMPORTANT BIRD AREAS FOR WWL SPECIES. IBA region, site name, counties, habitat types in IBA, crops grown in county, Bird Conservation Region (BCR) and notable species occurrences and important habitats in IBA. Table includes only IBAs important to waterbirds that are in agricultural landscapes. One IBA is on private land and is not listed here at the request of the landowners.

IBA REGION	IBA SITE	COUNTY	HABITAT TYPES WITHIN IBA	CROPS GROWN IN COUNTY	BCR	NOTABLE SPECIES OCCURRENCES IN IBA
4-MRV	Coldwater River National Wildlife Refuge	Tallahatchie Quitman	Non-tidal, open wetlands, scrub/shrub	Rice, Cotton, Soybean, Wheat, Corn	26	**Colonial waterbirds, waterfowl and shorebirds** Site hosts concentrations of Wood Storks, Great Egrets, Great Blue Herons, Snowy Egrets, Little Blue Herons, and occasional Roseate Spoonbills, waterfowl species include Mallards, Northern Pintails, Northern Shovelers, Galdwalls, American Wigeon, Teal Canvasbacks, Scaup and Ring-necked Ducks winter here. During 2002-2003, the refuge held more than 800 White-fronted Geese. It is not unusual to see concentrations of more than 10,000 ducks during the winter. Intensive monitoring from 1996-1998 resulted in 33 species of shorebirds.
4-MRV	Delta National Forest	Sharkey	Bottomland hardwood	Rice, Cotton, Soybean, Wheat, Corn	26	**Mississippi Kite, colonial waterbirds, waterfowl, neotropical songbirds (25 Species)** Forest provides essential habitats for a diverse array of woodland birds not only during the breeding season, but also during critical winter months. It is the largest migration track in North America. Forest offer waterfowl migrating south acorns, invertebrates, and other high-energy nutrients. Sharing the habitat with waterfowl are many neotropical migratory bird species, such as Summer Tanagers and Prothonotary Warblers. The delta region is important not only for the resources they provide for waterfowl and neotropical songbirds, but also for colonial waterbirds and raptors such as Mississippi Kites.
4-MRV	Eagle Lake	Warren	Lakes and rivers	Cotton, Soybean, Corn	26	**Bald Eagle, American White Pelican, Ducks, Geese** Lake holds a significant no. of Ducks, Geese, White Pelicans, Double-Crested Cormorants and other waterbirds use the lake during the winter. An average of 5,000 Ruddy Ducks recorded during Christmas Bird Counts, up to 1,500 American White Pelicans are recorded during the counts. Former Eagle Bend of the river harbored concentrations of Bald Eagles. Six to ten Bald Eagles can be seen roosting along the lake shore in winter.

IBA REGION	IBA SITE	COUNTY	HABITAT TYPES WITHIN IBA	CROPS GROWN IN COUNTY	BCR	NOTABLE SPECIES OCCURRENCES IN IBA
4-MRV	Hillside National Wildlife Refuge	Holmes Yazoo	Bottomland hardwoods, cultivated fields, non-tidal open wetlands,	Cotton, Soybean, Corn Wheat, Catfish	26	**Bald Eagle, herons/egrets (5,000 pairs), waterfowl-ducks and shorebirds** One of the largest forested tracts in the Mississippi Delta, it provides important stopover and nesting habitat for neotropical migrants. Noted for the large no. of wintering waterfowl which have exceeded 125,000 birds. Mallards are the most numerous species, with American Wigeon, Gadwall, Northern Shoveler, Teal, Scaup, Ring-necked Duck and Wood Duck also common. Numerous species of marsh and wading birds occur on the refuge and a rookery containing Great Blue Herons, Great Egrets, Snowy Egrets, Little Blue Herons, Anhingas and Black-crowned Night-Heron are present. A small amount of loess bluff habitat on the eastern edge.
4-MRV	Mahannah Wildlife Management Area	Issaquena Warren	Bottomland hardwood forest; cultivated fields; reforested fields.	Cotton, Soybean, Wheat, Corn	26	**Waterfowl** Wintering Mallard, Galdwall, American Wigeon, Canvasback, Lesser Scaup, Blue-winged Teal, Green-winged Teal, Northern Shoveler, Wood Duck, Canada Goose and northern Pintail. Tundra Swans rarely show up. In winter fields have Sedge Wrens and leConte's Sparrow (rare). Breeding birds include Painted Buntings and Eastern Wild Turkeys. Scissor-tailed Flycatchers are rare fall migrants.
4-MRV	Mathews Brake National Wildlife Refuge	Holmes Leflore	Bottomland hardwood; non-tidal open wetlands	Cotton, Soybean, Corn, Rice, Wheat, Catfish	26	**Bald Eagle, Waterfowl-Ducks (30,000)** The major feature of the site is a 1,810-acre oxbow lake consisting of Bald Cypress and Tupelo Gum in the deeper portion and Buttonbush and Swamp Privet thickets in more shallow water. Area should support an exceptional diversity of neotropical migrants, waterfowl and waterbirds Wading birds such as Wood Storks and Great Egrets visit during the summer and fall. Neotropical migrants such as Prothonotary Warblers and Swainson's Warblers nest throughout this site.
4-MRV	Morgan Brake National Wildlife Refuge	Holmes	Bottomland hardwoods, non-tidal open wetlands, cultivated fields	Cotton, Soybean, Corn	26	**Bald Eagle, herons/egrets (3,000 pair), Little Blue Heron, Snowy Egret, White Ibis, ducks, shorebirds** Critical stopover habitat for migrating shoreline birds species, variety of wading birds. Significant numbers of Wood Storks, Roseate Spoonbills and Tricolored Herons, colonial waterbirds. 500 nesting pairs of Little Blue Herons, wintering waterfowl. 200 species of migratory birds use the refuge.
4-MRV	Panther Swamp National Wildlife Refuge	Yazoo	Bottomland hardwood; cultivated fields; grassland	Cotton, Soybean, Wheat, Corn, Catfish	26	**Bald Eagle, Mississippi Kite, Wood Stork, Red-headed Woodpecker, colonial waterbirds, waterfowl** Breeding population of Prothonotary Warblers and Red-headed Woodpeckers. Woodland raptors and bald Eagles are common in the winter. Several species of wading birds, substantial numbers of White Ibis, Wood Storks are common.

IBA REGION	IBA SITE	COUNTY	HABITAT TYPES WITHIN IBA	CROPS GROWN IN COUNTY	BCR	NOTABLE SPECIES OCCURRENCES IN IBA
3-Hills/Praries	Pearl River Waterfowl Refuge and Wildlife Management Area	Madison	Bottomland hardwood, non-tidal open wetlands, lacustrine/riverine/shrub/scrub, mixed woods, grassland	Cotton, Soybean, Corn	27	**Bald Eagle, colonial waterbirds (200 pairs), waterfowl** A 1,500-acre waterfowl refuge and provides wintering habitat for residents and migratory waterfowl. Habitat is conducive to support numbers of permanent birds such as a variety of herons, egrets, Bald Eagles, Wood Ducks, various waterfowl, shorebirds and warblers. The marsh habitat supports nesting habitat for Least Bittern, Purple Gallinule and common Moorhen. This heronry supports approximately 200 nesting pairs of Anhingas, Great Herons and Great Egrets. Green Herons also nest here.
3-Hills/Prairies	Sardis Lake and Waterfowl Management Area	Panola Lafayette	Lacustrine/riverine	Rice, Cotton, Soybean, Corn	27	**Bald Eagle, Osprey, American White Pelican, Franklin's Gull, waterfowl, gulls** This 58,000 acres provides wintering habitat of Bald Eagles, White Pelicans, a variety of waterfowl, concentrations of Bonaparte's Ring-billed and Herring Gulls. Waterfowl frequently seen include Canada Goose, Black Duck, Mallard, Pintail, Galdwall, Hooded Merganser, Wood Duck, Canvasback and Ring-necked Duck.
4-MRV	Shipland Wildlife Management Area	Issaquena	Grassland, lacustrine/riverine/bottomland hardwood forest	Cotton, Soybean, Wheat, Corn	26	**Wood Storks, Interior Least Tern, shorebirds** Best known for its colonies of nesting Interior Least Terns. These birds are found on the extensive Ajax Bar complex of sandbars, Migratory shorebirds rest and fed on mudflats associated with the sandbars, Waterbirds include Wood Storks. In 2002 up to 1,000 shorebirds of 13 species were found at Shipland.
4-MRV	St. Catherine Creek National Wildlife Refuge	Adams Wilkinson	Bottomland hardwood, lacustrine/riverine, cultivated field, deciduous woodland	Soybean	26	**American White Pelican, Bald Eagle, White Ibis, Wood Stork, Great Blue Heron (100 pair), Great Egret (100 pair), Roseate Spoonbill, waterfowl, shorebirds.** Loess Hill forests provide valuable habitat for migrant landbirds, one of the few known nesting sites for Worm-eating Warblers in the state. Post-breeding waterbirds include Wood Storks, White Ibis and Roseate Spoonbills. Large numbers of wintering waterfowl and migrating shorebirds can be found. Two rookeries of herons and egrets and two to three Bald Eagle nesting territories exist.
4-MRV	Tara Wildlife Inc.	Warren	Bottomland hardwood; lacustrine/riverine/ cultivated field	Cotton, Soybean, Corn	26	**Bald Eagle, Wood Stork, colonial waterbirds, Anhinga (75 pair), Great Blue Heron (80 pair), Great Egret (700 pair), Snowy Egret (125 pair), Little Blue Heron (75 pair), Cattle Egret (500 pair), waterfowl** Post-breeding waders include Wood Storks, Roseate Spoonbills, White Ibis, Little Blue Heron. Late summer, storks and other waders are attracted to the drying pools. Waterfowl include Mallard, Northern Pintail and Ring-necked Duck. One Bald Eagle pair has nested on and around Tara since the early 1980's, making it one of the most consistently used nesting territories for this species in Mississippi. Small numbers of Ospreys nest. Species found along the Mississippi River include Warbling Vireos, Baltimore Orioles, Mississippi Kites and Painted Buntings.

IBA REGION	IBA SITE	COUNTY	HABITAT TYPES WITHIN IBA	CROPS GROWN IN COUNTY	BCR	NOTABLE SPECIES OCCURRENCES IN IBA
4-MRV	White's Lane	Yazoo	Bottomland hardwood; shrub/scrub	Cotton, Soybean, Wheat, Corn, Catfish	26	**White Ibis (1,450 pair), Black-crowned Night-Heron, Tricolored Heron, Anhinga, Great Egret (150 pair), Snowy Egret (150 pair), Little Blue Heron (300 pair), Cattle Egret (1,000 pair)** Supports 1,400 to 5,000 nesting pairs of herons and egrets on a regular basis. Supports significant breeding populations of White Ibises, Great Egrets, Snowy Egrets, Little Herons and Cattle Egrets. Species known to nest in this colony are Great Blue Heron, Tricolored Heron, Black-crowned Night-Heron and Anhinga. Also one of only four known sites in Mississippi for nesting Double-crested Cormorant. Holds the largest concentration of nesting White Ibis in the state, with an estimated 2,500 pairs nesting in 2000 and 300 to 400 pairs nesting in 2002. Black-crowned Night-Herons nest in large numbers as well, about 20 to 30 nesting pairs. Tricolored Heron nests here in small numbers. Pied-billed Grebe, Common Moorhen and Prothonotary Warbler nest in this swamp, as well as Wood Ducks. Roseate Spoonbill and tree Swallow have been sighted during breeding season.
4-MRV	Yazoo National Wildlife Refuge	Washington	Bottomland hardwood, cultivated fields, cypress/buttonbush swamp; moist soil/shorebird management areas	Rice, Cotton, Soybean, Wheat Corn, Catfish	26	**Great Heron (1,000 pair), Great Egret (1,00 pair), Snowy Egret (500 pair), Little Blue Heron (1,000 Pair), Cattle Egret (500 pair), Black-crowned Night-Heron (150 pair), waterfowl, Wood Ducks (nesting), shorebirds (20 species)** Swan Lake supports a multi-species heronry (eight or nine species) of more than 1,300 pairs of nesting waterbirds. This waterbird colony is one of only a few sites in the state that supports nesting Double-crested Cormorants. Cox Pond (240 acres) provide stopover habitat for fall migrating shorebirds. An average of 1,000 shorebirds use these ponds. 20 Species of shorebirds have been documented, (15 species) of wading birds, wintering waterfowl (18-20 species of ducks and geese). Winter duck population approaches approximately 100,000 birds. Ducks include mostly Mallards, Gadwall and Green-wingeded Teal. Other species include; Northern Shoveler, Northern Pintail, American Wigeon, Ring-necked Duck, Canvasback, Redhead, Scaup, Bufflehead, Ruddy Duck and Hooded Merganser. Four species of geese, mostly Snow Geese. Other species of geese seen are Greater-fronted Geese, Canada Geese and Ross's.

Sources: Reid, B., M. Woodrey, T. Shropshire (compilers). 2004. Important Birds Areas of Mississippi. Vicksburg, Mississippi, Audubon, Mississippi.

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