Migratory Bird (Neotropical and Shorebirds) Management Plan for the Barataria and Terrebonne Basins of Louisiana

BTNEP - 30 August 1996 MIGRATORY BIRD (NEOTROPICAL AND SHOREBIRDS) MANAGEMENT PLAN FOR THE BARATARIA AND TERREBONNE BASINS OF LOUISIANA

> BARATARIA-TERREBONNE NATIONAL ESTUARY PROGRAM

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> A publication of the Barataria-Terrebonne National Estuary Program

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EXECUTIVE SUMMARY

1. The Barataria-Terrebonne Basins (BTB) support large numbers of birds, with many wintering birds, but with a vast number of migrants passing through each spring and fall. Sites such as Grand Isle may serve as extremely important stopovers for migrants grounded by severe weather.

2. Analysis of GIS data using the National Wetlands Inventory and satellite data show general patterns of bird habitat across the BTB. Maps produced by the GIS analysis are presented in Appendix A.

3. Data produced by the Louisiana Breeding Bird Atlas Project show distinct geographic patterns of bird distribution across the BTB.

- The number of species breeding in the BTB declines from north to south, reflecting the decline in habitat diversity which also declines to the south.
- The pattern of number of transient migrants recorded during the surveying increases instead in the southern BTB. This apparently results from the concentrating effect of the coast, and the fact that for northbound trans-gulf migrants (as were all those recorded during this surveying which was done in spring) the gulf coast is their first possible landfall.
- The distribution of breeding species corresponds to general habitat patterns, usually relating to the distribution of forested areas, uplands, marshes, and the gulf coast.
- The distribution of localities where trans-gulf migrants were recorded corresponds much less to general habitat patterns, but has a large geographic component, that is, trans-gulf migrants tend to concentrate near the coast regardless of habitat. However, habitat is still important to trans-gulf migrants, and along the coast, they tend to choose wooded, chenier areas over more open marshes. The Grand Isle area has several important cheniers.
- Waterbird nesting colonies are distributed throughout the BTB. Waterbirds require only a small area of scrubby trees for nesting, and these patches can be found even in the marshes near the coast.
- Seabird nesting colonies are of course concentrated at the coast, although two species of seabirds, Least and Gull-billed terns, nest in urban New Orleans.
- Bald Eagle nest sites are distributed in the marshes away from the coast, where there are some trees for perches and nesting. The eagles seem to avoid the uplands along Bayou Lafourche, and are not found in the more forested, northern part of the BTB.

4. Maps of the distribution of breeding, wintering, and transient species produced from the Breeding Bird Atlas data are presented in Appendix B.

5. A Comprehensive Conservation Action Plan was developed using the information and analysis from the first part of this report. It provides recommendations for specific actions for bird conservation throughout the BTB, with focus on transient Neotropical migrant birds, but also with recommendations for breeding and wintering species. A brief description of the actions proposed by the plan follows.

6. Public Outreach: Actions in this section include efforts to educate the public about the uniqueness of the bird resource, and to develop ecotourism in the BTB. Also needed is an analysis of the impact of bird ecotourism on the Grand Isle area. Development of the potential for ecotourism of birds and birdwatchers could lead to economic growth in the BTB. Linking up with the Great Texas Coastal Birding Trail could be one way to take advantage of ecotourism programs already developing along the gulf coast.

7. Habitat Protection: Among the most critical habitats for birds in the BTB are the cheniers, and they are extremely small and therefore vulnerable to development or loss through natural processes. Protection should be devised for all cheniers and similar woodlands along the coast of the BTB. It is recommended that the Grand Isle chenier and possibly the Wisner / Plaisance chenier west of Cheniere Caminada be purchased for perpetual maintenance as wooded habitat for migrants, and as a site for a migration monitoring station (see below for more on monitoring). For other cheniers some other means will have to be found through a private lands initiative (more below on this also). Barrier island restoration projects planned for the future should include provisions for birds. The beaches used by nesting seabirds should be protected by being fenced off and marked with signs during the breeding season, and plans should be made for the protection of their breeding colonies in the event of an oil spill. Efforts to increase freshwater and sediment flow into the estuary and reduce toxins in the water for other purposes also will benefit bird populations, and bird conservation can add to the advantages of those programs. Finally, the managers of already-existing public lands should develop plans for including birds in their management objectives.

8. Private Lands Initiative: Most of the BTB is in the hands of private landowners. The Plan encourages the continuation of private ownership while at the same time encouraging the protection and enhancement of bird populations. Traditional resource use such as hunting, commercial and recreational fishing are in no way incompatible with birds, but forest management and farming can be modified in ways to make them more amenable to bird populations. Some things private landowners could be encouraged to do include reducing forest fragmentation by maintaining large, unbroken tracts of forest and scrub communities; reforesting areas that have been timbered; protecting existing forest and scrub communities on barrier islands through conservation easements; promoting marsh regeneration and conservation; and developing future oil and gas exploration projects using existing canals and access roads. In no way should landowners be coerced into these actions, but they should be encouraged to do so, and educational efforts made to let them know what steps they can take that would benefit birds and at what costs to them.

9. Monitoring: Because the BTB are critical to so many trans-gulf migrant birds, it provides a unique opportunity and responsibility to measure the populations of the migrants passing through. Site choice for migrant monitoring is especially critical; the Grand Isle chenier, once acquired by a conservation or public organization, would be the best location. A second site should be established at the Barataria Preserve unit of Jean Lafitte National Historical Park and Preserve. This second site is immediately available, as it is already in public ownership. A sampling protocol consisting of a combination of diurnal migration counts and area census counts probably would provide the most useful data, if followed consistently. A migrant monitoring program will have to rely heavily on volunteers, which may be a problem in the Grand Isle area, because it is so far from the large population centers in Louisiana such as New Orleans and Baton Rouge. It would be

therefore more difficult to find volunteers either in the local area or willing to travel frequently from their homes. Volunteers may be more readily found to serve at the Barataria Preserve site.

10. Need for Additional Research: Some additional research efforts are needed to be able to develop and future management plans for birds. A list of these could include, but is not limited to: local ecological studies to determine which plant species and habitats are most important to the trans-gulf migrants; analyzing the value of Chinese tallow trees as habitat for migrants; examining the value or hazard posed by offshore oil platforms.

11. Proposed timetables for short-term, medium-term, and long-term projects, and possible implementers of the actions recommended in this plan, are given in tables.

INTRODUCTION

Background

The Barataria-Terrebonne Basins (BTB) cover a crookneck-squash shaped area of approximately 6500 mi² in south Louisiana, with its base at the Gulf of Mexico and apex in Pointe Coupee Parish. Its sides are determined by the Mississippi River levee on the east and the East Atchafalaya Basin Protection Levee on the west.

The BTB have been heavily affected by cultural and natural forces (McKenzie et al. 1995). Because of the great hydrologic changes in the area, sediment deposition needed to replenish the system has been severely affected by human activity, and other human activities have greatly accelerated natural erosion processes, so that land loss has been 21 mi² per year (Reed 1995). The human population is increasing in the BTB. The result of these two converse trends is that in the future the BTB will have more people and less land (McKenzie et al. 1995).

In the Barataria-Terrebonne Basin system 353 species of birds have been recorded, including breeding, transient, and wintering species. Of these, about half are common or abundant at least periodically (Condrey et al. 1995).

Because of its unique location this region is especially important as a stopover site for Neotropical migrant birds. Trans-gulf migrants crossing between the Yucatan peninsula and North America use the Barataria-Terrebonne Basins as a landfall for northbound migrants or the final point of departure for southbound ones. Although trans-gulf migrants reach the gulf coast from west of Houston, Texas, to Florida, a large proportion of the migrant population uses the upper Texas coast and coastal Louisiana around to Mississippi. The Barataria-Terrebonne Basins are therefore important areas for the trans-gulf migrants, because they cover a significant part of this important section of gulf coast. For over one hundred years, but especially since the work of Dr. George Lowery in the 1940s and 1950s on Grand Isle (1946, for example), the area of the BTB has been recognized as a very heavily used stopover by Neotropical trans-gulf migrant birds. It is especially critical when foul weather in spring causes migrating birds to reach land exhausted, or in fall when bad weather forces the birds to abort their southward migration at the last moment, before leaving land.

Although habitats in the BTB are important for transient Neotropical migrant birds, the region is also important for wintering and breeding species as well, whether they are Neotropical migrants or not. Large flocks of waterfowl winter in the BTB, as well as significant portions of the populations of some passerine species such as Swamp Sparrow (all scientific names are given on the maps in Appendix B) and Yellow-rumped Warbler. Some seabird species have major breeding populations on the barrier islands of the BTB, and a few Neotropical migrant passerines such as Prothonotary Warbler also have significant fractions of their total populations breeding in the area.

In the past, the focus by organizations such as Partners in Flight has been on passerine Neotropical migrant birds. Recently that organization and many others are getting away from concentrating only on passerines and considering all migrants equally, including-the shorebirds, herons, and other

waterfowl. This report will do the same. In addition, because all species of birds, whether they migrate or not, will be affected by the management and conservation recommendations of this report, the recommendations will also take into account their effects on non-migrants and wintering species.

Because the BTB are so critical to these birds, it is important to develop a plan for properly managing the resource. However, although much focus of such a plan should be on the Neotropical migrants, it cannot ignore management and conservation of populations of wintering and breeding birds. The plan should build a framework in the BTB that encourages private, corporate, and government landowners to manage land under their care in such a way as to maximize its suitability as habitat for the Neotropical migrant (as well as resident and wintering) birds that use the area.

To that end, this project was undertaken to obtain information on the habitats in the BTB and the birds that use them. Information on the habitats and their distribution was obtained from satellite imagery using Geographic Information System (GIS) methods. Bird distribution data were obtained from the Louisiana Breeding Bird Atlas Project (BBA). Although the Breeding Bird Atlas Project is normally concerned only with those species that breed in an area, for the purposes of this project additional information on wintering and transient migrants was obtained in the field by the BBA surveyors.

Objectives

The overall objective of this project is to develop a management plan for Neotropical migrant birds that use the Barataria-Terrebonne Basins as a stopover area. Because the management plan will also affect non-migrants or wintering birds, the plan will also consider management impact on them, although the focus is on migrants.

The specific objectives for developing the plan include:

- Analysis of the data provided by the GIS and BBA efforts.
- Development of a system for monitoring and collection of field data for the future.
- Recommending specific management plans for habitat within the BTB.

This report will provide the results of the data analysis and a comprehensive conservation action plan for monitoring birds in the BTB and management of the birds' habitats in the area.

METHODS

Information to allow the development of the management plan was obtained from three sources: the literature, habitat analysis by use of a GIS, and species numbers and distribution data from the Louisiana Breeding Bird Atlas Project. Details of the latter two are given below.

Geographic Information System Analysis

Map of Aggregated National Wetland Inventory (NWI) Data

Arc/Info Export files of 1988 NWI data were obtained from the Louisiana DNR GIS Laboratory. The 1988 habitat data set was developed by the National Biological Service Southern Science Center (National Wetland Research Center) to update existing 1956 and 1978 digital data sets of the Louisiana coastal plain. Fall 1988 1:63,000-scale color infrared (CIR) aerial photography served as a base for the 1988 data set. The data were photointerpreted using the Cowardin coding system (Cowardin et al. 1979) and photorectified to 1:24,000-scale USGS quadrangles. The U. S. Fish and Wildlife Service (USFWS) and National Biological Service (NBS) digitized the maps, removed quadrangle seam lines, and converted the data to Arc/Info formats.

The analysis of the Cowardin codes attributed to NWI polygons in the BTB revealed that polygons could be organized by groups whose component attributes are mutually exclusive in distribution. Between groups, attributes may be shared, i.e., overlap. Mapping these attributes exploits most of the variation available for the NWI in the BTB. The groups are Miscellaneous, Wetland Physiognomic, Nontidal Flooding, Salinity, Tidal Flooding, Upland Physiognomic, and Woodland. Appendix A, Part 2, lists the classes mapped for each group, their area within three zones parallel (or nearly so) to the shore of the Gulf of Mexico (see Habitat Acreages, below), and the letters and numbers used to recognize each class from the Cowardin codes.

MicroImages TNTmips software was used to import, analyze, and map the data. Individual NWI polygons are labeled with multiple attributes, and many different aggregations of attributes can be mapped. Attributes were mapped individually rather than aggregating polygons according to any complex set of attributes and thereby precluding an understanding of the original data components. An example to illustrate the use of these maps: To see where cypress shrub-scrub occurs, simply overlay a transparency of the "shrub-scrub" map on the "cypress forest / scrub" map. Hundreds of such combinations are made possible by mapping each attribute individually.

Landsat-updated Aggregated NWI Map

A preliminary version of the classification of 1994 Landsat Thematic Mapper data for the northern portion of the BTB was obtained through the USGS Louisiana Gap Analysis Project. GAP prepared the classification using the Isodata unsupervised routine of ERDAS software. Isodata was configured to identify 100 spectral clusters in each 1000-pixel x 1000-pixel parcel of satellite imagery covering the state of Louisiana north of the state-designated Coastal Zone. The data were acquired (scanned) during November 1993 to January 1994. The image resolution was 25 meters

per pixel (square). A total of 18 classes were assigned to the 100 clusters of spectral data in each parcel of imagery. The Landsat data are archived as ERDAS .lan files.

An attempt was made to merge a portion of the Landsat classification with the NWI data. It was then determined that classes important to bird management would be lost (subsumed into others) in preparing a seamless mosaic. Accordingly, maps were prepared separately for the two data sets.

Habitat Acreages

Acreages for all 18 classes of the Landsat TM classification were calculated for the far northern portion of the BTB not covered by NWI data. Measurements calculated for that region are not comparable to the other zones because the cover classes are defined differently.

For the area covered by NWI data, acreages for twenty (20) individual NWI attributes were calculated, but several attributes were not measured. All of the attributes were mapped but some were found to comprise a trivial portion of the BTB. Several others are essentially modifiers rather than habitats (e.g. "seasonally flooded nontidal" as compared to "cypress forest / scrub", respectively). The NWI vector data were rasterized to an 85-meter grid in order to expedite the calculations, so measurements of linear features and attributes with poor regional representation would be unreliable and are not reported. Measurements were calculated for coverage in three zones of similar extent: the southern BTB zone from 29.0000 to 29.2250 degrees North, the central BTB zone from 29.2250 to 29.3750, and the northern BTB zone (not to be confused with the "far northern" zone not covered by NWI data) from 29.3750 to 30.0000, all units in decimal degrees of latitude. The central BTB zone makes up for its narrower latitudinal spread by its east-west spread. The northern BTB zone encompasses about 487,000 ha, the central BTB zone covers about 457,000 ha, and the southern BTB zone encompasses about 517,000 ha, with a greater percentage of water as compared to the northern and central zones. The southern zone ranges from about 0 to 25 miles from the coast. Most parts of the central zone range from about 25 to 40 miles from the coast. Most parts of the northern zone range from about 40 miles to 55 miles from the coast. Most parts of the far northern zone range from 55 miles to 80 miles from the coast.

Quadrangle Maps

Color, contrast-enhanced maps of each 7 1/2 minute quadrangle to be visited in the BTB region were printed using a Calcomp color-thermal printer, for a total of about 50 maps. The maps were distributed to Breeding Bird Atlas personnel for use in the field, supplementing older-vintage US Geological Service (USGS) topographic sheets. These maps were distributed to the field personnel and used to mark sites that were surveyed to produce locality species lists.

Species Maps within Conservation Areas and Maps of Migration Staging Areas

Maps were printed for each species showing records of migrating transients and special staging areas using symbols denoting breeding likelihood based on Breeding Bird Atlas field work. Maps of habitat and conservation areas are provided separately in this report. Claris Filemaker Pro software was used to prepare the species maps in a single database table. The maps are provided in this report.

Maps of Special Nest Locations

Maps of special nest locations were mapped by the Louisiana Natural Heritage Program. Strategic Atlas software mapped data is stored in the Biological Conservation Database (BCD). Several data layers were provided to the Heritage Program (the boundary of the BTB, parish boundaries, and features on the landscape) that serve to orient the user's perspective of the maps. The maps are provided in the Appendices.

Louisiana Breeding Bird Atlas Project

The Louisiana Breeding Bird Atlas Project is a three-year effort, begun in 1994, to gather data on the breeding distributions of birds in the state. The results will be an atlas, a collection of maps, showing where each bird has been found breeding. These maps are expected to be published with the species accounts in the upcoming revised edition of the Birds of Louisiana book. The information will also be shared with the Louisiana Natural Heritage Program and National Biological Service, to use in their Gap Analysis Project. The project is headquartered in the Louisiana Natural Heritage Program offices in Baton Rouge.

To gather data for the atlas, the Breeding Bird Atlas Project uses the grid of 7 1/2 minute quads established by the USGS. Each of these quads is 7 1/2 X 7 1/2 minutes of latitude and longitude, or approximately 7 X 8 miles. The grid covers the entire state, with 877 quads covering Louisiana. However, because of this large number, the atlas project has sampled only about one half of these. Peripheral quads that are less than one-half in the state and quads that are more than one-half water have not been sampled. Sampling of the remaining quads has been done in checker-board fashion with only alternate quads being surveyed.

The data for the Breeding Bird Atlas are not counts of number of individuals, but are instead the presence or absence of the species. Each species is further categorized as a "possible," "probable," or "confirmed" breeding species in the quad, based on evidence the birdwatchers can find, or "observed" for species recorded but not expected to be breeding, such as transient migrants.

Breeding Bird Atlas procedure for surveying in the Barataria-Terrebonne Basins was modified as necessary to obtain information not only on the species that breed there, but transient migrants and wintering birds as well. As with regular Louisiana Breeding Bird Atlas surveying, the field personnel visited every other quad in the BTB, in checkerboard fashion. There are 54 of the USGS 7 1/2 minute quads to be surveyed (surveying alternate quads) within the Barataria-Terrebonne Basins. The quads surveyed are shown in Appendix B.

Within these quads, the surveyors visited many specific sites, especially focusing on cheniers, wooded ridges, wooded natural and artificial levees, sites that are expected to be important for migrating birds as well as breeding birds. At each of these sites, the field personnel searched for birds, and produced a separate species list for each site, including migrants as well as non-migrants and breeding species. They also obtained some simple habitat data, such as dominant tree species, habitat type (for example, freshwater marsh, cypress swamp, or chenier). For use in the Breeding Bird Atlas, lists from all sites in a particular quad are combined to produce a single list. Lists of migrants and their status (either as migrant-breeding or migrant-non-breeding) were kept separately.

When correlated with the habitat information, these lists should produce a description of the distribution and habitat use of the migrants as well as the residents.

The majority of the BBA surveying was carried out between April 8 and June 20, 1995.

Migratory Status of Species

When most people think of "Neotropical migrant birds" they are thinking primarily of long-distance migratory songbirds with populations that entirely migrate from the temperate zone to the tropics. Although it would seem to be simple to categorize the birds occurring in the BTB as to whether they are Neotropical migrants or not, this is not the case. Only a relatively small number of species of birds actually migrate this way, although a major proportion of some songbird groups, such as the warblers, do so. The migratory status of waterbirds and seabirds is especially complicated, since almost all of those have populations that breed and freely move around the Gulf of Mexico.

Many species of birds have populations that migrate while other populations do not, and these populations may intermingle during part of the year. In addition some species migrate from elsewhere to winter in the BTB; these species will be included in lists of those recorded in the area, although they would not be considered "Neotropical migrant" birds. Finally, a few species have a complicated situation, with some individuals present all year, although perhaps the majority of individuals in the species migrates to winter in the Neotropics. This may be further complicated in that the year-round population may be augmented in winter by wintering birds from farther north that did not migrate all of the way to the Neotropics. This situation occurs more frequently in the BTB than in other parts of North America. The basins' proximity to the Gulf of Mexico and its resulting mild winters encourage some individuals of normally complete migrating species to remain over winter. Some examples of species with this pattern are White-eyed Vireo and Gray Catbird.

The result of these complicated patterns of migration are that few species fall completely into one category or the other. Shorebirds, waterfowl, and seabirds in particular usually cannot be neatly categorized. Passerine birds often can be more neatly grouped, but this is not always the case. Therefore, the migratory or non-migratory status of most species in the BTB is subjective. The exact assignment used in this report of each species into a migratory status category can be seen in the species' entries in Appendix B, Parts 3, 4, and 5.

Habitat Use Categories

Categorizing the species into habitat use groups is more straightforward. Because the habitat definitions are sufficiently broad, few species overlap into more than one category. The habitat use categories in this report are Forest, Human-dominated habitats (urban, suburban, and other human habitations), Marsh, Open habitats (including agricultural lands, mowed levees, etc.), Sea coast, and Water (other than sea; overlaps sometimes with Marsh).

RESULTS AND DISCUSSION

GIS Analysis Maps

The area of each habitat is presented in Appendix A, Part 1. The results of the mapping classification are the maps given in Appendix A, Part 3. Discussion and interpretation of these maps follows.

Salinity Regimes (Maps 1-5)

Only a small fraction of the BTB can be considered "uplands." These areas are almost all along the natural levees of the larger bayous, principally Bayou Lafourche, and the Mississippi River. By far the largest fraction of the area is covered by fresh waters, swamps, and marshes. The fresh waters extend to slightly south of Houma. They are then separated by two fairly narrow bands of intermediate and brackish waters from the second-largest area, the saline waters. As would be expected, saline waters occupy the entire southern part of the BTB from about Golden Meadow and Dulac south. The only uplands south of Golden Meadow (except for very narrow strips of spoil along canals) is on Grand Isle.

Non-tidal Flood Regimes (Maps 6-10)

Tidal effects in the BTB extend northward as far as the Intracoastal Waterway. North of the waterway, most of the bottomland is semi-permanently flooded. Higher areas adjacent to the uplands are either seasonally or temporarily flooded.

Tidal Freshwater Flood Regimes (Maps 11-14)

Areas immediately to the south (seaward) of the Intracoastal Waterway are tidal but fresh water. This forms a relatively narrow strip, but it is widest in the western part of the BTB, southeast of Morgan City, where the area is either permanently or semi-permanently flooded.

Tidal Flood Regimes (Maps 15-17)

The saline tidal area extends from about the southern edge of Pointe au Chien Wildlife Management Area south, but also following Barataria Bay northward to Lake Salvador. Substantial portions of this area are subtidal, especially the area around Lake Salvador.

Upland Physiognomic Classes (Maps 18-23)

Most of the uplands shown in the previous set of maps have been converted to agriculture, either cropland or grazing range. A notable exception to this is the area around Houma and Thibodaux, where a substantial portion of the uplands have been converted to urban and industrial use. Note also that a major portion of Grand Isle is also considered to be urban and industrial. Only small strips of the uplands remain in forest.

Wetland Physiognomic Classes (Maps 24-29)

The majority of the wetlands north of about Houma fall into the bottomland forest class. The marsh class occupies almost all of the remainder of the Barataria-Terrebonne Basins. Notably, an area of marsh-class habitat occupies the area to the north of the Bayou Lafourche natural levee in the area around Lake Salvador to Lac Des Allemands.

Special Features (Maps 30-34)

Although the special features on these maps occupy only a small fraction of the total area of the Barataria-Terrebonne Basin system, they are often very important habitats. Spoil and the excavated canals with which the spoil is usually associated form a network throughout the southern two-thirds of the BTB. The spoil banks, being artificial "uplands," often possess vegetation that is different from the surrounding areas; excavated canals often change the hydrology of the surrounding areas. These effects will be discussed elsewhere in this report. Partially drained and ditched areas also usually possess more upland-like habitat. Dunes occur only in strips on the barrier islands almost invisible on these maps, such as the Isles Dernieres, Timbalier islands, and between Port Fourchon and Grand Isle.

Woodland Classes (Maps 35-38)

Deciduous broadleaf forest is highly fragmented in the BTB. Because the uplands have been largely converted to cropland, and because swamp species do not tolerate salty water, little area remains for most broad-leaved trees. Most deciduous broadleaf forest remains in strips between cropland and in the wetter areas adjacent to cropland, areas that are too wet to be farmed but are not yet marsh.

Cypress forest or scrub-shrub occupies a greater area in the BTB, with especially large areas between Morgan City and Thibodaux and northeast of Thibodaux.

Publicly-Owned Managed Areas (Map 39)

Within the Barataria-Terrebonne Basins are eight publicly-owned managed areas. They are the Isles Dernieres, Salvador, Pointe au Chien, and Wisner Wildlife Management areas (managed by Louisiana Department of Wildlife and Fisheries), Bayou Segnette and Grand Isle State Parks (managed by Louisiana Department of Natural Resources), Mandalet National Wildlife Refuge (managed by the U. S. Fish and Wildlife Service), and the Barataria Preserve unit of Jean Lafitte National Historical Park and Preserve (managed by the National Park Service).

Breeding Bird Atlas Results and Maps

During 1994 and 1995, Breeding Bird Atlas surveyors recorded a total of 197 species of birds in the Barataria-Terrebonne Basins (Appendix B). Of these, 123 (62%) species breed or probably breed in the BTB. An additional six species may also breed in the BTB at least occasionally. Forty-one (21%) wintering non-breeding species were recorded, although this number may be low, because the surveys on which this number was based (the BBA surveys) took place in April-June, after

some wintering species had already returned to their breeding areas. Thirty-three species (17%) were recorded as transients, with no wintering or breeding populations¹. Of the 197 species, 128 (65%) have Neotropical migratory populations, even though perhaps the majority of the species' population does not migrate to the tropics.

The BBA data were used to produce maps of the distribution of birds in the BTB. These maps are presented in Appendix B. Summary maps, of more than one species, will be presented and interpreted first; then I will discuss the distribution of most species. All of these distributions will be interpreted and related to the GIS habitat maps above.

Total Number of Breeding Species Per Quad, and Number of Breeding Neotropical Migrants Per Quad

The number of species breeding in each quad in the Barataria-Terrebonne Basins declines steadily from north to south. The same pattern holds whether all species or only Neotropical migrant species are considered (Appendix B, Part 1). Relatively high numbers breed in quads along the Mississippi River, although their numbers still follow the larger pattern of fewer species farther south. Fewest species breed in the coastal areas of Terrebonne Parish, but a higher number breed near the coast in the Leeville-Fourchon-Grand Isle area of Lafourche Parish.

The number of bird species breeding in each quad seems to be related to the presence and amount of Upland habitat. Note that the Thibodaux-Houma area, at the southern end of the uplands area along Bayou Lafourche, show relatively high numbers of species for being as far south. The number of species is also high in the small strip of uplands along the Mississippi River levee all along its length in the BTB. Species numbers are also high in the Grand Isle-Port Fourchon-Leeville area at the mouth of Bayou Lafourche. The Grand Isle area is the only area of uplands at the coast. Quads in the area from Lake Salvador to Lac Des Allemands (Gheens and Bayou Boeuf) have relatively few species, although fairly far north. Of course, the presence of the lakes indicates that this is a wetland area, and therefore fits the pattern of fewer species in the wetlands.

As would be expected, the number of breeding species is also apparently related to the distribution of wooded habitats. The number of species drops sharply at the southern end of the bottomland forest, which roughly corresponds with the middle line on the map. It is at this point also that the waters become intermediate or brackish, but the smaller number of breeding species is probably more related to the absence of wooded habitats in the more saline coastal areas rather than a direct effect of the salinity on the bird species.

Number of Transient Species Per Quad

¹ The number of transients recorded would be expected to be low relative to the number of breeding species. Transients by definition spend little time in the area (hours or perhaps a few days), and are therefore less likely to be detected than breeding species, which spend months in an area.

The distribution of records of transient Neotropical migrant birds in the BTB is quite different from that of the breeding species, including the breeding Neotropical migrants. In fact, the number of transient species per quad has the opposite gradient to the breeding species, instead increasing from south to north. The pattern is also more varied.

The greatest number of transient species was recorded in the Grand Isle-Port Fourchon-Leeville area. High numbers were also recorded near the Atchafalaya River south of Morgan City, also near the coast. Unfortunately, access to the extreme southern part of Terrebonne Parish proved extremely difficult, and the atlas surveyors were not able to visit many areas that may have had as many transients as the Grand Isle or Morgan City areas. As with the number of breeding species, relatively high numbers were recorded in quads along the lower part of the Mississippi River in the BTB.

Fewer transient species were recorded in the center of the BTB than around the edges, and apparently fewer transients were recorded in the uplands than in the bottomlands. It is not clear why this is, although there are two possible, and not mutually exclusive, explanations. First, transient migrants tend to concentrate near the coast, because it is their first landfall. Second, most of the transient species are forest habitat species. Along the coast they tend to congregate in the small forested patches where they are easy to detect; inland, where it is more forested, they probably disperse throughout the available forest and become more difficult to find.

The distribution of transient Neotropical migrant birds does not show a clear relationship with any habitat, and may, in fact, be different in different habitats based on their distance from the coast. At or near the coast, upland habitat may be necessary, as at Grand Isle or along the Mississippi River quads. Inland, only habitat that is generally forested may be necessary.

Distribution of Transients and Wintering Species by Taxonomic Species Groups

Six maps of the distribution of non-breeding birds broken down into large taxonomic units are shown in Appendix B, Part 2. These maps show those quads where at least one individual of one species in the taxonomic group was recorded; therefore, each symbol (a small square) may represent one or many individuals and species, and shows only the localities where the transients were encountered. The Non-Breeding Non-Passerines group includes mainly waterfowl and shorebirds; the Non-Breeding Shorebirds is a subset of non-breeding non-passerines. The Non-Breeding Passerines group includes primarily swallows, thrushes, and warblers; Non-Breeding Warblers and Non-Breeding Non-Warblers are subsets of this group.

Five of the six maps show roughly the same pattern: few localities recorded non-breeding species in the upper or central parts of the BTB in northern Lafourche Parish. Non-breeding birds seem to concentrate more along the coast, Terrebonne Parish, along the Mississippi River below New Orleans, and along the western edge of the basin system, which is at the eastern edge of the Atchafalaya Basin. It has long been recognized that the coast has a concentrating effect on migrants, because if they are going to land, they tend to land when they first come to terra firma. The non-breeders recorded along the edges of the Mississippi River and Atchafalaya Basin may be using those areas because they have more natural habitat (not agricultural areas) than areas in the center of the BTB. The sixth map, Non-Breeding Shorebirds, shows a somewhat different pattern. These shorebirds seem to be rarely found inland. Almost all records are from near the coast, especially around Barataria Bay, except for a couple along the western edge of the Atchafalaya and a few along the Mississippi River. The shorebirds seem to avoid the entire central portion of the BTB.

Colonial-Breeding Species

Some species of waterbirds, mainly herons and ibis, and most seabirds breed colonially. Rookeries of these birds as groups are shown on maps in Appendix B, Part 2. The colonial waterbirds (cormorants, all herons and ibis, and the Roseate Spoonbill) breed throughout the BTB, from its northern limits to the coast. Although these species do not nest on the ground, they usually require a nesting area with only a few low willows, buttonbush, or other shrubs, a habitat that can be found throughout the area.

In the Barataria-Terrebonne Basin system the seabirds comprise some shorebirds (American Oystercatcher, Wilson's Plover, and Willet), the larids (Laughing Gull, Forster's, Gull-billed, Least, Sandwich, Royal, and Caspian terns), and the Black Skimmer. Of course, they are associated primarily with saline waters. In contrast to the waterbirds, the seabirds usually nest directly on the ground, and usually require a bare, sandy beach area above high tide for nesting. As would be expected, seabird colonies cluster in the quads along the coast, from the Atchafalaya River delta to Barataria Bay. Least Terns sometimes breed inland away from salt water, often on graveled rooftops. Least Terns account for the two colonies of seabirds inland, in New Orleans and Reserve, although Gull-billed Terns may also nest in New Orleans. The majority of seabird colonies seem to cluster in southern Lafourche and Jefferson parishes.

Bald Eagle

In Louisiana, the Bald Eagle has by far its greatest breeding population in the Barataria-Terrebonne Basins. The eagle's breeding distribution (see map on Page B-19 of Appendix B Part 3) appears to be related to the marsh areas with nearby forest in the BTB, and it seems to avoid the upland areas along the Mississippi River and Bayou Lafourche. The eagle does not breed in the more open marsh areas of southern Terrebonne and Lafourche parishes, where there are no trees for nesting and perching.

Note that the Bald Eagle, as a breeding species, is unusual for breeding species in the BTB. As opposed to most birds, the eagle begins breeding in winter, usually December or early January. Breeding is usually completed by April, and the birds then migrate out of the BTB for the summer. They return again in late summer or early fall.

CONCLUSIONS

The distribution of birds in the Barataria-Terrebonne Basin system is dependent on habitat, but it is also affected by the migratory status of the birds. Bird species can be broken down by their migratory status into three major species groups: breeding, wintering, and transient. All three of these groups include at least some Neotropical migrant bird species, although the transient group is made up entirely of Neotropical migrants. The wintering species group does not include as many Neotropical migrants, and those individuals of these species actually wintering in the BTB are obviously not themselves Neotropical migrants, but some populations of those species do migrate as far as the Neotropics.

The breeding and wintering species are similar in that both spend at least several months in the BTB. Their distributions in the BTB tends to correspond to major habitat features, such as uplands, forests or wooded areas, marshes, or seacoast. Transient species, in contrast, tend to concentrate geographically, in a way not necessarily related to habitat, especially not to the habitat normally used by the species for nesting, for example. Although a transient forest passerine would not be found walking on the beach in the BTB, the same bird could be found in brushy areas or scrub along a spoil bank in the marsh, a habitat it would never occupy normally. Because the transients find the BTB to be either their first landfall after or last landfall before their trans-gulf journey, they tend to cluster in a relatively small area near the coast. The Grand Isle area in particular is very important for transient Neotropical migrant birds.

The number of breeding species of birds in the BTB declines steadily from north to south. This is an effect of habitat changes-the amount of forested habitat also declines from north to south. The coastal marshes and seacoast have relatively few breeding species, because they have relatively low habitat diversity. The number of transient species runs exactly counter to the trend for breeding species. More transients were recorded in the southern part of the BTB than farther north. This a result of the same effect mentioned above. Transients tend to concentrate at the coast, regardless of habitat, because it is either their first or last landfall.

COMPREHENSIVE CONSERVATION ACTION PLAN

A. ACTION DESCRIPTION

- 1. The intent of this action plan is to build a framework in the Barataria-Terrebonne Basins for the conservation of bird populations that use the area. This framework will include components to educate the public about bird issues, monitor bird populations, and encourage private, corporate, and government landowners to protect critical areas and manage land under their care in such a way as to maximize its suitability as habitat for migratory and resident birds.
- 2. This action plan is necessary because a body of scientific evidence has been accumulated over the last decade which indicates long-term declines in the populations of some species of birds. Species groups affected range from Neotropical migrant songbirds, to forest and marsh dependent residents, to Arctic nesting shorebirds and prairie nesting waterfowl. The causes of these declines are, of course, various, complex, and in many cases not completely understood. However, a common theme linking these various species is that they have suffered serious loss of the habitat necessary to sustain them at some stage in their life cycle.

Migrants

Critical habitat for migrant birds in the BTB is provided in three ways:

As wintering grounds for species that breed to the north and migrate south to winter on the northern Gulf Coast. Included are huge concentrations of most species of dabbling duck, many diving ducks, American White Pelicans, rails, shorebirds including the Endangered Piping Plover, hawks including the Endangered Peregrine Falcon, and songbirds including Tree Swallow, Yellow-rumped Warbler, and Swamp Sparrow, species for which a significant percentage of the world population overwinter in the BTB. Approximately 130 species of migratory birds winter regularly in the basins, along with about 60 resident species.

As breeding grounds for species that winter in the tropics but return to the northern gulf coast each spring. The BTB provide important warm season habitat for Neotropical migrants including several species of heron and egret, shorebirds including Wilson's Plover and Black-necked Stilt, marsh birds including Least Bittern and Purple Gallinule, and birds that breed in forested wetlands including Mississippi Kite, Prothonotary Warbler, and Painted Bunting. Another migratory species that utilizes the BTB, the Bald Eagle, reverses the process, breeding in the winter and dispersing to the north in the summer. The BTB are the most important area on the northern Gulf Coast for this recovering, formerly endangered, population. About 73 species of Neotropical migrant regularly breed in the BTB.

As stopover habitat in spring and fall for birds migrating across the Gulf of Mexico on their way between the tropics and North America. Stopover habitats include barrier beaches, tidal mudflats, marsh ponds, and woodlands ranging from coastal cheniers to the swamps and natural levees of the upper estuary. A significant portion of North America's breeding birds winter in the Neotropics. Many fly south each fall funneling along the Mississippi River and staging in the BTB, building up fat reserves to sustain them on the arduous 550 mile flight across the Gulf of Mexico. For birds returning across the gulf in spring, the BTB can be a critical refueling stop, especially if adverse weather is encountered during the trans-gulf flight. In addition to the 73 species of Neotropical migrants which remain to breed, another 50 species or so regularly utilize the BTB during migration is in the millions, with densities of 25,000-85,000 individual birds per mile of coastline arriving daily during peak spring flights.

Residents

Each of the Barataria-Terrebonne Basin system's habitats (natural levees, swamps, freshwater marshes, brackish marshes, saline marshes, and barrier islands and beaches) hosts characteristic resident species. Among the 60 or so resident species are the Brown Pelican, Louisiana's state bird. Brown Pelicans were virtually extirpated from Louisiana after World War II due to bio-accumulation of pesticides and the resultant reproductive failure of the Louisiana population. The banning of certain pesticides followed by the re-introduction of pelicans from Florida, coupled with aggressive management and protection by the Louisiana Department of Wildlife and Fisheries and the U.S. Fish and Wildlife Service, has led to a tremendous rebound in the Louisiana population. Nevertheless, most, if not all, of the genetic diversity of the Louisiana population was lost when the population crashed. The BTB remain a stronghold and a repository of genetic diversity for other species now showing declines in other parts of their range such as White Ibis, Mottled Duck, Royal Tern, Red-shouldered Hawk, Loggerhead Shrike, and Seaside Sparrow.

3. This action plan will recommend mechanisms for preserving critical habitat, for restoring degraded habitat, monitoring bird populations, and educating the public in the conservation of birds. Suggestions will also be made for a program that allows interagency cooperation among government entities to insure that public agencies do not work at cross purposes, and that private individuals and corporations can voluntarily contribute to the effort by following the guidelines established.

The actions with the broadest application for birds are the hydrological modifications involving the diversion of freshwater and sediments into the estuary, and the restoration of the barrier islands. In addition to these fundamental basin-wide changes, however, smaller, specific actions can be taken which will enhance habitat for migratory and resident birds.

The actions fall into four categories. The actions will be discussed immediately below, and the implementation and implementing agencies will be recommended following.

Public Outreach

Educate the public about the uniqueness of the bird resource. The trans-gulf migrant and wintering bird populations that use the Barataria-Terrebonne Basins are a unique resource found few other places in the world. Every winter the number of individuals of wintering waterfowl, shorebirds, and seabirds is enormous. Even more striking, however, can be the quantity and diversity of species of Neotropical migrant birds, including brightly colored buntings, warblers, orioles, and grosbeaks, that "fall-out" into the cheniers and spoil-bank woods during migration. Such a phenomenon occurs only in a few places in the world. An educational effort including brochures, presentations at schools within the BTB, and other publicity materials, should be made to the residents of the BTB, to inform them of the unique resource they have and its value to the world. Another possibility for an educational effort would be to form an international pen-pals partnership perhaps between high schools in the BTB and in Yucatßn, Mexico, over the Internet. Because many of the trans-gulf migrants passing through the BTB originate or end their flight in the Yucatßn, students in the two schools could learn about other cultures while keeping track of what "our birds" are doing when on their wintering grounds.

Develop the potential for ecotourism of birds and birdwatchers. The BTB are an area of bird diversity and density comparable to the finest ecotourism destinations in the country, but its potential for this has been little tapped. Grand Isle and Fourchon attract hundreds, if not thousands, of user days each year by mostly regional birdwatchers, but the potential is much greater. Bird-oriented ecotourism has made a major economic impact on the Everglades, the Florida Keys, southeast Arizona, the lower Rio Grande Valley, and the upper Texas coast. The BTB are a natural destination for birdwatchers and other ecotourists, and has the advantage of being situated near a major tourist destination, New Orleans, and of containing other tourist attractions, like world-class fishing, historic plantations and the various cultural attributes of Acadiana. However, its greatest attraction, its tiny remnant chenier woodlands, enjoys no protection, and could be destroyed in a single day by a developer's bulldozer. Another major attraction, not only for birdwatchers but for casual nature tourists as well, are the Barataria-Terrebonne Basin system's vast flocks of colorful waders, from the abundant Snowy Egrets to the increasingly common Roseate Spoonbill. With the exception of the managed marshes along Fourchon Road, there are few places where the casual visitor has an opportunity to view this spectacle. Besides publicity, local businesses could be encouraged to cater to ecotourists. For example, a bed-and-breakfast type lodging with a focus on ecotourists in Grand Isle would probably prove attractive to birdwatchers in spring, fall, and winter, and might also be able to attract fishermen year-round.

Analyze the impact of bird ecotourism on Grand Isle, Port Fourchon, and other sites in the BTB. An important step in developing birdwatching as ecotourism in the BTB is to first understand the impact of the current, informal system of birdwatching visitors. As mentioned above, mainly local birdwatchers already use the BTB for possibly thousands of user days per year, yet the economic impact of this is not recognized by most local

businesses. Birdwatchers purchase gasoline and food at stores in Grand Isle and elsewhere, and they rent cabins for overnight stays. At present, they tend to concentrate in the area of Grand Isle and Fourchon beach, because these areas have access and amenities. A formal study demonstrating the economic impact of this informal ecotourism could be used as an educational tool to encourage further, more formal development of the ecotourism resource.

Link up with the Great Texas Coastal Birding Trail. A further enhancement of birdwatching ecotourism could be linking up the Barataria-Terrebonne Basin system's birdwatching sites with the Great Texas Coastal Birding Trail. The trail extends from the Rio Grande Valley of Texas north and eastward the full length of Texas's coast, as far as Beaumont. The trail has received grants of at least \$500,000 for development and publicity. Birdwatching along the Louisiana coast is a natural extension of the trail, especially if it were connected with sites in Cameron Parish, and the Atchafalaya Basin, thence to sites in the BTB such as Fourchon beach and Grand Isle. The BTB area could therefore leverage itself with the publicity already given to the Texas portion of the trail, and could encourage ecotourists along the trail to continue into Louisiana.

Habitat Protection

Purchase Grand Isle chenier for perpetual maintenance as wooded habitat for migrants. The remaining undeveloped chenier fragments on Grand Isle may be the most critical bits of habitat in the Barataria-Terrebonne Basins. The undeveloped chenier on the island is very small, amounting to only perhaps about 50 acres, but is very heavily used by Neotropical migrant birds during a "fall-out," when heavy weather forces birds to land. At present this chenier is completely unprotected, and could be destroyed in a single day. The chenier could become the focus of the Grand Isle ecotourism business, as the sanctuaries at High Island are for the Upper Texas Coast. The chenier is very accessible. The property could be purchased by a private conservation agency such as The Nature Conservancy or Audubon Society, or by the state of Louisiana or a federal agency, but with the understanding that it would remain as a preserve. It should be explained to local business leaders and landowners in Grand Isle that the purchase of the property will enhance the beauty of the island as well as potentially attract much business from ecotourists. In addition, the chenier could serve as a site for a migrant monitoring program, as described below.

Protect the Wisner / Plaisance chenier west of Cheniere Caminada. Second in importance to the Grand Isle chenier is the undeveloped chenier just west of Cheniere Caminada, west of Grand Isle, on Wisner and Plaisance properties. This chenier is in good condition, and although it does not apparently face the threat of development faced by the Grand Isle chenier, because of its small size and the possibility that it could be destroyed very quickly, is worthy of formal protection. The chenier may be available for purchase, and it may be possible to work with corporate partners interested in developing a wetland mitigation bank in the area. However, outright purchase of the Wisner / Plaisance chenier may not be necessary; see the section on the Private Lands Initiative, below.

Protect all other cheniers and similar woodlands along the coast of the BTB. In addition to the Grand Isle chenier and the Wisner / Plaisance chenier, all other similar woodlands

should also be protected, as they serve the same function. Preservation of these will be discussed further under the Private Lands Initiative, below.

Barrier island restoration projects planned for the future should include provisions for birds. This should include creation of tidal mud flats, spits, and overwash fans, planting or encouragement of mangroves on the backs of islands for nesting, and where practical, the establishment of higher ground behind the beach dune for the establishment of chenier scrub and woodland vegetation. Spoil from navigation dredging projects can in some cases be used to build or fortify these islands, as is being done by the Corps of Engineers in southern Plaquemines Parish. It may be necessary to build breakwaters or similar structures to protect the low islands from further erosion. These islands provide important nesting habitat for seabirds, which sometimes nest in colonies of thousands.

Protect beaches for use by nesting birds. Nesting colonies of pelicans, terns, skimmers and other species on public land should continue to be posted, and, if necessary in heavy public use areas, fenced. This program should be expanded on public land, and agreements with private landowners should be sought to allow such posting on private property. Vehicular access to beaches should be prohibited or restricted. Where vehicles are allowed, they should be confined to identified "roads", and all vehicles kept off of dunes and overwash fans. Even where no large nesting colonies are visible, Wilson's Plovers and Willets may nest, and Piping and Snowy plovers, as well as other shorebirds, may winter or use these areas during migration. Restricting vehicles will not only protect birds, it will protect the very structure of the barrier beaches themselves. The beach from Port Fourchon to Elmer's Island is especially critical because of its nesting plovers and heavy vehicular use.

Plan for protection of seabirds and their breeding colonies in the event of an oil spill. Because most seabird colonies lie within a few feet of sea level, they are especially vulnerable to the effects of an oil spill. The Natural Heritage Program of the Louisiana Department of Wildlife and Fisheries keeps records of where many of these colonies are located, and the data are updated annually through aerial surveys. Using this information, plans should be made for protection of the colonies in the eventuality of an oil spill. The colonies are only occupied and vulnerable for a few months in the breeding season each year, which should be taken into account. The seabirds are also vulnerable to an oil spill during feeding, which may be at some distance from the breeding colony or almost anywhere during the non-breeding season.

Increase freshwater and sediment flow into the estuary. The actions with the broadest application for birds will be accomplished through hydrological modifications involving the diversion of freshwater and sediments into the estuary. All of the changes being considered that would be advantageous for preserving the marshes and reducing the erosion of the coast are also generally advantageous for birds, too.

Reduce toxins. Actions being considered that would benefit fishermen in by reducing pesticide residues, chemical wastes, and oil well wastewater also will benefit birds, whether breeding, wintering, or transients.

Manage public lands for birds. The already publicly-held lands within the BTB should develop local management plans to benefit bird populations in accordance with this Comprehensive Plan. For example, although Grand Isle State Park has no chenier woodlands, management could encourage the growth of shrubs and scrubby trees, which would also be used by migrants. A fresh water supply, from a small pond perhaps maintained by rainwater, would also benefit the birds. Additional plans could be worked out for the Wisner, Pointe au Chien, and Salvador Wildlife Management Areas, Bayou Segnette State Park, and Barataria Preserve unit of Jean Lafitte National Historical Park and Preserve.

Public lands besides those already mentioned could also develop plans to benefit bird populations. These lands include the many levees, roadsides, city parks, and so forth. Plans could be made to reforest these areas where appropriate or to mitigate habitat loss when such areas are expanded. Roadsides, levees, and utility corridors could be maintained in other than a mowed grass condition; Brown-headed Cowbirds, perhaps the most serious threat to the productivity of many nesting Neotropical migrants, require short grass areas to feed, and have used mowed corridors to gain ingress deep into otherwise inhospitable.

Private Lands Initiative

Of course, the vast majority of the Barataria-Terrebonne Basin system is owned primarily by private citizens and corporations who manage their property for agricultural, silvicultural, oil production, fishing, and other purposes. Private land initiatives embrace a comprehensive approach to habitat protection and enhancement working with private landowners. This Comprehensive Plan encourages the continuation of private ownership while at the same time encouraging the protection and enhancement of bird populations.

Traditional resource use such as hunting, commercial and recreational fishing are in no way incompatible with birds. Forest management and farming can be modified in ways to make them more amenable to bird populations, often at little cost. Any efforts on private lands will be made only with voluntary landowner participation. Land purchases and easements will be accomplished by willing sellers and participants only. Present access for public use will be either maintained or improved.

One element of the private lands initiative may be development of conservation easements. These easements will be tailored to each property and written to allow uses not significantly altering the habitat. Easement properties remain in private ownership and are not usually open to the public.

A large part of the private lands initiative involves <u>educating landowners</u> in the options available to them for conservation.

Some potential components of the private lands initiative are listed below.

Encourage landowners to maintain large, unbroken tracts of forest and scrub communities. The BTB still possess large tracts of bald cypress-water tupelo swamp forest. Threats to the remaining forests include subsidence, saltwater intrusion, and draining and clearing for development or agriculture. Potential threats include logging, especially a new trend to log bald cypress before it reaches maturity in order to harvest the bark for "decorative mulch." More subtle threats include fragmentation by road building, canal dredging, levee building, and clearing of pipeline and utility rights-of-way. While wholesale clearing of forests will render them uninhabitable for forest birds, fragmentation can also have a pernicious effect, by introducing avenues for the ingress of nest predators like crows, jays, and raccoons, and nest parasites like cowbirds. Some species of interior forest nesting birds can suffer serious declines in productivity in fragmented forests. Indeed, some forest fragments are so heavily subjected to nest parasitism and nest predation, that they actually become population sinks, contributing no new birds to the population, and requiring a continual recruitment of new breeding age birds from outside the fragment in order to maintain a population presence.

Forest fragmentation can be reduced by timber harvesters while removing as much timber as before, by, for example, taking all of the timber from one large block rather than several small ones. Other ways to avoid fragmentation include laying new pipelines along existing rights-of-way instead of cutting new corridors, and so forth.

Promote reforestation where forest has been timbered. Reforestation has obvious advantages to landowners who have harvested their timber-it can allow harvesting again in the future. Reforestation also obviously can benefit bird populations by providing habitat. Full efforts should be made to encourage landowners to begin reforestation efforts as soon as possible after harvest; even shrubby re-growing trees provide habitat for migrants needing a resting site. Reforestation of swamps may require coordination among several landowners and / or government agencies, because it may require changing the water flow regime to allow dry periods for young trees, for example bald cypress, to become established.

Encourage landowners to protect existing forest and scrub communities on barrier islands through conservation easements. The Wisner / Plaisance chenier west of Cheniere Caminada (if not purchased outright) and swamp and natural levee woods near the coast in lower Plaquemines and Terrebonne Parishes should be preserved through conservation easements or voluntary measures. This is necessary not only for Neotropical migrants which depend upon these woodlands before or after the trans-gulf flight, but for maintaining the structural integrity of these crucial barriers that protect the seaward face of the estuaries, and therefore benefits landowners as well as the birds. Residents and camp owners near the coast should be encouraged to plant trees and shrubs by educating them about the benefits not only to trans-gulf migrants but also to their property and their community in the event of storms. The former chenier woodland on Grand Terre should be restored by removing or restricting the movements of goats and cows on the island, and grazing should be restricted in other cheniers, to allow revegetation.

Promote marsh regeneration and conservation. Private landowners have a great stake in preservation of the marshes in the BTB for their own livelihoods. They should be encouraged to participate in efforts to preserve the marshes and reduce erosion such as the hydrological modifications involving the diversion of freshwater and sediments into the

estuary. As mentioned above, bird populations that use the marshes would be benefited as well by any marsh preservation effort.

Other possible components of the private lands initiative:

- Tax incentives for land owners to maintain forests;
- Encouragement of sustained yield management practices where logging takes place;
- Encouraging future oil and gas exploration to take place from existing canals and access roads;
- Maximizing the potential of existing spoil banks to be utilized as stopover habitat; this is especially important in the near coastal areas, and might include planting trees such as live oak, hackberry, and prickly ash in saline areas, and the suppression, especially in freshwater areas, of Chinese tallow tree monocultures.

Monitoring

Because the Barataria-Terrebonne Basins are critical to so many trans-gulf migrant birds, they provide a unique opportunity and responsibility to measure the populations of the migrants passing through. As part of the conservation plan, therefore, it is important to establish a migrant monitoring program in the BTB.

Monitoring of migrants, while loaded with its own difficulties, at the same time provides opportunities to study bird populations in unique ways. Migrant monitoring tends to be less accurate and less able to detect short-term trends in populations, because of large amounts of variation introduced by the vagaries of weather. One day of severe weather at a migrant monitoring site can ground many thousands of birds that might normally pass over, inflating counts. On the other hand, a season with no severe storms, or none on the days when counts or being made, may have abnormally few birds counted, because they continued to pass over without being detected. Other monitoring programs such as the Breeding Bird Survey (BBS) or Breeding Bird Census are not as sensitive to local weather or single stormy days.

On the other hand, monitoring of migrants has two major advantages over the BBS and Breeding Bird Census. Counting migrants at a single site through which many pass can be a way of monitoring population changes over a vast area. Enormous numbers of birds breeding across almost the entire North American continent as far away as the Arctic pass through the Grand Isle area twice each year, in spring and fall, providing an opportunity to sample this entire population at one site. The second advantage is that migrant monitoring can sample populations that are not sampled by the other large scale counts such as the BBS. Neither the BBS nor Breeding Bird Census extends far northward into Canada, and because both are designed for counting breeding birds, neither adequately samples populations of species breeding in the far north, such as the Blackpoll Warbler. These warblers, however, pass through the BTB in large numbers each spring during their migration, and could be monitored during this passage. Therefore, the large number of migrants passing through the BTB provide a great opportunity for monitoring populations of birds across a vast area of the North American continent. Below is description of a monitoring program for the BTB area.

Site choice for migrant monitoring is especially critical. The localities chosen must be ones through which a large number of migrants pass and can be detected. Sites chosen usually are migrant traps or funnels; for example, a north-south peninsula that concentrates migrants before they cross a body of water, or an island.

An additional site requirement is its long-term stability. This includes both stability in biological and surveying terms. The site should have climax vegetation when monitoring is begun, so that through a period of years of monitoring, vegetational structure and composition should not change. It is also necessary that the monitoring program be able to continue for the long term, to make the data useful and allow the detection of a signal amid the year-to-year noise. The site should therefore be protected from the possibility of destruction through development. For a successful monitoring program to be established, if the site is not publicly owned, some other guarantee of long-term protection is necessary. This could be accomplished through any number of means, including outright purchase of the site, lease, or an agreement including a conservation easement. This long-term stability should be established before any migrant monitoring program is established.

Site 1: Grand Isle chenier. The Grand Isle chenier meets extremely well the criterion that a large number of migrants must pass through the area. Because of its location at the coast, the chenier can receive enormous numbers of migrants, birds that will pass later to many breeding areas across the continent. The site is also vegetationally stable; that is, its vegetation structure and composition are near climax and should not change much from natural succession processes. At present, however, the chenier is not protected from the possibility of destruction through development. For a successful monitoring program to be established, a guarantee of long-term protection for the chenier is necessary.

The Grand Isle chenier could be readily accessible to the bird counters, a further necessary condition when choosing a site. However, Grand Isle is somewhat distant from the population centers in Louisiana, the sources of volunteers and professionals capable of surveying migrants and working in a monitoring program. Grand Isle is two hours by car from New Orleans, three from Baton Rouge, and one-and-a-half from Thibodaux and Houma. This may make long-term use of volunteers more problematic, because they may be reluctant to travel long distances for the work many times.

Site 2: Barataria Preserve unit of Jean Lafitte National Historical Park and Preserve. Although the Jean Lafitte Preserve rarely has the spectacular numbers of migrants at one time that the Grand Isle chenier does, large numbers of migrating birds, of course, still do pass through the area. The park also provides a second site somewhat inland from Grand Isle. The park also has the advantage that it is already protected and in public ownership, so that any monitoring program could begin as soon as the sampling protocol were established and bird counters had been recruited and trained for the sampling. In addition, the park is much more readily accessible from the major population center of New Orleans, being only about a one-half-hour drive from the city. This would make use of volunteers as bird counters more likely, as the pool of volunteers willing to drive from New Orleans would likely be greater.

In addition, the Jean Lafitte Preserve already has bird population sampling data from previous efforts. Point count censuses and transects along the Palmetto and Plantation trails have been made in previous years.

A sampling protocol must be established and consistently followed. Migrant monitoring can be accomplished in several ways, from the extremely intensive and rigorous to the less formal. Mist-netting programs used in some programs require extensive training and equipment, large amounts of time in preparation and execution, and additional requirements for permits and record-keeping. Less formal counts require less in the way of preparation and equipment, but may also produce less accurate results, more dependent on observer effects (Hussell and Ralph 1995). Unless a permanent presence is developed at the monitoring site, however, a mist-netting program is probably too demanding because of the large amount of set-up and preparation time needed.

The best options for a monitoring program at the Grand Isle chenier should therefore probably include counting methods, and a combination of diurnal migration counts and area census counts probably would provide the most useful data. In diurnal migration counts an observer posted at a point with a long view counts migrating birds passing over an imaginary line. (During heavy migration birds can be readily seen flying at high altitude from out over the gulf and passing over the coast or dropping in to land.) Area censuses are counts of birds that have landed, and in the Grand Isle chenier for example, would probably involve the bird counter following a prescribed route along trails over a prescribed amount of time, and counting all birds detected. Both methods are observer counts, requiring skilled observers who follow a particular protocol, but little in the way of equipment. Training of already-skilled birdwatchers to follow the protocols would be relatively easy, but teaching unskilled birders both to identify birds and to follow the protocols might be prohibitively time-consuming.

Note, however, that establishment of the exact sampling protocol before the site has been established is not possible; therefore the protocol to be used can only be suggested in this document.

A migrant monitoring program will have to rely heavily on volunteers. Migrant monitoring is by definition restricted to seasonal activity. Diurnal migration counts and area censuses are techniques that lend themselves to single-day activity, such as a single weekend day. Useful data could therefore be obtained by volunteer counters serving one weekend day each week for the roughly two month spring and two month fall migration seasons. Unless a permanent presence is established at the monitoring site, which of course would require facilities and the expenses of a staff, it seems most feasible to use volunteers as bird counters, but with a professional project manager. Use of volunteers is not without considerable difficulty. Among them are the problems of finding adequately skilled volunteers within a reasonable distance from the monitoring site, and maintaining interest of volunteers for the long term of ten or more years. One problem with the Grand Isle chenier site is its remoteness from the population centers in Louisiana, as mentioned above. Although Grand Isle is in Jefferson Parish, it is about a two hour drive from the New Orleans area. Few skilled birdwatchers live closer to Grand Isle than New Orleans. Thus, getting volunteers to travel frequently to Grand Isle may be a serious difficulty in setting up a monitoring site there. This is especially critical in that all bird counting results would be best if obtained by one or a few bird counters, to reduce the problems caused by observer effects. It probably will be difficult to find one volunteer willing to visit the site many times during a season. It might be easier to find a team of volunteers who could rotate visits to the site while keeping the number of different observers to a minimum.

Despite these difficulties, establishing migrant monitoring sites and programs in the area of Grand Isle and at the Jean Lafitte National Historical Park and Preserve would be important steps in beginning to understand bird conservation issues in the BTB.

Need for Additional Research

Some additional research efforts are needed to be able to develop and refine future management plans for bird populations in the Barataria-Terrebonne Basins. The following list provides some possibilities and avenues for future research projects. These projects are primarily directed toward the transient Neotropical migrant birds.

- Develop ecological studies to determine which plant species and habitats are most important to the trans-gulf migrants arriving in the BTB in spring and in the fall. This will require studies to not only find what habitats the birds are in, but also whether they gain or lose weight or physiological condition while in a particular habitat. The critical habitats may not be the same in both seasons.
- Study the value of Chinese tallow trees as habitat. These introduced trees are aggressively invading the BTB, and at some sites in the marshes may be the only trees. However, as introduced species, their value as habitat for migrant birds is not known.
- Determine the value of providing fresh water sources on barrier islands for birds arriving from across gulf in spring. The arriving birds have undergone a nearly day-long flight without the possibility of replenishing their water, yet many of the southernmost sites are sandy barrier islands without fresh water sources.
- Examine the value or hazard posed by offshore oil platforms. Such platforms may prove useful as monitoring sites for migrants. It might be possible to make platforms into refuges for migrants during severe weather, for example providing fresh water for birds grounded on the platforms. Potential hazards posed by the platforms and their flares to low-flying birds should also be considered.

B. SPECIFIC LONG-TERM BENEFITS

1. One of the goals of BTNEP is to "realistically support diverse, natural biological communities." Actions deriving from this goal are intended to "identify, manage, and preserve vulnerable habitat to sustain biodiversity." A second goal is to "preserve and restore wetlands and barrier islands." A third goal is to "promote environmentally responsible economic activities that sustain estuarine resources." All of these goals are addressed by this Action Plan. The long term benefits of this plan include the following:

Preserve habitat in the BTB. This will not only protect birds, both migratory and resident, but interdependent biological communities as well.

Protect a nationally important resource. Few areas of the continent are as important to migratory birds as the BTB. The continued deterioration of this habitat could have devastating long-term consequences, especially for wintering waterfowl, pelicans, wading birds, nesting terns, and trans-gulf migrants.

Protect an important cultural resource. Part of the region's cultural identity is tied to the maintenance of natural habitats, and the living resources that depend upon them, from the vast flocks of waders that grace the region, to the ducks that are hunted and eaten.

Protect an important economic resource. Ecotourism already plays an important role in the region, especially for hunting, fishing, and sightseeing, but the potential exists for much greater utilization by those interested in wildlife viewing, especially of birds.

C. RESOURCES AND RESPONSIBILITIES

- 1. The Lead Implementer of this program should be the Louisiana Department of Wildlife and Fisheries (LDWF), including the Refuge Division and the Natural Heritage Program (NHP).
- 2. Support Implementers should include the Barataria-Terrebonne National Estuary Program, U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), the National Biological Service (NBS), the Louisiana Department of Natural Resources (DNR), the U.S. Army Corps of Engineers (COE), the Natural Resources Conservation Service (NRCS), the Coastal Wetlands Protection, Planning, and Restoration Act (CWPPRA) Task Force, local and parish governments, levee districts, the Louisiana Department of Transportation and Development (DOTD), Louisiana Department of Culture, Recreation and Tourism (CRT), the Louisiana Nature Conservancy (LNC), Louisiana Forestry Association (LFA), private and corporate landowners, Partners in Flight (PIF), the Gulf Coast Bird Observatory (GCBO), the Louisiana Ornithological Society (LOS), the Terrebonne Bird Club, the Crescent Bird Club, public landowning agencies like Louisiana State Parks, the National Park Service (NPS), the Refuge Division of Wildlife and Fisheries, the Audubon Institute, the Wisner Foundation, universities, port commissions, private landowners and companies, and oil, pipeline, and utility companies.

D. IMPLEMENTATION

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1. The LDWF monitors tern colonies, heronries, and eagle nests, and controls several wildlife management areas within the BTB. The LNC and NBS are helping to sponsor a Breeding Bird Atlas project, and BTNEP has funded researchers to complete the atlas program in the more inaccessible areas of the BTB. The NBS is conducting research along the Gulf Coast concerning habitat utilization by migrants, as are researchers at Louisiana State University (LSU), University of Southern Mississippi (USM), and Clemson University. Jean Lafitte National Historical Park and Preserve is sponsoring research on habitat utilization by Neotropical migrants in its Barataria Preserve, setting up point count censuses for breeding birds, and landscape studies of habitat fragment utilization in the area of the preserve. The Gulf Coast Bird Observatory, an outgrowth of the Gulf Coast Conservation Initiative of the Nature Conservancy, in partnership with local Audubon Societies, the USFWS, the National Fish and Wildlife Foundation, private companies, state agencies, and Partners in Flight, is spearheading efforts to preserve critical coastal stopover habitat in the Chenier Plain and has plans to expand that effort into the delta region. The North American Waterfowl Management Plan, Gulf Coast Joint Venture, Mississippi River Coastal Wetlands Initiative, is an effort coordinated by the USFWS to preserve and enhance waterfowl habitat.

2.	 Short Term Plans (0-1 years). Effort should begin immediately, and can be completed promptly. 		
	Step	Who	When
a.	Analyze impact of birdwatching ecotourists on the economy of the BTB.	CRT	1997
b.	Link up with the Great Texas Coastal Birding Trail.	CRT, GCBO	1997
c.	Erect barriers or signs protecting seabird nesting sites on beaches.	LDWF, USFWS	1996
d.	Plan for protection of seabird colonies in the event of an oil spill.	LDWF, DEQ, oil industry	1997
e.	Facilitate creation of partnership between basin user groups (bird clubs, Audubon chapter) and Gulf Coast Bird Observatory.	BTNEP, GCBO, bird clubs, Audubon Society	1996
f.	Include migrant bird information as part of BTNEP's education and outreach program and literature.	BTNEP	1996

2.	Short Term Plans (0-1 years). Effort should begin immediately, and can be completed promptly.		
g.	Incorporate planning for habitat improvement on barrier island restoration projects.	CWPPRA Task Force, COE	1997

3.	 Medium Term Plans (1-5 years). Effort should begin soon, but cannot be expected to be completed for 1-5 years. 		
	Step	Who	When
a.	Acquire chenier on Grand Isle, and begin efforts to acquire or otherwise protect the Wisner / Plaisance chenier west of Cheniere Caminada.	LNC, Audubon Society, LDWF, or DNR	Begin 1996
b.	Once the Grand Isle chenier has been acquired, establish a migrant monitoring program following the recommended protocols and staffed by volunteers. The program should be expected to run at least two months each spring and fall and to continue for at least 10 years.	GCBO, PIF, Audubon Society, NHP	Begin 1997
c.	Prioritize other critical stopover chenier and coastal woodlands for suitability as refugia and degree of threat.	NHP, LNC	Begin 1997
d.	Work with public landowning agencies to develop plans for managing their lands in ways beneficial to birds.	LDWF, NPS, DNR	Begin 1997
e.	Conduct public education campaigns in coastal communities about the uniqueness of the bird resource in the BTB, the importance of trees and shrubs to migrants and the integrity of the lands, etc.	BTNEP, NHP, GCBO, PIF, LOS	Begin 1997

f.	Promote birdwatching ecotourism within the BTB to local businesses as a potential economic source for them. Design an ecotourism package outlining destinations for birdwatchers, utilizing Grand Isle and Bayou Segnette State Parks, the Barataria Preserve of Jean Lafitte National Historical Park and Preserve, Fourchon pond and beach, Wisner Wildlife Management Area, private areas, etc. that are made available for tourists. Coordinate these efforts with the state sponsored effort to join the national Watchable Wildlife Program.	CRT, GCBO, private businesses	Begin 1997
g.	Work with regulatory agencies so that they will modify permits in such a way as to reduce the continued fragmentation of existing forests.	BTNEP, FWS, COE, EPA, DNR	Ongoing
h.	Work with DOTD, parish governments, local levee districts, and utility companies to modify green space maintenance, to de-emphasize short mowing cycles and the use of herbicides and emphasize the use of longer mowing cycles, wildflowers, and other alternative maintenance.	NHP, BTNEP, LGC	1997
i.	Commence bird-conservation related research projects, such as which habitats are critical to migrants, value of freshwater on barrier islands, usefulness of Chinese tallow trees to migrants, possibilities and hazards posed by offshore platforms, etc.	USFWS, NBS, GCBO, LSU, oil industry	Begin 1997

4.	Long Term Plan (5-10 years). Effort should begin soon, but cannot be expected to be completed for 5-10 years.		
	Step	Who	When
a.	Acquire or enter into voluntary agreements with landowners for the protection and enhancement of stopover habitat, especially chenier and coastal woodlands.	GCBO, LNC, NHP	Begin 1997

b.	Continue to build CWPPRA and other coastal restoration projects, especially on barrier islands, with design modifications incorporated for the needs of birds.	CWPPRA Task Force, DNR	Ongoing
с.	Restore marshes and decrease erosion through increased fresh water flow and increased sedimentation.	CWPPRA Task Force, COE, DNR, BTNEP, levee districts, and many others	Ongoing
d.	Reduce toxins by decreasing use of herbicides and pesticides, better control of runoff and waste water, and chemical waste.	CWPPRA Task Force, EPA, DNR, BTNEP, NRCS, and many others	Ongoing

E. MEASURING AND MONITORING

- 1. The area that will be affected by this action is covers the entire BTB. However, the greatest effects will be felt in the coastal and lower marsh communities, where stopover habitat will be identified and protected, ecotourism promoted, and barrier islands protected and enhanced. All efforts will be voluntary, and no land sales are proposed as part of this action plan through condemnation by government agencies. While preserving habitat may have subtle economic effects on the economy and tax-base of communities, the protection effort, if properly planned, should enhance the potential for economic stimulus from ecotourism, hunting, and other forms of recreation.
- 2. A new program should be established to monitor migrant populations within and passing through the BTB, as described above. Existing efforts by LDWF, NHP, USFWS, NPS, and NBS to monitor waterfowl, shorebirds, nesting colonies, rookeries, eagle nests, and to conduct point count censuses and Breeding Bird Surveys should be continued. For habitat monitoring in the delta, existing efforts by the LNC, NBS, USFWS and others using GIS will be sufficient for monitoring these actions.
- 3. This action can be judged to have been effective if, in five years, no major destruction of migrant habitat in the upper basins has taken place, and if the most critical and vulnerable habitat fragments near the coast have been afforded a measure of protection. The most crucial measurement of its effectiveness, will be tied to the overall effectiveness of Coastal Wetlands Protection, Planning, and Restoration Act (CWPPRA) and related efforts, if, over the next 30 years, barrier islands have been restored, existing marshes and forested wetlands revitalized, and new wetlands are being created by the diversion of sediments. A restored chain of barrier islands, inaccessible by automobile, will be of critical importance to migrants and nesters of many species, shorebirds, terns, wading birds, and songbirds. Restored and revitalized marshes and swamps will benefit wintering waterfowl, wading

birds, and breeding and transient songbirds. The one area where intervention is necessary in the short term is in the protection of coastal communities and cheniers, since these are the most vulnerable areas to development pressures. Clearly, the BTNEP can play an important role in facilitating dialog and partnership among the various owners and users.

LITERATURE CITED

- Condrey, R., P. Kemp, J. Visser, J. Gosselink, D. Lindstedt, E. Melancon, G. Peterson, and B. Thompson. 1995. Status, trends, and probable causes of change in living resources in the Barataria-Terrebonne Estuarine Systems. BTNEP Publ. No. 21. Thibodaux, Louisiana: Barataria-Terrebonne National Estuary Program.
- Cowardin, L.M., F.C. Golet, and E. T. LaRoe. 1979. Classification of Wetlands and Deep Water Habitats of the United States. U.S. Fish & Wildlife Service Biological Services Program. FWS/OBS-79/31. 103 pp.
- Hussell, D. J. T., and C. J. Ralph. 1995 (draft). Recommended methods for monitoring bird populations by counting and banding migrants. Migration Monitoring Council, 23 pp., unpublished.
- Lowery, G. H., Jr. 1946. Evidence of trans-gulf migration. Auk 63: 175-211.
- McKenzie, L. S., III, M. W. Wascom, W. R. Keithly, R. E. Emmer, W. H. Hudnall, M. T. C. Johnson, F. Niami, and B. A. Touchet. 1995. Land use and socioeconomic status and trends in the Barataria-Terrebonne Estuarine System. BTNEP Publ. No. 23. Thibodaux, Louisiana: Barataria-Terrebonne National Estuary Program.
- Reed, D. J., Ed. 1995. Status and historical trends of hydrologic modification, reduction in sediment availability, and habitat loss / modification in the Barataria-Terrebonne Estuarine System. BTNEP Publ. No. 20. Thibodaux, Louisiana: Barataria-Terrebonne National Estuary Program.

Appendix A. Classification of habitats from satellite data and National Wetlands Inventory (NWI) data. Parts 1 and 2 present the area of each habitat classification and the NWI codes used in the classification, respectively; Part 3 presents maps of the classification.

Appendix A, Part 1. Area of habitat classes in three zones. The Barataria-Terrebonne Basins were divided into three zones, a North Zone (487,000 ha total), Central Zone (457,000 ha total), and South Zone (517,000 ha total), and the area of each habitat calculated for each zone. Percentages do not add up to 100% within groups because of overlap among groups. Attribute names may not adhere to NWI syntax.

Hectares					
	% of		% of		% of
North	North	Central	Central	South	South
95413	20	58613	13	7403	1
116044	24	17756	4	697	0
2566	1	4792	1	1786	0
127047	26	63501	14	9025	2
291212	60	180084	39	3518	1
35650	7	41259	9	10425	2
5739	1	107970	24	76810	15
22	0	72470	16	428214	83
6414	1	15829	3	14520	3
	95413 116044 2566 127047 291212 35650 5739 22	North North 95413 20 116044 24 2566 1 127047 26 291212 60 35650 7 5739 1 22 0	% of North Central 95413 20 58613 116044 24 17756 2566 1 4792 127047 26 63501 291212 60 180084 35650 7 41259 5739 1 107970 22 0 72470	% of North % of Central % of Central 95413 20 58613 13 116044 24 17756 4 2566 1 4792 1 127047 26 63501 14 291212 60 180084 39 35650 7 41259 9 5739 1 107970 24 22 0 72470 16	% of North % of North % of Central % of 95413 20 58613 13 7403 116044 24 17756 4 697 2566 1 4792 1 1786 127047 26 63501 14 9025 291212 60 180084 39 3518 35650 7 41259 9 10425 5739 1 107970 24 76810 22 0 72470 16 428214

			Hec	tares		
		% of		%of		%of
Attributes Mapped	North	North	Central	Centra	South	South
UPLAND PHYSIOGNOMIC GROUP						
Upland Cropland (except rice)	76569	16	22431	5	241	0
Upland Forest	5757	1	5229	1	2890	1
Upland Grazing Range	16920	3	17526	4	1920	0
Upland Scrub-Shrub	1147	0	6542	1	16253	3
Upland Urban and Industry	33038	7	18421	4	5695	1
Upland Rice Cropland						
Upland Barren						
WETLAND PHYSIOGNOMIC GROUP						
Bottomland Forest	190143	39	47064	10	413	0
Bottomland Scrub-Shrub	7422	2	21230	5	3371	1
Marsh	84191	17	233048	51	177407	34
Floating Aquatic Beds	3400	1	7146	2	587	0
Submerged Aquatic Beds	3138	1	12941	3	2136	0
Water						

Appendix A, Part 1. Area of habitat classes in three zones, continued.

Appendix A, Part 2. NWI classification codes used for habitat groups in the classification. Dashes represent "wild card" characters.

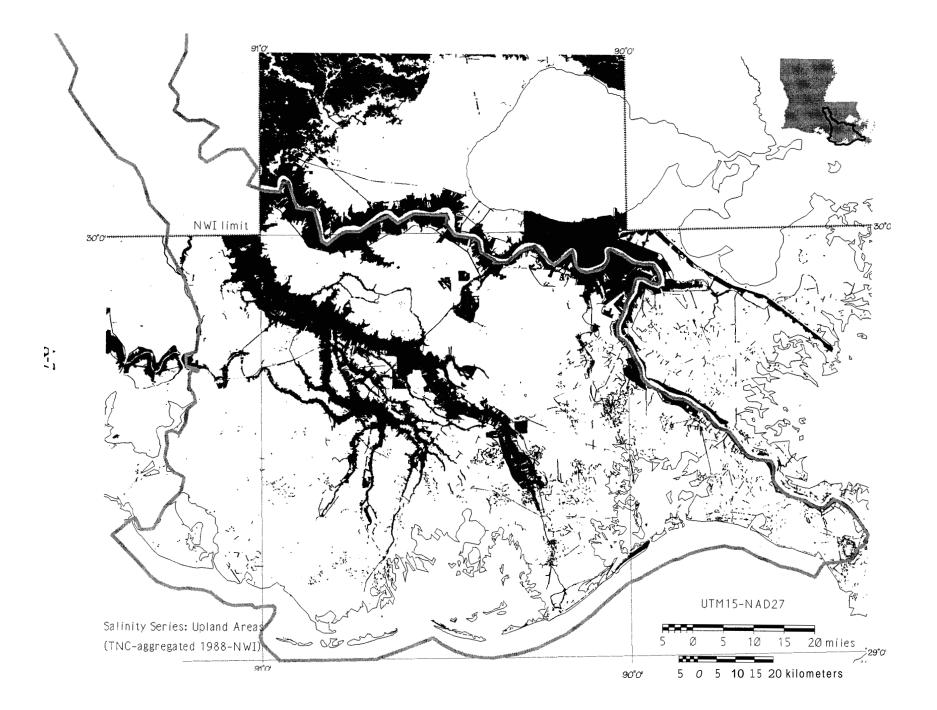
Attributes Mapped	Codes for NWI Attribute or union of attributes used
WOODLAND GROUP	
Deciduous Broadleaf (forest or scrub- shrub)	-FO1; -FO6; -SS1; -SS6
Bald cypress (forest or scrub-shrub)	-FO2; -SS2
Coniferous Broadleaf (forest or scrub- shrub)	-FO3; -FO7; -SS3; -SS7; UF6; UF8; USS; UF7 (in coastal zone)
Pine Woodland (forest or scrub-shrub)	-FO4; -SS4; UF7 (north of coastal zone)
Dead Woodland (forest or scrub-shrub)	-FO5; -SS5
SALINITY GROUP	
Uplands	U
Fresh Water Areas (not in uplands)	NOT upland, brackish, intermediate, or saline
Intermediate Water Areas	6
Brackish Water Areas	5
Saline Water Areas	4; E1AB; E2US; M2US; E1UB
MISCELLANEOUS GROUP	
Spoil	s
Partially drained / ditched	d
Diked / Impounded	h
Dune	UBd; URd
Excavated	X
UPLAND PHYSIOGNOMIC GROUP	
Upland Cropland (except rice)	UA, excluding UAr
Upland Forest	UF
Upland Grazing Range	UR
Upland Scrub-Shrub	USS
Upland Urban and Industry	UU
Upland Rice Cropland	Uar
Upland Barren	UB

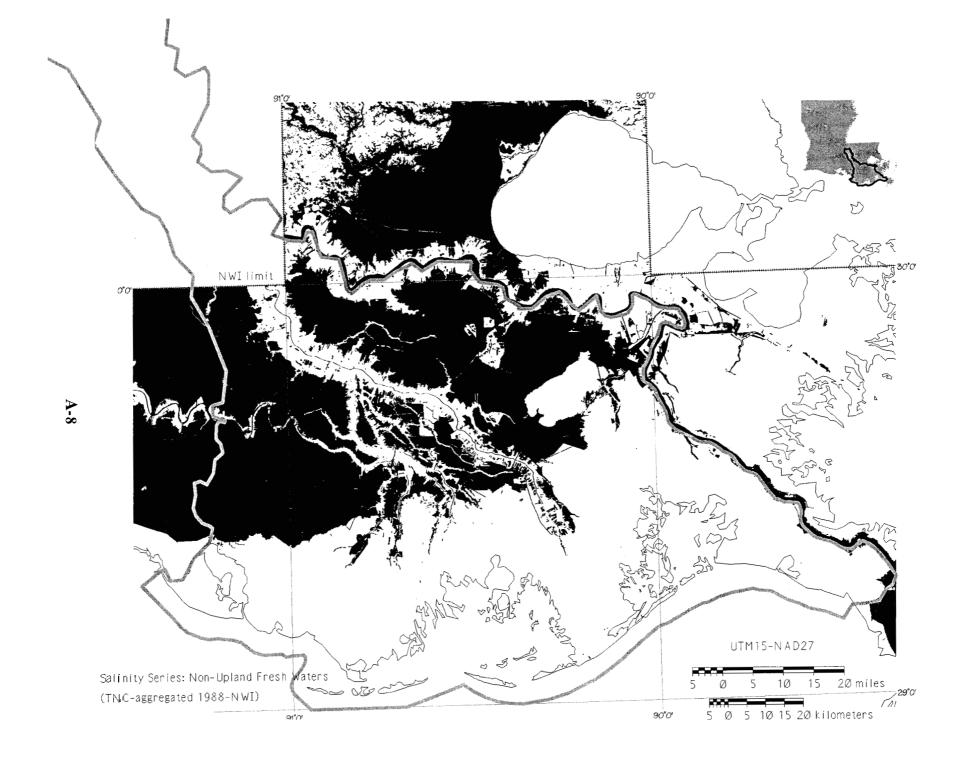
Appendix A, Part 2. NWI classification codes used for habitat groups in the classification, continued.

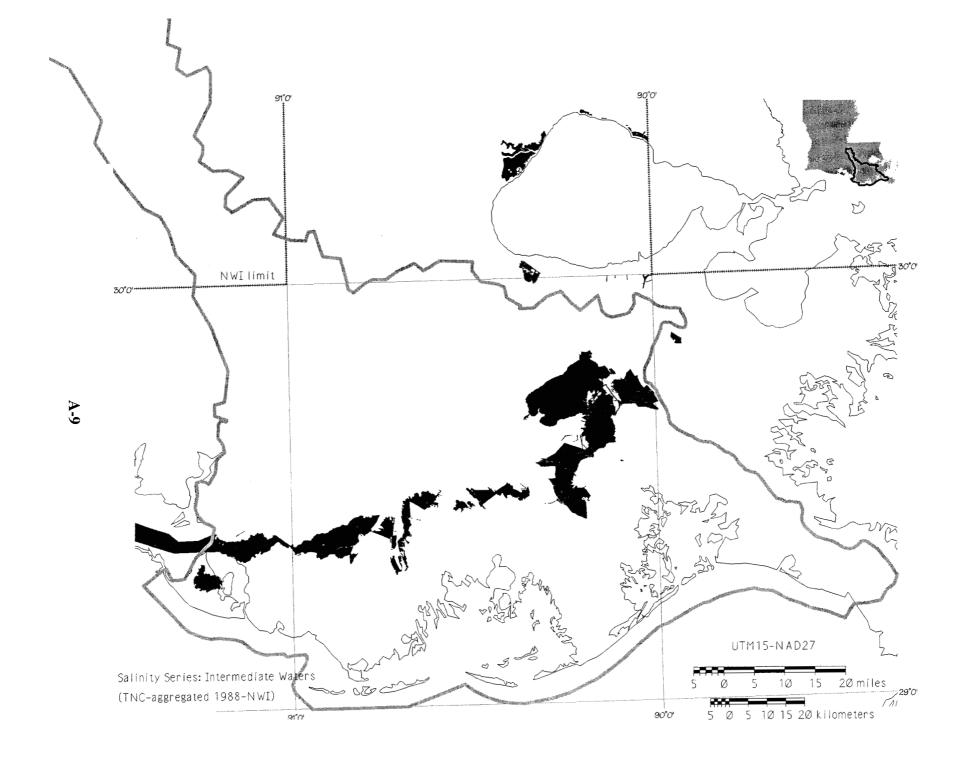
Attributes Mapped	Codes for NWI Attribute or union of attributes used
WETLAND PHYSIOGNOMIC GROUP	
Bottomland Forest	-FO1; -FO2; -FO3; -FO4; -FO5
Bottomland Scrub-Shrub	-SS1; -SS2; -SS3
Marsh	EM
Floating Aquatic Beds	AB4; AB6
Submerged Aquatic Beds	AB1; AB3; AB5
Water	OW; RB; RF; SB; UB
NONTIDAL FLOODING GROUP	
temporary	A
seasonal	C
semi-permanently	F
permanently	h
artificially	K
TIDAL FLOODING	
subtidal	L
regularly	N
irregularly	M; P
seasonally	R
temporarily	S
semipermanent freshwater	T
permanent freshwater	V

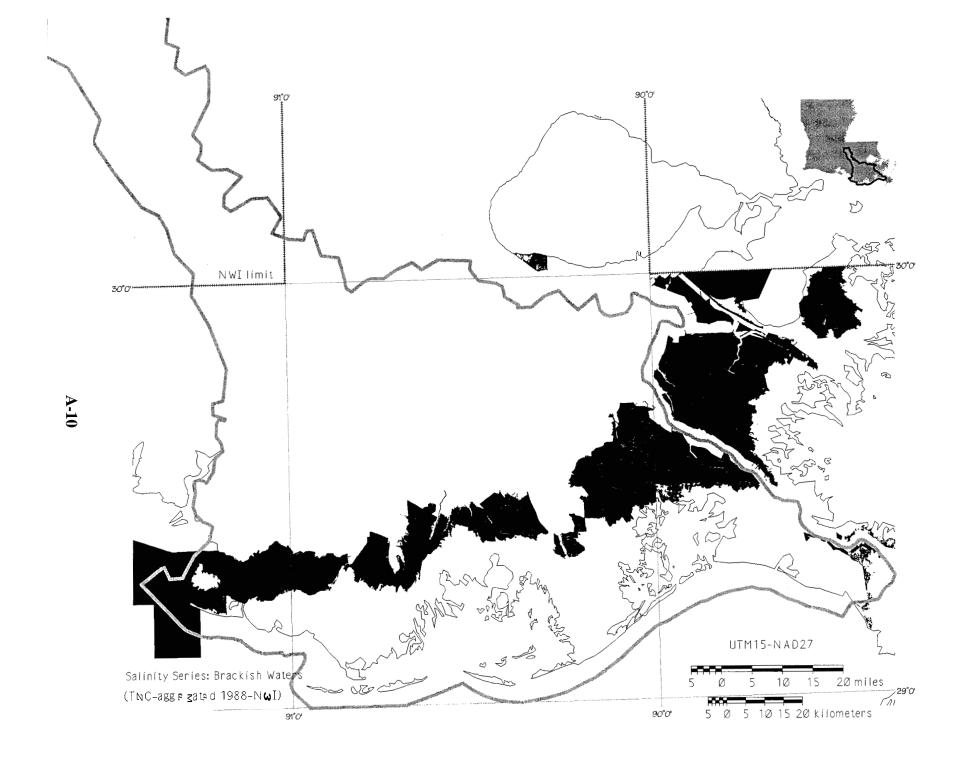
Appendix A, Part 3. Maps of the classification based on NWI and satellite data.

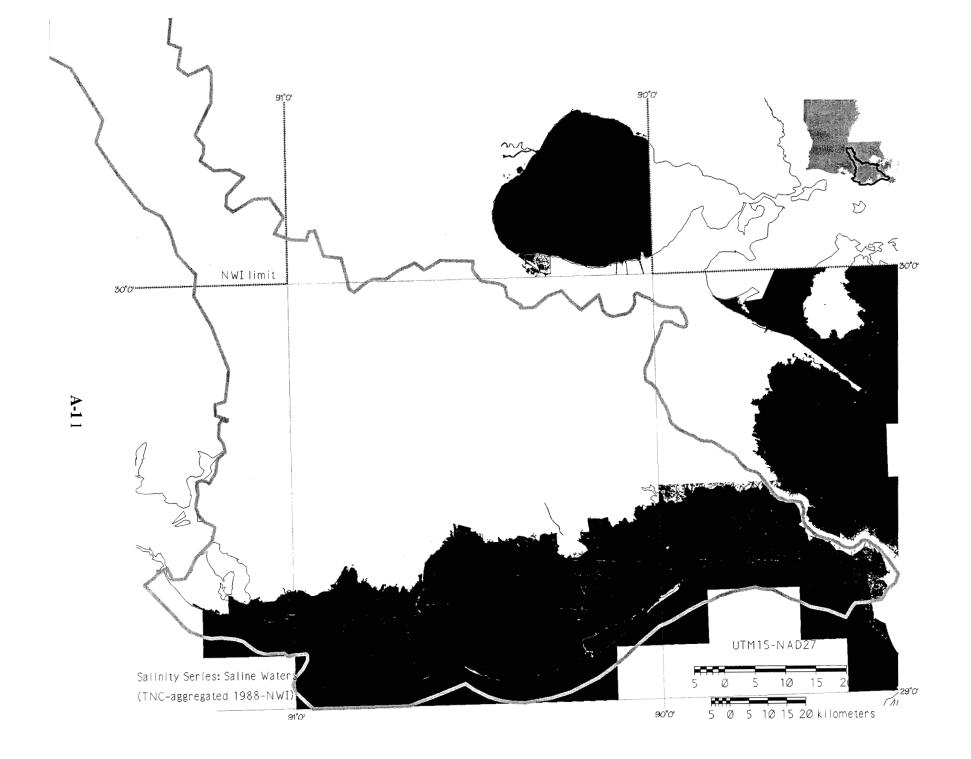
- Map 1. Salinity Regimes: Uplands
- Map 2. Salinity Regimes: Fresh waters, excluding uplands
- Map 3. Salinity Regimes: Intermediate waters
- Map 4. Salinity Regimes: Brackish waters
- Map 5. Salinity Regimes: Saline waters
- Map 6: Non-tidal Flood Regimes: Permanently flooded
- Map 7: Non-tidal Flood Regimes: Semi-permanently flooded
- Map 8: Non-tidal Flood Regimes: Seasonally flooded
- Map 9: Non-tidal Flood Regimes: Temporarily flooded
- Map 10: Non-tidal Flood Regimes: Artificially flooded
- Map 11: Tidal Freshwater Flood Regimes: Permanently flooded
- Map 12: Tidal Freshwater Flood Regimes: Semi-permanently flooded
- Map 13: Tidal Freshwater Flood Regimes: Seasonally flooded
- Map 14: Tidal Freshwater Flood Regimes: Temporarily flooded
- Map 15: Tidal Flood Regimes: Regularly flooded
- Map 16: Tidal Flood Regimes: Subtidal
- Map 17: Tidal Flood Regimes: Irregularly flooded
- Map 18: Upland Physiognomic Classes: Cropland except rice
- Map 19: Upland Physiognomic Classes: Grazing range
- Map 20: Upland Physiognomic Classes: Urban and industry
- Map 21: Upland Physiognomic Classes: Forest
- Map 22: Upland Physiognomic Classes: Scrub-shrub
- Map 23: Upland Physiognomic Classes: Barren
- Map 24: Wetland Physiognomic Classes: Bottomland Forest
- Map 25: Wetland Physiognomic Classes: Marsh
- Map 26: Wetland Physiognomic Classes: Bottomland scrub-shrub
- Map 27: Wetland Physiognomic Classes: Floating aquatic beds
- Map 28: Wetland Physiognomic Classes: Submerged aquatic beds
- Map 29: Special Features: Spoil
- Map 30: Special Features: Excavated
- Map 31: Special Features: Diked / impounded
- Map 32: Special Features: Partially drained / ditched
- Map 33: Special Features: Dune
- Map 34: Woodland Classes: Deciduous broadleaf forest or scrub-shrub
- Map 35: Woodland Classes: Cypress forest or scrub-shrub
- Map 36: Woodland Classes: Coniferous broadleaf forest or scrub-shrub
- Map 37: Woodland Classes: Dead forest or scrub-shrub
- Map 38: Publicly-owned managed areas

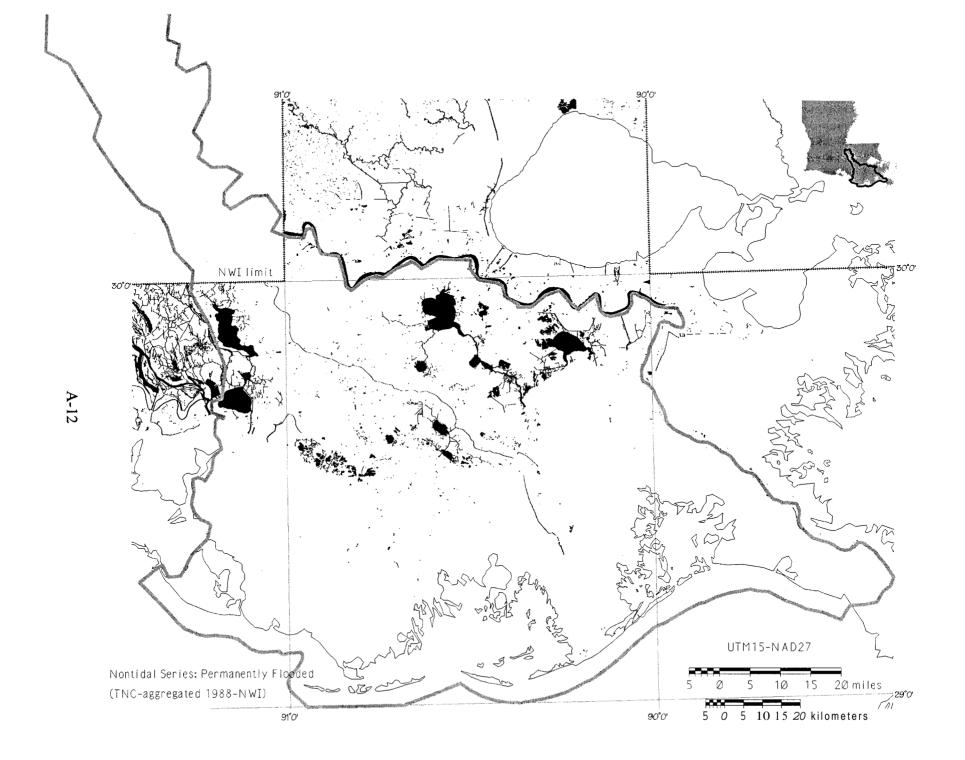


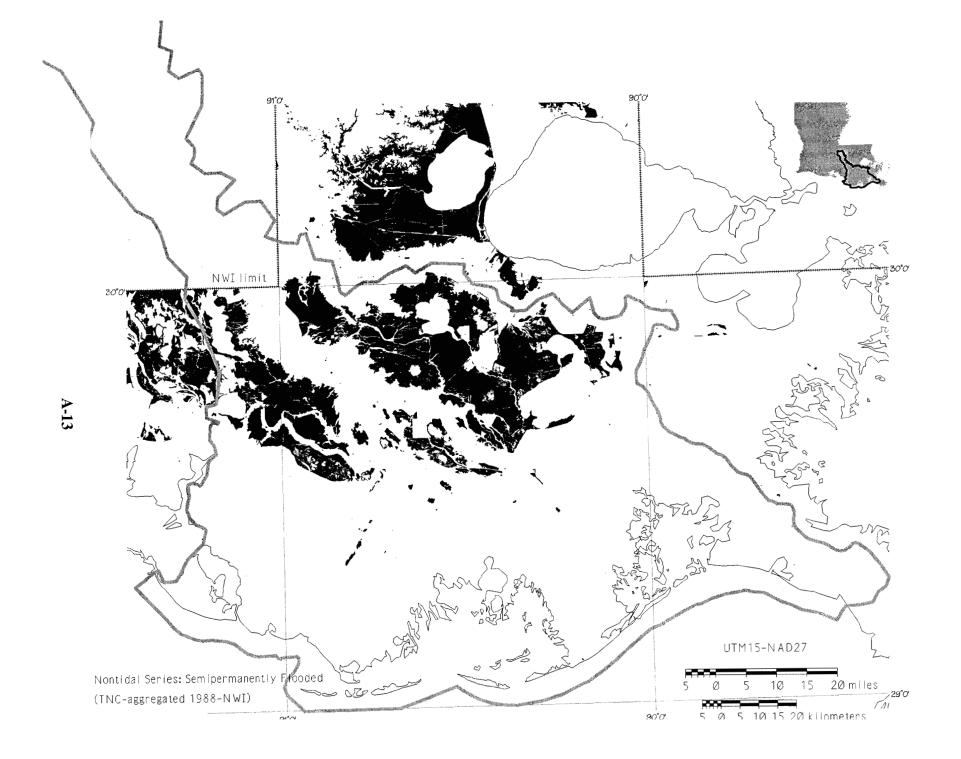


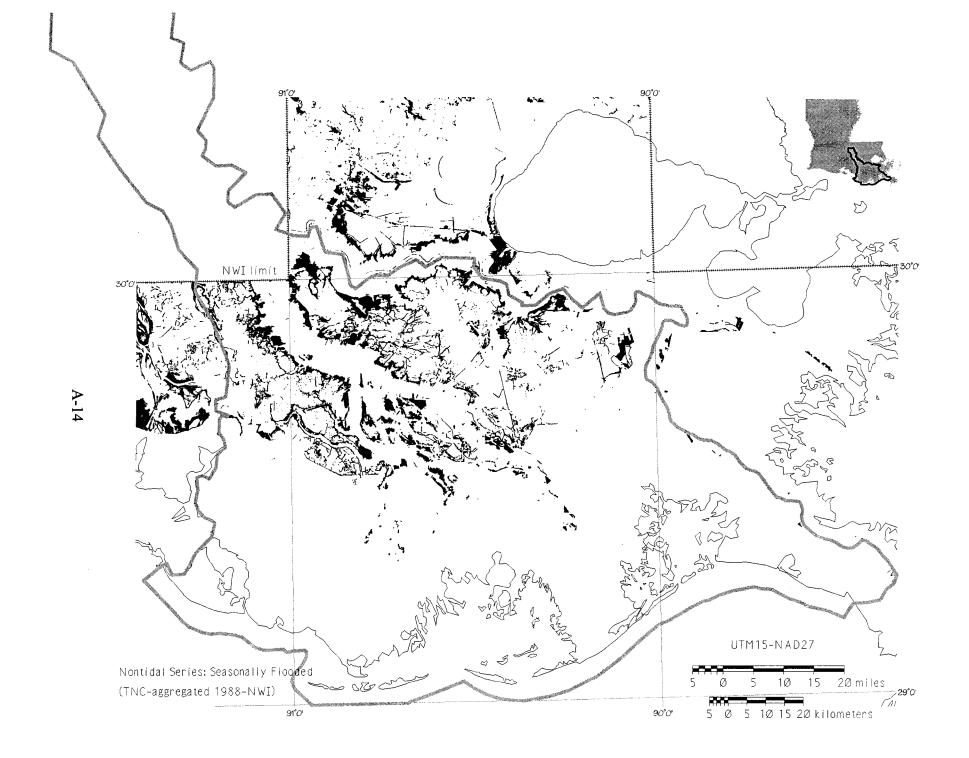


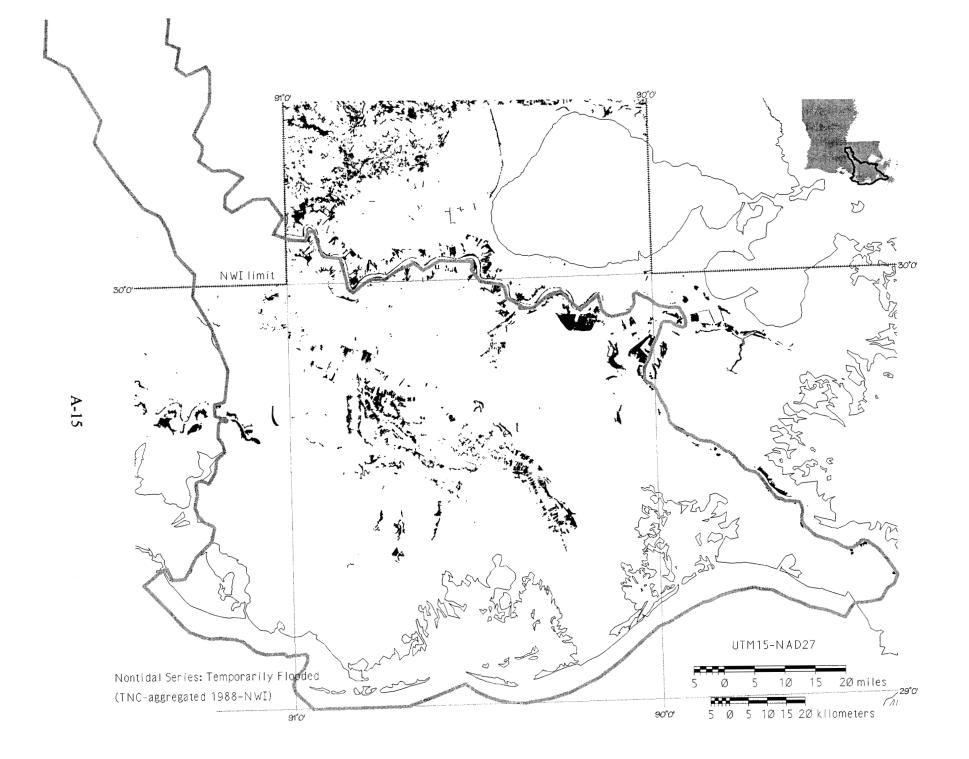




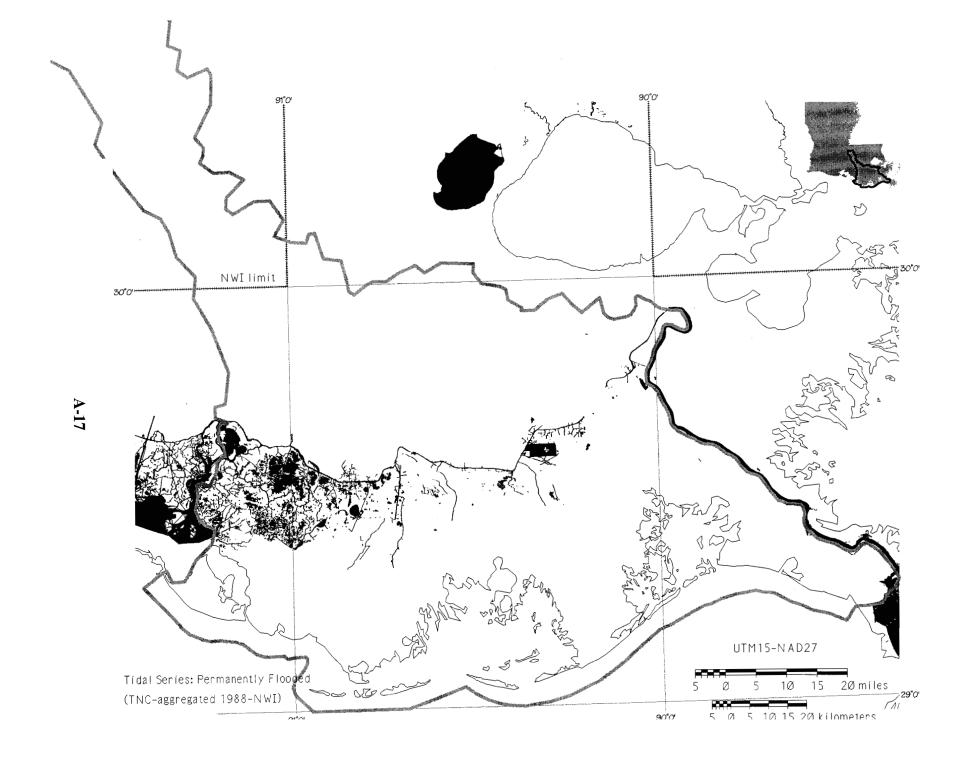


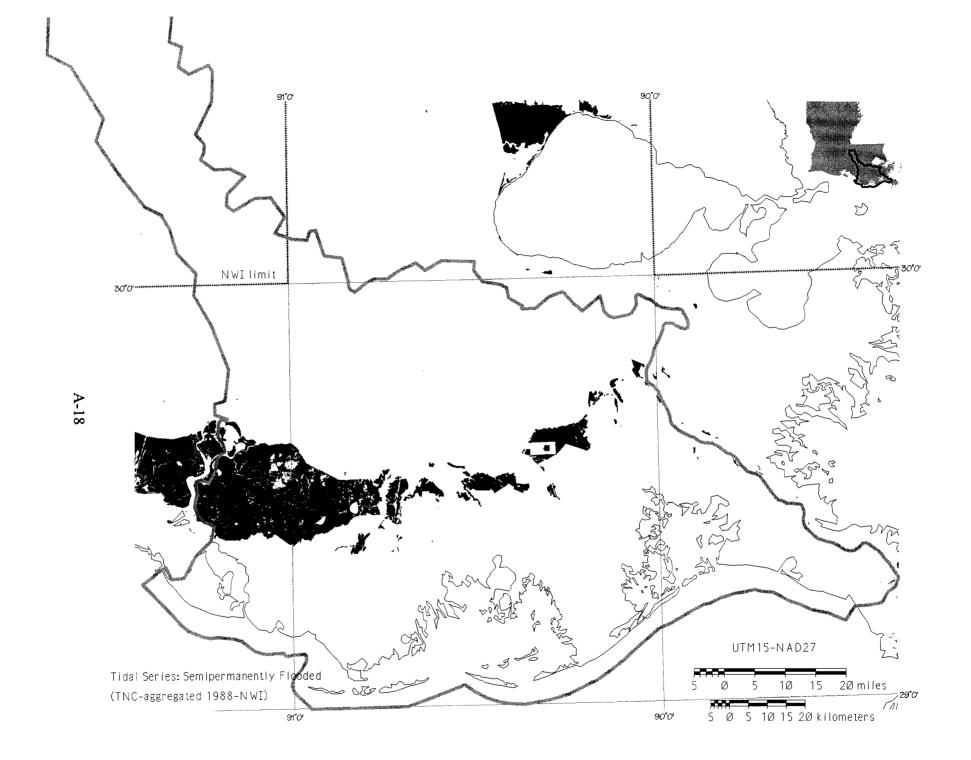


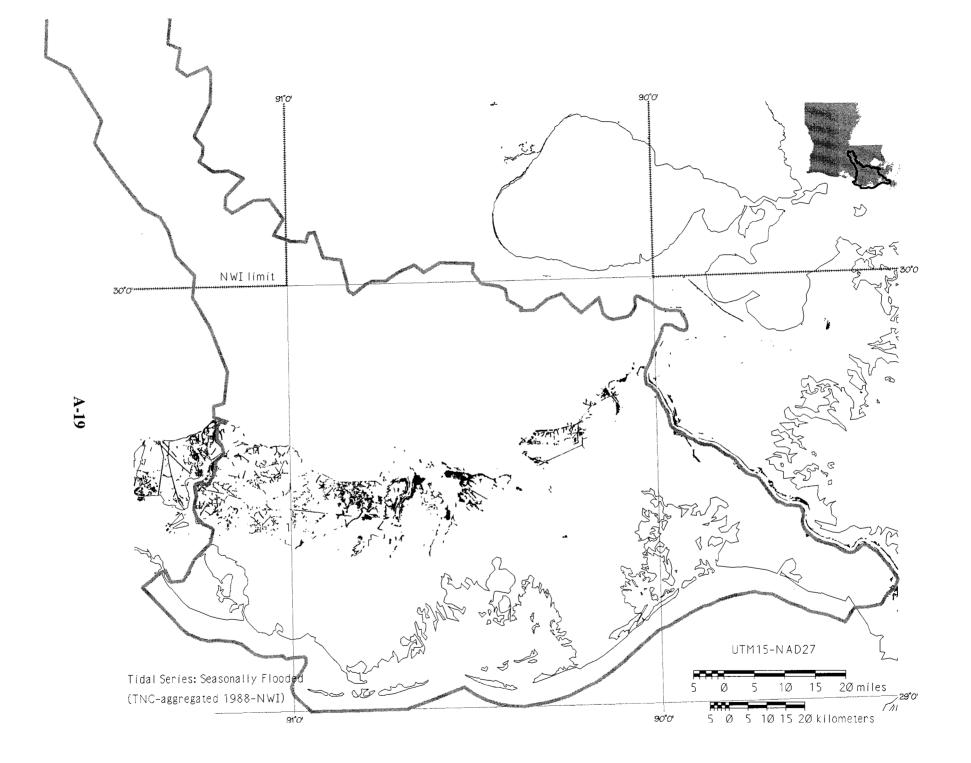


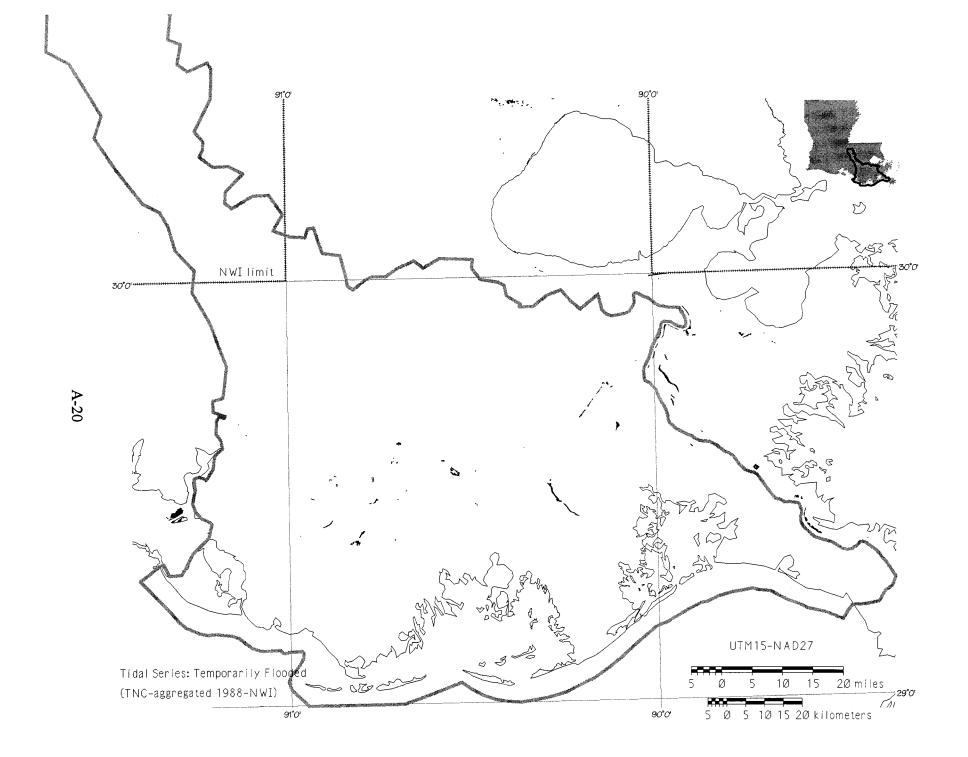


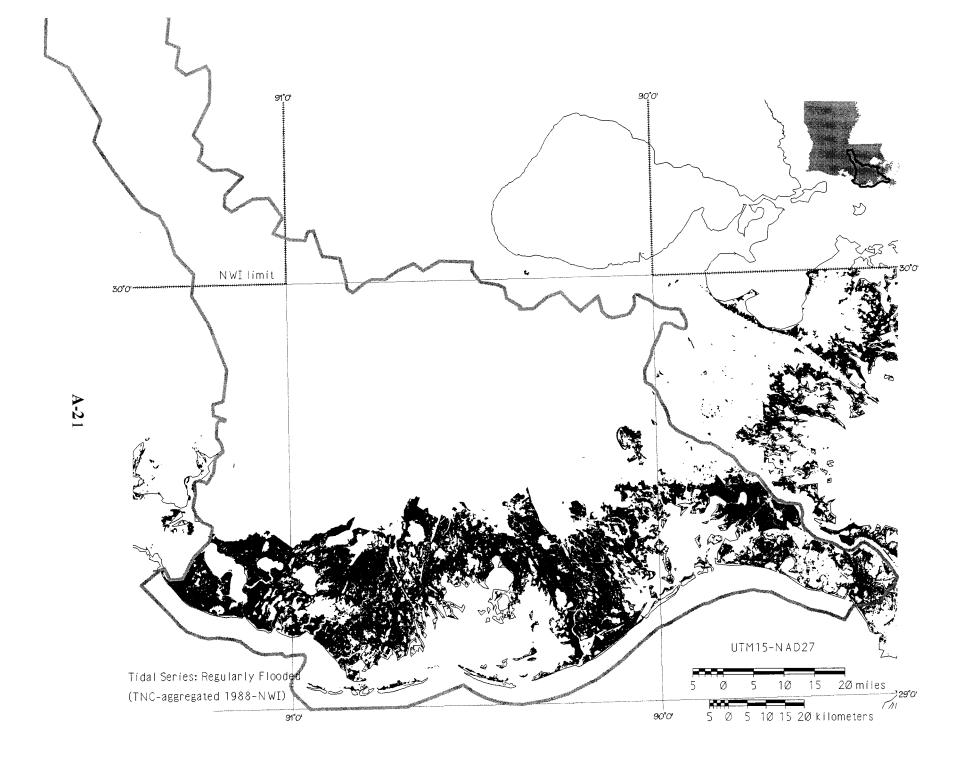


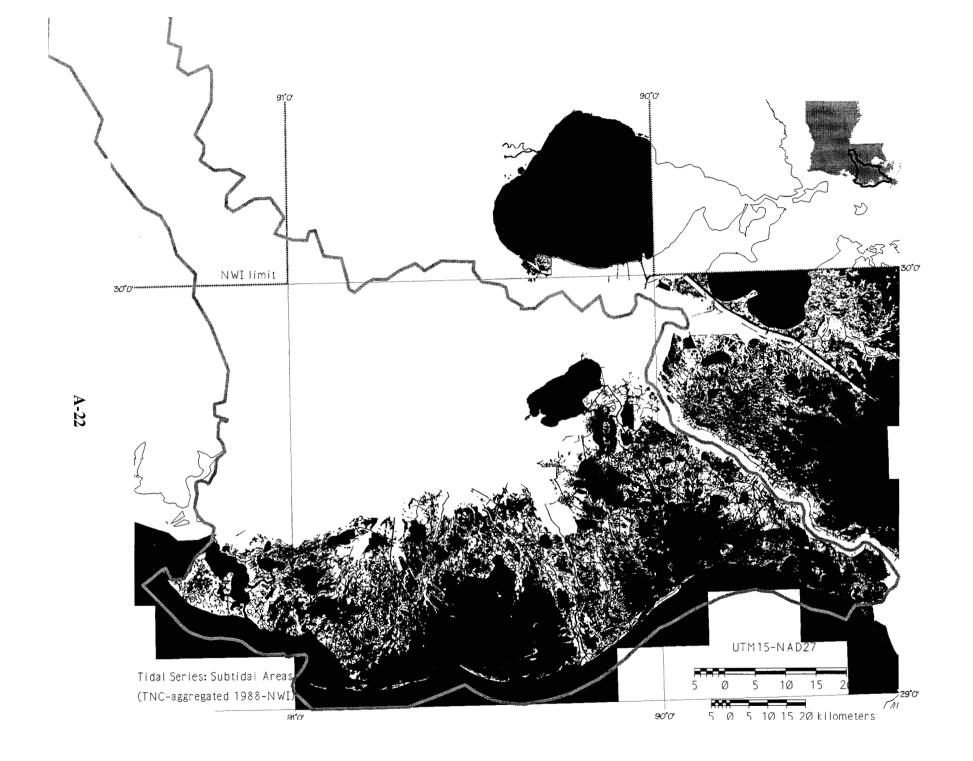


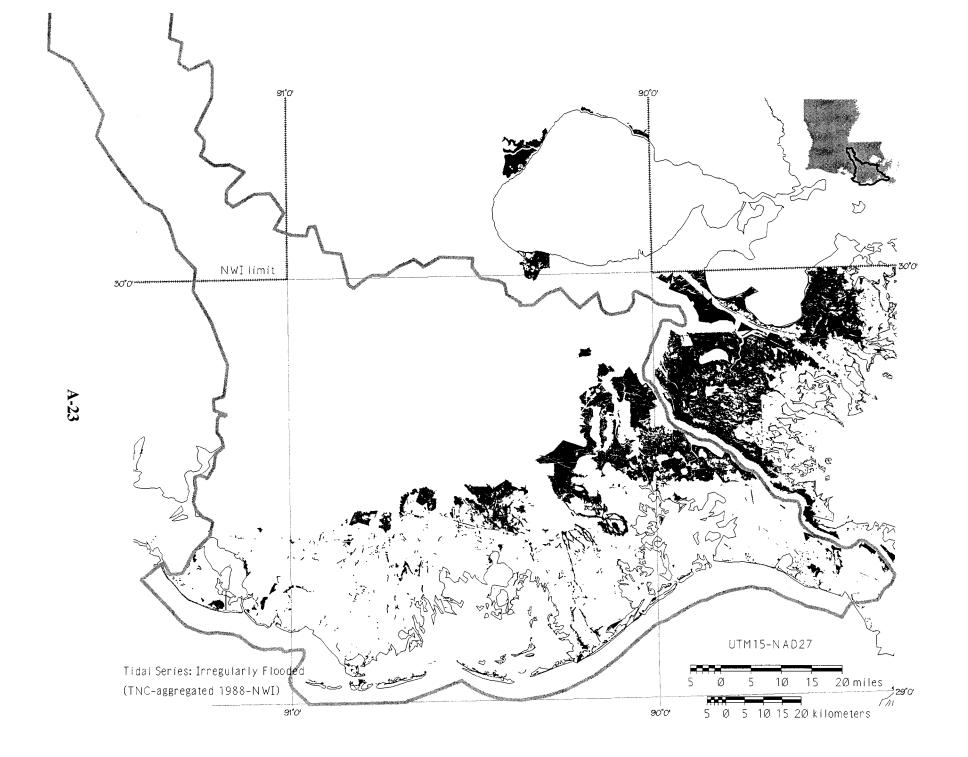


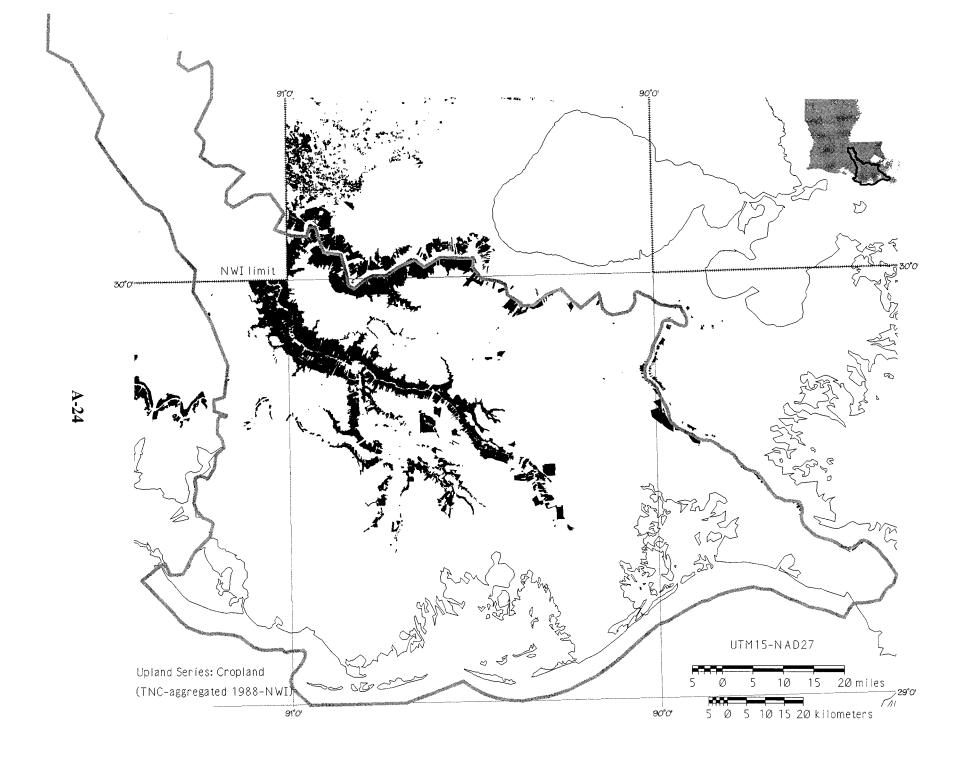


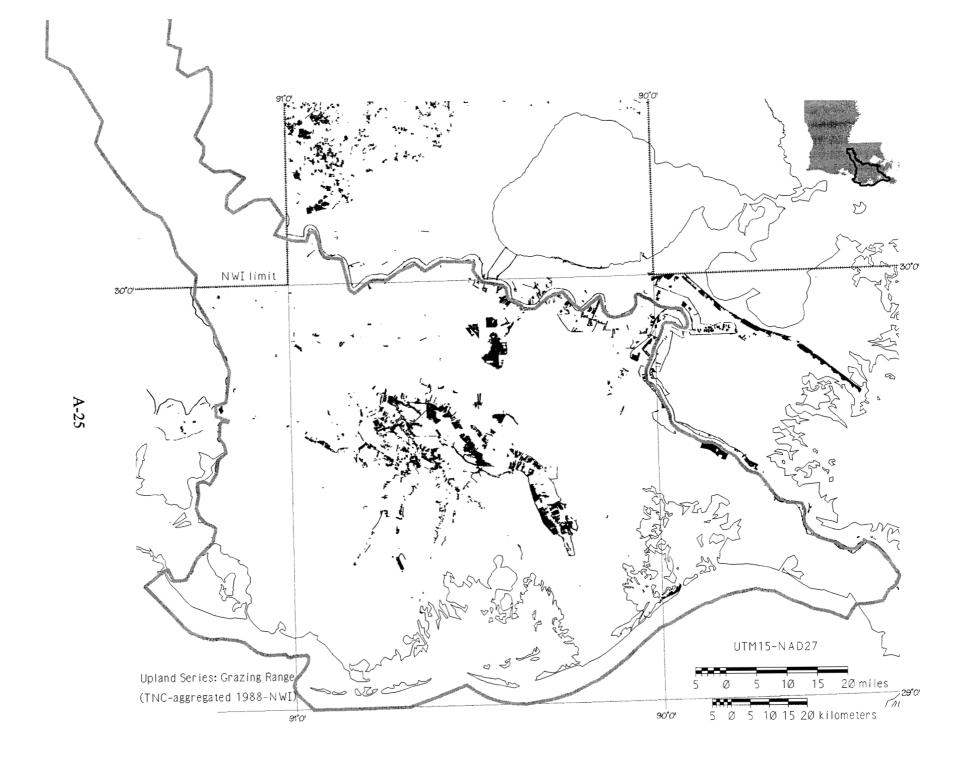


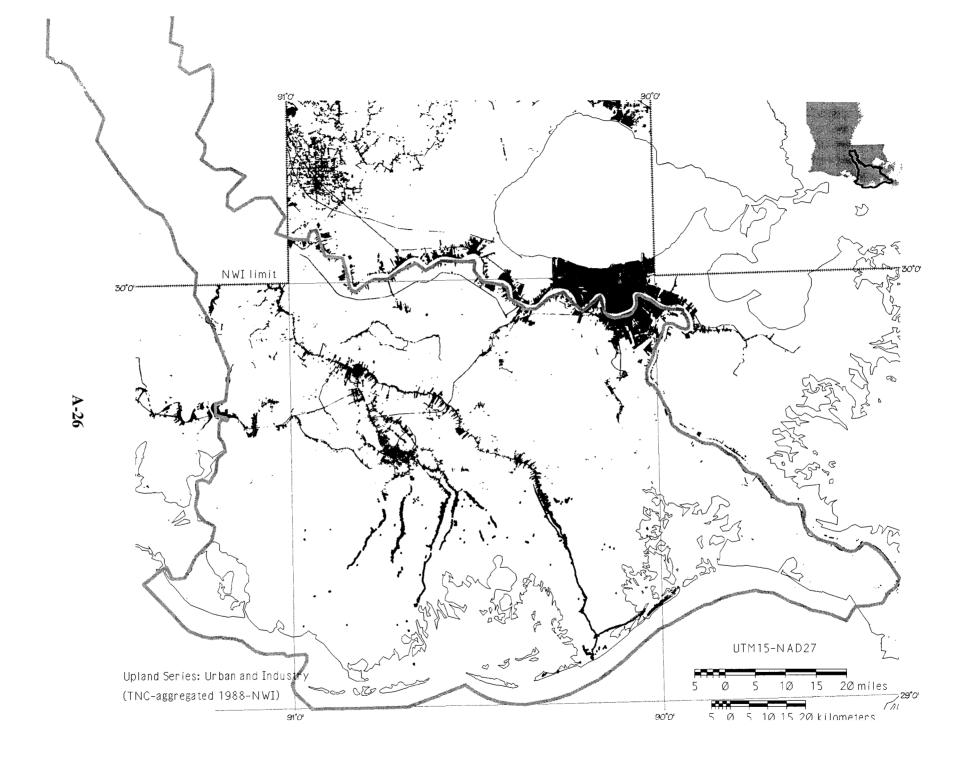


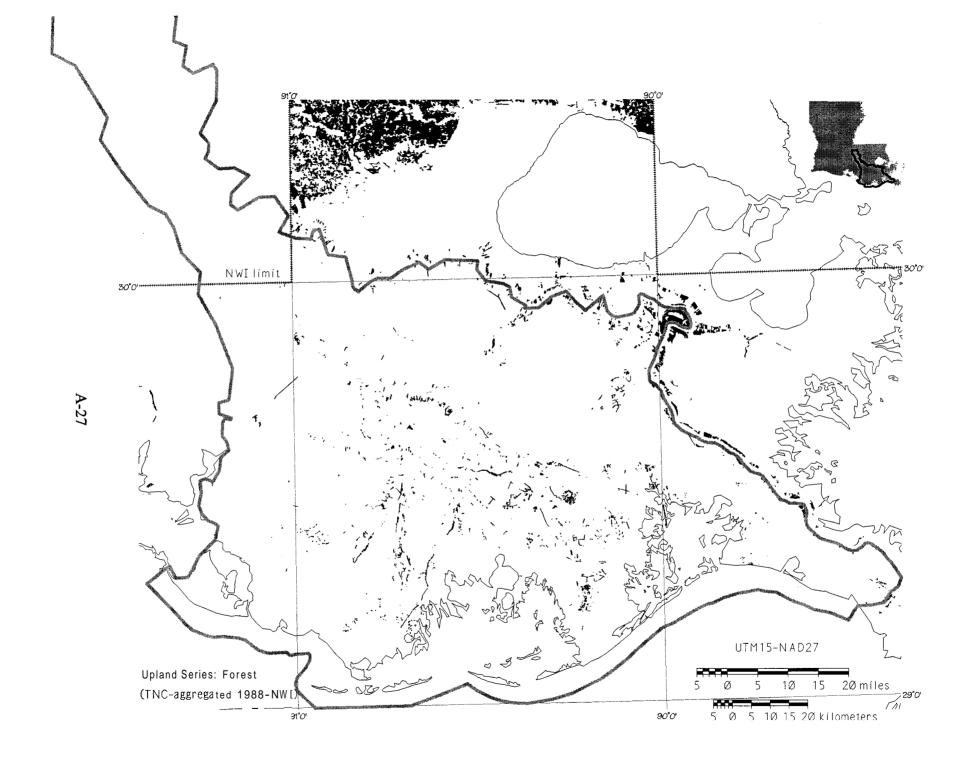


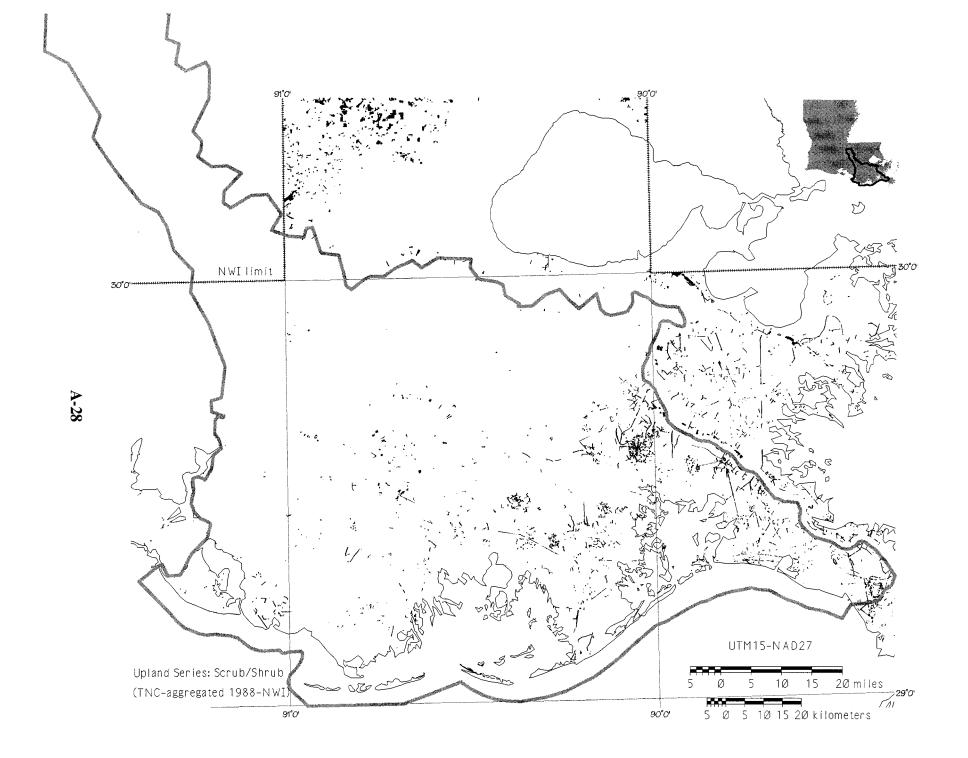


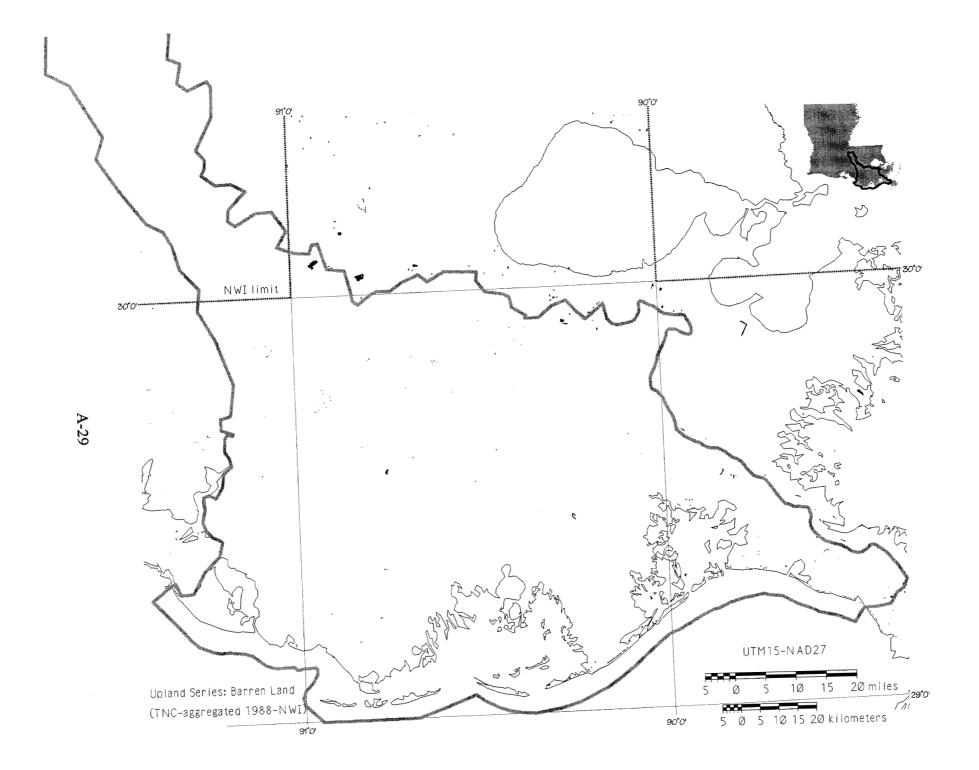


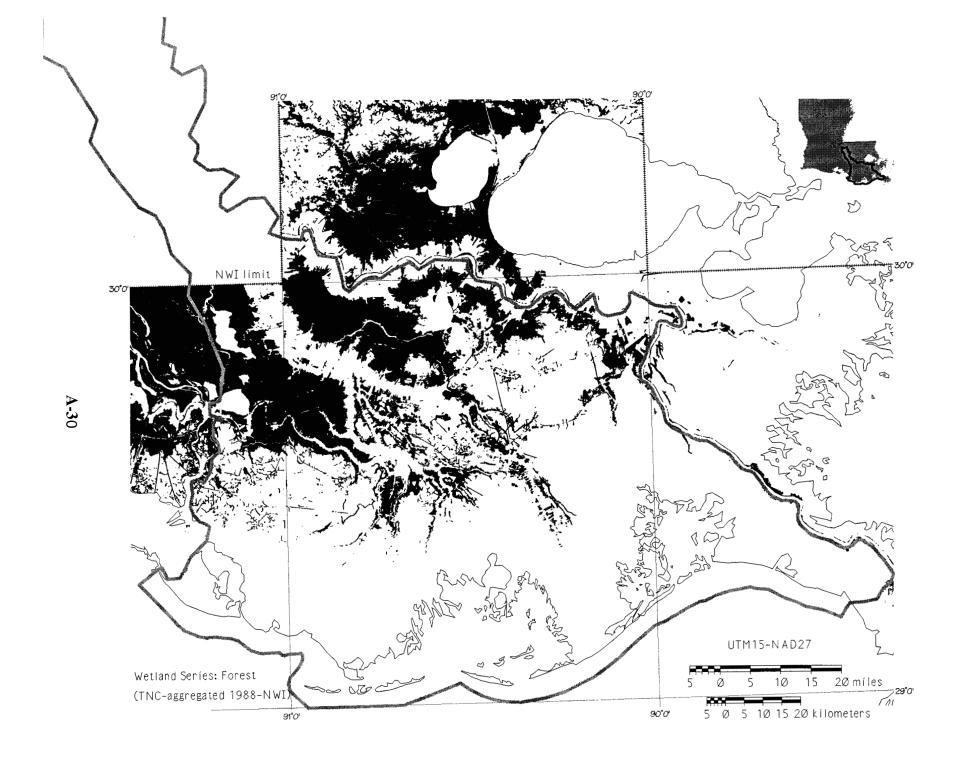


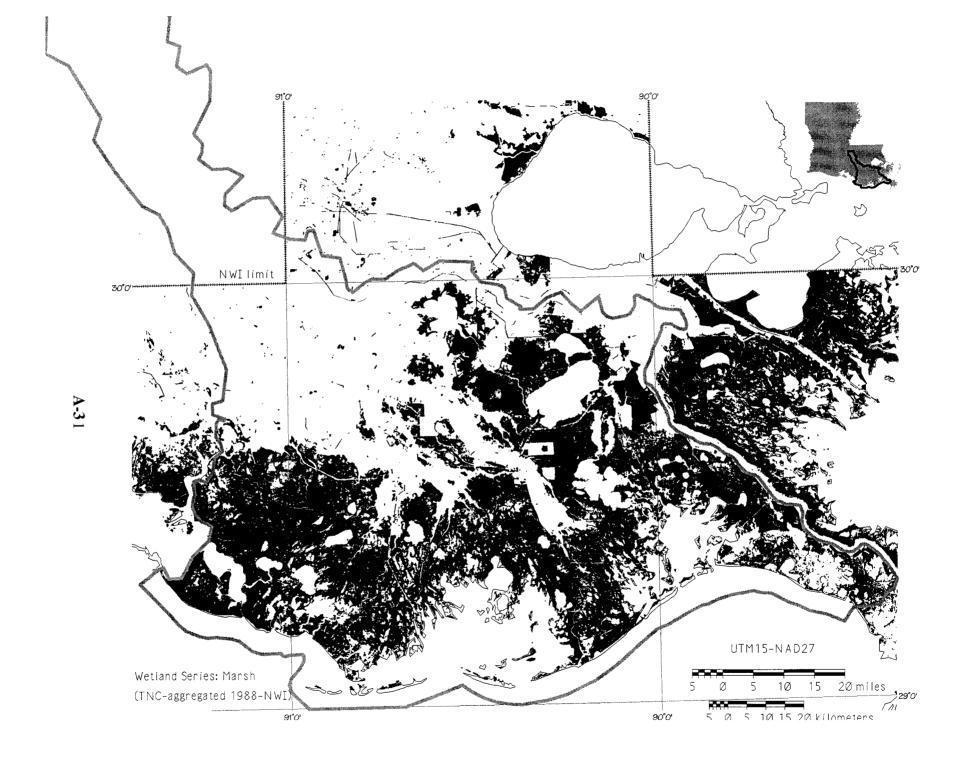


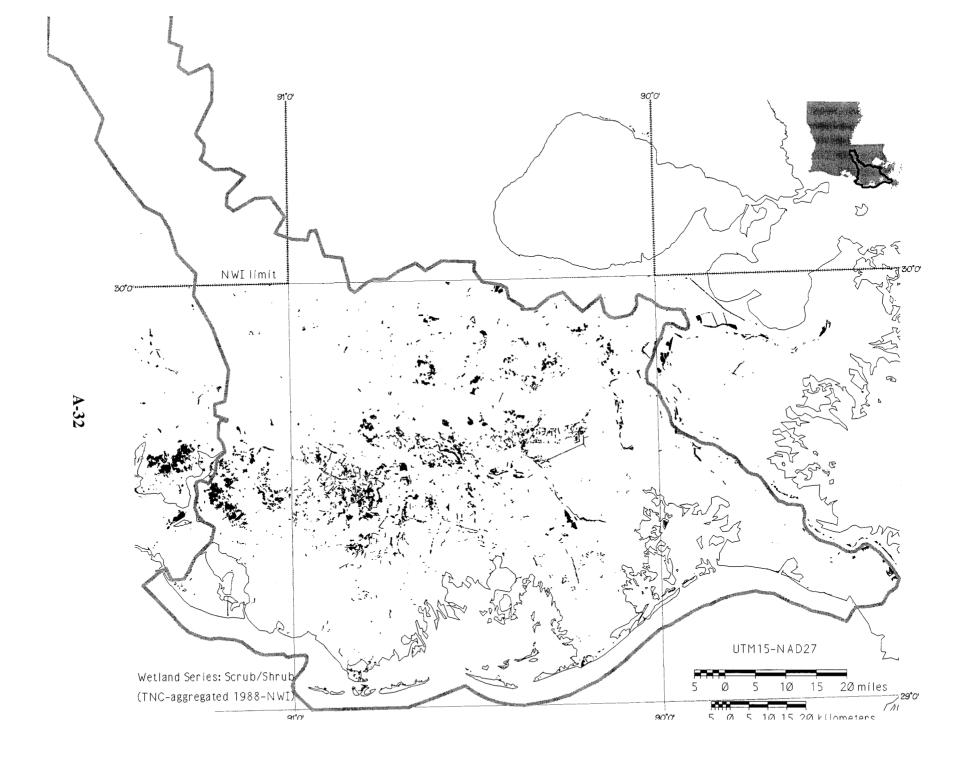




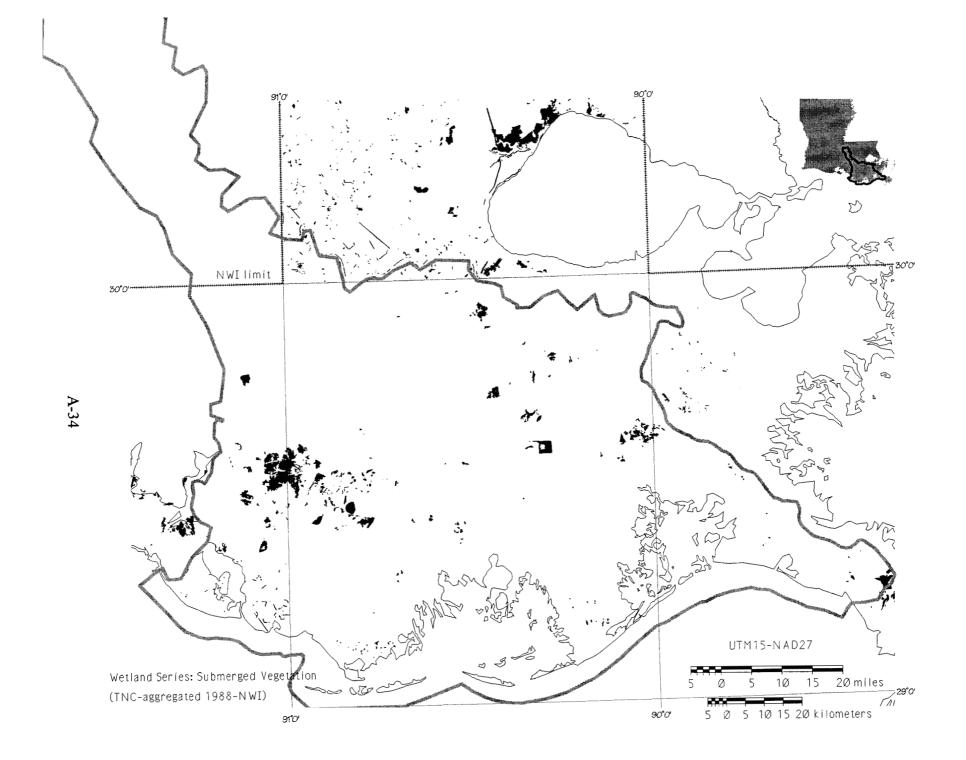


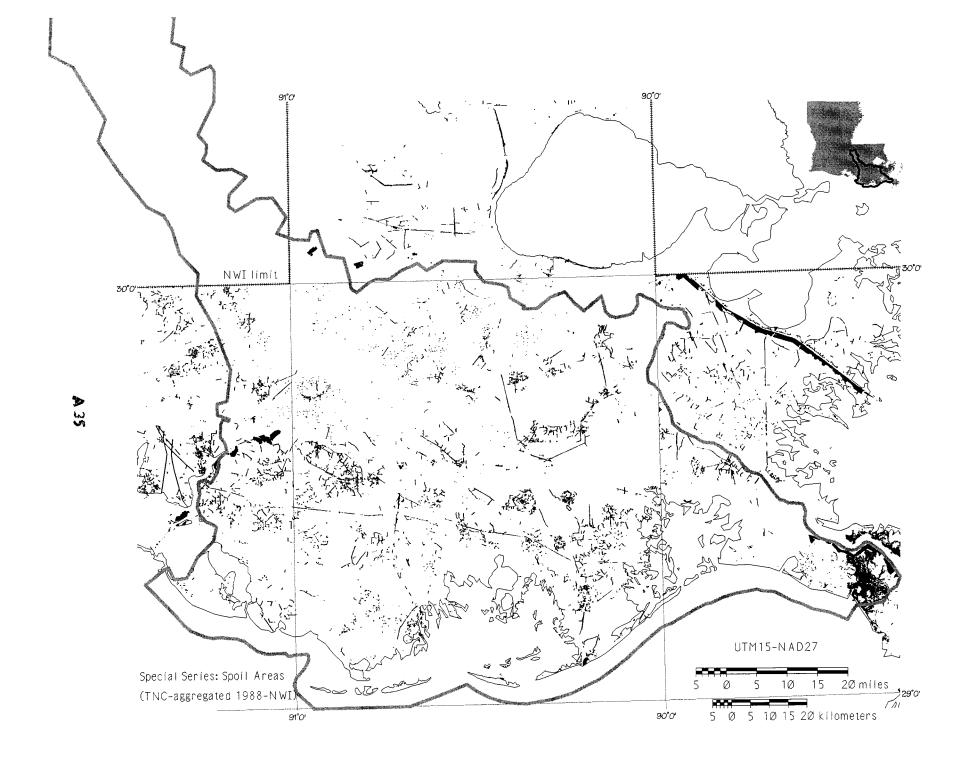


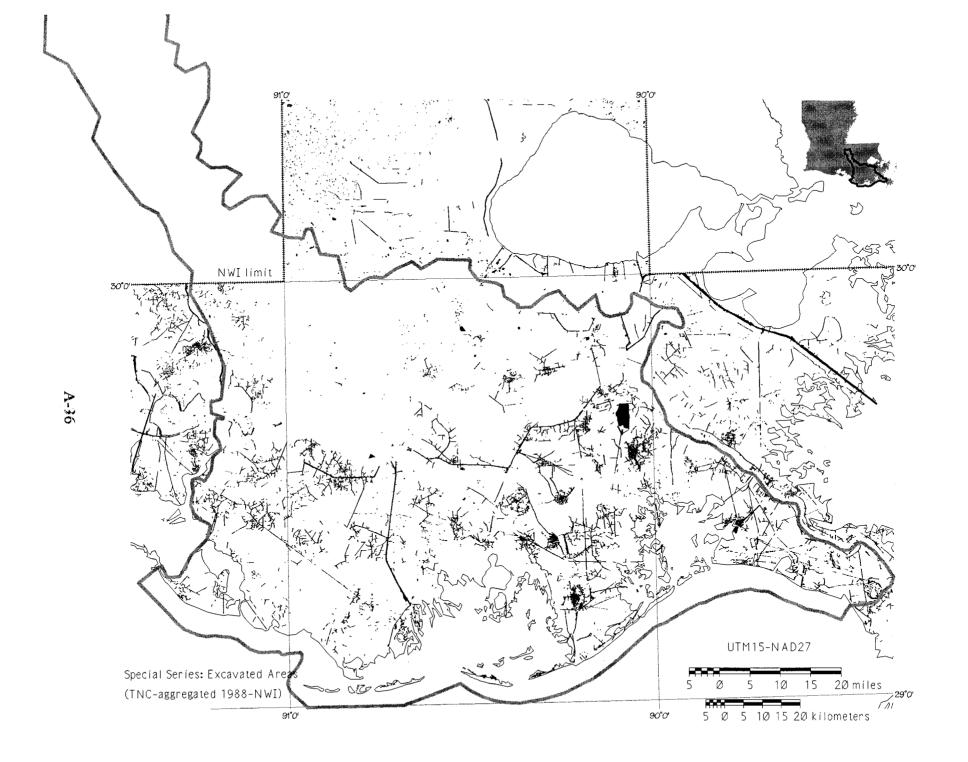




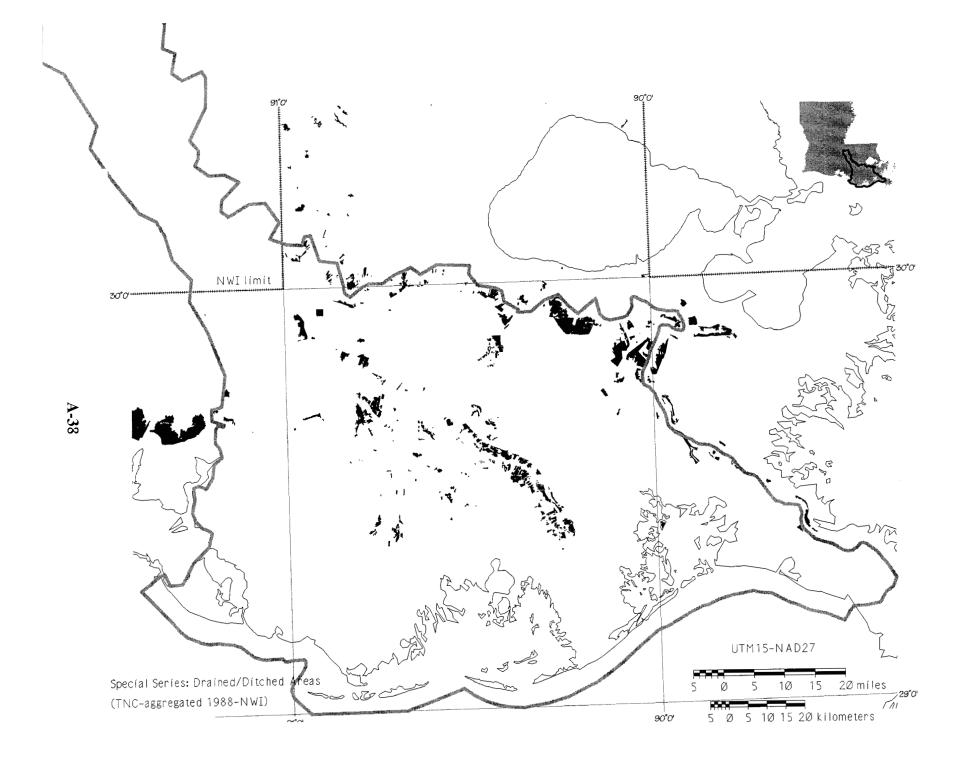


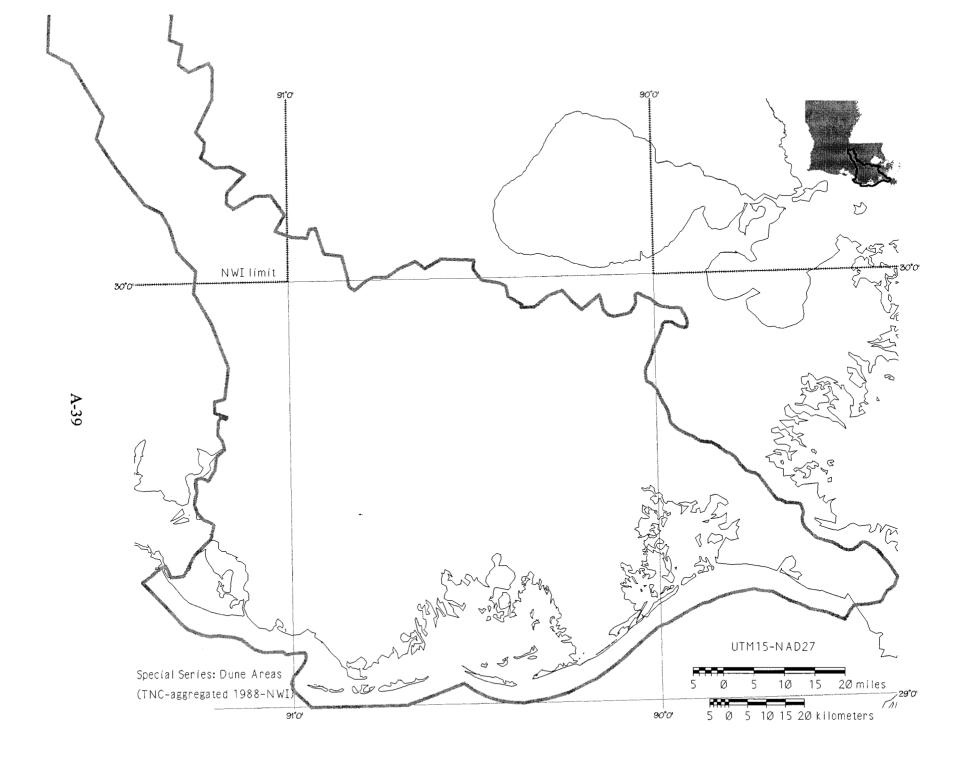


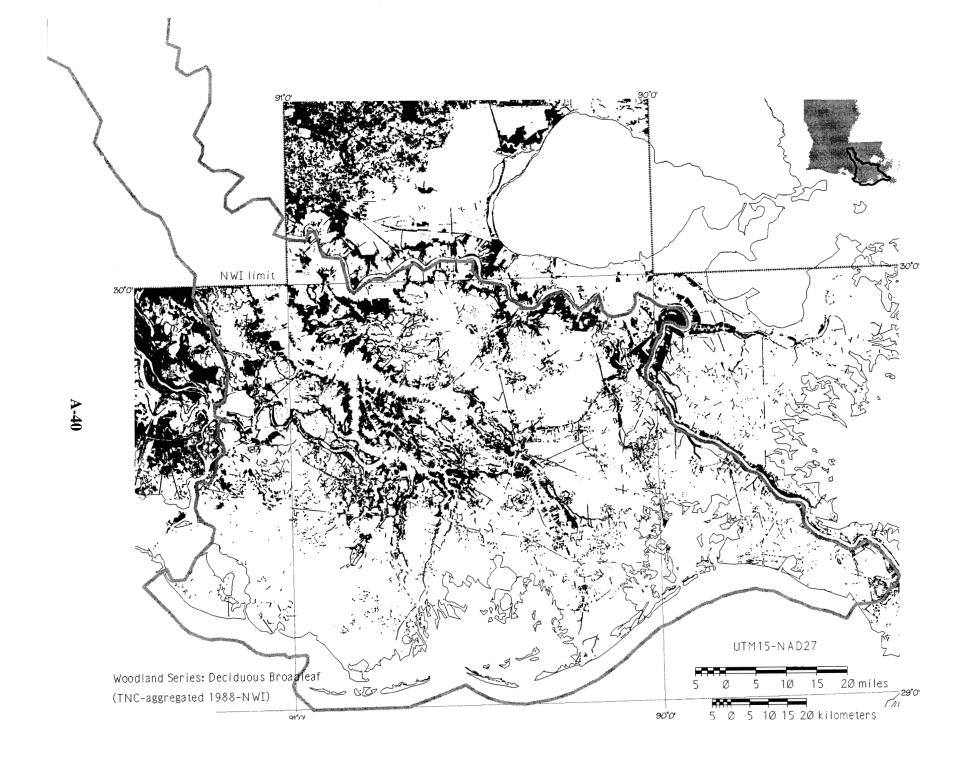


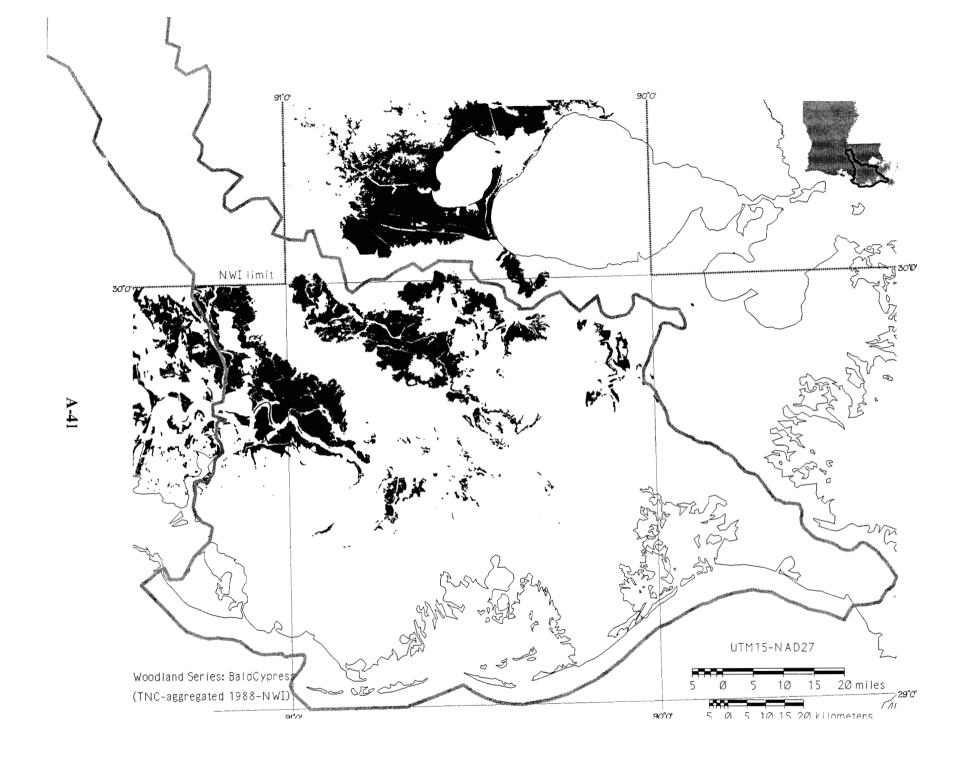


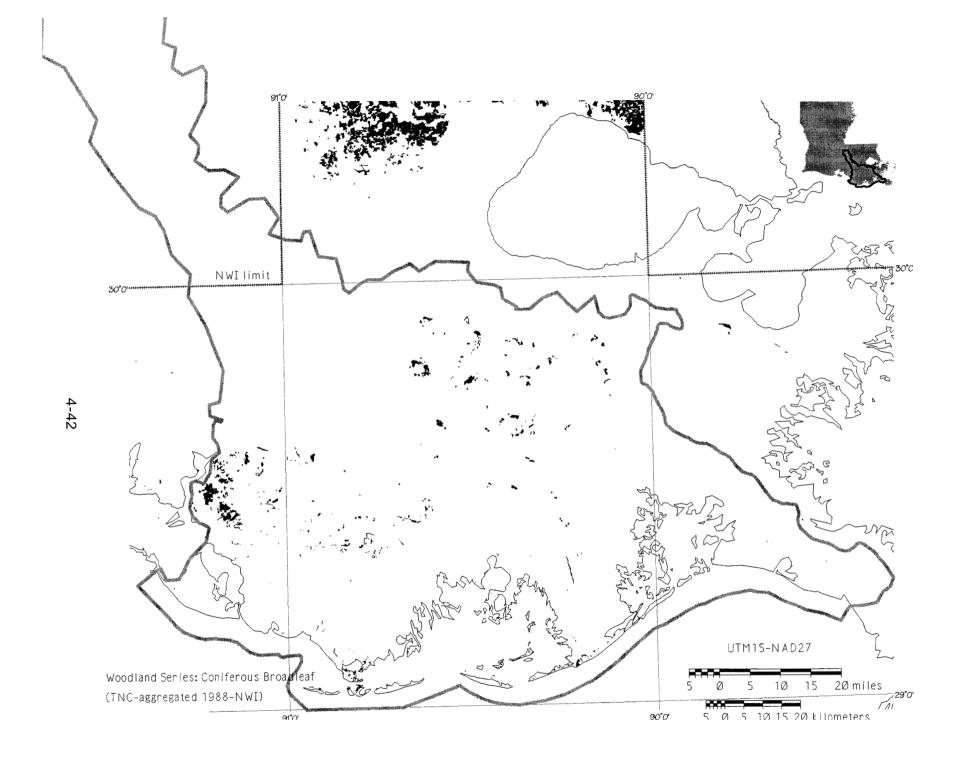


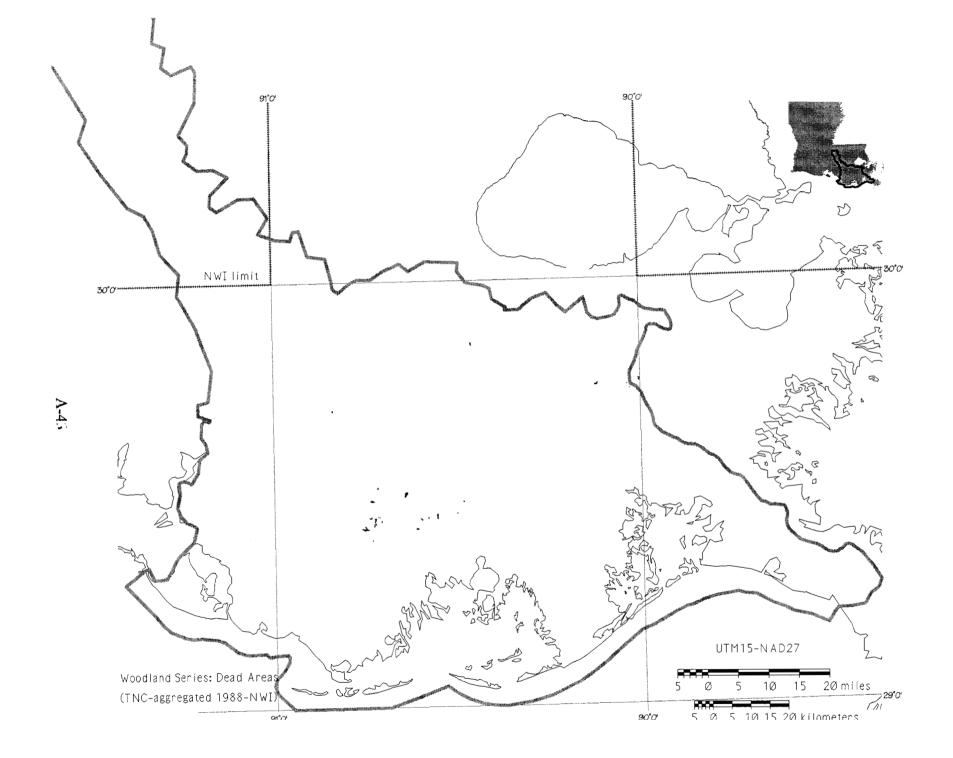


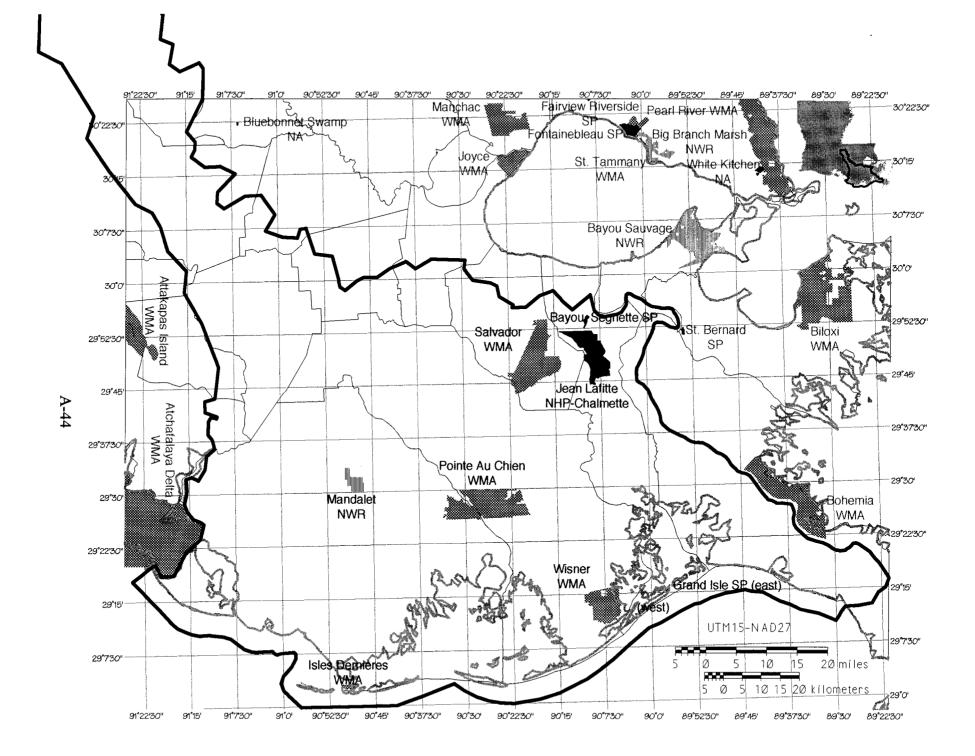












Appendix B. Bird Species Recorded by the Breeding Bird Atlas Project in the Barataria-Terrebonne Basins (1994-1995). Appendix B includes species lists of migratory and breeding status and habitat use and maps of distribution for those bird species recorded in the Barataria-Terrebonne Basins during Breeding Bird Atlas surveying in 1994 and 1995. The appendix is divided into five sections. The first two present summary maps; the remaining three are for each of the groups: breeding species, wintering species, and transient species. Each section first presents a table of the species and coded information on their migratory status and habitat preference. Maps of the localities at which the species was recorded by the Breeding Bird Atlas Project in the BTB follow. The scientific name of each species is given along with its common name on the species' map. Note that symbols for some quads appear to be offshore or over water. All symbols are centered in the quad they represent, and in some cases the center of the quad is offshore. All birds, however, were recorded on or near land.

Codes used to describe the migratory status of birds in the BTB.

Note that all of these categories except "BR" have populations that migrate, either to the Neotropics to winter, or from the further north to winter in the BTB, or both. However, the categories that include Transients ("T") all include Neotropical migrant birds, since by definition birds that migrate to the south of the BTB must be migrating to the Neotropics.

Code	Description
BR	Breeding Resident. Species that breed within the BTB and have no populations that migrate to or from the area. Example: Northern Bobwhite.
BW	Breeding / Wintering. Species that breed within the BTB but also have populations that migrate from northern areas to winter within the area. Example: Eastern Towhee.
BWT	Breeding / Wintering / Transient. Species with populations that breed and winter within the BTB but also have transient populations that migrate from further north to winter in the Neotropics. Example: Blue-gray Gnatcatcher.
BT	Breeding / Transient. Species with populations that breed within the BTB and migrate entirely from the area in winter, and which have populations that also breed farther north that pass through the BTB as transients. These would be what most conservationists refer to as "breeding Neotropical migrant birds." Example: Indigo Bunting.
Т	Transient. Species that do not breed in the BTB, and only pass through during migration. These could also be called "non-breeding Neotropical migrant birds." Example: Bay-breasted Warbler.

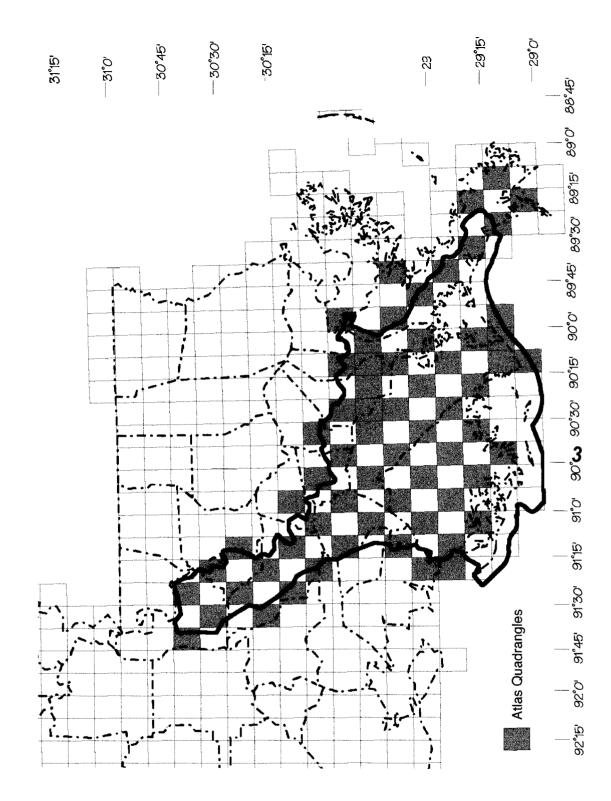
Codes used to describe the migratory status of birds in the BTB, continued.

- W Wintering. Species that do not breed in the BTB, but have wintering populations there, which do not generally migrate further south. Example: House Wren.
- WT Wintering / Transient. Species that do not breed in the BTB, but have wintering populations and populations that winter in the Neotropics and pass through as transients. Example: Black-bellied Plover.

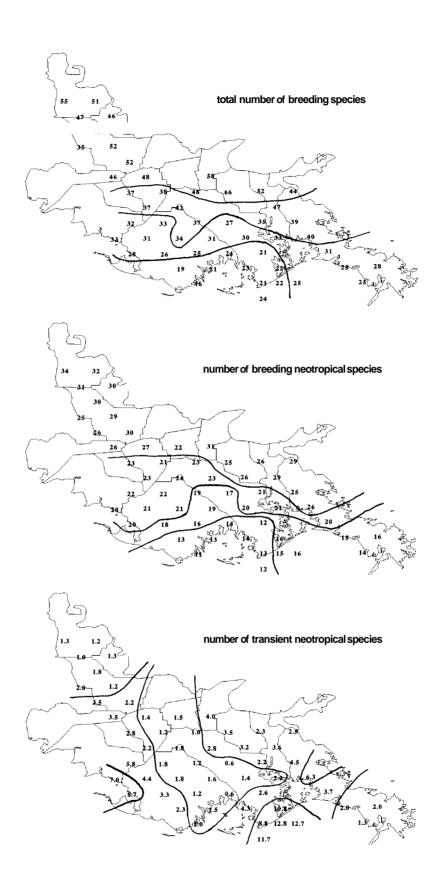
Codes used to describe the habitats used by birds in the BTB.

Code	Description
F	Forests, swamps, woodlots, cheniers, where trees predominate.
Н	Urban, suburban, and other human habitations.
М	Marsh, where marsh grasses predominate. May have some open water. See also Water.
0	Open habitats, including agricultural lands, grazing lands, mowed levees, open suburban areas.
S	Sea and coastal shores and beaches.
W	Water or aquatic habitats, where open water predominates. See also Marsh.

Appendix B, Part 1. Quads surveyed and number of species in each quad surveyed in the BTB. On the first map, gray squares show the quads within the BTB surveyed for the atlas. On the second map the raw data for number of species were smoothed to remove some observer and observer effort effects. This was done by replacing the value in a quad with the average of all quads that touched its corners, and repeating this process for all quads.



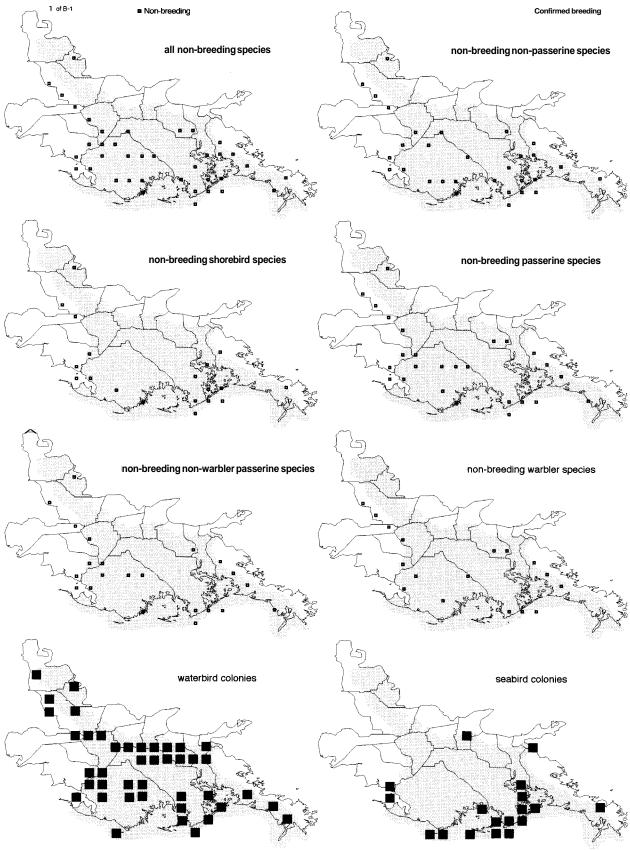
B-5



1 of A-1

B-6

Appendix B, Part 2. Locations of non-breeding species recorded in the BTB, by major taxonomic group, and locations of waterbird and seabird breeding colonies. On the maps of non-breeding species, each small box represents at least one record of a non-breeding species. Therefore, the symbols do not represent abundance or number of species, but only quads on which a non-breeding species was recorded. Quads with breeding colonies are indicated by large, solid squares.





Species	Migratory Status Code	Habitat Code	Note
Pied-billed Grebe	BWT	W	
Brown Pelican	BWT	S	
Anhinga	BWT	W	
Phalacrocorax sp.	BWT	W	Double-crested or Neotropic Cormorant
Least Bittern	BWT	M/W	
Black-crowned Night-Heron	BWT	W	
Yellow-crowned Night-Heron	BWT	W	
Green Heron	BT	W	Formerly Green-backed Heron
Tricolored Heron	BWT	W	
Little Blue Heron	BWT	W	
Reddish Egret	BWT	S	
Cattle Egret	BWT	W/G	
Snowy Egret	BWT	W	
Great Egret	BWT	W	
Great Blue Heron	BWT	W	
Glossy Ibis	BW	W	
White-faced Ibis	BWT	W	
White Ibis	BWT	W	
Roseate Spoonbill	BWT	W	
Mallard	BW	W	
Mottled Duck	BR	M/W	
Blue-winged Teal	BWT	W	
Wood Duck	BW	F/W	
Hooded Merganser	BW	F/W	
King Rail	BW	Μ	
Clapper Rail	BR	Μ	
Purple Gallinule	BT	Μ	
Common Moorhen	BWT	M/W	
Black-necked Stilt	BWT	W	
Wilson's Plover	BWT	S	
Killdeer	BWT	0	
Willet	BWT	S	
Laughing Gull	BWT	S	
Forster's Tern	BWT	S	

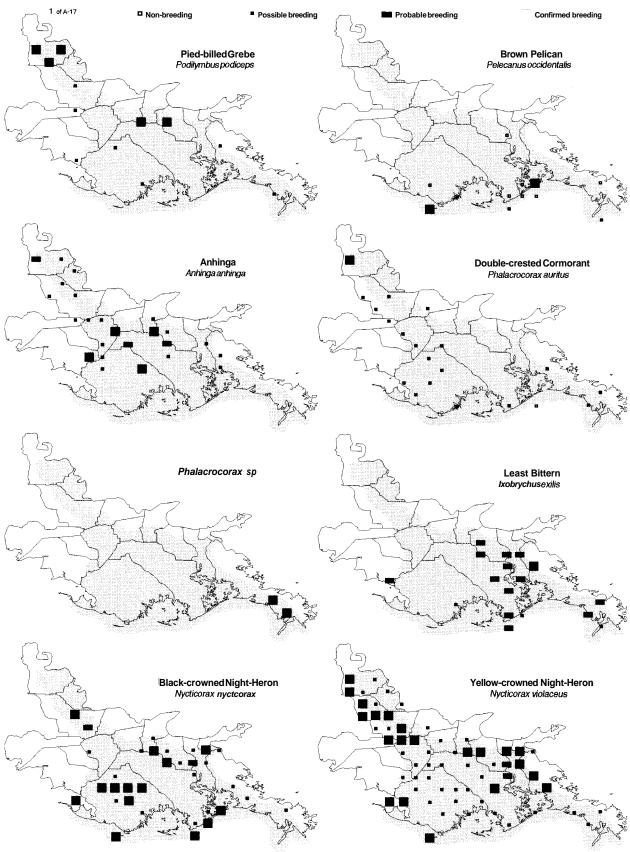
Que d'au	Migratory	Habitat	N-4-
Species	Status Code	Code	Note
Gull-billed Tern	BT	S	
Least Tern	BT	S	
Sandwich Tern	BWT	S	
Royal Tern	BWT	S	
Caspian Tern	BWT	S	
Sooty Tern	BT	S	
Black Skimmer	BWT	S	
Turkey Vulture	BWT	F	
Black Vulture	BR	F	
Bald Eagle	BWT	Μ	Breed in winter, then migrate out.
Mississippi Kite	BT	F	
Red-shouldered Hawk	BW	F	
Broad-winged Hawk	BT	F	
Red-tailed Hawk	BW	0	
Osprey	BWT	W	
Northern Bobwhite	BR	0	
Wild Turkey	BR	F/O	
Rock Dove	BR	Н	
Mourning Dove	BWT	0	
Eurasian Collared Dove	BR	Ο	Introduced
Monk Parakeet	BR	Ο	Introduced
Yellow-billed Cuckoo	BT	F	
Common Barn Owl	BR	M/O	
Great Horned Owl	BR	F	
Barred Owl	BR	F	
Eastern Screech Owl	BR	F	
Common Nighthawk	BT	O/S	
Chimney Swift	BT	Н	
Ruby-throated Hummingbird	BT	F	
Belted Kingfisher	BW	W	
Northern Flicker	BW	F	
Red-bellied Woodpecker	BR	F	
Red-headed Woodpecker	BW	F	

	Migratory	Habitat	
Species	Status Code	Code	Note
Downy Woodpecker	BR	F	
Hairy Woodpecker	BR	F	
Pileated Woodpecker	BR	F	
Eastern Kingbird	BT	O/F	
Great Crested Flycatcher	BT	F	
Eastern Wood-Pewee	BT	F	
Acadian Flycatcher	BT	F	
Purple Martin	BT	Н	
N. Rough-winged Swallow	BT	F/O	
Barn Swallow	BT	F/O	
Blue Jay	BW	F	
American Crow	BW	F	
Fish Crow	BW	F	
Tufted Titmouse	BR	F	
Carolina Chickadee	BR	F	
Carolina Wren	BR	F	
Marsh Wren	BW	М	
Blue-gray Gnatcatcher	BWT	F	
Eastern Bluebird	BW	O/F	
Wood Thrush	BT	F	
American Robin	BW	Н	
Loggerhead Shrike	BW	0	
Gray Catbird	BWT	F	
Northern Mockingbird	BW	H/O	
Brown Thrasher	BW	F	
European Starling	BR	0	
White-eyed Vireo	BWT	F	
Yellow-throated Vireo	BT	F	
Red-eyed Vireo	BT	F	
Prothonotary Warbler	BT	F	
Northern Parula	BT	F	
Yellow-throated Warbler	BWT	F	

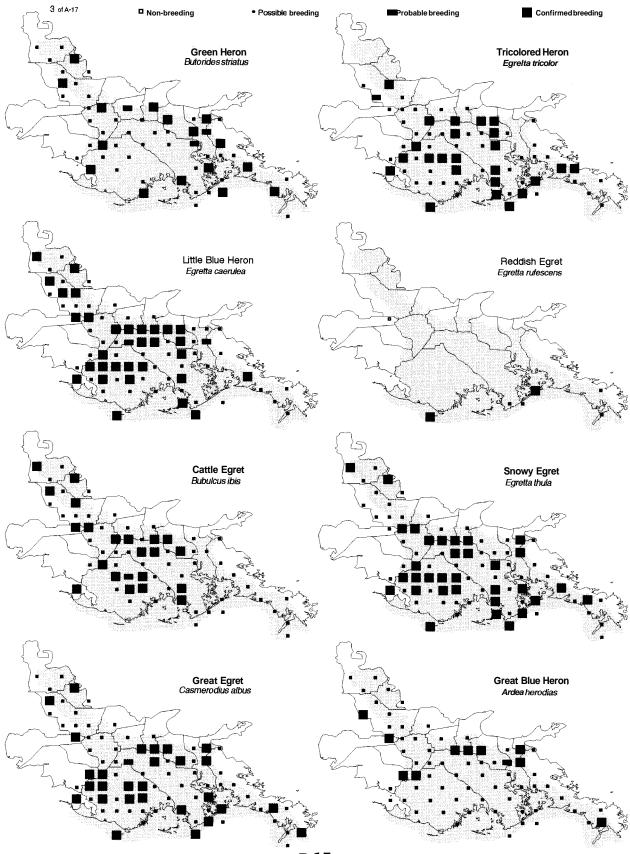
Code Cod F F F F T M, T M, F F F		
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Г F /Т М/ Г F	- /O -	
Τ Μ. Γ Ε	/O F	
ΓF	7	
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V F	F Formerly Rufous	s-sided Towhee
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American Oystercatcher	BR	No confirmed breeding in the BTB, but it is confirmed in areas nearby outside the basins. It is likely to breed occasionally on barrier islands within the BTB.
Swallow-tailed Kite	BT	No confirmed breeding in the BTB, but it is confirmed in areas nearby outside the basins. It is likely to breed occasionally in the BTB, especially in the northern, wooded areas or near the wooded portions of the Atchafalaya Basin.
Cooper's Hawk	BW	No recent confirmation of breeding within the BTB, but historical records and breeding in nearby areas suggest that the hawk may be a rare breeder within the BTB.
White-winged Dove	?	No confirmations yet in the BTB, but it has been sighted in the New Orleans area. The species is expanding its range eastward from southwestern Louisiana, and would be expected to eventually be recorded breeding in the BTB.
Shiny Cowbird	?	This species is invading North America from the Caribbean, and has been recorded on Grand Isle within the BTB, but with no evidence of breeding. However, because of its range expansion elsewhere, it is likely to eventually breed in the BTB.
Great-tailed Grackle	BR	This species typically breeds along the coast in western Louisiana, and has been recorded in the BTB, although not breeding. It is likely that the grackle occasionally breeds in the BTB, especially in the western part near Morgan City.

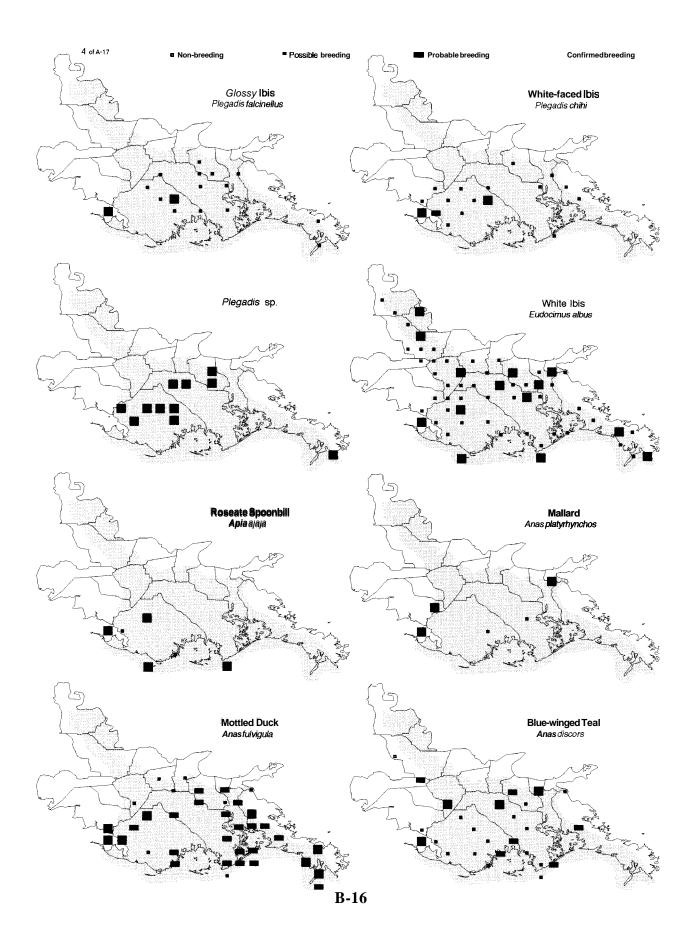
Species suspected breeding in the BTB, but not yet confirmed.

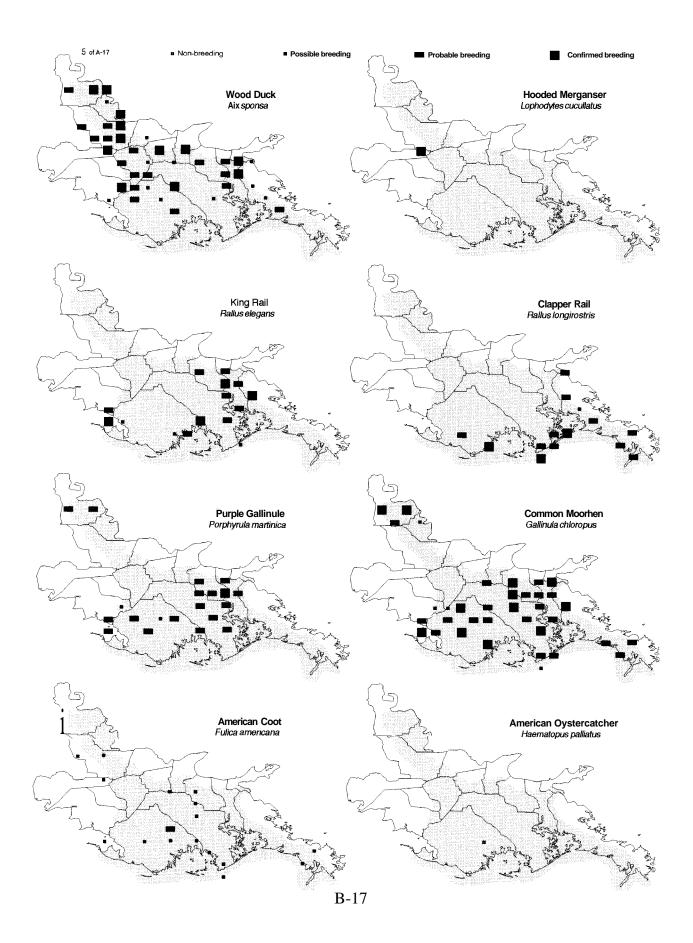


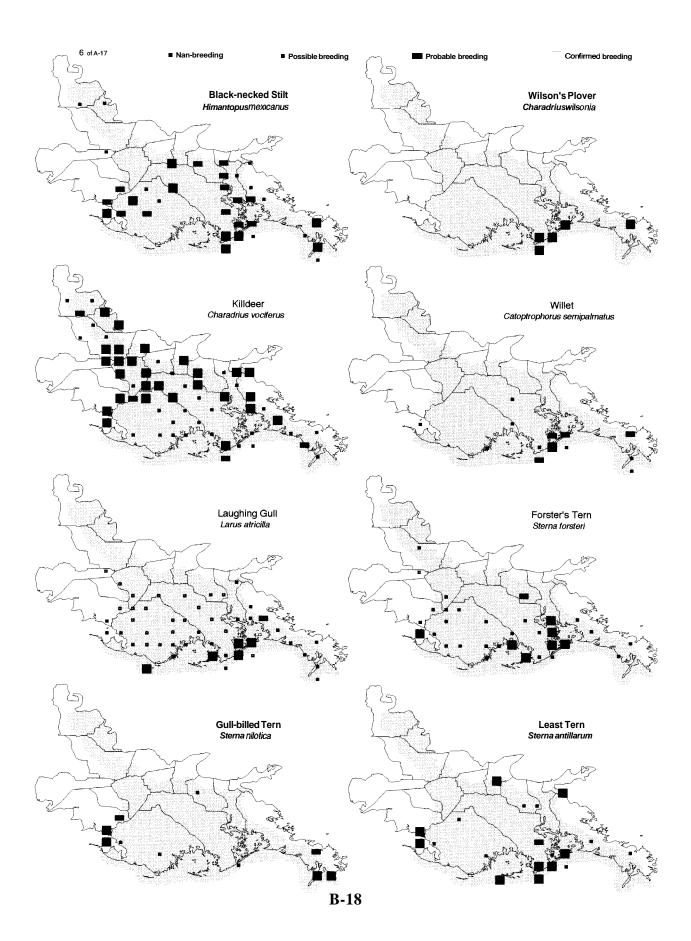


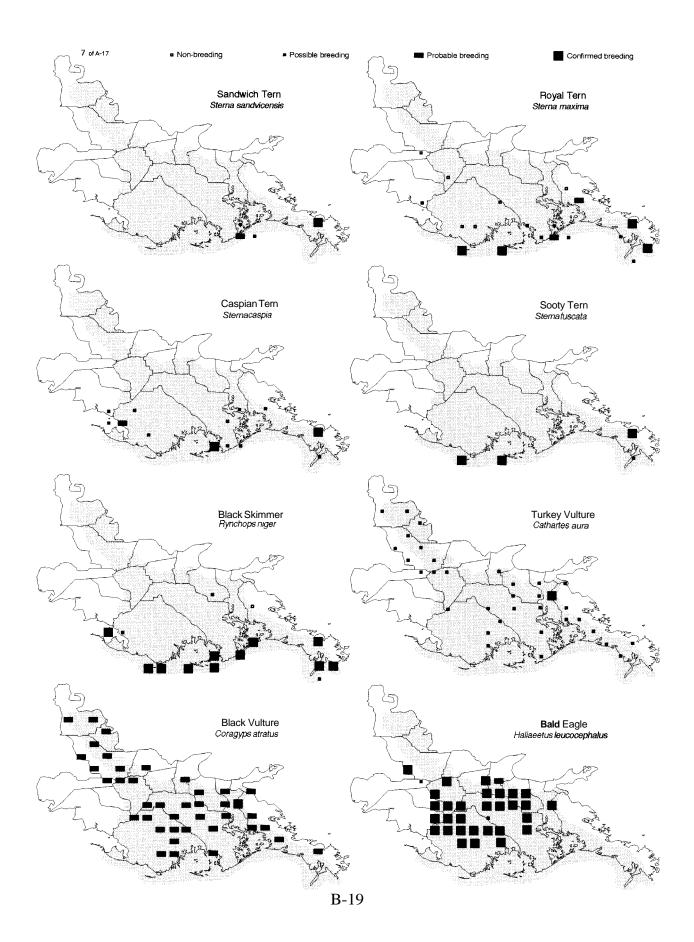


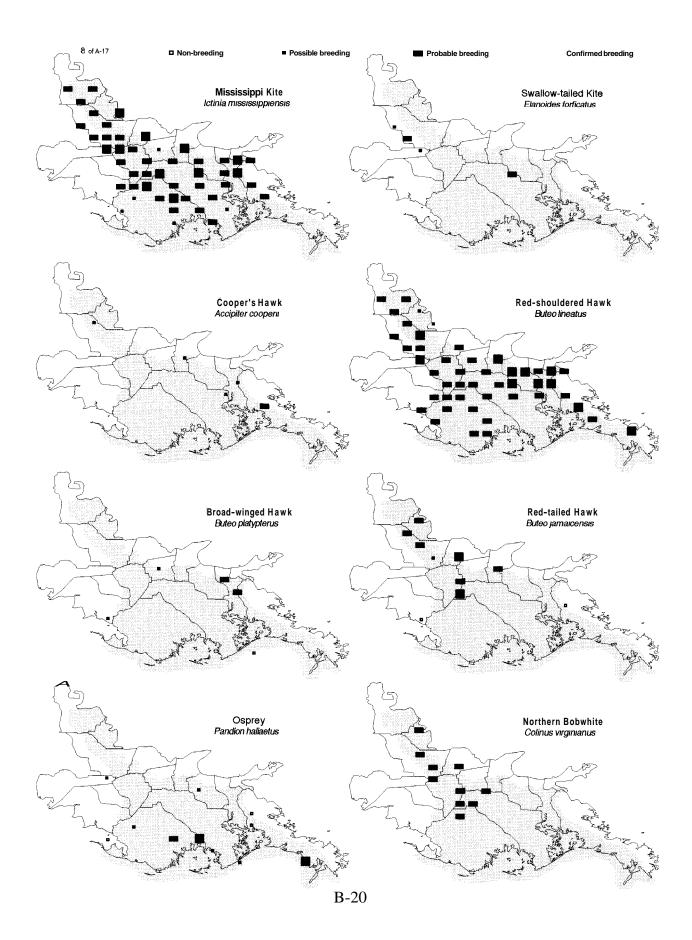


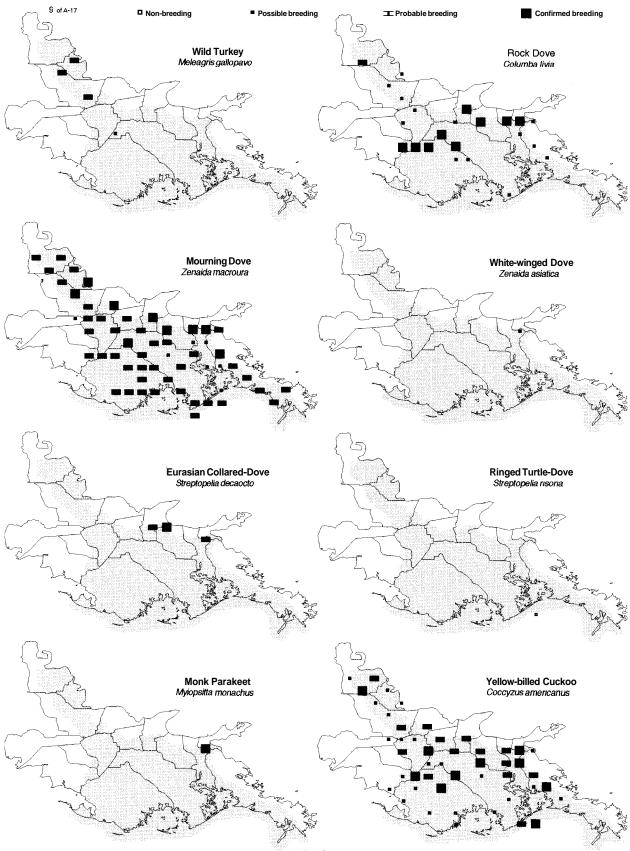




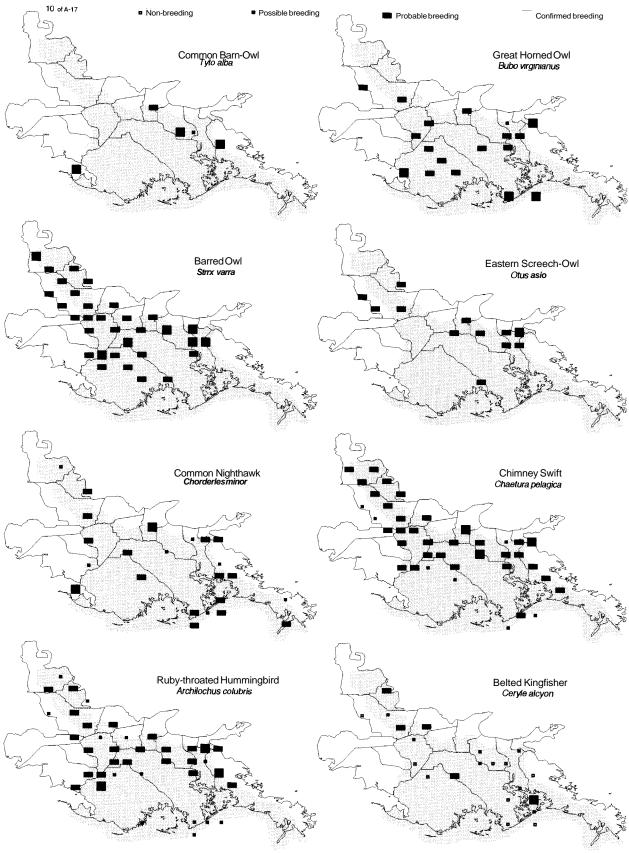




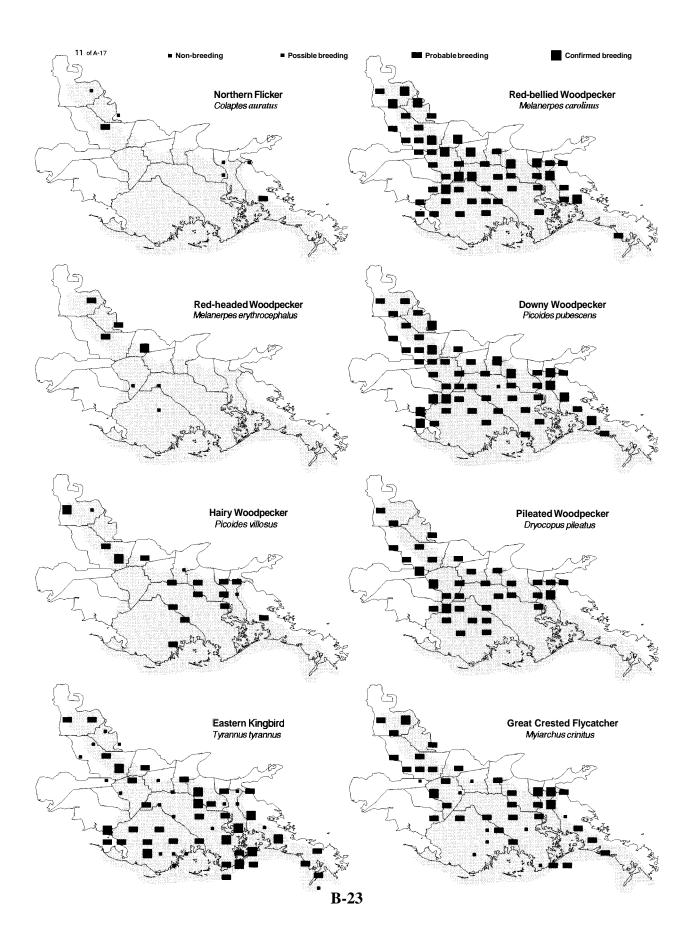


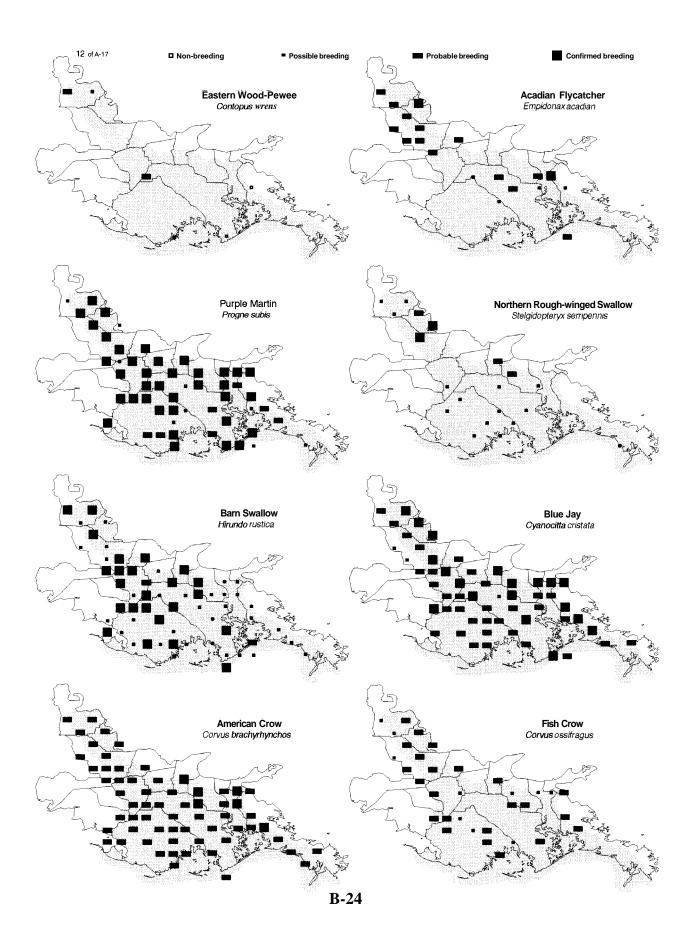


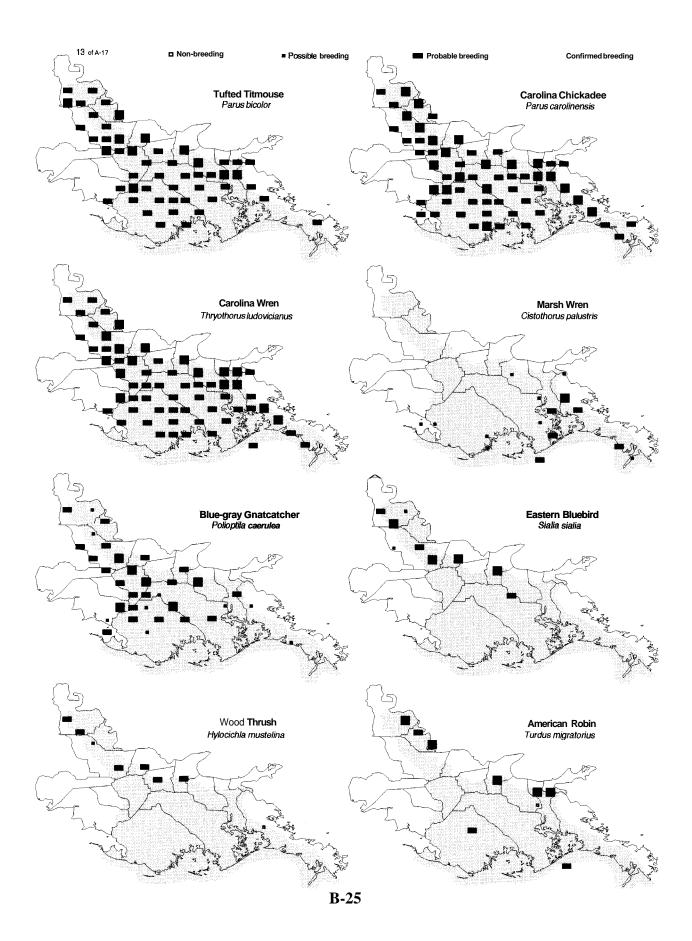


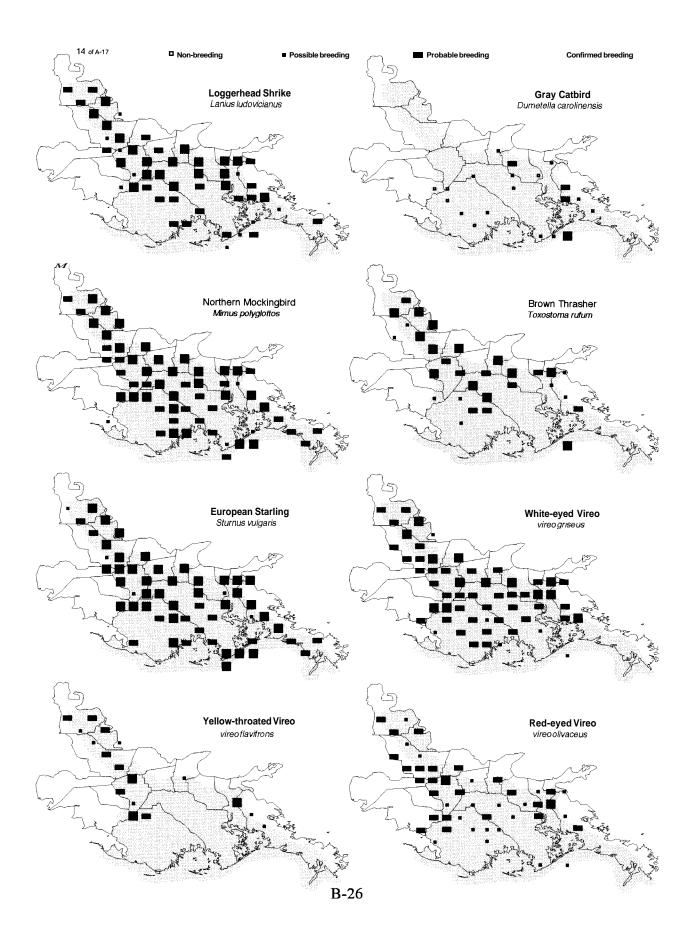


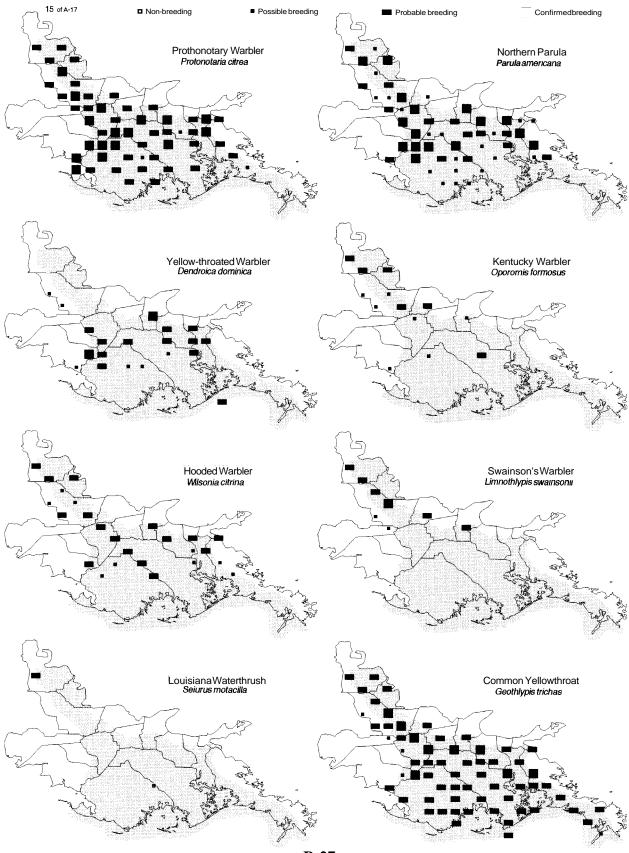




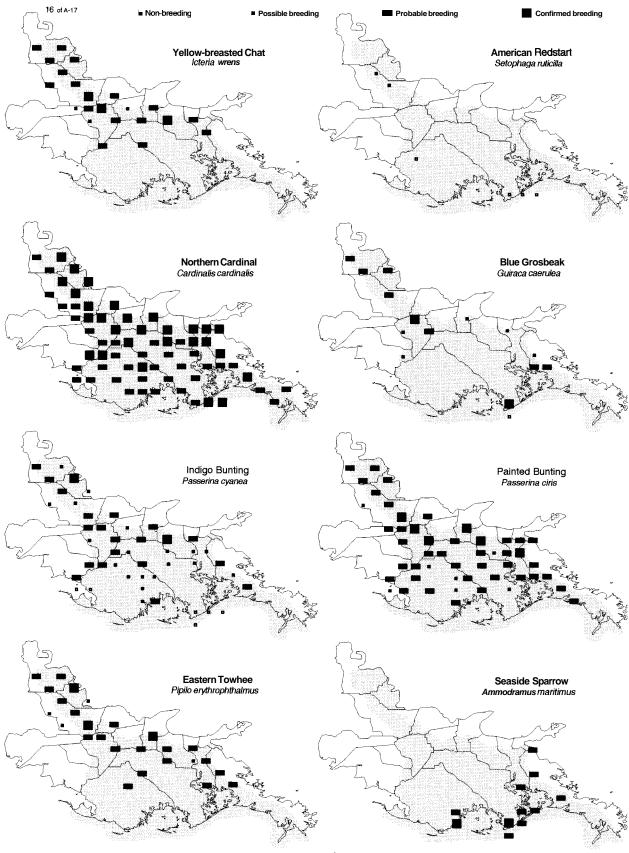




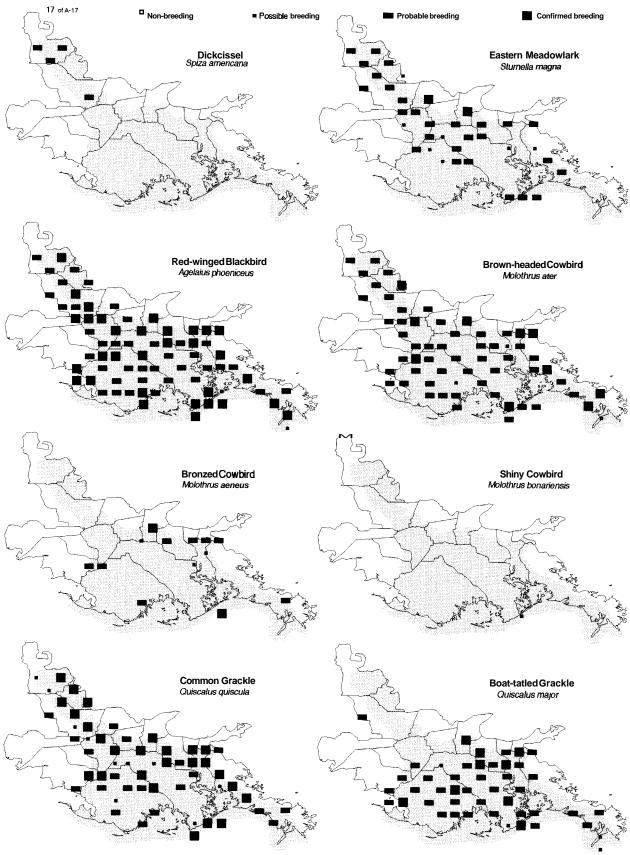




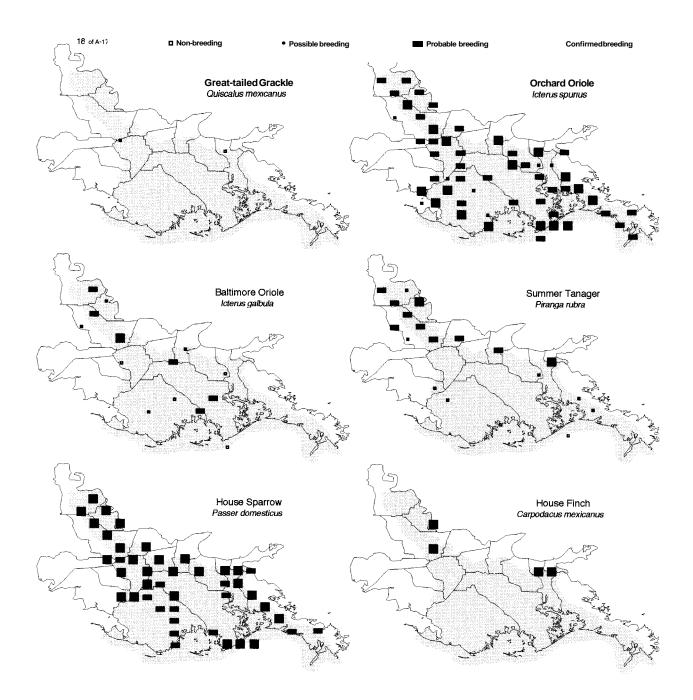










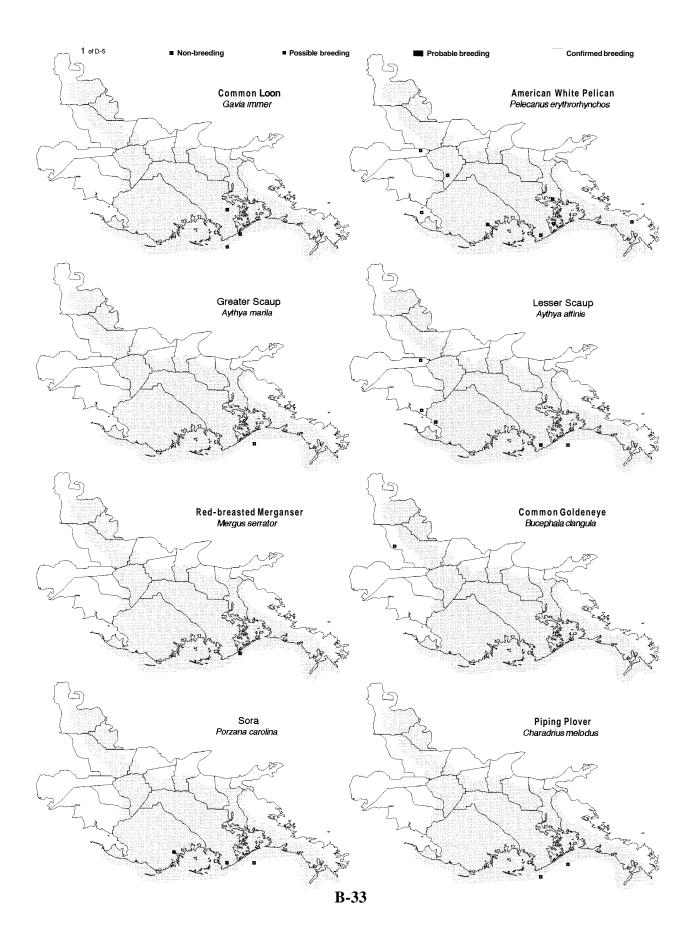


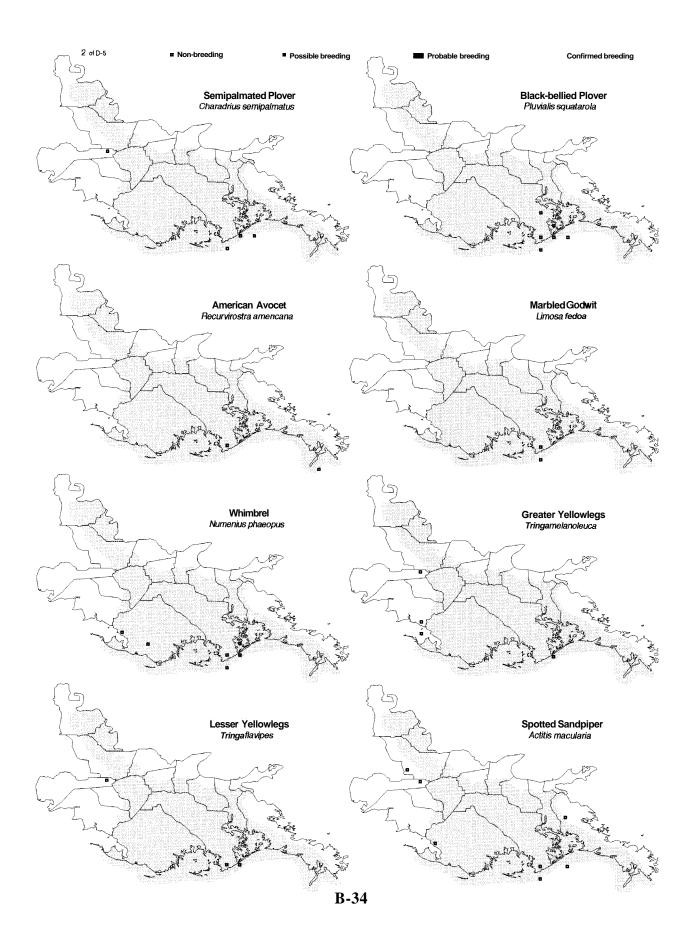
Appendix B, Part 4. Species wintering but not breeding in the Barataria-Terrebonne Basins. Some of these species may also have transient populations that breed in the Neotropics and pass through the BTB during migration.

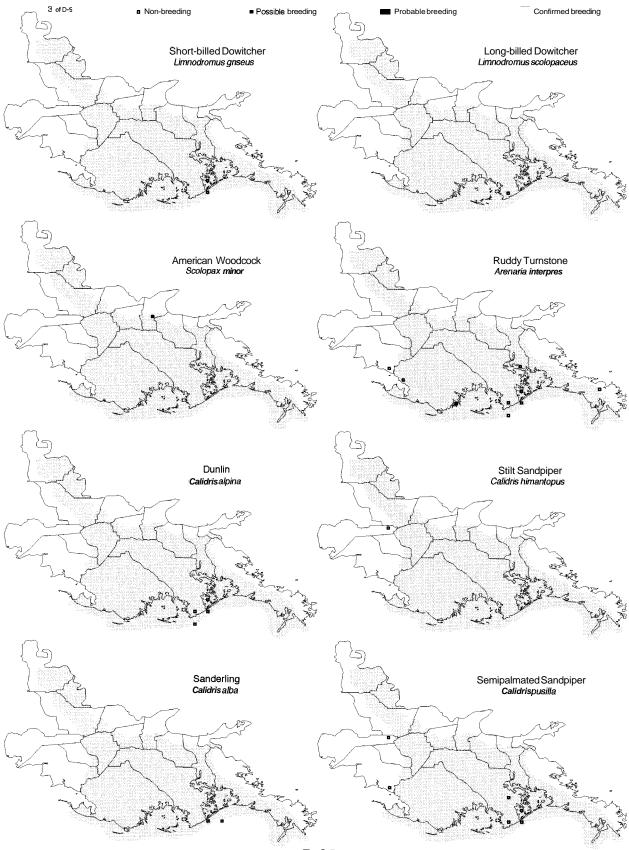
a .	Migratory	Habitat	N
<u>Species</u>	Status Code	Code	Note
Common Loon	W	W	
White Pelican	W	W	
Greater Scaup	W	W	
Lesser Scaup	WT	W	
Red-breasted Merganser	W	W	
Common Goldeneye	W	W	
Sora	W	М	
Black Rail	W	М	
Piping Plover	W	S	
Semipalmated Plover	WT	S	
Black-bellied Plover	WT	S	
American Avocet	WT	W	
Marbled Godwit	WT	S	
Whimbrel	WT	S	
Greater Yellowlegs	WT	W	
Lesser Yellowlegs	WT	W	
Spotted Sandpiper	WT	W	
Short-billed Dowitcher	WT	W	
Long-billed Dowitcher	WT	W	
American Woodcock	W	F	
Ruddy Turnstone	WT	S	
Dunlin	WT	W	
Stilt Sandpiper	WT	W	
Sanderling	WT	S	
Semipalmated Sandpiper	WT	W	
Western Sandpiper	WT	W	
Least Sandpiper	WT	W	
Ring-billed Gull	WT	W	
Herring Gull	WT	W	
Northern Harrier	W	O/M	
American Kestrel	W	0	
Tree Swallow	WT	0	
House Wren	W	0	
Ruby-crowned Kinglet	W	F	
Cedar Waxwing	W	F	
-			

	Migratory	Habitat	
Species	Status Code	Code	Note
Solitary Vireo	WT	F	
Yellow-rumped Warbler	W	F	
Savannah Sparrow	W	0	
White-throated Sparrow	W	F	
Swamp Sparrow	W	M/F	
Brewer's Blackbird	W	0	

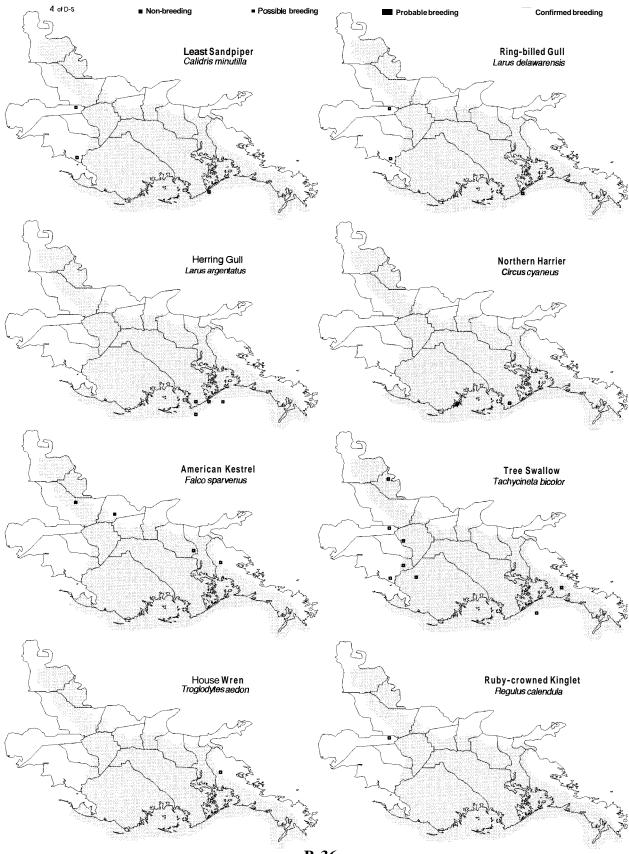
Appendix B, Part 4. Species wintering but not breeding in the Barataria-Terrebonne Basins, continued.



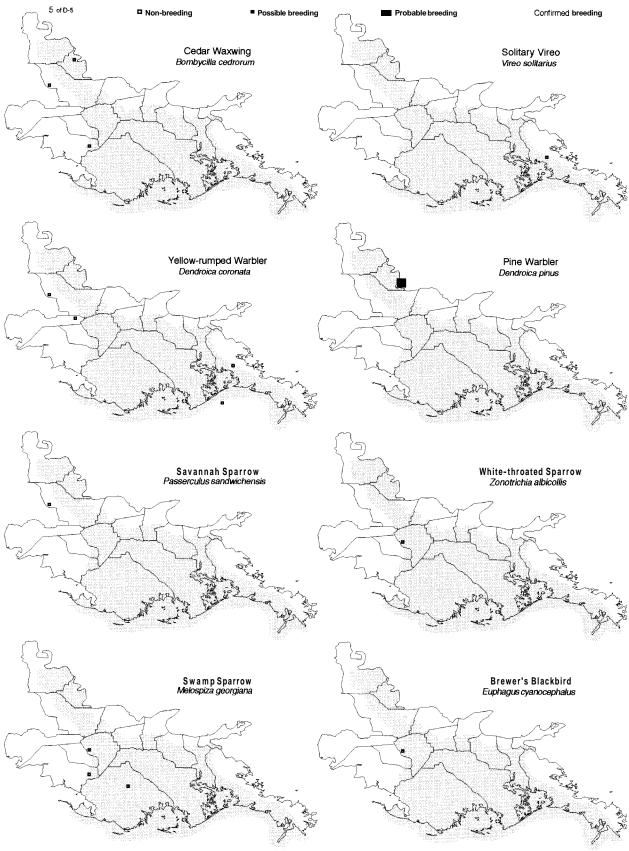














Migratory Habitat Species Status Code Code Note Magnificent Frigatebird Т S Nomadic rather than transient. Solitary Sandpiper Т W Red Knot Т W Т White-rumped Sandpiper W Т **Pectoral Sandpiper** W **Upland Sandpiper** Т W Common Tern Т W Black Tern Т W **Bank Swallow** Т 0 Т F Veery Swainson's Thrush Т F Gray-cheeked Thrush Т F Т F Warbling Vireo Golden-winged Warbler Т F Tennessee Warbler Т F Nashville Warbler Т F Т F Black-and-white Warbler F Black-throated Blue Т Warbler Blackburnian Warbler Т F Chestnut-sided Warbler Т F Magnolia Warbler Т F Bay-breasted Warbler Т F Blackpoll Warbler Т F Palm Warbler Т F Yellow Warbler Т F Mourning Warbler Т F Canada Warbler Т F Worm-eating Warbler Т F Ovenbird Т F Louisiana Waterthrush F Т Rose-breasted Grosbeak Т F Bobolink Т 0 Т F Scarlet Tanager

Appendix B, Part 5. Transient species that winter in the Neotropics and pass through the Barataria-Terrebonne Basins en route to more northern breeding grounds.

