Status, Trends, and Probable Causes of Change in Living Resources in the Barataria-Terrebonne Estuarine System

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PREFACE

In 1990, the U.S. Environmental Protection Agency (EPA) and the State of Louisiana agreed to work as partners to establish the Barataria-Terrebonne National Estuary Program (BTNEP). The overall mission of the BTNEP is to work with a wide variety of citizens and interest groups to develop a comprehensive, long-term management plan to preserve and protect the fragile environmental resources of both the Barataria and Terrebonne basins. This novel partnership is based on the premise that true change will take place only if the basins' stakeholders determine for themselves the problems and the solutions. The BTNEP is composed of representatives of not only federal, state, and local government, but also landowners, industry, fishermen, farmers, citizens groups, and academic institutions. The BTNEP is administered by the Louisiana Department of Environmental Quality and governed by a series of committees, each with varied representation and expertise. The committees are collectively referred to as the Management Conference. The final product of the five-year planning process is a Comprehensive Conservation and Management Plan (CCMP) which incorporates specific actions to enhance the quality of life in the Barataria and Terrebonne basins.

One of the many steps taken during the five-year planning process was the development of a series of four reports, which document the current status and the past trends of particular resources within the basins. Members of the report preparation teams were selected by the Management Conference based on their expertise in a particular subject, and with an eye toward ensuring that each subject was given accurate, fair, and balanced treatment. The entire Management Conference and a team of designated reviewers reviewed each draft report and provided comments to the preparation teams at day-long interactive review meetings. At that time the Management Conference also agreed upon needed modifications to each report.

The final step in the BTNEP planning process is the finalization of the CCMP. The information presented in this report will be instrumental in the development of all the management recommendations made in the final CCMP, which is scheduled for submission to EPA in the summer of 1996.

For information about this or other reports or the CCMP, please contact the BTNEP Office.

Steve Mathies
Program Director

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We are especially grateful to the designated reviewers for the living resources portion of the study for their guidance, helpful insight, and avenues to data and information. We appreciate the help of the Barataria-Terrebonne National Estuary Program office staff, including Steve Mathies, Richard DeMay, Tracy Kling, Stevie Smith, and Tanya Matherne.

Invertebrates

All long-term data sets were obtained from the Louisiana Department of Wildlife and Fisheries (LDWF). Data for shrimp and crab were obtained as compressed SAS data files. Oyster data were obtained from records and reports at the LDWF's Bourg and Grand Terre field offices. Macroinfauna data were obtained from the Louisiana Offshore Oil Port (LOOP) annual reports prepared by the Coastal Ecology section of the LDWF. Dr. Badiollah R. Asrabadi, Department of Mathematics, Nicholls State University, Thibodaux, Louisiana, provided invaluable assistance in sorting and rearranging these massive data sets on the computer.

We are grateful to the LDWF personnel for the use of their data, and for their many helpful discussions on data and station selection and data analysis and interpretation.

Finfish

Fish data from fishery-independent sampling programs were obtained from LDWF for selected sampling stations in the

BTNEP area. The Office of Fisheries, Marine Fisheries Division, provided catch and effort data for the target fish species similar to those presented on a statewide basis in Perret et al. (1993). In addition, the Office of Fisheries provided catch and effort data from three trawl stations in the environmental monitoring of the LOOP from Barataria Bay (LOOP 1994).

We gratefully acknowledge the LDWF personnel for the use of their data, and for their many helpful discussions on data and station selection and data analysis and interpretation.

Birds

We are deeply grateful to Robert D. Purrington, Department of Physics, Tulane University, for providing us with a prepublication copy of his book *Birds of Southeastern Louisiana* (Purrington 1995) and for reviewing our interpretation of his findings.

We thank Mike Carloss of the Fur and Refuge Division of the LDWF for providing the data from the 1994 waterbird surveys in southeastern Louisiana.

Robert Helm of LDWF made available to us valuable data on the January estimates of wintering waterfowl in southeastern Louisiana.

Mammals

We thank Noel Kinler of the Fur and Refuge Division of the LDWF for providing us with the unpublished fur harvest data.

CHAPTER 1
EXECUTIVE SUMMARY

Findings

Two hundred and ninety-four years ago the French explorer Pierre Le Moyne, sieur d'Iberville sailed over one of the many shallow sandbars that marked the mouth of the Mississippi River into a teeming wilderness paradise. Landing at what we now call Head of Passes, he went ashore, found a great quantity of game, "duck, geese, snipe, teal, bustards and other birds," and went hunting "a variety of animals such as stags, deer, buffalos (bison)." A short distance upstream Iberville climbed a willow and looked out over what we now call the Barataria-Terrebonne estuarine system (BTES). He saw impenetrable, endless marshes, dense canebrakes, limitless possibilities and resources. As he continued upstream, the river became cloaked in towering cypress swamps filled with thousands of parakeets. He befriended the native Americans and traded with them for their bounty of bear, bison, and corn. He and the later French learned of the opossum and pelican, and feasted on oysters, crawfish, shrimp, redfish, sheepshead, and sandhill cranes.

Iberville's observations mark the first written qualitative assessment of the living resources of the BTES. He was followed by a succession of explorers, priests, and finally scientists who recorded and measured various aspects of the system's animal populations. This work collects the most recent quantitative assessments of abundance, trends, and probable causes of change for a wide variety of the BTES living resources, and then draws ecosystem-level linkages.

In compiling this report we collected population trend information from the last 30 years for 130 of the 682 species of vertebrates known to occur, to have occurred in historic times, or expected to occur within the BTES, and for six selected species of invertebrates (oyster, crab, and shrimps). We report trend data for 10 finfish, one amphibian, nine reptiles, 104 birds and six mammals. Little harvest-independent BTES population information exists for most species other than shrimp, birds, and estuarine-dependent fish, but it appears likely that more is available for this estuary than for most others. The most significant data gaps are for freshwater fish and amphibians. Harvest-independent information was used exclusively, except in the case of furbearers, where the previous 55-year trapping record was thought to be more indicative of population than most take numbers.

This species information sets the stage for examining the trends from an historical ecological perspective. Species were compared in ecologically significant groups to derive landscape-level indices of changes in species richness that could be linked to historical habitat modification, hunting pressure, or the introduction of exotic species. These linkages form the basis here for

our conclusions and recommendations. These recommendations, if followed, could bring us closer to realizing one of the ultimate goals of the Barataria-Terrebonne National Estuary Program, that of bringing about an increase in the overall abundance and diversity of aquatic and terrestrial species that reside in or move through the BTES.

Most species for which BTES data are available have not experienced continuous declines in population over the past 30 years despite the dramatic loss of marsh and barrier island habitat that has occurred during this period. This is true for all of the estuarine-dependent finfish and shellfish and for most of the wading birds and raptors. A significant number of species show an increasing trend that can be attributed to recovery from relatively recent overharvesting, as for the American Alligator, and from reproductive failure associated with bioaccumulation of toxins introduced primarily in the 1950s and 1960s, particularly DDT and its relatives. A large number of predatory birds, including the endangered Bald Eagle and Brown Pelican, fall into this category. The BTES is now the most important area on the northern Gulf Coast for the recovery of these two conspicuous species. A number of common songbirds of suburbs and towns have increased in population since the 1970s, possibly due to an increase in mixed wood, shrub, and open field that has occurred as subdivisions have aged and as intensively cropped sugar cane fields have been converted to residential use. Growth of common songbird populations in the BTES follows national trends for the most part.

Most of the migratory waterfowl that winter in the BTES are exhibiting increasing numbers, paralleling continental trends. These increases have been attributed primarily to restoration of northern wetland breeding grounds but also to a reduction in hunting pressure. The resident Wood Duck, a tree cavity nester, has shown important increases as mature swamp forest nesting sites have increased. A small number of seabirds, including a nationally significant population of Black Skimmers, are in a decline that is clearly caused by erosion of remote barrier island nesting sites. Some frogs and turtles of the fresh and brackish waters of the Barataria-Terrebonne area continue to be harvested despite evidence that populations have been depressed since the 1930s.

The threatened Louisiana Black Bear continues to reside in the northernmost portion of the BTES (Pointe Coupee) but has recently stopped breeding there because of an absence of males. Similarly, the Reddish Egret appears to have suspended breeding on Terrebonne's barrier islands, although it continues to be seen there. On the other hand, a number of animals have expanded their breeding ranges into the BTES, including the Brown and Bronzed Cowbirds, Cattle Egret, and Roseate Spoonbill. Introduction of true exotics has also had a significant impact on the distribution and abundance of native species within the BTES. The introduction of the Nutria in the 1950s has profoundly affected swamp and marsh ecology and appears to be outcompeting the Muskrat over much of its former BTES range. Similarly, the European Starling continues to outcompete native species for tree cavity nesting sites.

Far more species of birds regularly use the BTES for breeding or stopovers during part of the year (around 220) than are resident year round (about 60). An additional 100 species are occasional visitors. The importance of the BTES for migrants cannot be overemphasized and is largely attributable to its position at the southern end of the Mississippi River valley and to the

variety of wetland habitat that continues to be available. Any management plan must consider the needs of wintering populations that include most species of dabbling duck, many diving ducks, White Pelicans, rails, shorebirds including the endangered Piping Plover, hawks including the endangered Bald Eagle and Peregrine Falcon. A large percentage of the worldwide populations of the Tree Swallow, Yellow-rumped Warbler and Swamp Sparrow overwinter in the BTES.

The swamp and bottomland forests of the BTES, and marshes to a lesser degree, are spring and summer breeding grounds for nearly 40 species of neotropical migrants that winter in the Caribbean and Central and South America, including the Mississippi Kite, Prothonotary Warbler and Painted Bunting. Several species of heron, egret, and shorebirds and marsh birds like the Least Bittern are neotropical migrants that nest in the BTES. An additional 50 neotropical migrant species regularly stop over in the BTES during their fall and spring flights between breeding grounds outside the BTES and the tropics. Management of the BTES must consider the needs for maintaining good stopover habitat (maritime forested areas) that can be very important to many species, particularly during adverse weather conditions over the Gulf.

More than 60 species of birds are year-round residents of the BTES. A number of these populations, including the White Ibis, Mottled Duck, Royal Tern, Red-shouldered Hawk, Loggerhead Shrike and Seaside Sparrow, are stable or increasing in the BTES while they continue to decline in most other parts of their ranges.

Most of the major human factors that historically affected species diversity and abundance in the BTES were most effective before the 30-year period documented in this report. These include deforestation of the swamps and bottomland hardwoods, leveeing of the Mississippi River and draining of the land, the resultant coastal erosion and barrier island retreat, overhunting, the contraction of freshwater habitat that followed the damming of Bayou Lafourche, permanent deforestation of the canebrakes and levees, reforestation of the swamps, introduction of the offshore trawl fishery, and introduction of DDT into the biosphere. Combinations of these factors often acted simultaneously. For example, overhunting and habitat loss resulted in the extirpation of the Bison, Carolina Parakeet, Passenger Pigeon, and Wild Turkey.

Since 1970, little progress has been made in diverting freshwater into Barataria-Terrebonne, although the beneficial effect of the Atchafalaya has continued to grow. Marsh loss has continued at record rates and the disappearance of the barrier islands has accelerated. These last two trends carry ominous portents for both BTES and the nation as a whole. Most evidence indicates that the marsh breakup that precedes its complete conversion to open water actually increases marsh edge habitat in the short term. This may explain the lack of an apparent decline in estuarine-dependent fish and bird species while presaging an abrupt decrease once marsh acreage drops below some critical threshold. In contrast to the situation for marsh-dependent species, it seems clear that barrier island loss is already having effects on nationally important breeding populations of seabirds, including the Sandwich Tern, which appears to have reached saturation of available nesting habitat, and the Black Skimmer, which

is in decline. These two species have been among the most eager colonists of recently constructed artificial barrier islands.

Completely extinct species cannot be replaced, but the Brown Pelican and Wild Turkey, once locally extirpated, have been reintroduced and are now making a comeback. State and federal fish and game agencies, using a variety of new legal authorities including the Endangered Species Act, have brought harvesting under control and are currently managing the recovery of several species in the BTES, including the Bald Eagle and American Alligator. Overharvesting is not now occurring with any populations for which harvest-independent information is available. The Snapping Turtle, Alligator Snapping Turtle, Bullfrog, and Pig Frog continue to be overharvested, but there are no data on their status or trends. Government action to curb the manufacturing and use of DDT-based pesticides has allowed a large number of BTES predators, particularly birds, to increase their numbers to stable levels.

Swamp forests that were clear-cut before the 1940s are now maturing as vast tracts of highly productive second-growth forests. The aging of these forests appears to be having a positive effect on the large number of migratory and resident bird species that feed or breed in cypress forests and gather there before and after trans-Gulf flights. While they are being drained at a lower rate than in the past, many of the forests that survived cutting and the contraction of the freshwater zone ("saltwater intrusion") are currently "drowning" as a result of deltaic subsidence. Furthermore, they are virtually all in private ownership and could be logged in the near future, particularly if the trend to harvest immature trees for the bark (decorative mulch) becomes more prevalent. Even if they are not clear-cut, simply breaking up continuous stands will affect many species by providing avenues for invasion by nest predators like crows and jays and brood parasites like cowbirds.

Resource managers have taken the most important steps to limit bioaccumulating toxins and overharvesting. The positive results of these actions are beginning to be evident even to casual observers and are quite apparent in the existing trend data. From an ecological perspective, the paramount threat to animals in the BTES is now quite plainly one of habitat loss and degradation. Reversing habitat loss is also the most difficult because it requires all people of the basin to make sacrifices, at least in the short term, to ensure that long-term goals are reached. It must be remembered, however, that hard-won improvements in habitat can be quickly negated if populations are once more allowed to be overharvested or poisoned. Monitoring of species that are high in the food chain or particularly susceptible to direct contamination—for example Brown Pelican, Hooded and Red-breasted Merganser, Anhinga, Double-crested Cormorant, raptors, Nearctic River Otter, and amphibians—is recommended.

Those habitats with the highest species diversity and abundance are the barrier islands, natural marshes (including bayous and lakes), second-growth bald cypress swamp, and bottomland hardwood forests. The association of these habitats in the deltaic plain is unique to the BTES. Re-introduction of fresh water and sediment from the Mississippi and Atchafalaya Rivers is essential to expanding the freshwater swamp and marsh habitat to historical dimensions and to maintaining what still remains, but these are expensive and complex public works projects. Saving large tracts of second-growth cypress forests from clearcutting in the

future is also essential but could set up conflicts with private landowners because so little of the area is currently protected. Finally, and perhaps most pressing, a number of the best known and most conspicuous fish and wildlife species depend upon the remnants of the BTES's once-expansive barrier island/barrier beach habitats. It is predicted that the islands of most importance to nesting and stopover seabirds will disappear shortly after the turn of the century if the sand supply is not significantly augmented.

Habitats that are not as unique to the BTES but still support species diversity and abundance are pastures and non-intensively cropped farmlands, old fields, rural roadsides, and forested suburban and urban areas. Here, efforts should be focused on providing for a wide variety of vegetated habitats that include trees, shrubs, flowers, and mowed and unmowed areas. Efforts should also be made to reduce use of fertilizers, pesticides, and herbicides. For aquatic species, it is important to reduce runoff of fertilizers and pesticides into water bodies (nonpoint source pollution).

Finally, habitats that are not currently supportive of wildlife provide opportunities for significant improvement. These are lands currently subject to intensive agricultural practices, sparsely vegetated suburban/urban areas, and industrial sites. Small changes in management practices in these areas can greatly increase their value as habitat. As the human population increases, and the migration from rural to urban areas continues, urban area is expected to increase. New designs to increase the habitat value of urban areas are therefore of utmost importance. There follows a series of more specific recommendations for future management of the BTES's living resources.

Management Recommendations

Overview

- Maintain, enhance, restore the systems integrity of the BTES habitats. The BTES living resources need clean sources of fresh and salt water, natural flows of fresh water through shallow streams and over wetlands, and sediment nourishment. Systems integrity requires a balance of diverse natural and artificial habitats in manners that promote production of aesthetically, recreationally, and commercially important species while achieving maximum biodiversity and natural abundance. To accomplish this it is necessary to preserve, maintain, and enhance a variety of wooded, vegetative habitats with particular emphasis on maturing second-growth forests, swamps, and bottomland hardwoods; coastal marshes and islands, wooded cheniers, and bayou banks; old fields and non-intensive agricultural fields and pastures; and vegetative suburban and urban areas with a mix of trees, understory, and mowed and unmowed lawns.
- Reverse the trend in barrier island retreat and coastal erosion in ways that will restore, maintain, and enhance the natural habitats of the BTES fishes, amphibians, reptiles, birds, and mammals.
- Maintain, enhance, and restore forested wetlands.

- Promote less intense agricultural practices.
- Promote habitat for birds and other wildlife in suburban and urban settings.
- Reduce the introduction of toxins into the air, water, and land.
- Monitor populations of species that are high in the food chain or are susceptible to direct contamination by pesticides, herbicides, and other pollutants.
- Maintain the existing long-term sampling programs and institute system-wide sampling programs for the unmonitored BTES living resources.
- Continue vigilance to prevent overfishing of stocks that are currently monitored and appear stable.
- Begin to monitor, restore, and enhance the stocks and habitats of overfished frogs and turtles.
- Minimize to the maximum extent possible the harassment and destruction of BTES living resources by domesticated animals, with special attention to unconfined dogs and cats.

Commercially Important Invertebrates

- Maintain and enhance where possible shallow-water wetland and estuarine habitats for aquatic species.
- Establish long-term data-collecting sites for aquatic species in shallow-water wetlands and estuarine habitats to coincide with deeper-water estuarine sites.
- Assure that salinity gradients are maintained through the estuaries in order to stimulate and sustain reproduction and survival of larvae, juvenile, and adult shellfish and other aquatic species.
- Reduce pollution that degrades aquatic habitat and threatens the abundance, existence, and harvestability of estuarine species.
- Restore and maintain barrier islands in ways that will preserve, enhance, and restore their habitat value for shellfish.

Freshwater Finfish

- Continue to monitor the stocks of the two catfish species.
- Monitor other freshwater species in the BTES to form a data base.
- Keep saltwater intrusion from penetrating too far into the BTES.
- Provide submerged aquatic vegetation (this may involve planting programs), but prevent it from becoming too dense or overcrowded.

Estuarine Finfish

- Restore, enhance, and preserve coastal marsh environments in ways that will maintain, enhance, and restore their habitat value for fish.
- Maintain and restore barrier island habitat so washovers do not fill island creeks and meanders.

Estuarine/Marine Finfish

- Continue to assess the impacts of fishing mortality on stocks.
- Slow continued coastal erosion to prevent destruction of important nursery habitat.
- Monitor bycatch, particularly young fish that use the BTES as essential nursery, to determine which species could be having high juvenile mortality from non-target fisheries.
- Restore and maintain barrier islands in ways that will maintain, enhance and restore their habitat value for fish.

Amphibians

- Begin a systematic survey of the BTES amphibians.
- Identify, protect, and enhance essential habitats.
- Implement management measures to restore the Bullfrog and Pig Frog stocks and habitats.

Reptiles

Maintenance of careful monitoring programs of the harvest of the American Alligator and its eggs is recommended. Although current populations seem to be below the carrying capacity of the existing marsh (as demonstrated by the increasing population size), habitat loss, especially in the fresh and intermediate marsh, might become a problem in the near future. This species will, therefore, benefit from management practices that maintain healthy fresh and intermediate marshes.

- Identify, protect, and restore important habitat.
- Implement programs to assess the status and trends of the BTES reptile populations.
- Implement management measures to restore, enhance, and maintain the Snapping Turtle and Alligator Snapping Turtle stocks and habitats.
- Enhance, restore, and preserve existing fresh to brackish water habitats.
- Reverse the trend in barrier island loss and retreat.

Birds

Birds are the most diverse, abundant, and visible of the BTES living resources. Management measures that promote the maintenance of a high diversity and abundance of birds will also enhance the other BTES living resources. Because of this, it is recommended that measures be taken to preserve, maintain, and enhance a variety of wooded, vegetative habitats with particular emphasis on maturing second growth forests, swamps, and bottomland hardwoods; coastal marshes and islands, wooded cheniers, and bayou banks; old fields and non-intensive agricultural fields and pastures; and vegetative suburban and urban areas with a mix of trees, understory, and mowed and unmowed lawns. Management within the BTES should concentrate on the protection of existing habitat; reduction of introduced toxins; cleanup of toxic waste sites; greening and flowering of rural, suburban, and urban areas; continued enforcement of conservation measures; and public education.

- Restore, maintain, and enhance barrier islands with special emphasis on their habitat value for nesting seabirds and neotropical migrating songbirds.
- Create new barrier and coastal islands with dredged material to serve as habitat for seabirds and migrating birds.
- Reverse the trend in coastal erosion and barrier island retreat by introducing fresh water and sediments in ways that will create, maintain, and enhance the habitat value of the region for resident and migratory birds.
- Protect nesting sites and colonies from disturbance by humans and domesticated animals.
- Reduce the introduction of toxins into the air, water, and land.
- Continue, initiate, and maintain programs to educate the public about ways in which they can provide habitat for birds and protect nesting sites and colonies.

Seabirds

- Maintain, restore, and create habitats for seabirds.
- Maintain barrier islands, especially those islands containing major colonies of seabirds (i.e., Raccoon Point, Wine Island, and Queen Bess). These projects should be designed so that suitable nesting sites for seabirds are maintained and restored. These nesting sites include unvegetated sand flats or beaches for the Black Skimmer and most tern species, vegetated dunes for the Laughing Gull, and back marshes with mangrove-lined creeks for the Brown Pelican.
- Create new barrier islands with dredged material to enhance their habitat value for seabirds. Maintain and/or nourish the existing sand bar in Little Pass Timbalier to create a more stable nesting island (similar to the Wine Island Project). Plantings of mangrove and/or other shrubs could make such an island available for breeding by the Brown Pelican.

- Protect seabird colonies from disturbance by humans, dogs, and cats.
- Limit vehicle access to Fourchon Beach to protect nesting seabirds.
- Post all active seabird colonies.
- Educate the public.
- In case of an oil spill, special efforts should be made to protect colony sites.

Wading Birds

Management of these species should concentrate on the protection of habitat. In addition, existing colonies should be protected from human disturbance. Most species of wading birds currently have stable populations. However, the population of the Reddish Egret has significantly declined. Since this species feeds in the very shallow tidal pools of barrier islands, it might benefit from barrier island restoration projects. It uses mangrove thickets to breed, so planting mangroves on barrier islands might provide it with additional breeding habitat.

- Maintain, restore, enhance, and create habitat for wading birds.
- Maintain, restore, and enhance barrier islands, especially those islands containing major colonies of wading birds (i.e., Raccoon Point [B-020] and Queen Bess [A-019]). These projects should be designed so that suitable nesting sites for wading birds are maintained and restored. These are the back marshes with mangrove-lined creeks, and the back dunes with shrubs like *Iva frutescens* and *Baccharis halimifolia*.
- Create new barrier islands with dredged material in ways that will create nesting, roosting, and foraging habitats for wading birds. Maintain or nourish the existing sand bar in Little Pass Timbalier to create a more stable nesting island (similar to the Wine Island Project). Planting mangroves could make such an island available for Reddish Egret breeding.
- Protect colonies from human disturbance.
- Post all active colonies.
- Educate the public.

Waterfowl

Management for waterfowl should concentrate on the reduction of habitat loss, especially the freshwater marsh. Impounding traditionally has been used in many areas of the Louisiana coastal zone to manage for waterfowl. However, impoundments are costly to construct and maintain, can restrict access of marine organisms, and reduce sedimentation (Chabreck et al. 1989, Boumans and Day 1994). Freshwater diversion should provide excellent habitat for dabbling ducks and geese as is demonstrated by the large flocks of waterfowl that use the Atchafalaya and Wax Lake deltas (Fuller et al. 1988).

- Begin freshwater diversion projects to create freshwater habitats.

- Reduce saltwater intrusion and turbidity to increase the growth of submerged aquatic vegetation.
- Backfill oil and gas access canals and pipeline canals where possible. This will produce large shallow ponds with submerged aquatics (Abernethy and Gosselink 1988, Rosaz and Reed 1994), providing additional feeding habitat for dabbling ducks, especially in fresh to brackish marshes.

Other Wetland Birds

- Preserve, maintain, and enhance habitats for other wetland birds.
- Monitor populations of wetland birds because they are important indicators of wetland function.

Raptors

- Preserve, restore, enhance, and acquire nesting habitats.
- Reduce the use of pesticides and the release of toxins.
- Continue public education efforts to prevent the take and disturbance of nesting birds.

Shorebirds

- Protect, enhance, restore, and acquire important habitats with special emphasis on barrier islands.
- Prevent harassment of birds by humans, dogs, and cats.
- Restrict introduction of toxins.

Other Resident Birds

- Preserve, maintain, and enhance a variety of wooded, vegetative habitats with a particular emphasis on maturing second growth forests, swamps, and bottomland hardwoods; coastal marshes, wooded cheniers, and bayou banks; nonintensive agricultural fields and pastures; and vegetated suburban and urban areas with a mix of trees, flowers, shrubs, and mowed and unmowed lawns.
- Restrict use of pesticides and herbicides.
- Continue, initiate, and maintain programs to educate the public about ways in which they can provide habitat for birds, with special emphasis on urban, suburban, agricultural, and forested areas.
- Minimize to the maximum extent possible the harassment and destruction of other resident birds by domesticated animals, especially unconfined dogs and cats.

Other Migratory Birds

- Preserve, maintain, and enhance marine forests and forest-like areas on the BTES barrier islands, coast, coastal cheniers, and spoil banks.
- Preserve, maintain, and enhance a variety of wooded, vegetative habitats with particular emphasis on maturing second growth forests, swamps, and bottomland hardwoods; coastal marshes and islands, wooded cheniers, and bayou banks; old fields and non-intensive agricultural fields and pastures; and vegetative suburban and urban areas with a mix of trees, understory, and mowed and unmowed lawns.
- Restrict use of pesticides and herbicides.

Mammals

It is difficult to make group recommendations for the mammals because, apart from fur harvest records, little is known about the status and trends for species in this group. Therefore, population estimates acquired in a more systematic fashion are recommended for all mammals.

Despite this absence of information, it has to be emphasized that populations of Common Muskrat and Nutria are mostly regulated by trapping. Trapping has decreased significantly due to lower fur prices. The potential for significant damage to coastal marshes exists, as highlighted by Linscombe and Kinler (1994). There is a serious need to control populations of these species.

CHAPTER 2
INTRODUCTION

Two hundred and ninety-four years ago the French explorer Pierre Le Moyne, sieur d'Iberville sailed over one of the many shallow sandbars that marked the mouth of the Mississippi River into a teeming wilderness paradise. Landing at what we now call Head of Passes, he went ashore, found a great quantity of game, "duck, geese, snipe, teal, bustards and other birds," and went hunting "a variety of animals such as stags, deer, buffalos (bison)." A short distance upstream Iberville climbed a willow and looked out over what we now call the Barataria-Terrebonne estuarine system (BTES). He saw impenetrable, endless marshes, dense canebrakes, limitless possibilities and resources. As he continued upstream, the river became cloaked in towering cypress swamps filled with thousands of parakeets. He befriended the native Americans and traded with them for their bounty of bear, bison, and corn. He and the later French learned of the opossum and pelican, and feasted on oysters, crawfish, shrimp, redfish, sheepshead, and sandhill cranes.

Iberville's observations mark the first written qualitative assessment of the living resources of the BTES. He was followed by a succession of explorers, priests, and finally scientists who recorded and measured various aspects of the system's animal populations. This work collects the most recent quantitative assessments of abundance, trends, and probable causes of change for a wide variety of the BTES living resources, and then draws ecosystem-level linkages.

In undertaking the current assessment of the living resources of the BTES, we were guided in our approach by the Scientific/Technical Committee of the Barataria-Terrebonne National Estuary Program (BTNEP). The Living Resources Team was specifically asked to investigate what was known about the status, trends, and probable causes of change of 77 specific species and species groupings and then develop ecosystem linkages.

This report is one of four status and trends reports prepared as a part of the BTNEP. The other reports deal with socio-economic and land use issues, water quality, and loss of wetland habitat.

One of the goals of the BTNEP should be, quite simply, an increase in the overall abundance and diversity of aquatic and terrestrial species that reside in or move through the 6,500 square miles of the BTES (Figure 2.1), the estuary between the Mississippi and Atchafalaya rivers. People respond to a complex variety of social and economic factors that can—at least in the short term—override concerns about the quality of the environment. Animals do not have that luxury. Whether or not wild populations flourish depends first on the quality and quantity of habitat, and second, on the degree to which humans affect them by harvesting and introducing toxic chemicals and exotic species. In the long run, degradation of the environment and loss

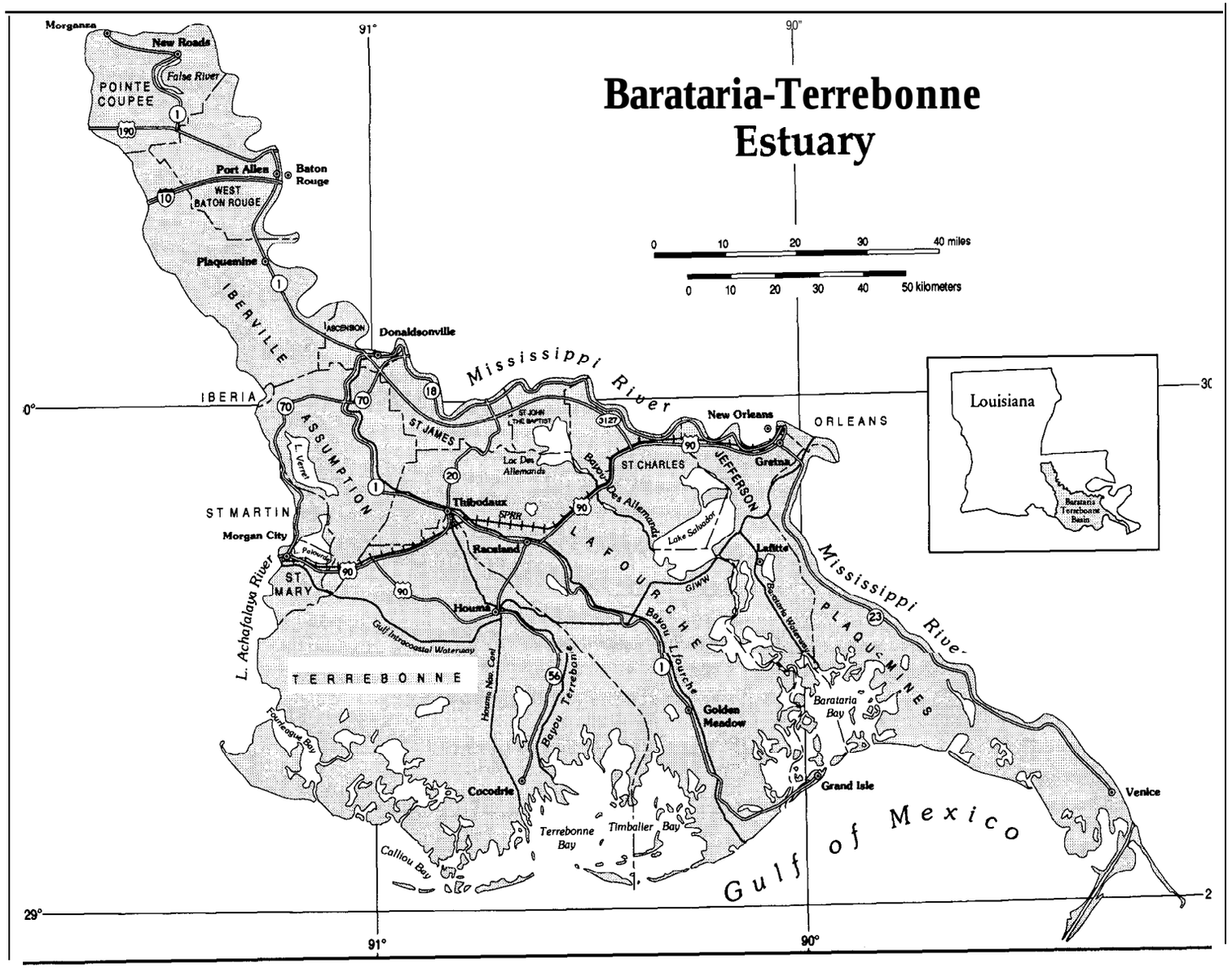

Figure 2.1. Base map delineating the extent of the Barataria-Terrebonne estuarine system (BTES).

of species affects the human economy, quality of life, and health; but the condition of the animals is an early warning system that we would be well advised to heed. The condition of the animals provides an integrated view of environmental health that cannot be obtained simply by looking at habitat or water quality, individually. Gosselink and Lee (1989) use changes in biotic diversity as an indicator of the status and trends of ecosystem or landscape health. In seeking information on biotic diversity, they first asked the following questions. How are the animals currently distributed on the landscape? In what habitats are they common or rare? Has distribution changed? Are populations increasing, decreasing or remaining the same? Is there ecologically meaningful information in the patterns that emerge from the collected species data? Taken together, the answers to these questions provide an indication of general species richness.

In an ecological assessment of the Pearl River basin, Gosselink et al. (1990) assessed changes in biotic diversity based on available measures of general species richness, on the status of "indicator species" identified as particularly sensitive to ecologically important impacts, and finally, on the condition of threatened and endangered species. We have followed much the same approach. The choice of indicator species should vary from system to system, but is limited to species for which a reasonable amount of information is available. Gosselink et al. (1990) chose large, wide-ranging carnivores for the largely wooded Pearl River basin along the Louisiana-Mississippi state line. We have more information in the BTES on a number of ecologically significant groupings of birds, specifically raptors for the uplands and wetlands associated with trees, and the wading, shore, and sea birds for the marsh and barrier island habitats.

In some other aspects, this report differs significantly from Gosselink et al. (1990) and from other system-level assessments that have been prepared for the Barataria system (Day et al. 1973, Bahr et al. 1983) and for the marshes of the deltaic plain (Gosselink 1984). First, it is intended to provide a baseline assessment of the current condition and past history of a limited number of species of particular interest. Certain fish, amphibian, reptile, bird, and mammal species or species groupings were selected by the BTNEP Scientific/Technical Committee for initial detailed consideration (Table 2.1). For fish, only those species that are considered estuarine-resident or estuarine-dependent are included. These constitute only 41% of the fish species that have been reported from the BTES. All animals discussed in this report are vertebrates with the exception of eight aquatic invertebrates (shrimps, crabs, oyster, clams, and crawfish) and a general "benthos" category. The report, of necessity, focuses on these animals without a judgement of their ecological significance or the availability of harvest-independent information.

Readers will find that many species, including common species, were not selected for detailed consideration. More than 700 vertebrate species have been reported from BTES. All are listed phylogenetically in Appendix A, but time, resources, and the availability of information did not permit an encyclopedic approach to the rest of the work. Experience indicates that status and trend data are not available for most species. Apart from some important commercial and game species,

Table 2.1. Species and species groupings selected by the BTNEP Scientific/ Technical Committee for an initial detailed consideration of status, trends, and probable causes of change.

LIVING RESOURCES SPECIES LIST

Fisheries Organisms

Common name	Scientific name
Spotted Sea Trout	*Cynoscion nebulosus*
Sand Sea Trout	*Cynoscion arenarius*
Atlantic Croaker	*Micropogon undulatus*
Bay Anchovy	*Anchoa mitchilli*
Gulf Menhaden	*Brevoortia patronus*
Southern Flounder	*Paralichthys lethostigma*
Red Drum	*Sciaenops ocellata*
Brown Shrimp	*Penaeus aztecus*
White Shrimp	*Penaeus setiferus*
Blue Crab	*Callinectes sapidus*
Striped Mullet	*Mugil cephalus*
American Oyster	*Crassostrea virginica*
Killifish	
Bluegill	*Lepomis macrochirus*
Bass	*Micropterus salmoides*
Channel Catfish	*Ictalurus punctatus*
Blue Catfish	*Ictalurus furcatus*
Crawfish	*Procambarus clarkii*
Crappie	*Pomoxis* spp.
Striped Bass	*Morone saxatilus*
Seabob	*Xiphopeneus kroyeri*

Birds

Swimmers: loons, grebes, cormorants, anhingas, waterfowl, coots, gallinules
Seabirds: pelicans, gulls, terns, skimmers
Long-legged Waders: herons, bitterns, egrets, ibis, storks
Shorebirds: rails, avocets, plovers, sandpipers, snipes
Raptors: kites, hawks, owls
Songbirds: neotropical migrants

Table 2.1 (cont.)

Mammals

Squirrels, deer, swamp rabbit
Furbearers: nutria, muskrat, mink, otter, opossum, bobcat, raccoon, fox, beaver.

Reptiles and Amphibians
Bullfrog
Pig Frog
Diamondback Terrapin
Snapping Turtle

Plankton

Phytoplankton
Zooplankton

Benthic Communities

Estuarine Marsh Benthos
Estuarine Open-Bay Benthos
Marine Benthos

Endangered or Threatened Species

American Alligator (similarity of appearance)
Peregrine Falcon
Piping Plover
Brown Pelican
Sea Turtles (all)
Bald Eagle
Louisiana Black Bear
Eskimo Curlew

a census has been taken only of birds. As time and data allowed, the authors added to the BTNEP list some additional species and species groupings. In the end, trend data from the BTES was assembled for 136 species, of which 76% were birds. Trend data from the BTES was not available for 23 species and/or species groupings of those broadly selected by the Scientific/Technical Committee.

We have adopted the following procedure in ascertaining whether status or trend information exists. First, we looked for published and, in some cases, unpublished evaluations of population condition by respected experts. We cite the most recent summary document rather than the individual primary sources. Where data were available, as for the fishery independent catch/effort statistics, we conducted our own analyses. Where population data from within the BTES was lacking, we include discussions of state and national trends, but do not generally make a finding regarding trends within the BTES.

The authors are ecologists, and so are quite aware that a species-oriented approach, almost by definition, cannot capture biotic diversity. On the other hand, broad landscape-level overviews might not, for example, identify habitat types that may be necessary or important for only a few species or cover small areas. We needed such detailed information to make specific management recommendations within an ecosystem context. The approach taken here is to combine the detail of a species-specific approach with the system-level ecological perspective. The species information was first synthesized at two levels: 1) the individual species accounts, and 2) ecologically significant species groupings like "shore birds," "hawks and owls," or "estuarine/marine finfish." In both cases, ecological conclusions were drawn about the status, trends, and probable causes of change. In Chapter 4, these trends are further synthesized to draw broader conclusions.

When this report was first compiled, the individual species accounts immediately followed the synthesis describing the ecological grouping to which the species belonged. Because of the large number of species treated that structure made it difficult for a reader to follow general trends as they emerged. Therefore we reordered the document. The present Chapter 3 contains only the discussions on the status and trends of ecological groupings. That is followed by a synthesis of findings (Chapter 4), then our conclusions and management recommendations (Chapter 5). All species-specific accounts of status and trends are contained in Chapter 6, which is subdivided like Chapter 3. This regrouping makes the document more readable, while emphasizing that the generalities that emerge are supported by the detailed species-specific information and data that we could obtain.

This report is titled "Living Resources," but it does not contain a compilation of commercial fisheries landings statistics. These are presented in a companion BTNEP report, "Land-use and Socio-economic Status and Trends of the Barataria-Terrebonne Estuarine System" (McKenzie et al. 1995). References may be made here to harvest information, but distribution and abundance data presented for an animal that supports a commercial fishery (like shrimp) are "fishery-independent." The Louisiana Department of Wildlife and Fisheries (LDWF) collects a wealth of this information and uses it to make management decisions that require estimates of the density of animals available to various fishing gear.

Indicator Species

Gosselink and Lee (1989) define indicator species as those with large ranges whose presence or absence is an index of landscape integrity. Others have considered more common and ubiquitous organisms for indicator status, like amphibians for freshwater areas, that have particular sensitivities to air or water quality, for example. From the standpoint of water quality, analysis of the tissue concentrations of sessile filter-feeding organisms like mussels and clams, rather than their presence or absence, can be used to assess sublethal exposure to various pollutants that bioaccumulate. Some of these water quality issues are discussed in a companion BTNEP report (Rabalais et al. 1995). Here, we focus on birds in groupings based upon their requirements for particular nesting and foraging habitats as indicator species.

Endangered Species

Seventeen vertebrate species that were listed as threatened or endangered by the U.S. Fish and Wildlife Service as of August 1995 and are known to occur, to have recently occurred, or are expected to occur in the BTES (Table 2.2). This is slightly more than 60% of the 27 threatened or endangered vertebrate species listed as occurring in the state of Louisiana and includes all but one of the birds and most of the reptiles listed in this grouping for Louisiana.

The Florida Panther has been locally extirpated from BTES and it is considered likely by many that the Red Wolf, Bachman's Warbler, and Ivory-billed Woodpecker are actually extinct. Six of the endangered species listed for Louisiana were certainly never more than very occasional visitors: the five large whales and the Eskimo Curlew. If these 10 species are excluded, the BTES can be described as a home for most of the 13 of the 17 (76%) remaining threatened and endangered vertebrates in Louisiana.

The endangered Bald Eagle, Brown Pelican, Piping Plover, and Least Tern are now sighted frequently in the BTES. Two Least Tern populations occur in Louisiana and only the northern interior population is actually endangered. Virtually all of the Least Terns seen in the BTES belong to the southern, coastal population, which is not listed as endangered, but the northern part of the BTES does extend into the range of the endangered population. The American Alligator is quite common in the BTES and is listed as threatened as a policy matter only to avoid creating a market for illegally obtained hides. For these species at least, the BTES may be considered a possible center for recovery efforts.

Table 2.2. Federally listed threatened and endangered vertebrates in Louisiana. "T" indicates threatened, "E" indicates endangered, and * indicates the species is found, is expected to be found, or has not been determined to be extinct in the Barataria-Terrebonne estuarine system (modified from U.S. Fish and Wildlife Service 1995c, and modified according to Tables A.1, A.3, A.4, and A.5).

Common Name	Scientific Name	State
Mammals		
Louisiana Black Bear	*Ursus americanus luteolus*	T*
Florida Panther	*Felis concolor coryi*	E
Finback Whale	*Balaenoptera physalus*	E
Humpback Whale	*Megaptera novaeangliae*	E
Right Whale	*Eubalaena glacialis*	E
Sei Whale	*Balaenoptera borealis*	E
Sperm Whale	*Physeter catodon*	E
Red Wolf	*Canis rufus*	E*
Birds		
Eskimo Curlew	*Numenius borealis*	E*
Bald Eagle	*Haliaeetus leucocephalus*	T*
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	E*
Brown Pelican	*Pelecanus occidentalis*	E*
Piping Plover	*Charadrius melodus*	E*
Least Tern	*Sterna antillarum*	E*
Bachmans Warbler	*Vermivora bachmanii*	E*
Ivory-billed Woodpecker	*Campephilus principalis*	E*
Red-cockaded Woodpecker	*Picoides (Dendrocopos) borealis*	E
Reptiles		
American Alligator	*Alligator mississippiensis*	T*
Gopher Tortoise	*Gopherus polyphemus*	T
Atlantic Ridley	*Lepidochelys kempii*	E*
Green Turtle	*Chelonia mydas*	T*
Hawksbill	*Eretmochelys imbricata*	E*
Leatherback	*Dermorchelys coriacea*	E*
Loggerhead	*Caretta caretta*	T*
Ringed Sawback Turtle	*Graptemys oculifera*	T
Finfishes		
Gulf Sturgeon	*Acipenser oxyrinchus desotoi*	T*

Pallid Sturgeon	*Scaphirhynchus albus*	E

Historical Perspective

The collection and compilation of quantitative information on the abundance of species did not really begin in the BTES until the mid 1960s. As a result, the trends that we have analyzed are at most 30 years long. While significant changes have occurred in the BTES with respect to habitat, pollution, and human population during this period, many of the human effects that most profoundly affected the ecosystem took place before 1960. It is important to understand the sweeping nature of some of these historical changes in habitat and management so that the current situation can be seen in perspective. In many important ways, the animals of the BTES are now recovering from stresses that were far more severe in the past.

The human relationship to the BTES environment for the great majority of European occupation (roughly from 1699 until the mid 1960s) was spelled out in the three "Es": exploit, exotics, and export. A commitment to leveeing and draining, logging, and agricultural practices of the most destructive kind was mandated by colonial law as a condition for settlers to receive land patents. Most of the river banks were quickly cleared of the "cane brakes" and dense cypress swamps described by early visitors. Drainage was progressively improved to expand cultivation into the bottomland hardwood forests. Levees were constructed along what we now consider the Mississippi River and, perhaps more importantly, Bayou Lafourche was disconnected from the Mississippi entirely in 1904. The estuary was gradually isolated from its most important sources of upland fresh water. Freshwater swamps and marshes underwent a contraction that was not complete until the 1970s.

Particularly valuable or vulnerable species including the Bison, Carolina Parakeet, Passenger Pigeon, and Wild Turkey were hunted to extinction in BTES before the 1900s. Virtually all of the old growth bottomland hardwood and cypress was logged out by the 1930s. Most large mammals like the Black Bear and Florida Panther that were seen as competing with humans or threatening their livestock were also largely gone by that time (Lowery 1974a).

Similar drastic changes were occurring across the nation. The effects of such "progress" within BTES and across the nation did raise some concerns and a number of important conservation efforts began sporadically in the 1890s, largely to rescue populations understood to be in decline.

In 1870 California established the first state refuge. This was followed two years later by the establishment of the first national park, Yellowstone, in 1872 and by the prohibition on taking the park's wildlife in 1894. In 1903 an executive order of President Theodore Roosevelt established the nation's first federal wildlife refuge, and in 1911 Louisiana established its first state refuge.

The Lacey Act of 1909 stopped the traffic in egret and other bird plumes. The Migratory Bird Treaty Act of 1918 gave legal protection to all birds except the introduced House Sparrow and European Starling, and provided specific procedures for setting seasons and regulations on the take of prescribed migratory birds.

While these fledgling conservation measures were gathering momentum, exotics were being imported. The Nutria, House Sparrow, European Starling, and a large number of plants

continued to be introduced. These exotics have flourished to the detriment of the landscape and/or native species. The Nutria spread throughout the southeastern United States, causing huge eat-outs of marshes in and outside of the BTES. The European Starling is well established and is outcompeting the Red-headed Woodpecker for nesting sites.

Within Louisiana the destruction of the wild commercial oyster industry led to an historic and, it turns out, very well-conceived decision to establish a state-managed private leasing system. Out of this legislatively adopted proposal grew the mariculture system that continues to this day and resulted in the introduction of commercial oystering to much of the BTES's brackish bays and bayous.

One factor that early conservationists did not anticipate was the effect of industrial and agricultural toxins on wildlife populations. Widespread use of DDT and other broad-spectrum pesticides in the 1950s and 1960s led to a buildup of these toxins and their metabolites in fish and birds. Some species in the BTES—the Bald Eagle, for example—apparently experienced reproductive failure and were nearly driven to extinction. The Brown Pelican became locally extinct and was later re-introduced. As is shown in a companion BTNEP report, "Status and Historical Trends of Eutrophication, Pathogen Contamination, and Toxic Substances in the Barataria and Terrebonne Estuarine Systems" (Rabalais et al. 1995), DDT and its metabolites continue to be detected in tissue—though in greatly reduced concentrations—from animals of the BTES more than 20 years after the use of this pesticide was banned in the United States. While the threat from DDT may be largely over, several metals and herbicides continue to accumulate in fish, shellfish, and birds from the BTES and are cause for concern.

Passage of the Endangered Species Act in 1973 brought attention to the problem of vanishing species and provided incentives for their protection and penalties for their destruction. The act also provided funding to resource agencies to develop recovery plans, several of which have resulted in turnarounds in the BTES area, particularly for the Brown Pelican and Bald Eagle.

The adoption of a federally approved Coastal Zone Management Program in 1978 began a change in the long-standing tradition that promoted destruction of the BTES's swamps and marshes. It also started the data gathering that again raised the alarm about the rate of conversion of wetlands to open water (Gagliano et al. 1981). Several important pieces of legislation were passed in 1989 and 1990 that provide both state and federal mandates and funding to actually begin the restoration of habitats like marshes and barrier islands. The Wetland Reserve Program included in the 1990 Farm Bill provided the first incentives to return marginal croplands to forest, and the farmers in the BTES have been active in this program.

It is important to understand that the BTES provides habitat for both migratory and resident species and for some animals which cross these category boundaries. Migratory birds that use the BTES fall into four categories. Most of the ducks and shorebirds and several hawks and songbirds breed to the north and migrate south to winter along the Gulf Coast (winter migrants). A second group includes those that breed in the BTES during the spring and summer, but migrate to the tropics during the winter (summer residents). These BTES breeders are neotropical migrants and include several species of wading, shore, and marsh birds as well as

the conspicuous Mississippi Kite, Prothonotary Warbler, and Painted Bunting. About 40 species of neotropical migrants regularly breed in the BTES. The Bald Eagle appears to reverse this process, breeding in the BTES primarily during the winter and dispersing to the north during the summer (winter resident). Finally, more than 50 species of neotropical migrants do not regularly breed in the BTES but are common visitors as they head south to the tropics in the fall and return to their spring breeding sites outside of the BTES. These fall and spring visitors flock to the barrier islands, marshes, and swamps of the BTES to build up fat reserves before and after transoceanic flight.

Today, we are just beginning to look at the abundance and diversity of a few of the animals as indicative of our success or failure as stewards. Second- and third-growth bottomland hardwood and cypress-tupelo forests are maturing in the BTES. Pastures are replacing some croplands in low-lying cleared areas, while residential and urban development is occurring in old sugarcane fields on the ridges. It is now possible for the first time to actually do something about the marsh and barrier island loss that most broadly affects the overall abundance and diversity of aquatic and terrestrial species that reside in or move through the BTES. This report is designed to be a guide to the species-specific information necessary for a comprehensive restoration initiative. That information is summarized in Chapter 4. Broad management recommendations follow in Chapter 5.

CHAPTER 3
SUMMARY OF FINDINGS BY SPECIES GROUP

Introduction

We have placed the BTES living resources into 15 ecological groups: aquatic invertebrates, freshwater finfish, estuarine finfish, estuarine/marine finfish, amphibians, reptiles, seabirds, wading birds, waterfowl, other wetland birds, raptors, shorebirds, other resident birds, other migrating birds, and mammals.

In this chapter we discuss our summary findings on the status, trends, and probable causes of change of these 15 groups. These summary findings are reported in similar formats for each ecological group. Generally that format contains a short introduction; materials and methods, where original data analyses were conducted during this study; historical trends and causes of change; habitat requirements; major factors threatening the population; and group recommendations.

Before each introduction to an ecological grouping, we list the species within that group contained in Chapter 6. These species are those for which we could find information on status, trends, and/or probable causes of change and which the BTES Scientific/Technical Committee thought were sufficiently common in the BTES to include in this report.

We have placed the three finfish groupings under a finfish section with its own brief introduction. In a similar fashion we have placed the eight bird groupings under a bird section. In the bird section we have tried to further draw summary findings by using a format similar to that of our ecological groupings.

AQUATIC INVERTEBRATES

Brown Shrimp, White Shrimp, Pink Shrimp, Seabob Shrimp, Blue Crab, Eastern Oyster, Macroinfauna

Introduction

The penaeid Shrimp fisheries, especially for the White, *Penaeus setiferus*, and for the Brown, *P. aztecus*, are commercial mainstays of the Louisiana seafood industry. The fishery's historical roots in Louisiana and the nation are rich and diverse (Condrey and Fuller 1992). In addition to White and Brown Shrimp, fishermen harvest smaller amounts of the Pink Shrimp, *P. duorarum*, and the Seabob, *Xiphopenaeus kroyeri*. Besides its commercial importance, the species group is of significant trophic importance as a food source for many estuarine finfish.

The Blue Crab, *Callinectes sapidus*, is a eurhyaline species that is found from the offshore waters in the Gulf of Mexico to the most inland freshwater marshes of Louisiana. Of all the species listed in this report, the Blue Crab perhaps most exemplifies the coupling of the marine and freshwater ecosystems that sustains Louisiana's aquatic productivity.

The Eastern Oyster, *Crassostrea virginica*, is a euryhaline species that completes its entire life within an estuary. Water currents, bottom substrate, tidal flushing, and an array of other chemical and physical parameters interact to produce an estuarine area capable of sustaining a natural oyster population (Galtsoff 1964)

Macroinfaunal species are important sources of food for a variety of estuarine and marine animals and are also used as an index for assessing the health of an estuary (Gaston et al. 1994). Benthic macroinvertebrates are those which live within soft bottoms and are retained by a 0.5mm mesh screen. The principal species are polychaetes, nemerteans, crustaceans, and mollusks. Fish species have been shown to feed on macroinfauna (Darnell 1958, Sikora et al. 1972). Penaeid Shrimp species also apparently feed on polychaetes with the derived fatty acids and lipids possibly aiding in ovarian development (Middleditch et al. 1979). Researchers use a number of macroinfaunal population and community indices to characterize the environment (Pielou 1977) and to investigate the presence and concentration of chemical contaminants (Rabalais et al. 1991).

The Red Swamp Crawfish, *Procambarus clarkii*, is ubiquitous in the freshwater swamps and wetlands of Louisiana. It is a species of significant commercial and ecological value within the Barataria and Terrebonne basins (Perret and Melancon 1991). As much as 60% of the state's annual production is harvested from aquaculture ponds within the state (De La Bretonne et al. 1989). Its ecological role within the basins is also significant (Huner and Barr 1980). Crawfish play an important seasonal role as food for many animals including fish, amphibians, reptiles, and birds (Avault 1972). The Crawfish is interwoven with the natural history and culture of Louisiana. Ironically, there are no fishery-independent long-term data available on the species within the basins.

The Stone Crab, *Menippe adina*, is found in the more coastal bays and near-shore waters of the estuaries. Perry et al. (1983) describes the seasonal distribution and abundance of the species with information on the reproduction, morphometrics, size distribution, and fishery potential. Horst and Bankston (1986) studied the potential of a small Stone Crab fishery in the Barataria system, but determined that a commercial fishery was marginal. Baltz and Horst (1986), in a catch-per-unit-effort (CPUE) study within the Barataria estuary, found that peak catches occurred in deep bay waters over shell substrate. The Stone Crab is not a target species of any state or federal agency for long-term study. Consequently, the only available long-term data on the species for the Barataria and Terrebonne estuaries are incidental catch during other studies. Stone Crab fishery-independent CPUE data can be found in the Louisiana Department of Wildlife and Fisheries (LDWF) trawl data, but the incidence of catch are small and sporadic and do not provide enough information for analysis. Therefore, the species is not profiled in this report.

The Clam, *Rangia cuneata*, is another species ubiquitous in brackish waters usually less than 15–19 ppt (Hopkins et al. 1973). Most know the species as the foundation for road beds in Louisiana, thus the animal has come to be called the Road Clam. This species is not only of commercial value but also of ecological importance. It is an important link between primary producers and secondary consumers in estuarine waters (LaSalle and de la Cruz 1985). The Clam has been studied extensively in Lake Pontchartrain and Lake Maurepas east of the Mississippi River (Darnell 1958, Tarver and Dugas 1973), but has not received the same scientific interest in the Barataria and Terrebonne estuaries. Because there are no long-term data sets on the Road Clam, it is not profiled in this report.

Materials and Methods

All long-term data sets were obtained from the LDWF. Data for Shrimp and Crab were obtained as compressed SAS® data files. Oyster data were obtained from records and reports at the LDWF's Bourg and Grand Terre field offices. Macroinfauna data were obtained from the Louisiana Offshore Oil Port (LOOP) annual reports prepared by the Coastal Ecology section of the LDWF. The gear types used in the collection of data for Shrimp and Crab were 16-ft trawl, 6-ft trawl, and seine (Table 3.1). Methodology and objectives of sampling protocols for the data can be obtained from the LDWF's *Marine Fisheries Division Field Procedures Manual Version No. 92-2* and from the LOOP annual reports.

Shrimp and Crab data were analyzed and graphed using PC SAS® and Quatro Pro® 5.0. Statistical analyses consisted of converting CPUE data to log-10 and then performing a simple linear regression. Predicted log-10 CPUEs were calculated from the linear regression equation. The antilog of the predicted CPUEs was calculated, thereby transforming the values to geometric mean CPUEs. The geometric mean CPUEs were plotted on the graphs. Wherever the regression was not significant at the .05 and .01 levels, the regression line is referred to as a reference line and does not imply a significant linear trend. The graphed reference line is intended to aid the reader in observing the variability in the data.

Wherever the term "*all stations*" is reported as the data set used for analysis, the data include all locations sampled for that year for that specific gear type. Wherever the term, "*regular stations*" is reported as the data set used for analysis, the data include only the permanent stations that are regularly sampled with that specific gear type. The locations of regular stations are listed in Table 3.2. The sampling effort for Shrimp by area, gear, station, and year is given in Table 3.3.

Habitat Requirements

The life cycles of the estuarine-dependent White, Brown and Pink Shrimp are similar in that each spawn in Gulf waters, with the resulting post larvae migrating to the estuaries where they grow to subadults and adults before moving back to the Gulf. In comparison to the above species, little is known about the life cycle of the Seabob

Table 3.1. Louisiana Department of Wildlife and Fisheries harvest gear used in analysis for each species.

	All Sample Sites		Regular (Permanent) Sample Sites				
SPECIES	16SW	16EW	16B	16T	6EW	SEINE	M^2
Brown Shrimp	X	X	X	X	X	X	
White Shrimp	X	X	X	X		X	
Pink Shrimp	X	X	X	X			
Seabob Shrimp	X	X	X	X			
Blue crab	X	X	X	X		X	
Oyster							X
Red Swamp Crawfish*							
Rangia Clam*							
Stone Crab*							

*No fishery-independent long-term data available from LDWF or elsewhere for the BTES estuaries. No analyses.

16 = 16-ft trawl; 6 = 6-ft trawl; SW = statewide; EW = Barrataria and Terrebonne estuaries combined; B = Barataria estuary; T = Terrebonne estuary; M^2 = square meter density data from the state's oyster seed reservations

Table 3.2. Location of Louisiana Department of Wildlife and Fisheries's regular (permanent) sample stations by gear for Coastal Study Area 3 (Barataria estuary) and Coastal Study Areas 4 and 5 (Terrebonne estuaries).

	CSA - III	Site Number	Latitude	Longitude
16-ft Trawl (Offshore)	Grand Terre Beach	047	29E16'18"	89E55'58"
	3-Mile Grand Terre	045	29E15'03"	89E54'12"
	3-Mile Grand Isle	044	29E11'45"	89E57'06"
	Beach-G.I. Water Tower	048	29E15'00"	89E58'00"
16-ft Trawl (Inshore)	St. Mary's Point	005	29E25'30"	89E56'00"
	Independence Island	008	29E18'30"	89E56'00"
	Caminada Bay	015	29E15'18"	90E01'36"
	Bay Ronquille	042	29E20'18"	89E52'12"
6-ft Trawl (Regular)	Porpoise Bay	022	29E13'06"	90E04'54"
	Airplane Lake	020	29E13'18"	90E06'42"
	Bay Jaque	023	29E17'06"	90E07'42"
	Bay L'Ours	031	29E20'36"	90E05'06"
	Mud Lake	028	29E27'30"	90E00'36"
	Wilkinson Bay	040	29E27'48"	89E54'36"
	Bay Batiste	006	29E26'36"	89E50'30"
	Lake Grand Ecaille	009	29E23'00"	89E50'00"
	Bay Long	037	29E20'48"	89E49'24"
	Grand Bank Bayou	033	29E19'12"	89E53'48"
6-ft Trawl (Crash)	Creole Bay	003	29E21'42"	90E02'00"
	Bayou Garci	030	29E15'06"	90E07'24"
	Bay Rambo	024	29E20'06"	90E07'18"
	Snail Bay	025	29E26'12"	90E03'48"
	Little Lake	029	29E27'42"	90E06'30"
	Lake Five	027	29E31'30"	89E57'15"
	Round Lake	026	29E33'42"	89E57'06"
	Bay Dispute	032	29E18'48"	89E52'18"
	Billet Bay	052	29E21'48"	89E45'24"
Square Meter	Lower Hackberry	001	29E23'30"	90E03'00"
	Middle Hackberry	002	29E24'06"	90E01'48"
	Upper Hackberry	003	29E25'24"	90E01'36"

Table 3.2. (cont.)

	CSA - IV	Site Number	Latitude	Longitude
Seine	Grand Terre Pond	340	29E17'50"	89E55'25"
	Grand Terre Beach	341	29E15'00"	89E57'50"
	Bassa Bassa Bay	342	29E21'25"	89E59'30"
	Manilla Village	343	29E25'50"	89E58'25"
	Turtle Bay	344	29E31'10"	90E04'60"
	Coffee Bay	345	29E27'10"	90E07'00"
16-ft Trawl (Offshore)	Whiskey Pass Beach	012	29E01'24"	90E46'10"
	Whiskey Pass Offshore	020	29E00'00"	90E50'00"
	Wine Island Beach	024	29E03'42"	90E38'42"
	Wine Island Offshore	025	29E00'42"	90E38'42"
16-ft Trawl (Inshore)	Moss Bay	001	29E12'42"	90E40'52"
	Lake Barre	206	29E15'52"	90E33'15"
	Lake Pelto	209	29E05'00"	90E42'24"
	Terrebonne Bay	210	29E10'00"	90E33'54"
6-ft Trawl (Regular)	Bay Henry	013	29E15'36"	90E40'37"
	Moss Bay	015	29E13'03"	90E42'02"
	Oak Bayou	019	29E09'00"	90E43'00"
	Bay Bourbeux	311	29E16'45"	90E34'00"
	Bayou Charles Theriot	312	29E17'20"	90E33'15"
6-ft Trawl (Crash)	Bay Cocodrie	313	29E15'00"	90E39'00"
	Bay LeFleur	314	29E17'15"	90E36'40"
	Old Lady Lake	315	29E15'30"	90E24'10"
	Bay Jean La Croix	316	29E20'22"	90E25'00"
	Bay Rosa	317	29E18'00"	90E19'00"
	Little Lake	318	29E13'30"	90E15'25"
	L-1	319	29E11'30"	90E16'00"
	Devil's Bay	320	29E09'00"	90E15'30"
Seine	Trinity Bayou	440	29E05'00"	90E44'23"
	Bay Coon Road	441	29E08'53"	90E40'50"
	Bay Henry	442	29E15'25"	90E40'45"
	Cross Roads	443	29E18'08"	90E39'42"
	Lake Quitman	444	29E20'47"	90E40'20"
	Lake Boudreaux	445	29E27'10"	90E37'30"

16-ft Trawl (Offshore)	4 mi. Off Bayou De West	014	29E07'24"	91E06'54"

Table 3.2. (cont.)

	CSA - IV	Site Number	Latitude	Longitude
16-ft Trawl (Inshore)	Lake Mechant	005	29E19'50"	90E57'20"
	Caillou (Sister) Lake	008	29E15'40"	90E55'00"
	Bay Moncleuse	019	29E14'42"	90E51'42"
	Hackberry	020	29E12'30"	91E52'18"
6-ft Trawl (Regular)	New Route Bay	051	29E17'21"	91E00'42"
	Mud Hole Bay	052	29E14'56"	91E00'36"
	American Bay	053	29E11'50"	90E56'36"
	Sanders Bay	054	29E15'06"	90E56'35"
	Mud Lake	056	29E16'48"	90E55'00"
	Sister Lake	057	29E15'36"	90E54'55"
6-ft Trawl (Crash)	Bayou Severin	055	29E15'42"	90E51'45"
	King Lake	058	29E15'48"	90E59'00"
	Lost Lake	059	29E19'36"	91E04'00"
	Violin Lake	060	29E16'42"	91E03'42"
	Bay Del'Quest	061	29E14'48"	90E50'36"
	Redfish Bayou	062	29E12'00"	90E53'42"
	Hackberry Lake	063	29E12'30"	90E52'12"
	Dog Lake	064	29E10'00"	90E50'42"
	Bay Charlie	065	29E10'24"	90E48"12"
	Pelican Lake	066	29E06'36"	90E48'24"
Square Meter	Grand Pass	000	----------	----------
	Walker's Point	002	----------	----------
	Old Camp	003	----------	----------
	Mid Sister Lake	007	----------	----------
	1989 Shell Plant	012	----------	----------
	North Bay Junop	001	----------	----------
	S Bay Junop @ Rat Bayou	002	----------	----------
	Mid Bay Junop	003	----------	----------
	Mid Bay Junop @ Hellhole Bayou	004	----------	----------
	S Bay Junop @ Bayou deWest	005	----------	----------

Table 3.2. (cont.)

	CSA - IV	Site Number	Latitude	Longitude
Seine	Last Island	540	29E03'18"	90E56'29"
	Bayou Grand Caillou	541	29E10'14"	90E56'00"
	Sister Lake	542	29E12'57"	90E55'40"
	Sander's Bay	543	29E15'22"	90E56'33"
	Mud Lake	544	29E17'28"	90E54'54"
	Bayou Chevreau	545	29E19'31"	90E54'10"
	Low Deuce	546	29E21'36"	90E55'09"

Table 3.3. Sampling efforts by area, gear, station, and year for Shrimp species.

	Area	State	B&T	B&T	T	B	B&T	B&T
	Gear Station	16ft All*	16ft All	16ft Reg.*	16ft Reg.	16ft Reg.	6ft Reg.*	Seine* Reg.
Year								
67		654	206	159	12	147		
68		985	333	185	14	171		
69		644	397	220	45	175	152	
70		802	595	328	97	231	291	
71		961	759	386	101	285	364	
72		996	552	277	13	264	390	
73		1459	612	270	36	234	460	
74		1365	943	275	44	231	480	
75		987	415	247	42	205	410	
76		792	227	179	8	171	162	
77		556	166	160	--	160	370	
78		439	162	162	--	162	475	
79		675	178	157	27	130	392	
80		1005	354	248	41	207	661	
81		1036	339	280	151	129	436	
82		1375	605	453	170	283	573	
83		1329	619	469	156	313	590	
84		1208	591	441	153	288	617	
85		1387	751	588	215	373	580	
86		1134	681	586	183	403	636	287
87		1296	736	582	209	373	735	276

88		1308	721	592	220	372	712	212

Table 3.3. (cont.)

	Area	State	B&T	B&T	T	B	B&T	B&T
	Gear Station	16ft All*	16ft All	16ft Reg.*	16ft Reg.	16ft Reg.	6ft Reg.*	Seine* Reg.
89		1171	577	497	205	292	603	215
90		1332	618	520	176	344	527	213
91		1373	712	590	198	392	638	217
92		1361	660	544	190	354	477	263
93		1366	614	492	188	304	422	280
94		1421	615	495	213	282	387	280

* "All stations" refers to every sample taken within a year, which includes special project sample sites. "Regular stations" refers to permanent stations that LDWF has established within the estuaries. Seine sampling program was initiated in 1986.

Shrimp (Condrey et al. 1992). It lives and spawns in the Gulf and migrates towards the coast. The Seabob is not considered to be estuarine-dependent, although utilization of lower estuarine waters by juveniles and gravid females is common (Juneau 1977).

Migration through the estuaries is an annual event for all four penaeid species. Brown Shrimp postlarvae recruitment from the Gulf of Mexico to the estuaries usually peaks in February and March with mass migration to the Gulf occurring by early to mid summer as water temperatures increase. White Shrimp post larvae recruit to the estuaries from June through August with mass migration to deeper estuarine waters and near-shore Gulf waters with the passage of cold fronts in late fall and early winter (Gaidry and White 1973). Overwintered Gulf White Shrimp may return to the deeper estuarine waters in the early spring for a short period. Pink Shrimp post larvae appear primarily from May to December. Seabob gravid females appear in the lower estuaries from July to August and nongravid from December to March (Juneau 1977).

The Blue Crab, *Callinectes sapidus*, is a euryhaline species that may inhabit fresh to oceanic waters during its life. Spawning females and early larval stages inhabit the lower estuaries because of a physiological need for salinities exceeding 20 ppt (Guillory et al. 1995). Juveniles and adults can be found in all salinities, including fresh water. The Blue Crab juveniles are often found in shallow marsh areas and grass beds, possibly to avoid predators or to obtain cover during ecdysis (Jawarski 1972). Habitat preferences appear to be correlated with developmental stage and water temperature (Steel and Perry 1990).

When all other environmental conditions are met, salinity appears to be the overriding parameter that determines oyster distributions through an estuary (Melancon et al. 1995). Sustained salinities greater than 15 ppt, especially when coinciding with warm waters, increase predation rates on the immobile oyster. The 15 ppt ceiling is due to the fact that the Oyster's two major predators, the protozoan parasite *Perkinsus marinus*, and the conch *Stramonita haemostoma*, require high salinities. In contrast, sustained salinities below 7–8 ppt may reduce survival and suppress gonadal development (Loosanoff 1952). Spat (recently set oyster larvae) generally require salinities near 10–12 ppt for good survival (Cake 1983). Large subtidal oyster populations are therefore usually found in narrow estuarine zones where salinities are conducive to the physiological needs of the species and where some major predators are excluded.

Major Factors Affecting the Species

Mobile estuarine species utilize inundated wetlands and marsh-water edge as habitat (Rozas and Reed 1993). Turner (1977) demonstrated a positive correlation between Shrimp fishery production and corresponding marsh acreage. White and Boudreaux (1977) emphasized the importance of the marsh and its adjacent shallow-water areas as critical nursery areas for Shrimp.

Deteriorating wetlands temporarily increase marsh-water edge habitat, thereby potentially increasing access for Shrimp and other aquatic species. This paradox— deteriorating wetlands potentially stimulating secondary production—has led to the hypothesis that wetland habitat is

essential for sustained populations and that continued loss of marsh may have imminent consequences on fishery production, especially Shrimp (Browder et al. 1989, Zimmerman et al. 1991). Chambers (1991) has shown evidence that fishery declines in the United States have already begun due to habitat degradation through wetland loss, toxic chemical releases, alteration of freshwater flows, and nutrient over-enrichment. Minello and Zimmerman (1992) demonstrated the importance of marsh habitat as refuge from predators and that an increase in estuarine finfish populations may diminish Shrimp and Crab numbers.

Eutrophication of our estuaries and near-shore Gulf waters may result in hypoxic and anoxic conditions (Rabalais et al. 1985, Rabalais 1992) as well as shifts in species of primary producers, which may be utilized as food sources for secondary consumers (Turner and Rabalais 1991). Water quality, in terms of public health concerns for shellfish-growing waters, continues to be a threat to the survival of one of the oldest, best-established fisheries in coastal Louisiana, the oyster industry (Kilgen et al. 1985).

Reduced salinities may impact the survival and abundance of some estuarine species. Marsh management and restoration projects in place and proposed have the potential of modifying the hydrology, salinity, and accessibility of estuarine habitats. The paradox to this situation is that much aquatic productivity within the Barataria and Terrebonne estuaries is intricately interwoven with the wetlands. Without the preservation, and enhancement where possible, of wetland habitats, the aquatic productivity of many species may decline significantly.

Group Recommendations

- Maintain and enhance where possible shallow-water wetland and estuarine habitats for aquatic species.

- Establish long-term data collection sites for aquatic species in shallow-water wetlands and estuarine habitats to coincide with deeper-water estuarine sites.

- Assure that salinity gradients are maintained through the estuaries in order to stimulate and sustain reproduction and survival of larvae, juveniles, and adults of shellfish and other aquatic species.

- Reduce pollution that degrades aquatic habitat and threatens the abundance, existence, and harvestability of estuarine species.

FINFISH

The fish community in the Barataria basin is the most diverse of any estuary in Louisiana, with 191 species from 68 families. The adjacent Terrebonne-Timbalier basin is only slightly less diverse with 153 species in 59 families. Table A.1 (see Appendix A) presents a summary species list from these two basins, documenting 208 species in 70 families from the BTES.

Methods and Materials

Fish species were arranged by life history patterns as presented in Thompson and Deegan (1983), Deegan and Thompson (1985), and Thompson and Forman (1987), placing each species into one of four categories: 1) freshwater, 2) estuarine, 3) estuarine-marine, or 4) marine.

Fish data from fishery-independent sampling programs were obtained from LDWF for selected sampling stations in the BTES area. The Office of Fisheries, Marine Fisheries Division, provided catch and effort data for the target fish species similar to that presented on a statewide basis in Perret et al. (1993) . In addition, the Office of Fisheries provided catch and effort data from three trawl stations in the environmental monitoring of the LOOP from Barataria Bay (LOOP 1994).

Data on the target species were available from 16-ft trawls, 50-ft seines, 750-ft experimental gill nets, and 750-ft trammel nets. Catch from the gill nets was summed over all five panels of different mesh size (LDWF 1992b).

It is important to note that the data used for the status and trend estimations presented here were not originally obtained for this purpose, so conclusions drawn from this analysis should be used with caution.

Catch and effort data were summed for each year using SAS® 6.10. This was transferred to Harvard Graphics for Windows® 3.0 and plotted over time for each target species. Regressions were performed by the Harvard Graphics® package ($\log_{10}$ CPUE). None of the trends was significantly different from a no-change status. A trend line, defined by the Harvard Graphics® package as a "straight line, determined by best fit that passes through the defined data points" was plotted for each species/CPUE data combination. Effort was plotted whether the target species was captured or not.

FRESHWATER FISHES

Blue Catfish, Channel Catfish, Largemouth Bass, Bluegill, and Black or White Crappie

Introduction

At this time the BTES has no direct riverine freshwater inflow so freshwater fishes make up a relatively minor portion of the overall system although they can play important community roles in the upper basin. This is particularly true in Lake Salvador, Lake Cataouatche, Lac des Allemands, Lake Boeuf, Lake de Cade, Lake Penchant, and Lake Theriot. Locally they can play a major role in both recreational and commercial fisheries.

Historical Trends and Causes of Change

There is virtually no long-term data on freshwater fishes in the BTES region and certainly insufficient data to identify any potential causes of change. Data presented are from a marine species monitoring program and are limited. There is a popular perception that certain freshwater fishes are declining in abundance due to saltwater intrusion, but direct evidence is lacking. Lantz (1970) reported on fish production in Lac des Allemands showing Channel Catfish most abundant in both numbers and weight. Blue Catfish were found to be relatively rare. Bluegill and both White and Black Crappie were reported in consistently low numbers during the three-year study. Allen et al. (1985) reviewed the fish community of Lake Penchant and found no evidence that salinity changes were influencing species composition or abundance. Chambers (1980) studied the fish fauna of the upper Barataria system and found a diverse assemblage of freshwater fishes. Thompson and Forman (1987) reported that Channel Catfish ranked first (by weight) and second (by number) in the upper Barataria Bay. Blue Catfish ranked fourth (by weight) and fifth (by number) in this same region. There is no long-term information on the Centrarchid species for this same area. Allen et al. (1985) studied Lake Penchant, examining impacts for the suggested decline of Largemouth Bass in the lake. They reported on the presence of Bluegill, Black and White Crappie, and Largemouth Bass in the lake. Meador and Kelso (1989) studied Largemouth Bass in relation to salinity in Little Lake. Figures 3.1–3.8 provide some status and trend information for Blue and Channel Catfish. Figures 3.9 and 3.10 present trammel net catches of Largemouth Bass showing low, but consistent, catches in 1987–1994.

Habitat Requirements

These species need fresh water to low-salinity environments. Blue Catfish and Largemouth Bass are tolerant to about 10–12 ppt in the BTES, but the other species prefer waters below 5 ppt. Bass and Sunfish such as Bluegill and Crappie prefer areas with cover or concealment, such as submerged aquatic vegetation or marsh grasses (Durocher et al. 1984, Wiley et al. 1984), but too-dense areas of plant congestion have been shown to be detrimental to their populations, interfering with both feeding and reproduction (Maceina and Shireman 1982).

Both Blue and Channel Catfish are open water, benthic species although they spawn along protected shorelines with irregular undercut banks, often associated with submerged stumps and logs.

Major Factors Affecting the Populations

No data are available documenting threats to freshwater fishes in the BTES. To the extent that saltwater intrusion penetrates the BTES, freshwater fish species could be pushed farther inland, although Blue Catfish, Largemouth Bass, and to a lesser extent, Channel Catfish, can tolerate or even thrive in low salinity (less than 10 ppt) waters.

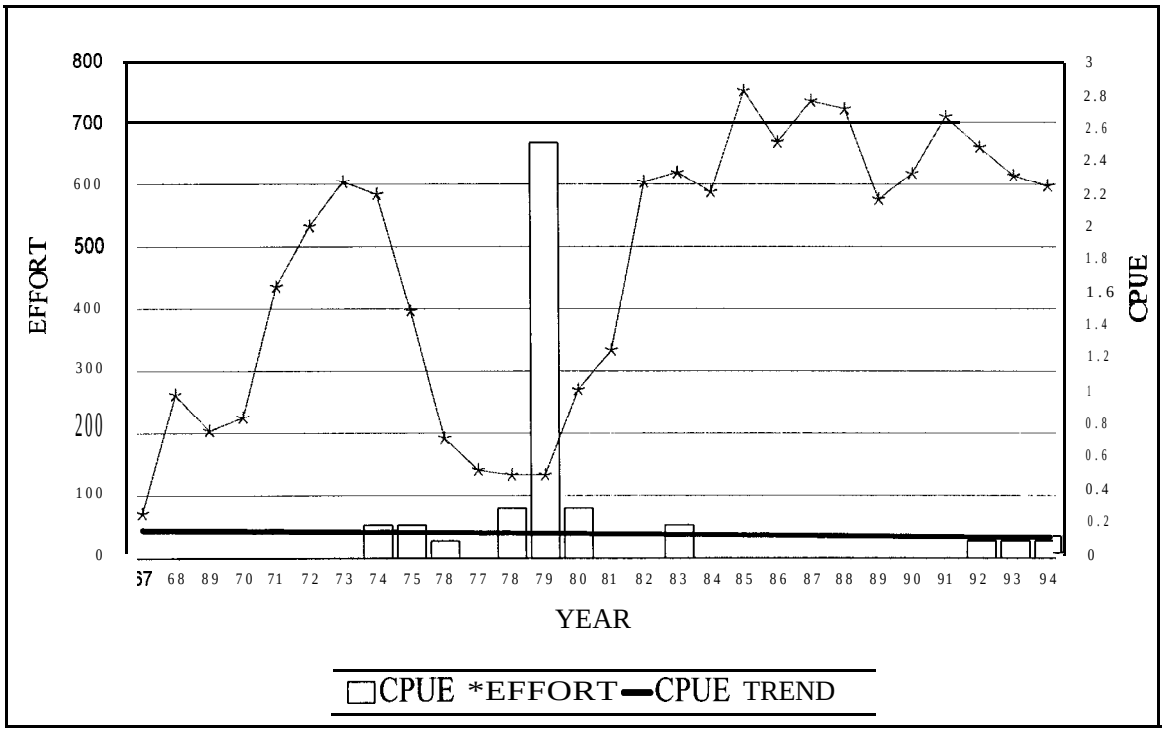

Figure 3.1. Catch/effort for Blue Catfish, 1967- 1994, 16-ft trawl, for BTES.

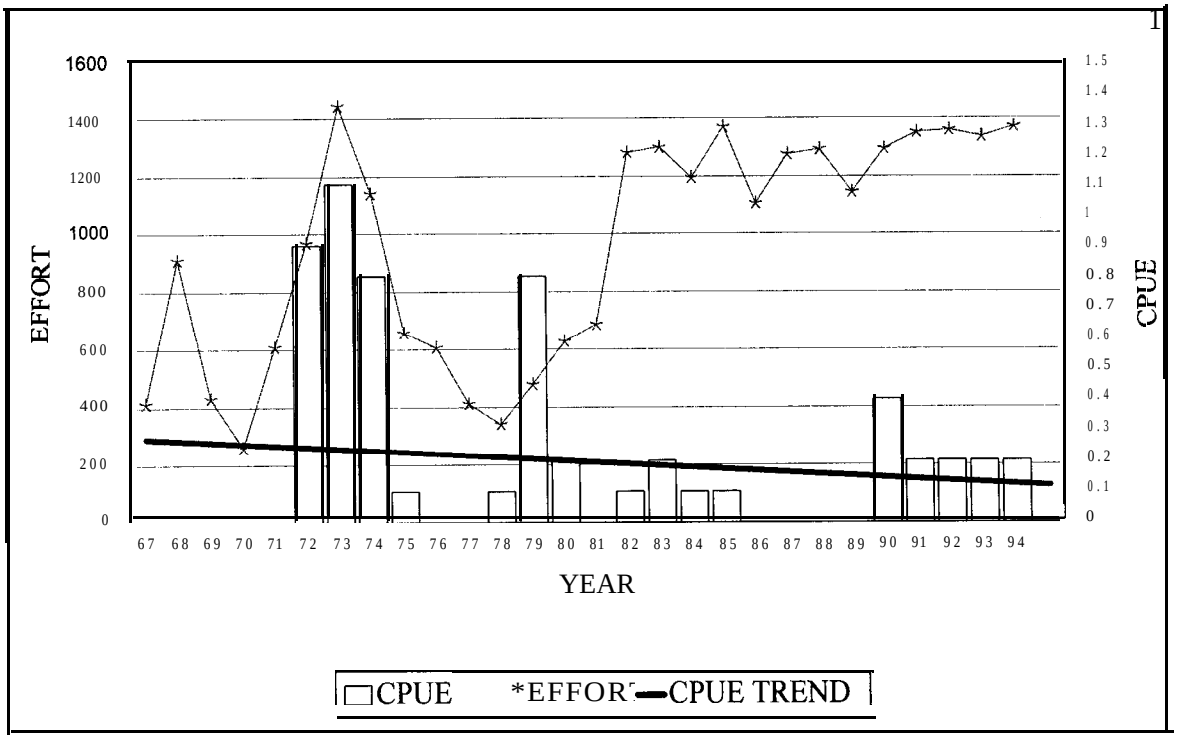

Figure 3.2. Catch/effort for Blue Catfish, 1967-1994, 16-ft trawl, statewide.

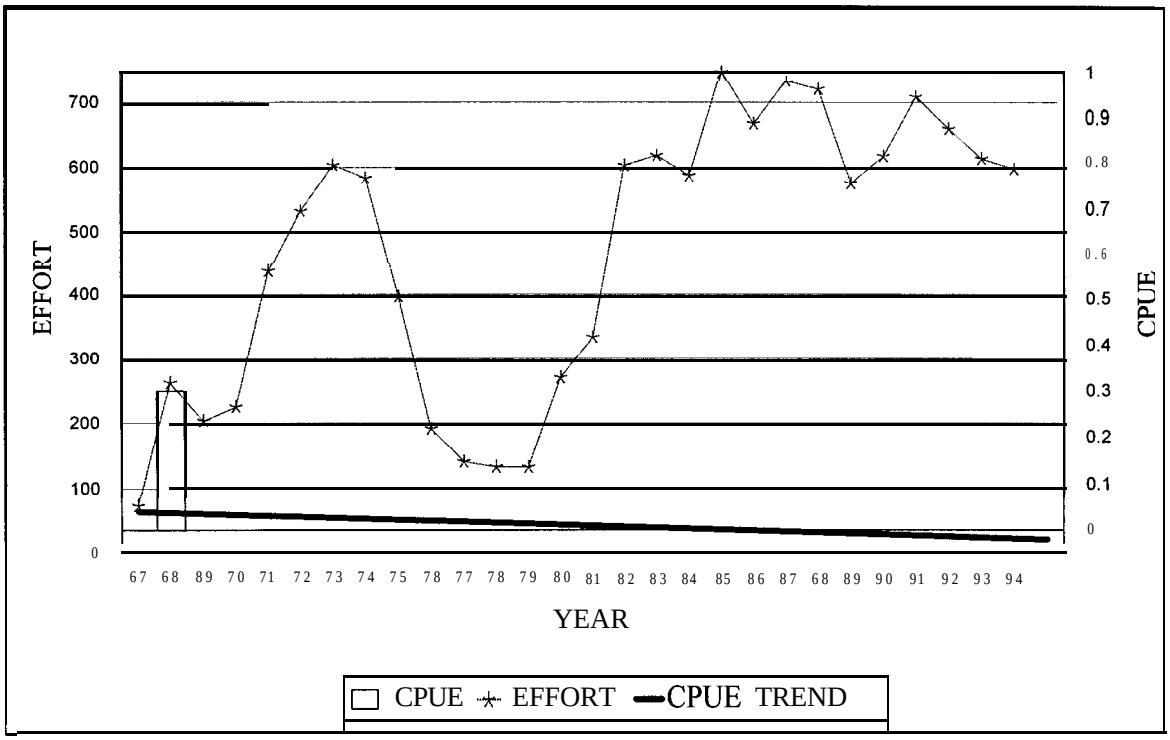

Figure 3.3. Catch/effort for Channel Catfish, 1967-1994, 16-ft trawl, for BTES.

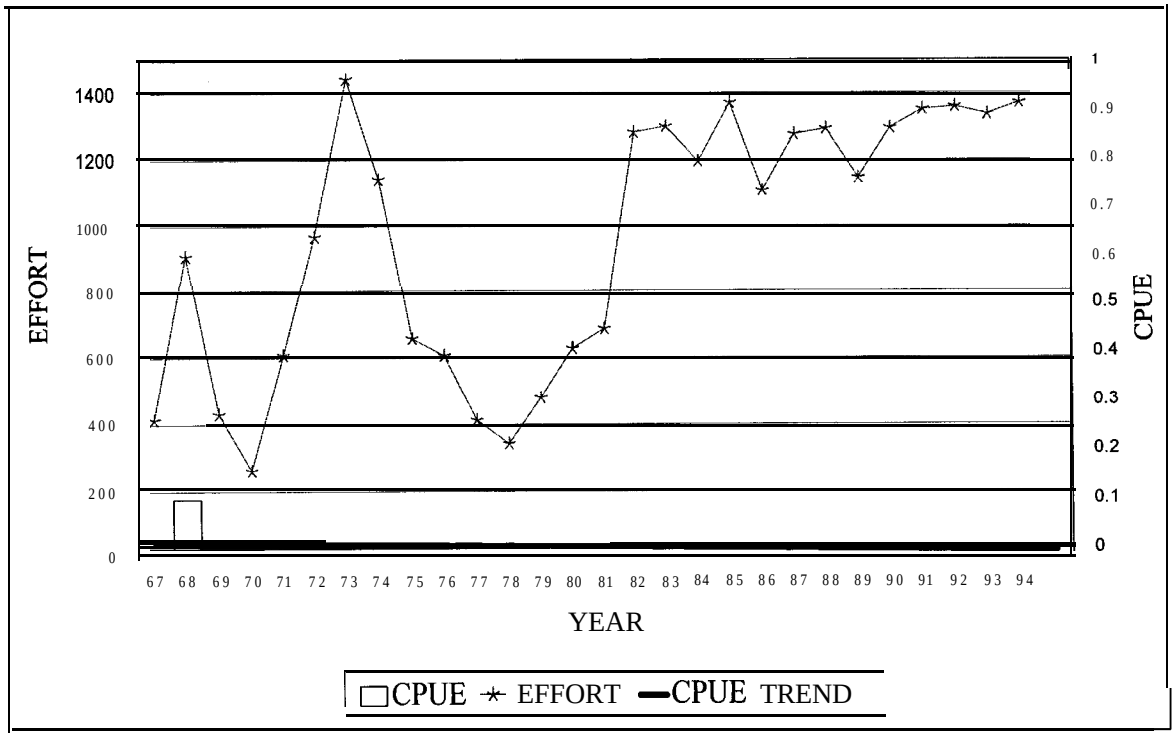

Figure 3.4 Catch/effort for Channel Catfish, 1967-1994, 16-ft trawl, statewide.

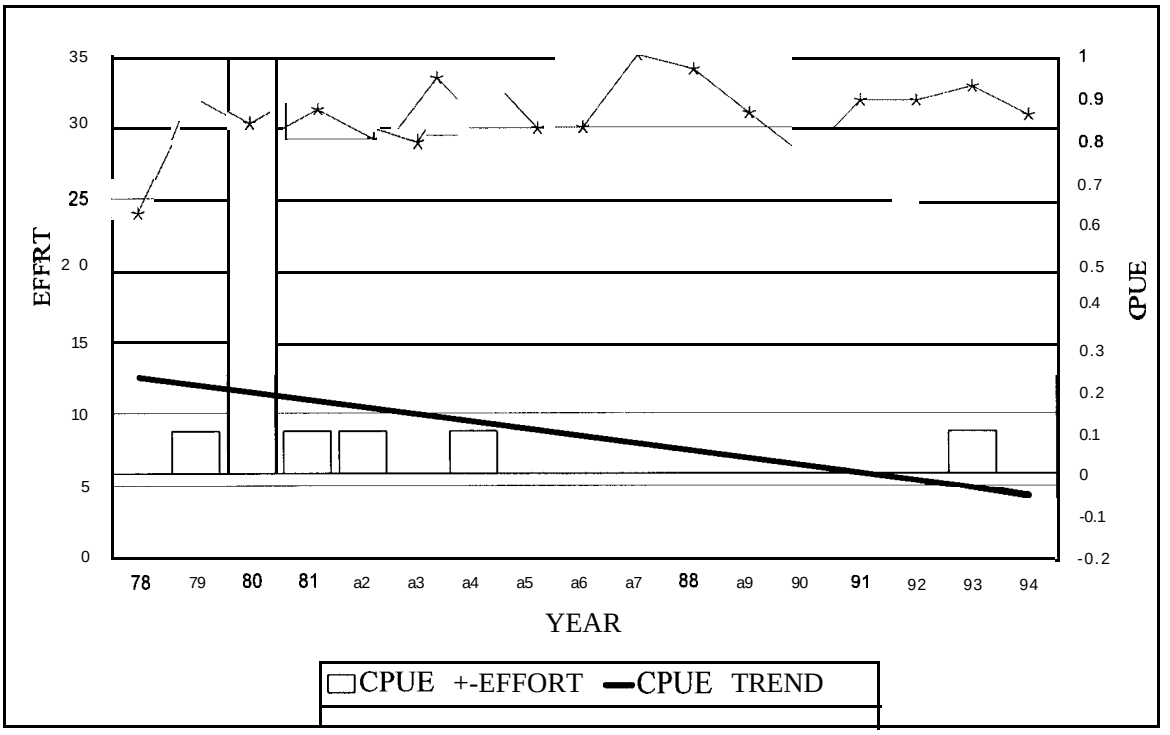

Figure 3.5. Catch/effort for Blue Catfish, 1978-1994, 16-ft trawl from LOOP stations, for BTES.

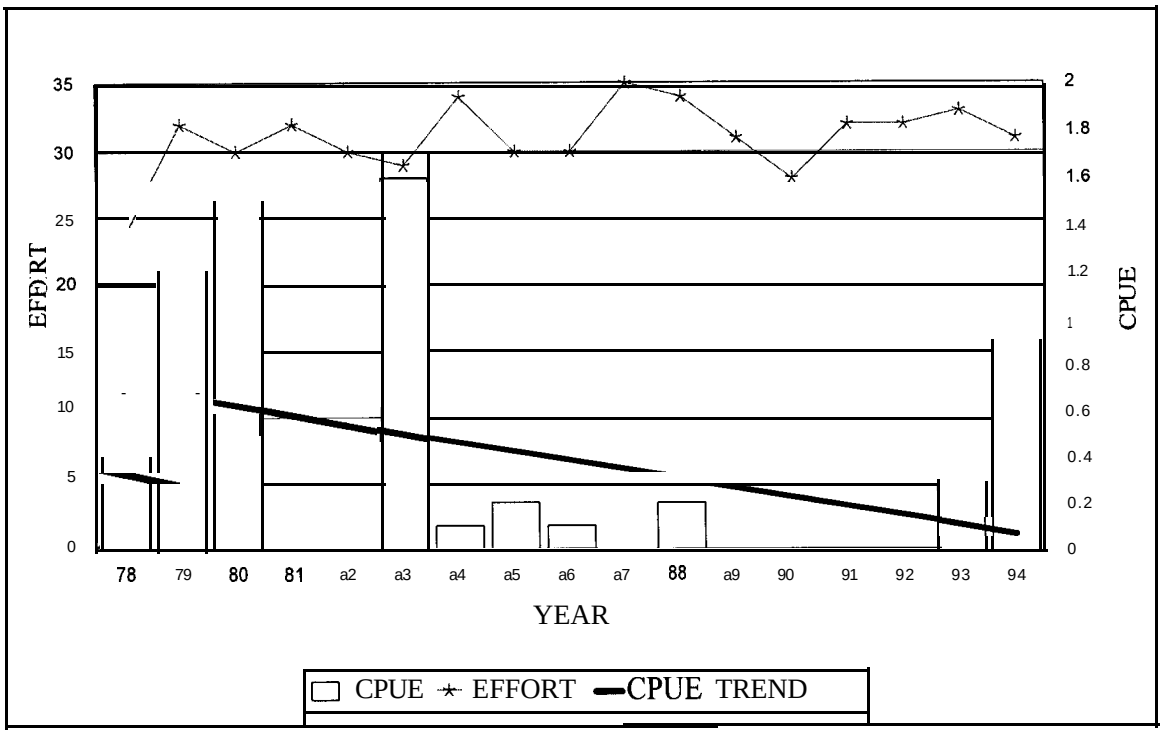

Figure 3.6. Catch/effort for Channel Catfish, 1978-1994, 16-ft trawl from LOOP stations, for BTES.

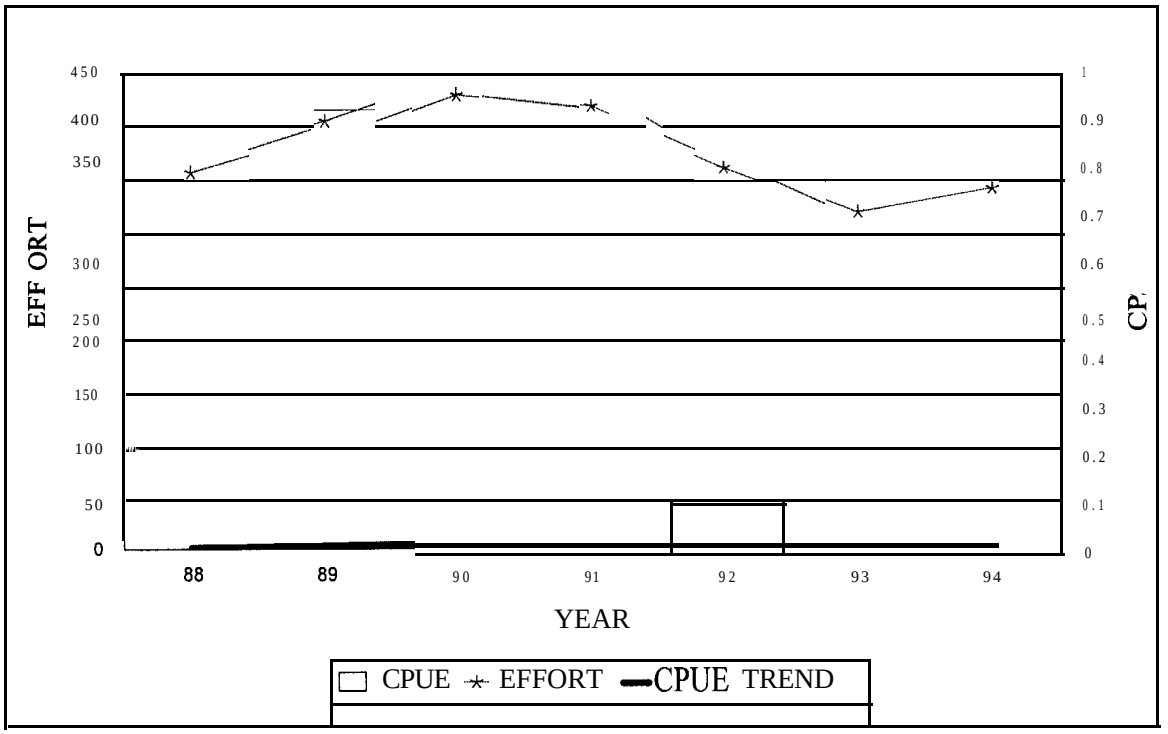

Figure 3.7. Catch/effort for Blue Catfish, 1988-1994, gill net (all meshes combined), for BTES.

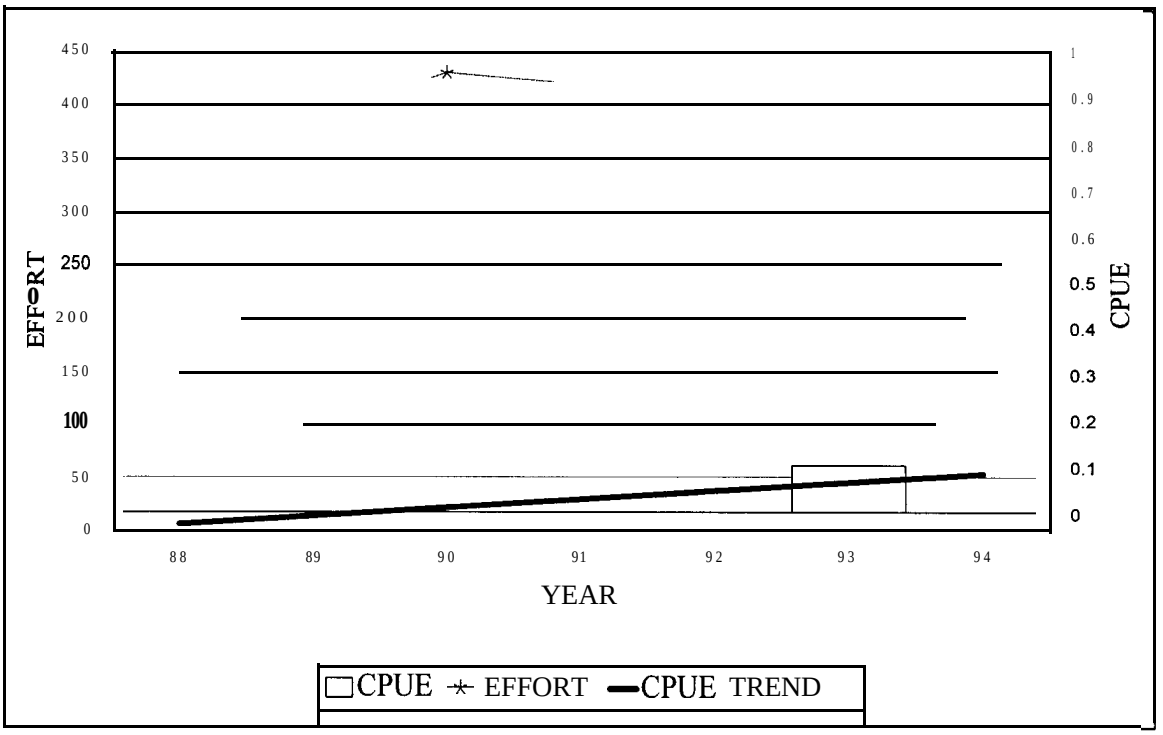

Figure 3.8. Catch /effort for Channel Catfish, 1988-1994, gill net (all meshes combined), for BTES.

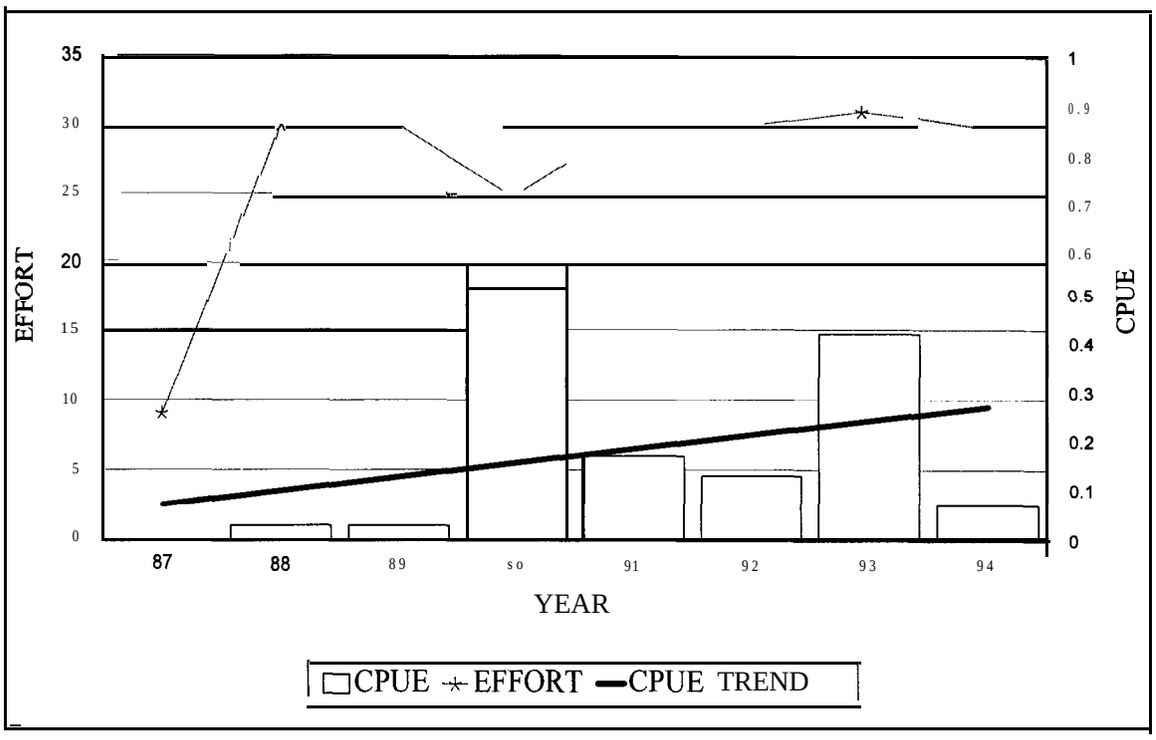

Figure 3.9. Catch/effort for Largemouth Bass, 1987-1994, trammel net, for BTES.

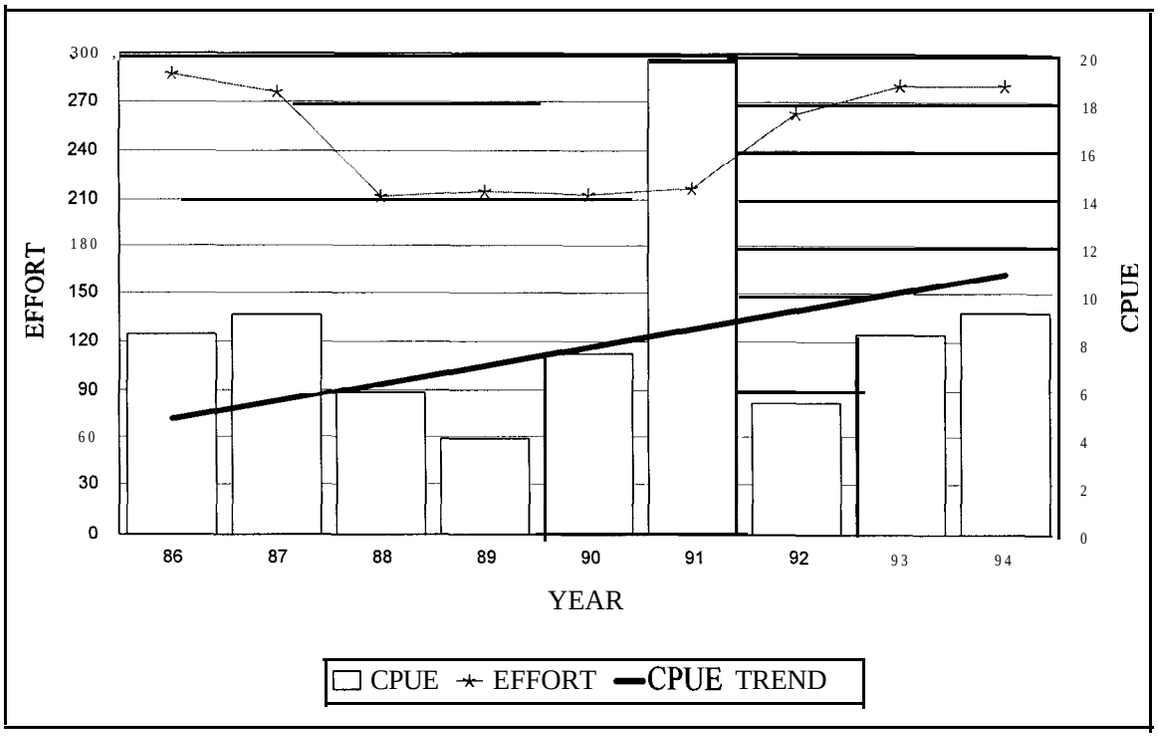

Figure 3.10. Catch/effort for Gulf Killifish, 1986-1994, 50-ft seine, for BTES.

There is a popular perception that the current fishery for the two Catfish is impacting their populations, but long-term data are scarce. They can thrive in open waters, so coastal erosion may have minimal impact on them, but the Bass and Sunfish species prefer edge habitats, so coastal erosion could have a major detrimental effect on their habitat and particularly on the shorelines where they breed.

Group Recommendations

- Continue to monitor the stock of the two catfish species.
- Monitor other freshwater species in the BTES region to form a data base.
- Keep saltwater intrusion from penetrating too far into the BTES basins.
- Provide submerged aquatic vegetation (this may involve planting programs), but prevent it from becoming too dense or overcrowded.

ESTUARINE FISHES

Killifishes
(Gulf, Longnose, Bayou, and Saltmarsh)

Introduction

These fishes are permanent members of the estuarine community, completing their entire life cycle within the BTES. As a group they span a wide range of ecological conditions, ranging from fresh water to full Gulf of Mexico salinity including marsh edge, creeks, and meanders. Forman (1968) reviewed the biology of several Killifishes from Grand Isle.

Historical Trends and Causes of Change

Figure 3.10 shows status and trends for Gulf Killifish collected by seine in the BTES area, 1986–1994. Population levels appear stable with only 1991 having a noticeably higher CPUE. This agrees with Perret et al. (1971) and Thompson (1988) who reported abundance data on both Gulf Killifish and Longnose Killifish between 1968 and 1987 and found both species to be among the most abundant fishes collected by seine in the BTES. Thompson (1988) found a third species, the Bayou Killifish, to be much less common. Very little information is available on this species or the fourth Killifish in the BTES, the Saltmarsh Killifish.

Habitat Requirements

Killifishes are confined to shallow shoreline habitats. Both Gulf and Longnose Killifishes frequent both marsh edge and open beaches. The Bayou and Saltmarsh Killifish (Thompson 1980) are found almost exclusively in shallow marsh coves, creeks, and bayous.

Major Factors Affecting the Population

No data are available documenting threats to Killifishes, but logically coastal erosion would effect their preferred habitat of shallow, edge environments.

Group Recommendations

- Restore, enhance, and preserve coastal marsh environments in ways that maintain, enhance, and restore their habitat value for fish.

- Maintain and restore barrier island habitat so washovers do not fill island creeks and meanders.

ESTUARINE/MARINE FISHES

Atlantic Croaker, Bay Anchovy, Black Drum, Gulf Menhaden, Red Drum, Sand Seatrout, Spotted Seatrout, Southern Flounder, Spot, Striped Mullet

Introduction

These species are among the most abundant in the BTES, but vary greatly from season to season due to their migratory life cycle. These fishes spawn offshore in the open Gulf of Mexico or lower bays, where they enter the BTES as larvae and young juveniles that use the estuary as a nursery. Subadults and adults migrate out of the estuary to the open Gulf of Mexico and several species make little further use of the BTES, with adults being uncommon to rare. Several of the species, however, return to the estuaries as adults, being common both by numbers and weight. Several species make large contributions to the secondary production of the BTES.

Historical Trends and Causes of Change

These species are the best-studied fishes in the BTES due to their recreational, commercial, and ecological importance. They have been reviewed by Perret et al. (1971), Adkins and Bowman (1976), Barret et al. (1978), Adkins et al. (1979), and Perret et al. (1993) for the

BTES. Perret et al. (1993) examined long-term state trends of trawl-caught Bay Anchovy, Spotted Seatrout, Gulf Menhaden, Striped Mullet, Atlantic Croaker, Spot, and Sand Seatrout reporting high interannual variation in CPUE with level or slightly increasing trends over time (1967–1991). No trend appeared to be significantly different from a no-change status.

There are no data at present that show change in any target species from the BTES. Part of this is due to the high interannual variation in CPUE, which as Perret et al. (1993) noted, probably should be expected from fish species with short life cycles. These short-lived fishes will be strongly influenced by local environmental conditions and the production of many generations over the period examined. Black and Red Drum are exceptions, being remarkably long-lived species.

Attention has recently been given to the question of fishing pressure causing decline in the stock of Spotted Seatrout, Red Drum, Black Drum, and Striped Mullet. This subject has been addressed in a series of draft documents formulating management plans (LDWF 1990, LDWF 1991a, LDWF 1991b and c, and 1992a). No evidence of overfishing was found.

Habitat Requirements

This group of estuarine/marine fish species has a wide range of preferred habitats although most of the target species are most common in open water, either as benthic or pelagic species. Several of the species, such as Southern Flounder, Red Drum, or Spotted Seatrout can also be found along shore or in bayous, meanders, and canals. Except for some lower bay spawning by Spotted Seatrout, none of these habitats in the BTES are used for spawning by these species.

Major Factors Affecting the Population

Many of the BTES estuarine/marine fish species are affected by coastal erosion through loss of habitat. For some of the more heavily targeted species in recreational and commercial fisheries, the potential for human-induced mortality should be continuously monitored.

Group Recommendations

It is difficult to formulate management suggestions for the estuarine/marine fishes because of the wide range of species requirements, but on a broad scale, recommendations are:

- Continue to assess impacts of fishing mortality on stocks.
- Slow continued coastal erosion to prevent destruction of important nursery habitat.
- Monitor for by-catch, particularly of the young fish that use the BTES as essential nursery, to determine which species could be having high juvenile mortality from non-target fisheries.

AMPHIBIANS

Bullfrog

Introduction

There are seven species of salamanders and newts and 15 species of frogs and toads recorded for the BTES (see Table A.2).

Historical Trends and Causes of Change

Little is recorded about the relative abundance of BTES amphibians. Other than Bullfrogs, nothing appears to have been published on their status and trends or probable causes of change. The wild harvest of Bullfrogs peaked in the 1930s and then declined due to a combination of overcollecting, pollution, and destruction of breeding sites. The current population is considered to be severely diminished.

The lack of abundance and trend data on amphibians is common worldwide and is of concern for three reasons.

First, amphibians are considered to be an indicator species. They are extremely sensitive to environmental changes in temperature and moisture. Their permeable skin makes them susceptible to the uptake of toxins in the air and water. Their abundance is often diminished by pollution. Most recently, it appears that some populations may be sensitive to increases in ultraviolet rays associated with the thinning of the ozone layer (Blaustein et al. 1994).

Second, in many regions of the world, populations of amphibians have recently experienced apparent dramatic declines in abundance (Bradford et al. 1994). Probable reasons for these apparent declines include overharvest, habitat loss and degradation, pollution, introduced species, and increases in ultraviolet radiation. Quantification of these apparent changes is often precluded because of a lack of historic data.

Third, the consequences of loss of amphibian abundance can be detrimental to human ecology. For example, with the demise of the U.S. and French Bullfrog populations, Bangladesh began an export-oriented fishery on its native wild Bullfrog. The government recently ended the export trade when it learned of the environmental consequences. In their natural state, the Bullfrog population kept insect populations under biological control, thus limiting crop damage and illnesses such as malaria. With reduced frog populations, the native farmers were forced to import pesticides. The Bangladesh government concluded that the export value of the Bullfrog fishery was not sufficient to offset the environmental and societal costs associated with diminished populations of Bullfrogs.

Habitat Requirements

As a group the amphibians exhibit a wide variety of habitats from lakes and ponds, streams and marshes, to treetops. They ingest mollusks; arthropods; finfish; amphibians; and small reptiles, birds, and mammals.

Major Factors Affecting the Population

The BTES amphibians are directly or potentially threatened by wetland habitat loss and degradation, pollution, and increases in ultraviolet radiation. In addition, the Bullfrog and probably the Pig Frog continue to be overharvested.

Group Recommendations

- Begin a systematic survey of the BTES amphibians.
- Identify, protect, and enhance essential habitats.
- Implement management measures to restore the Bullfrog and Pig Frog stocks.

REPTILES

Loggerheads, Snapping Turtle, Green Turtle, Alligator Snapping Turtle, Hawksbill, Leatherback, Kemp's Ridley, Diamond-backed Terrapin, American Alligator

Introduction

Twenty-one species of turtles; six species of lizards, anoles, and skinks; 23 species of snakes; and one species of crocodilians have been identified in the BTES (see Table A.3).

American Alligators are the largest reptilians within the BTES. They feed on virtually any animal they can capture and hold in their powerful jaws. Alligators can be found from the swamps in the upper basin to the brackish marshes, but nesting is generally restricted to marsh habitats with salinities less than 10 ppt (Joanen and McNease 1987a). Occasionally wanderers are observed in the salt marsh. Alligators construct underground dens that serve primarily as a retreat for the winter. These dens can be located in the marsh connected to holes dug by the alligator, or in the muddy banks of streams and lakes (Dundee and Rossman 1989).

Currently the American Alligator is federally listed as "threatened due to similarity of appearance" to the American Crocodile.

Materials and Methods

Status and trend data for the southeastern Louisiana breeding population of American Alligator are taken from McNease et al. (1994). These data are augmented by unpublished data from Visser (LOOP environmental monitoring surveys) on the populations of American Alligator at Lake Boeuf, around Clovelly, and along Bayou Chevreuil in Barataria basin. These data include aerial surveys of alligator nests in July[1] and population estimates in the early summer. For a detailed description of the methods and areas of the surveys see Visser et al. (1994). Linear regressions were fitted to untransformed data to determine trends. Trends are reported as significant when the slope of the regression was significantly ("=0.05) different from zero.

Historical Trends and Causes of Change

Direct harvest and (in the case of sea turtles) loss and degradation of nesting habitat historically has resulted in depletion of all of the basin's commercially important reptiles. Conservation measures intended to restrict or eliminate some of these directed takes have had mixed results. Of these cases the American Alligator represents a true success story in that management measures implemented by the state are restoring the stock. On the other hand, sea turtle populations continued to decline despite prohibitions on directed U.S. take and import. To offset these declines, mandatory use of turtle excluder devices (TEDs) were and still are required to reduce incidental mortality in shrimp trawls.

Habitat Requirements

Alligators occur in many bodies of still or slow-moving water. Alligator nests are found in greatest density in the intermediate (0.027 nests/ha) and fresh (0.022 nests/ha) marshes and less frequently in the brackish (0.012 nests/ha) marshes (McNease et al. 1994; data reported here are average densities for 1984–1993 in southeast Louisiana).

Small alligators (less than 1 m total length) feed on insects, small fish, crayfish, crabs, small amphibians, and reptiles. Large alligators have a varied diet consisting of crustaceans (crayfish, crabs, and shrimp), amphibians (mostly frogs), reptiles (snakes, turtles, and small alligators), fish, birds (especially ducks, coots and herons), and mammals (especially Muskrat and Nutria and sometimes dogs and hogs) (Dundee and Rossman 1989). Nutria and Muskrat make up a significant proportion of the diet when available (Joanen and McNease 1987a). When farmed alligators are fed Nutria the hatching rate of their eggs is significantly higher than that of alligators raised on a fish diet (Joanen and McNease 1987b).

The five sea turtles that visit the BTES coastline all require nesting beaches which are, at least currently, outside of BTES. Most of the sea turtles frequent shallow coastal waters, often in association with coral reefs, grassbeds, rock outcroppings, and human-made hard structures. One of the sea turtles is more oceanic. As a group they feed on sponges, jellyfish, mollusks, crustaceans, sea urchins, fishes, seaweeds, and grass.

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[1] The peak of the alligator breeding season (McNease et al. 1994).

The other reptiles in the BTES utilize a wide variety of habitats from brackish marsh to freshwater swamps, lakes, and rivers, to backyard trees, gardens, and ponds, to the sides of buildings. As a group they ingest grasses and other vegetation, insects and spiders, crustaceans, mollusks, finfish, amphibians, reptiles, birds, and mammals.

As with amphibians, there is a lack of data on the status and trends of most of the BTES reptiles (the alligator being an important exception). This is true even of the endangered and threatened sea turtles and the commercially important Snapping Turtle and Alligator Snapping Turtle.

Major Factors Affecting the Populations

Due to the value of alligator skin in the leather trade, alligators were killed in such great numbers that biologists feared the species might become extinct (Dundee and Rossman 1989). In 1963, the state closed the alligator harvest in Louisiana. At this point the remaining population was conservatively estimated at 40,000 individuals (Chabreck 1980). With this protection the alligator population recovered so quickly that in 1972 a limited trapping season was opened in the southern parishes. The enactment of the federal Endangered Species Act closed the season in 1974. However, since 1975 alligators have been harvested based on a complex system of applications, licenses, tags, and report forms administered by the LDWF. Initially harvesting was limited to the western coastal zone, but since 1981 alligators have been harvested statewide (Joanen and McNease 1987a).

Since the alligator harvest is strictly regulated, the threat of overharvesting seems small. In addition, the demand for alligator skins is increasingly met by the production of farm-raised alligators. However, most alligator farms are supplied with eggs retrieved from the wild (nest raiding) and in turn a percentage of the hatched alligators are returned to the wild (5% at 1 m length; Joanen and McNease 1987b). Although the population appears to be increasing in conjunction with this aggressive egg harvesting program, it is not known what the long term effects could be on the population. Potential concerns are the following:

- Sex ratio of released individuals. The sex of the hatchlings is determined by the temperature of the incubator (Joanen and McNease 1987b).

- Alteration of the gene pool, because natural selection on the hatchlings does not occur.

- Introduction of disease into the wild population.

- Females raised in captivity exhibit strikingly different breeding behavior (Joanen and McNease 1987b).

The five sea turtles that visit and/or forage along the BTES coast continue to be threatened with directed and undirected take outside the United States and with continued alteration and

loss of nesting habitat outside of the BTES. The two freshwater turtles of commercial value are considered to be overharvested. Coastal erosion and barrier island retreat within the BTES directly threaten the Diamond-backed Terrapin. Continued loss of freshwater habitats threatens the American Alligator and Snapping Turtles, as well as most of the other BTES reptiles.

Group Recommendations

- Identify, protect, and restore important habitat.
- Assess the status and trends of the BTES reptile populations.
- Restore the Snapping Turtle and Alligator Snapping Turtle stocks.
- Enhance, restore, and preserve existing fresh to brackish water habitats.
- Reverse the trend in barrier island loss and retreat.
- Require monitoring of alligator egg harvest.

BIRDS

Introduction

Three hundred and fifty-three species of birds representing 17 orders and 46 families have been recorded in the BTES (Table A.4). Of this number, 185 are reported to be currently common to abundant at least periodically. Sixty-four of the 353 species are residents. While a diverse group, the birds dramatically reflect habitat change associated with varying human uses of the landscape. For the residents these changes are limited to the BTES, while for the migrants these changes include areas outside of BTES.

The BTES is an important component of the migratory route for a number of birds. The barrier islands and outer coast are especially critical to migrating birds who have encountered storms over the Gulf of Mexico. If exhausted, these birds can land, recover, and refuel before continuing on their migratory route.

Historical Trends and Causes of Change

Populations of birds that benefit from human activity have expanded worldwide and within the nation and the BTES. Likewise, populations of birds that do not benefit from human activity have contracted. The expansions and contractions have involved both range and abundance. Human-induced habitat changes, egg collection, hunting and shooting, domesticated animals (especially cats and dogs), introduced species (especially rats), human disturbance of nesting birds and sites, eutrophication, pesticides and other toxins, removal of predators or prey or competitors, provision of artificial nesting sites, and feeding stations have all played a role in changing abundances.

Within the BTES the Brown Pelican was formerly extinct, but has been reintroduced. The Passenger Pigeon and the Carolina Parakeet were formerly abundant but are now extinct. The Passenger Pigeon was driven to extinction by hunting and the removal of the vast virgin forest of eastern North America. The Carolina Parakeet was driven to extinction through hunting for food and feathers and because of the damage the bird did to crops.

The American Robin is an example of a forest species that has adapted to non-intensive urban areas created by humans and is now common in the BTES in winter.

Birds like the Mourning Dove and the Mockingbird have increased. Their increase is associated with the removal of the dense virgin forests and its replacement with agricultural and vegetated urban and suburban areas.

Birds like the Black Skimmer are in a decline partly because valuable nesting sites are lost through shoreline erosion and barrier island retreat and partly because their nesting sites are not protected from human intervention.

Birds like the Starling have been introduced into North America and are outcompeting native species for habitat and food.

Birds like the Herons and Egrets were nearly driven to extinction by eggers and hunters in the 19th and early 20th centuries. Populations were restored by the enactment of conservation efforts, only to be threatened by pesticides like DDT. Restrictions on DDT-like pesticides allowed these populations to recover.

Birds like ducks and geese declined in the earlier part of this century with the continued loss of wetland habitat for agriculture and various building practices and water control practices. They have more recently benefited from wetland protection/ enhancement/creation practices, controlled hunting, and the elimination of lead shot.

Birds like the Black-throated Green Warbler, which is currently a common migrant in the BTES and one of the most common breeders in northeast coniferous forests, are experiencing local declines across the continent. The decline is expected to continue because of the deforestation of Mexican habitat.

Some birds, like the Indigo Bunting, which is a common to abundant BTES migrant, are increasing in some portions of its range and decreasing in others. Declines are associated with maturation of second-growth forests, intense agriculture practices, and urbanization. Increases occur where the land is bushy and weedy or where forests are immature or open.

Some birds like the Red-shouldered Hawk are common residents of the BTES but are listed as endangered, rare, or of special concern in other states. These birds benefit from large contiguous forests. When forests are fragmented or opened up, certain hawks and owls outcompete the Red-shouldered Hawk for nesting sites.

One bird, the Cattle Egret, appears to be near the end of a recent, dramatic worldwide expansion of its range and is now a common to abundant resident in the basin.

Major Factors Affecting the Population

Habitat loss. All birds are threatened with habitat loss within and outside the BTES. Coastal island retreat and shoreline erosion pose an immediate threat to a large number of birds. These habitats are particularly important to migrants who have encountered storms at sea, as they provide a temporary refuge for resting and refueling. Additionally, they provide a unique nesting site for many seabirds.

Wetland loss is of concern to a large number of the birds, both inside and outside the BTES. While not as species rich as rain forests, wetlands are important nesting, foraging, and stopover sites for a wide variety of BTES birds.

Intense agriculture practices and loss of flowering and seed- and fruit-producing trees and shrubs in rural, suburban, and urban settings threaten many of the BTES birds.

Toxins. Many of the migratory BTES birds are threatened by the use of DDT-like pesticides in Mexico, Central, and South America. Those BTES birds which feed on fish or other birds, as well as those BTES birds which feed on seeds are threatened with bioaccumulated toxins. These toxins include DDT-like residues, currently applied pesticides and herbicides, industrial and urban pollutants, oil spills, at-sea fuel dumping, illegal dumping on land, residual lead shot, and lead fishing weights. Once these substances enter the food chain, they bioaccumulate and can lead to reduced reproductive success and death.

Take. Within the United States, some of the BTES population continues to be shot despite prohibition on their take. The reasons vary from intended human consumption to perceived competition for fish resources.

Many of the BTES migratory songbirds are shot for sport in Mexico and Central and South America. Some are also caught for the trade in caged birds.

Human disturbance. The BTES seabirds and wading birds continued to be threatened with human disturbance of their nesting sites or colonies, which can cause increased nesting mortality. This disturbance can be mild and unintentional (as in the case of someone walking near a site), or severe, as in the destruction of nestings, eggs, and nests when vehicles are driven through the site.

Group Recommendations

Management within BTES should protect existing habitat; reduce introduced toxins; cleanup toxic waste sites; provide habitat in rural, suburban, and urban areas; continue enforcement of conservation measures; and educate the public.

Specific Recommendations

- Restoration of barrier islands. Creation of new barrier and coastal islands with dredged material with an emphasis on habitat use by seabirds and migrating birds.
- Freshwater/sediment introduction for coastal restoration.
- Protection of nesting sites and colonies from human disturbance.
- Reduction of introduced toxins. Cleanup of toxic waste sites.

SEABIRDS

Brown Pelican, Black Skimmer, Sandwich Tern, Royal Tern, Least Tern, Forster's Tern, Gull-billed Tern, Caspian Tern, Laughing Gull

Introduction

This species grouping includes birds that are colonial nesters within the BTES, feed within the coastal and offshore waters, and belong to the families of Pelicans (Pelecanidae), Gulls, Terns, and Skimmers (Laridae). The BTES coastline is blessed with a comparative abundance of seabirds. They are an integral part of the scenic landscape of coastal marshes and barrier islands.

Materials and Methods

Most of the status data reported here are taken from Martin and Lester (1991) for the Louisiana coastal zone, and Visser and Peterson (1994) for most of the BTES and data of the 1994 waterbird surveys of the Louisiana Natural Heritage Program for southeastern Louisiana made available to us by Mike Carloss of the LDWF. Trends are based on the survey records from Visser and Peterson (1994) and Martin and Lester's comparison of their data to Portnoy (1977). National status and trends for the coastal zone are based on Spendelow and Patton (1988).

Historical Trends and Causes of Change

Egg collectors nearly eradicated the abundant bird populations the early French explorers found and Audubon painted (Bent 1921). Fortunately these birds responded to conservation measures enacted in the early 1900s that eliminated or reduced their take. Between 1940 and 1960 many seabird populations were negatively effected by toxic chemicals that entered the coastal waters. The local extinction of the Brown Pelican is the most dramatic example of how toxins can effect seabird populations (Wilkinson et al. 1994). Restrictions on the use of some pesticides such as DDT have resulted in a rebound of some seabird populations. The Brown Pelican was reintroduced using the Florida population of this species.

Habitat Requirements

Seabirds feed mostly within the shallow bays and the near coastal waters on small fish. They use sandbars, barrier beaches, and marsh islands at the edge of large bays to nest. Figure 3.11 shows the distribution of known seabird rookeries within the BTES. Table 3.4 lists the species that were present at each colony site and the years these colonies were active. Caspian Terns are rarely observed nesting within the BTES.

Major Factors Affecting the Population

Currently most BTES seabird populations are directly or potentially threatened by coastal erosion, human disturbance of nesting sites, storms and hurricanes, oil spills, entrapment in fishing lines, and illegal take (Burger 1981, Visser and Peterson 1994, Wilkinson et al. 1994). In addition, populations should be monitored for the threat of bioaccumulation of toxins.

Group Recommendations

! Habitat maintenance, restoration and creation.

- Restoration of barrier islands, especially those islands containing major colonies (i.e., Raccoon Point [B-020], Wine Island [B-007], and Queen Bess [A-019]). These stabilization projects should be designed so that suitable nesting sites for seabirds are maintained and restored. These nesting sites include unvegetated sand flats or beaches for the Black Skimmer and most tern species, vegetated dunes for the Laughing Gull, and back marshes with mangrove-lined creeks for the Brown Pelican.
- Creation of new islands with dredged material. Restoration of the existing sandbar in Little Pass Timbalier (B-004) is recommended to create a more stable nesting island (similar to the Wine Island Project). Plantings of

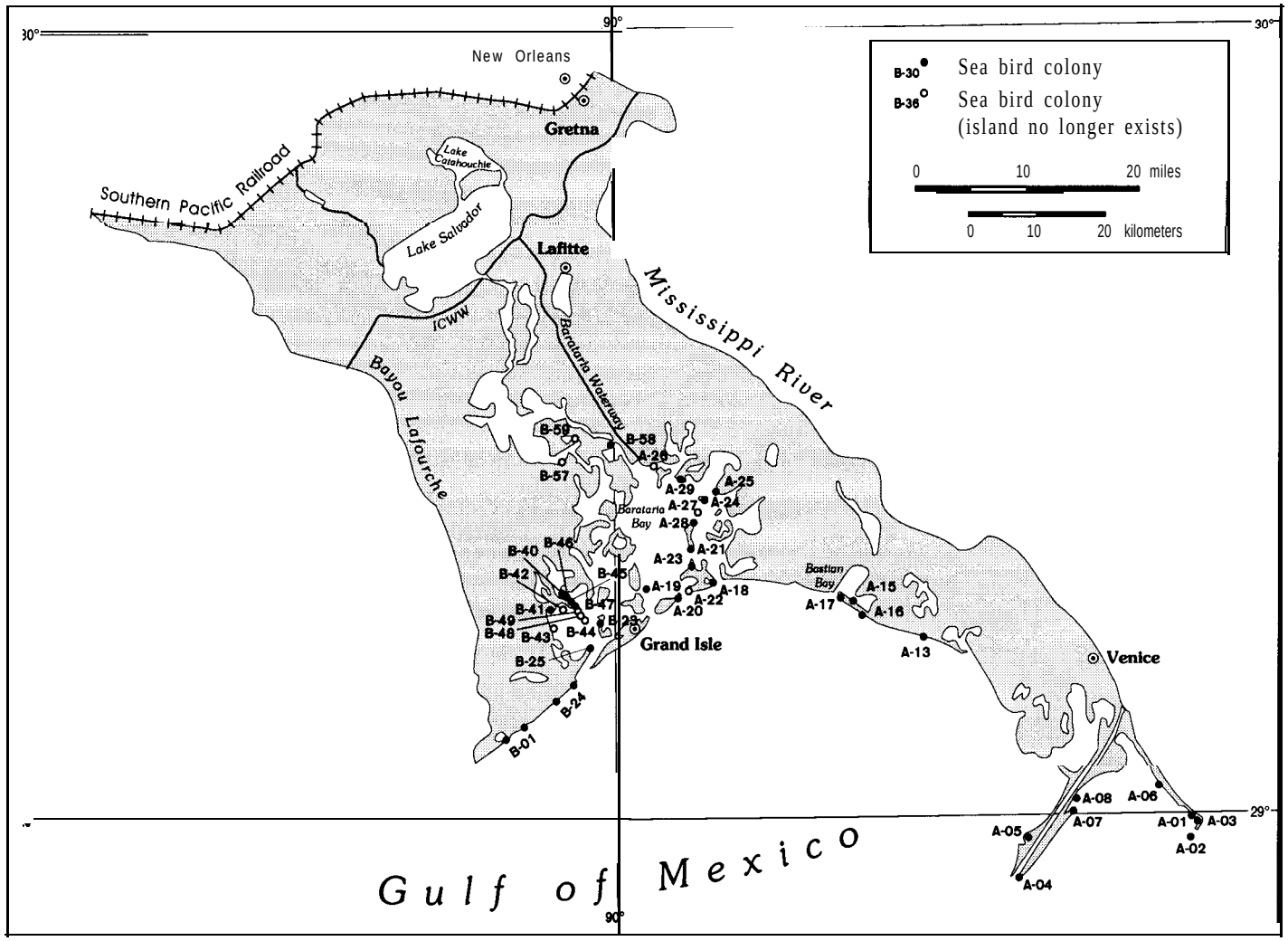

Figure 3.1 la. Location of all seabird colony locations in Barataria Basin. See Table 3.4 for years of activity and species present.

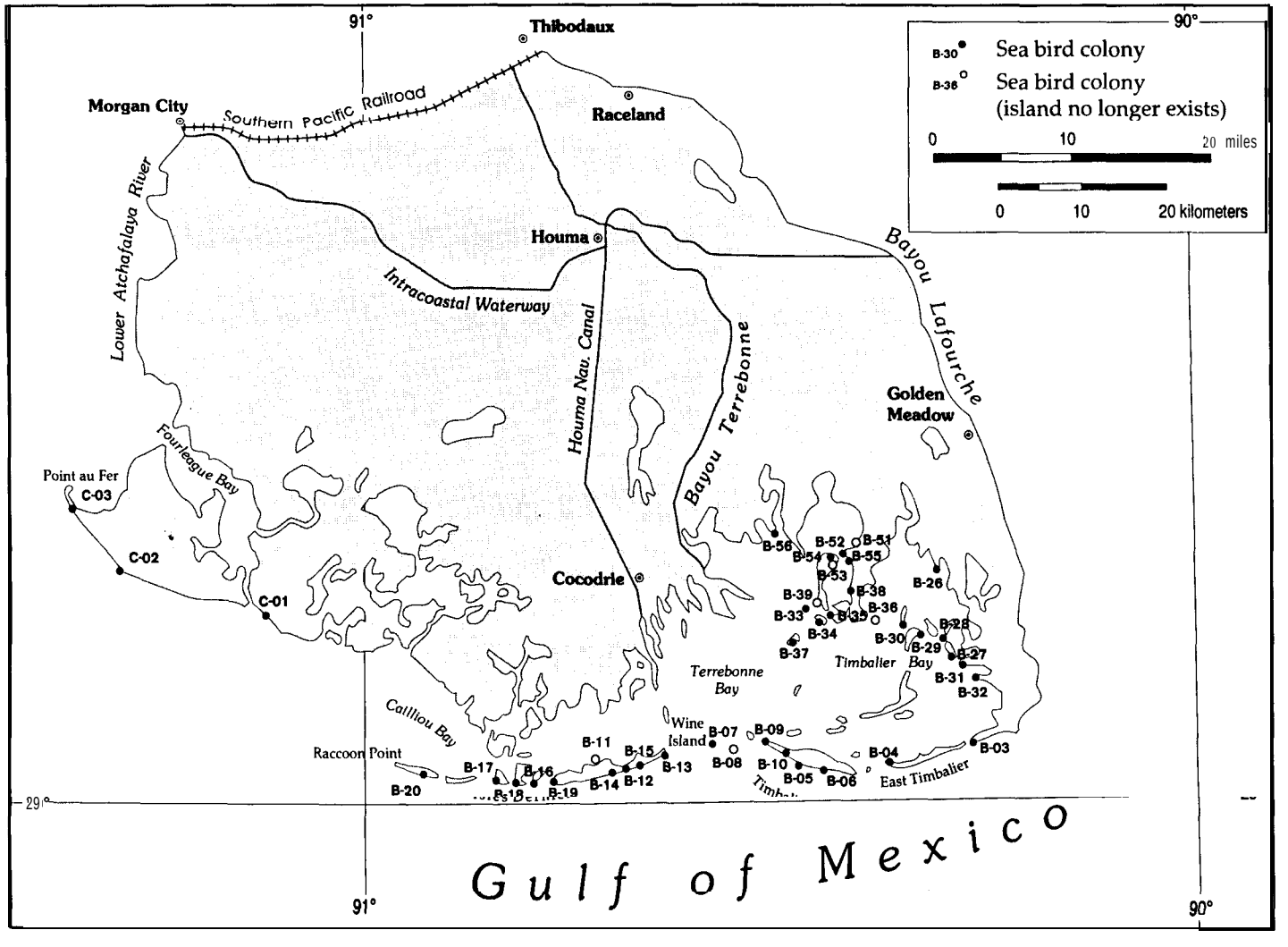

Figure 3.11 b. Location of all seabird colonies in Terrebonne basin. See Table 3.4 for years of activity and species present.

Table 3.4. **Seabird colony numbers, years of activity, and species present (for at least one year) for all reported colony sites within the Barataria-Terrebonne estuarine system.**

Colony number					Species present[1]								
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	FT	BS	LT	LG	RT	SN	BP	GT	CT
A-001	172	603043		76-90*	X			X	X	X	X		
A-002	173	603078		83-90		X						X	
A-003	350	603033		76			X						
A-004	287			90		X							
A-005	349	603032		76	X		X						
A-006	288			90		X	X	X	X				
A-007	065	603041		76, 83		X						X	
A-008	243	603042		76-90		X	X						
A-013	283			90		X							
A-015	005	603076		83		X							
A-016	006	603076		83		X							
A-017	284	603045		76, 90			X						
A-018	285			90			X						
A-019	003	603002	3002	76-94		X		X	X	X	X		
A-020	004	603047	3047	76-94*		X	X						

Table 3.4. (cont.)													
Colony number					Species present[1]								
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	FT	BS	LT	LG	RT	SN	BP	GT	CT
A-021	218	603004	3004	76-94*	X	X		X	X				
A-022	343	603003	3003	76-81		X		X					
A-023			N29	91-94	X	X		X					
A-024	007	603007	3007	76-85	X								
A-025	008	603008	3008	76-94*	X								
A-026	187	603001	3001	76-85	X								
A-027	188	603006	3006	76-87	X	X		X					
A-028	219	603005	3005	76-92	X								
A-029	344	603016	3016	76-78	X								
B-001	026/241	602043	043	76-94*		X	X						
B-003	049	602099	099	83, 94		X	X						
B-004	051	602042	042	76-94*		X	X	X	X	X	X		X
B-005	196			87			X						
B-006	239	602053	053	76-91		X	X						
B-007	055	602097	097	83-94		X			X	X			
B-008	056	602098	098	83-91*		X							

Table 3.4. (cont.)													
Colony number					Species present[1]								
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	FT	BS	LT	LG	RT	SN	BP	GT	CT
B-009	240			89		X							
B-010	340	602041	041	76			X						
B-011	073	602032	032	76-91	X	X		X					
B-012	074	602096	096	83, 87		X	X						
B-013	238	602057	057	78		X	X						
B-014	334	602033	033	76-86*			X						
B-015	335	602034	034	76			X						
B-016	058	602056	056	78-94*		X	X			X			
B-017	059	602094	094	83-94*		X		X		X			
B-018	342	602055	055	76, 87-90		X	X						
B-019			56A	86-94		X	X						
B-020	186	602031	031	76-94		X		X	X	X	X		

Table 3.4. (cont.)													
Colony number					Species present[1]								
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	FT	BS	LT	LG	RT	SN	BP	GT	CT
B-023	269			90	X								

B-024	286/341	602044	044	76-93*		X	X						
B-025			N35	92-94				X					
B-026	157	602066	066	83-94	X								
B-027	298		N18	86-92	X			X					
B-028	299		N17	87-94	X			X					
B-029	300	602039	039	76, 78, 90, 94	X			X					
B-030	301	602038	038	76, 78, 87-94	X			X					
B-032			N16	86-94	X			X					
B-033	095	602058	058	78-84	X								
B-034	096	602071	071	83-94	X			X	X				
B-035	217		N19	87-89	X								
B-036	308	602059	059	78-83	X		X	X					
B-037	337	602036	036	76-78	X								
B-038	338	602037	037	76	X								
B-039			N07	83-84	X								

Table 3.4. (cont.)

Colony number					Species present[1]								
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	FT	BS	LT	LG	RT	SN	BP	GT	CT
B-040	010	602047	047	76-92*	X			X					

B-041	011	602048	048	76-94*	X			X					
B-042	012	602049	049	76-86	X								
B-043	013	602050	050	76-89	X			X					
B-044	014	602051	051	76-86	X								
B-046	016	602063	063	83-94*	X			X					
B-047	017	602064	064	83-92	X			X					
B-048	018	602065	065	83-89	X								
B-049			N10	83	X								
B-051	110	602067	067	83	X								
B-052	111	602068	068	83-94*	X	X							
B-053	112	602069	N08	83-85	X								
B-054	113	602101	101	83, 87, 94	X								
B-055	216		N27	88, 91-92	X			X					

Table 3.4. (cont.)

Colony number					Species present[1]								
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	FT	BS	LT	LG	RT	SN	BP	GT	CT
B-056	336	602035	035	76-78	X								
B-057	009	602062	062	83-90	X								
B-058	191		N25	90-94	X								

B-059	**297**	**602046**	**046**	**76-91**	**X**								
B-069	**180**	**602061**	**061**	**81-90**	**X**								
C-001	**236**	**602013**		**76, 90**			**X**						
C-002	**160**	**602054**		**76, 83**		**X**	**X**						
C-003	**161**	**602093**		**83**		**X**							
Total number of colonies:					**44**	**33**	**24**	**25**	**8**	**7**	**4**	**2**	**1**

[1] FT = Forster's Tern, BS = Black Skimmer, LT = Least Tern, LG = Laughing Gull, RT = Royal Tern, SN = Sandwich Tern, BP = Brown Pelican, GT = Gull-billed Tern, and CT = Caspian Tern
[2] This report. Numbers correspond with those in Figure 3.1
[3] From Martin and Lester (1991)
[4] From Keller et al. (1984)
[5] From Visser et al. (1994)
[6] Based on Martin and Lester (1991) and Visser and Peterson (1994)

mangrove and/or other shrubs could make such an island available for breeding by the Brown Pelican.

- Protection of colonies from human disturbance.
  - Limit vehicle access to Fourchon Beach.
  - Post all active colonies.
  - Educate the public.

- In case of an oil spill, special efforts should be made to protect colony sites.

WADING BIRDS

Great Blue Heron, Great Egret, Little Blue Heron, Snowy Egret, Tri-colored Heron, Cattle Egret, White Ibis, Reddish Egret, White-Faced Ibis, Black-Crowned Night-Heron, Glossy Ibis, Roseate Spoonbill

Introduction

Wading birds are large birds that live in the coastal marshes and swamps of the BTES. They are water birds that do not swim or dive for their food but wade in shallow water were prey is taken with swift strikes (Terres 1980). All of them build their nests within the estuary and most nest in colonies. Some use the large trees in the cypress swamps, others use shrub or tree groves in the marshes, bays, or barrier islands. Others build nests among the reeds and cattails in the marshes. Most feed on small fish, insects, frogs, and snakes.

No wading birds are federally listed as endangered or threatened. Reddish Egret and Roseate Spoonbill are considered a "species of special concern" in Louisiana.

Materials and Methods

Most of the status data reported here are taken from Martin and Lester (1991) for the Louisiana coastal zone, Visser et al. (1994) for most of the BTES, and the 1994 wading bird surveys for southeastern Louisiana of the LNHP made available to us by Mike Carloss of the LDWF. Trends are based on Martin and Lester's comparison of their data to Portnoy (1977) and data from the LOOP surveys of wintering wading-birds. National status and trends for the coastal zone are based on Spendelow and Patton (1988).

Historical Trends and Causes of Change

Due to their colonial breeding habits most of these birds were easy prey for eggers who regularly raided colonies, and hunters who collected whole birds and feathers for the millinery trade. Concern over the declining populations rose, and in the early 20th century state and federal laws were passed to protect these birds from hunters. In Louisiana, the egrets were

restored in part by the conservation efforts of Edward A. McIlhenny (Lowery 1974b). However, during the middle part of this century these birds faced another threat. This time their food source was poisoned by pesticides like DDT. Luckily the use of many of the worst pesticides has been banned and the BTES again supports healthy populations of wading birds.

Habitat Requirements

Wading birds feed on small fish and invertebrates mostly within the shallow bays, marsh ponds, and along the edges of bayous and canals. Only the Cattle Egret regularly feeds on dry land, mostly eating insects. Nesting habitats range from swamp forests to barrier islands. Figure 3.12 shows the distribution of known wading bird rookeries within the BTES. Table 3.5 lists the species present at each colony site and the years these colonies were active.

Major Factors Affecting the Population

Currently BTES wading birds are directly or potentially threatened by habitat loss, human disturbance of nesting sites, and illegal take. In addition, populations should be monitored for the threat of bioaccumulation of toxins.

Group Recommendations

Management of these species should concentrate on the protection of habitat. In addition, existing colonies should be protected from human disturbance. Most species of wading birds have stable populations. However, the Reddish Egret has significantly declined. Since this species feeds in the very shallow tidal pools of barrier islands, it may benefit from barrier island restoration projects. It uses mangrove thickets to breed, so planting mangroves on barrier islands might provide additional breeding habitat.

Specific Recommendations[1]

- **!** Habitat maintenance, restoration and creation.
    - Restoration of islands. Especially those islands containing major colonies of wading birds (i.e., Raccoon Point [B-020] and Queen Bess [A-019]). These stabilization projects should be designed such that suitable nesting sites for wadingbirds are maintained and restored. These are the back marshes with

[1] See information on individual species in Chapter 6 for species-specific recommendations.

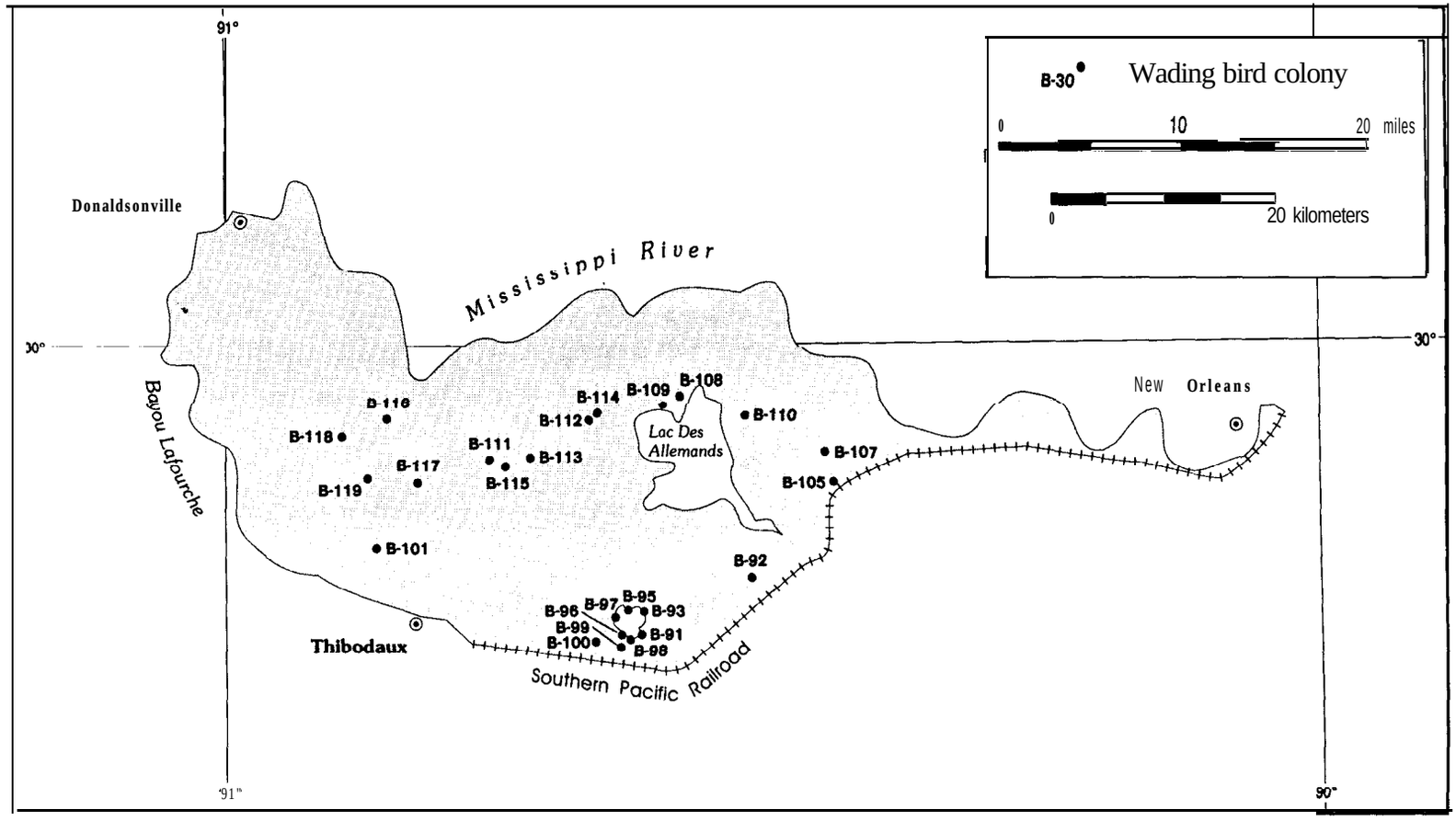

Figure 3.12a. Location of all wading-bird colonies in northern Barataria basin. See Table 3.5 for years of activity and species present.

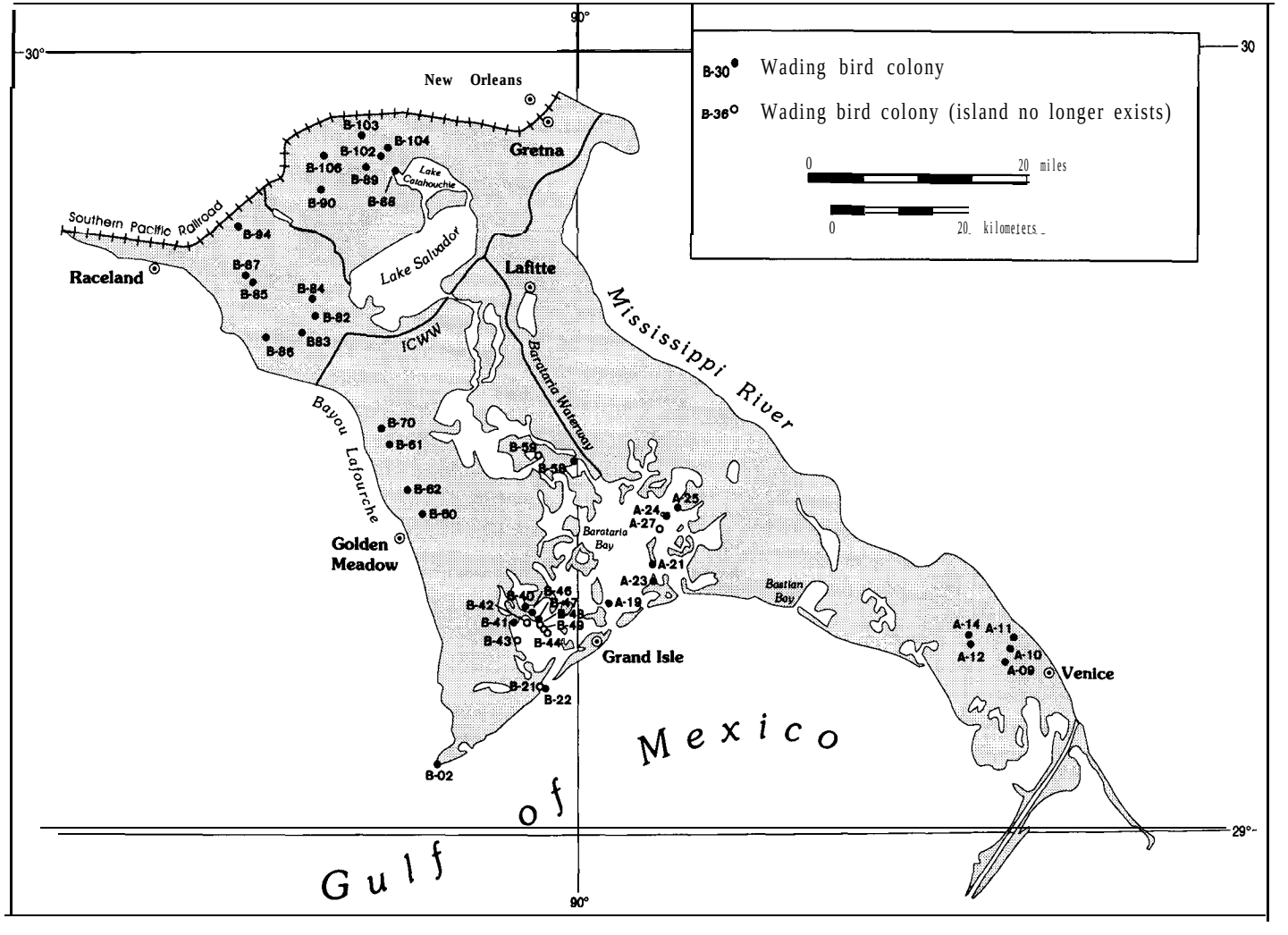

Figure 3.12b Location of all wading-bird colony locations in southern Barataria Basin. See Table 3.5 for years of activity and species present.

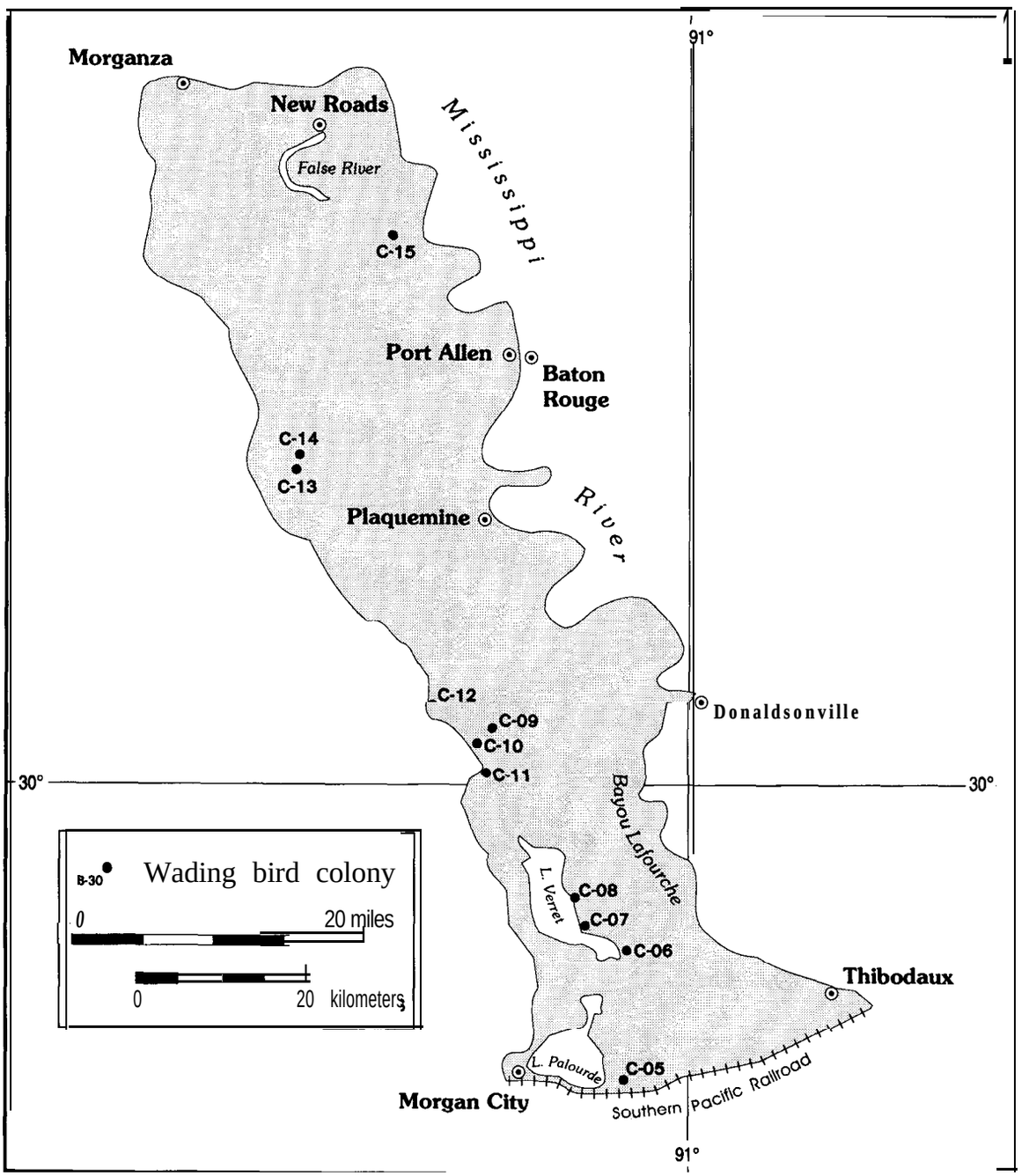

Figure 3.12c. Location of all wading-bird colonies in northern Terrebonne basin. See Table 3.5 for years of activity and species present.

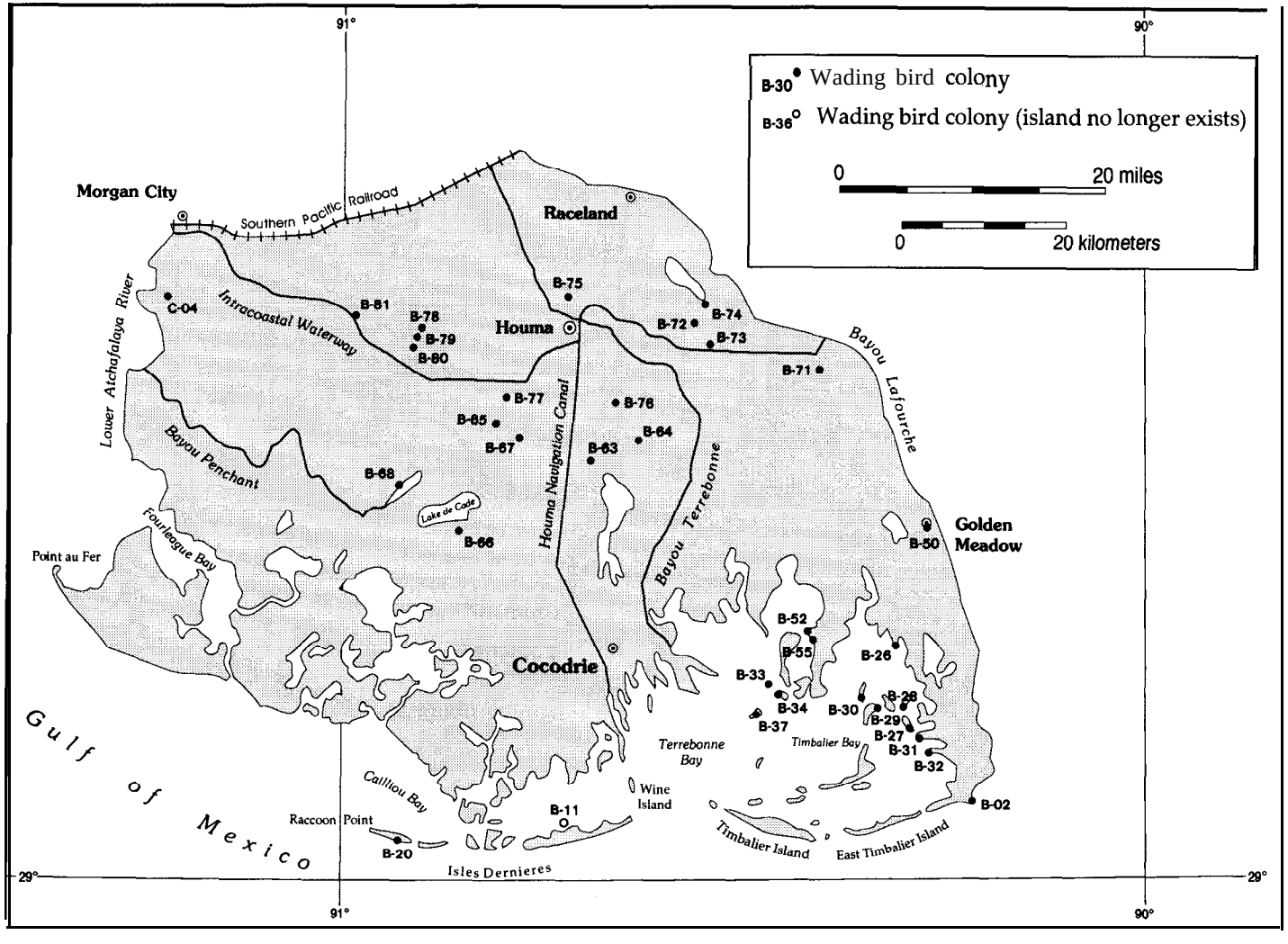

Figure 3.12d Location of all wading-bird colony locations in southern Terrebonne Basin See Table 3.5 for years of activity and species present.

Table 3.5. Wadingbird colony numbers, colony activity, and species present for at least one year at the colony site.

Colony number					Species present[1]											
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	SE	GE	TH	LB	CE	BC	GB	WI	PI	YC	RE	RS
A-009	159	602039		76, 83	X	X	X	X								
A-010	272	603030		76, 90	X	X		X								
A-011	273			90	X		X	X								
A-012	271			90	X	X	X									
A-014	270			90	X		X									
A-019	003	603002	3002	76-94	X	X	X	X		X		X	X			
A-021	218	603004	3004	76-94*	X	X	X	X		X		X	X		X	
A-023			N29	91-94	X	X										
A-024	007	603007	3007	76-85	X		X			X					X	
A-025	008	603008	3008	76-94*	X	X	X			X						
A-027	188	603006	3006	76-87	X	X	X			X					X	
B-002			N32	91-94	X	X	X		X			X				X
B-011	073	602032	032	76-91	X	X	X			X					X	
B-020	186	602031	031	76-94	X	X	X	X		X					X	X
B-021	054	602100	N01	82-84	X	X	X									

Table 3.5. (cont.)

Colony number					Species present[1]											
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	SE	GE	TH	LB	CE	BC	GB	WI	PI	YC	RE	RS
B-022	202		N1A	85-95	X	X	X			X					X	
B-025			N35	92-94	X		X			X						
B-026	157	602066	066	83-94	X	X	X									
B-027	298		N18	86-92	X	X	X			X			X		X	
B-028	299		N17	87-94	X	X	X			X						
B-029	300	602039	039	76-78, 90,94	X	X	X			X						
B-030	301	602038	038	76-78, 87-94	X	X	X	X		X		X	X			
B-031	339	602040	040	76-78	X	X	X			X					X	
B-032			N16	86-94	X	X	X			X			X		X	
B-033	095	602058	058	78-84	X		X									
B-034	096	602071	071	83-94	X	X	X			X						
B-037	337	602036	036	76-78	X	X	X			X						
B-040	010	602047	047	76-92*	X	X	X									
B-041	011	602048	048	76-94*	X	X	X			X						

Table 3.5. (cont.)

Colony number					Species present[1]											
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	SE	GE	TH	LB	CE	BC	GB	WI	PI	YC	RE	RS
B-042	012	602049	049	76-86	X	X	X	X								
B-043	013	602050	050	76-89	X	X	X			X						
B-044	014	602051	051	76-86	X	X	X			X			X			
B-045	015	602052	052	76-83	X	X	X									
B-046	016	602063	063	83-94*	X		X									
B-047	017	602064	064	83-92	X	X	X			X		X				
B-048	018	602065	065	83-89	X		X	X					X			
B-049			N10	83		X	X									
B-050	190		N22	87-94	X	X										
B-052	111	602068	068	83-94*	X		X									
B-055	216		N27	88, 91-92	X	X	X			X					X	
B-058	191		N25	90-94	X	X	X									
B-059	297	602046	046	76-91	X		X									
B-060	296	602045	045	76, 88-89	X	X		X	X			X				
B-061	304		N12	83-94*	X	X		X	X				X			
B-062			N34	93-94		X			X			X				

Table 3.5. (cont.)

Colony number					Species present[1]											
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	SE	GE	TH	LB	CE	BC	GB	WI	PI	YC	RE	RS
B-063	072	602091	091	83-94*	X	X	X	X	X		X		X			
B-064			N31	91	X	X	X	X	X			X				
B-065	119	602072		83	X		X	X				X				
B-066	120	602092		83	X	X	X									
B-067	256		N40	90-94	X	X		X								
B-068	333	602030		76	X	X		X		X				X		
B-070	237		N11	83-84, 90-92	X			X	X			X				
B-071			N36	93		X		X	X							
B-072	045	602085	N06	83-93*	X		X	X		X		X	X			
B-073	332	602028	028	76	X	X	X	X	X	X						
B-074			N24	88-93	X		X	X	X			X				
B-075	093	602090	090	83, 91-94				X	X							
B-076			N30	91	X		X	X	X							
B-077	092	602029	N37	76-93#	X	X	X	X	X	X	X	X	X			
B-078	020	602083		83-90		X					X					

Table 3.5. (cont.)

Colony number					Species present[1]											
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	SE	GE	TH	LB	CE	BC	GB	WI	PI	YC	RE	RS
B-079	021	602084		83-90	X	X	X	X	X	X		X	X			
B-080	022	602084		83-90	X	X	X	X	X	X		X	X			
B-081	327	602015		76-78		X										
B-082	067	602027	027	76-91		X		X	X							
B-083	077	602086	086	83-94*	X			X								
B-084	078	602095	N05	83	X			X		X		X				
B-085	079	602102	N04	83-86		X					X					
B-086	242		N21	87-92		X	X				X					
B-087	125	602089	089	83	X			X	X							
B-088	215		N26	90-94	X			X	X			X				
B-089	329	602025	025	76, 85-86	X			X								
B-090	198		N38	88		X					X					
B-091	019	602088	088	83-94	X		X	X	X				X			
B-092	175		N39	90-94		X					X	X				
B-093	201		N15	85-94	X		X	X	X			X	X			
B-094			N33	92-94	X	X	X	X	X			X				

Table 3.5. (cont.)

Colony number					Species present[1]											
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	SE	GE	TH	LB	CE	BC	GB	WI	PI	YC	RE	RS
B-095	100	602021	021	76-94	X		X	X	X			X	X			
B-096	101	602073	073	83-92	X		X	X	X							
B-097	102	602074	074	83-94	X	X	X	X	X	X		X	X			
B-098	121			90	X		X	X	X							
B-099	254		N28	90-93		X					X					
B-100			N43	94		X										
B-101	179	602077	N02	82-83	X		X	X								
B-102	130	602026	026	76-94*	X	X	X	X	X		X		X			
B-103	330	602060	060	78		X		X			X					
B-104			N20	87-89, 93	X				X			X	X			
B-105	088	602023	023	76-85,93-94	X		X	X	X				X	X		
B-106	089	602024	024	76-94*	X	X	X	X	X		X					
B-107	090	602087	087	83-85	X		X	X		X				X		
B-108	053	602019	N09	83-94	X			X								
B-109	103	602020	019/020	76-94	X		X	X	X	X						

B-110	104	602022	022/N03	76-94	X	X	X	X	X	X	X		X			

Table 3.5. (cont.)

Colony number					Species present[1]											
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	SE	GE	TH	LB	CE	BC	GB	WI	PI	YC	RE	RS
B-111	052		N23	88-92		X					X			X		
B-112	127	602070	070	83-94	X	X		X			X					
B-113	128	602075	075	83-94*		X					X			X		
B-114	129	602076	076	83-94*		X					X					
B-115	255			90		X					X					
B-116	050	602017	017	76-90		X					X	X				
B-117	105	602018	018	76-94*	X	X	X	X	X		X	X		X		
B-118	131	602016	N13	76, 83-93		X	X	X	X		X			X		
B-119			N42	94	X	X		X	X							
C-004	326	602012		76-78	X	X	X	X	X	X		X				
C-005	001/002	602014		76-90		X					X					
C-006	084	602078		83-90		X					X					
C-007	085	602079		83-90		X					X					
C-008	258			90		X					X					

C-009	126	589026		83, 90	X	X		X			X			X		
C-010	193			83, 90	X	X	X	X	X		X					

Table 3.5. (cont.)

Colony number					Species present[1]											
BTNEP[2]	LNHP[3]	USFWS[4]	LOOP[5]	Years active[6]	SE	GE	TH	LB	CE	BC	GB	WI	PI	YC	RE	RS
C-011	194			83		X					X					
C-012	158	589008		76-90	X	X	X	X	X		X	X		X		
C-013	086	589029		83-90	X	X		X			X			X		
C-014	087	599030		83-90	X	X		X			X			X		
C-015	247			90	X	X		X	X			X				
Total number of colonies:					88	82	70	59	38	34	30	28	21	11	10	2

[1] SE = Snowy Egret, GE = Great Egret, TH = Tri-colored Heron, LB = Little Blue Heron, CE = Cattle Egret, BC = Black-crowned Night Heron, GB = Great Blue Heron, WI = White Ibis, PI = White-faced and Glossy Ibis, YC = Yellow-crowned Night-Heron, RE = Reddish Egret, RS = Roseate Spoonbill
[2] This report. Numbers correspond with those in Figure 3.2.
[3] From Martin and Lester (1991).
[4] From Keller et al. (1984).
[5] From Visser et al. (1994).
[6] Based on Martin and Lester (1991) and Visser and Peterson (1994).
* Colony not occupied every year.
# Colony infrequently surveyed but active almost all years it was surveyed.

Black Mangrove-lined creeks, and the back dunes with shrubs such as *Iva frutescens* and *Baccharis halimifolia*.

- Creation of new islands with dredged material. Restoration of the existing sandbar in Little Pass Timbalier (B-004) is recommended to create a more stable nesting island (similar to the Wine Island Project). Plantings of mangrove could make such an island available for breeding by the Reddish Egret.

! Protect colonies from human disturbance.
- Post all active colonies.
- Educate the public.

WATERFOWL

Geese
(Snow Goose)

Dabbling Ducks
(Mallard, Northern Shoveler, Northern Pintail, Gadwall, Blue-winged Teal, Mottled Duck, Green-winged Teal, Wood Duck, American Wigeon)

Diving Ducks
(Lesser Scaup, Red-breasted Merganser, Greater Scaup, Hooded Merganser, Ring-necked Duck)

Introduction

Magnificent flocks of waterfowl use BTES as their winter home or as a rest stop on their way to their wintering grounds in Central and South America. Waterfowl can be divided into three groups based on general feeding patterns. Geese feed on emergent vegetation, dabbling ducks feed on the bottoms of shallow ponds, and diving ducks dive to feed on the bottom of deeper water bodies.

Most of these birds breed in the plains of the northern United States and Canada. Only the Wood Duck and the Mottled Duck nest within the BTES. Some feed on the seeds of grasses and graze on submerged plants, while others feed on small animals that live in the bottoms of shallow bays.

The Louisiana coastal marshes are of great importance to migratory waterfowl. The Louisiana coast provides wintering habitat for a quarter of the North American dabbling ducks, and year-round habitat for half of the continental Mottled Duck population (Chabreck et al. 1989). However, the most recent numbers suggest that the southeastern Louisiana marshes

provide wintering habitat for only 8% of the wintering dabbling ducks (Table 3.6), with significantly higher percentages of Gadwall (36%) and Green-winged Teal (16%).

Materials and Methods

Data analyzed for waterfowl include continent-wide surveys of the breeding populations of the 10 most common duck species and all geese (U.S. Fish and Wildlife Service and CWS 1994). January estimates of the population wintering in the southeastern Louisiana coastal zone (data from LDWF made available to us by Robert Helm), and data from the LOOP mid-winter[1] surveys. Both national and state data consist of total population estimates based on representative surveys. LOOP data are reported only as number of birds observed per survey and are not extrapolated to estimate populations within southwestern Barataria. Therefore, trends are comparable but absolute numbers are not. We fitted linear regressions to untransformed data to determine trends. Trends are reported as significant when the slope of the regression was significantly ("=0.05) different from zero.

The continent-wide survey of breeding duck populations in the summer is the data set with the least amount of variation, because the ducks are more stationary during the breeding season. Therefore, these data are most reliable to determine real population trends, however, this survey only includes the 10 most common duck species (Mallard, Scaup, Northern Pintail, Blue-winged Teal, American Wigeon, Northern Shoveler, Green-winged Teal, Gadwall, Redhead, and Canvasback). Surveys of wintering waterfowl are less reliable, because migration and distribution are determined by weather and available wintering habitat. In addition, the number of surveys (both LOOP and LDWF) differed from year to year. To reduce some of this variation, we only used data from the January surveys of LDWF and mid-winter surveys from the LOOP data set.

Historical Trends and Causes of Change

Most of the changes in waterfowl populations are attributed to the decline in their wetland habitat, from their breeding grounds in the north, their refueling stops along the major flyways, to the wintering grounds along the coasts of the United States. During the late 1970s and early 1980s, the decline in waterfowl populations was magnified due to a severe drought in the breeding grounds. The 1986 North American Waterfowl Management Plan was implemented in both the United States and Canada. This plan recognizes that waterfowl populations depend on restoring wetlands and associated ecosystems throughout North America. In addition, hunting regulations

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[1] December 1 to February 28.

Table 3.6. Population estimates for the nine most common duck species in North America and the percentage wintering in southeastern Louisiana.

Species	North American Breeding Population[1]	SE Louisiana Wintering Population[2]	Percentage Wintering
Mallard	6,980,100	254,000	4%
Northern Pintail	2,972,300	86,000	3%
Blue-winged Teal	4,616,200	28,000	1%
Green-winged Teal	2,108,400	347,000	16%
American Wigeon	2,382,300	212,000	9%
Northern Shoveler	2,912,000	139,000	5%
Gadwall	2,318,300	825,000	36%
Dabbling Ducks	24,289,600	1,891,000	8%
Scaup[3]	4,529,000	39,000	1%
Wood Duck[4]	2,728,365	134,346	5%

[1] From USFWS and CWS (1994).
[2] From LDWF (1995).
[3] Louisiana population is underestimated, because surveys did not include large open bays and nearshore waters.
[4] From Bellrose and Holm (1994).

have reduced pressure on the population from harvesting (USFWS 1994). Due to these actions, populations have somewhat rebounded in the last few years.

Habitat Requirements

Dabbling ducks and geese need shallow ponds and flooded marsh to feed, although some also use agricultural fields for feeding (i.e., Mallard, Northern Pintail, Geese) and generally show a preference for fresh marsh (Chabreck et al. 1989). Within the BTES the large areas of fresh marsh in the Terrebonne basin and the birdfoot delta are an important resource especially for Gadwall, Green-winged Teal, Northern Shoveler, and Mallard. The brackish marshes along the edge of Four League Bay support small numbers of Snow Goose. Brackish marshes throughout the BTES provide additional habitat for dabbling ducks, especially for Gadwall.

Diving ducks, on the other hand, use the large lakes and bays to feed. Large flocks of Scaup use Timbalier and Terrebonne bays for both resting and feeding. Scaup also use large freshwater lakes, such as the submerged part of Delta Farms in Barataria basin.

Major Factors Affecting the Population

Within the BTES, waterfowl populations are most seriously threatened by habitat loss and illegal take. Outbreaks of contagious and infectious diseases (i.e., avian botulism and avian cholera) as well as parasites, which are now occasional, might become more common as the birds crowd the decreasing winter habitat (Chabreck et al. 1989). Lead toxicosis from ingestion of shot is a chronic problem in waterfowl (Chabreck et al. 1989), but this might be a thing of the past since new regulations require the use of steel shot.

Group Recommendations

Management for waterfowl should concentrate on the reduction of habitat loss, especially freshwater marsh. Traditionally, impounding has been used in many areas in the Louisiana coastal zone to manage for waterfowl. However, impoundments are costly to construct and maintain, can restrict access of marine organisms, and can reduce sedimentation (Chabreck et al. 1989, Boumans and Day 1994). Freshwater diversion should provide excellent habitat for dabbling ducks and geese as is demonstrated by the large flocks of waterfowl that use the Atchafalaya and Wax Lake deltas (Fuller et al. 1988).

Specific Recommendations

- Freshwater diversion.

- Reduction of saltwater intrusion and turbidity to increase the growth of submerged aquatic vegetation.

- Backfilling of oil and gas access canals and pipeline canals where possible. This will produce large shallow ponds with submerged aquatics (Abernethy and Gosselink 1988, Rosaz and Reed 1994), providing additional feeding habitat for dabbling ducks, especially in fresh to brackish marshes.

OTHER WETLAND BIRDS

American White Pelican, Double-crested Cormorant, Olivaceous Cormorant, Anhinga, American Bittern, Least Bittern, Yellow-crowned Night-Heron, Common Moorhen, American Coot, Belted Kingfisher, Fish Crow, Seaside Sparrow

Introduction

This group is a collection of wetland birds that do not fit in any of the previous categories (seabirds, wading birds, and waterfowl). All members of this group use the wetlands of the BTES for at least part of the year. Almost all feed on small fish, amphibians, snails, and insects. A few, such as American Coot and Common Moorhen, feed mostly on aquatic vegetation.

Historical Trends and Causes of Change

Many of the wetland birds were significantly impacted by toxins introduced in the wetlands in the 1960s. Species higher in the food web, such as Anhinga, Double-crested Cormorant, and American White Pelican, are still recovering from population declines in the 1960s and 1970s.

Habitat Requirements

Most of the wetland birds show a preference for the fresh marsh and swamp. However, American White Pelican, American Bittern, and Seaside Sparrow prefer more saline marshes. Anhinga and Yellow-crowned Night-Heron breed mostly in small (less than 50 birds) colonies throughout the swamp.

Major Factors Affecting the Population

The populations of most of the wetland birds in the BTES are stable to increasing. Some are declining nationally (American Bittern, Belted Kingfisher and Seaside Sparrow), but no information on BTES populations exists.

Group Recommendations

- Habitat protection and enhancement.

- These species are important indicators of wetland function and populations should be monitored.

RAPTORS

Bald Eagle, Northern Harrier, Cooper's Hawk, Red-shouldered Hawk, Red-tailed Hawk, Peregrine Falcon, American Kestrel, Barn Owl, Barred Owl

Introduction

Members of this group are commonly termed birds of prey because they hunt and feed on a variety of vertebrates. The hawks often can be seen soaring over open and forested landscapes. The owls are heard in forested areas in the evening.

Historical Trends and Causes of Change

Habitat change, pesticides, and shooting have impacted many of these birds. Habitat change has affected nesting areas and prey abundance. In some cases, as with the Red-tailed Hawk, habitat change from densely forested areas to more open countryside has probably resulted in a population increase. In other cases, as with the Red-shouldered Hawk, this same habitat change has probably resulted in a decline, because it has allowed other hawks and owls to outcompete it for nesting habitat. Intense farming activity normally reduces nesting sites and the availability of prey for these birds.

Pesticides, especially DDT, have negatively impacted these species by thinning their eggshells and reducing their reproductive output.

Historically, many of these large birds were shot for sport or to protect small farm animals.

Habitat Requirements

As a group these birds occupy a wide variety of habitats from marshes and fields to open forested areas (including suburbs and urban areas) to dense forests. They feed on a wide variety of invertebrates and vertebrates.

Major Factors Affecting the Populations

Because they are top carnivores, these birds continue to be threatened by the bioaccumulation of toxins, and loss of nesting habitats. The availability of prey often affects the abundance of the raptors.

Group Recommendations

- Preserve, enhance, restore, and acquire important habitat.
- Reduce use of pesticides and release of toxins.
- Continue public education to prevent take and disturbance of nesting birds.

SHORE BIRDS

Piping Plover, Semipalmated Sandpiper, Western Sandpiper, Common Snipe, American Woodcock

These birds are normally associated with the intertidal area and lake shores where many of them forage, but the group also consists of more widely distributed birds like the Killdeer and Woodcock. Many of this group are regular to accidental migrants, though some are common residents.

Historical Trends and Causes of Change

These birds have been negatively impacted by destruction of beach habitat; harassment of nesting sites by people, dogs, and vehicles; egg collection; and hunting. Many of these birds were in a state of decline before the Migratory Bird Convention of 1916. Bioaccumulation of toxins is thought to negatively affect some of these birds.

Habitat Requirements

This group uses as habitat the shores of oceans, lakes, and streams; prairie wetlands; open fields; and near forest streams. As a group these birds eat a variety of invertebrates and finfish.

Major Factors Affecting the Population

These birds are largely unprotected from human encroachment and disturbance of their beach habitats in the BTES. Destruction of beach habitat and harassment by humans and dogs are major threats.

Group Recommendations

- Protect, enhance, restore, and acquire important habitats.
- Prevent harassment of birds by humans, dogs, and cats.
- Restrict introduction of toxins.

OTHER RESIDENT BIRDS

Wild Turkey, Rock Dove, Mourning Dove,
Red-bellied Woodpecker, Downy Woodpecker, Pileated Woodpecker,
American Crow, Carolina Chickadee, Tufted Titmouse,
Carolina Wren, Blue-gray Gnatcher,
Northern Mockingbird, Loggerhead Shrike,
European Starling, Northern Cardinal, Rufous-sided Towhee,
Eastern Meadowlark, Brown-headed Cowbird,
House Finch, House Sparrow

Introduction

As defined in Table 3.7, there are 32 other resident BTES birds representing 12 families.

This diverse group contains two popular game birds: the Wild Turkey and the Mourning Dove. Also represented here are familiar native birds of vegetated suburban and urban areas like the Mourning Dove, the Downy Woodpecker, the Blue Jay, the Northern Mockingbird, and the Northern Cardinal. Some of these birds, like the European Starling and the House Sparrow were introduced, have flourished, and are outcompeting native species.

Historical Trends and Causes of Change

The Wild Turkey was a common Louisiana resident when the early French explorers arrived in 1699. It was likely locally extirpated from the BTES, as it was from much of its former range, through hunting and habitat loss. It has benefitted from reintroduction efforts, habitat restoration, and controlled hunting—all the direct result of management.

The Rock Dove, European Starling, and House Wren were all introduced into the United States and have flourished. They are outcompeting native species and are often considered a pest.

Several native species like the Mourning Dove, American Crow, Northern Mockingbird, Northern Cardinal, and Rufous-sided (eastern) Towhee have benefited

Table 3.7. Other resident birds in the Barataria-Terrebonne estuarine system*.

Common family names (after Table A.4)	Scientific name of the family	Number of species of BTES residents in family
Pheasants, Grouse, Quails	*Phasianidae*	2
Doves and Pigeons	*Columbidae*	2
Woodpeckers	*Picidae*	5
Jays and Crows	*Corvidae*	3
Chickadees and Titmice	*Paridae*	2
Wrens	*Troglodytidae*	2
Old World Warblers and Thrushers	*Muscicapidae*	3
Mimic Thrushes	*Mimidae*	1
Shrikes	*Laniidae*	1
Starlings	*Sturnidae*	1
Wood Warblers, Tanagers, Grosbeaks, Sparrows, Blackbirds, Orioles	*Emberizidae*	9
Old World Sparrows	*Passeridae*	1

*Other resident birds in the BTES are defined here as resident birds not treated in the preceding section and for which at least one member of the family has been recorded as at least an occasionally common BTES resident.

from the removal of the virgin forests and are now common BTES residents. These birds benefit from less intensive human uses of the landscape.

While several of the Woodpeckers are common BTES residents, they are cavity nesters and usually excavate nests in decaying limbs. One of this group, the Ivory-billed Woodpecker, is likely extinct.

While now a very common BTES resident, the Northern Mockingbird was formerly reduced or decimated locally in some areas of its U.S. range by the caged bird trade and egg collecting. It has benefited from its legal protection from take. Recently the continental population has been in a decline. There is some suggestion that at least the New Orleans population (which is outside of BTES) may also be in a recent decline.

Within the BTES the Loggerheaded Shrike has maintained a common and stable population recently, while the continental population has declined at an annual rate of 3.5%.

The Eastern Meadowlark is a common BTES resident and one of the most widely distributed songbirds. While the local BTES population has likely been stable, the continental population is in a state of decline. This decline is believed to be due to various land use practices, like the mowing of fields, which results in a loss of nesting habitat and nests (when mowing coincides with nesting).

The Brown-headed Cowbird benefitted from removal of the virgin forest and from fragmentation of second growth forests. It has become a common BTES resident, and is negatively impacting other birds through its parasitism of their nests.

The House Sparrow, an introduced species, was first reported in Southeast Louisiana in 1874. Its maximum abundance was likely reached before automobiles replaced horses, although it is currently a common to very abundant BTES resident.

Habitat Requirements

These other resident birds require a variety of habitats. Some, like the Wild Turkey, can occupy swamps, clearings, farms, plantations, prairies, and grasslands, but are restricted from suburban and urban areas. Others, like the Mourning Dove, occupy forested and open areas and can also readily use vegetated suburban and urban areas. Still others, like the Northern Mockingbird, thrive under cultivated and mowed conditions. Many, like the Woodpeckers and the European Starling use tree cavities to nest. The Rock Dove roosts and nests in crevices of buildings.

These birds eat seeds, fruits, vegetable matter, acorns, insects, spiders, earthworms, fish, small birds, and small mammals.

Major Factors Affecting the Populations

Many of these birds benefit from human use of a variety of vegetative habitats, though some require contiguous forests. Several have benefited from controls on hunting or protection from take. Several are cavity nesters and benefit from land-use practices that leave dead limbs and trees. Several native birds in this group are

negatively impacted by introduced exotics (some of which are introduced members of this group). These exotics outcompete the natives for food and nesting sites.

For the most part, these birds are negatively affected by intensive agriculture practices and devegetation of urban and suburban areas.

Group Recommendations

- Preserve, maintain, and enhance a variety of wooded, vegetative habitats with a particular emphasis on maturing second growth forest, swamps, and bottomland hardwoods; coastal marshes, wooded cheniers, and bayou banks; old fields and non-intensive agricultural fields and pastures; and vegetated suburban and urban areas with a mix of trees, understory, and mowed lawns.

- Restrict use of pesticides and herbicides.

OTHER MIGRATING BIRDS

Yellow-billed Cuckoo, Tree Swallow, House Wren, Ruby-crowned Kinglet, Hermit Thrush, American Robin, Brown Thrasher, Water Pipit, Orange-crowned Warbler, Chestnut-sided Warbler, Black-throated Green Warbler, Blackburnian Warbler, Cerulean Warbler, Prothonotary Warbler, Ovenbird, Hooded Warbler, Blue Grosbeak, Indigo Bunting, Savannah Sparrow, Sharp-tailed Sparrow, White-throated Sparrow, Bronzed Cowbird, American Goldfinch

Introduction

As defined in Table 3.8, there are 153 other migrating birds representing 15 families.

Generally, other migrating BTES birds can be placed into three groups based upon where they breed and where they winter. One group breeds north of the BTES and winters in the BTES (e.g., the Water Pipit). A second group breeds in the BTES in the summer and winters to the south of the BTES (e.g., the Hooded Warbler). A third group breeds north of the BTES and passes through the BTES on a regular, irregular, or accidental basis in the spring and/or fall as it leaves or returns to its winter ranges south of the BTES (e.g., the Blackburnian Warbler).

Some species have members in two of these groups. For example, most of the American Robins seen in the BTES breed north of the BTES and winter in the BTES. However, a few American Robins breed in the BTES.

The most spectacular abundance and diversity of the other migratory BTES birds occurs on an irregular basis in the spring. The event is called a fallout. It occurs when neotropical migratory birds encounter inclement weather in the form of cold fronts over the Gulf of Mexico. These birds are returning from their winter grounds

Table 3.8. Other migratory birds in the Barataria-Terrebonne estuarine system*.

Common family name (after Table A.4)	Scientific name of the family	Number of species of BTES migrants in family
Cuckoos and Allies	*Cuculidae*	3
Nightjars	*Caprimulgidae*	4
Swifts	*Apodidae*	1
Hummingbirds	*Trochilidae*	9
Woodpeckers	*Picidae*	2
Flycatchers	*Tyrannidae*	18
Swallows	*Hirundinidae*	6
Wrens	*Troglodytidae*	4
Old World Warblers and Thrushes	*Muscicapidae*	10
Mimic Thrushes	*Mimidae*	3
Pipits	*Moatcillidae*	2
Waxwings	*Bombycillidae*	1
Vireos	*Vireonidae*	8
Wood Warblers, Tanagers, Grosbeaks, Sparrows, Blackbirds, Orioles	*Emberizidae*	75
Finches	*Fringillidae*	7

*Other migratory birds in the BTES are defined as those migratory birds not treated in the preceding section and for which at least one member of the family has been recorded as at least an occasionally common migrant in BTES.

in South America, Central America, and/or the Caribbean to their summer breeding grounds in North America. If the birds have exhausted their energy reserves fighting the inclement weather over the Gulf, they will land in the first available forested areas. In the BTES those are the forested areas of Grand Isle and the forested coastal cheniers and spoil banks. There the birds will rest and refuel before continuing their migratory route. This "safe haven in a storm" feature makes the BTES coastal maritime forested areas very important for a great many neotropical migrants.

Historical Trends and Causes of Change

Most small migratory birds have three habitat requirements: a summer breeding habitat, a winter foraging habitat, and stopover habitats along their spring and fall migration routes. The stopover habitats are normally visited during the day and are important for resting and refueling. These three habitats form a chain in the life cycle of these migratory birds. Loss of suitable habitat within any of these three areas breaks the chain and can lead to a decline in population.

Some examples of how these small migratory birds (including neotropical migrants) depend on these three habitats are given below and are derived from the species accounts in Chapter 6.

The Yellow-billed Cuckoo is a common to sometimes abundant BTES migrant and a common BTES breeder that has undergone an average annual continental decline of 1.4%, 1966–1993, and there are strong indications that it has declined greatly in BTES as a breeder. The continental decline is associated with loss of habitat to intensive agricultural practices in the bird's breeding habitats.

The Black-throated Green Warbler is a neotropical migrant that is a common migrant in the BTES and sometimes the most common breeder in the coniferous forests of northeast North America. There have been some recent local declines in the breeding population to the north of the BTES. A decline in future abundance is expected due to deforestation of its Mexican wintering habitat.

The Blackburnian Warbler is an uncommon to common BTES migrant which is believed to have been in a historic decline due to deforestation and chlorinated hydrocarbon pesticides. While the current North American population is believed to be stable, future declines are expected from tropical deforestation.

The Prothonotary Warbler is common in the BTES in summer and a common migrant in the BTES. The continental population has undergone a decline of 1.5%, 1966–1993. Since it is a bird of swamps and bottomland hardwoods and prefers to nest in cavities, the continental decline may be associated with habitat loss.

The Ovenbird is a common BTES migrant. Its continental breeding population declined at 1% over the shorter period of 1978–1987, but increased at a rate of 0.5% over the longer period of 1966–1993. The Ovenbird is adversely affected by fragmentation of the North American forest in its breeding range because this allows for greater predation and Cowbird nest parasitism.

Like the Ovenbird, the Hooded Warbler is adversely affected by forest fragmentation in its breeding habitat which allows for increased predation and cowbird nest parasitism. It is common in the BTES in summer and its breeding

population shows a significant continental increase of 1.6%, 1966–1993. The positive population trends for the Ovenbird and Hooded Warbler would suggest maturation of forests in their breeding areas.

The Indigo Bunting is a common to abundant BTES migrant and uncommon to common in summer in the BTES. While Payne (1992) feels that the U.S. population is increasing in abundance and range, Peterjohn et al. (1994) notes that the Breeding Bird Survey (BBS) indicates a continental decline of 0.6%, 1966–1993. Local declines are noted with maturation of forests, intensification of agricultural practices, mowing of fields and roadsides, and urbanization.

The Savannah Sparrow is common in winter in the BTES and abundant and widespread in open North American habitats. There have been no discernible trends in the U.S. population since 1868, but the species probably benefited from early European colonization. Annual abundance is affected by food availability and storms. Local extinctions and declines in abundance are associated with urbanization and reversion of farmlands to forests.

The Sharp-tailed Sparrow is common in winter in the BTES. While the continental population is believed to be in a state of decline, the BBS indicates no significant continental trend. Since it is a bird of marshes, wet meadows, and river banks, it will be affected by wetland loss.

The White-throated Sparrow is common in the BTES in winter and is common throughout much of its North American range. Its North American population is currently estimated at 10–20 million birds. Its breeding population appears to be in a continental decline of 1.3% per year, 1966–1993, due to intensive agricultural practices and maturation of second growth forests.

The Bronzed Cowbird is uncommon to common in the BTES in summer and uncommon to rare in the winter in the BTES. It began a range expansion at least at the beginning of the twentieth century and was first noted in Louisiana in 1961. It is a bird of open fields and shrubby areas and benefits from agricultural practices that clear the original vegetation and/or add irrigation.

Habitat Requirements

As a group these birds require mature and second growth forests, fragmented forests, shrubby areas, wetlands, swamps, bottomland hardwoods, coastal marshes, wet meadows, and non-intensive agricultural areas. During migration they may require maritime forests, coastal cheniers, and wooded spoil banks. They eat seeds, vegetative matter, insects, spiders, and amphipods.

Major Factors Affecting the Populations

These birds are affected by habitat changes in the three different areas where they breed, winter, and migrate. Within their migratory route these birds have important habitats where they stop over to rest and refuel. Within the BTES the most spectacular stopover habitat is irregularly used by the BTES neotropical migrants.

This habitat is the maritime forested areas of the BTES barrier islands, cheniers, and spoil banks. The irregular use occurs when the birds encounter inclement weather and are exhausted during migration. When this occurs they will fall out in large numbers to rest and refuel.

Many of these birds benefit from human use of a variety of vegetative habitats, though some require contiguous second growth forests, swamps, and bottomland hardwoods. Several of these birds are cavity nesters and benefit from land use practices that leave dead limbs and trees. Many of these birds are negatively affected by Cowbird parasitism of their nests (outside of the BTES). Several are believed to be threatened with tropical deforestation, though others will benefit from this deforestation as long as it does not result in intensive agricultural or urban/suburban use of the land.

There is a largely undocumented threat to the neotropical migrants in this group from pesticide/herbicide uses in the Central and South American and Caribbean regions of their ranges.

Group Recommendations

- Preserve, maintain, and enhance marine forests and forest-like areas on the BTES barrier islands, coast, coastal cheniers, and spoil banks.

- Preserve, maintain, and enhance a variety of wooded, vegetative habitats with particular emphasis on maturing second growth forests, swamps, and bottomland hardwoods; coastal marshes, wooded cheniers, and bayou banks; old fields and non-intensive agricultural fields and pastures; and vegetative suburban and urban areas with a mix of trees, understory, flowers, and mowed and unmowed lawns and parks.

- Restrict use of pesticides and herbicides.

MAMMALS

Nutria, Nearctic River Otter, Common Muskrat, North American Mink, Northern Raccoon, Louisiana Black Bear

Introduction

Forty-eight species of undomesticated mammals representing 19 families have been identified in the BTES (see Table A.5). The species can be grouped based on its members' feeding habits as herbivores, omnivores, and carnivores.

The herbivores discussed are both prolific rodents. The Common Muskrat is a native species, in contrast to the Nutria, which originated in Argentina and was artificially introduced in North America. The Muskrat is present throughout the southern part of the state and is most numerous within the coastal marshes. Muskrats

are an important component of the marsh ecosystem, and can have a major impact on wetland vegetation especially in brackish marshes (O'Neil 1949). The Nutria is present throughout the state. This species has been implicated as the source of a decrease in vegetated marsh and the lack of regeneration in swamp forests (Shaffer et al. 1992, Conner 1993, Linscombe and Kinler 1994).

The Northern Raccoon is widespread throughout North and Central America and occurs in all parishes of Louisiana. The Louisiana Black Bear occurs in the central part of the state from the Arkansas border south along the Mississippi River to the Atchafalaya basin and the swamps of the central southern part of the state. In the mid 1960s, the LDWF introduced 161 Black Bears from Minnesota as part of a restocking program. Although properly classified as carnivores, their feeding habits are omnivorous (Lowery 1974a).

The North American Mink is widespread throughout North America, except for the desert Southwest and the Arctic, and can be found throughout Louisiana. Mink are never found far from water. They are chiefly nocturnal and remain active throughout the year. The Nearctic River Otter used to be widespread throughout North America, except for the desert Southwest and the Arctic. Currently, this species has disappeared from the interior of the United States but can still be found throughout Louisiana. Louisiana otters have been used to restock otter populations in other parts of the United States.

The Louisiana Black Bear is the only mammal occurring in the BTES that is federally listed as a threatened species

Materials and Methods

Status data for the southeastern Louisiana harvested populations of furbearers are taken from Linscombe and Kinler (1985). These are the most reliable records, because they were obtained during a period of relatively constant trapping (Kinler n.d.). These data do not cover saline marshes due to the low population densities of furbearers observed and minimal level of trapping in this marsh type.

For the Common Muskrat, these data are augmented by data on the number of Muskrat houses along the LOOP pipeline from Visser et al. (1994). Trends in the Muskrat population are difficult to determine due to the natural cycles of boom and bust, which usually last 10 to 14 years. To accurately determine trends a period of at least 50 years of data gathered in a consistent manner is needed. Fur trapping has seriously declined in the last 15 years as a result of reduced demand due to anti-fur sentiments, economic recession, and the increase in fur farms. Therefore, no recent trends can be determined from the fur harvest data. Muskrat house densities in southwestern Barataria have only been surveyed for the last 15 years and covered only one boom/bust cycle.

Historical trends of furbearer populations (up to 1985) are based on the reports on comparative take from the LDWF as reported in Lowery (1974a), Ensminger and Linscombe (1980), and unpublished reports made available to us by Greg Linscombe and Noel Kinler of the LDWF.

Historical Trends and Causes of Change

Population densities of many of the larger mammals were greatly reduced after early European colonization. The Bison were seasonally fairly abundant throughout Louisiana and the BTES in 1699. They were hunted for food and pelts, and the last one seen in the state was shot in 1803 (Lowery 1974a). The Cougar and American Black Bear were formerly fairly numerous in heavily forested areas of Louisiana. Now their numbers and range are greatly reduced because of hunting and loss of habitat.

Some mammalian species, such as the Nine-banded Armadillo and Coyote have recently expanded their range into Louisiana and the BTES. Others, such as the Old World Rats and the Nutria, have been introduced and are now common.

Some mammalian species have adapted to suburban and urban settings and are common to not unusual backyard wildlife. These include the Virginia Opossum, the squirrels, and the Northern Raccoon.

The first serious trapping of Muskrat in Louisiana started in the early part of this century, following the expansion of three-cornered sedge (*Scirpus olneyi*) which resulted from the burning of marsh to facilitate the trapping of Alligators. This early Muskrat trapping increased when Muskrat damaged cattle ranges in Cameron parish and a bounty was offered for each pelt. Soon the cattle farmers left the Louisiana marshes, but by that time enough Louisiana pelts had reached the northern fur finishers to establish their superior quality. At the same time (1912) legislation was passed to control the trapping season, and the first records of the number of pelts taken were made for taxation (Lowery 1974a). Up to 1950, the fur harvest records show the cyclical nature of Muskrat populations, with peaks approximately every 10 to 14 years, with the largest harvest in the late 1940s (Figure 3.13). This boom cycle leads to "eat-outs" that damage the brackish marsh. This population volatility was controlled by trapping during the early part of this century (O'Neil 1949). Since the early 1950s the harvest of Muskrat has seriously declined and it is generally believed that this was due to the introduction of Nutria into the Louisiana coastal marshes in the early 1940s (Lowery 1974).

The first recorded introduction of Nutria occurred in the early 1930s near New Orleans, but these Nutria were assumed to have been recovered by trappers shortly thereafter. However, more Nutria were imported into Louisiana for fur farming and soon some escaped and/or were released both for their potential for fur and aquatic vegetation control. Soon the population increased and the first trapping of Nutria started in 1944 (Lowery 1974). The number of harvested Nutria dramatically increased up to 1960 and has been stable up to 1980.

The number of harvested Raccoons has been relatively stable since the beginning of this century. The highest numbers were harvested in the 1940s and late 1970s to early 1980s and relatively few in the 1950s and 1960s. The peak harvests in the late 1970s and early 1980s might have been due to the increase in price of Raccoon fur, which reached $17 per upland and $9 per coastal pelt in the 1978–79 season (Ensminger and Linscombe 1980). In addition to trapping, Raccoons are hunted during a regulated season.

The harvest of Mink has significantly declined since the 1950s. This might be due to the disappearance of clear-cut swamp forests that were present in the 1920s. Clear-cut

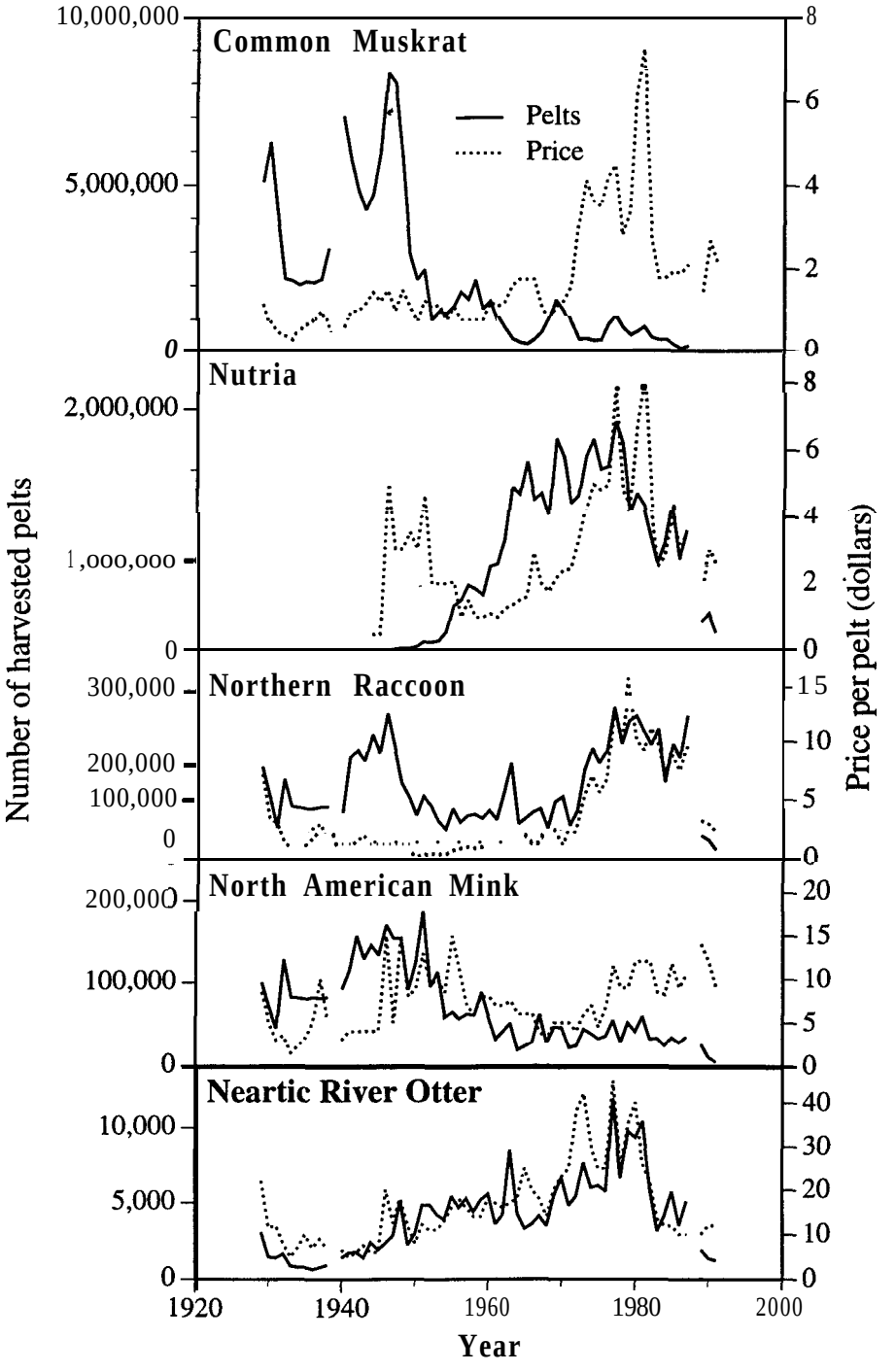

Figure 3.13. Trends in furbearer harvest and prices in Louisiana for the top five in harvested numbers, 1929-1991. Trends reflect population trends up to 1985 (see text).

swamp forest provides excellent habitat for the Mink (Linscombe and Kinler 1985). However, the demand for wild Mink also dropped considerably due to the steady supply and variation of color provided by Mink from ranches (Lowery 1974). This is reflected in the price for wild Mink, which reached a low of $3 per pelt in 1968. Since then, trapping has not increased as fur prices rebounded. This could reflect the abandonment of the trapping lifestyle or a true decrease in the Mink population. A population decrease might be related to the decreasing Muskrat population, since Mink density was correlated with Muskrat density in Louisiana marshes (Allen 1984).

Otters are still fairly numerous in the coastal marshes of Louisiana, but elsewhere, because of destruction of their habitat along streams and rivers, their numbers are probably only a fraction of what they once were (Lowery 1974). Mason and MacDonald (1986) attribute the disappearance of Otters from the interior of the United States to excessive trapping in the early part of this century and suggest that habitat destruction might have contributed but was not the main cause. Although pesticides had a significant impact on the populations of the European Otter (*Lutra lutra*), the effects of pesticides on the Nearctic River Otter population in North America have not been determined (Mason and MacDonald 1986).

Habitat Requirements

As a group these mammals range from the coastal waters, through the BTES marshes, swamps, and bottomland hardwoods, to old fields, agricultural areas, and suburban and urban settings. As a group their diet includes vegetation, fruit, seeds, insects, crustaceans, mollusks, finfish, amphibians, reptiles, birds, and other mammals.

Major Factors Affecting the Populations

Due to its prolific nature, few factors are catastrophic to the Muskrat population, except over-population resulting in "eat-outs." However, the introduction of Nutria in coastal Louisiana has presumably resulted in a decrease in the Muskrat population, especially in the fresh and intermediate marshes. This species will soon be affected by the decrease in available habitat as coastal erosion continues. However, since trapping of Muskrat has declined significantly in recent years, the potential for population explosions, especially in the brackish marsh, should be considered. These explosions could lead to locally severe habitat destruction.

The decline of the Black Bear in Louisiana has been attributed to both decrease in habitat and hunting pressure. Most Black Bear within Louisiana are found within the Atchafalaya and Tensas basins. Bears that primarily live within the Atchafalaya basin occasionally use the bottomland hardwood forests in the northern part of Terrebonne basin.

Group Recommendations

It is difficult to make group recommendations for the mammals because, other than fur harvest records, little is known about the status and trends for species in this group. Therefore, population estimates acquired in a more systematic fashion are recommended for all mammals.

Despite this absence of information, it has to be emphasized that populations of Common Muskrat and Nutria are mostly regulated by trapping. Trapping has decreased significantly due to lower fur prices. The potential for significant damage to coastal marshes exists, as highlighted by Linscombe and Kinler (1994), and bring with it the serious need to control populations of these species.

CHAPTER 4
SYNTHESIS OF POPULATION INFORMATION

Introduction

Six hundred and eighty-two vertebrate species are reported from the BTES including 208 finfish (31%), 22 amphibians (3%), 51 reptiles (7%), 353 birds (52%), and 48 mammals (7%). Apart from the most important commercial and game species, birds are the only group for which a census has been repeatedly taken. As time and data allowed, the authors added to the list provided by the Barataria-Terrebonne National Estuary Program (BTNEP) Scientific/Technical Committee some additional species and species groupings. Purrington (1995b) has, for example, provided extremely valuable, qualitative population assessments for all of the BTES birds and trends for many. His status information is included in Table A.4 (see Appendix A) and his trend information incorporated in the text of Chapters 3 and 6. The complete analysis summarized here involves trend data from the BTES for 136 species, of which 104 (76%) are birds, 10 are finfish, nine are reptiles, six are aquatic invertebrates, six are mammals, and one is an amphibian. Trend data were not available for 23 species/ species groupings selected by the Scientific/Technical Committee.

The species information is catalogued taxonomically in Chapters 3 and 6, but this is not necessarily the most meaningful approach from an ecological perspective. Here, we divide the species into harvested and unharvested categories. We summarize for the harvested species the salient points derived from an original analysis of population data or an expert assessment of harvest data (furbearers). We consider, second, groups of birds that are not currently subject to legal harvesting. These bird groups, when considered together, have the greatest potential to reflect the effects of habitat change within the BTES through noticeable changes in population density. The indicator groups include seabirds, wading birds, marsh birds, raptors, and a diverse group of birds that thrive on mixed field and wooded habitat. Finally, we conclude this synthesis with a consideration of the threatened and endangered vertebrate species.

Harvested Animals

Population data for animals that support significant recreational harvests are surprisingly low for most animals and most locales, even if reasonably good take information has been collected. The BTES does not differ from most estuaries in the nation in this respect. More long-term harvest-independent population data are
available for a number of shellfish and finfish species in the BTES than in probably any other estuary in the United States, largely because the BTES supports such important recreational

and commercial fisheries and local managers were quick to recognize the importance of this information.

Animals considered in this section include invertebrates, fish, amphibians, reptiles, birds, and mammals. Fisheries-independent population information does not exist for any freshwater fish, amphibians, reptiles, or mammals, except for the American Alligator. On the other hand, the finfish analysis includes some species like the bay anchovy that are not targeted by fishermen but are collected incidentally by the LDWF in seines, trawls, and trammel nets used to assess commercially important shrimp, crab, and finfish populations. The waterfowl data include both migratory and resident species. The assessment of mammals is limited to commercially trapped furbearers.

All of the information on harvested species is brought together to provide a sense of how commercial and recreational species are managed in the BTES. This information is very important to those who hunt, fish, and trap, but it does not necessarily have the same value from an ecological standpoint as do population data about unharvested species that compete for breeding and foraging habitat in the absence of hunting and fishing pressure.

Aquatic Invertebrates

The LDWF has collected excellent CPUE population information on Brown and White Shrimp in the BTES since 1967, and on Pink and Seabob Shrimp since the early 1980s. All of these shrimp are taken in the commercial and recreational shrimp fishery that is an economic mainstay of many BTES communities. The scientific population assessment program currently carried out by LDWF originally arose out of a concern that shrimp populations could be negatively affected by fishing pressure. That pressure had increased significantly with the changeover in the 1940s from an inshore/nearshore to an inshore/nearshore/offshore fishery. Brown Shrimp populations are about equal to White Shrimp populations today, but this was not always the case. Long-time observers of the shrimp industry described a dramatic decline in White Shrimp harvests between 1948 and 1962, a decline from which that species appears to have at least partially recovered.

White, Brown, and Pink Shrimp are estuarine-dependent species that spawn offshore and enter the estuary as postlarvae. They grow along the edges of the salt and brackish marsh vegetation as juveniles and collect in deeper bays and channels for migration offshore as adults. The timing of estuarine usage and migration differs significantly among the species. Much less is known about the Seabob Shrimp, which is not considered as dependent on the estuary as the others.

The data from the past 30 years show no sign of a dramatic shift in dominance among the principal species, as apparently occurred prior to the start of systematic sampling. All shrimp populations appear to be stable, at least to the extent that only one trend, that of an increase in Seabob Shrimp, was statistically significant. Scientific management of the shrimp fishery appears to be effective in preventing overharvesting, although very large interannual variability persists.

Blue Crab are found in all parts of the estuary except the freshwater swamp. They require salinities greater than 20 ppt for spawning. Juveniles appear to seek grass beds and the marsh/water interface to avoid predation, particularly when molting. Prime spawning grounds are found on the higher salinity sand flats on the bay side of the barrier islands. Blue Crab populations in the BTES are high and appear to be stable to increasing.

The Eastern Oyster is an estuarine resident whose distribution within the BTES has benefited greatly from human involvement. Barataria-Terrebonne oystermen, in cooperation with the LDWF, practice a form of marine farming. A system involving private leases, and a supply of spat and culch from public beds by the state, was put in place to save the industry from overharvesting in the late 1800s. Generally this system has worked well. BTES trends for spat production show increases since 1990, suggesting that conditions for successful reproduction have been good in the relatively wet years of the early 1990s. However, water quality remains a serious concern for the oyster fishery.

Finfish

Thirty-seven freshwater finfish species have been reported in the BTES, accounting for 18% of the total number of fish species. Many of these freshwater fishes, including Blue Catfish, Largemouth Bass, and Channel Catfish, can tolerate or even thrive in low-salinity waters (less than 10 ppt). Other species prefer waters below 5 ppt, but most can tolerate some salinity. Both Blue and Channel Catfish are benthic, open-water species, though they spawn along protected undercut banks. Bass and Sunfish like the cover provided by submerged aquatic vegetation or marsh grass. Although there is much speculation among commercial and recreational fishermen regarding changes in the stocks of some of these fish, no CPUE data exist that would allow determination of shifts in population. The lack of information on freshwater fish is an important data gap, particularly if projects like river diversions are to be undertaken. Freshwater species would be likely beneficiaries of such projects, and long-lived benthic species like catfish would be good candidates to monitor possible build-up of toxic chemicals.

The remaining fish reported from the BTES fall into three types: estuarine resident fish, estuarine/marine, and marine, depending on the degree to which they are dependent upon the estuary. One hundred twenty-one (58%) fish reported from the BTES, including many of the most prized gamefish like Tarpon and Amber Jack, are marine species that are sometimes found in the estuary but are not dependent on it. They are not discussed further in this report. We report here in more detail the status and trends information on the estuarine resident and estuarine/marine species, which include 24 (12%) and 26 species (12%), respectively.

Very little population data exist for the Minnows, Killifish, Silversides, and Gobies that spend their entire lives in the estuary, the resident estuarine species. They are found from freshwater headwaters to the Gulf and several species are among the most abundant of any fish in the system. They are ecologically significant as forage fish for most of the commercially and recreational important finfish species. The Gulf and Longnose Killifishes are the best known and

generally are the most abundant fishes found in seine samples from the marsh edge and open beaches in the lower reaches of the estuary. The Bayou and Saltmarsh Killifish are less common and are often found in shallow marsh coves and creeks on the bay side of barrier islands. CPUE data for the Gulf Killifish suggest that there has been a large and stable population over the past decade.

The fish that support the vast majority of the recreational and commercial finfish fisheries are all estuarine/marine species that spawn offshore in the open Gulf of Mexico or, in the case of Spotted Seatrout and Bay Anchovy, in lower portions of the estuarine bays. Larvae and young juveniles use the BTES as a nursery. Subadults and adults migrate out of the estuary to the Gulf. Some make no further use of the estuary but several important species return to its lower reaches.

This category contains both the most abundant prey and predator species. The Bay Anchovy and Gulf Menhaden are among the most abundant members of the fish community. The Bay Anchovy appears to be common throughout the BTES in fresh water and salt, tolerating lower oxygen levels than most other fish. The Gulf Menhaden supports an important industrial purse seine fishery for the adults offshore, while the young and juveniles favor soft mud bottoms along marsh edges and tend to move toward the Gulf and more open estuarine waters as they grow. It would be inaccurate to say that the populations are stable as interannual variability is high in the CPUE for these two important forage species, but there does not appear to be any consistent trend toward an increase or decrease.

The Spotted and Sand Seatrout return to the estuary as adults, and support important estuarine commercial and recreational inshore fisheries. The Spotted Seatrout is one of the few estuarine/marine species that spawns in the lower reaches of the estuarine bays. Young Sand Seatrout prefer soft-bottomed open-water areas while juvenile Spotted Seatrout seek more sheltered marsh edge and grassbed habitats as nursery grounds. Sand Seatrout are well sampled by the trawl and seine methods used by LDWF for CPUE sampling, while spotted seatrout are believed to avoid all but gill and trammel nets. The Sand Seatrout appears to be increasing but the trend is not significant, while the data for Spotted Seatrout suggest that the population has not changed in recent decades.

The Red Drum and Black Drum are long-lived. This characteristic has led to implementation of management strategies, at least for Red Drum, to ensure spawning by multiple year classes. Postlarval and small juvenile Red Drum appear to seek the marsh edge and mud bottoms in tidal creeks on the bay side of barrier islands, while large adults are found in large numbers in the deepest parts of tidal passes between the islands. The young of the year are widely dispersed throughout the bayou and canal systems with some salinity. The nursery habitat requirements of Black Drum are not known, but it appears that this species may spend more of its life in the estuary than does the Red Drum. It is more of a benthic feeder than the Red Drum, and prefers muddy bottoms as a juvenile and shell reefs as an adult.

Striped Mullet support important commercial fisheries in Louisiana. They migrate to the Gulf to spawn, but adults apparently return to take up residence in the estuary, although they are also found along muddy Gulf beaches. Mullet ingest plankton. Young mullet appear to seek

shallow, mud-bottomed marsh ponds and bayous. Extremely high interannual variability obscures any consistent trend.

The Atlantic Croaker uses the BTES almost exclusively as a nursery ground. Juveniles favor soft organic-rich waterbottoms wherever they are found in the lower estuary. The population appears in CPUE data to be more cyclic than most and to be presently increasing from a low in the late 1980s though this trend is not significant. Over the full period of record from 1967 to 1994, the population appears essentially stable.

The Southern Flounder is not common in the BTES. It occurs just offshore of soft-bottomed marsh beaches. Little is known about where the flounder spawns or the habitat preferred by juveniles. Long-term records from the BTES and statewide suggest that this species may be in decline, but the trend is not significant.

Population data are available to assess finfish status and trends for a single resident estuarine species and for nine estuarine/marine species. However, there were no statistically significant trends for any of the finfish species, and generally the populations are assumed to be stable over this period.

Amphibians

Virtually nothing is known about the populations of seven species of salamanders and 13 species of frogs and toads reported from the BTES. The Bullfrog and Pig Frog continue to be harvested despite evidence that their populations decreased precipitously in the 1930s and have not recovered since.

The lack of abundance and trend data on amphibians is common on a worldwide basis. This lack of basic data is of concern for three reasons.

First, amphibians are considered to be an indicator species. They are extremely sensitive to environmental changes in temperature and moisture. Their permeable skin makes them susceptible to the uptake of toxins in the air and water. Their national abundance is often diminished by pollution. Most recently, it appears that some populations may be sensitive to increases in ultraviolet rays associated with the thinning of the ozone layer (Blaustein et al. 1994).

Second, in many regions of the world, populations of amphibians have recently experienced apparent dramatic declines (Bradford et al. 1994). Probable reasons for these apparent declines include overharvest, habitat loss and degradation, pollution, introduced species, and increases in ultra-violet radiation. Quantification of these apparent changes is often precluded because of a lack of historic data on status and trends.

Third, the consequences of loss of amphibians can be detrimental to human ecology. For example, with the demise of the U.S. and French bullfrog populations, Bangladesh began an export-oriented fishery on its native wild bullfrog. The government recently ended the export trade when it learned of the environmental consequences. In their natural state, the bullfrog population kept insect populations under biological control, thus limiting crop damage and illnesses such as malaria. With reduced frog populations, the native farmers were forced to

import pesticides. The Bangladesh government concluded that the export value of the bullfrog fishery was not sufficient to offset the environmental and societal costs associated with a diminished bullfrog population.

The BTES amphibians are directly or potentially threatened by wetland habitat loss and degradation, pollution, and increases in ultra-violet radiation. In addition, the Bullfrog and probably the Pig Frog continue to be overharvested.

Reptiles

Little information is available about the turtles of the BTES. Undisturbed barrier island and beach habitat are required for nesting by sea turtles. None of the five sea turtles is reported to currently nest in the BTES, although Loggerhead nesting was reported in Louisiana in 1962. All are either threatened or endangered and some are believed to be among the animals most imminently facing extinction in the U.S. today.

Two of the 16 freshwater and brackish water turtle species, the Snapping Turtle and Alligator Snapping Turtle, are commercially harvested in the BTES. The Snapping Turtle occurs in permanent ponds, lakes and bayous, but is sometimes found in brackish water and on land. It feeds on a wide variety of animals, from invertebrates to fishes and mammals. This turtle is eagerly sought by hunters. The population is believed to be overfished, depressed and in decline, but no census information is collected. The Snapping Turtle would appear to be a good candidate for protection in the future. Alligator Snapping Turtle is heavily depleted in Louisiana. The Diamond-backed Terrapin may be declining in Louisiana, but there is disagreement on its status.

The American Alligator is the one reptile for which extensive population information exists. They are the largest predator remaining in the BTES. Alligators can be found from the swamps of the northern basins to the brackish marshes but nesting is generally restricted to marshes unaffected by salinities greater than 10 ppt. The alligator is listed by the federal government as "threatened due to similarity of appearance". The commercial harvest of Alligator was closed in 1963 in Louisiana and populations recovered so quickly that a limited harvest has been permitted since the early 1970s. American Alligator populations are not currently in danger of decline in Louisiana or the BTES. Surveys conducted in the BTES show that all recorded breeding populations have been either stable or increasing over the past 10 years. It is expected that population densities in the BTES will stabilize in the future at levels similar to those currently reported from southwestern Louisiana marshes. Although the population appears to be increasing in conjunction with an aggressive egg harvesting program, it is unknown what the long-term effects could be. The recovery of the alligator indicates that their preferred foods and nesting sites continue to be available. Young alligators feed on insects, small fish, crawfish, crabs, small amphibians, and reptiles. Larger alligators feed additionally on birds, particularly ducks and wading birds, and on Nutria and Muskrat. Predation by alligators is believed to have been an important control for many marsh animals, which was removed during the period of

overharvest. In a future without significant trapping, alligators may once again become the principal control on Nutria and Muskrat.

Waterfowl

Thirty-five species of swans, geese, and ducks are reported from the BTES. This total includes the Trumpeter Swan, which is locally extinct. Harvest-independent population information is available from the BTES for 14 species if the Greater and Lesser Scaup are considered together. Published Louisiana harvest information is available only for the Wood Duck.

Most of the waterfowl found in the BTES in the winter are not year-round residents. They are migrants that breed outside of the BTES, like many of the commercially important finfish species. The BTES is of international significance as a wintering ground for migratory waterfowl, attracting a significant percentage of all North American dabbling ducks. Only the Wood and Mottled Duck nest within the BTES and can be considered resident. Louisiana is home to half of the North American Mottled Duck population.

The population status of migratory geese and ducks is significantly determined by factors outside the BTES, while resident populations are more reflective of local conditions. On the other hand, ducks and geese are highly opportunistic and will seek superior winter feeding grounds. Increasing wintering populations indicate that at least good habitat exists for particular species within the basin. However, changes in wintering waterfowl populations can be explained by a variety of factors that are independent of the total population size, for example, increased flooding of cornfields in the Midwest to attract waterfowl and weather that influences southward migration.

Few geese have traditionally wintered in the BTES. They continue to be found in relatively small numbers in western Terrebonne around Fourleague Bay and Point au Fer Island where flocks feed on large stands of the intermediate marsh species, Olney's three square, when the marsh is flooded. The North American breeding population is on the rise and this is contributing to increases in wintering geese in southwestern Louisiana, but increases have not been noted in the BTES.

Dabbling ducks and geese seek out shallow ponds and flooded freshwater marsh to feed, although many will also graze in agricultural fields. They eat seeds, sedges, submerged aquatics and other vegetable matter, but the Blue-winged Teal, Mottled Duck, and many other species supplement this diet with insects and molluscs. Species seeking primarily freshwater habitat in Barataria were observed in the winter of 1992-93 to rank in decreasing order of abundance as follows: Green-winged Teal (4.42-100 ha^{-1}), Blue-winged Teal (3.75-100 ha^{-1}), Mallard (1.78-100 ha^{-1}) and Mottled Duck (0.97-100 ha^{-1}). Of these, the Green-winged Teal, and Mottled Duck populations have increased over the past decade, while mallards have decreased.

Brackish marshes, particularly if they include ponds with submerged aquatics, are also heavily used by dabbling ducks. Species seeking primarily brackish marsh habitat in Barataria were observed in the winter of 1992-93 to rank in decreasing order of abundance as follows:

Gadwall (46.84-100 ha^{-1}), Northern Shoveler (1.96-100 ha^{-1}), American Wigeon (1.65-100 ha^{-1}) and Northern Pintail (0.26-100 ha^{-1}). Of these, the Gadwall and Northern Shoveler appear to be increasing in abundance in Barataria, while the Northern Pintail has decreased over the past decade.

Diving ducks feed in large shallow freshwater lakes and more brackish bays and rest in large rafts far from shore. Scaup are the most numerous of the diving ducks (1.63-100 ha^{-1}) in Barataria's large brackish lakes although they are also common in the Gulf. They have a diverse diet including both plant and animal material, including fish, clams, snails, and crabs. Three other diving ducks were observed in the winter of 1992-93 to rank in decreasing order of abundance as follows: Red-breasted Merganser (0.63-100 ha^{-1}), Hooded Merganser (0.37-100 ha^{-1}), and Ring-necked Duck (0.01-100 ha^{-1}). The Ring-neck feeds primarily on plants, but the Mergansers are primarily fish eaters. Populations of both Mergansers are increasing in Barataria.

The Wood Duck has very different habitat requirements from the Mottled Duck, the only other resident species, but both are increasing in Barataria-Terrebonne. Wood Ducks nest in cavities in mature (>60 years old) swamp and bottomland hardwood trees. They feed on seeds and nuts but ducklings require some animal food, mostly insects. Populations in the BTES are considered to be limited by the availability of nesting cavities. This limitation has been successfully alleviated in younger forests by provision of artificial nest boxes.

Census information gathered over the past decade in Barataria indicates that the populations of a majority of the common ducks, 8 of 13, are increasing. The populations that are increasing use all of the wetland and aquatic habitats of the estuary from bottomland hardwoods to open bays and salt marshes, and include both fish and plant eaters. The two species that are declining in the BTES, the Mallard and Northern Pintails, are also declining nationally. Winter habitat reduction, particularly loss of irregularly flooded bottomland hardwoods, has been proposed by some experts as one reason. Loss of such habitat has been extensive in the BTES over the past 20 years due to clearing and expansion of forced drainage districts.

Maturing second growth swamp and bottomland hardwoods should offer increased nesting opportunities to wood ducks, while estuarine habitat and food sources in the BTES appear to be supportive of increased wintering populations of migratory ducks and breeding populations of the mottled duck. It is expected that wintering habitat will become limiting for more of the waterfowl that use the BTES in the future as restoration of northern nesting habitat proceeds.

Mammals

Forty-eight mammals are reported for Barataria-Terrebonne, including 10 species of bats, one dolphin, and animals like the Bison and Florida Cougar that are locally extinct. Despite this very diverse fauna, published harvest-independent information is available only for the Common Muskrat. This rodent builds conspicuous raised houses in the marsh that can be readily counted from the air. Other data analyzed are limited to commercial fur harvest records for four other species: the Nutria, Northern Raccoon, North American Mink, and the Nearctic River Otter. World demand for pelts of all kinds has been depressed for 15 years, so recent fur harvest data is less useful as a population index than it was in the past.

The Common Muskrat is a prolific, short-lived species that naturally exhibits cycles of population boom and bust, generally lasting 10 to 14 years. The Muskrat eats wetland vegetation and is now largely confined to brackish and saline marshes in the BTES, although it is widely distributed in freshwater marshes in other regions where it does not compete with Nutria.

Trend data for periods of 50 years are needed to extract multi-cycle trends. State records of harvest from the commercial trapping industry began in 1915 and are useable through 1985, but muskrat house surveys have been conducted only since 1980. The peak muskrat harvest occurred in Louisiana in 1950 and was followed by a precipitous decline in the 1950s and a more gradual decrease through three cycles until the end of the useful record in 1985.

The introduction of Nutria from Argentina in the early 1940s is believed to have been the principal cause of the apparent contraction of Muskrat range in Louisiana's coastal marshes over the next three decades. Nutria share many of the food preferences of muskrat, but will also eat young bottomland hardwood and swamp shrubs and trees and crops including sugarcane and rice. Nutria are now ubiquitous in the BTES freshwater swamps and marshes but are less frequently seen in brackish and saline marshes.

It is believed that nutria populations will eventually experience cycles like those of the Muskrat but the useful harvest record (1950 to 1985) is too short to verify this. The first 20 years documents a rapid expansion following invasion, leaving only about 15 years for free cycling. The current population status of Nutria in the BTES is unknown, though presumed high. Marsh "eat-outs" caused by nutria have recently been mapped from the air for the first time in the BTES and will be resurveyed to provide some harvest-independent indications of at least very high populations.

The Louisiana pelt harvest from Muskrat alone in 1950 (8 million) was nearly four times larger than the largest subsequent combined harvest of both Muskrat and Nutria, which occurred in 1980. This is probably related to the difference in size of the two species. Nutria are much larger, averaging six to eight times the weight of the Muskrat. Presumably each Nutria requires a larger foraging area and food supply than does a Muskrat, but it seems unlikely that the amount of fresh and intermediate marsh available today in coastal Louisiana could support the immense populations of animals that it apparently did as recently as 1950. It appears likely,

therefore, that habitat loss has played a role in driving competition between the Nutria and Muskrat, and in the apparent decline of Muskrat populations generally.

Muskrat house surveys in Barataria provide the most recent BTES data on population for this species. They indicate that population in the brackish and saline marshes increased through the 1980s, peaked in 1991 and 1992 at levels of more than 1 house per ha, and is now declining. Populations in the fresh to intermediate marshes remain depressed. It is expected that alligators will exert additional predation pressure more heavily on Nutria than on Muskrat as alligator populations increase in the part of the range of both species dominated by the Nutria.

Muskrat and Nutria—when they are present in great numbers—can degrade the marsh and, where subsidence is rapid, appear to hasten conversion to open water. They will completely denude areas of emergent marsh vegetation, thereby causing loss of sediment and a reduction in the ability to trap newly introduced sediments. Loss of sediment translates into loss of elevation, which is critical to marsh sustainability in most of the BTES, as is documented in a companion report.

The Northern Raccoon is found in the BTES from suburban backyards to the coastal barrier islands. It is trapped for its fur and hunted for food. Its current population status is unclear as recent trapping records provide little reliable information. The Raccoon has historically been most abundant in the swamp where it builds dens in tree hollows 10 to 15 m above the forest floor. It is omnivorous, swims well, and is quite resourceful in seeking high ground when the marsh floods. Fur harvests at least since 1950 were driven largely by price rather than availability and do not show the cyclic volatility of the Muskrat population. Near-record harvests characterized the last decades before the price dropped, suggesting that populations were quite high at that point. As trapping pressure has declined precipitously since then, there is little reason to suspect that populations are much lower today. Raccoon populations should benefit from the maturing of the second-growth swamp as additional nesting cavities become available. Raccoons are more severely limited by lack of suitable dens in the marsh than in the forests, but have been able to use a variety of human structures to maintain breeding populations on several of the largest barrier islands. There, they find abundant food—debris washed up on beaches, trash left by campers, and, very importantly, eggs of nesting birds. It is likely that predation by Raccoons is an important factor limiting the production of many nesting colonial seabirds to the smallest, most flood-prone and most isolated barrier islands in the BTES.

The North American Mink and Nearctic River Otter are important predators on fish, but crawfish, crabs, frogs, turtles, snakes, rodents, and birds are also eaten. The smaller Mink tends to have the more varied diet. They are both found throughout the wetlands of the BTES but Mink are most numerous in the swamp and fresh marsh, while the Otter is most commonly trapped in the brackish and intermediate marsh. Mink are principally tree cavity nesters but use Muskrat houses in the marsh. Otters build dens in the banks of bayous.

Mink and Otter always produced the most valuable pelts, bringing five to 10 times the price of a Muskrat pelt. Otter and Mink pelts brought as much as $40 and $15 a fur in the early 1980s. Fur harvest data for the Mink and Otter up to 1985 suggest that Mink populations may

be in decline, as harvest did not increase in the 1970s and 1980s when prices were high. In contrast, there were near-record Otter harvests in the early 1980s and harvest always closely followed price for this valuable species. It is believed that Otter populations are stable in the BTES in contrast to the general decline noted elsewhere in the more riverine populations of North America. Many theories have been advanced for the apparent decline of the Mink in Louisiana but no definitive assessment has been made.

Unharvested Birds—Indicator Species

The BTES contains nationally significant breeding populations of many sea and wading birds that nest colonially, including large portions of the national breeding populations of Sandwich Tern (77%), Forster's Tern (52%), and Black Skimmer (44%). Colonial seabirds nest on beaches, primarily on the most inaccessible of Terrebonne's barrier islands, and on small islands in the salt marsh.

Barrier island habitat has been reduced proportionally more than any other in the BTES in the last 40 years. The most important islands for bird nesting are predicted to disappear within the next few decades unless major restoration work is done. The islands move landward in response to wave washover, as do coastal barriers in many parts of the world. The BTES islands are distinct from most other U.S. barrier islands, however, in that they have exhausted external sources of sand that moved with the littoral drift system from deltaic headlands. As they sink, more of the sand is lost below the wave base and the island area shrinks. The pace of barrier island loss has accelerated over the past two decades and is most dramatic for the few islands most used by seabirds. Islands are now being restored with dredged sand as part of the coastal restoration program. New areas have quickly attracted breeding seabirds.

The abundant colonial wading birds of the BTES nest throughout the estuary, but primarily in the swamp. The swamp forest has not experienced significant land loss at least in the southern two-thirds of the BTES over the past 40 years. Smaller numbers of less abundant waders nest on salt marsh islands and barrier islands. The salt marsh has experienced the most loss since at least 1978 of any marsh type in the BTES, but has probably increased the availability of the small, wrack-covered islands used by a few species for nesting.

Differences in the nesting habits and success of the two groups of colonial birds are compared in the first indicator group below—colonial sea and wading birds. Many colonial nesters forage widely over a variety of different wetland habitats. Some, like the Brown Pelican and the Great Blue Heron, are among the largest birds in North America and all seabirds and waders are predators that sit at or near the top of the estuarine food web. They consume a wide variety of freshwater and marine invertebrates and vertebrates. The Cattle Egret, a naturally invading species that began breeding in the BTES in the 1950s, commonly feeds in upland pastures in association with domestic cattle. The colonial nesters of the BTES are a true ecological indicator group for which we have a remarkable amount of high quality data for nearly 20 years (Visser and Peterson 1994, Visser et al. 1994).

Abundance and trend information from the BTES for birds other than waterfowl and the colonial sea and wading birds is qualitative in nature but reflects reviews of quantitative bird count data, mainly by Purrington (1995b). Christmas Bird Counts (CBC) have been conducted since 1960 by the New Orleans Audubon Society in a 15-mile-diameter circle around that city. The route is only partially within the BTES and covers an area that has undergone urbanization during the period of record. Purrington (1995b) has made an effort to separate trends that apply only to the New Orleans area from those that are believed to be more representative of the BTES, by considering New Orleans CBC results together with data from other compilations, such as the U.S. Fish and Wildlife Service Breeding Bird Surveys (BBS).

Eagles, ospreys, hawks, and owls are large, wide ranging predators with well-known nesting and foraging habitat preferences. Some of the most conspicuous that are active during the day, even if rare, are well represented in bird counts. The second indicator group of raptors includes species that forage or nest in upland, swamp, and marsh habitats.

Marsh is being converted to open water in the BTES at a rate of more than 20 square miles per year—the most widespread habitat change in progress in the BTES. A few conspicuous birds that can be considered primarily marsh species that are not colonial nesters are included in an indicator group titled "other marsh birds." These are a diverse group ranging from winter visitors like the American White Pelican and American Coot to residents like the Anhinga and Common Moorhen.

We review a group called "common birds of cities and towns," as these are the ones that enrich the lives of the most people every day. These are birds that tolerate or benefit from living in close proximity to people. As the records come largely from outlying areas of New Orleans that have experienced suburban and urban development over the past 35 years, they may provide a glimpse into the future for upland areas elsewhere in Barataria-Terrebonne that are now being converted from intensive agricultural to suburban use.

Colonial Sea and Wading Birds

An extensive body of population data exist for the diverse colonial nesting seabird and wading bird populations of the BTES. Most species nest in a relatively small number of mixed-species colonies. Birds and colonies are conspicuous from the air and have been counted systematically by the LDWF, USFWS, and by Louisiana State University researchers since 1976 (see Tables 3.4 and 3.5). Populations have been estimated periodically by the USFWS and LDWF. Here, information about nesting habitat availability and suitability is summarized for the seven most abundant seabirds and nine most abundant wading birds.

The seabirds and wading birds are listed in Table 4.1 in decreasing order of the number of colony sites that were used from 1976 to 1994. The 1994 BTES population

Table 4.1. Summary of colony counts for colonial seabirds and wading birds in the BTES: 1976–1994.

	Habitat[1]	1994 Pop.[2]	Chg. Pop.	Colonies	Peak #	% Peak #	All Colonies	Stable[3]	% Stable
Seabirds		(1,000s)	76–94	Active '94	1976–94	Active '94	1976–94	Active '94	Active '94
Forster's Tern	Salt Marsh Island	1	NC	14	29	48	44	7	50
Black Skimmer	Barrier Island Spits, Beach Washover	2	--	13	24	54	33	10	77
Least Tern	Beach Washover, Barrier Island	1	NC	6	15	40	24	4	67
Laughing Gull	Barrier Island Dunes, Salt Marsh Island	54	--	15	18	83	25	9	60
Royal Tern	Barrier Island	15	NC	6	8	75	8	6	100
Sandwich Tern	Barrier Island	11	+	6	7	86	7	6	100
Brown Pelican	Barrier Island Dunes	2	+	3	4	75	4	3	100
mean						66			79
Wading Birds									
Snowy Egret	Swamp, All Marsh	2	NC	38	53	72	88	22	58
Great Egret	Swamp, Marsh, Barrier Island	3	NC	32	45	71	82	17	53

Tri-colored Heron	Swamp Marsh, Salt Marsh Island	2	NC	29	50	58	70	18	62
Little Blue Heron	Swamp, Fresh Marsh	4	NC	24	38	63	59	16	67
Cattle Egret	Swamp, All Marsh	3	NC	18	23	78	38	10	56
Black-crowned Night Heron	Swamp, Marsh, Mangroves	1	NC	15	21	71	54	9	60
Great Blue Heron	Swamp, Fresh Marsh	1	NC	9	22	41	30	8	89
White Ibis	Swamp, Willows, Mangroves	0.5	+	12	17	71	28	5	42
White-face & Glossy Ibis	Salt Marsh Island	1	+	13	17	76	21	9	69
mean						67			62

[1] In order of preference
[2] Carloss (1995)
[3] Stable colonies are those continuously occupied for 10 years or more.

information shows that birds that have used the most nesting sites are not the most numerous. There are more Laughing Gulls than all other seabirds and wading birds combined. Royal Terns and Sandwich Terns also have large populations relative to the other species, but these three species have occupied a modest number of breeding sites over the past 18 years.

Most BTES seabird species nest on Isles Dernieres, the westernmost barrier islands that form the seaward boundary of Timbalier and Terrebonne Bay. They are remote, accessible only by boat, and some are small enough not to harbor breeding populations of raccoons. The seabirds that have used the most nesting sites are those that breed either exclusively outside of the barrier islands or will use other, less-isolated beach habitat.

Forster's Tern has a more inland distribution than other seabirds because it nests on the small salt marsh islands that are plentiful at the edges of large expanding bays. It has a stable population and should not be subject to the barrier island nesting habitat limitations that affect other seabirds. Laughing Gulls have recently started using marsh islands in addition to their traditional barrier island dune habitat. Black Skimmer and Least Tern use unvegetated beach washovers from Point Au Fer to the Plaquemine shore. The Skimmer also colonizes supratidal bars that occur at isolated passes and beaches.

Non-barrier island sites are occupied less regularly and are more frequently abandoned by the species that use them. Barrier island sites tend to be maintained for 10 years or more. The marsh nesting Forster's Tern has occupied the most sites of any seabird, but only half of these sites have been stable (>10 yrs old). The Royal Tern, Sandwich Tern, and Brown Pelican nest only in stable colonies on the islands, but appear to be increasing their nesting on restored islands.

Breeding populations of the Sandwich Tern and Brown Pelican are increasing in the BTES but are currently confined to a relatively small number of barrier island sites that are close to the maximum used in any previous year. Brown Pelicans have increased since a breeding population was reestablished to the BTES in 1971. Their success following local extinction was made possible by the reduction in use of and eventual ban on DDT and other persistent, bioaccumulating pesticides, and by the availability of suitable barrier island nesting habitat. The colony data suggest that any additional population increases may well depend on barrier island restoration efforts. The Sandwich Tern appears to be even closer to its maximum as it is currently using 86% of all sites it has occupied since 1976, and all of these sites have been used for more than 10 years. Given the changes that these insubstantial islands undergo with every storm, it is more remarkable that so few suitable sites have been lost than it is surprising that the birds cannot find new ones.

The Black Skimmer and Laughing Gull are experiencing decreases in population in the BTES. The Black Skimmer established a number of new sites in the mid 1980s outside of the barrier islands but has decreased its use of these sites in recent years. It nested in 1994 at only 54% of the sites it occupied in 1983 (the peak year) and is becoming increasingly restricted to its more isolated barrier island colonies. Laughing Gull colony counts peaked later with the establishment of a number of small colonies on marsh islands, though some of these have since been abandoned. The Laughing Gull continues to occupy 83% of all sites, however, so it is not

clear whether the trend toward a reduction in colonies and population will continue or is a temporary fluctuation.

For both the Black Skimmer and Laughing Gull, it appears that the barrier islands are the mainstay of the populations and that temporary establishment of colonies elsewhere may be an initial response to population pressure. The fact that both of these birds have had larger populations in the recent past and that the Black Skimmer, at least, is actively colonizing recently created islands suggests that food availability is probably not a limiting factor. Another possibility is that the few old colonies available on the barrier islands may not be able to support the breeding populations that they once could and that new, relatively unsuccessful colonies established in less suitable habitat cannot offset the general decline. This could be a result of continuing erosion and contraction of the nesting habitat, crowding, or any number of subtle factors. If this is the case, it is possible that the recent decrease in these species could be the beginning of a more general long-term decline.

Although Least Tern numbers are believed to be stable, the colony statistics are quite similar to those of the Black Skimmer. Since 1990, the number of active colonies has dropped by nearly half. Both the Black Skimmer and Least Tern nest at Fourchon in areas that are frequently disturbed by humans, dogs, and vehicles. Breeding success at these less isolated locations occurs only when washovers and tidal channels temporarily isolate parts of the beach and stop traffic during the breeding season. Human protection of colonies during nesting in this location likely would have significant positive effects for these species that seem to be able to tolerate a somewhat higher level of human contact than others.

All of the BTES wading birds nest in trees or shrubs. Most colonies, with the exception of those of the White-Faced and Glossy Ibises, are found in the swamp. Most species will, however, nest on barrier islands and in almost any marsh, fresh to salt, where shrubs or mangroves are available. The White-Faced and Glossy Ibises are exceptions, nesting primarily on salt marsh islands. The wading birds tend to establish and abandon a larger number of colonies for a given population size than do the seabirds, although they also use a large number of stable sites (Table 4.1). This may reflect the much greater variety of suitable nesting habitat available to these birds.

Many of the wading birds of the BTES were hunted to very low levels a century ago for their plumage. Populations of the Snowy Egret, Great Blue Heron, White-Faced Ibis, and Glossy Ibis are known to have been affected by pesticides in the more recent past. Today, however, it appears that most populations in the BTES are stable, suggesting that any population rebound from these stresses has probably already come and gone. Apparent increases in the Ibises could be related to recovery from pesticides.

Table 4.1 does not contain information available in Chapter 3 for the Gull-Billed Tern and Caspian Terns, each of which maintains a single colony in the BTES on barrier islands. Their populations are judged to be less than 200 birds, but stable. Two additional colonial wading birds described elsewhere do not appear—the Reddish Egret and the Roseate Spoonbill. Colony counts are not as meaningful for the Reddish Egret as it sometimes nests alone. The Reddish Egret is a beautiful fisher of sandy flats and tide pools that nests in mangroves on

barrier islands. Although a small population exists in the BTES, they have nested only intermittently at two colonies since 1976. Important colonies for this species are located outside of the BTES on the Chandeleur Islands. No nesting was observed in the BTES in 1994.

The Roseate Spoonbill has only begun nesting in the BTES since 1990 in an apparent eastward expansion of its local breeding range. The first colony was established on the westernmost barrier in Terrebonne and a second was started a year later in shrubs on a bank of dredged material at a slightly more inland site on Bayou Lafourche.

Raptors

Habitat loss and the toxic effects of organochlorine pesticides caused significant declines in all of the raptor species listed in Table 4.2 and a number of others. Banning DDT in the United States and a shift to biodegradable pesticides in smaller quantities has allowed many populations to recover, though habitat loss limited this increase in the 1980s and 1990s. Raptor populations in the BTES appear to be relatively stable for most species.

Bald Eagle, Osprey, and Cooper's Hawk were devastated by organochlorine pesticides despite significant differences in diet. The Bald Eagle and Osprey are principally fish eaters, while the Cooper's Hawk feeds on birds and small mammals. BTES populations for these three birds of prey are following the national trend toward a gradual increase, though they remain rare. Breeding by the Osprey and Cooper's Hawk may be occurring in the BTES but has not been officially documented. The Bald Eagle has become a far more common winter migrant in the BTES. The BTES has recently emerged as the most important nesting area in Louisiana and is considered nationally important to the recovery of this endangered species. The Red-shouldered Hawk continues to decline in U.S. migratory counts, but is stable in BTES. The national decrease has been attributed to deforestation, but forests in the BTES are not being cut as they once were and are gradually maturing, so resident Red-shouldered Hawks might not be expected to follow the national trend. Similarly, the national increase in Red-tailed Hawk is believed to be a result of conversion of woods to fields, relatively little of which has occurred in the past 15 years. All other raptors for which trends can be inferred are classified as stable.

Other Marsh Birds

Given that marsh habitat is decreasing at such a rapid rate in the BTES, it seems reasonable to look at species in addition to colonial wading birds and seabirds that are dependent on this habitat. Five of the seven species listed in Table 4.3 are primarily fish eaters, with the exceptions being the American Coot and Common Moorhen. The

Table 4.2. Raptor status and trends in Barataria-Terrebonne estuarine system.

Species	BTES Habitat	Pesticide Effect	Status	Population Trend
Bald Eagle	Bottomland, Swamp Forests	Confirmed	Rare breeder, rare to casual winter visitor	Depressed but Up
Osprey	Bottomland, Swamp Forests, Marsh	Confirmed	Uncommon migrant; uncommon to rare in winter; local breeder	Up
Northern Harrier	Marshes, Pastures	Not Confirmed	Common winter visitor	Stable for Past 30 yrs in BTES
Sharp-shinned Hawk	Open woodlands, fields with trees and shrubs	Not Confirmed	Uncommon in winter; fairly common migrant	Stable for last 20 yrs
Cooper's Hawk	Open woodlands, fields, suburbs	Confirmed	Quite uncommon in winter; uncommon migrant; rare breeder	Up
Red-shouldered Hawk	Bottomland, Swamp Forests, Field Edge	Not Confirmed	Common resident	Stable
Red-tailed Hawk	Open Fields with Scattered Perch Trees	Not Confirmed	Common in winter; uncommon and local breeder	Stable to Increasing
American Kestrel	Open Fields, Marsh, Suburbs	Not Confirmed	Common in winter; rare breeder	Stable for past 30 yrs

Table 4.3. Status and trends of selected marsh birds in Barataria-Terrebonne Estuary.

Species	BTES Habitat	Pesticide Effect	Status	Population Trend
Anhinga	Swamp, Fresh Marsh	Not Confirmed	Common breeder, rare winter	Stable to Increasing in BTES
Olivaceous Cormorant	Swamp, Fresh Marsh	Not Confirmed	Casual visitor	Stable
Double-crested Cormorant	Swamp, Fresh Marsh	Confirmed	Common in winter	Increasing Winter Population
American White Pelican	Marsh	Not Confirmed	Common winter, non-breeders present in summer	Stable
American Coot	Marsh	No	Common winter, rare/uncommon summer	Stable
Common Moorhen	Fresh marsh	No	Common resident	Stable
Least Bittern	Fresh to Brackish Marsh	Not Confirmed	Uncommon to common summer resident	Decline since early 1970s

Anhinga and Cormorants will breed in the colonies of wading birds, while the Least Bittern is a non-colonial wading species. The American White Pelican, American Coot, and Double-crested Cormorant are migratory birds that breed outside of the BTES. The Double-crested Cormorant is believed to have suffered population declines in the past due to pesticides but does appear to be in a rebound phase.

All of the BTES populations of these species are believed to be stable or increasing with the exception of the Least Bittern. Of all those listed here, the Least Bittern makes the most use of nonfresh marshes. BTES land loss data compiled in a companion report indicate that the most significant losses at least since 1978 have been in nonfresh marshes. Swamp and fresh marsh acreage have remained relatively unchanged during recent decades although there is good evidence that the fresh marsh contracted considerably in the first half of this century after the artificial closure of Bayou Lafourche and completion of the flood control levees on the Mississippi and Atchafalaya rivers.

Salt and brackish marshes are lost as a consequence of subsidence in a process that results in increasing fragmentation of continuous stands of marsh vegetation into small islands and eventually individual hummocks of grass. It seems likely that this degradation could affect the inconspicuous rails and gallinules that, like the Least Bittern, spend more of their lives in this habitat than any other birds. Bird count data for the King Rail suggest that it, too, may have declined. A more rigorous analysis of the census information for these species would be helpful.

Common Resident BTES Birds of Cities and Towns

Population status and trends for 13 of the most common species found as residents in at least suburban and urban settings in the BTES are listed in Table 4.4.

Two of the birds included here, the House Sparrow and European Starling, are introduced exotic species, while the Brown-headed Cowbird is a brood parasite that has invaded the BTES. The Brown-headed Cowbird has now largely been displaced in the New Orleans area by the Bronze-headed Cowbird, but it is not clear what this means for the BTES as a whole.

Five species, including the European Starling, appear to be increasing, while two appear to be decreasing. Six species are stable. Decreases in the Red-bellied Woodpecker and Northern Mockingbird and increases in Downy Woodpecker, Brown Thrasher and Northern Cardinal are tentative. Increases for the Carolina Chickadee and European Starling are more definite. The Loggerhead Shrike, a predator on insects and small birds and mammals, is stable in the BTES but is in serious decline nationally. Most increasing trends in the BTES appear to have begun in the 1970s and reverse previous declines.

All of these birds, with the possible exceptions of the exotic House Sparrow and European Starling, are birds of open woodlands and forest edges that have adapted well to the mix of lawns, shrubs, and shade trees that characterize many residential areas in the cities and towns of the BTES. People who appreciate the presence of

Table 4.4. Status and trends of common native birds of cities and towns in Barataria-Terrebonne.

Species	BTES Habitat	Factors	Status	Population Trend
Mourning Dove	Field, Open Woodlands	None	Very Common to Abundant Resident	Stable in BTES, stable to decreasing U.S.
Red-bellied Woodpecker	Open Woodlands, Parks, Gardens	European Starlings	Common Resident	Slow Decline in BTES, stable U.S.
Downy Woodpecker	Open Woodlands, Parks, Gardens	None	Common Resident	Possible Increase since mid 1970s, stable U.S.
American Crow	Open Woods, Forest Edge	None	Common to Abundant Resident	Stable
Carolina Chickadee	Open Woods, Forest Edge	None	Common Resident	Increase since early 1970s, stable U.S.
Carolina Wren	Brushy Thickets	None	Common to Very Common Resident	Stable BTES, increase U.S.
Northern Mockingbird	Open Woodlands, Parks, Gardens	None	Very Common Resident	Possible Decline in BTES, decrease U.S.

Brown Thrasher	**Open Woods**	**None**	**Common winter, some local breeding**	**Stable to increasing since late 1970s**
Northern Cardinal	**Open Woods, Fields, Parks, Suburbs**	**Parasitism by Cowbirds**	**Very Common Resident**	**Possible Increase in BTES but Decline in N.O., stable U.S.**
Loggerhead Shrike	**Open Woods, Forest Edge**	**None**	**Common Resident**	**Stable BTES, sign. decline U.S.**
House Sparrow	**Urban, Suburban, Farmlands**	**Formerly benefitted from horse pastures.**	**Exotic, Common to Abundant Resident**	**Stable since 1970**
European Starling	**Farmlands, woods, cities**	**Competes for tree cavities with native species**	**Exotic, Abundant Resident**	**Increasing since 1926 in BTES, decrease U.S.**

Brown-headed Cowbird	**Open Woodlands, Brushy thickets, Pasture, Suburbs**	**Competing with Bronzed Cowbird**	**Common Resident**	**Stable, except where displaced (in N.O)**

these birds throughout the BTES have contributed to their increase by providing feeding stations and nesting boxes.

Suburban development expanded rapidly in the 1960s and 1970s in the BTES, largely displacing agricultural fields that had previously been intensively farmed for sugar cane. As the developments constructed at this time have aged, residents have planted trees and shrubs that have greatly increased the habitat value of the land for most species, compared to its condition when under cultivation. Domestic cats now are the most important predators in these areas, but maturing trees and shrubs appear to be providing sufficient cover that resident songbird populations are generally increasing.

Other Migrating Birds

As defined in Table 3.8 there are 153 other migratory birds that are mainly small songbirds that use the BTES for a portion of their life cycle. They fall into three groupings based upon where they winter and where they breed. One group breeds north of BTES and winters in BTES (e.g., the Water Pipit). A second group breeds in BTES in the summer and winters south of BTES (e.g., the Hooded Warbler). A third group passes through BTES as it migrates between the northern breeding grounds and southern wintering areas (e.g., the Yellow Warbler). This third group is mainly composed of neotropical migrating songbirds.

Some species, such as the American Robin, have members in two of these groups.

One of the most important roles BTES plays in the status and trends of the vast majority of these species is based on the timing of inclement weather. It occurs when migrating birds, especially small neotropical migrating songbirds, encounter strong cold fronts over the Gulf of Mexico during their spring returns to North America and become exhausted. When this happens they will fall out of their migration pattern into maritime forested areas. Here they rest and refuel before continuing their flight. Within BTES, the maritime forested areas of Grand Isle and other barrier islands, coastal shores, cheniers, and spoil banks are important fallout areas for these birds.

BTES provides three types of habitats for the Other Migrating Birds. Depending on the species, these are summer nesting and foraging, winter foraging, and stopover resting and refueling sites. As denoted below, habitat change in any of these areas can affect the overall population.

The Yellow-billed Cuckoo is an example of a common to sometimes abundant BTES migrant and a common BTES breeder that has undergone a continental decline associated with loss of habitat to intensive agricultural practices.

The Black-throated Green Warbler and the Blackburnian Warbler are neotropical migrants. They are both at least common BTES migrants. The Black-throated Green Warbler is sometimes the most common breeder in the coniferous forests of northeast North America. The Blackburnian Warbler underwent a historic decline associated with deforestation and chlorinated hydrocarbon pesticides and is currently believed to

have a stable breeding population. Both are expected to undergo future declines associated with deforestation in their wintering ranges in Mexico and the tropics.

The Prothonotary Warbler is common in BTES in summer and is a common BTES migrant. Its continental population has undergone an average annual decline of 1.5%, 1966–1993. Since it is a bird of swamps and bottomland hardwoods as well as a cavity nester, this decline may relate to habitat loss.

The Ovenbird and the Hooded Warblers are both common BTES migrants. Forest fragmentation in their northern breeding range adversely affects these populations as it increases predation and nest parasitism by Cowbirds. Both birds are undergoing continental increases probably associated with the regrowth of forests and conversion of abandoned farms to forests.

On the other hand, reforestation, as well as intensification of agricultural practices and urbanization, is likely resulting in continental declines in the abundance of the Indigo Bunting, a common to abundant BTES migrant. This is also true on a local scale for the Savannah Sparrow, which is common in winter in BTES, and on a continental scale for the White-throated Sparrow, which is common in BTES in winter and common throughout much of North America.

The Sharp-tailed Sparrow is common in winter in BTES. It is a bird of marshes, wet meadows, and river banks. While the continental population is believed to be in a state of decline associated with wetland loss, the BBS shows no significant trends.

A nest parasite, the Bronzed Cowbird, is undergoing a range expansion associated with human-induced habitat changes.

Threatened and Endangered Species

Endangered species are those in danger of extinction throughout all or a significant portion of their range. Threatened species are those likely to become endangered within the foreseeable future (USFWS 1978). The federally listed species in these categories were listed in Table 2.2. Where available, status and trend data and habitat requirements for these species have been described in their appropriate taxonomic groupings. The Brown Pelican, Bald Eagle, and Peregrine Falcon have recovered both locally and nationally as a consequence of protection under the Endangered Species Act, while the recovery of the American Alligator began earlier as the result of action by the state. Few Black Bears currently use the BTES and no breeding population currently exists. Individuals observed in BTES are mostly young males that wander from the relatively large population of the lower Atchafalaya basin and a few females that live in the bottomland forest in Point Coupee Parish.

Cumulative Effects on BTES Living Resources

This discussion of information on the living resources of the BTES is probably one of the most exhaustive regional syntheses yet attempted. In many ways, however, when we look at trends that extend, for the most part, no further than 30 years into the past, we are really still looking at

a snapshot in the growth and decline of populations. We are looking at a brief interval that we try to understand through a very human lens. That lens tends to magnify the importance of (1) the few phenomena that we are able to measure, and (2) the role of humans in influencing the apparent changes that we measure. That having been said, it is still appropriate to attempt to put the things that we believe have affected species richness and abundance into a larger regional and historical context.

Before the arrival of European settlers, native Americans exploited the living resources of the Barataria-Terrebonne region. In all likelihood, their effects on the landscape and its biota were more pervasive than we now realize. The native populations used fire extensively to clear forests of undergrowth and create artificial conditions that were conducive for their foraging and agricultural activities. Their hunting affected many of the most valuable terrestrial species, like the bison and colonial birds that were easy prey, and large predators like the bear and wolf with whom they competed.

When European settlers arrived, the level of technology applied to exploitation increased significantly. Clearing of the natural levee "canebrakes" and cypress and oak forests proceeded quickly as agriculture expanded up and down the rivers and bayous and back from the banks into the bottomlands. These levees were thoroughfares for wide ranging animal species as well as for the new settlers. Using these thoroughfares, European settlers quickly exterminated many local populations of birds and wildlife.

Leveeing of the Mississippi River began as soon as the plantation system became established and was essentially completed within the first three decades of the 20th century. This resulted in a relatively sudden reduction in annual inputs of fresh water and sediments into the BTES. That reduction was also very abruptly influenced by the artificial closure of Bayou Lafourche in 1907. Although the amount of water conveyed into the BTES by Bayou Lafourche had decreased over several hundred years, it was still the major avenue for fresh water into the BTES at this time. It is probable that an ongoing contraction of the freshwater portions of the BTES was greatly accelerated by these actions. That contraction continued through much of the current century, though information in a companion BTNEP report (Reed et al. 1995) indicates that a new equilibrium had been reached before 1978.

Although the area occupied by freshwater swamps and marshes in the BTES is still vast, it is currently only that portion that can be maintained by rainfall falling within a much reduced catchment area. Certainly this contraction must have set in motion significant changes in animal populations at which we can now only guess. Virtually all of the harvest-independent fisheries and bird data that provide us with the trends discussed in this report document a recent period of equilibrium that has not been characterized by significant changes in the area of fresh marsh.

Concurrent with these wrenching changes in the freshwater supply to the system was a period of unrestricted hunting and trapping for fur, feathers, and alligator hides. Several of the wading birds were hunted almost to extinction before the turn of the century and the vast populations of Carolina Parakeets and Passenger Pigeons were decimated beyond return. The barrier islands were developed as resorts and supported several substantial communities that are no longer in existence. Eggers and market hunters exploited the seabirds and destroyed

many major colonies. Raccoons and other egg eaters moved or increased onto the islands with humans. Only very gradually after the turn of the century did more modern conservation ideals begin to affect wildlife management policy, and much of this realization came only when most exploited populations were no longer sufficiently abundant to support commercial hunting. Many of the seabird and wading bird populations that are stable today may never have completely recovered from the effects of unrestricted hunting.

A second extremely significant landscape change was brought about by the clear-cutting of all of the virgin forests of the BTES in the last half of the 19th century and the first decades of the 20th. From a habitat standpoint, the essentially instantaneous removal of all of the trees from the swamp and from most of the bottomlands must have had effects on species richness and abundance and on hydrology that we can only imagine today. The period that this report monitors is characterized by the slow recovery of these second-growth forests, and the response of the fauna to successional development on a vast scale.

At the same time, prices for fur went up on international markets as many of the traditional northern species were depleted. Trappers moved out into the marshes of the BTES to exploit the large populations of furbearers that still existed there. They trapped not only the Muskrat but also most of its predators, particularly the American Alligator, setting in motion dramatic changes in the ecology of the marsh that we continue to see played out in some of the data analyzed in this report. The artificial introduction of the Nutria to this system in the 1950s again changed the ecology as the invading species displaced its native competitors. Finally, the collapse in the price of fur in the early 1980s ended trapping as an effective control on Muskrat and Nutria and set the stage for the current era of habitat destruction associated with these animals. Unfortunately, it also ended much of our data on populations of these species as they now cycle toward some new equilibrium.

Fisheries were essentially unrestricted also but were limited by the technology available to exploit them. Even so, the oyster industry that had developed to harvest from naturally occurring reefs was on the verge of collapse due to area overfishing around the turn of the century. Scientists were brought in to make recommendations for restoring this fishery and the current system of state/private cooperation in husbandry of artificially created oyster grounds was established and has sustained the industry to the present. The modern offshore shrimp trawling fishery came into being when engine powered vessels became widely available in the 1930s. This meant that shrimp could be harvested offshore as well in the bays and by far more efficient means than were possible previously.

The collection of fisheries-independent shrimp population information and the use of this information to prevent overharvest came about after fishermen became concerned about what appeared to be a long-term decline of the dominant White Shrimp fishery. Trawls hauled to sample shrimp also sampled a great number of finfish of commercial importance. These samples formed an information base for recommending changes to existing seasons and gear. The wealth of CPUE data analyzed in this report documents a number of fisheries that are today under scientific management, though fishing pressure is recognized to be only one factor

determining population in any given year. Managers point to the lack of long-term trends in such data as evidence that they are doing their job.

Meanwhile, back on the ridges, agriculture moved into a new era as mechanization made it possible for fewer workers to clear, drain, and farm more land. Introduction of agricultural fertilizers and chemicals to control pests and weeds brought in the era of "intensive" agriculture after World War II. New crops like soybeans were introduced that could grow in wetter soils and fetched high prices on world markets. More and more chemicals were applied in an effort to increase yields and a number of the most persistently toxic organochlorine types, like DDT and chlordane, ran off into the swamps and bayous and accumulated in fish and wildlife. The uplands became less habitable for many species that had previously prospered alongside farmers. Predators that ate contaminated rodents, birds, and fish began to experience declines in reproductive capacity that quickly translated into population decreases. Species richness and abundance plunged.

The publication of *Silent Spring* by Rachel Carson in 1967 brought what was happening into focus for many. Early environmental legislation mandated that the most persistent bioaccumulating toxins be phased out by the 1970s, as less dangerous and more degradable pesticides and herbicides were developed. Farmers began to use less without significantly reducing yields as they became more knowledgeable and the cost of these chemicals increased. Much of the trend data developed in this report for the seabirds, wading birds, and raptors document recovery from the period in the 1950s and 1960s when toxic chemicals were most rapidly introduced into the biosphere. Toxins persist in the system and undoubtedly continue to affect many species, most of which we know nothing about. We have virtually no population data on the invertebrates, amphibians, reptiles, fish, and small mammals of the freshwater swamps, bayous, and lakes that receive the most inputs of agricultural and industrial chemicals in the BTES.

The period of the 1950s through the early 1980s was the oil and gas boom in the the Barataria-Terrebonne area and on the adjacent outer continental shelf. Exploration, development, and transport of hydrocarbon wealth from and through the basin ushered in a period in which thousands of miles of canals were dredged through the marshes and swamps of the BTES. The natural hydrology was disrupted as more efficient artificial channels conveyed an increasingly larger part of the ebb and flow of fresh and salt water into areas that were previously relatively isolated. Conversely, the dredged banks lining these waterways connected to isolate or impound other areas. The natural tendency for the sinking marshes to disappear was greatly accelerated by lack of water exchange that prevented sediment and nutrients from reaching the marsh surface. The loss of the marshes, particularly the saline marshes, gradually increased.

Today, while few new canals are being dredged, marsh loss continues at near record levels in the BTES. Populations of the major estuarine-dependent fish and shellfish species that use these marsh areas do not yet appear to have been reduced in any statistically significant sense by the loss of this habitat. This paradox is generally explained as resulting from the intersection of two trends going in opposite directions. As marsh area is reduced, the land-water edge that

provides the very necessary nursery and feeding habitat for larval and juveniles of most species initially increases. Most researchers predict that, later in the degradation process, edge habitat will be reduced and population declines will begin to appear.

The pace of marsh loss is proportionally exceeded only by the rate at which the barrier islands are disappearing. The importance of these narrow sand strips to many nationally important fish and birds, including endangered species, has been well demonstrated. The information on nesting of seabirds presented in this report is about as close as we are ever likely to get to definitive evidence of the effect of habitat destruction on bird populations.

Wildlife management has had some recent successes with respect to species that have come under state/federal protection. The resurgence in numbers of the Red Drum, Bald Eagle, American Alligator, Brown Pelican, and most of the migratory waterfowl are evidence of the resilience of populations when they are protected and assisted through enlightened management. With respect to the colonial seabirds, it appears that these opportunistic species can enlarge their populations significantly if they are protected from human disturbance in the relatively small amount of habitat and time they require each year to produce young.

Returning one more time to the ridges of the BTES, it is apparent in the data on common songbirds that another trend is in progress that will be important as the local human population begins to grow again after the decrease that occurred with the passing of the oil boom. This population, like that of the colonial seabirds, is also confined to about 20% of the total land area of the BTES. As human population begins to creep up and approach 1980 levels once again, human residents of the BTES are becoming more urban. The possibility exists that this growth will bring about improvements in ridge habitats for a number of species as well as all the environmental stresses that are normally associated with development. The land that is being used for development now is not the drained bottomland hardwoods of the past, but sugar cane fields that were previously managed for intensive crop production. Wooded residential areas may very well turn out to provide more habitat than the croplands that they replace.

In summary, analysis of the fragmentary status and trends information that exists for the last few decades can lead to important recommendations for increasing the biodiversity of a system like the BTES even if it does not provide a truly holistic ecological understanding. We have a better "snapshot" of this system than most because the living resources of this system have been so important to the economic development of the area. We have seen both the damage that such a system can sustain without collapse and the potential for enormous improvement that is possible in the future. Actually, in every indicator group for which we have sufficient data, we see the cumulative effects of trends toward increase and trends toward decrease operating together. We see the maturing of the swamp forest bringing with it more habitat for species like the Bald Eagle and Wood Duck and probably a number that only earlier generations would find familiar. The deterioration of the marsh brings with it an increase, at least initially, in some aquatic and marine species, while holding a more ominous portent for general decline in the future.

When dealing with species affected by multiple factors like habitat loss and reduction in predation that individually might tend to reduce or increase the population, it is quite possible to

find no discernible trend in the population size. This would not mean that the species is not affected, but rather that neither of the opposing factors is dominant through the period of record. If habitat loss became more severe or predation increased, then the population would begin to decline. Conversely, if habitat loss was reversed through restoration, for example, or predation was further reduced, then the population would go up.

There is a definite need to start ecologically based monitoring of indicator species. These should be species that are not commercially harvested and represent the major habitats within BTES as well as some species that are high in the food web and could alert us of toxins accumulating in the system. As an example, the condition of barrier islands could be monitored using Brown Pelican, gulls and terns, Black Skimmer, and Killifish. The saline marshes could be monitored using Forster's Tern and Killifish. Fresh marshes could be monitored using the Common Moorhen, Red-winged Blackbird, and selected mice and frogs. Selected raptors, birds, and snakes could be used to monitor the swamp forest and bottomland hardwoods. Mourning Doves, Mockingbirds, and Northern Cardinals could be used to monitor suburban and urban areas.

CHAPTER 5
CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Conclusions

In general, this report shows that most of the species studied have had stable or in some cases increasing populations over the past 30 years. However, many of the living resources in the BTES are currently recovering from abuses of the past such as overharvesting (legal and illegal) and bioaccumulation of toxins released into the basin. At present, few species are declining as a result of the rapid loss of habitat that has been documented for the basin. However, it is expected that some populations soon will become limited by available habitat. A few species continue to be overharvested and their populations remain depressed from levels in the 1930s–1950s due to a combination of overharvesting, pollution, and habitat loss.

For almost all species suitable habitat has been identified as one of the main limiting factors on the population: notable examples are White and Brown Shrimp, Eastern Oyster, Bullfrog, Snapping Turtle, all endangered Sea Turtles, Black Skimmer, and North American Mink. Others, such as American Alligator and Brown Pelican, are expected to reach habitat saturation in the near future. Therefore, habitat loss is considered one of the major factors affecting the living resources in the BTES. Of special concern is the rapid erosion of barrier islands that provide important habitat for fish, shellfish, seabirds, and migratory songbirds. However, marshes, swamps, water bodies with natural flows, forested, agricultural, suburban, and urban areas provide habitat for the animals that live in the BTES. Maintenance of the integrity of the system should be the highest priority. This requires management to maintain, restore, enhance, and acquire existing habitats to the maximum extent possible. For example, barrier island restoration and fresh water/sediment introduction should be coupled and

implemented in ways sensitive to fish and wildlife habitat requirements.

Although pollution is not currently identified as a factor controlling populations in the BTES, many species are still recovering from the effects of pesticides that entered the system in the 1950s and 1960s. Monitoring of species that are high in the food chain or are particularly susceptible to direct contamination—for example Brown Pelican, Hooded and Red-breasted Merganser, Anhinga, Double-crested Cormorant, raptors, Nearctic River Otter, and amphibians—is recommended. The potential for accidental oil spills is great in coastal Louisiana and seabirds that nest on low-lying islands could be seriously affected during their breeding season (May through July).

The Bullfrog, Snapping Turtle, and Alligator Snapping Turtle populations have been greatly reduced due to a combination of overfishing, pollution and/or habitat loss. Continued harvesting of these species should be reconsidered.

There is a general lack of data on abundance for many of the BTES living resource species making it difficult to determine status and trends. This lack of data tends to lead to overharvest (as with the Bullfrog) or to a loss of biodiversity and/or abundance (as is probably the case with many amphibians, reptiles, and birds). This lack of data makes recovery efforts difficult (as may have been the case with White Shrimp during the period of its apparent decline, 1948 through 1962).

Those habitats with the highest species diversity and abundance are the barrier islands, natural marshes (including bayous and lakes), and second-growth bald cypress swamps and bottomland hardwood forests. The association of these habitats in the deltaic plain is unique to the BTES. Re-introduction of fresh water and sediment from the Mississippi and Atchafalaya rivers is essential to expanding the freshwater swamp and marsh habitat to historical dimensions and to maintaining what still remains, but these are expensive and complex public works projects. Saving large tracts of second-growth cypress forests from future clear cutting is also essential but could set up conflicts with private landowners as so little of the area is currently protected. Finally, and perhaps most pressing, a number of the best known and most conspicuous fish and wildlife species depend upon the remnants of the BTES's once

expansive barrier island/barrier beach habitats. It is predicted that the islands of most importance to nesting seabirds will disappear shortly after the turn of the century if the sand supply is not significantly augmented. Many of these island areas are important to neotropical migrants when they have encountered inclement weather over the Gulf of Mexico during their spring return to North America.

Habitats that are not as unique to the BTES but are still supportive of species diversity and abundance are pastures and non-intensively cropped farmlands, old fields, rural roadsides, and forested suburban and urban areas. Here, efforts should be focused on providing for a wide variety of vegetated habitats that include trees, shrubs, flowers, and mowed and unmowed areas. Efforts should also be made to reduce use of fertilizers, pesticides, and herbicides. For aquatic species, it is important to reduce runoff of fertilizers and pesticides into waterbodies ("nonpoint source" pollution).

Finally, habitats that do not now support wildlife can be significantly improved. These are lands currently subject to intensive agricultural practices, sparsely vegetated suburban/urban areas, and industrial sites. Small changes in management practices in these areas can greatly increase their value as habitat. As the human population increases, and the migration from rural to urban areas continues, urban area is expected to increase. New designs to increase the habitat value of urban areas are therefore of utmost importance. Following are a series of more specific recommendations for future management of the BTES's living resources.

Management Recommendations

Overview

- Maintain, enhance, and restore the systems integrity of the BTES habitats. The BTES living resources need clean sources of fresh and salt water, natural flows of fresh water through shallow streams and over wetlands, and sediment nourishment. Systems integrity requires a balance of diverse natural and artificial habitats that promotes production of aesthetically, recreationally, and commercially important species while achieving maximum biodiversity and natural abundance. To accomplish this it is necessary to acquire, preserve, maintain, and enhance a variety of wooded, vegetative habitats with particular emphasis on maturing second growth forests, swamps, and bottomland hardwoods; coastal marshes and islands, wooded cheniers, and bayou banks; old fields and non-intensive agricultural fields and pastures; and vegetative suburban and urban areas with a mix of trees, understory, and mowed and unmowed lawns.

- Reverse the trend in barrier island retreat and coastal erosion in ways that will restore, maintain, and enhance the natural habitats of the BTES fishes, amphibians, reptiles, birds, and mammals.

- Maintain, enhance, and restore forested wetlands.

- Promote less intense agricultural practices.

- Promote habitat for birds and other wildlife in suburban and urban settings.

- Reduce the introduction of toxins into the air, water, and land.

- Monitor populations of species high in the food chain or susceptible to direct contamination by pesticides, herbicides, and other pollutants.

- Maintain the existing long-term sampling programs and institute system-wide sampling programs for the unmonitored BTES living resources.

- Continue vigilance to prevent overfishing of stocks that are currently monitored and appear stable.

- Initiate efforts to monitor, restore, and enhance the stocks and habitats of overfished frogs and turtles.

- Minimize to the maximum extent possible the harassment and destruction of BTES living resources by domesticated animals, with special attention to unconfined dogs and cats.

Commercially Important Invertebrates

- Maintain and enhance where possible shallow-water wetland and estuarine habitats for aquatic species.

- Establish long-term data-collecting sites for aquatic species in shallow-water wetlands and estuarine habitats to coincide with deeper-water estuarine sites.

- Assure that salinity gradients are maintained through the estuaries in order to stimulate and sustain reproduction and survival of larvae, juveniles and adults of shellfish and other aquatic species.

- Reduce pollution, in terms of aquatic habitat degradation, as a threat to the abundance, existence, and harvestability of estuarine species.

- Restore and maintain barrier islands in ways that will maintain, enhance, and restore their habitat value for shellfish.

Freshwater Finfish

- Continue to monitor the stocks of the two catfish species.

- Monitor other freshwater species in the BTNEP region to form a data base.

- Keep saltwater intrusion from penetrating too far into the BTES basins.

- Provide submerged aquatic vegetation (this may involve planting programs), but prevent it from becoming too dense or overcrowded.

Estuarine Finfish

- Restore, enhance, and preserve coastal marsh environments in ways that will maintain, enhance, and restore their habitat value for fish.

- Maintain and restore barrier island habitat so washovers do not fill island creeks and meanders.

Estuarine/marine Finfish

- Continue to assess impacts of fishing mortality on stocks.

- Slow continued coastal erosion to prevent destruction of important nursery habitat.

- Monitor bycatch, particularly young fish using the BTES as an essential nursery, to determine which species could be having high juvenile mortality from various non-target fisheries.

- Restore and maintain barrier islands in ways that will maintain, enhance, and restore their value as fish habitat.

Amphibians

- Begin a systematic survey of the BTES amphibians.

- Identify, protect, and enhance essential habitats.

- Implement management measures to restore the Bullfrog and Pig Frog stocks and habitats.

Reptiles

Careful monitoring programs of the harvest of the American Alligator and its eggs are recommended. Although current populations seem to be below the carrying capacity of the existing marsh (as demonstrated by the

increasing population size) habitat loss, especially in the fresh and intermediate marsh, might become a problem in the near future. This species will, therefore, benefit from management practices that maintain "healthy" fresh and intermediate marshes.

- Identify, protect, and restore important habitat.

- Implement programs to assess the status and trends of the BTES reptile populations.

- Implement management measures to restore, enhance, and maintain the Snapping Turtle and Alligator Snapping Turtle stocks and habitats.

- Enhance, restore, and preserve existing fresh to brackish water habitats.

- Reverse the trend in barrier island loss and retreat.

Birds—Overview

Birds are the most diverse, abundant, and visible of the BTES living resources. Management measures that promote the maintenance of a high diversity and abundance of birds will also promote a high abundance and diversity of the BTES living resources. Because of these factors, it is recommended that management measures preserve, maintain, and enhance a variety of wooded, vegetative habitats with particular emphasis on maturing second growth forests, swamps, and bottomland hardwoods; coastal marshes and islands, wooded cheniers, and bayou banks; old fields and non-intensive agricultural fields and pastures; and vegetative suburban and urban areas with a mix of trees, understory, and mowed and unmowed lawns. Management within the BTES should concentrate on the protection of existing habitat; reduction in introduced toxins; cleanup of toxic waste sites; greening and flowering of rural, suburban, and urban area; continued enforcement of conservation measures; and public education.

- Restore, maintain, and enhance barrier islands with special emphasis on their habitat values for nesting seabirds and neotropical migrating songbirds.

- Create new barrier and coastal islands with dredged material to create habitat for seabirds and migrating birds.

- Reverse the trend in coastal erosion and barrier island retreat through the introduction of fresh water and sediments in ways that will create, maintain, and enhance the habitat values of the region for resident and migratory birds.

- Protect nesting sites and colonies from disturbance by humans and domesticated animals.

- Reduce the introduction of toxins into the air, water, and land.

- Continue, initiate, and maintain programs to educate the public about how they can provide habitat for birds and protect nesting sites and colonies.

Seabirds

- Maintain, restore, and create habitats for seabirds.

- Maintain barrier islands, especially those islands containing major colonies of seabirds (i.e., Raccoon Point, Wine Island, and Queen Bess). These projects should be designed so that suitable nesting sites for seabirds are maintained and restored. These nesting sites include unvegetated sand flats or beaches for the Black Skimmer and most tern species, vegetated dunes for the Laughing Gull, and back marshes with mangrove-lined creeks for the Brown Pelican.

- Create new barrier islands with dredged material in ways that will enhance their habitat value for seabirds. Maintain and/or nourish the existing sand bar in Little Pass Timbalier to create a more stable nesting island (similar to the Wine Island Project). Plantings of mangrove and/or other shrubs could make such an island available for breeding by the Brown Pelican.

- Protect seabird colonies from disturbance by humans, dogs, and cats.

- Limit vehicle access to Fourchon Beach to protect nesting seabirds.

- Post all active seabird colonies.

- Educate the public.

- In case of an oil spill, special efforts should be made to protect colony sites.

Wading Birds

Management of these species should concentrate on the protection of habitat. In addition, existing colonies should be protected from human disturbance. Most species of wading birds currently have stable populations. However, the Reddish Egret has significantly declined. Since this species feeds in the very shallow tidal pools of barrier islands, it might benefit from barrier island restoration projects. It uses mangrove thickets to breed, so planting of mangroves on barrier islands might provide additional breeding habitat for this species.

- Maintain, restore, enhance, and create habitat for wading birds.

- Restore and enhance barrier islands so that suitable nesting sites for wading birds are maintained and restored. These are the back marshes with Black Mangrove-lined creeks, and the back dunes with shrubs such as *Iva frutescens* and *Baccharis halimifolia*.

- Create new barrier islands with dredged material to create nesting, roosting, and foraging habitats for wading birds. Maintain or nourish the existing sand bar in Little Pass Timbalier to create a more stable nesting island (similar to the Wine Island Project). Plantings of mangrove could make such an island available for Reddish Egret breeding.

- Protect colonies from human disturbance.

- Post all active colonies.

- Educate the public.

Waterfowl

Management for waterfowl should concentrate on the reduction of habitat loss, especially the loss of freshwater marsh. Traditionally, impounding has been used in many areas in the Louisiana coastal zone to manage for waterfowl. However, impoundments are costly to construct and maintain, can restrict access of marine organisms, and reduce sedimentation (Chabreck et al. 1989, Boumans and Day 1994). Freshwater diversion should provide excellent habitat for dabbling ducks and geese as is demonstrated by the large flocks of waterfowl that use the Atchafalaya and Wax Lake deltas (Fuller et al. 1988).

- Initiate freshwater diversion projects to create freshwater habitats.

- Reduce saltwater intrusion and turbidity to increase the growth of submerged aquatic vegetation.

- Backfill oil and gas access canals and pipeline canals where possible. This will produce large shallow ponds with submerged aquatics (Abernethy and Gosselink 1988, Rosaz and Reed 1994), providing additional feeding habitat for dabbling ducks, especially in fresh to brackish marshes.

Other Wetland Birds

- Preserve, maintain, and enhance habitats for other wetland birds.

- These species are important indicators of wetland function and populations should be monitored.

Raptors

- Preserve, restore, enhance, and acquire nesting habitats.

- Reduce use of pesticides and release of toxins.

- Continue public education efforts to prevent take and disturbance of nesting birds.

Shorebirds

- Protect, enhance, restore, and acquire important habitats with special emphasis on barrier islands.
- Prevent harassment of birds by humans, dogs, and cats.
- Restrict introduction of toxins.

Other Resident Birds

- Preserve, maintain, and enhance a variety of wooded, vegetative habitats with a particular emphasis on maturing second growth forests, swamps, and bottomland hardwoods; coastal marshes, wooded cheniers, and bayou banks; nonintensive agricultural fields and pastures; and vegetated suburban/urban areas with a mix of trees, flowers, shrubs, and mowed and unmowed lawns.

- Restrict use of pesticides and herbicides.

- Continue, initiate, and maintain programs to educate the public about how they can provide habitat for birds with special emphasis on urban, suburban, agricultural, and forested areas.

- Minimize the harassment and destruction of other resident birds by domesticated animals, with special emphasis on unconfined dogs and cats.

Other Migrating Birds

- Restore, preserve, maintain, acquire, and enhance marine forests and forest-like areas on the BTES barrier islands, coast, and coastal cheniers and spoil banks.

- Preserve, maintain, acquire, and enhance a variety of wooded, vegetative habitats with particular emphasis on maturing second growth forests, swamps, and bottomland hardwoods; coastal marshes and islands, wooded cheniers, and bayou banks; old fields and non-intensive agricultural fields and pastures; and vegetative suburban and urban areas with a mix of trees, understory, and mowed and unmowed lawns.

- Restrict use of pesticides and herbicides.

Mammals

It is difficult to make recommendations for the mammals because, other than fur harvest records, little is known about the status and trends for species in this group.

Therefore, population estimates acquired in a more systematic fashion are recommended for all mammals.

Despite this absence of information, it has to be stressed that populations of Common Muskrat and Nutria are mostly regulated by trapping. Trapping has decreased significantly due to lower fur prices. The potential for significant damage to coastal marshes exists as highlighted by Linscombe and Kinler (1994). There is a serious need to control populations of these species.

CHAPTER 6
SPECIES ACCOUNTS

Introduction

This chapter provides information on status, trends, habitat requirements, causes of change, and species recommendations for all the species for which we could determine status and trends. The species are listed in the order in which they are discussed in the species grouping chapter. The same format is used throughout this chapter to make information retrieval easier. If no information was found for one of the categories, that category was omitted.

The format used for the individual species accounts is as follows:

Common name and scientific name—Because we are ecologists and not taxonomists, we decided to use a recent taxonomic publication as the source for our scientific and common names. The sources are given in Table 6.1. Although the common names chosen in these references might not be those most widely used in Louisiana, this avoided the confusion of using several common names.

Status—This contains the most recent estimate—either quantitative or qualitative—of the population. Information on populations within the BTES is given when available. This may be augmented by estimates for other areas that include or are part of the BTES (for example southeast Louisiana or western Barataria basin) when available.

Trends—This section discusses statistically significant trends (see materials and methods, Chapter 3, for appropriate species grouping) as well as generalized trends where appropriate.

Habitat requirements—This lists both the habitat and the food requirements of the species as described in the literature.

Causes of change—This lists causes of population change that have been reported in the literature including changes outside of the BTES (which may not always agree with the trends observed inside). In general, the literature mentions negative influences on the population more commonly than positive ones. However, sometimes the positive influence can be inferred. For example, if harvesting reduces the population, regulation of harvesting should increase it.

Table 6.1. Sources for scientific and common names used in this document.

Group	Source
Mollusks	Turgeon et al. (1988)
Crustaceans	Williams et al. (1989)
Finfish	Robins et al. (1991)
Amphibians	Dundee and Rossman (1989)
Reptiles	Dundee and Rossman (1989)
Birds	Purrington (1995b) & Farrand (1983)
Mammals	Banks et al. (1987)

Species recommendations—These are recommendations made in the literature on the species and/or recommendations based on the informed opinion of the authors.

AQUATIC INVERTEBRATES

Brown Shrimp
Penaeus aztecus

Status

! The annual fluctuations in the 16-ft and 6-ft trawl and the seine data are common. The relative abundance of the species is generally determined by the prevailing environmental conditions in the estuaries (Perret et al. 1993). LDWF's com-mercial Brown Shrimp season predictions are based on the prevailing salinities, water temperatures, and acres of marsh habitat with salinity at and above 10 ppt.

Trends

There are *no statistically significant linear trends* in the 16-ft and 6-ft trawl and seine fishery-independent CPUE for Brown Shrimp. The CPUE was highly variable from year to year and accounts for the lack of statistically significant trends. *Generalized* trends and observations are summarized as follows: (*the reference line on a graph is for general reference only*).

! Data with a positive slope to the reference line:
- State-wide yearly 1967–94 16-ft trawl CPUE (Figure 6.1).

- Barataria and Terrebonne estuaries-wide yearly 1967–94 16-ft trawl CPUE (Figure 6.2).

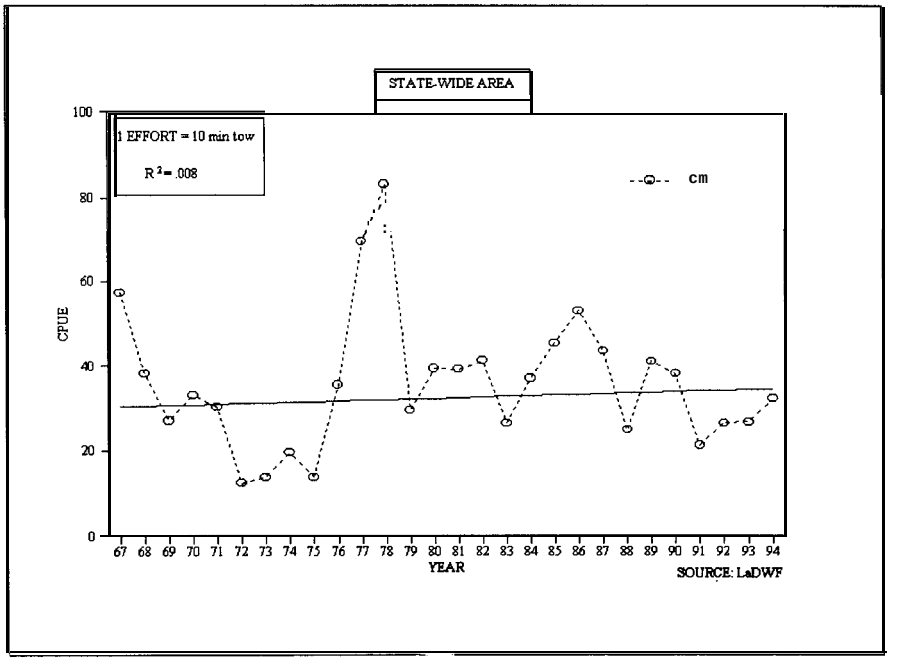

Figure 6.1. Trend of Brown Shrimp catch per unit of effort from 16-ft trawl for all stations state-wide.

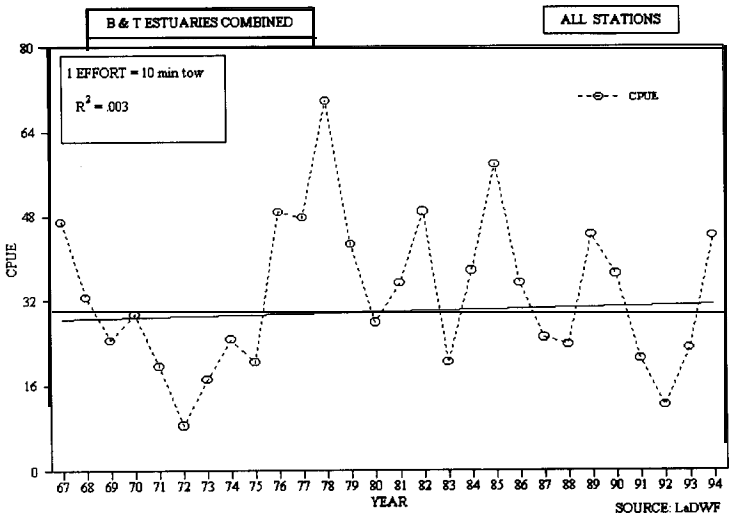

Figure 6.2. Trend of Brown Shrimp catch per unit of effort from 16-ft trawl for all stations within the BTS.

- Terrebonne estuary yearly 1967–94 16-ft trawl CPUE (Figure 6.3).
- Barataria and Terrebonne estuaries-wide 1967–94 March–July 16-ft trawl CPUE (Figure 6.4).

! Data with a negative slope to the reference line:
- Barataria estuary yearly 1967–94 16-ft trawl CPUE (Figure 6.5).
- Barataria and Terrebonne estuaries yearly 1967–94 6-ft trawl CPUE (Figure 6.6).
- Barataria and Terrebonne estuaries-wide yearly 1986–94 seine CPUE (Figure 6.7)

! Summary: There are no significant linear temporal trends in the data. The only data that suggest a possible downward temporal trend are the seine data (Figure 6.7). However, the seine data exhibited a positive slope for the last two years, 1993–94, of this nine-year data set. Except for the seine data, all other data sets exhibit a reference line that is nearly flat and could easily change direction with the addition of one or a few data points. There appears to be a cyclic pattern in the yearly CPUE data; CPUE will increase for a period of years and then decrease. *The data presented are summarized at a general level. Interpretation must be weighed with the understanding that more subtle temporal trends may be present.*

Causes of Change

! Annual fluctuations in CPUE of 16-ft data are indicative of this species' annual migration through the estuaries and the influence of the prevailing environmental conditions within the estuaries on the relative abundance of the species. The influence of hydrological conditions, especially salinity and temperature, have been correlated with Brown Shrimp abundance in the estuaries (Gaidry and White 1973, Barret et al. 1978) and with state-wide fishery-independent trawl CPUE data (Perret et al. 1993).

! The annual fluctuations in the CPUE of 6-ft trawl data in the shallow-water nursery areas of the estuaries are probably caused by the same prevailing flux in annual environmental conditions experienced in the deeper areas.

! The annual fluctuations in the CPUE of seine data in the shallow-water shoreline nursery areas of the estuaries are probably caused by the same prevailing flux in annual environmental conditions. However, a general trend of decreasing annual CPUE in the seine data exists. The cause of the general decline is unknown, but may be due to the following:

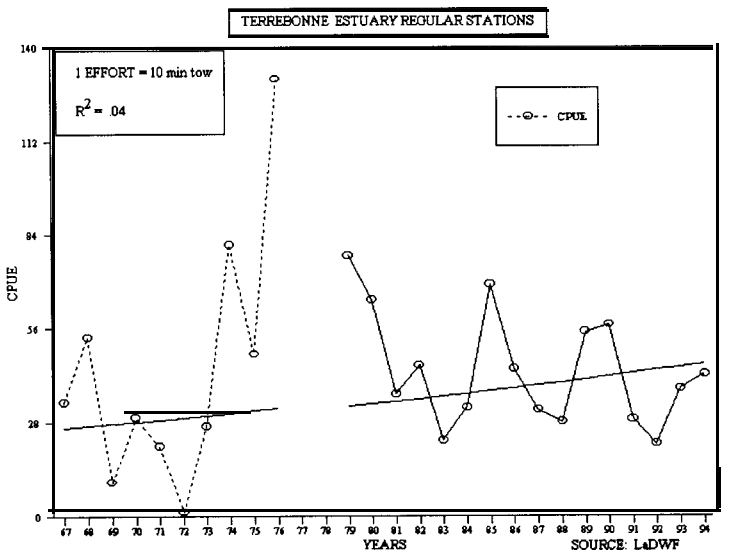

Figure 6.3. Trend of Brown Shrimp catch per unit of effort from 16-ft trawl for all regular stations in the Terrebonne estuary.

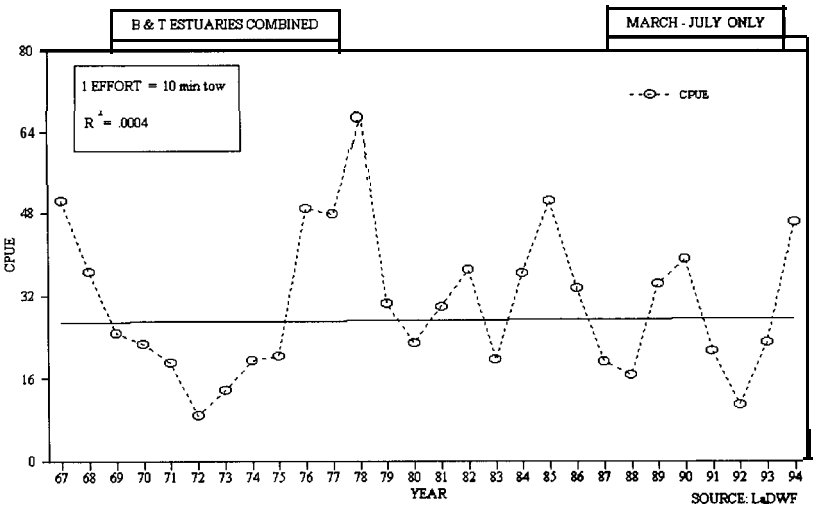

Figure 6.4. Trend of Brown Shrimp catch per unit of effort from 16-ft trawl for all regular stations sampled between March-July.

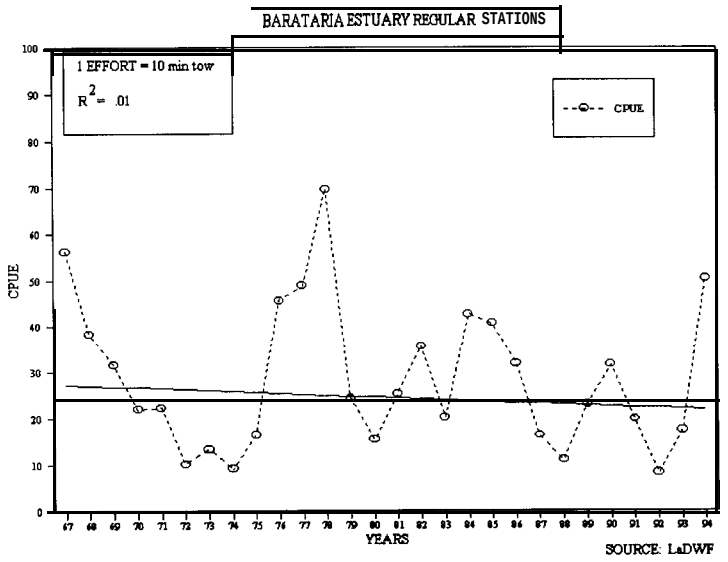

Figure 6.5. Trend of Brown Shrimp catch per unit of effort from 16-ft trawl for all regular stations in Barataria estuary.

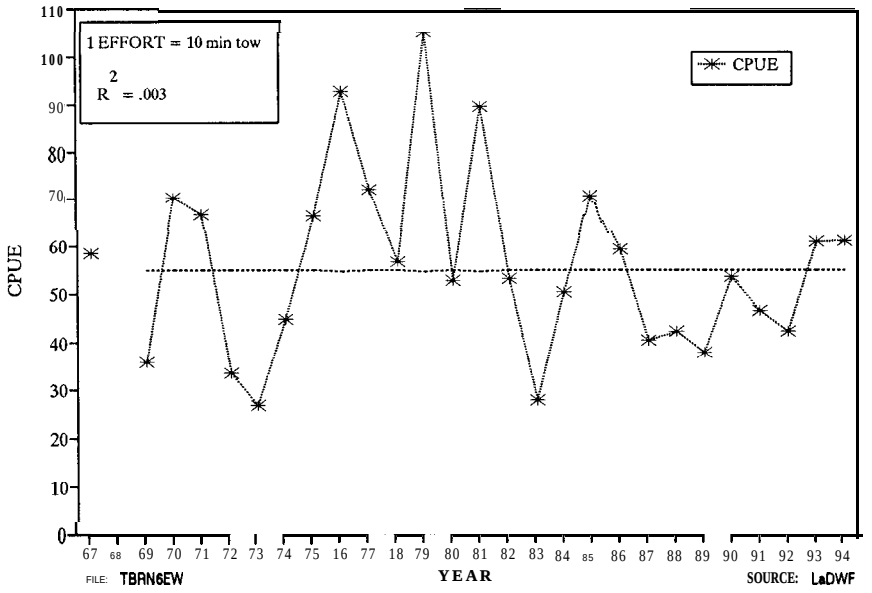

Figure 6.6. Trend of Brown Shrimp catch per unit of effort from 6ft trawl for all stations within the BTS.

- As wetlands are lost, declines in shrimp production are imminent and may be occurring now (Browder et al. 1989).
- As marsh deteriorates to open water, shrimp and other species become more susceptible to predation and populations may decline (Minello and Zimmerman 1983).
- Widespread use of shallow-water commercial harvest gear, may be reducing the populations (personal observations).
- The seine data set is too small to conclude anything and a seine may not be the appropriate gear type to describe shrimp populations.

! It is not known what may be causing a cyclic pattern in the data.

Species Recommendations

! Further analyze all CPUE data and correlate with species length data and hydrological data.

! Further analyze the cyclic patterns observed in the data sets.

! Continue LDWF collection of 16-ft, 6-ft and seine data at the permanent stations within the estuaries to add to the long-term data set. Sampling protocols should remain the same from year to year.

! Establish permanent 6-ft sampling stations in shallow-water habitats year round. Presently LDWF takes samples with 6-ft trawls from early spring through mid-summer to correspond with the Brown Shrimp season.

! Document the influence of natural predation and human harvest on Brown Shrimp populations in shallow-water estuarine nursery habitat.

! Document habitat couplings for Brown Shrimp populations between shallow-water wetland and near-shore areas with the deeper waters of the estuaries.

! Maintain and enhance saline marsh.

White Shrimp
Penaeus setiferus

Status

! The annual fluctuations observed in the 16-ft trawl data and the seine data are considered to be common. Hydrologic conditions in the estuaries influence the distribution and abundance of the species, including the passage of cold fronts in the fall and early winter,

which stimulate movement to deep estuarine waters (Gaidry and White 1973, Perret et al. 1993).

Trends

There are *no statistically significant linear trends* in the 16-ft trawl and seine fishery-independent CPUE for White Shrimp. The CPUE was highly variable from year to year and accounts for the lack of statistically significant trends. *Generalized* trends and observations are summarized as follows: (*the reference line on a graph is for general reference only*)

! Data with a positive slope to the reference line:
- Barataria and Terrebonne estuaries-wide yearly 1986–94 seine CPUE (Figure 6.8). Note that if the years 1986, 1993 and 1994 are not considered, the trend would be flatter.

! Data with a negative slope to the reference line:
- State-wide yearly 1967–94 16-ft trawl CPUE for all stations (Figure 6.9).
- Barataria and Terrebonne estuaries-wide yearly 1967–94 16-ft trawl CPUE for all stations (Figure 6.10).
- Barataria estuary yearly 1967–94 16-ft trawl CPUE for regular (permanent) stations (Figure 6.11).
- Terrebonne estuary yearly 1967–94 16-ft trawl CPUE for regular stations (Figure 6.12).
- Barataria and Terrebonne estuaries-wide 1967–94 July–December 16-ft trawl CPUE for regular stations (Figure 6.13).

! Summary: There are no significant linear temporal trends in the data. However, the majority of data analyses exhibit a yearly downward general trend when 1967–94 are used in the analyses. Downward trends appear to be driven by the 1967–80 period. From 1981–94 the downward trends are not as pronounced and in the case of the regular stations for Barataria and Terrebonne estuaries there is a change to a more flat to upward trend. There appears to be a cyclic pattern in the yearly CPUE data. CPUE will increase for a period of years and then decrease. *The data presented are summarized at a general level. Interpretation must be weighed with the understanding that more subtle temporal trends may be present.*

Causes of Change

! Annual fluctuations in CPUE of 16-ft data are indicative of this species' annual migration through the estuaries and the influence of the prevailing environmental conditions within the estuaries on the relative abundance of the species. The influence of hydrologic conditions,

especially salinity and temperature, have been correlated with White Shrimp abundance in the estuaries (Gaidry and White 1973,

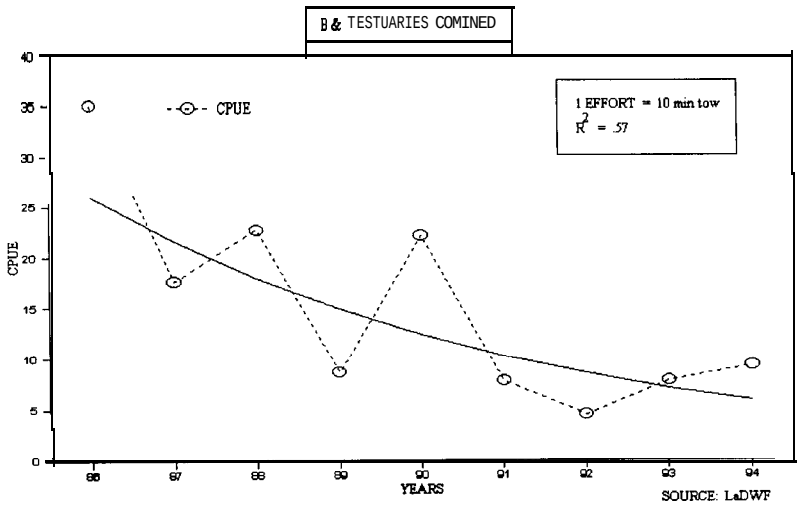

Figure 6.7. Trend of Brown Shrimp catch per unit of effort from seine for regular stations in the BTS.

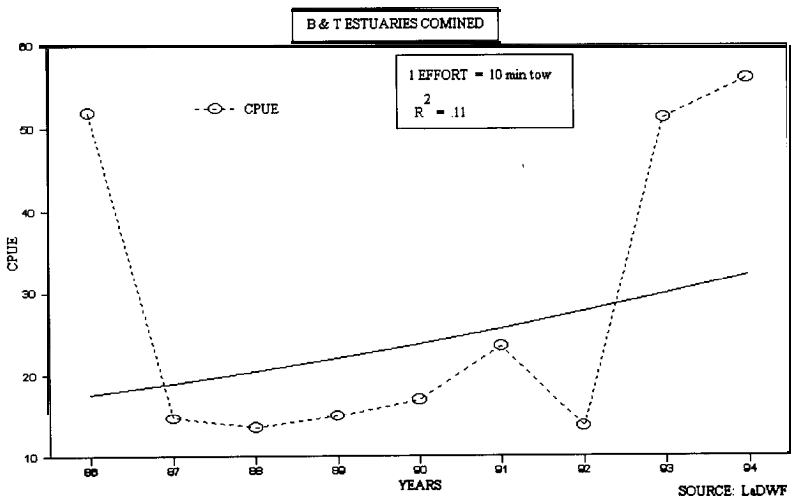

Figure 6.8. Trend of White Shrimp catch per unit of effort from seine for regular stations in BTS.

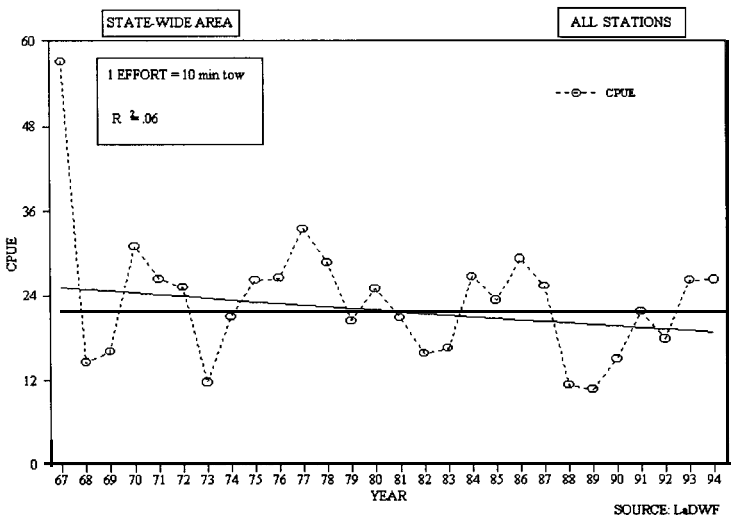

Figure 6.9. Trend of White Shrimp catch per unit of effort from 16-ft trawl for all stations state-wide.

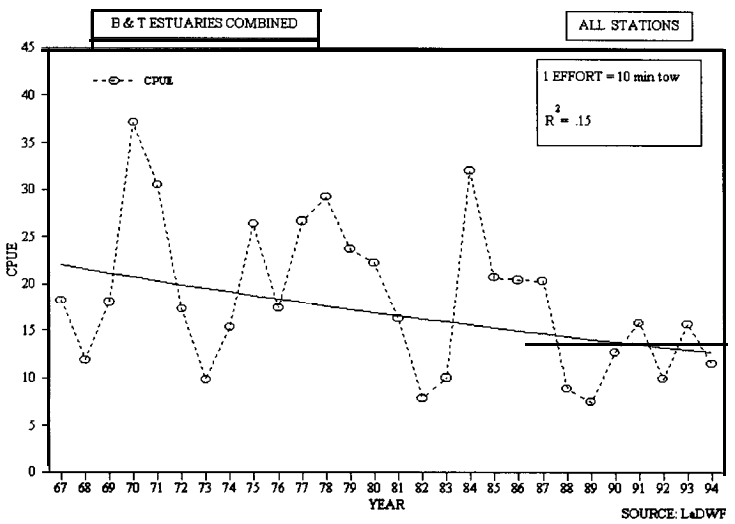

Figure 6.10. Trend of White Shrimp catch per unit of effort from 16-ft trawl for all stations within the BTS.

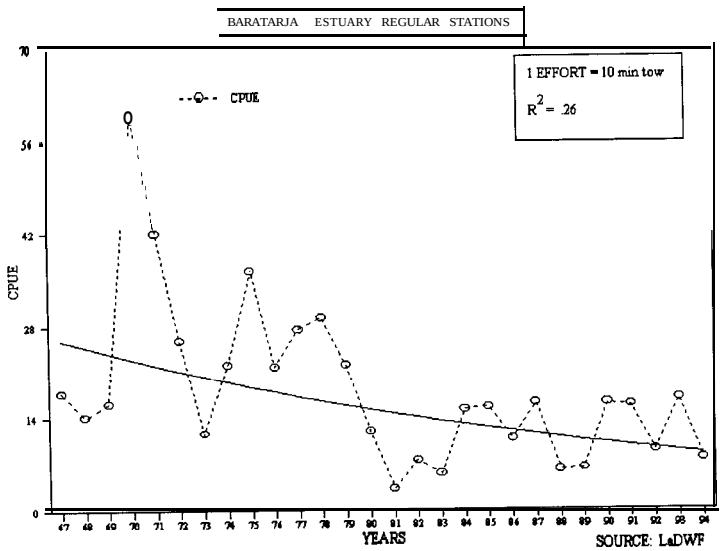

Figure 6.11. Trend of White Shrimp catch per unit of effort from 16-ft trawl for regular stations in Barataria estuary.

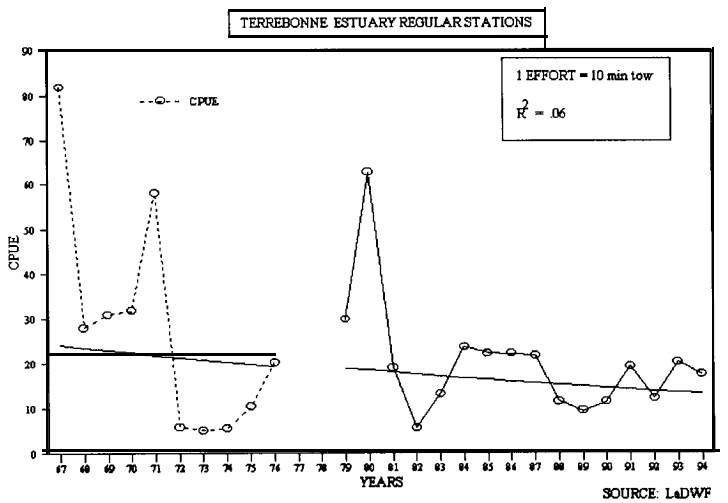

Figure 6.12. Trend of White Shrimp catch per unit of effort from 16-ft trawl for regular stations in Terrebonne estuary.

Barret et al. 1978) and with state-wide fishery-independent trawl CPUE data (Perret et al. 1993).

- The annual fluctuations in the CPUE of seine data in the shallow-water shoreline nursery areas of the estuaries are probably caused by the same prevailing flux in annual environmental conditions. However, a general trend of increasing annual CPUE in the seine data exists. The cause of the general trend is due primarily to the significant numbers of shrimp caught in 1993 and 1994. The seine data set may be too small to conclude any trend and may not be the most appropriate gear type to describe shrimp populations.

- The general decline in CPUE exhibited for all other data sets for the period 1967–94 may be due to one or more of the following:
  - As wetlands are lost, shrimp production declines are imminent and may be occurring now (Browder et al. 1989).
  - As marsh deteriorates to open water, shrimp and other species become more susceptible to predation and populations may decline (Minello and Zimmerman 1983).
  - Widespread use of shallow-water commercial harvest gear may be reducing the populations (personal observations).

- The change in temporal pattern of CPUEs after 1981 may be partially due to a change in sampling effort by the LDWF. In 1981 yearly sampling efforts increased significantly and may have influenced yearly CPUE patterns (see Table 3.3 for yearly efforts).

- It is not known what may be causing a cyclic pattern in the data.

Species Recommendations

- Further analyze all CPUE data and correlate with species length data and hydrological data.

- Further analyze the cyclic patterns observed in all data sets, especially the change in yearly 16-ft trawl CPUE patterns after 1980.

- Continue LDWF collection of 16-ft and seine data at the permanent stations within the estuaries to add to the long- term data set. Sampling protocols should remain the same from year to year.

- Establish permanent long-term 6-ft sampling stations in shallow-water habitats year round. Presently LDWF takes samples with 6-ft trawls from early spring through mid-summer to correspond with the Brown Shrimp season. There are limited data available on this important nursery habitat.

- Document the influence of natural predation and human harvest on White Shrimp populations in shallow-water estuarine nursery habitat.

- Document habitat couplings for White Shrimp populations between shallow-water wetland and near-shore areas with the deeper waters of the estuaries.

- Maintain and enhance saline marsh where possible.

Pink Shrimp
Penaeus duorarum

Status

- The Pink Shrimp is of relatively low abundance estuaries-wide when compared to White and Brown Shrimp, although localized concentrations can be found.

Data analysis was limited to 1981–94. There were no data available for nine years between 1967 and 1980.

Trends

There are *no statistically significant linear trends* in the 16-ft trawl fishery-independent CPUE for Pink Shrimp. The CPUE was highly variable from year to year and accounts for the lack of statistically significant trends. *Generalized* trends and observations are summarized as follows: (*the reference line on a graph is for general reference only*).

- There were no positive (upward) trends in any of the data analyses.

- Data with a negative slope to the reference line:
  - State-wide yearly 1981–94 16-ft trawl CPUE (Figure 6.14) for all stations.
  - Barataria and Terrebonne estuaries-wide yearly 1981–94 16-ft trawl CPUE for all stations (Figure 6.15).
  - Barataria—yearly 1981–94 16-ft trawl CPUE, regular (permanent) stations (Figure 6.16).
  - Terrebonne—yearly 1981–94 16-ft trawl CPUE, regular stations (Figure 6.17).
  - Barataria and Terrebonne estuaries-wide 1981–94 March–April 16-ft trawl CPUE (Figure 6.18).

- Summary: There are no significant linear temporal trends in the data. However, all of the data indicate a general downward trend. The most negative slope is in the Terrebonne estuary for the regular (permanent) stations. *The data presented are summarized at a*

general level. Interpretation must be weighed with the understanding that more subtle temporal trends may be present.

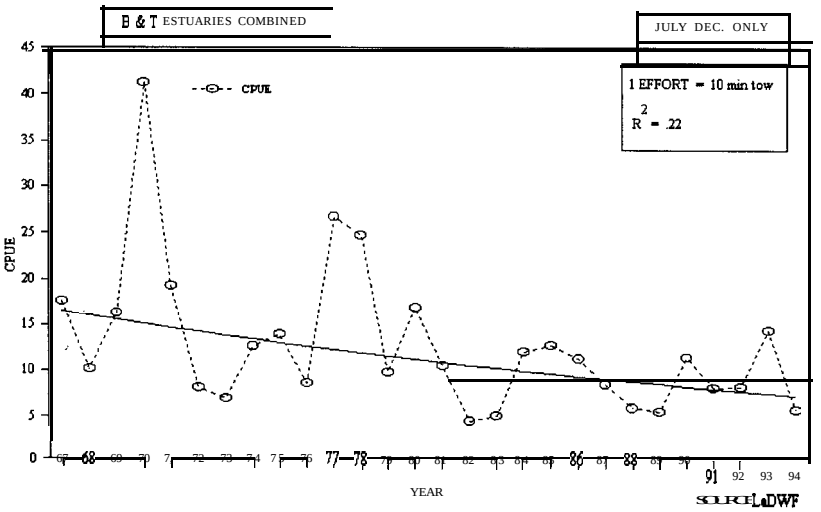

Figure 6.13. Trend of White Shrimp catch per unit of effort from 16-ft trawl for regular stations sampled between July and December.

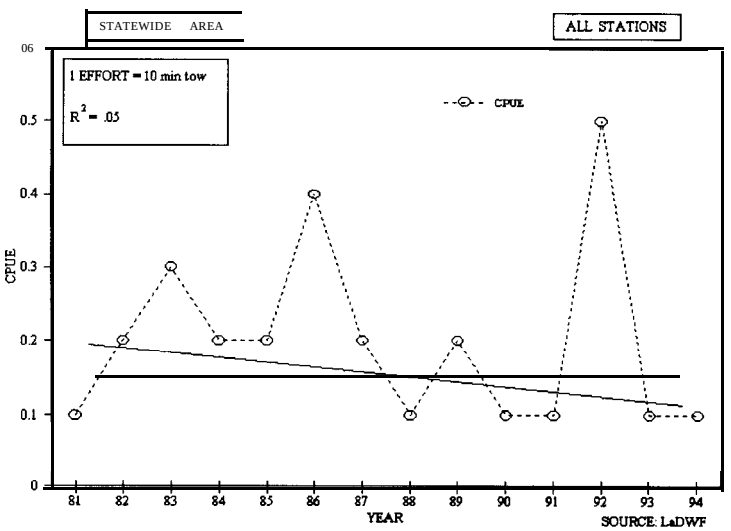

Figure 6.14. Trend of Pink Shrimp catch per unit of effort from 16-ft trawl for all stations state-wide.

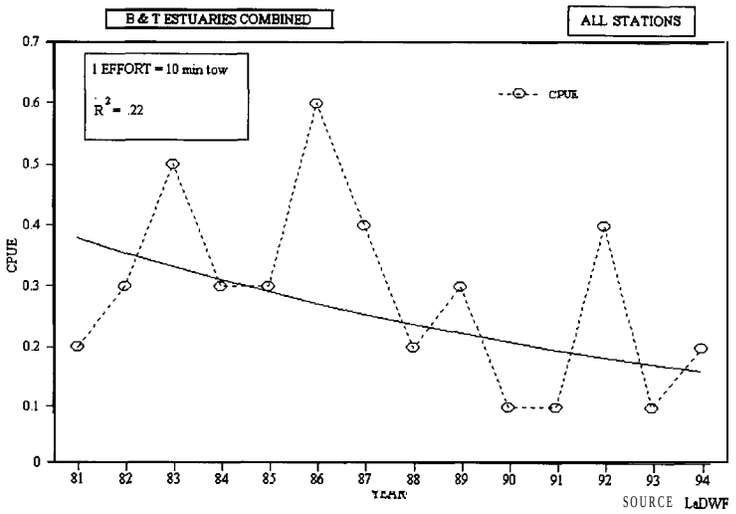

Figure 6.15. Trend of Pink Shrimp catch per unit of effort from 16-ft trawl for all stations within the BTS.

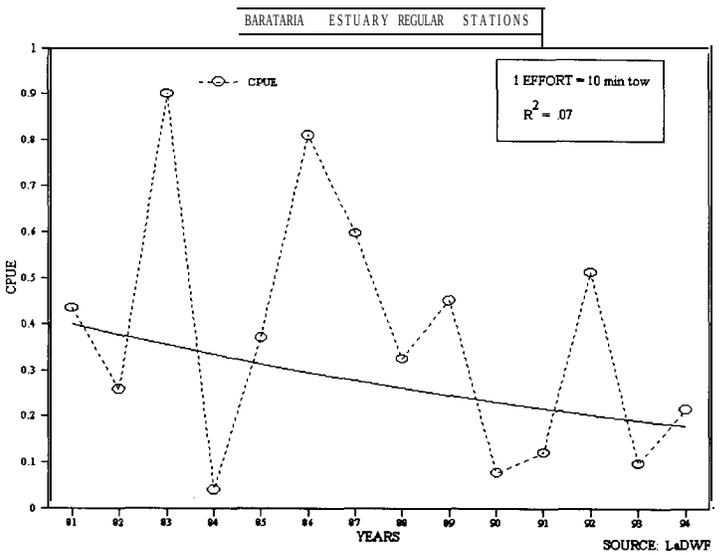

Figure 6.16. Trend of Pink Shrimp catch per unit of effort from 16-ft trawl for all stations within the Barataria estuary.

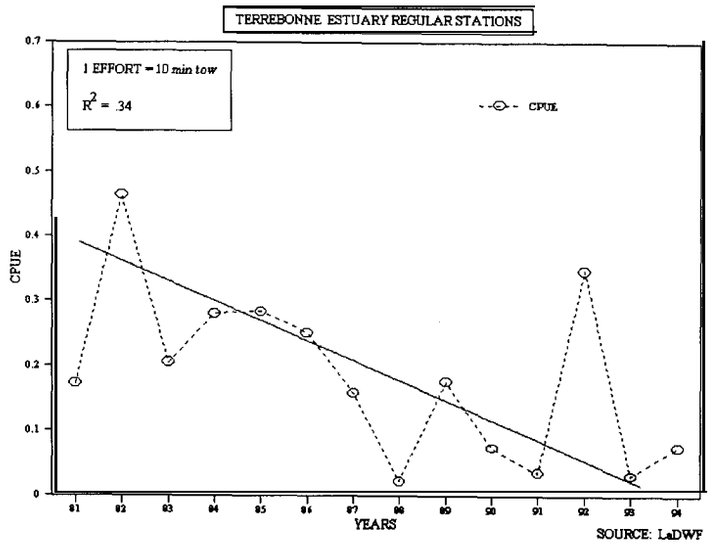

Figure 6.17. Trend of Pink Shrimp catch per unit of effort from 16-ft trawl for regular stations in Terrebonne estuary.

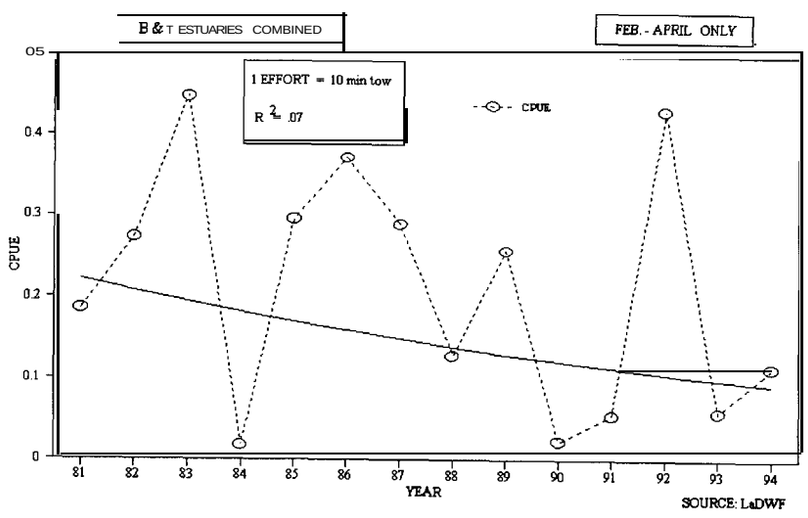

Figure 6.18. Trend of Pink Shrimp catch per unit of effort from 16-ft trawl for regular stations sampled between February and April.

Causes of Change

- Annual fluctuations in the data are indicative of this species' annual migration through the estuaries and the influence of the prevailing environmental conditions within the estuaries on the relative abundance of the species (Condrey et al. 1992).
- The general decline in CPUE exhibited for all other data sets for the period 1967–94 may be due to one or more of the following:
  - As wetlands are lost, declines in Shrimp production are imminent and may be occurring now (Browder et al. 1989).
  - As marsh deteriorates to open water, Shrimp become more susceptible to predation; populations may decline (Minello and Zimmerman 1983).
  - Wide-spread use of shallow-water commercial harvest gear may be reducing the populations (personal observations).

Species Recommendations

- Further analyze all CPUE data and correlate with species length data and hydrologic data.

- Continue LDWF collection of 16-ft data at the permanent stations within the estuaries to add to the long-term data set. Sampling protocols should remain the same from year to year.

- Establish permanent long-term 6-ft sampling stations in shallow-water habitats year round. Presently LDWF takes samples with 6-ft trawls from early spring through mid-summer to correspond with the Brown Shrimp season. There are limited data available on this important nursery habitat.

- Document the influence of natural predation and human harvest activities on Pink Shrimp populations in shallow-water estuarine nursery habitat.

- Document habitat couplings for Pink Shrimp populations between shallow-water wetland and near-shore areas with the deeper waters of the estuaries.

- Maintain and enhance saline marsh where possible.

Seabob Shrimp
Xiphopenaeus kroyeri

Status

- The Seabob Shrimp is of relatively low abundance estuaries-wide when compared to White and Brown Shrimp, although localized concentrations can be found.

- In a Louisiana study, Juneau (1977) indicated that little is known about the species' natural history and this situation continues to this day (Condrey et al. 1992).

Trends

There was *one statistically significant linear trend* in the 16-ft trawl fishery-independent CPUE for Seabob Shrimp. The CPUE was highly variable from year to year and accounts for the lack of statistically significant trends in the other data sets. *Generalized* trends and observations are summarized as follows: (*the reference line on a graph is for general reference only)*.

- A significant upward trend was observed in the 1970–94 16-ft trawl data for the regular (permanent) stations located in the Barataria estuary (Figure 6.19). There is a significant difference in yearly CPUE between the years 1970–79 and 1980–94. When only 1980–94 data years are analyzed, the data exhibit a negative (downward) slope that is not statistically significant.

- Data with a negative slope to the reference line:
  - Barataria and Terrebonne estuaries-wide 1981–94 16-ft trawl CPUE for all stations (Figure 6.20).

- Data with positive slope to the reference line:
  - State-wide yearly 1971–94 16-ft trawl CPUE for all stations (Figure 6.21).

- Data with no slope to the reference line:
  - Terrebonne estuary 1982–94 16-ft trawl CPUE for regular stations (Figure 6.22).

- Summary: There are no significant linear temporal trends in the data, except for the one case listed above. Except for that, all other data sets exhibit a reference line that is nearly flat and could easily change direction with the addition of one or a few data points. *The data presented are summarized at a general level. Interpretation must be weighed with the understanding that more subtle temporal trends may be present.*

Causes of Change

- It is not known what caused such a significant increase in CPUE after 1980 for the Barataria estuary. It is recommended that caution be used in interpreting the

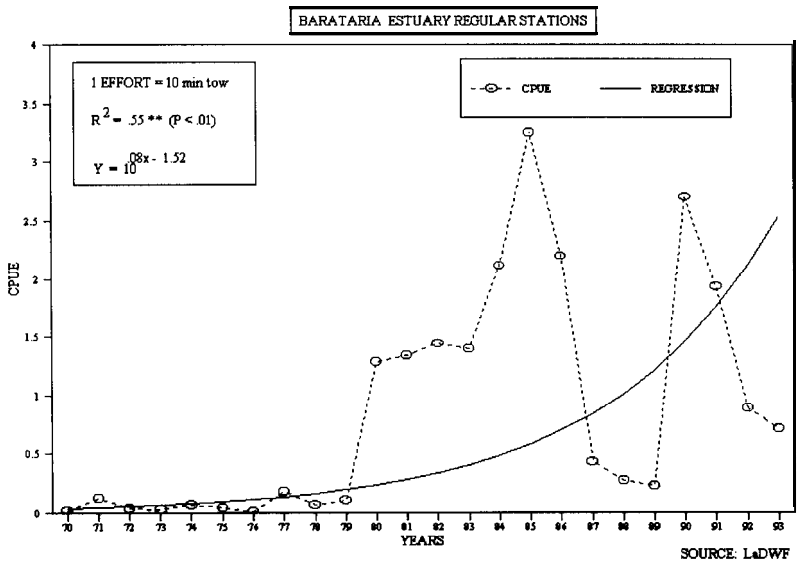

Figure 6.19. Trend of Seabob Shrimp catch per unit of effort from 16-ft trawl for regular stations in the Barataria estuary.

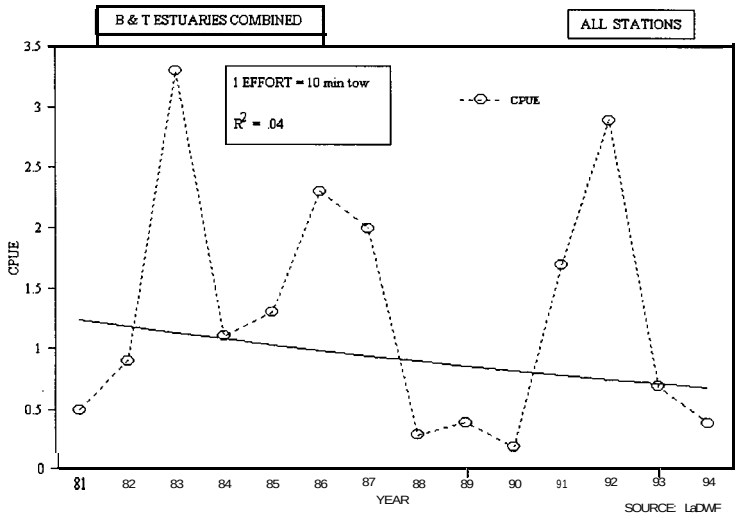

Figure 6.20. Trend of Seabob Shrimp catch per unit of effort from 16-ft trawl for all stations within the BTS.

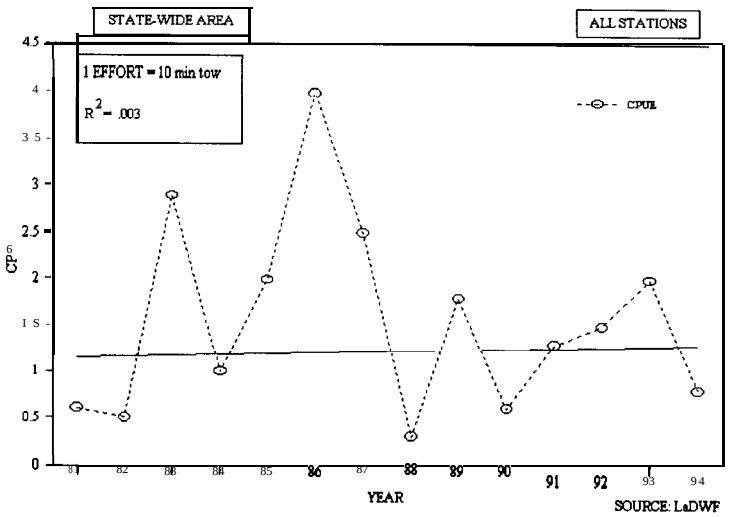

Figure 6.21. Trend of Seabob Shrimp catch per unit of effort from 16-ft trawl for all stations state-wide.

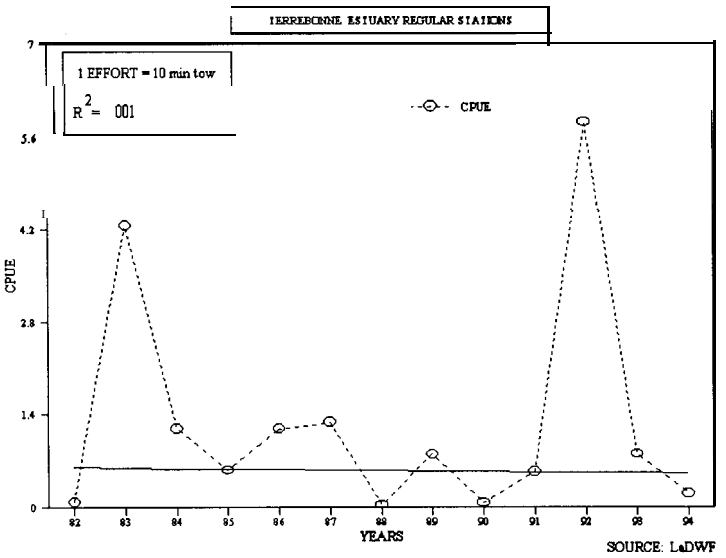

Figure 6.22. Trend of Seabob Shrimp catch per unit of effort from 16-ft trawl for regular stations in Terrebonne estuary.

upward trend. LDWF significantly increased its 16-ft trawl sampling effort in 1981 and this may have had some impact on CPUE.

- Other data are highly variable from year to year, resulting in little slope to the reference line. This is indicative of a species that is probably significantly dependent on the prevailing ambient estuarine and Gulf water conditions. When the species migrates from the Gulf to the lower estuaries, barrier islands appear to play a role in the distribution (Juneau 1977). Barrier island erosion may have a negative impact on the species.

Species Recommendations

- Further analyze the CPUE data, especially for comparison of the pre- and post- 1980 period.

- Further analyze all CPUE data and correlate with species length data and hydrologic data. There is evidence that the species may be attracted to large river outflows during certain periods (Juneau 1977).

- Continue LDWF collection of 16-ft data at the permanent stations within the estuaries to add to the long-term data set. Sampling protocols should remain the same from year to year.

- Document habitat couplings for Seabob populations between lower estuarine areas near barrier islands and Gulf of Mexico waters.

- Maintain and enhance barrier islands where possible, because they appear to have an important influence on the distribution of the species.

Blue Crab
Callinectes sapidus

Status

- The annual fluctuations observed in the 16-ft trawl data and the seine data are considered common (Adkins 1972). The relative abundance of the species is generally determined by the prevailing environmental conditions in the estuaries (Guillory et al. 1995).

Trends

There were *no statistically significant linear trends* in either the 16-ft trawl or the seine data for Blue Crab CPUE. The CPUEs from year to year were variable and

account for the lack of statistically significant trends. *Generalized* trends and observations are summarized as follows: (*the reference line on a graph is for general reference only)*

- Data with a positive (upward) slope to the reference line:
  - State-wide 1967–94 yearly 16-ft trawl CPUE for all stations (Figure 6.23).
  - Barataria-Terrebonne estuaries-wide yearly 16-ft trawl CPUE for all stations (Figure 6.24).
  - Barataria estuary yearly 1967–94 16-ft trawl CPUE for regular (permanent) stations (Figure 6.25)
  - Barataria-Terrebonne estuaries-wide 1986–94 seine data (Figure 6.26).
  - Barataria-Terrebonne estuaries-wide 16-ft trawl May–September CPUE for regular stations (Figure 6.27).

- Data with a negative (downward) slope to the reference line:
  - Terrebonne estuary yearly 16-ft trawl CPUE for regular stations (Figure 6.28).

- Summary: There are no significant linear temporal trends in the data. Except for the one case, all data exhibit an upward shift through the years. There is a significant difference in yearly CPUE between the years 1967–77 and 1980–94. When only 1980–94 data are analyzed, the data exhibit a positive slope, but not statistically significant. *The data presented are summarized at a general level. Interpretation must be weighed with the understanding that more subtle temporal trends may be present.*

Causes of Change

- It is not known what caused the decrease in CPUE after 1980 for the Terrebonne estuary. It is recommended that caution be used in interpreting the downward trend. LDWF significantly increased 16-ft trawl sampling effort in 1981 and this may have had some impact on CPUE.

- The Barataria and Terrebonne wetlands are characterized as deteriorating environments (St Pe and DeMay 1993). Deteriorating wetlands are characterized by having greater periods of inundation and increased areas of marsh-water edge habitat. This situation is thought to stimulate an increase in survival and harvest of fishery species, including the Blue Crab (Guillory et al. 1995). The increasing trend in overall abundance may be a response to this process.

Species Recommendations

- Further analyze all CPUE data and correlate with species length data, sex, and hydrological data.

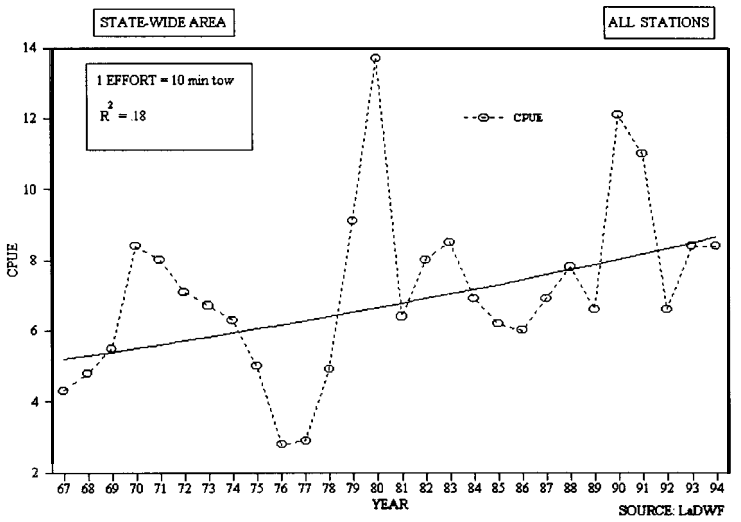

Figure 6.23. Trend of Blue Crab catch per unit of effort from 16-ft trawl for stations state-wide.

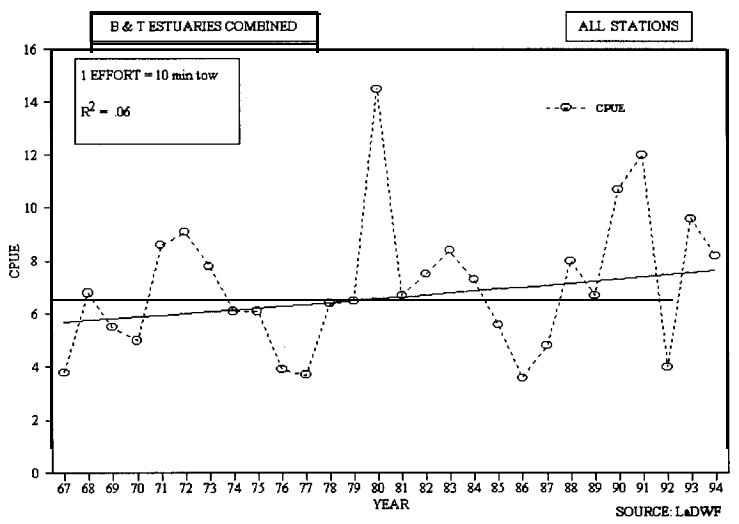

Figure 6.24. Trend of Blue Crab catch per unit of effort from 16-ft trawl for all stations within the BTS.

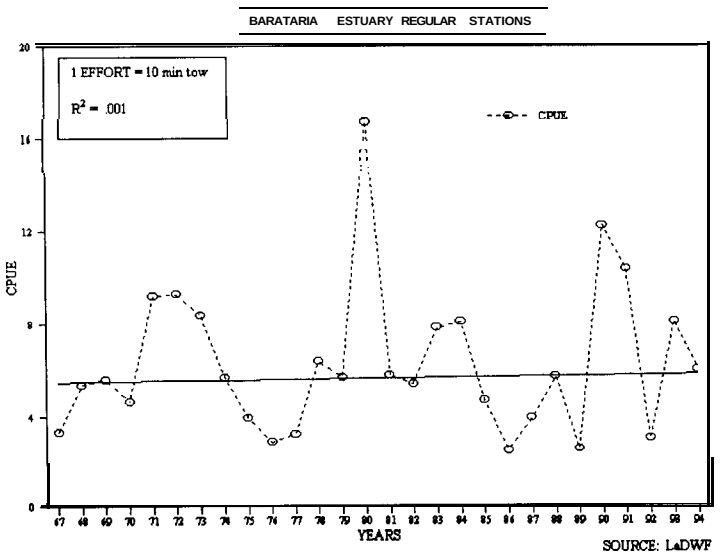

Figure 6.25. Trend of Blue Crab catch per unit of effort from 16-ft trawl for all regular stations in the Barataria estuary.

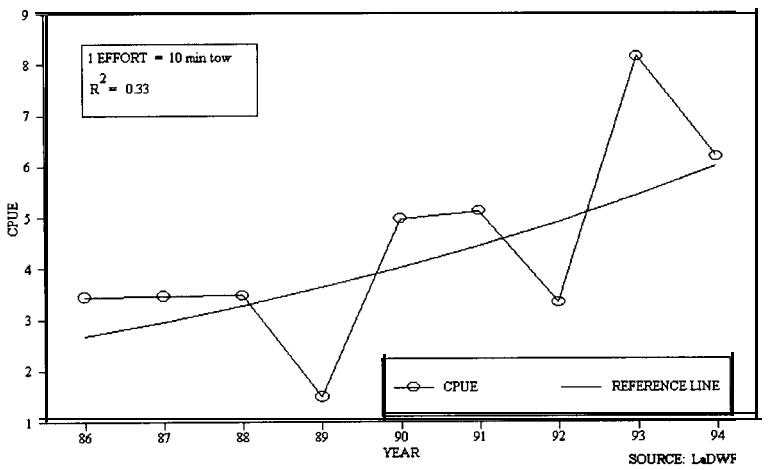

Figure 6.26. Catch per unit of effort for Blue Crab caught in seine for the combined Barataria and Terrebonne estuaries.

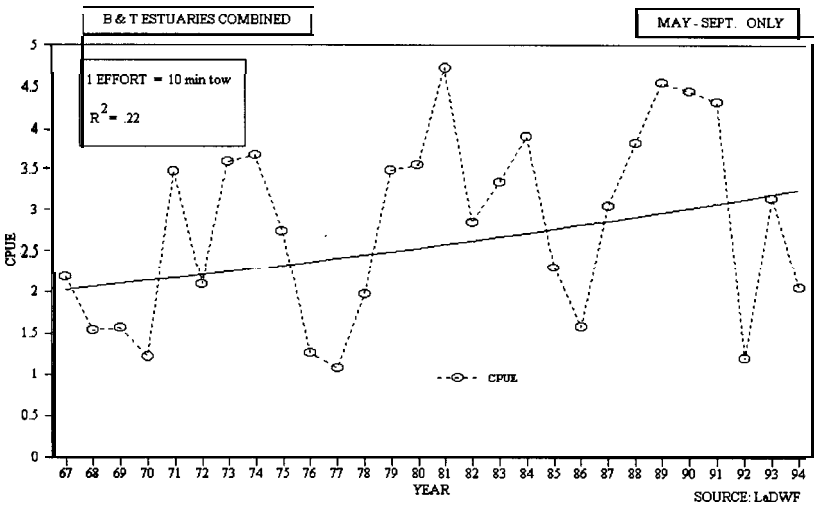

Figure 6.27. Trend of Blue Crab catch per unit of effort from 16-ft trawl for regular stations sampled between May and September.

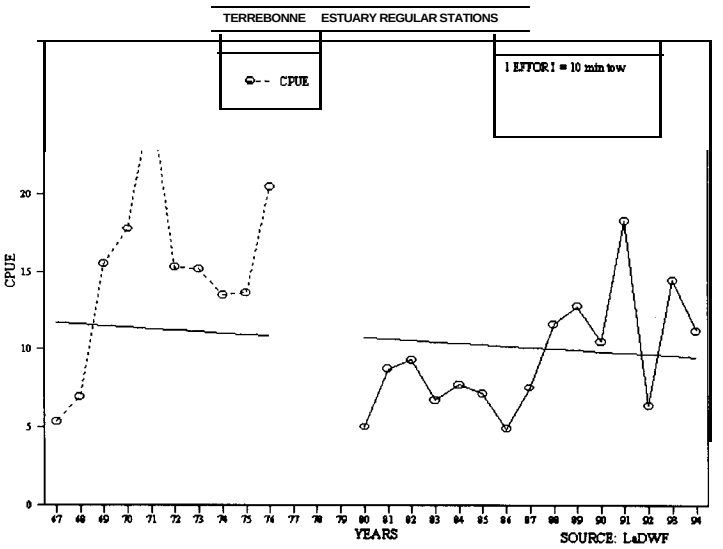

Figure 6.28. Trend of Blue Crab catch per unit of effort from 16-ft trawl for regular stations in Terrebonne estuary.

- Further analyze the change in yearly 16-ft trawl CPUE patterns after 1980.

- Continue LDWF collection of 16-ft and seine data at the permanent stations within the estuaries to add to the long-term data set. Sampling protocols should remain the same from year to year.

- Establish permanent long-term 6-ft sampling stations in shallow-water habitats year round. Presently LDWF takes samples with 6-ft trawls from early spring through mid-summer to correspond with the Brown Shrimp season. There is limited data available on this important nursery habitat.

- Document the influence of natural predation and human harvest on Blue Crab populations in shallow-water estuarine nursery habitat.

- Document habitat couplings for Blue Crab populations between shallow-water wetland and near-shore areas with the deeper waters of the estuaries.

- Maintain and enhance, where possible, saline to fresh marsh for habitat utilization by the Blue Crab.

Eastern Oyster
Crassostrea virginica

Status

- The Barataria and Terrebonne estuaries' oyster habitat zones have been mapped and stored in a GIS data format (Arc info) at the Louisiana Department of Natural Resources (Melancon et al. 1995). Four resource zones were delineated by salinity: (1) a dry zone, where subtidal oyster populations may exist when salinity increases in the upper areas of the estuaries, (2) a wet zone, where subtidal oysters may exist when salinity decreases in the more coastal areas of the estuaries, (3) a wet-dry zone where subtidal oyster populations exist continuously within the estuaries, and (4) a high-salinity zone, the most coastal area, where salinity remains high and natural subtidal oysters seldom survive long because of predation and disease.

- The private leases and public oyster reservations contribute significant aquatic habitat to the estuaries. This species is the oldest state-managed coastal fishery. The industry has evolved into a very successful partnership between oystermen and the state (Dugas 1982, Pawlyk and Roberts 1986). This relationship has developed a fishery that has over 200,000 acres of private leases within the Barataria and Terrebonne estuaries and three public oyster reservations managed by the LDWF.

- Two of the oyster seed reservations, Caillou (Sister) Lake, with 7,700 acres, and Bay Junop, with 2,450 acres, are located in the Terrebonne system while the Barataria system has the Hackberry Bay reservation. Bottom habitat types within the oyster reservations were mapped in the summer of 1994 (Powell et al. 1994a, 1994b).

- Caillou Lake is the largest public oyster reservation in the two estuaries. LDWF has aided the industry by planting cultch (substrate) material to increase suitable habitat for oyster seed (1–3-inch oysters) (Figure 6.29). Hackberry Bay has had four shell plants: 1973, 1989, 1994 and 1995. The 1994 plant was 10,500 cubic yards of shell. Bay Junop is a shallow body of water and is used primarily for sack production (>3-inch oysters), with some natural seed stock also harvested. It is a small area mostly utilized by local oystermen unless production is low on the public oyster grounds east of the Mississippi River (Dugas n.d.).

- Since 1962, oystermen have harvested from Caillou Lake 388,180 sacks of market oysters and 658,484 barrels of seed oysters (Figure 6.30). The fluctuations from year to year are not necessarily due to environmental conditions; LDWF manages the lake for optimum harvest and may close it every other year and as needed.

- Since 1975, oystermen have harvested from Bay Junop 106,694 sacks of market oysters and 18,513 barrels of seed oysters (Figure 6.31). The fluctuations from year to year are not necessarily due to environmental conditions; LDWF manages the bay for optimum harvest and may close it every other year and as needed.

- Sewage contamination of oyster growing waters is a concern of the industry (Kilgen et al. 1985). Bay Junop has been closed due to high fecal coliform counts in 1973, 1987, and 1988. Caillou Lake was closed due to high fecal coliform counts in 1993 (Meier n.d.).

Trends

- For the period 1981–90, Lake Caillou is used to represent weekly salinity trends necessary for oyster survival on a seed reservation. The 10-year pattern indicates that there are relatively low salinities in the spring with an increase through the summer (Figure 6.32).

- In Caillou Lake, seed oysters (25–75mm in length) are present year-round. From 1990–94 there was a sustained increase in the density of oysters on the public reservation (Figure 6.33).

- Seed oysters are also present in Bay Junop year-round. From 1989–94 there was a sustained increase in the density of oysters on the public reservation (Figure 6.34).

- **Seed oysters are also present in Bay Junop year-round. From 1989–94 there was a sustained increase in the density of oysters on the public reservation (Figure 6.34).**

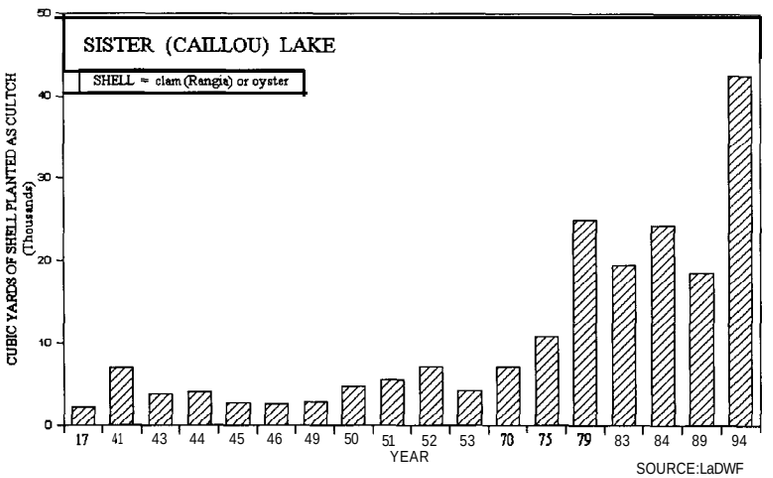

Figure 6.29. Cubic yards of shell planted in Sister Lake by LDWF as clutch substrate for oyster spat set.

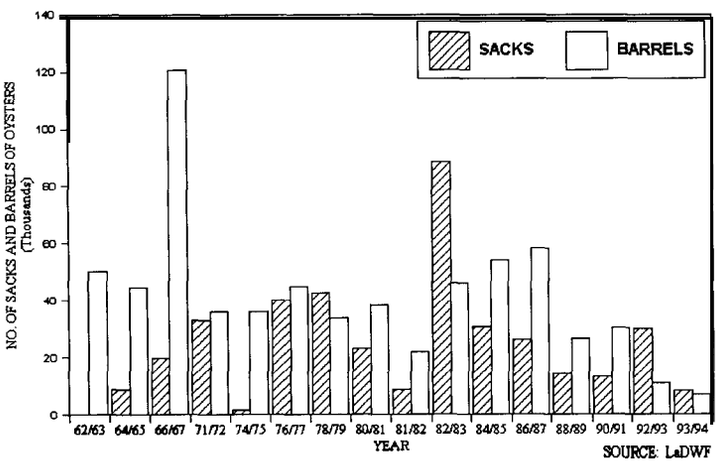

Figure 6.30. Sacks and barrels of oysters harvested from the LaDWF's Calliou (Sister Lake) oyster seed reservation.

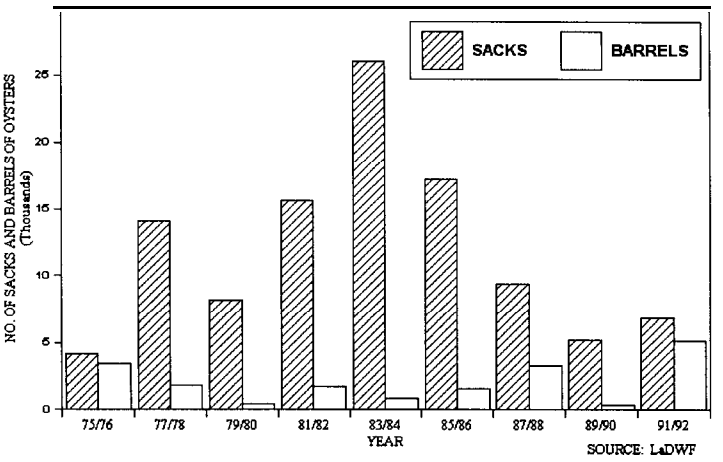

Figure 6.31. Sacks and barrels of oysters harvested from the LaDWF's Bay Junop oyster seed reservation.

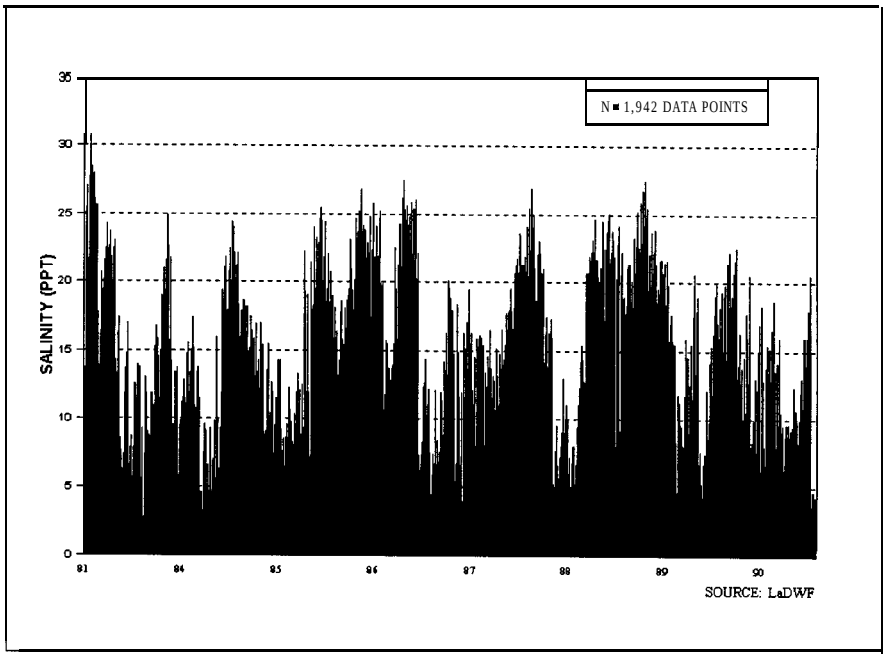

Figure 6.32. Bottom salinities in Sister Lake (Calliou Lake).

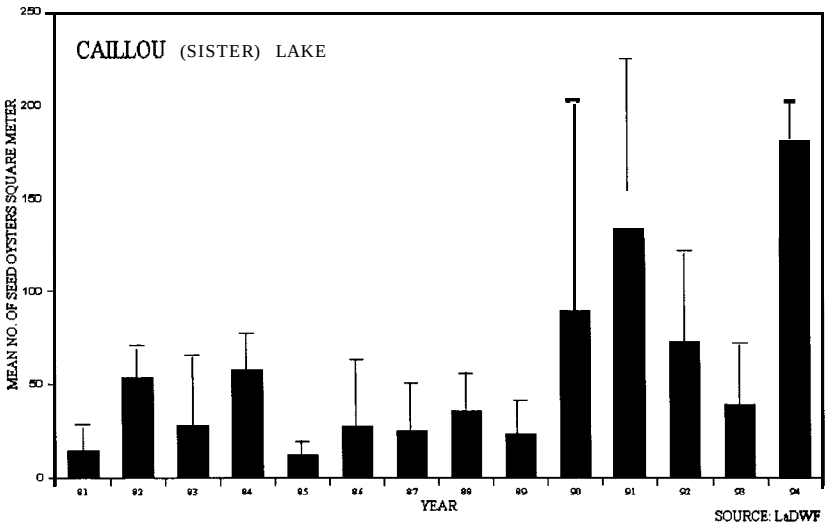

Figure 6.33. Mean number of seed oysters (25-75mm) per square meter from hand-collected samples taken in Calliou Lake.

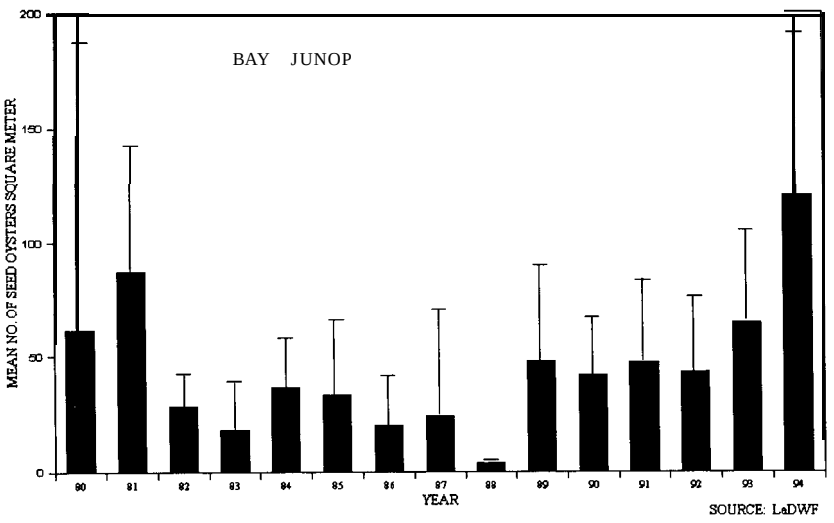

Figure 6.34. Mean number of seed oysters (25-75mm) per square meter from hand-collected samples taken in Bay Junop.

- **Water acreage, and therefore potential oyster habitat, has increased significantly from 1956 through 1988 within the Barataria and Terrebonne estuaries. Water acreage in the dry oyster resource zone has increased 77%, from 68,090 acres to 120,310 acres. Water acreage in the wet-dry oyster resource zone has increased 67%, from 155,209 acres to 259,348 acres. Water acreage in the wet oyster resource zone has increased 41%, from 117,280 acres to 165,553 acres. Water acreage in the high-salinity oyster resource zone has increased 9%, from 255,839 acres to 279,967 acres. (Figure 6.35).**

- **Private oyster lease acreage in three parishes within the Barataria and Terrebonne estuaries increased over 180% during a 30 year period from 1959 to 1991 (Figure 6.36).**

Causes of Change

- **The increases in oyster density on the public oyster reservations since 1990 may be due to one or both of the following: (1) increase in substrate availability due to cultch plantings by the LDWF, and (2) lower salinities during much of the 1990–94 period, which reduced the potential for oyster predation and disease problems. Reduced salinities can be attributed to excessive rainfall (Melancon et al. 1995) and possibly to an increase in the movement of Atchafalaya River water into western Terrebonne by the construction of the Wax Lake dam (Adkins n.d., Bodin, n.d., Scott, n.d.).**

- **Spring freshets, as observed in the Sister Lake salinity data, are considered important for oyster survival (Chatry et al. 1983). Salinities sustained above 15 ppt in summer-temperature waters are conducive to increased predation by the oyster drill, *Stramonita hemostoma* (St. Amant 1938, Melancon 1990) and the protozoan parasite, *Perkinsus marinus* (Soniat 1985). Sustained salinities below 8–10 ppt may impact oyster spat survival and may significantly suppress gonadal development in adults (Loosanoff 1952).**

- **Marsh erosion and loss have increased potential oyster habitat acreage in the four oyster resource zones. Most of the potentially "new" oyster habitats are shallow-water environments (personal observations).**

- **The increase in leased acreage may in part be a response to an increase in "new" shallow-water habitat acreage. In addition, encroaching high salinity conditions in the lower estuaries may be shifting productive habitat farther inland (Van Sickle et al. 1976). Point and nonpoint sources of human sewage pollution may also be stimulating private leasing—oystermen need acreage in different locations to offset health closures (personal observations).**

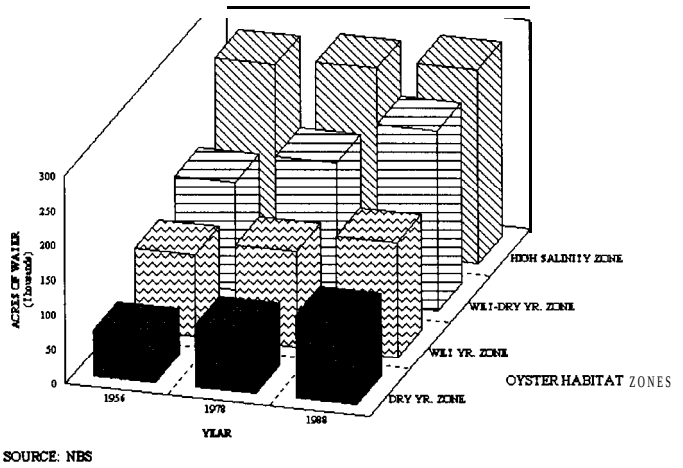

Figure 6.35. Status and trends of water acreage changes in each oyster habitat zone within the Barataria and Terrebonne estuaries.

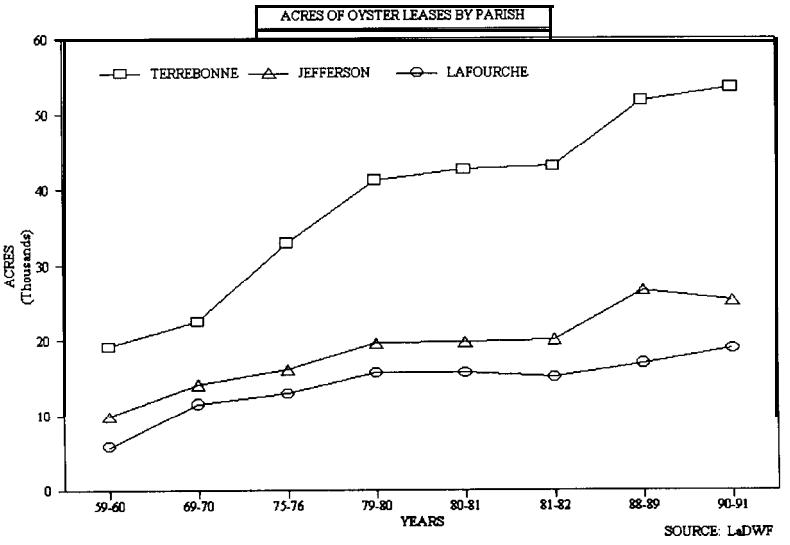

Figure 6.36. Trend in acres leased within the Barataria and Terrebonne estuaries during the past 30 years.

Species Recommendations

- Document and correlate the long-term influence of salinity on oyster distribution and abundance on the public oyster reservations.

- Collaborate with the oyster industry to document and correlate the long-term influence of salinity on oyster distribution and abundance on private leases within the estuaries.

- Document the ecological role of shallow-water oyster habitats that are being created within the estuaries due to eroding wetlands.

- Develop a GIS overlay of pollution closure lines and LDWF oyster lease locations on the oyster resource map. The map may be used to identify trends within the oyster resource zone on private oyster lease acreage shifts, impact on the fishery due to pollution closures, and any habitat changes.

- Improve the water quality of shellfish growing waters.

Macroinfauna
(Benthos)

Status

- Over 90% of the commercially important fish and shellfish species are estuarine-dependent and many utilize the Macroinfauna as a food source (Sikora and Sklar 1987). Nutrient cycling may also be regulated to an extent by benthos. Benthic infauna are also considered excellent biological indicators of environmental conditions (Kasprzak et al. 1994).

- Despite their ecological importance and potential indicator status, the macroinfaunal communities within the Barataria and Terrebonne estuaries have received relatively little attention in the past as indicators of long-term changes within the estuaries.

- The only long-term macroinfaunal data known to exist for the region are the LOOP data collected by the LDWF. Other benthic studies within the estuary have been short term, to either characterize the ecosystem (Philomena 1983) or respond to known or potential sources of pollution (Rabalais et al 1991).

Analyses of the LOOP data were limited. The data were not available on computer and the data that follow were gleaned from the LDWF's annual reports.

Trends

- Seasonal cycling of diversity, H', evident in the data sets. The most stable site, in terms of H', was the far-offshore station (Figure 6.37). The most erratic diversity was observed at the nearshore site (Figure 6.38), and the lowest diversity in the nearshore station (Figure 6.39) and the one farthest inland (Figure 6.40).

- Preliminary analyses of species richness (D) and evenness (J) show no obvious trends.

- Arthropods dominated the fauna, followed by Annelids.

Any further information on trends may be obtained from the annual LOOP reports on file at the Baton Rouge office of the Coastal Ecology Section of the LDWF. In addition, LDWF, with Vittor and Associates, Inc., is analyzing the LOOP data set.

Causes of Change

- Spring and summer decrease in species diversity may be a natural phenomenon resulting from changing environmental conditions including, but not limited to, decreasing dissolved oxygen.

- Relatively more stability at the far-offshore station may be due to less flux in seasonal water quality.

Recommendation

- Establish permanent benthos stations within the estuaries.

ESTUARINE/MARINE FINFISH

Atlantic Croaker
Micropogonias undulatus

Status

- Found to be second most abundant trawl species in the BTES (Thompson and Forman 1987) and statewide (Perret et al. 1993).

Trends

- Slight decline in BTES seine-caught young croaker, 1986–1994 (Figure 6.41).

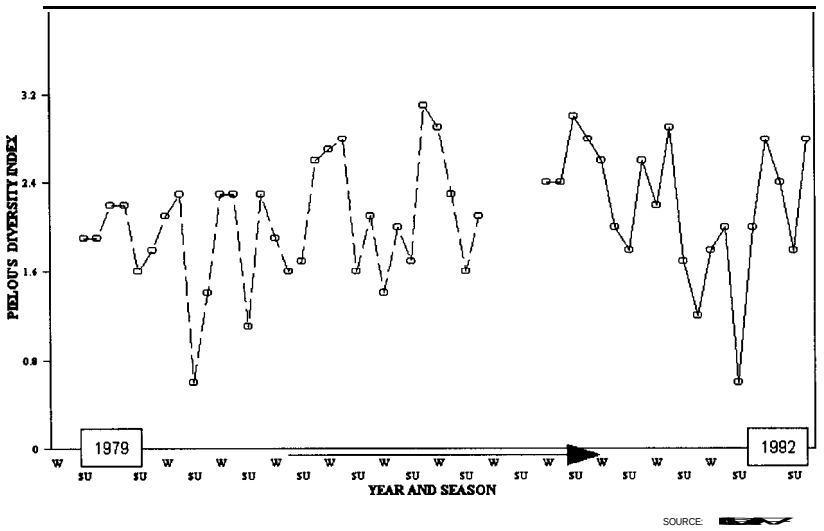

Figure 6.37. Macroinfauna species diversity (H') at station 435 near-shore LOOP pipeline.

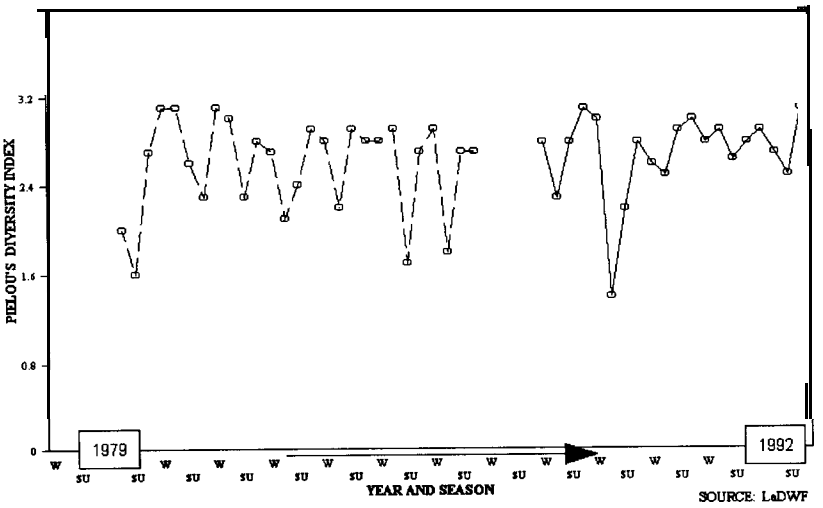

Figure 6.38. Macroinfauna species diversity (H') at station 482 offshore LOOP pipeline.

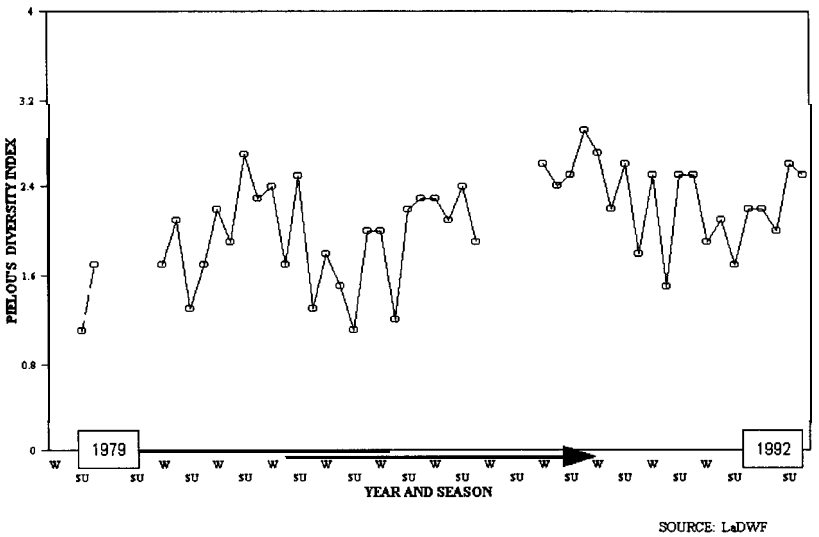

Figure 6.39. Macroinfauna species diversity (H') at station 407 lower-estuary LOOP pipeline.

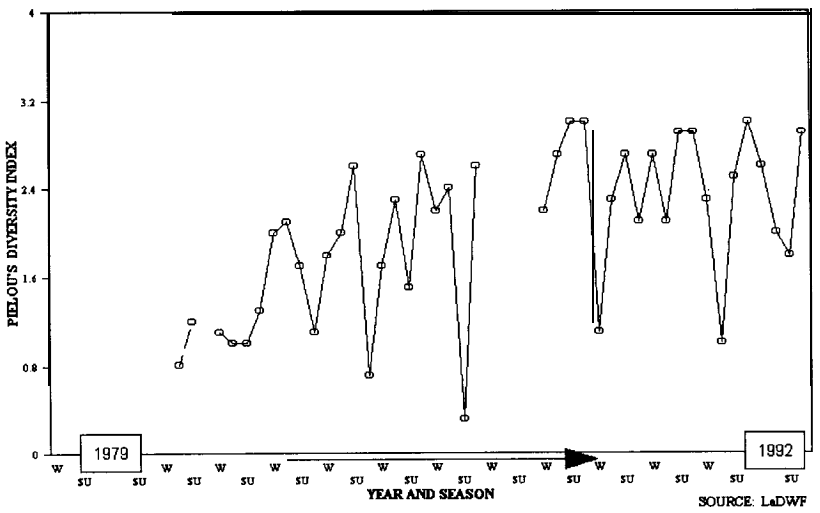

Figure 6.40. Macroinfauna species diversity (H') at station 461 upper-estuary LOOP pipeline.

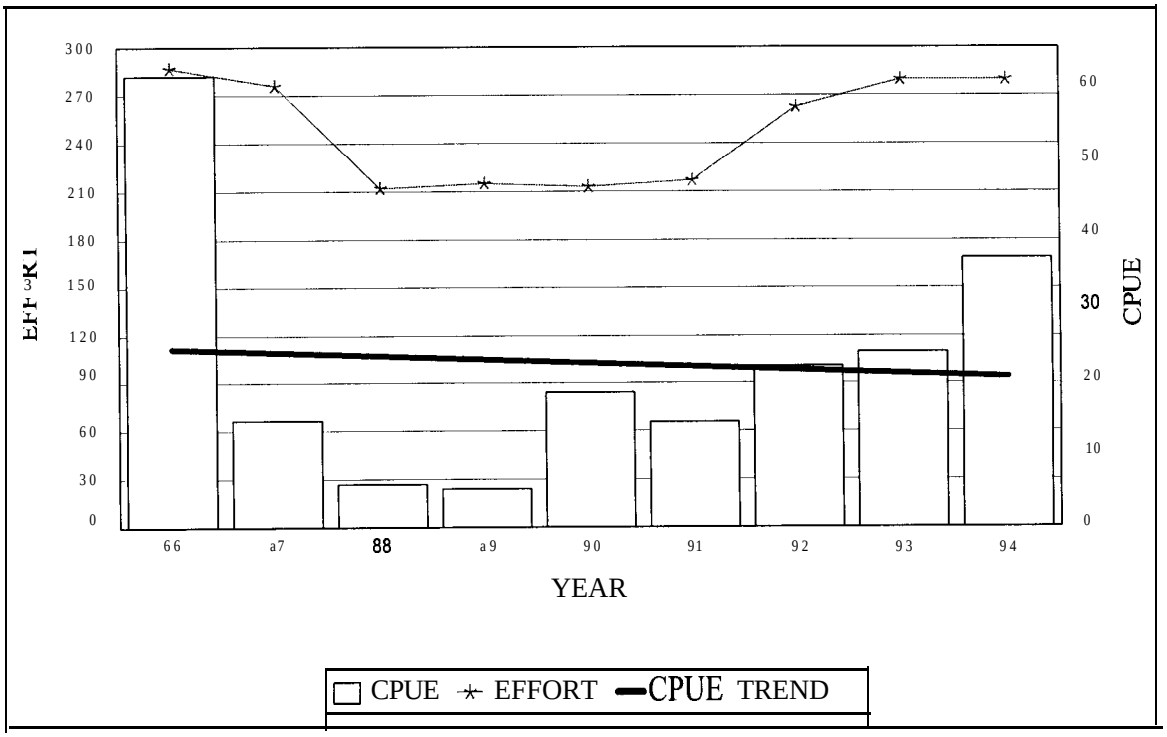

Figure 6.41. Catch/effort for Atlantic Croaker, 1986-1994, 50-ft seine for BTES.

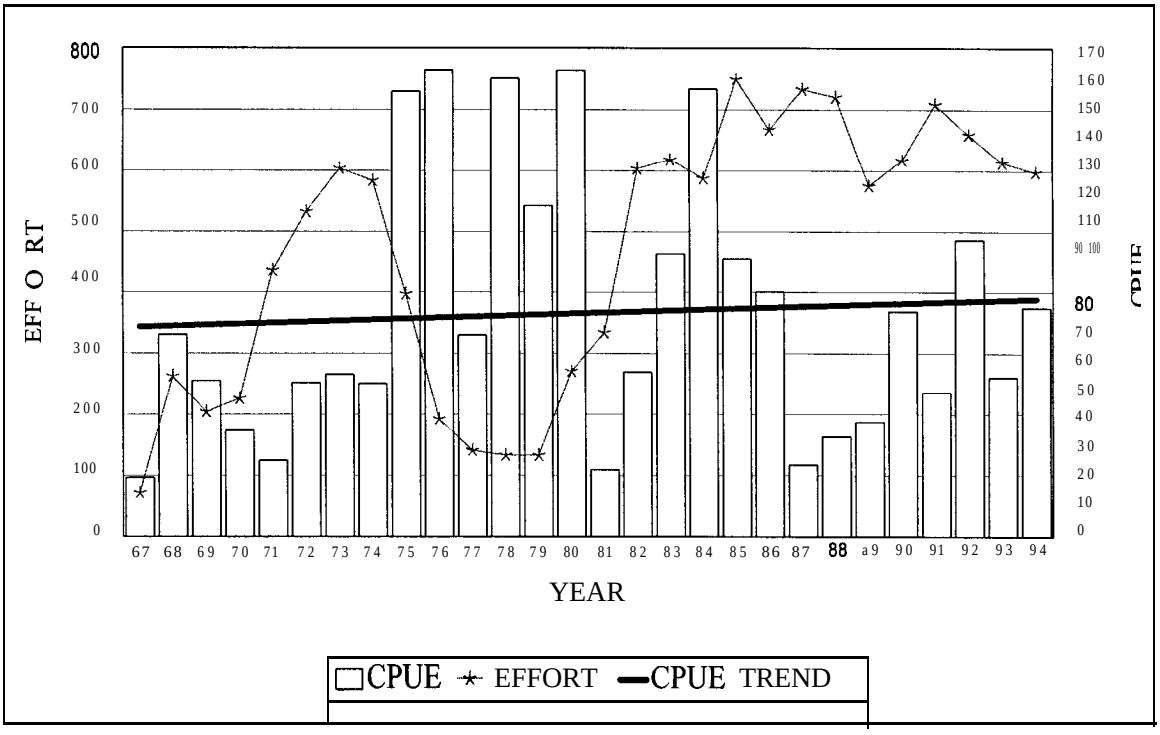

Figure 6.42. Catch/effort for Atlantic Croaker, 1967-1994, 16-ft trawl for BTES.

- Slight increase, but strong interannual variation, for trawl-caught croaker, 1967–1994, in the BTES (Figure 6.42).

- Decrease in trawl-caught croaker from LOOP stations, 1978–1994; strong drop-off in 1987, increasing since (Figure 6.43).

- Statewide trend similar to BTES (Figure 6.44).

- Slight increase in gill net catch for croaker, 1988–1994, particularly past two years for BTES region (Figure 6.45).

Causes of Change

There are no data directly related to Atlantic Croaker. Coastal erosion and trawl by-catch probably have a detrimental effect on the success of young croaker.

Habitat Requirements

- Diaz (1982) noted that estuaries are inhabited almost exclusively by juveniles, preferring marshes interlaced with creeks, meanders showing high turbidity, and open estuaries with mud bottoms.

- Lassuy (1983a) discussed the preference for turbid waters and associated soft, detrital bottoms in intermediate salinities.

Species Recommendations

- In coastal reconstruction projects, allow for soft-bottomed marsh meanders.

- Monitor croaker stock for excessive human-induced mortality of young.

Bay Anchovy
Anchoa mitchilli

Status

- Most abundance fish species in canal study (Adkins and Bowman 1976).

- Thompson and Forman (1987) considered this species "the single most important member of the nektonic community from an ecological viewpoint, ranking first in abundance and

second in biomass across the entire spectrum of the basin" in reference to the Barataria basin.

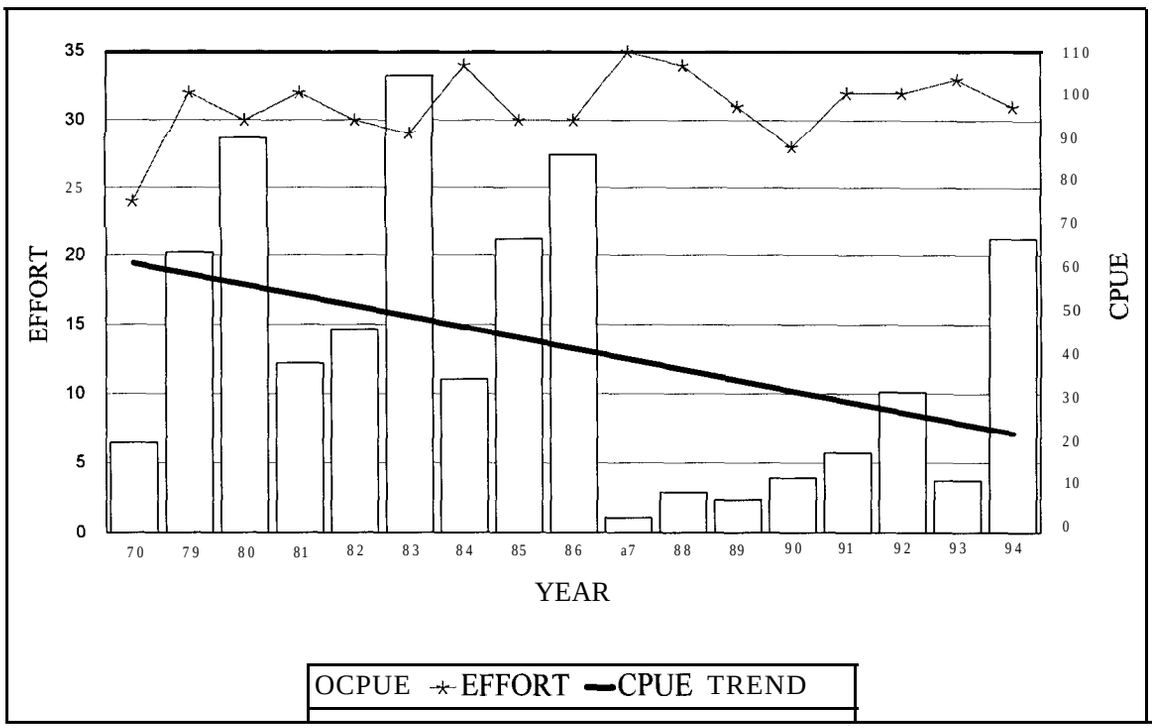

Figure 6.43. Catch/effort for Atlantic Croaker, 1978-1994, 16-ft trawl from LOOP stations for BTES.

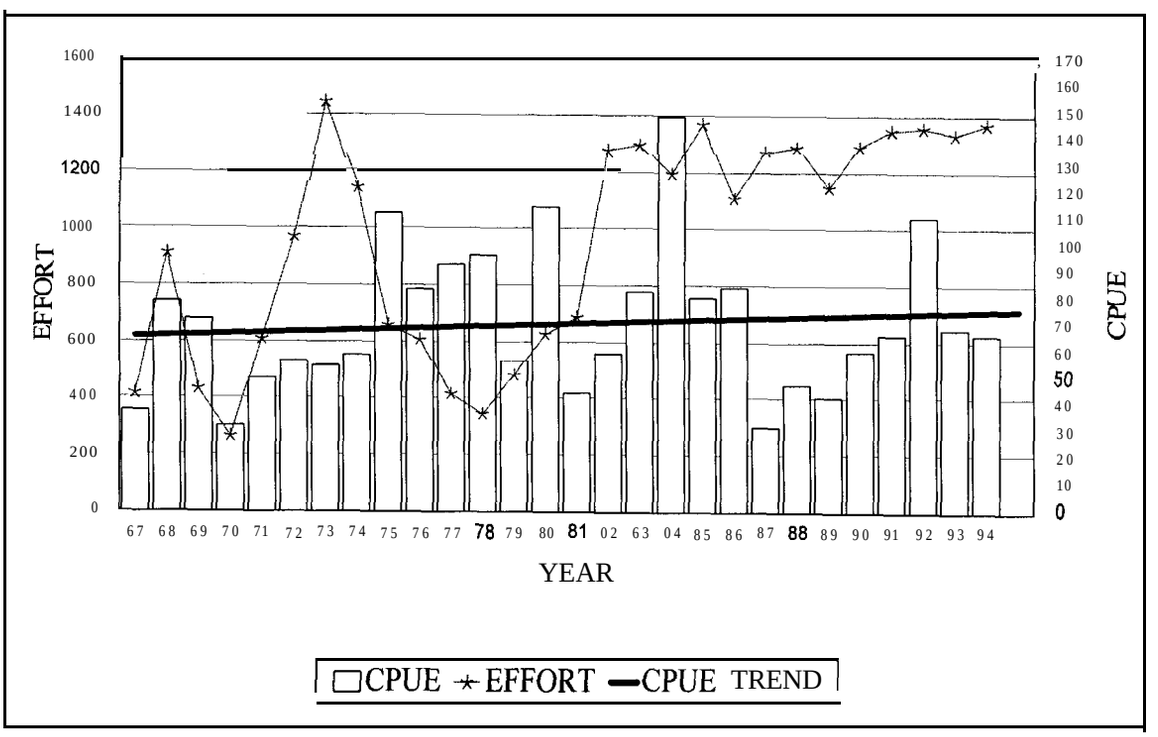

Figure 6.44. Catch/effort for Atlantic Croaker, 1967-1994, 16-ft trawl, statewide.

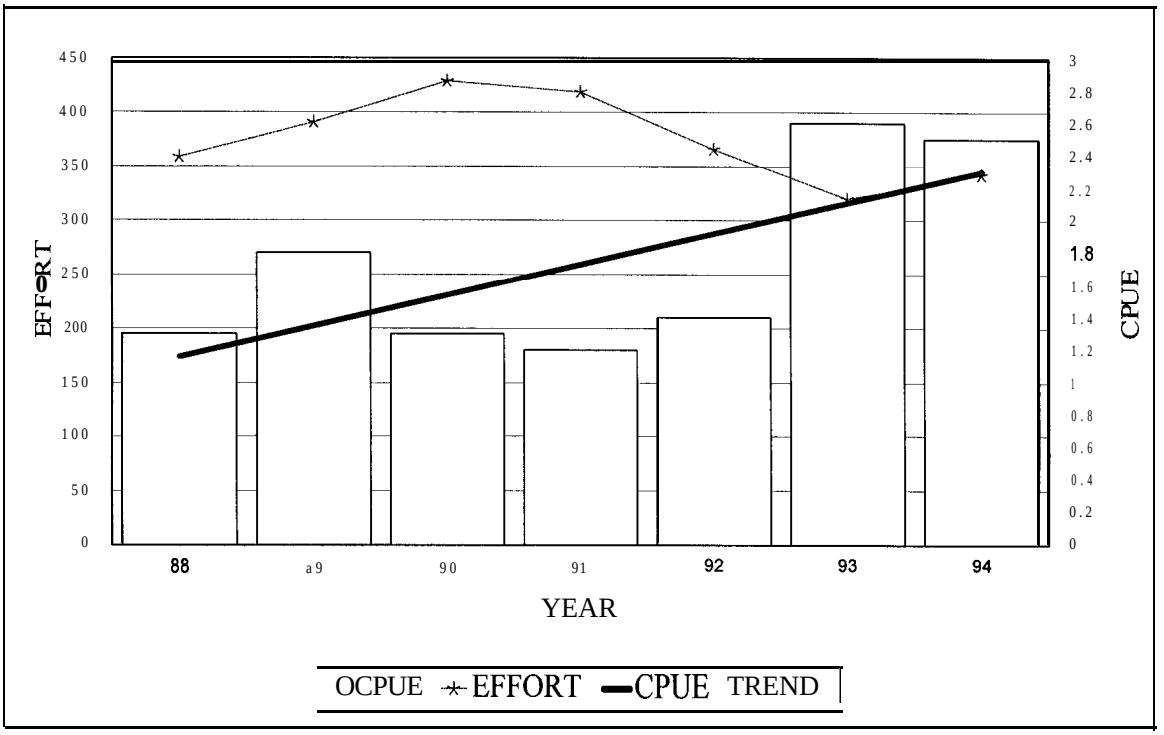

Figure 6.45. Catch/effort for Atlantic Croaker, 1988-1994, gill net (all meshes combined) for BTES.

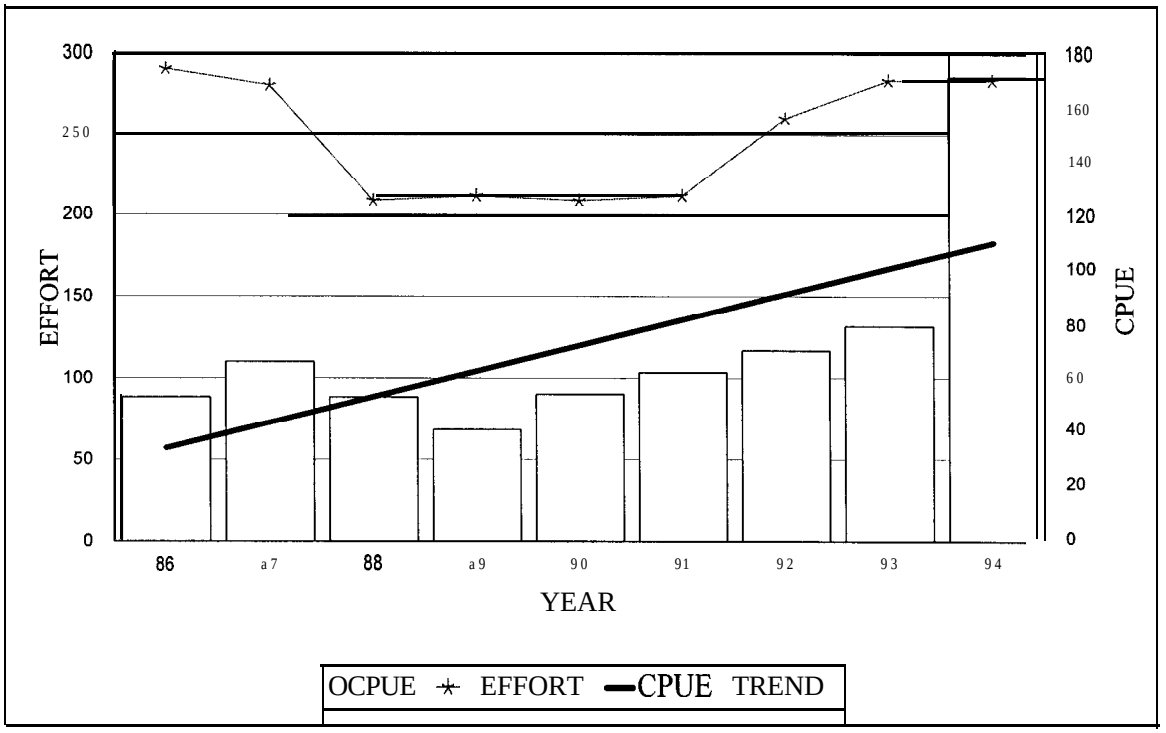

Figure 6.46. Catch/effort for Bay Anchovy, 1986-1994, 50-ft seine for BTES.

- Most abundant fish species by number and frequency of occurrence state-wide (Perret et al. 1993).

- Most abundant trawl-caught species state-wide in coastal Louisiana (Perret et al. 1971 and Barrett et al. 1978).

Trends

- Slight increase in BTES seine-caught Bay Anchovy, 1986–1994 (Figure 6.46).

- Increase, then decrease in 16-ft trawl catches of Bay Anchovy, 1967–1994; large interannual CPUE variation in BTES (Figure 6.47).

- Constant CPUE, except for 1993–1994, in trawl-caught Bay Anchovy from LOOP stations, 1978–1994 (Figure 6.48).

- Statewide trend in 16-ft trawl catches of Bay Anchovy similar to BTES (Figure 6.49).

Causes of Change

There are no data directly related to Bay Anchovy. CPUE suggests no real changes over time in Bay Anchovy population. Strong interannual variation is likely linked to short generation time and the variability of the estuarine environment.

Habitat Requirements

- Wide variety of environmental conditions; will tolerate wide range of water temperature and salinity. Can be nearly ubiquitous over much of BTES region. Some spawning within the lower BTES.

- Morton (1989) reported a wide range of habitats including sand beaches, open bays, muddy coves, river mouths, and seagrass beds; even migrations up rivers and streams. He noted that water temperature and salinity had little influence on species distribution.

- Robinette (1983) reported that bay anchovies are strongly euryhaline, ranging from riverine fresh water to nearly 50 ppt. He noted that the Bay Anchovy had a strong tolerance for low oxygen levels, often being the dominant fish in stressed environments.

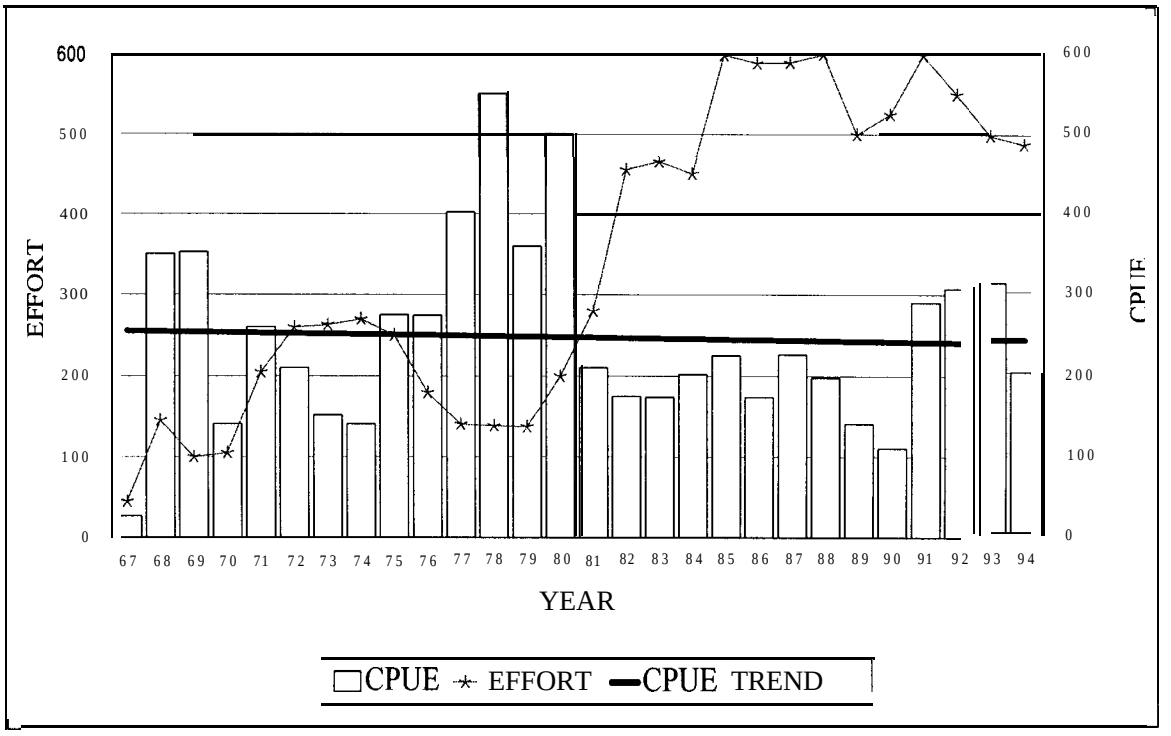

Figure 6.47. Catch/effort for Bay Anchovy, 1967-1994, 16-ft trawl for BTES.

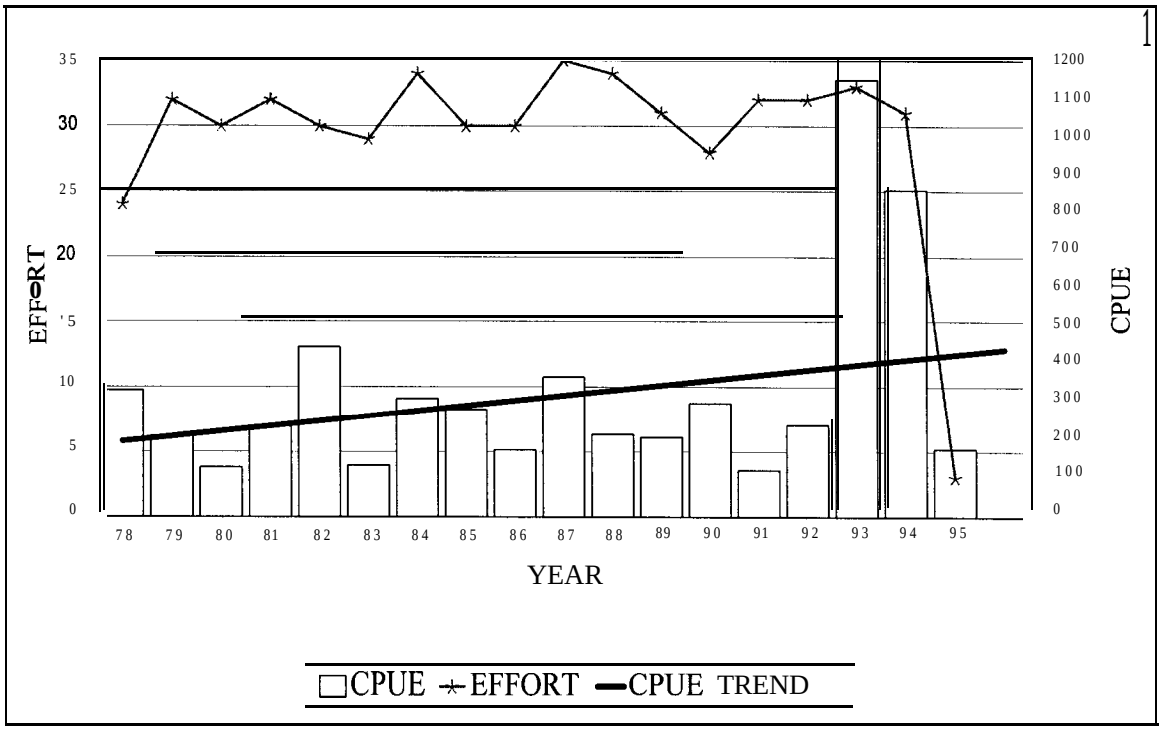

Figure 6.48. Catch/effort for Bay Anchovy, 1978-1994, 16-ft trawl from LOOP stations for BTES.

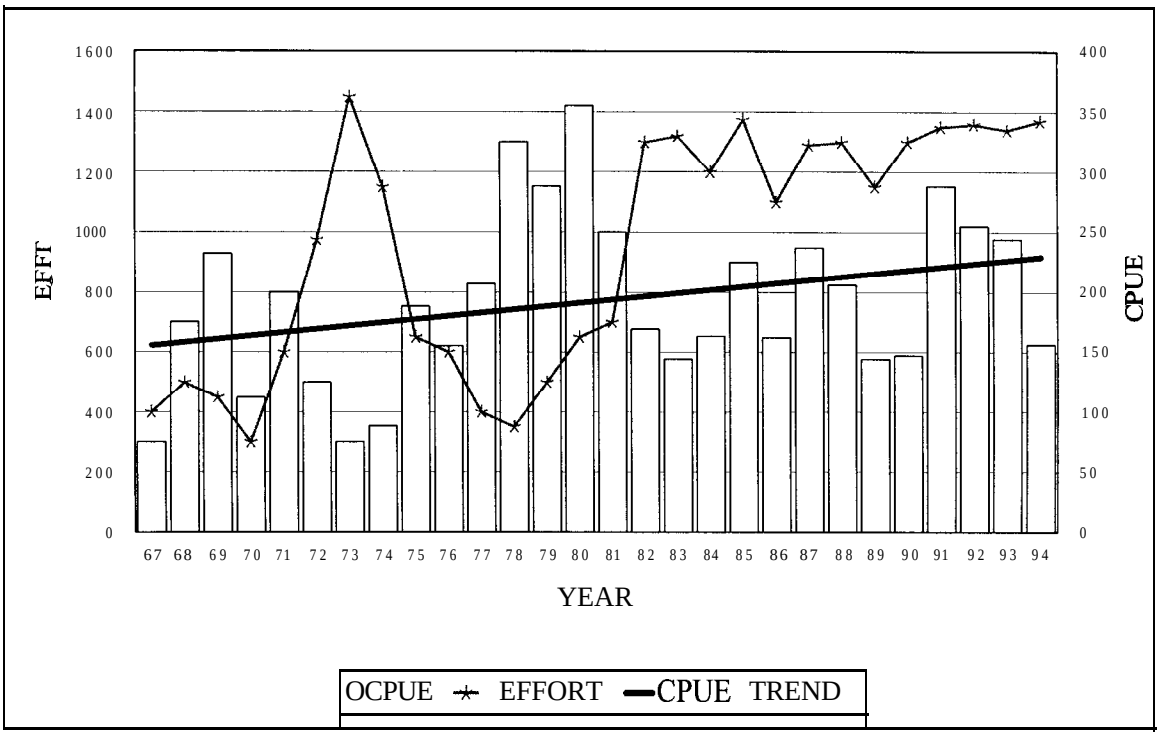

Figure 6.49. Catch/effort for Bay Anchovy, 1967-1994, 16-ft trawl, statewide.

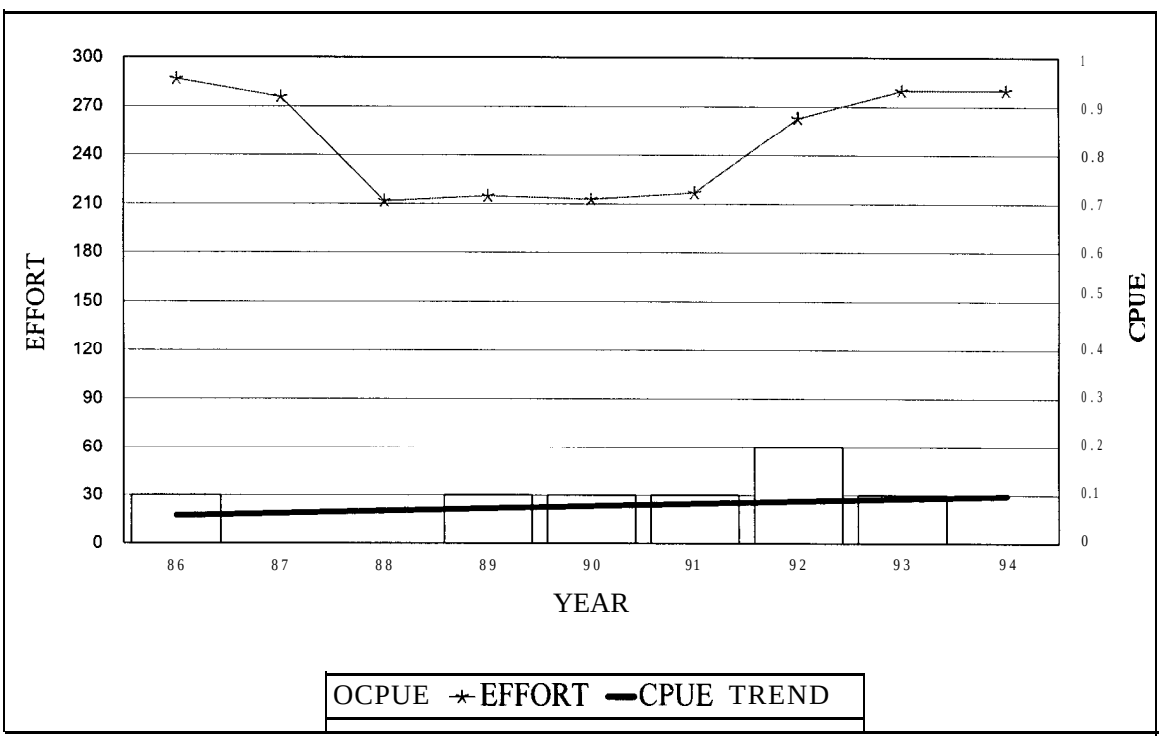

Figure 6.50. Catch/effort for Black Drum, 1986-1994, 50-ft seine for BTES.

Species Recommendations

- No recommendations needed since Bay Anchovy is most abundant fish species in BTES; Thompson and Fitzhugh (1986) suggested that an overabundance of Bay Anchovy was a sign of an impacted fish community. Examine fishery-independent data sources to see if Bay Anchovy is becoming "over dominant" in trawl and seine surveys. This may be an indication of loss of fish diversity.

Black Drum
Pogonias cromis

Status

- Not an abundant species in BTES region but its large size can make it an important contributor to estuarine biomass estimations.

- Seldom ranked in top 10 to 15 fish species in most biological surveys, but large size of adults makes certain sampling gears ineffective for estimating true abundance.

- Adkins et al. (1979) found Black Drum third most abundant species in gill net and 11th most abundant in trammel net samples.

Trends

- Low, but consistent CPUE in BTES seine-caught juvenile Black Drum, 1986–1994 (Figure 6.50).

- Almost no data for Black Drum caught in 16-ft trawl, 1967–1994 (Figure 6.51).

- Low, consistent CPUE in BTES trawl-caught Black Drum, statewide, 1967–1994 (Figure 6.52).

- Large interannual variation in gill net samples of Black Drum, 1988–1994; may be slight increase over past few years (Figure 6.53).

- High variation, 1987–1994, in trammel net catches; trend similar to gill net catches (Figure 6.54).

Causes of Change

No data directly related to Black Drum. As a benthic feeder, coastal erosion may have detrimental effect on feeding habits. LDWF (1990) addressed question of

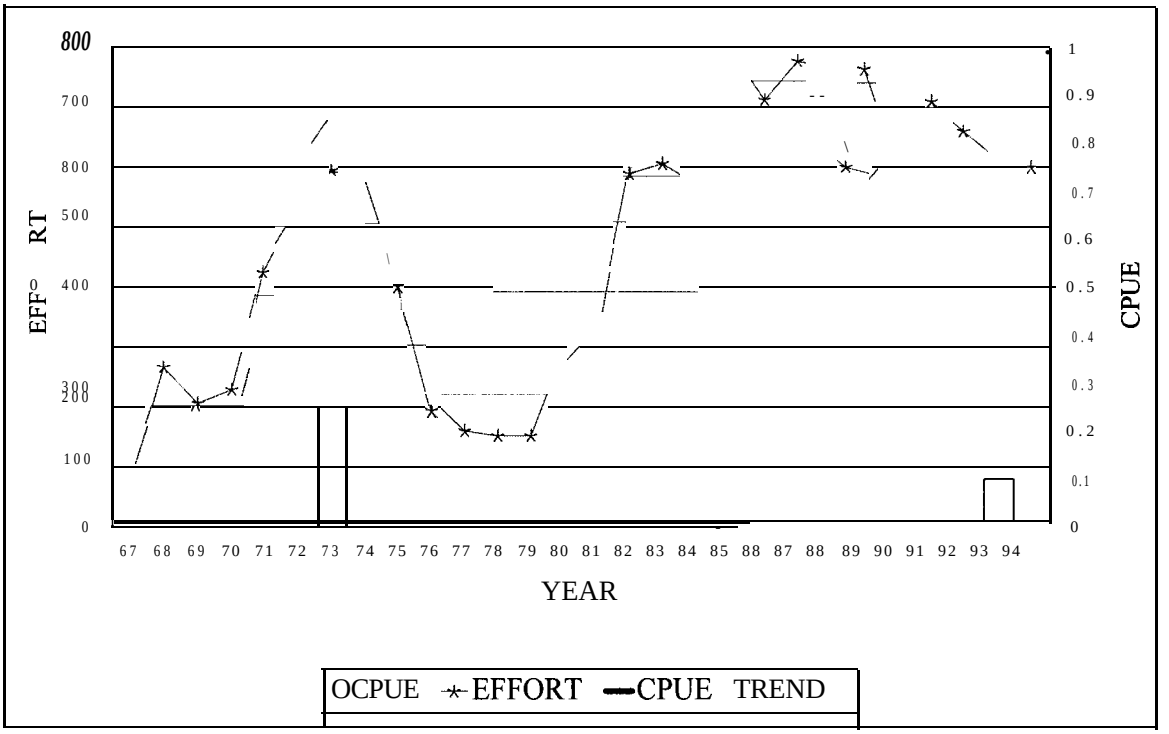

Figure 6.5 1. Catch/effort for Black Drum, 1967-1994, 16-ft trawl for BTES.

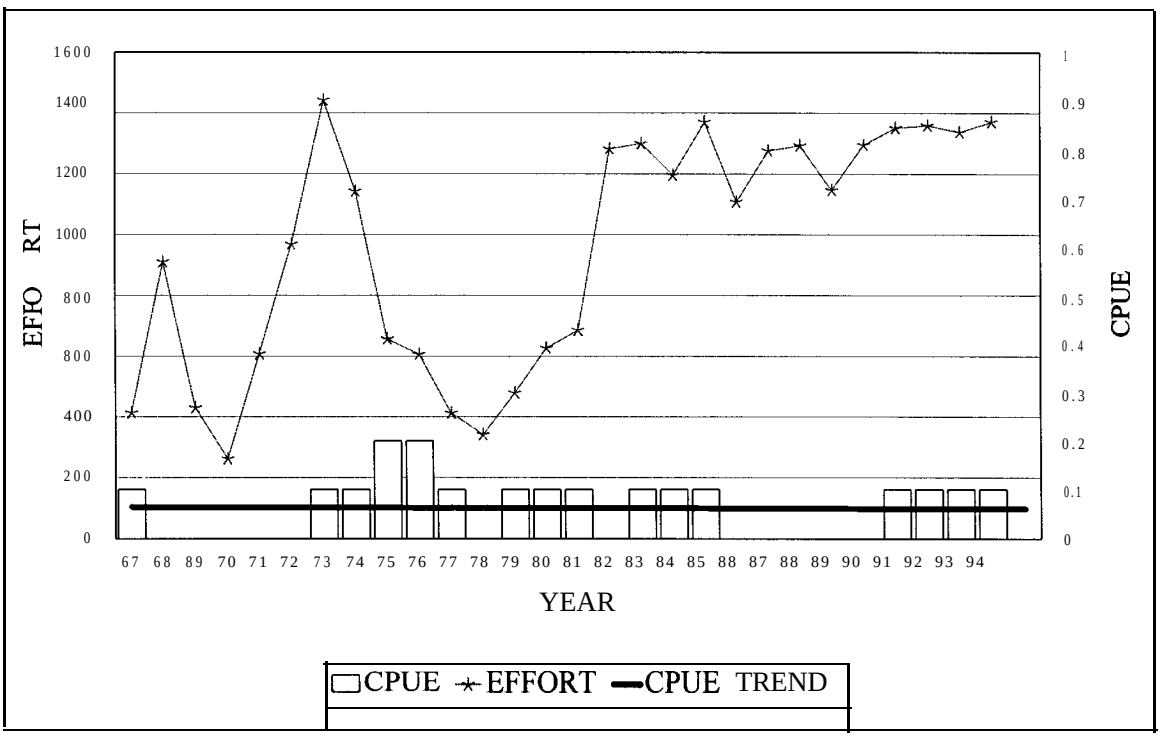

Figure 6.52. Catch/effort for Black Drum, 1967-1994, 16-ft trawl, statewide.

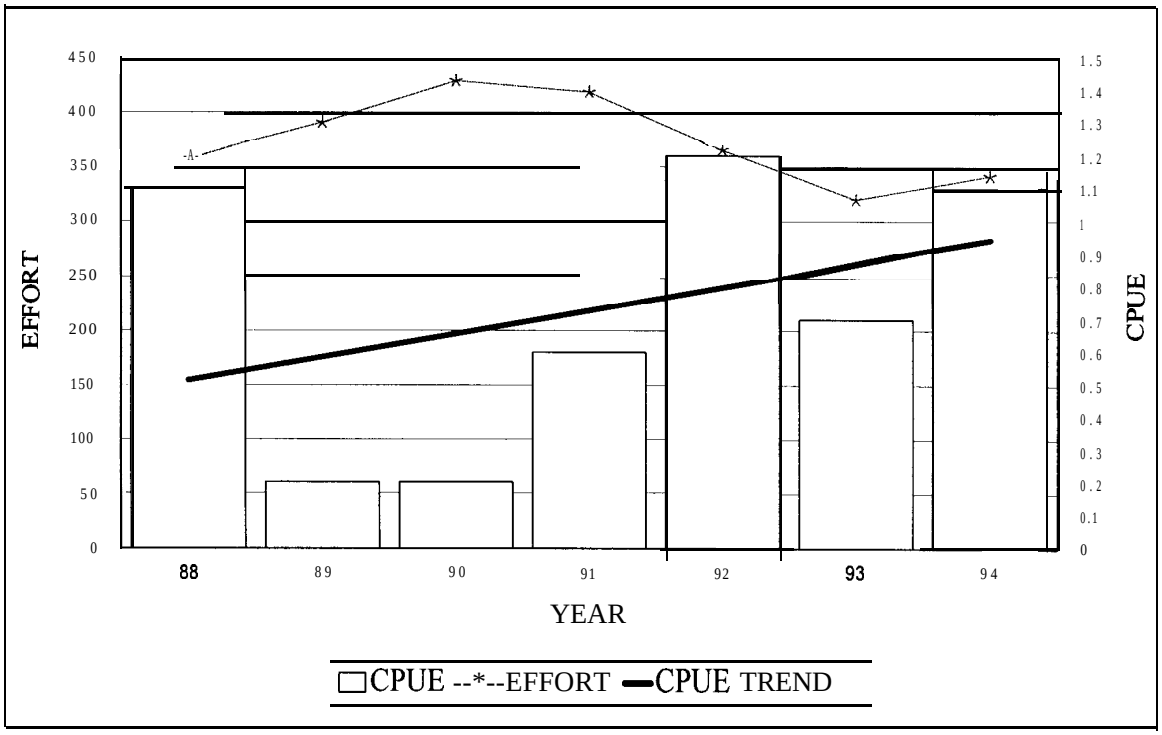

Figure 6.53. Catch/effort for Black Drum, 1988-1994, gill net (all meshes combined) for BTES.

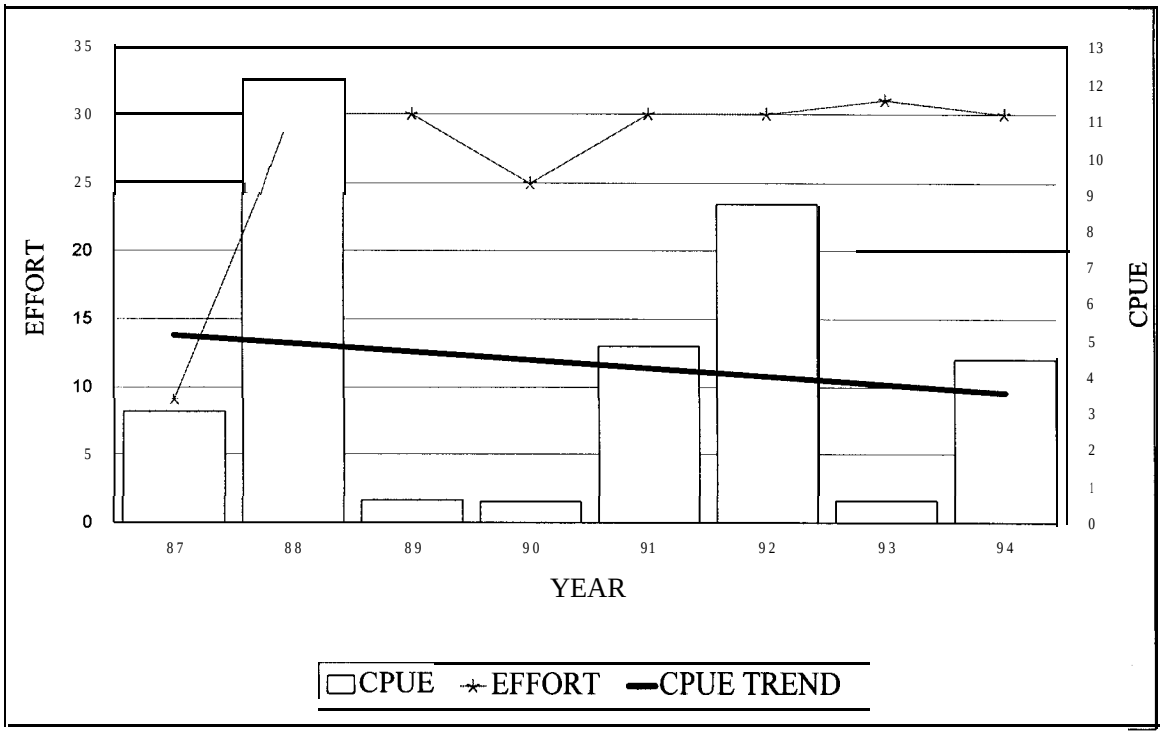

Figure 6.54. Catch/effort for Black Drum, 1987- 1994, trammel net for BTES.

overharvest with growth of commercial fishery as Black Drum became a replacement species for Red Drum, but found no evidence of overharvest at that time.

Habitat Requirements

- Sutter et al. (1986) reported that juvenile Black Drum were most common over muddy bottoms, with adults being found over shell reef bottoms. They also noted Black Drum being common over soft bottoms. Reported salinities ranged from 9 to 26 ppt, covering much of the salinity regime in BTES.

- Habitat Requirements of young Black Drum in BTES not well known since young are not common in most studies.

Species Recommendations

- Continue to monitor fishery, particularly of large, long-lived adults.

- Establish habitat requirements of young Black Drum, particularly in conjunction with potential loss of habitat through coastal erosion.

- Maintain shell bottoms that are preferred habitat of adult Black Drum, particularly in any coastal reconstruction projects so that not all rebuilt bottom habitat is only mud or sand.

Gulf Menhaden
Brevoortia patronus

Status

- Fourth most abundant fish species in BTES (Thompson and Forman 1987).

- Second most abundant fish species in trawl surveys in lower Barataria Bay (Thompson and Forman 1987).

- Third most abundant fish species in trawl surveys statewide.

Trends

- Decline in seine-caught Gulf menhaden, 1986–1994, although slight increase in 1993–1994 (Figure 6.55).

- **!** Wide range of interannual variation for Gulf menhaden caught in BTES with 16-ft trawl; no trend seen (Figure 6.56).

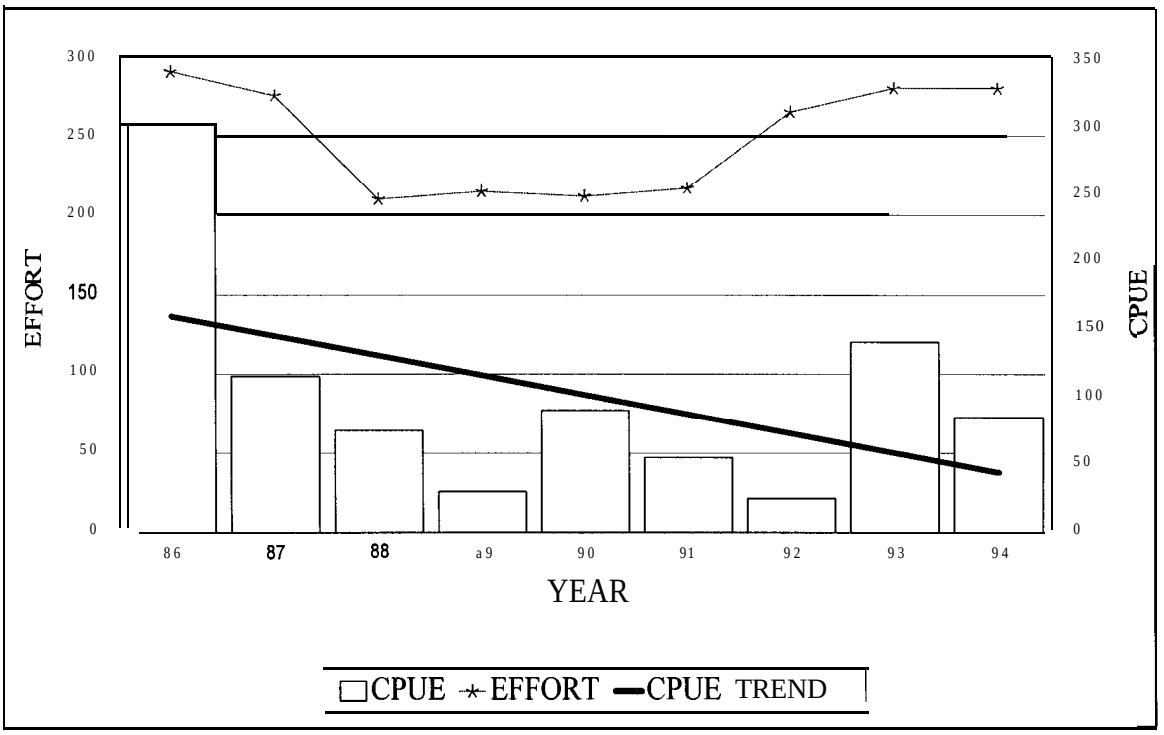

Figure 6.55. Catch/effort for Gulf Menhaden, 1986-1994, 50-ft seine for BTES.

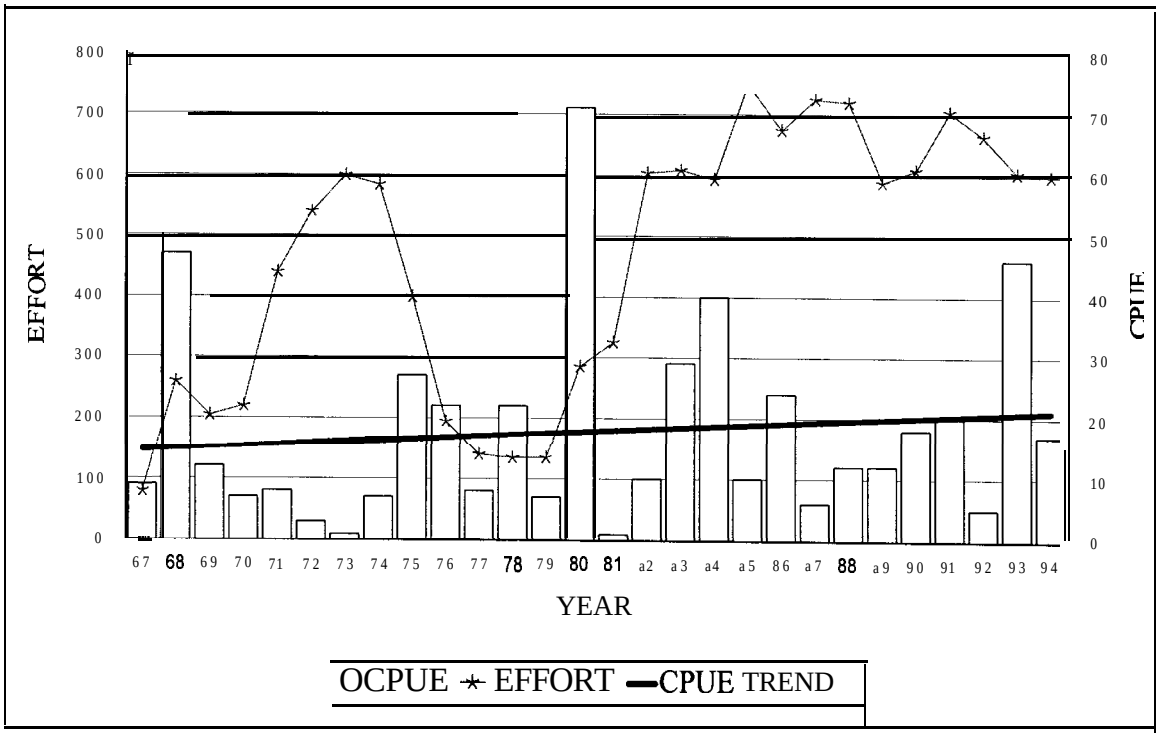

Figure 6.56. Catch/effort for Gulf Menhaden, 1967- 1994, 16-ft trawl for BTES.

- Consistent CPUE in trawl-caught Gulf Menhaden, from LOOP stations, 1978–1994, except for very high CPUE in 1993–1994 (Figure 6.57).

- Wide range of CPUE for statewide trawl-caught Gulf Menhaden 1967–1994, similar to BTES (Figure 6.58).

- Relatively consistent gill net catches of Gulf Menhaden in BTES region, 1986–1994, except for high CPUE in 1990 (Figure 6.59).

Causes of Change

No data directly related to Gulf Menhaden. Probably no consistent change in population since it has ranked as one of the most abundant fish species in the BTES region over past 30 years as sampled by Perret et al. (1971), Adkins and Bowman (1976), Barrett et al. (1978), and LOOP (1994). Coastal erosion may be detrimental to young-of-the-year with orientation towards marsh edge and meanders.

Habitat Requirements

- Young and juveniles inhabit shallow shore and marsh habitats becoming more oriented to open waters as they grow.

- Christmas et al. (1982) reported that estuaries are inhabited primarily by young and juveniles, but that some adults return to estuarine open water habitats. They noted that Gulf Menhaden are particularly sensitive to cold spells that drop estuarine water temperatures quickly.

- Lassuy (1983c) reported that small young are found over soft, mud bottoms near shallow shorelines, often along marsh edges.

- Young seem more oriented towards fresh or lower salinity waters in upper Barataria basin (Simoneaux 1979).

Species Recommendations

- Marsh reconstruction to provide shallow habitat preferred by young menhaden.

- Monitor by-catch for young Gulf Menhaden within estuary, to determine which fishery is source of "non-target" menhaden mortality and possible corrective recommendations.

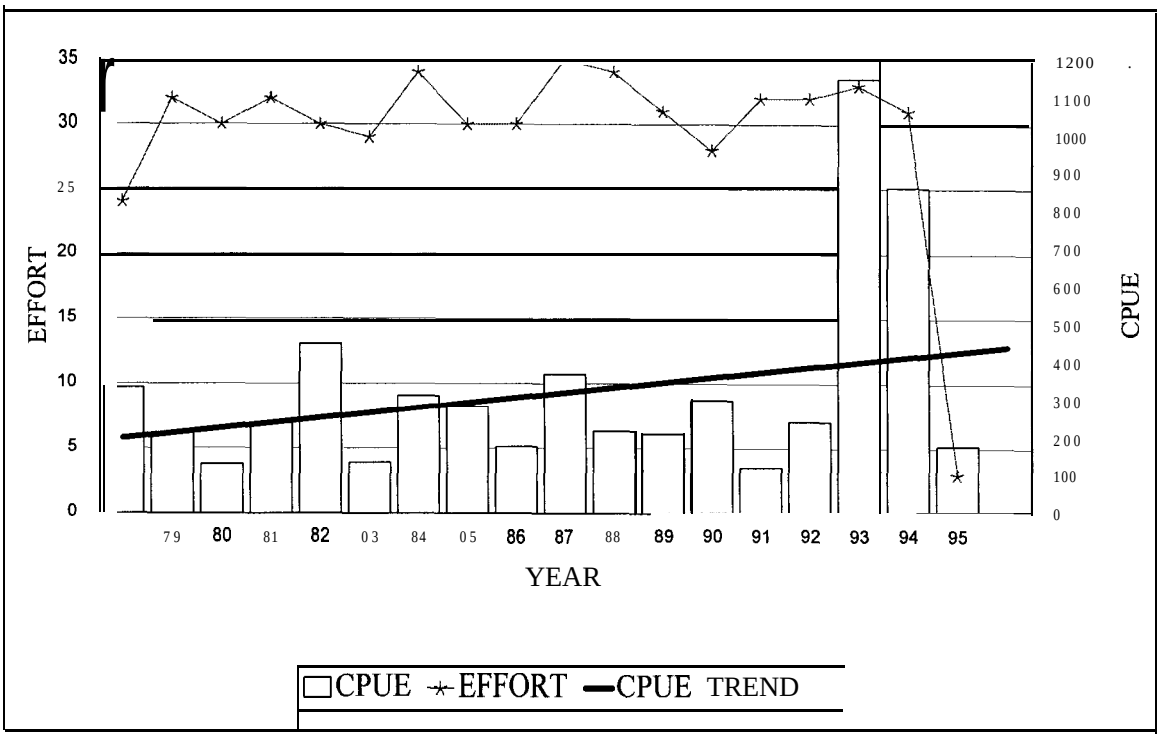

Figure 6.57. Catch/effort for Gulf Menhaden, 1978-1994, 16-ft trawl from LOOP stations for BTES.

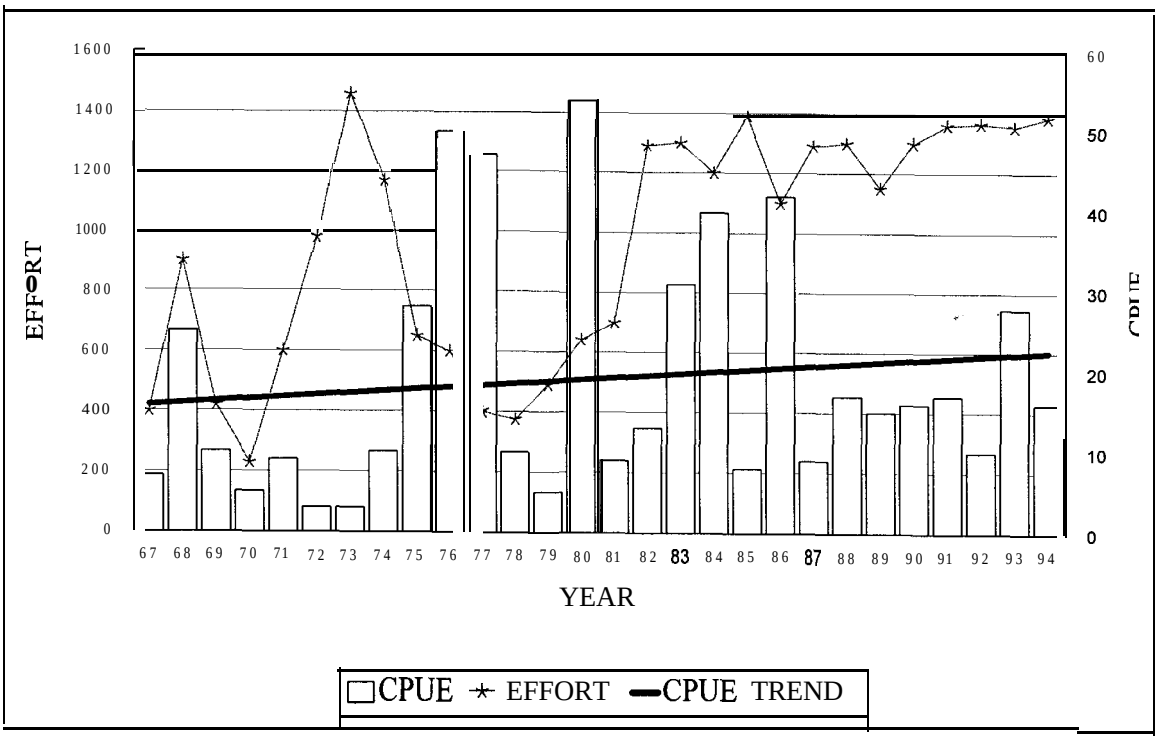

Figure 6.58. Catch/effort for Gulf Menhaden, 1967-1994, 16-ft trawl, statewide.

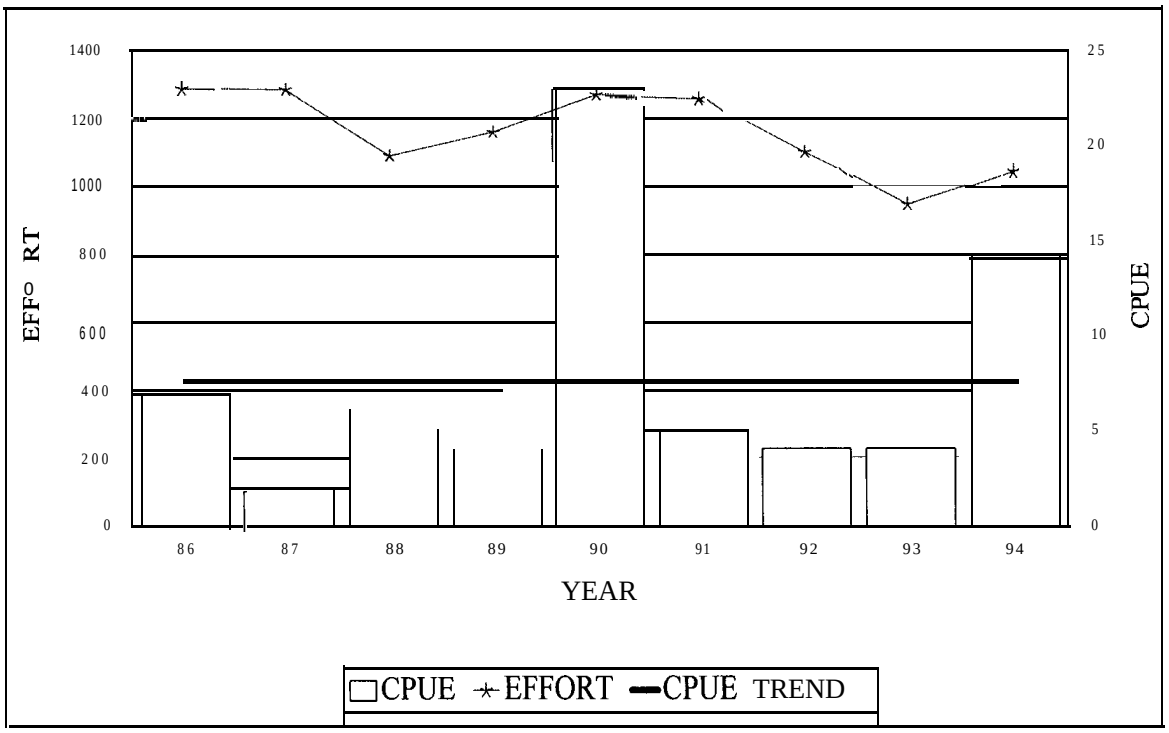

Figure 6.59. Catch/effort for Gulf Menhaden, 1986-1994, gill net (all meshes combined) for BTES.

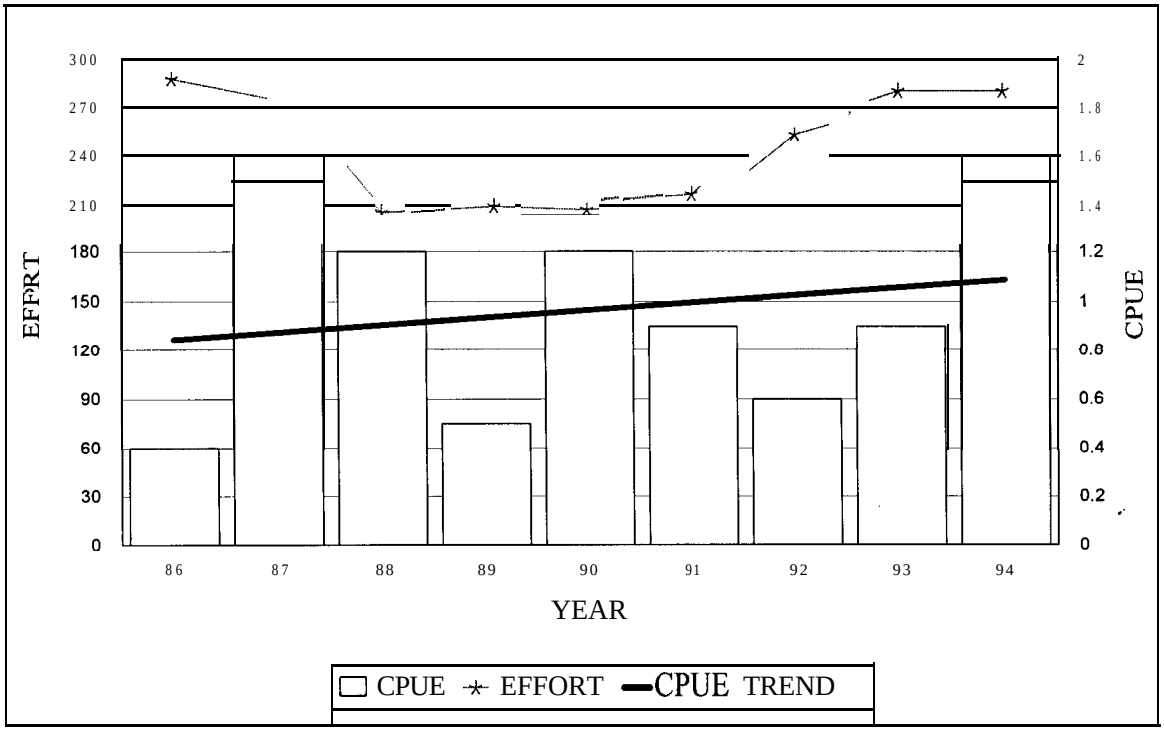

Figure 6.60. Catch/effort for Red Drum, 1986-1994, 50-ft seine for BTES.

Red Drum
Sciaenops ocellatus

Status

- Long-term catch/effort data on Red Drum not well documented since the species is not adequately represented in some biological sampling gears.
- Not a common fish species in many BTES samples, although as a species attaining large size it can make up a high percentage of biomass estimations.
- LDWF (1991b) profiled Red Drum, reviewing both fishery and biological data.
- LDWF (1991c) reported that stock levels in Louisiana could not be adequately described due to lack of historical data for comparison, but that recruitment levels have been relatively stable for about 15 years.
- It has been suggested that with current fishery regulations, the Red Drum population level is strong.
- Most Red Drum inhabiting the BTES are immature young and juveniles.

Trends

- Relatively consistent CPUE for BTES seine-caught Red Drum (mostly young-of-the-year) in BTES region, 1986–1994 (Figure 6.60).
- Data too sparse for any trend determination for 16-ft trawl-caught Red Drum, 1967–1994, either for BTES region or statewide, (Figure 6.61 and 6.62).
- Slight increase in gill net samples of Red Drum in the BTES, 1988–1994 (Figure 6.63).
- Relatively consistent catches of Red Drum by trammel nets in the BTES, 1987–1994; some increase in CPUE 1992–1994 (Figure 6.64).

Causes of Change

There are no data directly related to Red Drum, but it is widely perceived that this species has been overfished across both Louisiana and the entire Gulf of Mexico. Whether this perception is accurate is open to question. Receiving considerably less attention is the question of loss of nursery habitat from environmental modifications and coastal erosion.

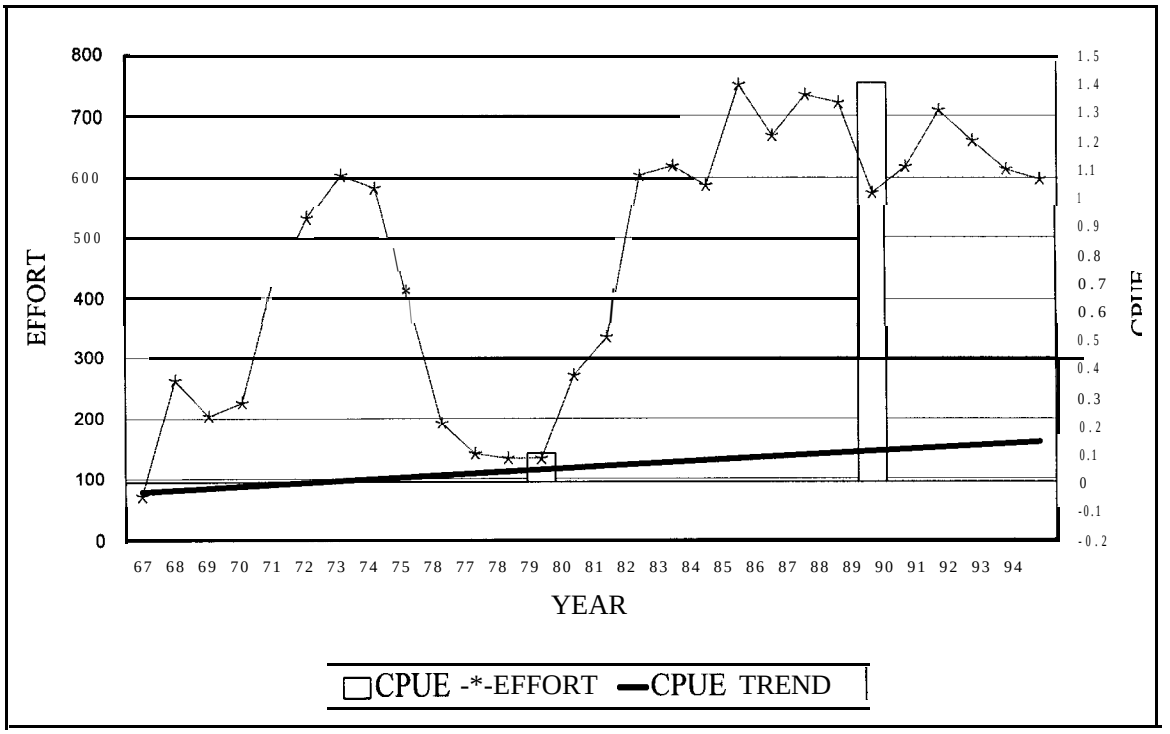

Figure 6.61. Catch/effort for Red Drum, 1967-1994, 16-ft trawl for BTES.

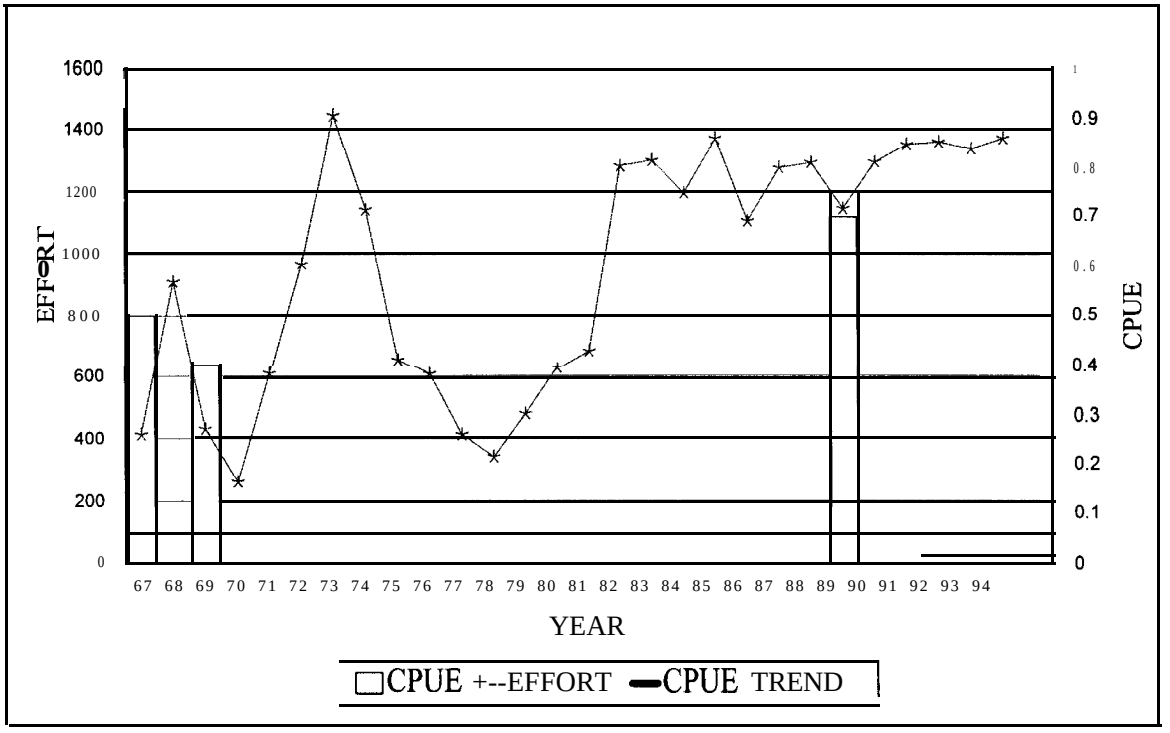

Figure 6.62. Catch/effort for Red Drum, 1967-1994, 16-ft trawl, statewide.

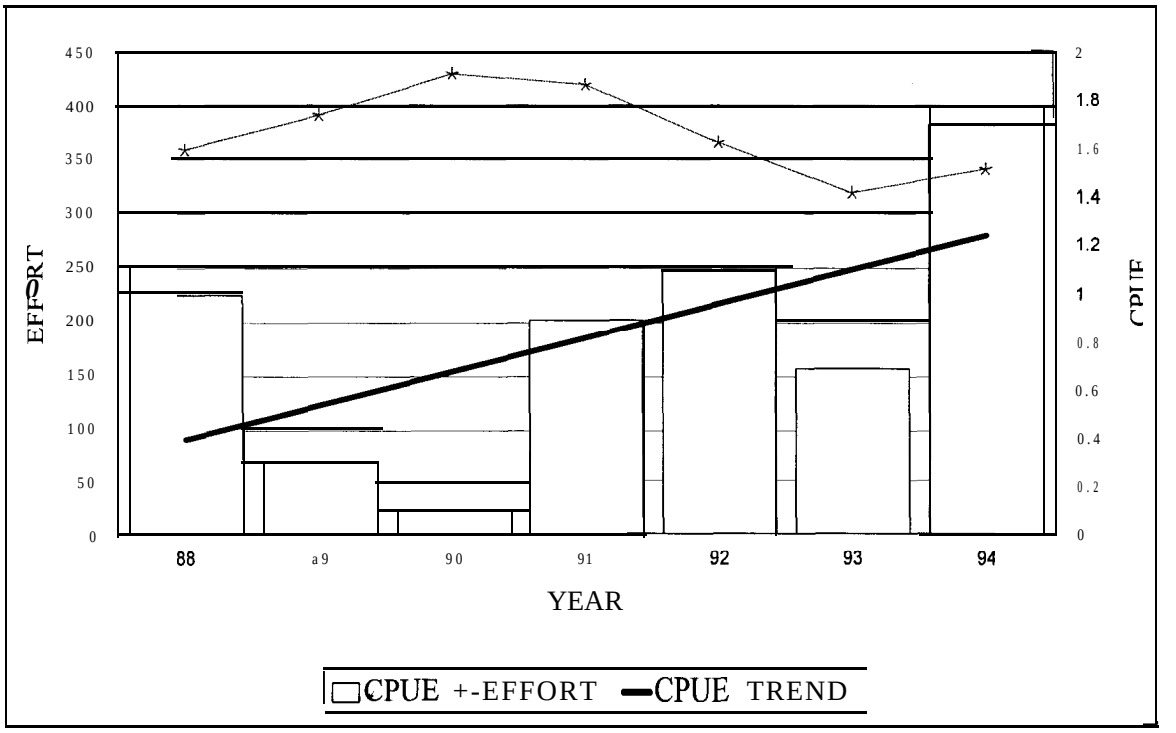

Figure 6.63. Catch/effort for Red Drum, 1988- 1994, gill net (all meshes combined) for BTES.

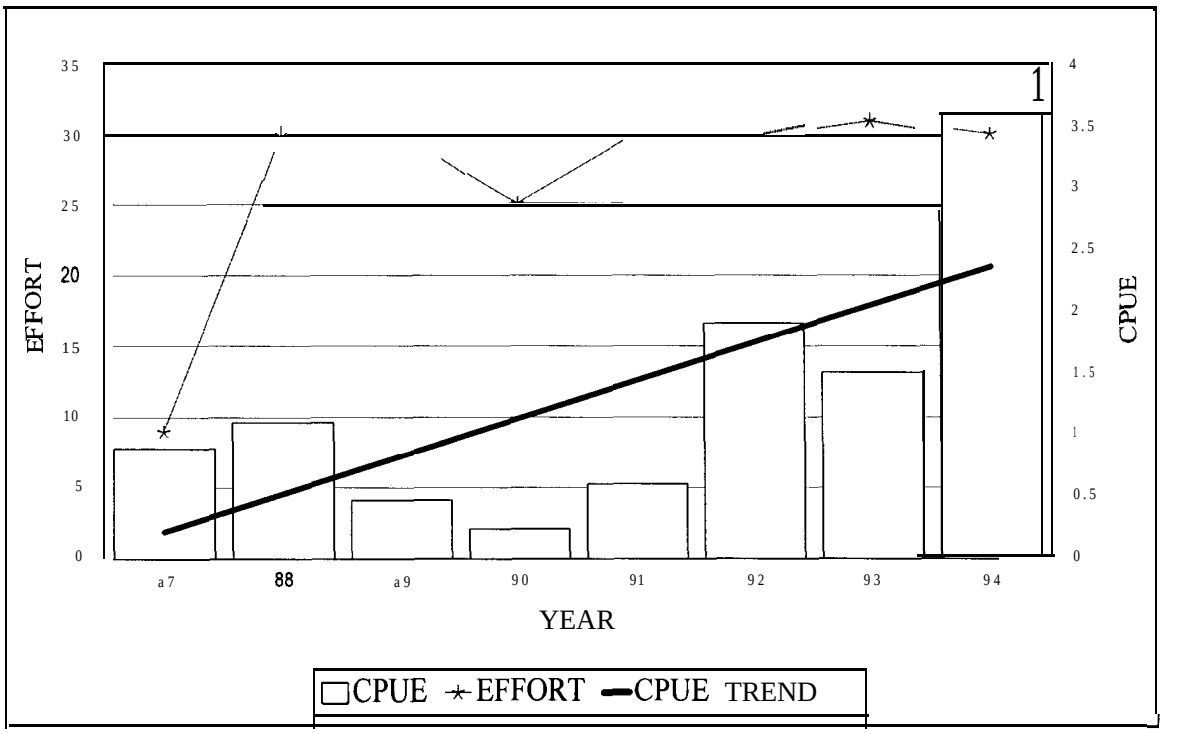

Figure 6.64. Catch/effort for Red Drum, 1987-1994, trammel net for BTES.

Habitat Requirements

- Reagan (1985) reported that young Red Drum can be found in grass bed areas, but this may not be the primary habitat for young Red Drum in the the BTES.

- Thompson (1988) found postlarval and small juvenile Red Drum closely associated with the marsh edge over mud bottoms in barrier island meanders, where they were very abundant.

- Adult Red Drum can be found in tidal passes throughout the BTES region, this being a very popular recreational fishing area for Red Drum.

- LDWF (1991b) reported that young Red Drum inhabit inshore estuarine waters of low, moderate, or even high salinities, while adult Red Drum prefer more open waters along beaches and the Gulf of Mexico. This points to little use of the inside waters of the BTES by adults.

Species Recommendations

- Document specific nursery habitat for young Red Drum within BTES region.

- Include this habitat in all coastal reconstruction projects, particularly involving barrier islands.

- Monitor use of open beaches by adult Red Drum during any barrier island reconstruction, particularly for potential of spawning near these beaches.

Sand Seatrout
Cynoscion arenarius

Status

- Found to be seventh most abundant fish species captured by trawl in the BTES region (Thompson and Forman 1987).

- Found to be the seventh most abundant trawl-caught fish species, sixth by frequency of occurrence statewide (Perret et al., 1993).

- Barret et al. (1978) reported that Sand Seatrout was the fifth most abundant across Louisiana during their 1968–69 study; they also reported it during all months of the year. The BTES had among the lowest CPUE for trawls compared to other estuaries in Louisiana.

- Adkins and Bowman (1976) found Sand Seatrout the third most abundant fish species in their canal study.

Trends

- Slight increase in seine-caught Sand Seatrout, 1986–1994, in the BTES (Figure 6.65).
- Slight increase in Sand Seatrout caught in 16-ft trawl, 1967–1994, in the BTES region (Figure 6.66).
- Slight decrease in Sand Seatrout CPUE from LOOP stations, 1978–1994; decrease most evident from 1983 to present (Figure 6.67).
- Statewide Sand Seatrout CPUE trend similar to BTES region (Figure 6.68).
- Wide interannual variation in Sand Seatrout gill net CPUE, 1988–1994; noticeably lower CPUE 1993–1994 in BTES region (Figure 6.69).

Causes of Change

There are no data directly related to Sand Seatrout. The trends conflict among the data sources, but the general indication is of a slight increase in catch.

Habitat Requirements

- Sutter and McIlwain (1987) reported that young Sand Seatrout prefer soft organic bottom habitat, but adults occupy a wider variety of open water habitats. They prefer more open water environments compared to Spotted Seatrout. Young to adults tolerate a wide range of salinity (0–30 ppt) and water temperature (10–30EC), helping to explain their high estuarine abundance.

Species Recommendations

- Monitor Sand Seatrout in by-catch for human-induced mortality of young.

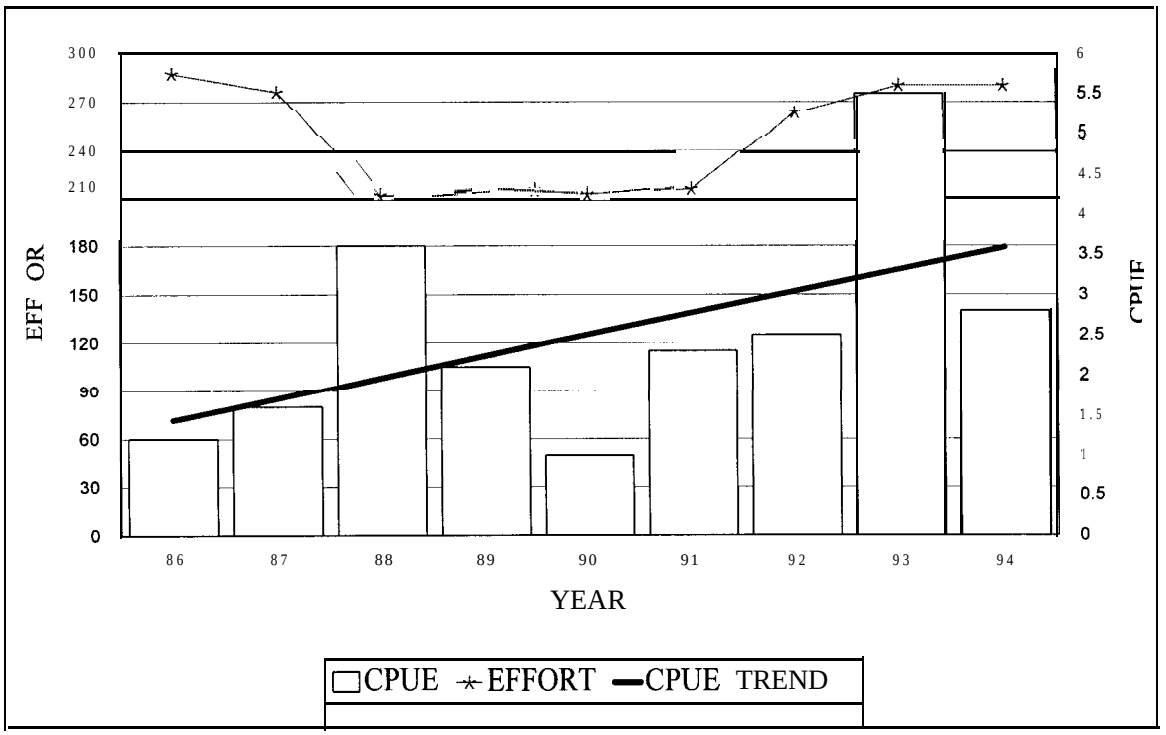

Figure 6.65. Catch/effort for Sand Seatrout, 1986-1994, 50-ft **seine for BTES.**

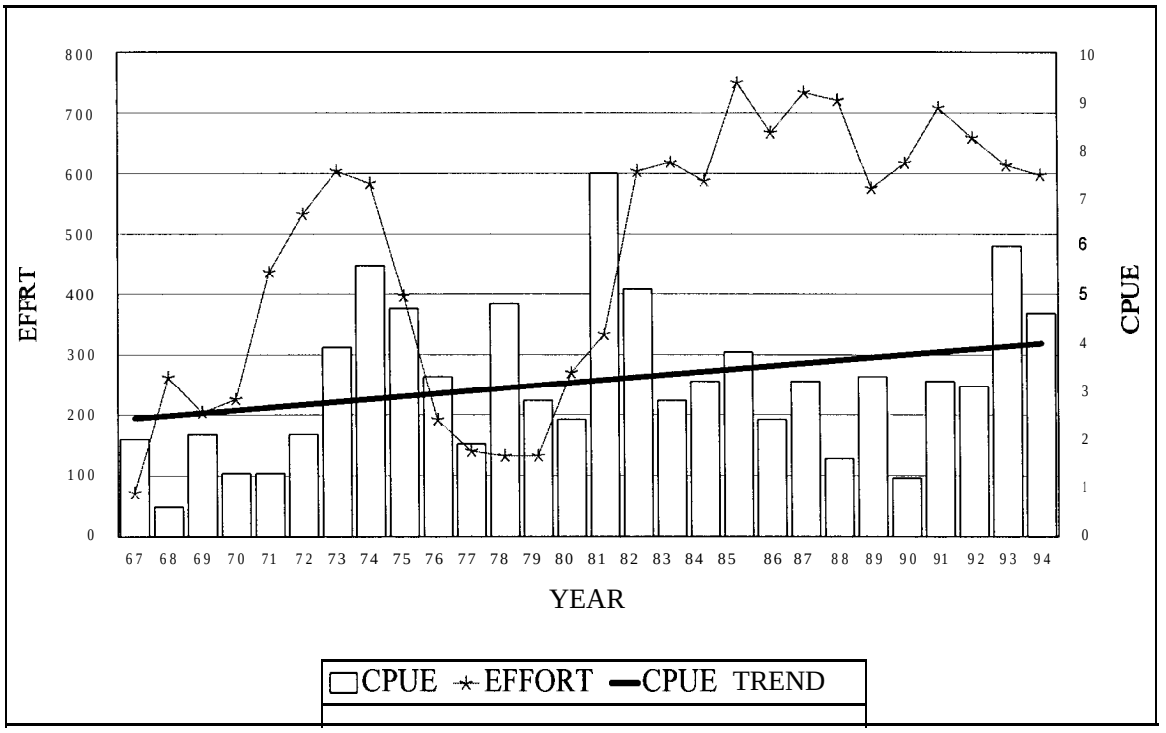

Figure 6.66. Catch/effort for Sand Seatrout, 1967-1994, 16-ft trawl for BTES.

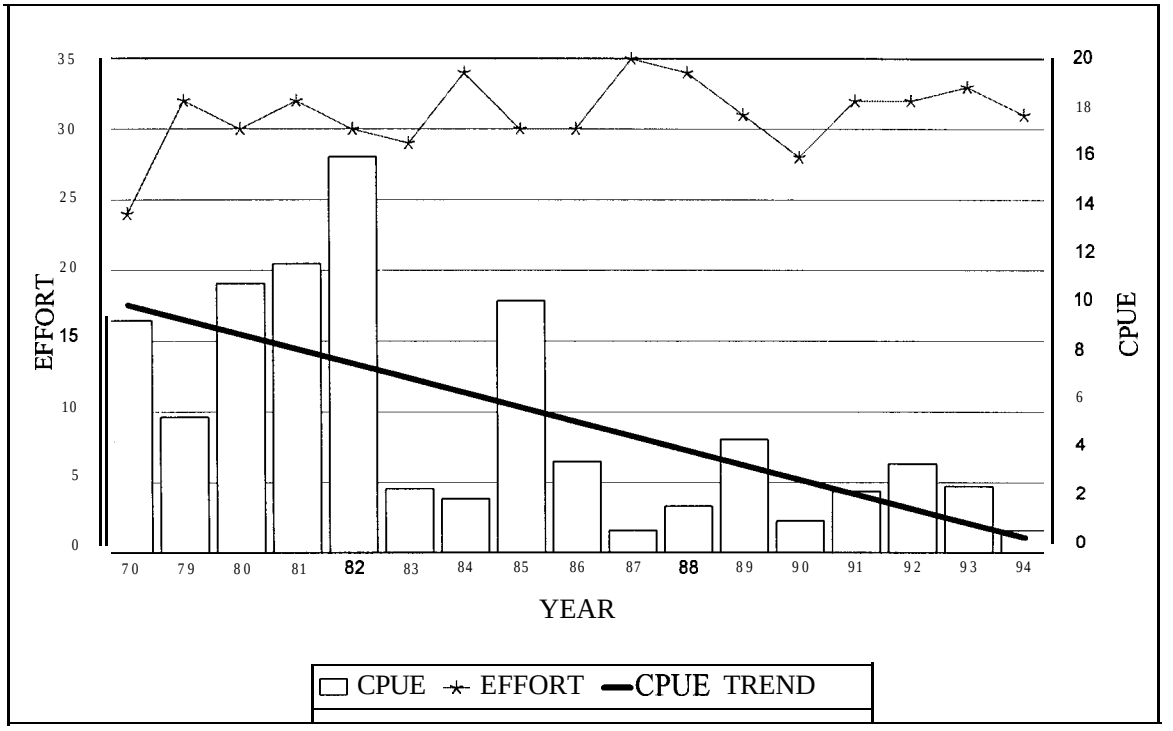

Figure 6.67. Catch/effort for Sand Seatrout, 1978-1994, 16-ft trawl from LOOP stations for BTES.

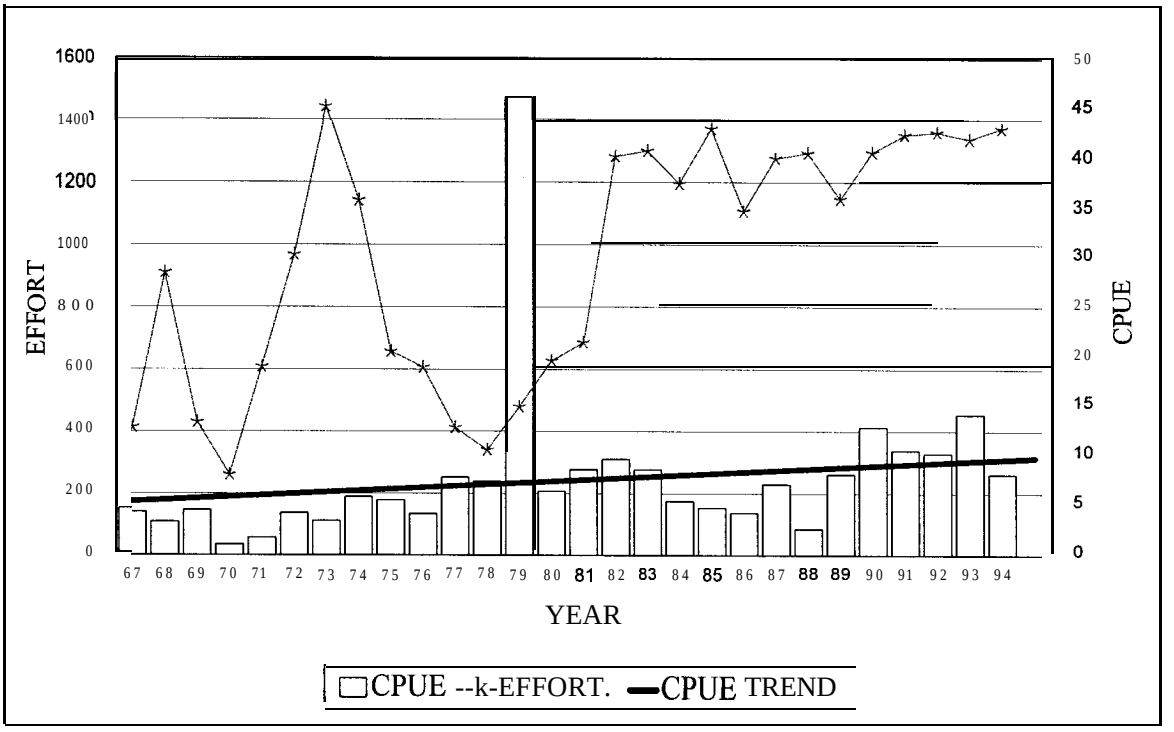

Figure 6.68. Catch/effort for Sand Seatrout, 1967-1994, 16-ft trawl, statewide.

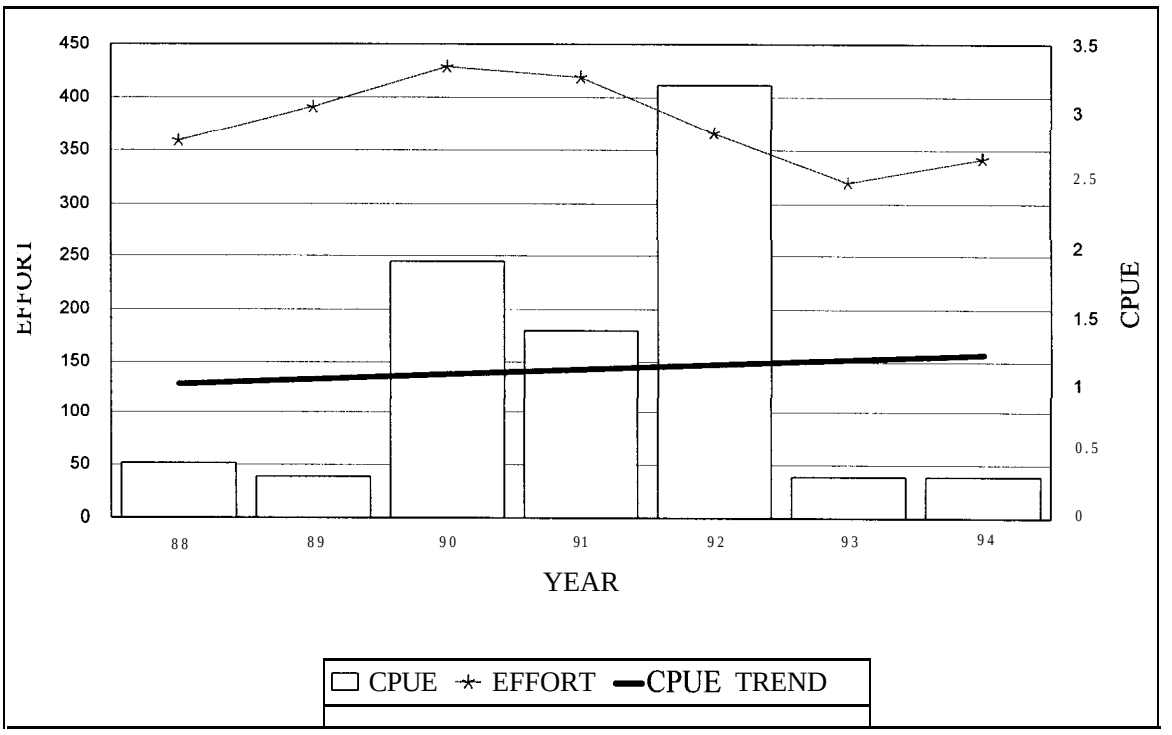

Figure 6.69. Catch/effort for Sand Seatrout, 1988-1994, gill net (all meshes combined) for BTES.

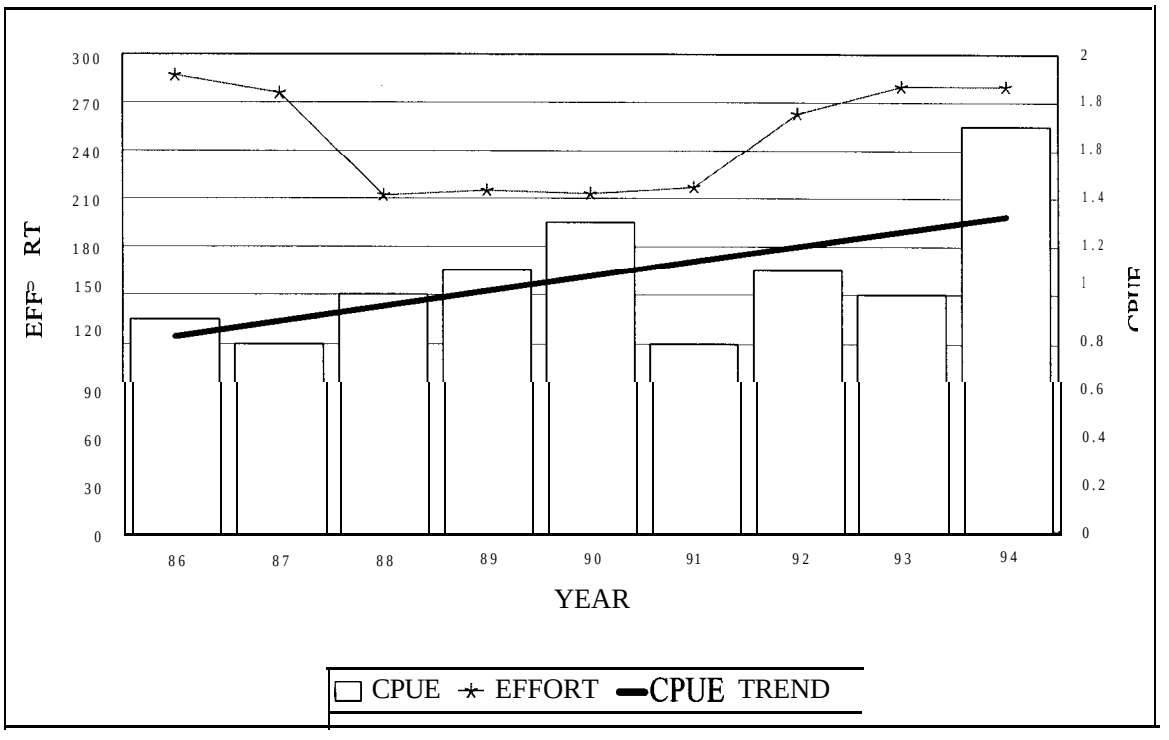

Figure 6.70. Catch/effort for Spotted Seatrout, 1986-1994, 50-ft seine for BTES.

Spotted Seatrout
Cynoscion nebulosus

Status

- Not ranking in top 10–15 most abundant species in most studies but, like Black Drum and Red Drum, can contribute strongly to biomass estimates.

- Not sampled adequately by most regular gears; particularly underestimated by trawl surveys.

- Ranked 38th in abundance and 28th by frequency of occurrence in statewide trawl survey; very low CPUE (Perret et al. 1993).

- Adkins and Bowman (1976) reported Spotted Seatrout as eleventh most abundant fish in canal study.

- Adkins et al. (1979) found Spotted Seatrout most abundant fish in gill net and trammel net study, 1976–77.

- Adkins and Bourgeois (1982) reported Spotted Seatrout as the most abundant fish in a gill net study, 1979–80 in Terrebonne-Timbalier basin.

- LDWF (1991a) reported that this species is possibly the single most important recreational and commercial marine fish species in Louisiana, being targeted by more recreational fishermen in coastal Louisiana than any other species and being among the top one or two fish species in creel catches. Statewide biological and fishery status was reviewed in LDWF (1991a).

Trends

- Slight increase in seine-caught Spotted Seatrout, 1986-1994, in BTES area (Figure 6.70).

- Low, consistent CPUE for 16-ft trawl-caught Spotted Seatrout, 1967–1994, in BTES area (Figure 6.71).

- CPUE trend low for Spotted Seatrout from LOOP trawl stations with some interannual variation, but reasonably consistent (Figure 6.72).

- Low CPUE for 16-ft trawl-caught Spotted Seatrout, 1967–1994, statewide showed slight decrease but low values for this gear suggest trend is not important (Figure 6.73).

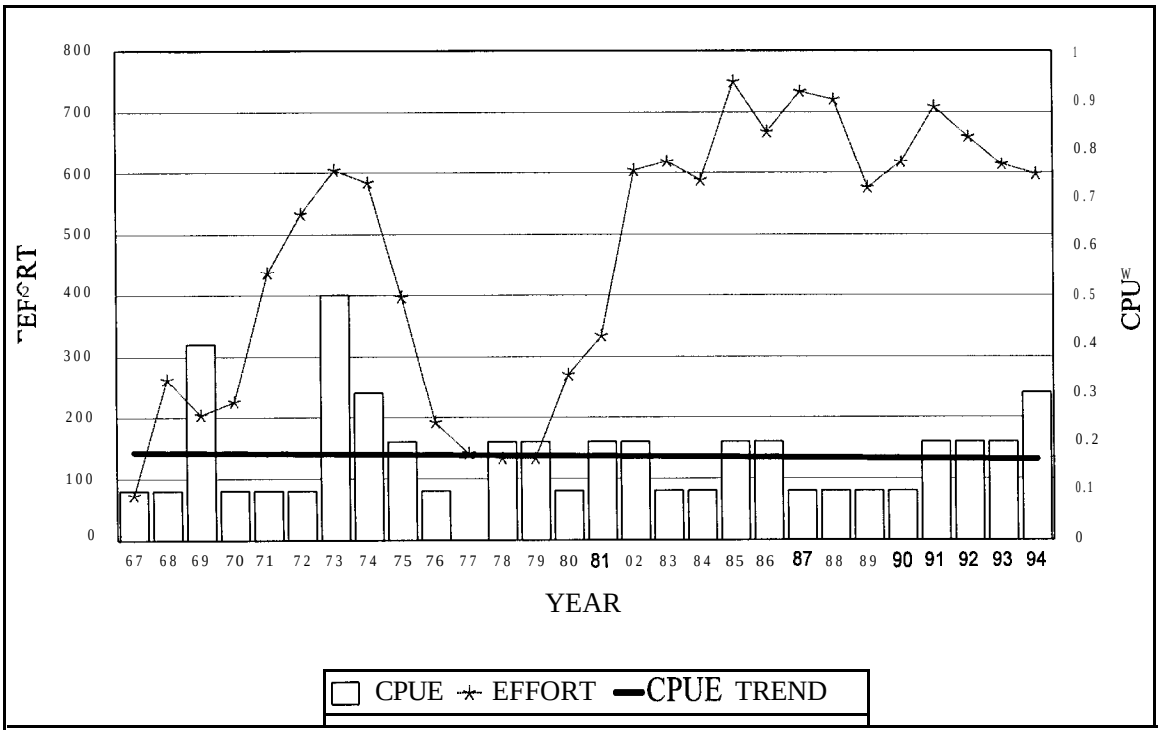

Figure 6.71. Catch/effort for Spotted Seatrout, 1967-1994, 16-ft trawl for BTES.

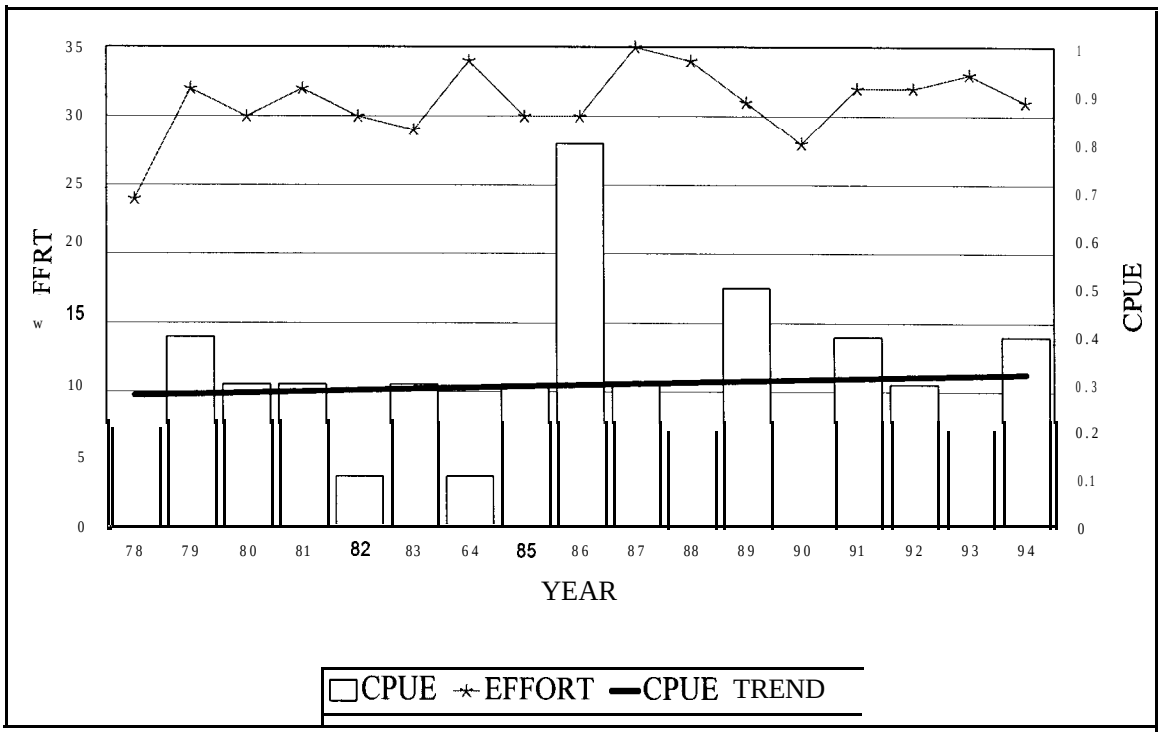

Figure 6.72. Catch/effort for Spotted Seatrout, 1978-1994, 16-ft trawl from LOOP stations for BTES.

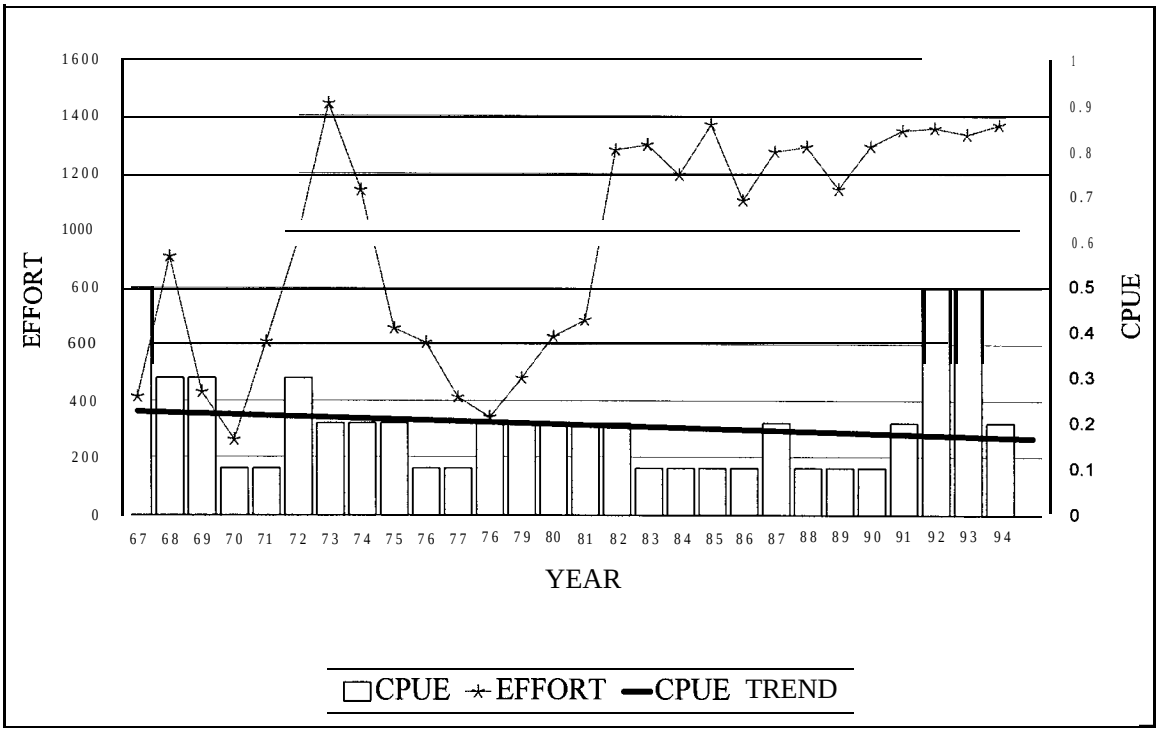

Figure 6.73. Catch/effort for Spotted Seatrout, 1967-1994, 16-ft trawl, statewide.

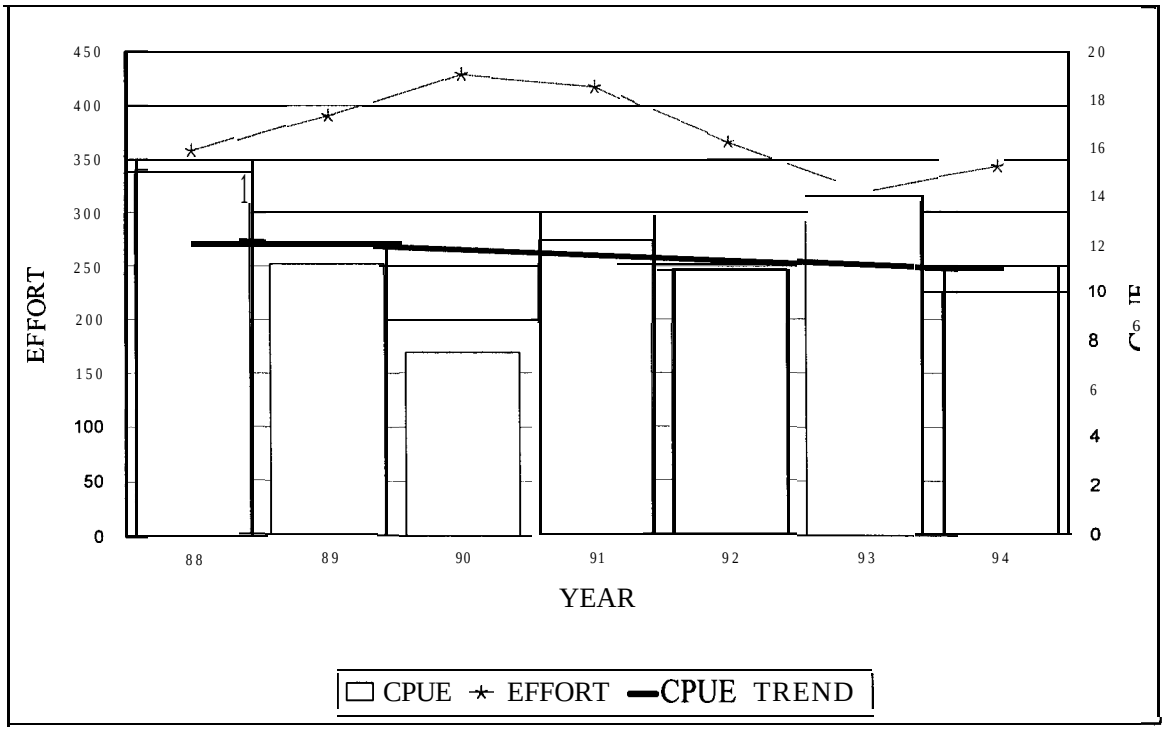

Figure 6.74. Catch/effort for Spotted Seatrout, 1988-1994, gill net (all meshes combined) for BTES.

- High, consistent CPUE for gill net samples of Spotted Seatrout, 1988–1994, for BTNET area strongly points to unchanged population (Figure 6.74).

- Slight decline in CPUE for BTES trammel net catches through 1989, with consistent values through 1994 (Figure 6.75).

Causes of Change

- Loss of nursery habitat of submerged seagrasses and marsh for young-of-the-year Spotted Seatrout.

- Spawning in lower portions of the BTES may have been negatively impacted by coastal erosion.

Habitat Requirements

- Peterson (1986) reported high catches of young Spotted Seatrout at shallow marsh edge with soft, organic bottom types. Highest catches and frequency of occurrence were at stations with salinities between 15–20 ppt. This study was in western Barataria Bay.

- Lassuy (1983b) reviewed the importance of grassbeds and other vegetation as part of Spotted Seatrout's preferred habitat but noted that other reports suggested that food availability was more important than physical habitat. He also noted several studies that reported Spotted Seatrout preferred regions of lower turbidity. Overall, Spotted Seatrout have been reported from wide ranges of both salinity and water temperature, but there are data to support their sensitivity to quick declines in water temperature.

Species Recommendations

- Provide for vegetated nursery regions in any coastal reconstruction project, duplicating natural preferred habitats.

- Continue exploration for specific parameters of nursery habitat; map them for the BTES.

- Identify specific spawning habitat for BTES areas and protect these areas and provide for construction of similar areas in coastal restoration plans.

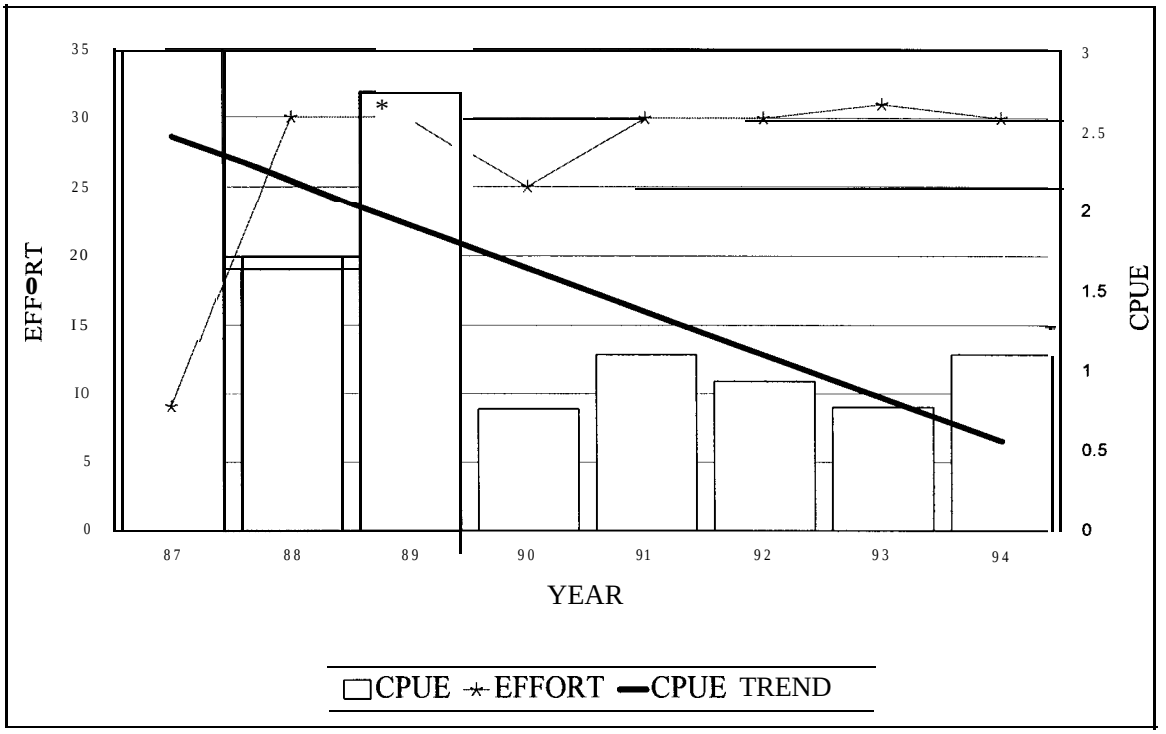

Figure 6.75. Catch/effort for Spotted Seatrout, 1987-1994, trammel net for BTES.

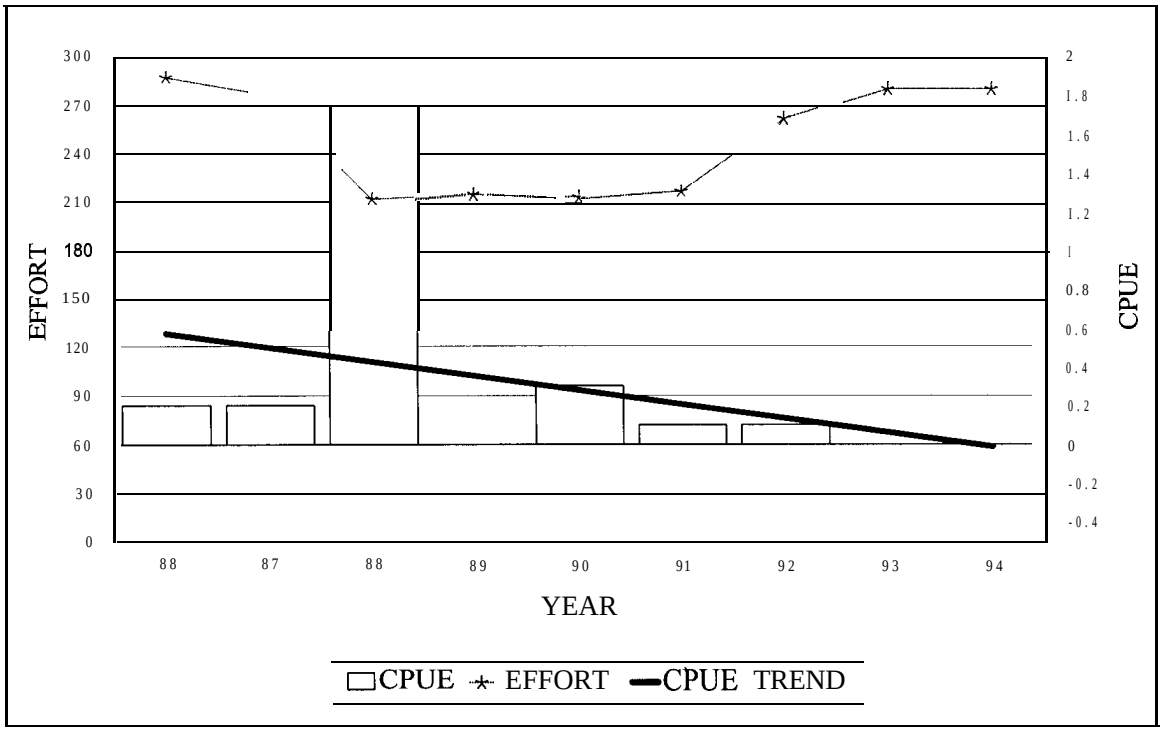

Figure 6.76. Catch/effort for Southern Flounder, 1986-1994, 50-ft seine for BTES.

Southern Flounder
Paralichthys lethostigma

Status

- Not a common species in the BTES, but documentation of "true" abundance difficult.
- Adkins et al. (1979) reported Southern Flounder as eighth most abundant fish species, but overall not common.
- Adkins and Bourgeois (1982) reported 46 juvenile-adult Southern Flounder in their two-year gill net study.
- Barrett et al. (1978) reported small Southern Flounder catches statewide, 1974–1976.
- Perret et al. (1971) reported low Southern Flounder catches statewide, 1978–1969, with BTES area abundances intermediate, between low catches eastward and higher catches to the west.

Trends

- Low, consistent catches of Southern Flounder by seine, 1986–1994, except for high CPUE in 1988. No Southern Flounder taken by seine in 1993–1994 in the BTES (Figure 6.76).
- Variable CPUE for 16-ft trawl-caught Southern Flounder, 1967–1994, in BTES area. High CPUE for 1960s and 1970s results in trend of declining abundance since 1976 (Figure 6.77).
- Trend in trawl-caught Southern Flounder for BTES LOOP stations with similar irregular, declining trend, 1978–1994 (Figure 6.78).
- Trend in trawl-caught Southern Flounder statewide, 1967–1994, is also an irregular slightly declining trend (Figure 6.79).
- Catch for Southern Flounder in gill nets in BTES area, 1988–1994, is too low to determine any trend (Figure 6.80).
- BTES trammel net catch for Southern Flounder, 1987–1994, is low but consistent (Figure 6.81).

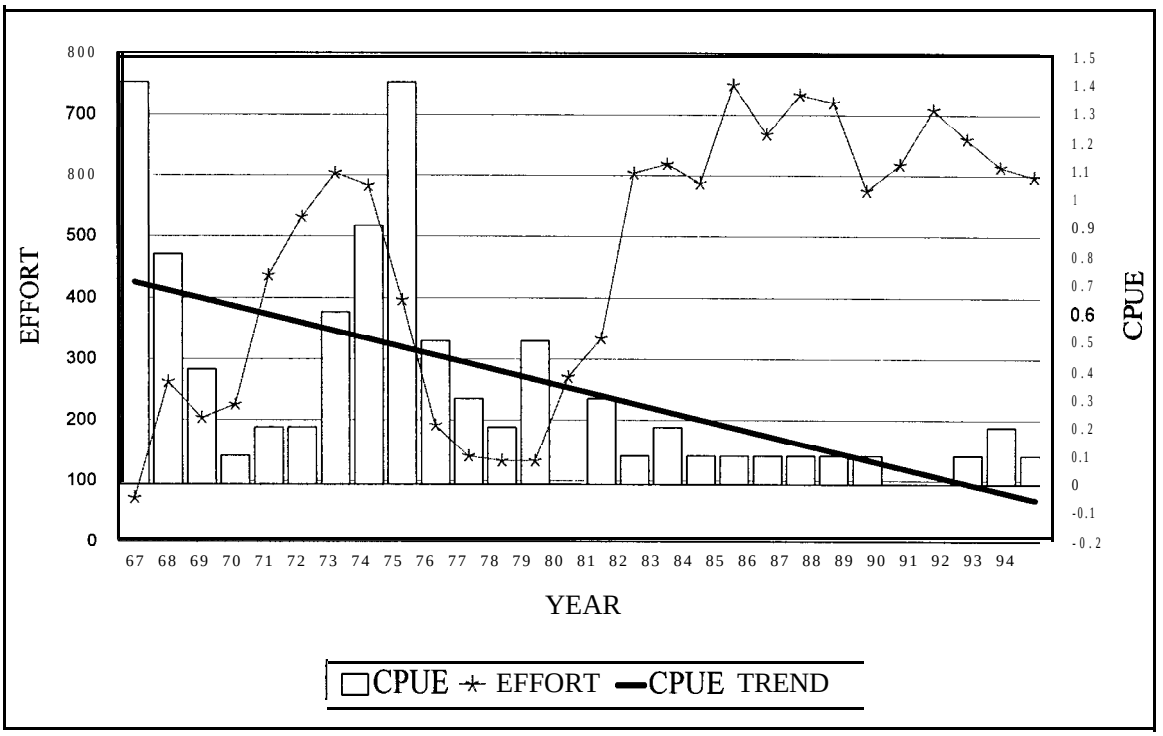

Figure 6.77. Catch/effort for Southern Flounder, 1967-1994, 16-ft trawl for BTES.

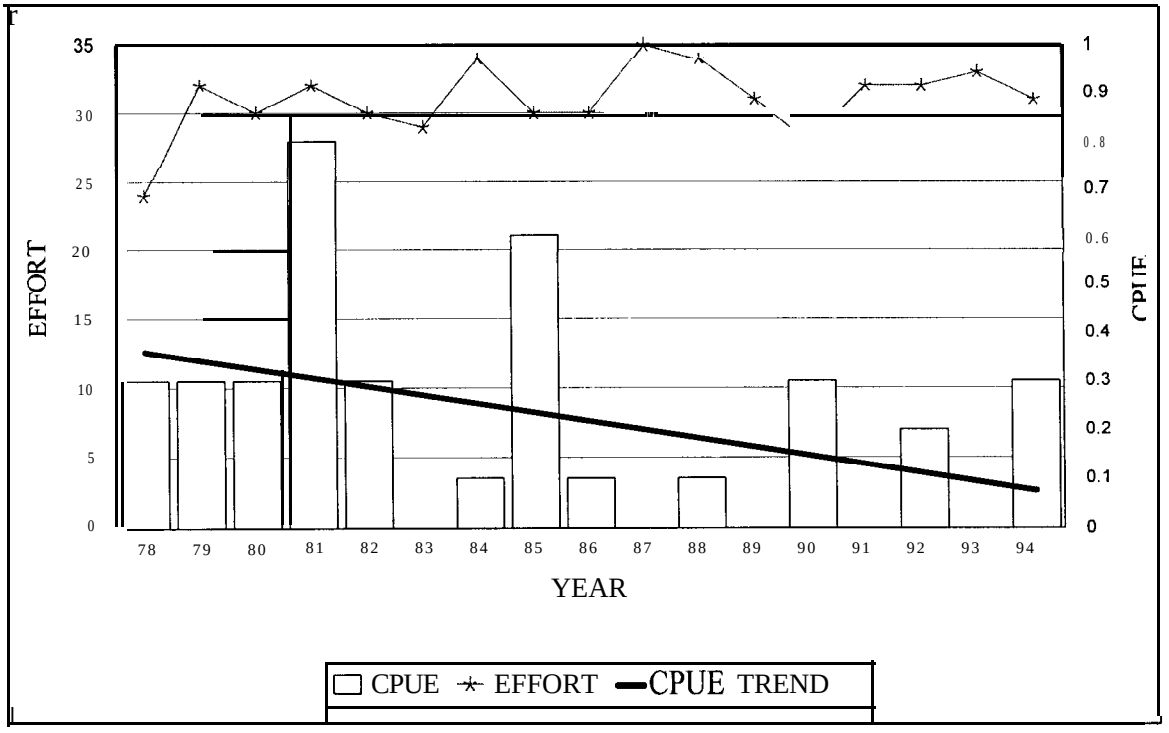

Figure 6.78. Catch/effort for Southern Flounder, 1978-1994, 16-ft trawl from LOOP stations for BTES.

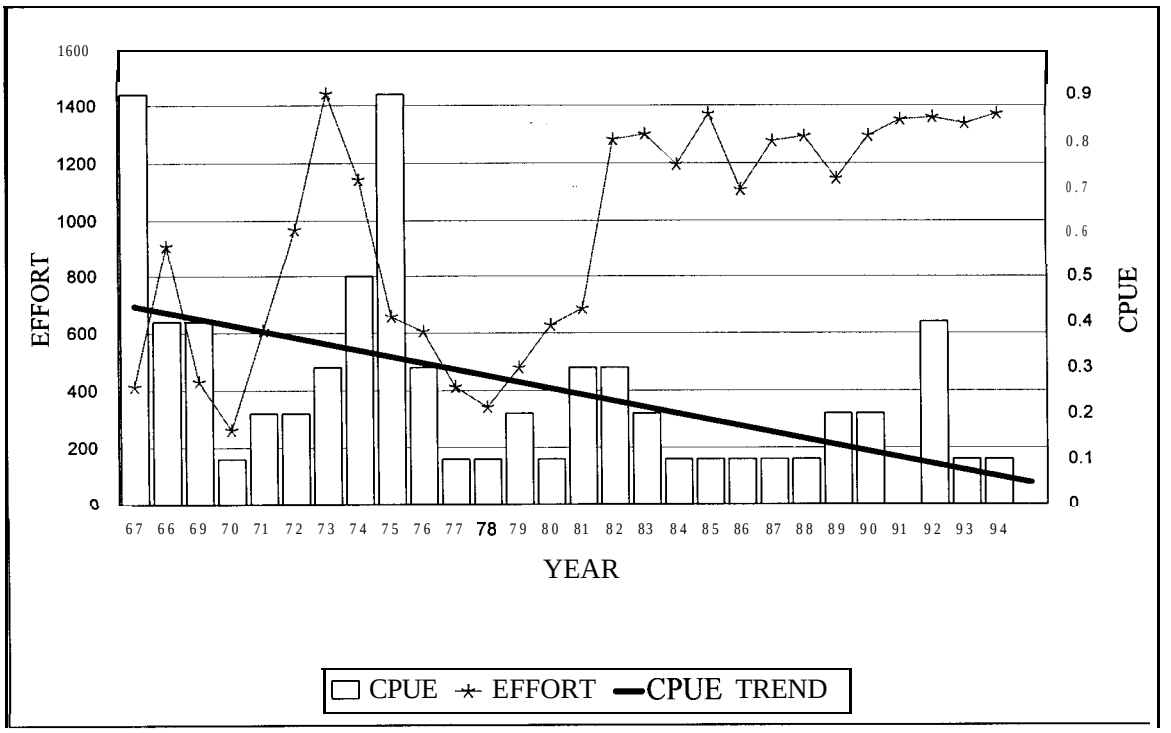

Figure 6.79. Catch/effort for Southern Flounder, 1967-1994, 16-ft trawl, statewide.

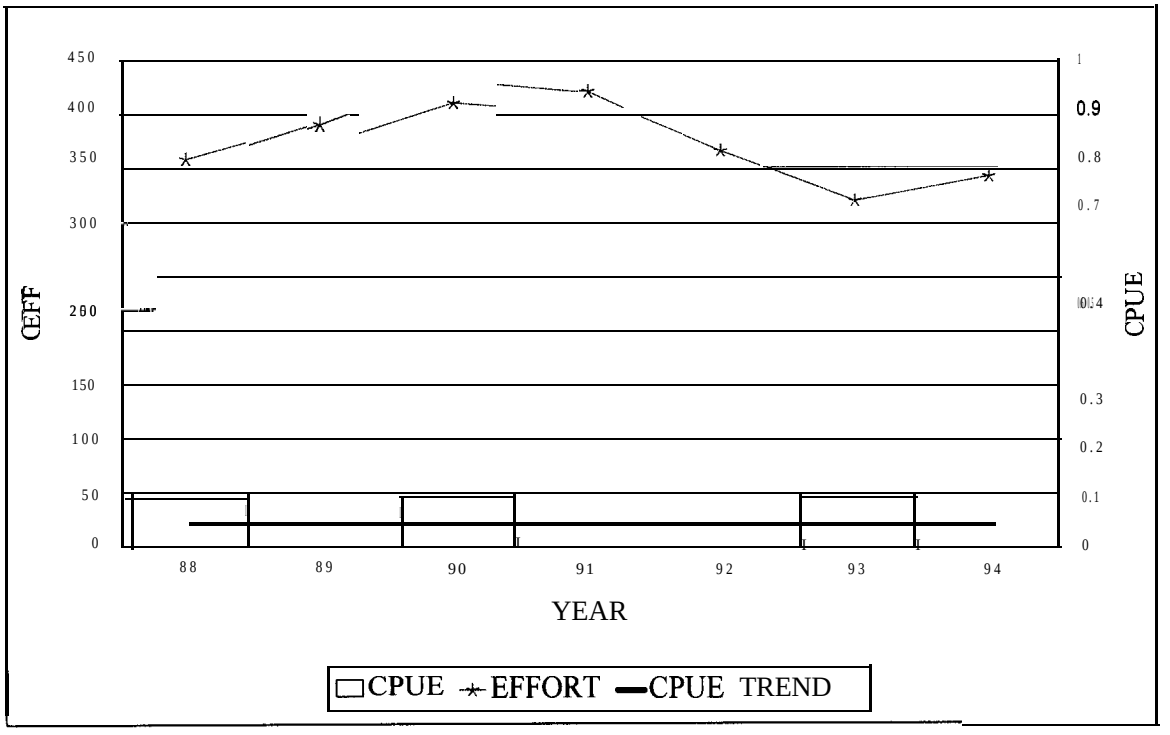

Figure 6.80. Catch/effort for Southern Flounder, 1988-1994, gill net (all meshes combined) for BTES.

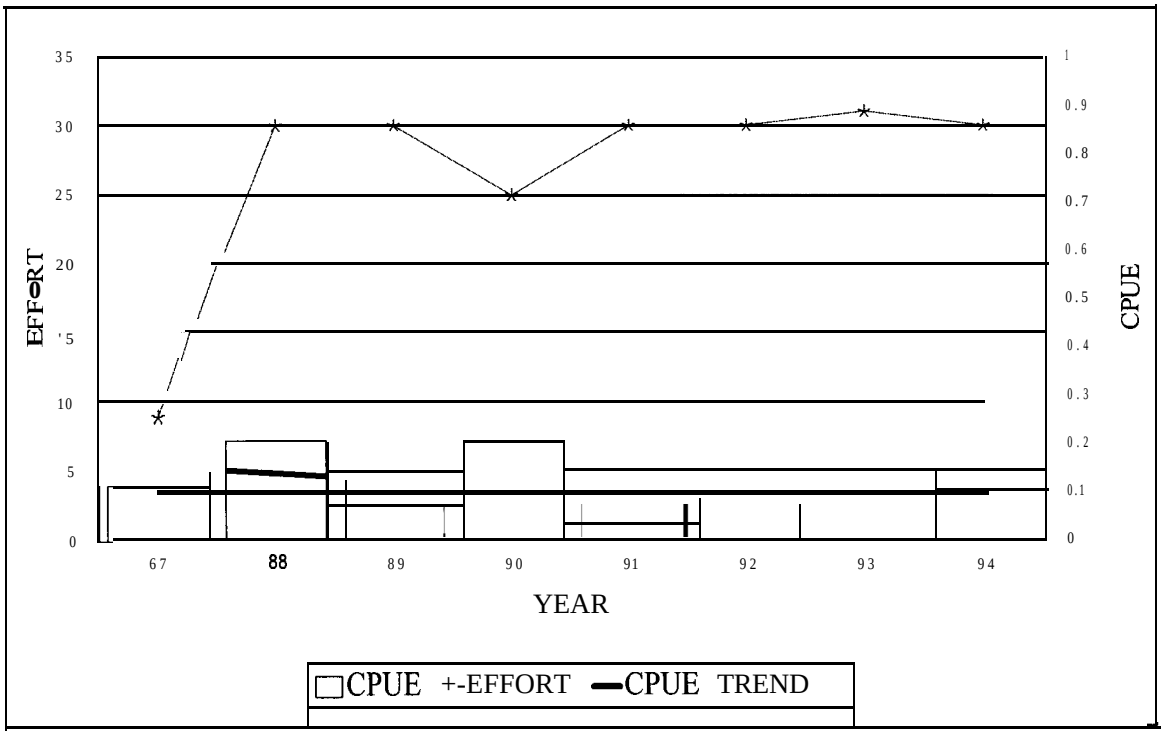

Figure 6.81. Catch/effort for Southern Flounder, 1987-1994, trammel net for BTES.

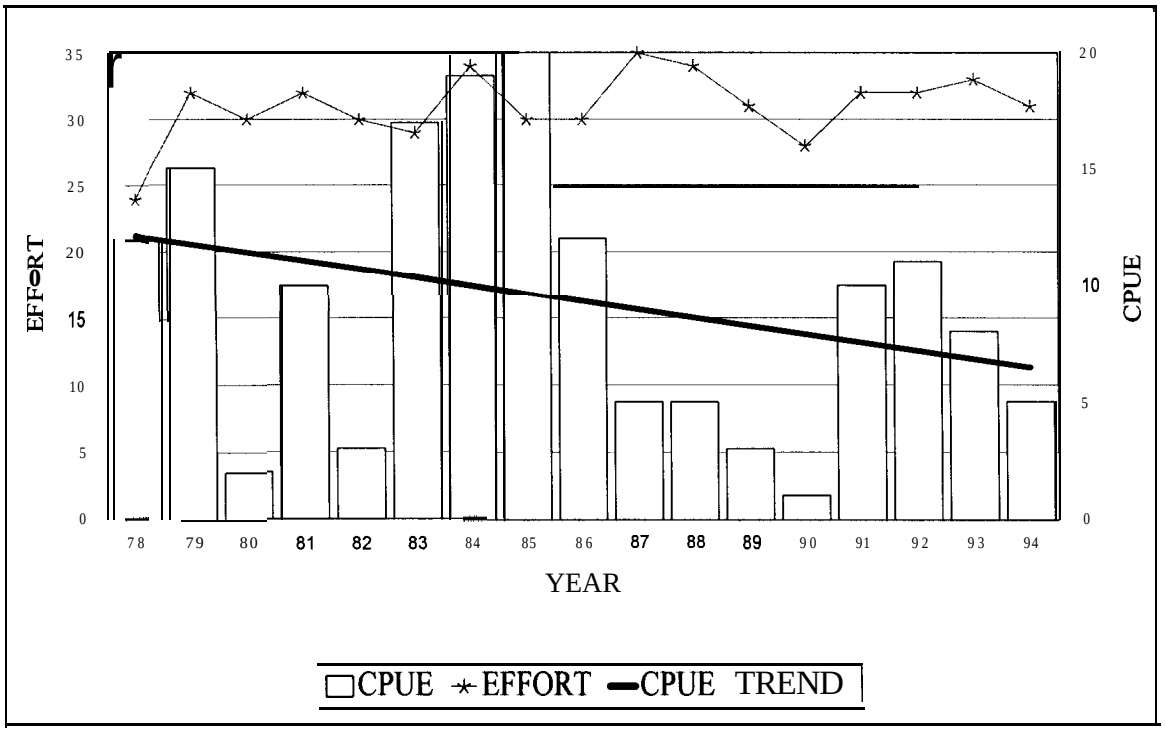

Figure 6.82. Catch/effort for Spot, 1978-1994, 16-ft trawl from LOOP stations for BTES.

Causes of Change

There are no data directly related to Southern Flounder. Coastal erosion has probably impacted the shallow, muddy, protected nursery areas for the species. The species is not abundant in BTES area, so a continued decline could result in Southern Flounder becoming very rare. Data on human-induced mortality of Southern Flounder have received little attention, particularly in regard to shrimp trawlers capturing spawning adults.

Habitat Requirements

- Perret et al. (1971) noted that this species is found over mud bottoms along estuarine shorelines in shallow water.

- There is some suggestion that Southern Flounder are more common in estuaries with freshwater input, with the young commonly penetrating into freshwater habitats.

- Reagan and Wingo (1985) reviewed Louisiana studies on Southern Flounder, noting its temperature tolerance from 5 to 35EC. Salinity tolerance was also wide, from 0–36 ppt.

Species Recommendations

- Shallow, soft-bottom shorelines should be included in coastal reconstruction projects.

- Determine habitat preference for young and juvenile Southern Flounder.

- Examine by-catch from commercial shrimp fishery to assess the effects of mortality on flounder population.

Spot
Leiostomus xanthurus

Status

- Found to be fifth most abundant trawl species in BTES region (Thompson and Forman 1987). It was third most abundant trawl species in lower Barataria Bay.

- Found to be sixth most abundant trawl species and seventh in frequency of occurrence statewide (Perret et al. 1993).

- Adkins et al. (1979) reported Spot fourth most abundant fish species caught by gill nets and fifth most abundant in trammel net, 1976–1977.

- Barrett et al. (1978) reported that Spot were collected in all areas across coastal Louisiana, during all months, being the fourth most abundant trawl-caught fish species.

- Adkins and Bourgeois (1982) did not capture many Spot in their 1979–1981 gill net study.

- Perret et al. (1971) report Spot as the third most abundant commercial fish species across coastal Louisiana.

- Parker (1971) found Spot to be an abundant species in Louisiana, 1959–1961, during a life history study.

Trends

- Trend in trawl-caught Spot for BTES LOOP stations was irregular with no consistent pattern, 1978–1994 (Figure 6.82).

Causes of Change

No change in abundance has been identified.

Habitat Requirements

- Stickney and Cuenco (1982) reported that mud and fine sand bottoms are important habitat requirements because of the feeding behavior of Spot.

- Parker (1971) reported Spot as a benthic species with infaunal feeding habitats found primarily over mud bottoms with detritus. He recorded a wide range of both salinity (1–25 ppt) and water temperature (8–32E C).

- Music (1974) reported a wide range of water temperature (7–32EC) and salinity (0–35 ppt) with young Spot being abundant in creeks and streams over mud bottom. He noted adult Spot being common on open beaches.

- Adkins and Bourgeois (1982), in contrast to many reports that only juvenile Spot use estuarine habitats, reported numerous large, adult Spot over a wide range of Terrebonne Bay.

- Perret et al. (1971) reported largest collections of Spot in salinities above 10 ppt.

- Hales and Van Den Avyle (1989) reported that Spot occur over a wide range of environmental conditions, but they also reported on the importance of unimpacted benthic communities for estuarine success of Spot.

- Phillips et al. (1989) noted that Spot have been recorded in salinities of 0–60 ppt and noted studies documenting wide environmental fluctuations where Spot are abundant; this tolerance appears to decline with age.

Species Recommendations

- Provide for soft mud and detritus-bottomed meanders and bayous as part of coastal restoration.

- Bottom type is tied to the infaunal feeding behavior of Spot, so maintain minimal disturbance of bottom sediments.

Striped Mullet
Mugil cephalus

Status

- True abundance of Striped Mullet difficult to assess with typical sampling gear since Striped Mullet is a pelagic species.

- Striped Mullet ranked in top ten by weight in lower Barataria basin (Thompson and Forman 1987).

- Striped Mullet ranked thirty-first in abundance and thirty-third in frequency of occurrence statewide (Perret et al. 1993).

- Adkins et al. (1979) reported Striped Mullet ranked fifth in gill net catches and third in trammel net catches, 1976–1977, in BTES area.

- Perret et al. (1971) reported Striped Mullet sixth most common species captured by seine in the BTES.

- LDWF (1992a) reviewed status of Striped Mullet as part of management plan and concluded "thus, the data does not indicate any declines in the stock over the time period examined," this being through 1990.

Trends

- **!** Possible decline in seine-caught Striped Mullet in the BTES, 1986–1994, although trend strongly influenced by high 1986 CPUE (Figure 6.83).

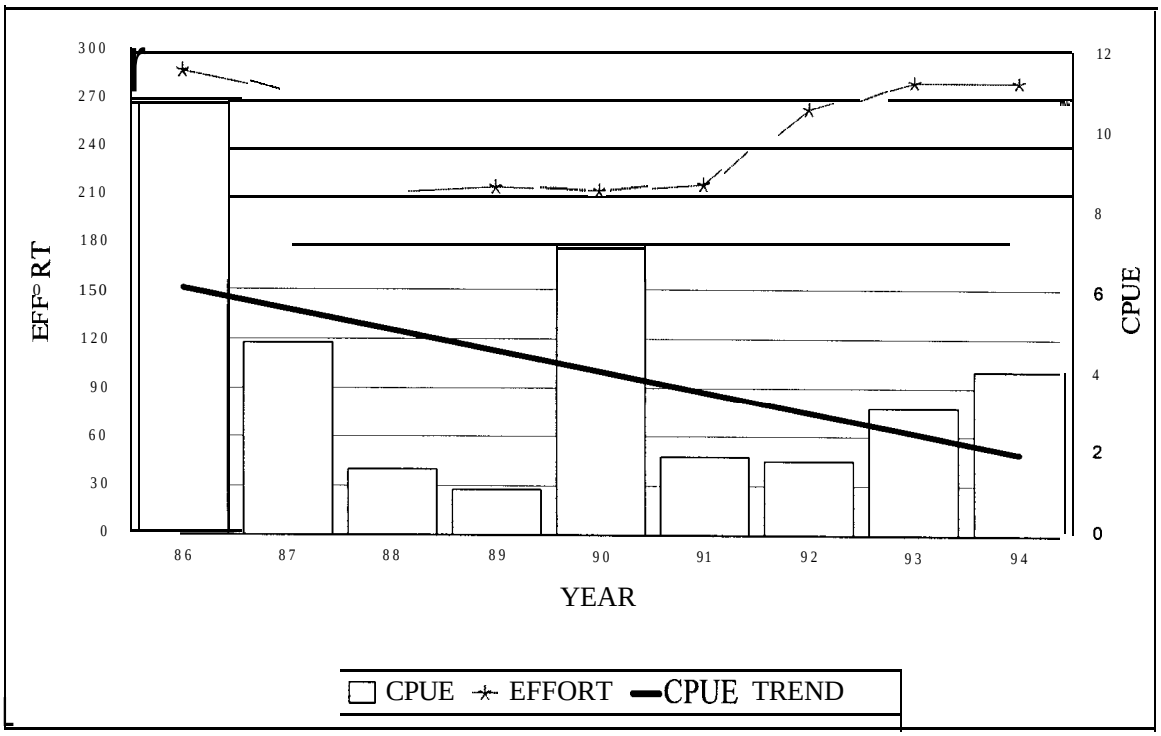

Figure 6.83. Catch/effort for Striped Mullet, 1986- 1994, 50-ft seine for BTES.

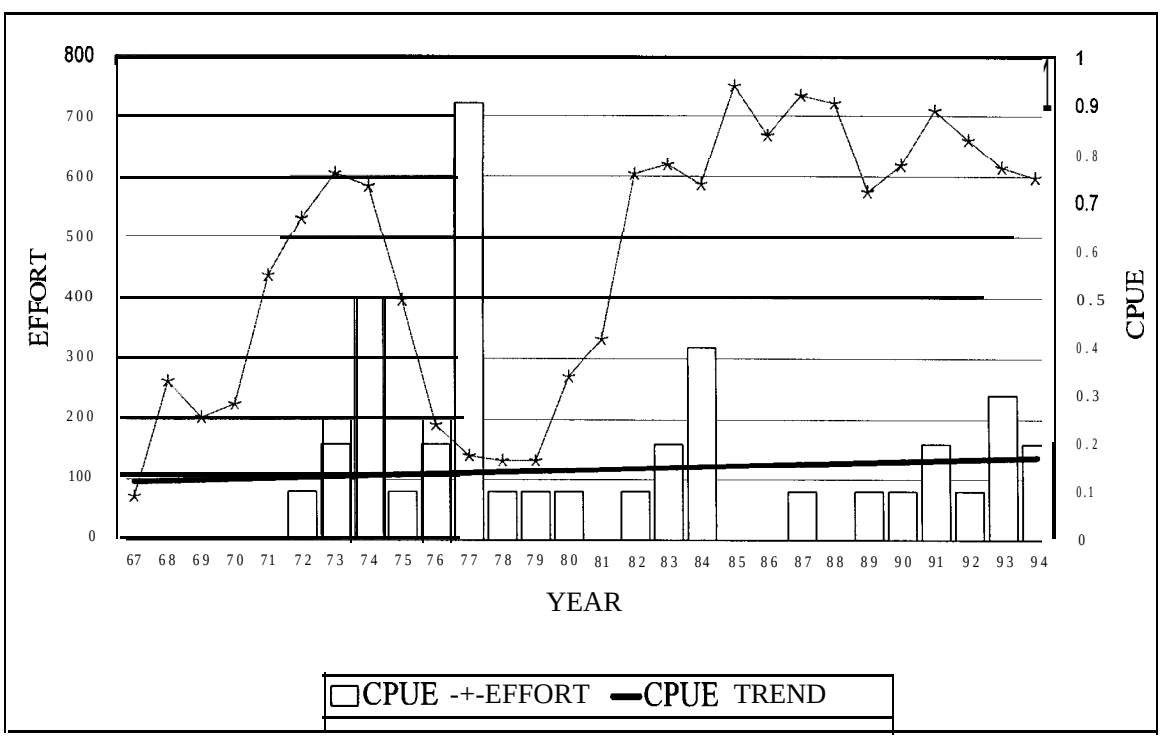

Figure 6.84. Catch/effort for Striped Mullet, 1967-1994, 16-ft trawl for BTES.

- Slight, insignificant increase indicated, but trend influenced by few high CPUE years for 16-ft trawl-caught Striped Mullet, 1967–1994, in the BTES (Figure 6.84).

- Slight decrease in CPUE, statewide, for 16-ft trawl-caught Striped Mullet, 1967–1994; trend influenced by few unusually high CPUE years (Figure 6.85).

- Slight increase in CPUE for gill net catches, 1988–1994, BTES area (Figure 6.86).

- High interannual CPUE, no clear trend in trammel net catches, 1987–1994, BTES (Figure 6.87).

Causes of Change

There are no data directly related to Striped Mullet. The popular perception is that the commercial fishery is causing a strong decline in population but there are no supporting data and there are many misconceptions about the Mullet fishery. The young use shallow, mud-bottomed marsh as nursery, so coastal erosion is probably having some impact on the population.

Habitat Requirements

- Collins (1985) reported a wide range of habitats, from riverine fresh water to over 75 ppt salinity. Larvae migrate into shallow marsh and beach areas suggests that Striped Mullet are susceptible to water temperatures below 16–18E C. Adults found in open waters of estuaries.

- Life cycle includes migration to open Gulf of Mexico for spawning (LDWF 1992a).

Species Recommendations

- Fishery regulations should include no harvest of young, immature mullet.

- Provide for shallow nursery habitat in coastal restoration.

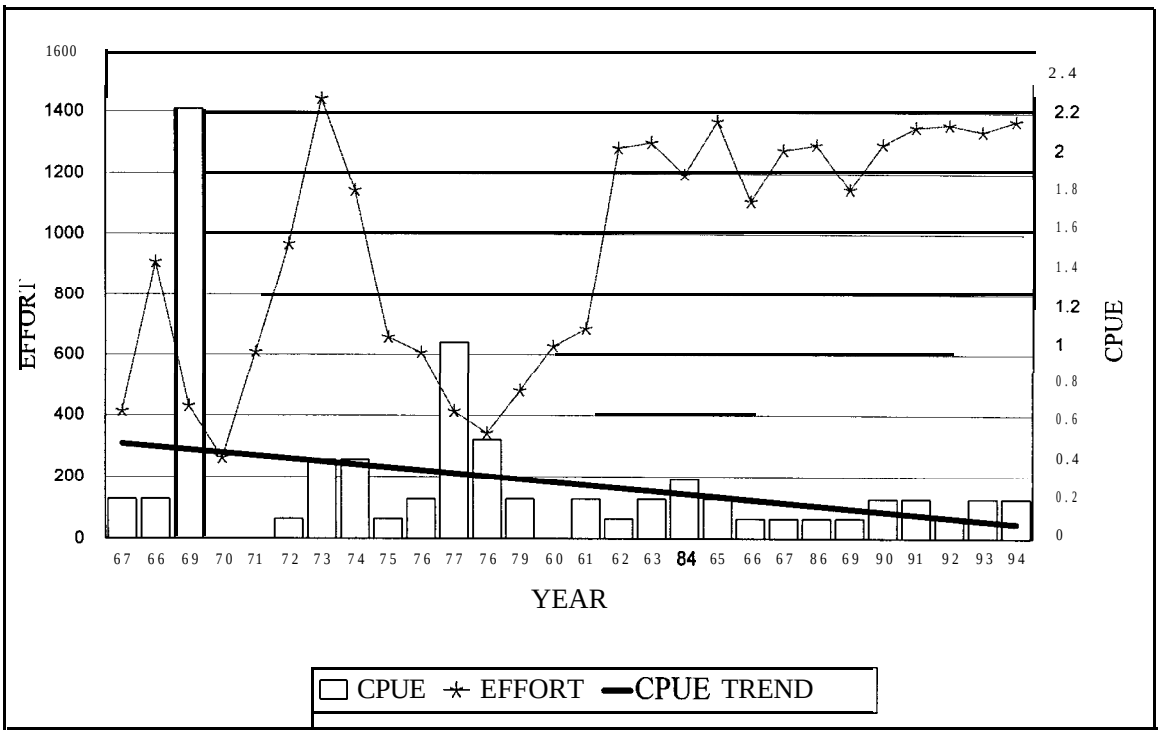

Figure 6.85. Catch/effort for Striped Mullet, 1967- 1994, 16-ft trawl, statewide.

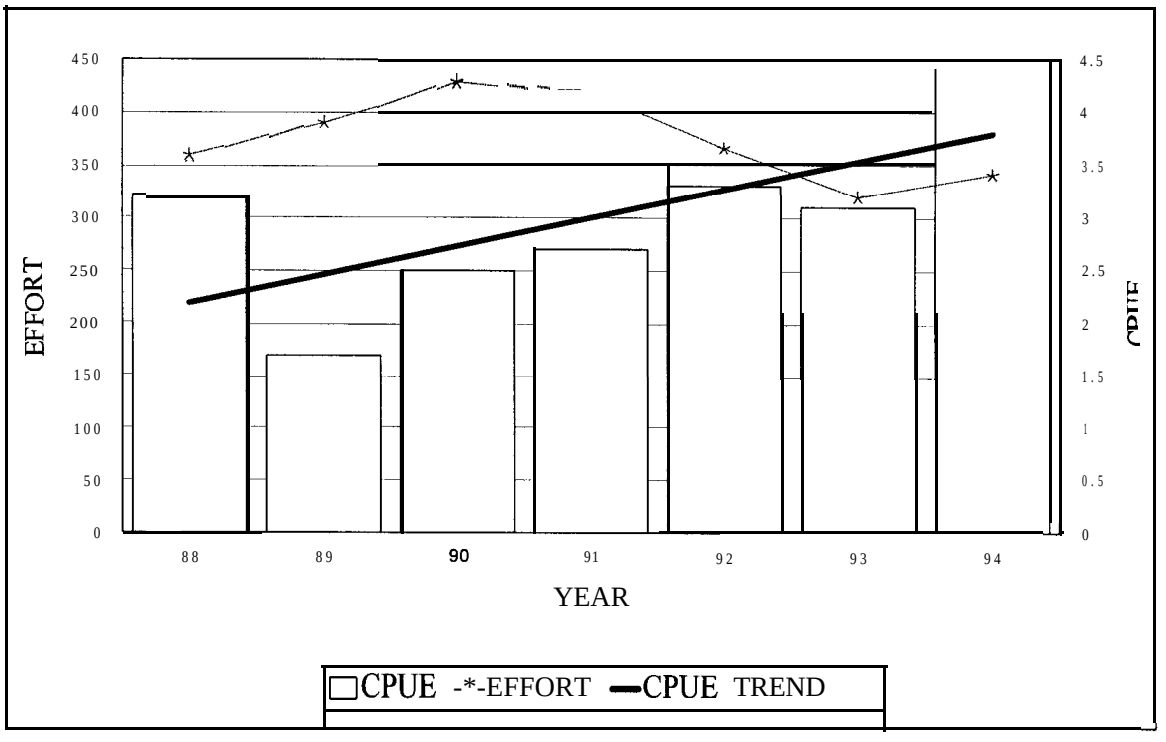

Figure 6.86. Catch/effort for Striped Mullet, 1988-1994, gill net (all meshes combined) for BTES.

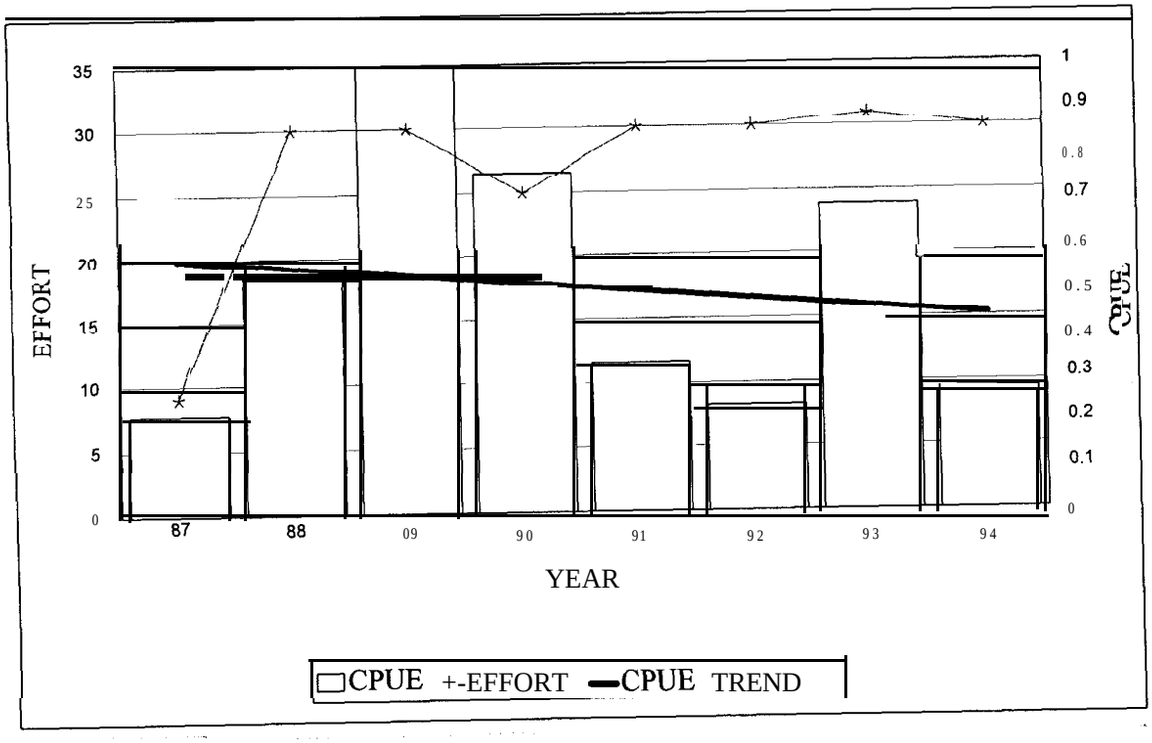

Figure 6.87. Catch/effort for Striped Mullet, 1987-1994, trammel net for BTES.

AMPHIBIANS

Bullfrog

Status

! Current population is severely diminished (Dundee and Rossman 1989).

Trends

! Wild harvest peaked in the 1930s and then declined (Dundee and Rossman 1989).

Causes of Change

Cause	Effect	Source
Overcollecting	Decline in abundance	Dundee and Rossman 1989
Pollution	Decline in abundance	Dundee and Rossman 1989
Destruction of breeding sites	Decline in abundance	Dundee and Rossman 1989

Habitat Requirements

Freshwater lakes, ponds, streams, swamps, marshes, and almost any temporary fresh water where the tadpole can complete its six-month cycle of maturation. Can migrate across land during rain. Opportunistic carnivore. Eats insects, crawfish, finfish, frogs, salamanders, snakes, birds, mice, and bats (Dundee and Rossman 1989).

Species Recommendations

! Consider conservation measures that would restore the stock.

REPTILES

Loggerhead
Caretta caretta

Status

! Listed as threatened throughout its range (National Research Council 1990).

- The Chandeleur Islands are probably the major Loggerhead nesting beach in the western or even northern Gulf of Mexico, though the rate of nesting there is probably not high (Fuller and Lohefener 1990).

- No valid record of occurrence along the BTES coast, though could be expected (Dundee and Rossman 1989).

Trends

- Survey data for most important U.S. nesting site (Melbourne Beach, Florida) of insufficient length for trend analysis, 1982–1989.
- Nesting abundance on Hutchinson Island, Florida, may be increasing, 1973–1989.
- Nesting abundance on Cape Island, South Carolina, has declined at an average annual rate of 119 nests from a high near 3,000 nests in the early 1970s to a low near 1,000 nests in the 1980s, 1973–1989.
- Nesting abundance on Little Cumberland Island, South Carolina, has declined at an annual average of 3%, 1964–1989 (National Research Council 1990).
- Last reported nesting in Louisiana, 1962 (Dundee and Rossman 1989)

Causes of Change

- Overharvest.
- Loss of nesting sites.
- Artificial lighting near nesting site.
- Foot and vehicle traffic on nesting sites.
- Incidental mortality in shrimp hauls not equipped with TEDs.
- Marine debris.
- Dredging (National Research Council 1990).

Habitat Requirements

Circumglobal range, preferring temperate and subtropical waters. Frequently forage around hard structures such as coral reefs, rock outcroppings and submerged human-made structures.

Enters estuaries, coastal streams, and rivers. Omnivorous. Ingests a variety of sponges, jellyfish, mollusks, crustaceans, sea urchins, fishes, seaweeds, and grasses (Fuller et al. 1987).

Green Turtle
Chelonia mydas

Status

- Listed as threatened, except for breeding population of Florida and the Pacific coast of Mexico, which are listed as endangered (NOAA 1995).

Trends

- Declined from an estimated population of 50 million turtles in the sixteenth through eighteenth centuries to a current 100,000 to 400,000 adults worldwide (Fuller et al. 1987).
- Nesting population increasing on Hutchinson Island, Florida, 1971–1989.
- Nesting survey data for Melbourne Beach, Florida, not of sufficient length for trend analysis (National Research Council 1990).

Causes of Change

- Overharvest.
- Loss of nesting sites.
- Artificial lighting near nesting site.
- Foot and vehicle traffic on nesting sites.
- Incidental mortality in shrimp hauls not equipped with TED.
- Marine debris.
- Dredging (National Research Council 1990).

Habitat Requirements

As adults, shallow seas and bays where their primary food of marine grasses and macrophyte algae are present. Adults also eat small mollusks and crustaceans. Young more carnivorous than adults (Fuller et al. 1987).

Hawksbill
Eretmochelys imbricata

Status

- Listed as endangered throughout its range (National Research Council 1990).
- First valid record for the Louisiana coast occurred in 1995 (Rester and Condrey n.d.).
- No valid record for the BTES, though could be expected (Dundee and Rossman 1989).

Trends

- Continuing to decline toward extinction. Formerly considered one of the sea turtles most likely to become extinct (Carr 1972). Now considered one of the 10 animals in the United States most likely to become extinct.

Causes of Change

- Overharvest.
- Loss of nesting sites.
- Artificial lighting near nesting site.
- Foot and vehicle traffic on nesting sites.
- Incidental mortality in shrimp hauls not equipped with TEDS.
- Marine debris.
- Dredging (National Research Council 1990).

Habitat Requirements

Primarily sea waters less than 15 m deep as in coral reefs and coastal bays. Feeds on invertebrates and marine grasses and macrophytic algae (Fuller et al. 1987, Dundee and Rossman 1989).

Kemp's Ridley
Lepidochelys kempi

Status

- Listed as endangered throughout its range (National Research Council 1990).
- May not avoid extinction in the wild (Dundee and Rossman 1989).

Trends

- The major nesting population has declined to about 1% of the 1947 abundance (National Research Council 1990).
- No longer a breeder along the Louisiana coast because of population declines (Dundee and Rossman 1989).

Causes of Change

- Overharvest.
- Loss of nesting sites.
- Artificial lighting near nesting site.
- Foot and vehicle traffic on nesting sites.
- Incidental mortality in shrimp hauls not equipped with TED.
- Marine debris.
- Dredging (National Research Council 1990).

Habitat Requirements

Shallow, coastal waters. Primarily a carnivore and likely a bottom feeder. Eats crabs, clams, snails, fish, jellyfish, and barnacles (Fuller et al. 1987, Dundee and Rossman 1989).

Snapping Turtle
Chelydra serpentina

Status

- Overfished in terms of adult per juvenile recruit (Dundee and Rossman 1989).

Causes of Change

- Heavy fishing pressure in Louisiana (Dundee and Rossman 1989).

Habitat Requirements

Fresh water, especially permanent ponds, lakes, or streams. Enters brackish waters and land. Feeds on sponges and a wide variety of animals from worms through crustaceans and fishes to mammals (Dundee and Rossman 1989).

Species Recommendations

- Identify, protect, and enhance freshwater habitats.

- Identify causes of population decline.

Alligator Snapping Turtle
Macroclemys temminckii

Status

- Heavily depleted in Louisiana.

- Depleted in some areas of the southeastern states (Pritchard 1989).

Causes of Change

- Heaving trapping (Pritchard 1989).

Habitat Requirements

Large rivers and lakes, swamps near rivers, and brackish marsh near fresh water bodies. Eats turtles, fishes, mollusca, crustaceans, caron, and vegetable matter (Dundee and Rossman 1989).

Species Recommendations

- Identify, protect, and enhance freshwater habitats.

Leatherback
Dermochelys coriacea

Status

- Listed as endangered throughout its range (National Research Council 1990).
- World population estimated at 120,000 nesting females (Fuller et al. 1987).

Causes of Change

- Overharvest.
- Loss of nesting sites.
- Artificial lighting near nesting site.
- Foot and vehicle traffic on nesting sites.
- Incidental mortality in shrimp hauls not equipped with TED.
- Marine debris.
- Dredging (National Research Council 1990).

Habitat Requirements

Oceanic, preferring deeper waters, but entering bays and estuaries. Feeds primarily on jellyfish, but eats sea urchins, squids, crustaceans, fishes, and some vegetable matter.

Diamond-backed Terrapin
Malaclemys terrapin

Status

- Unknown or declining in Louisiana, North Carolina, and South Carolina.

- Stable or increasing in Massachusetts and New York.
- Declining in Connecticut, Mississippi, and New Jersey.
- Stable, declining or unknown in Florida.
- Unknown or stable in Rhode Island.
- Declining or stable in Maryland.
- Unknown in Alabama, Delaware, Georgia, Texas, and Virginia (Seigel and Gibbons 1995).

Trends

- Overharvest seriously reduced populations along the U.S. east coast in the early part of this century. Many local populations responded to conservation measures enacted in the 1920s (Dundee and Rossman 1989).
- Two subspecies are listed as Category 2 candidates with the U.S. Fish and Wildlife Service for possible listing under the Endangered Species Act if sufficient evidence can be obtained and warrants such action.
- Sufficient evidence exists to also list all other subspecies as Category 2 candidates with the U.S. Fish and Wildlife Service (Seigel and Gibbons 1995).

Causes of Change

- Incidental drowning in crab traps.
- Drainage and impoundment of salt marshes.
- Human disturbance of nesting sites.
- Changes in the flow of fresh water into estuarine systems.
- Commercial harvesting.
- Incidental mortality associated with motorboats, cars, and trucks (Seigel and Gibbons 1995).

Habitat Requirements

Brackish marsh, preferring open channel to grassy flats. Eats mollusks, worms, and perhaps some plants (Dundee and Rossman 1989).

Species Recommendations

- Research should be undertaken to assess excluder devices in crab traps with reference not only to Diamond-backed Terrapin but also to crab catches.

- Acquire basic information on status, trends, and probable cause of change (Seigel and Gibbons 1995).

American Alligator
Alligator mississippiensis

Status

Threatened due to similarity of appearance in Louisiana.

- 28,839 alligator nests[1] were estimated for Louisiana in 1993 (McNease et al. 1994).

- 16,567 alligator nests[2] were estimated for southeast Louisiana in 1993 (McNease et al. 1994).

- The population in 1983 was estimated as 379,000 individuals in coastal Louisiana marshes, and 168,000 animals is a conservative estimate for the non-marsh population (Joanen and McNease 1987a).

Trends

- The Louisiana breeding population has significantly increased in the last 24 years (McNease et al. 1994) at an average of 13% per year.

- The southeast Louisiana breeding population has significantly increased in the last 24 years. The long-term outlook is that population densities in southeast Louisiana will catch up with densities in the currently slightly more productive marshes in southwest Louisiana (McNease et al. 1994).

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[1] 1 nest/42.7 ha x 1,231,429 ha of habitat=28,839 nests

[2] 1 nest/46.7 ha x 773,694 ha of habitat=16,567 nests

- The breeding population and the number of alligators in Lake Boeuf has been stable for the last 10 years, but the number of alligators in the marshes and swamps surrounding Lake Boeuf has significantly increased (Figure 6.88).

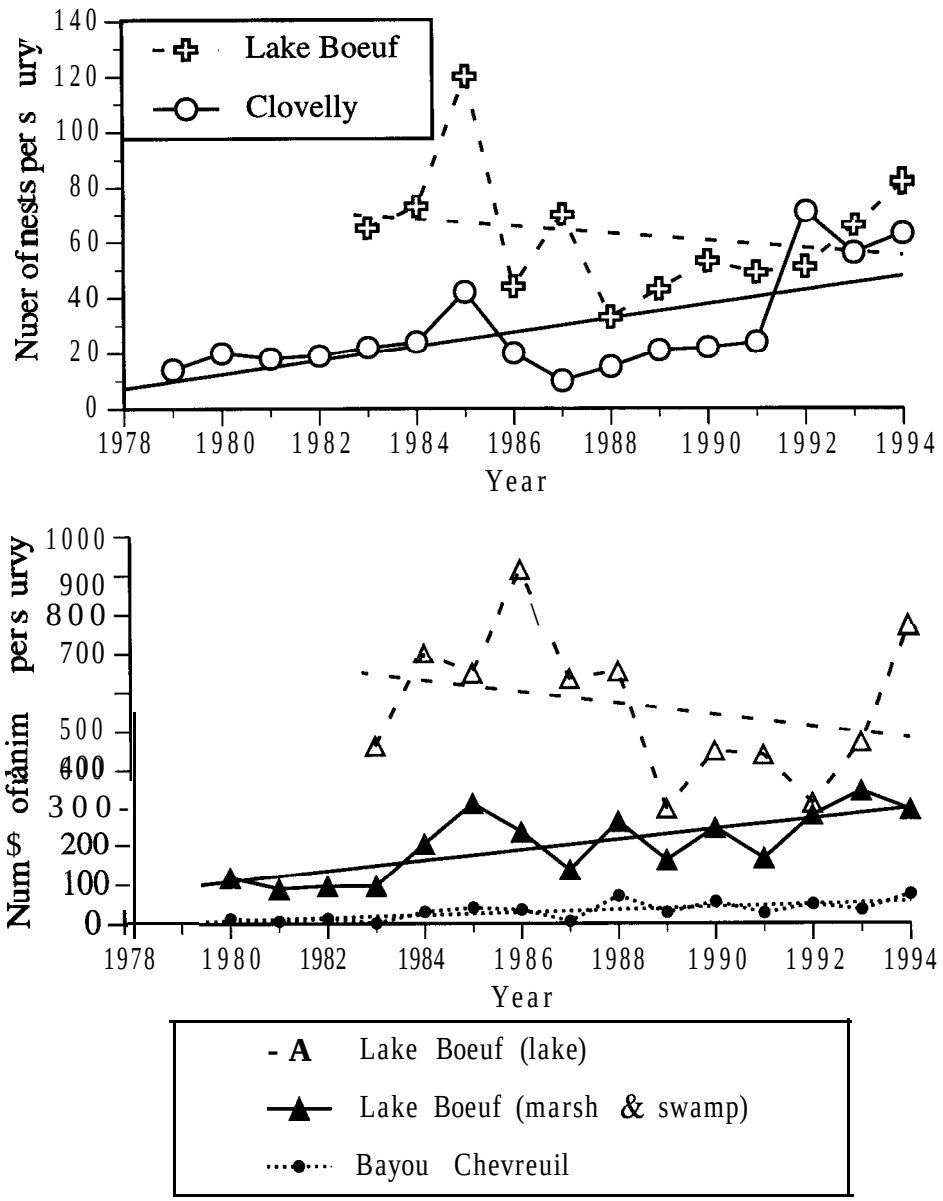

Figure 6.88. Number of nests and animals for selected alligator populations in western Barataria.

- The breeding population in the intermediate marshes of the Clovelly[1] area has significantly increased in the last 15 years (Figure 6.88).

- The number of animals in Bayou Chevreuil has significantly increased in the last 15 years (Figure 6.88).

Causes of Change

Cause	Effect	Source
Over harvesting	Decline of the population	Dundee and Rossman (1989)
Extreme water levels	Reduced reproduction	McNease et al. (1994)
Nest predation by raccoon	Reduced reproduction	Chabreck (1980)
Drought	Increased mortality of individuals < 1 m	Chabreck (1980)
Protection from overharvest	Increase in population	

Habitat Requirements

Alligators live in many still or slow-moving water bodies. Nests are found in greatest density in the intermediate (0.027 nests per ha) and fresh (0.022 nests per ha) marshes and less frequently in the brackish (0.012 nests per ha) marshes (McNease et al. 1994; data reported here are average densities for 1984–93 in southeast Louisiana).

Small alligators (less than 1 m total length) feed on insects, small fish, crayfish, crabs, small amphibians, and reptiles. Large alligators have a varied diet consisting of crustaceans (crayfish, crabs, and shrimp), amphibians (mostly frogs), reptiles (snakes, turtles, and small alligators), fish, birds (especially ducks, coots, and herons), and mammals (especially Muskrat and Nutria and sometimes dogs and hogs) (Dundee and Rossman 1989). Nutria and Muskrat make up a significant proportion of the diet when available (Joanen and McNease 1987a). When farmed alligators are fed Nutria the hatching rate of their eggs is significantly higher than that of alligators raised on a fish diet (Joanen and McNease 1987b).

Species Recommendations

Management of the American Alligator through maintenance of careful monitoring of the harvest of animals and eggs is recommended (see section on major factors threatening the population). Although current populations seem to be below the carrying capacity of the existing marsh (as demonstrated by the increasing population size), habitat loss, especially in the fresh and

[1] Fresh-intermediate marsh area on LOOP surveys

intermediate marsh, might become a problem in the near future. This species will, therefore, benefit from management practices that maintain "healthy" fresh and intermediate marshes.

BIRDS

SEABIRDS

Brown Pelican
Pelicanus occidentalis

Status

- Endangered
- The BTES contained 1,950 breeding birds in 1994 (Carloss 1995).
- The BTES contained 900 breeding birds in 1993 (Visser and Peterson 1994). This estimate does not include the small colony at the mouth of the Mississippi River (A-001), which in 1990 consisted of 27 breeding birds (Martin and Lester 1991), but was abandoned in 1991 (Wilkinson et al 1994).
- Louisiana had 2,196 breeding birds in 1990 (Martin and Lester 1991).
- The Wilkinson et al. (1994) survey reported 12,699 nests in 1989 on the Gulf Coast.
- The United States contained 26,461 nests in 1989 (Wilkinson et al. 1994).

Trends

- Within the BTES the breeding population is increasing (Visser and Peterson 1994).
- Within Louisiana the breeding population is increasing (Martin and Lester 1991).
- Along the Gulf Coast the breeding population is increasing (Wilkinson et al. 1994).
- Within the United States the breeding population is increasing (Wilkinson et al. 1994).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Botulism	Death of adults	Collazo (1985)
Endrin	Local extinction	Wilkinson et al. (1994)
DDT	Failed reproduction	Wilkinson et al. (1994)
Human disturbance of nesting sites	Abandonment of colony	Wilkinson et al. (1994)
Entanglement in fishing line	Death of adults	Wilkinson et al. (1994)
Fowl ticks	Failed reproduction	Wilkinson et al. (1994)
Illegal take of eggs	Failed reproduction	Wilkinson et al. (1994)
Banning of DDT	Population recovery	Hawes (1995)
Import of Florida birds	Restocking	Hawes (1995)

Habitat Requirements

- Within the BTES, Brown Pelicans nest on dunes and shrubs on Queen Bess, Raccoon Point, and Mississippi Mud Lumps.

- Brown Pelicans feed primarily in shallow estuarine waters and in marine waters within 30 km of the shore. Their prey consists of fish, primarily Gulf Menhaden and Mullet (Hintgen et al. 1985).

Species Recommendations

Expansion of the population within the BTES is currently restricted by the availability of suitable breeding habitat (Visser and Peterson 1994). Existing colonies (Queen Bess [A-019], Raccoon Island [B-020], and Mississippi River Mud Lumps [A-001]) should be protected from further erosion and human disturbance. In addition, the public should be educated about the harm done to these animals by the disturbance of the colonies and the death of birds due to entrapment in fishing line and other garbage. This species remains vulnerable to environmental toxins and populations should be closely monitored for signs of reduced breeding success. Additional nesting habitat could be created in the form of dredged material islands. Successful breeding on such an island occurred in Alabama (Wilkinson et al. 1994). We suggest creation of such an island in Little Pass Timbalier (B-004). This colony site had a few breeding pairs in 1985 and 1990 (Visser and Peterson 1994). This island should be planted with Black Mangrove and other salt-tolerant shrubs (i.e., *Iva frutescens*), to provide nesting substrate. Martin and Lester

(1991) recommend a buffer zone of 600 m around colonies and no activities in or near the colony between October 31 and August 1.

Black Skimmer
Rhynchops niger

Status

- The BTES contained 1,855 breeding birds in 1994 (Carloss 1995).
- The BTES contained 4,055 breeding birds in 1993 (Visser and Peterson 1994). This estimate does not include the small colonies at the mouth of the Mississippi River. In 1990 these colonies contained 825 breeding birds, which was 27% of the BTES population (calculated from Martin and Lester 1991).
- Spendelow and Patton (1988) reported 46,458 breeding birds between 1976 and 1982 along the Gulf Coast.
- Spendelow and Patton (1988) reported 64,788 breeding birds between 1976 and 1982 within the United States.

Trends

- Within the BTES the breeding population is declining (Visser and Peterson 1994).
- Within Louisiana the breeding population is declining (Martin and Lester 1991).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Disturbance of nesting sites	Failed reproduction/ Colony abandonment	Visser and Peterson (1994)
Mammal predation	Failed reproduction/ Colony abandonment	Visser and Peterson (1994)
Loss of breeding habitat (erosion)	Failed reproduction/ Colony abandonment	Visser and Peterson (1994)
Flooding of nest sites	Failed reproduction	Burger (1982)
Avian predation at colony sites	Failed reproduction	Burger (1982)

Habitat Requirements

- Within the BTES, Black Skimmers nest on various unvegetated substrates, always near shallow estuaries. The largest colonies occurred on barrier beaches and spoil islands, but many skimmers also nested on the small shell berms of small marsh islands (Portnoy 1977).

- Food of the Black Skimmer consists mainly of small fish and some shrimp (Bent 1921).

Species Recommendations

The decline of this species within the BTES is mostly due to the decline in available nesting habitat (Visser and Peterson 1994). Habitat would become available if human access (especially off-road vehicles) to the beaches at Fourchon were restricted during the breading season. This species also benefits from the creation of dredged spoil islands such as the one at Wine Island. We suggest creation of a similar island in Little Pass Timbalier (B-004). Human disturbance of colonies should be eliminated by posting colonies and education. Martin and Lester (1991) recommend a buffer zone of 200 m around colonies and no activities in or near the colony between May 1 and September 16.

Sandwich Tern
Thalasseus sandvicensis

Status

- The BTES contained 11,000 breeding birds in 1994 (Carloss 1995).

- The BTES contained 9,635 breeding birds in 1993 (Visser and Peterson 1994). This estimate does not include the small colony at the mouth of the Mississippi River (A-001), which in 1990 consisted of 250 breeding birds (Martin and Lester 1991).

- Spendelow and Patton (1988) reported 69,616 breeding birds between 1976 and 1982 along the Gulf Coast.

- Spendelow and Patton (1988) reported 71,460 breeding birds between 1976 and 1982 within the United States.

Trends

- Within the BTES the breeding population is increasing (Visser and Peterson 1994).

- Along the Gulf Coast the breeding population is increasing (Spendelow and Patton 1988).

- Within the United States the breeding population is increasing (Spendelow and Patton 1988).

Causes of Change

Cause	Effect	Source
Hurricanes	Reduced reproduction	Visser and Peterson (1994)
Human disturbance	Reduced reproduction	Burger (1981)
Loss of breeding habitat	Failed reproduction	Visser and Peterson (1994)
Habitat replacement	Increased breeding	Russell (1995)

Habitat Requirements

- Within Louisiana, Sandwich Terns nest on unvegetated barrier beaches and spoil islands (Portnoy 1977, Visser and Peterson 1994).

- The Sandwich Tern feeds on small mullet, menhaden, anchovies, shrimp, pelagic worms, and squid (Terres 1980).

Species Recommendations

Very little is known about the causes of population change in this species. However, 97% of the U.S. population of this species breeds along the Gulf Coast and the barrier islands of the BTES provide a significant resource for this species. The successful colonization of Wine Island (after restoration) by this species demonstrates the success of using dredged material islands to increase breeding habitat. We, therefore, suggest creation of a similar island in Little Pass Timbalier (B-004). The remoteness of all colonies of this species from civilization shows that this species is extremely sensitive to human disturbance. Therefore, human disturbance of colonies should be eliminated by posting the colonies and educating the public. Martin and Lester (1991) recommend a buffer zone of 200 m around colonies and no activities in or near the colony between April 15 and September 16.

Royal Tern
Thalasseus maximus

Status

- The BTES contained 14,800 breeding birds in 1994 (Carloss 1995).

- The BTES contained 1,365 breeding birds in 1993 (Visser and Peterson 1994). This estimate does not include the colony at the mouth of the Mississippi River (A-001), which in 1990 consisted of 250 breeding birds (Martin and Lester 1991). Using Martin and Lester's data we calculated a population of 8,000 breeding birds within the BTES system in 1990.

- Spendelow and Patton (1988) reported 55,144 breeding birds between 1976 and 1982 along the Gulf Coast.

- Spendelow and Patton (1988) reported 135,540 breeding birds between 1976 and 1982 within the United States.

Trends

- Within the BTES the breeding population is stable (Visser and Peterson 1994).

- Within Louisiana the breeding population is increasing (Martin and Lester 1991).

- Along the Gulf Coast the breeding population is stable (Spendelow and Patton 1988).

Causes of Change

Cause	Effect	Source
Hurricanes	Reduced reproduction	Visser and Peterson (1994)
Human disturbance	Reduced reproduction	Burger (1981)
Egg collection	Failed reproduction	Bent (1921)

Habitat Requirements

- Within Louisiana, Royal Terns nest on unvegetated barrier beaches and spoil islands (Portnoy 1977, Visser and Peterson 1994).

- Food of the Royal Tern consists mainly of small shell- and finfish (Bent 1921).

Species Recommendations

Very little is known about the causes of population change in this species. The successful colonization of Wine Island (after restoration) by this species demonstrates the success of using dredged material islands to increase breeding habitat. We, therefore, suggest creation of a similar island in Little Pass Timbalier (B-004). The remoteness of all colonies of this species

from civilization shows that it is extremely sensitive to human disturbance. Therefore, human disturbance of colonies should be eliminated by posting the colonies and educating the public. Martin and Lester (1991) recommend a buffer zone of 200 m around colonies and no activities in or near the colony between April 15 and September 16.

Least Tern
Sterna antillarum

Status

- The BTES contained 800 breeding birds in 1994 (Carloss 1995).

- The BTES contained 1,170 breeding birds in 1993 (Visser and Peterson 1994). This estimate does not include two major colonies along the beaches of eastern Barataria (A-017 and A-018), which in 1990 consisted of 600 breeding birds (Martin and Lester 1991). Using Martin and Lester's data we calculated a population of 830 breeding birds within the BTES system in 1990.

- Spendelow and Patton (1988) reported 17,380 breeding birds between 1976 and 1982 along the Gulf Coast.

- Spendelow and Patton (1988) reported 44,646 breeding birds between 1976 and 1982 within the United States.

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Trends

- Within the BTES the breeding population is stable (Visser and Peterson 1994).

- Along the Gulf Coast the breeding population is increasing (Spendelow and Patton 1988).

Causes of Change

Cause	Effect	Source
Human disturbance	Failed reproduction Abandonment of colony	Visser and Peterson (1994)
Mammal predation	Failed reproduction/ Abandonment of colony	Carreker (1985)
Loss of breeding habitat	Failed reproduction	Visser and Peterson (1994)
Flooding of nest sites	Failed reproduction	Carreker (1985)
Avian predation	Failed reproduction	Carreker (1985)

Habitat Requirements

- Within Louisiana, Least Terns nest on flat unvegetated substrate near good feeding areas. Diverse sites include barrier beaches, spoil islands, vacant house lots, and airports (Portnoy 1977).

- Food of the Least Tern consists mainly of small (<8 cm long) fish (predominantly anchovy) and crustaceans, and feeding occurs mostly in shallow water (Carreker 1985).

Species Recommendations

Elsewhere, this species has benefited from fencing around colony sites (Carreker 1985). Human disturbance of colonies should be eliminated through posting of colonies and education. Martin and Lester (1991) recommend a buffer zone of 200 m around colonies and no activities in or near the colony between April 15 and September 16.

Forster's Tern
Sterna forsteri

Status

- The BTES contained 1,090 breeding birds in 1994 (Carloss 1995).

- Louisiana had 3,680 breeding birds in 1990 (Martin and Lester 1991).

- Spendelow and Patton (1988) reported 23,096 breeding birds between 1976 and 1982 along the Gulf Coast.

- Spendelow and Patton (1988) reported 23,096 breeding birds between 1976 and 1982 within the United States.

Trends

- Within the BTES the breeding population is stable (Visser and Peterson 1994).
- The Louisiana breeding population is decreasing (Martin and Lester 1991).
- Along the Gulf Coast the breeding population is stable (Spendelow and Patton 1988).
- Within the United States the coastal breeding population is stable (Spendelow and Patton 1988).
- BBS indicates a significant annual continental increase of 5.0%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Human disturbance of nesting sites	Failed reproduction Abandonment of colony	Martin and Zwank (1987)
Mammal predation at colony sites	Failed reproduction/ Abandonment of colony	Martin and Zwank (1987)
Flooding of nest sites	Failed reproduction	Martin and Zwank (1987)
Avian predation	Failed reproduction	Martin and Zwank (1987)
Oilspill	Potential threat to colonies	Martin and Zwank (1987)

Habitat Requirements

This species breeds in mainland marsh or on grassy islands in bays and lagoons. It builds nests of grasses and stalks of marsh plants (Lowery 1974b).

Species Recommendations

Human disturbance of colonies should be eliminated through posting of colonies and education. Breeding sites for this species within the BTES are highly unstable and consist of small (less than 1 ha) marsh islands with significant amounts of wrack. Colonies are used for an average of four years and than abandoned as islands decrease in elevation. Currently, new marsh islands suitable for breeding are frequently formed as surrounding marsh erodes. Existing colonies

should be protected from human disturbance and oil spills. Martin and Lester (1991) recommend a buffer zone of 200 m around colonies and no activities in or near the colony between March 15 and August 1.

Gull-billed Tern
Sterna nilotica

Status

- The BTES contained 40 breeding birds in 1994 (Carloss 1995).
- Louisiana had 161 breeding birds in 1990 (Martin and Lester 1991).
- Spendelow and Patton (1988) reported 3,799 breeding birds between 1976 and 1982 along the Gulf Coast.
- Spendelow and Patton (1988) reported 5,399 breeding birds between 1976 and 1982 within the United States.

Trends

- The Louisiana breeding population is stable (Martin and Lester 1991).
- Along the Gulf Coast the breeding population is stable (Spendelow and Patton 1988).

Habitat Requirements

Beaches, estuaries, coastal bays, salt marshes, dry and flooded fields, and some inland lakes. In the BTES almost strictly coastal, with a strong preference for marshy areas. Nests in sandy depressions. Eats large insects and occasionally dives for small fish and marine invertebrates (Lowery 1974b, Farrand 1983).

Species Recommendations

The only colony (A-002) of this species should be protected from human disturbance and oil spills. Martin and Lester (1991) recommend a buffer zone of 200 m around colonies and no activities in or near the colony between May 1 and September 16.

Caspian Tern
Sterna caspia

Status

- The BTES contained 40 breeding birds in 1994 (Carloss 1995).
- Caspian Terns breed occasionally within the BTES (Visser and Peterson 1994).
- Louisiana had 670 breeding birds in 1990 (Martin and Lester 1991).
- Spendelow and Patton (1988) reported 2,912 breeding birds between 1976 and 1982 along the Gulf Coast.
- Spendelow and Patton (1988) reported 18,908 breeding birds between 1976 and 1982 within the United States.

Trends

- The Louisiana breeding population is increasing (Martin and Lester 1991).
- Along the Gulf Coast the breeding population is stable (Spendelow and Patton 1988).
- BBS indicates a significant annual continental increase of 7.2%, 1966-1993 (Peterjohn et al. 1994).

Habitat Requirements

Partial to foraging in marshes as opposed to front beaches. Found along river systems, canals, large lakes, coastal waters, bays, and beaches. Eats mainly small finfish often pirated from smaller seabirds (Lowery 1974b, Farrand 1983).

Species Recommendations

The colonies (B-004 and B-030) supporting this species should be protected from human disturbance and oil spills. Martin and Lester (1991) recommend a buffer zone of 200 m around colonies and no activities in or near the colony between April 15 and September 16.

Laughing Gull
Larus atricilla

Status

- The BTES contained 53,700 breeding birds in 1994 (Carloss 1995).

- Louisiana had 28,975 breeding birds in 1990 (Martin and Lester 1991).
- Spendelow and Patton (1988) reported 219,748 breeding birds between 1976 and 1982 along the Gulf Coast.
- Spendelow and Patton (1988) reported 498,392 breeding birds between 1976 and 1982 within the United States.

Trends

- The breeding population within the BTES is decreasing (Visser and Peterson 1994).
- The Louisiana breeding population is stable (Martin and Lester 1991).
- Along the Gulf Coast the breeding population is stable (Spendelow and Patton 1988).
- BBS indicates a significant annual continental increase of 5.5%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Human disturbance of nesting sites	Failed reproduction Abandonment of colony	Burger (1981)
Loss of breeding habitat	Failed reproduction	Visser and Peterson (1994)
Cannibalism	Failed reproduction	Burger (1981)

Habitat Requirements

In the BTES nests primarily on coastal islands and mud lumps. Common in beaches and salt marshes. Eats small crabs, surface fish, shrimp, discarded bycatch, eggs of seabirds, and refuse. Begs for food from humans in many coastal settings. Travels inland to eat earthworms in fields after plowing or heavy rains (Lowery 1974b, Farrand 1983).

Species Recommendations

Existing colonies should be protected from human disturbance and oil spills. Martin and Lester (1991) recommend a buffer zone of 200 m around colonies and no activities in or near the colony between April 1 and August 1.

WADING BIRDS

Great Blue Heron
Ardea herodias

Status

- The BTES contained 775 breeding birds in 1994 (Carloss 1995).
- Louisiana had 9,785 breeding adults in 1990 (Martin and Lester 1991).
- Along the Gulf Coast an average of 14,712 breeding adults were present between 1976 and 1982 (Spendelow and Patton 1988).
- Eastern United States had an average population of 36,248 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- The LOOP corridor in western Barataria basin contains a stable wintering population (Figure 6.89).
- Louisiana has an increasing nesting population (Martin and Lester 1991).
- New Orleans Christmas counts show increasing wintering populations (Purrington 1995b).
- BBS indicates a significant continental annual increase of 3.2%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Nest predation	Displacement of colony	Kelly et al. (1993)
Habitat loss	Decreasing population	Kelly et al. (1993)
Chemical contamination	Reduced health of adults and reduced reproductive success	Sanderson et al. (1994)
Acidification of lakes[1]	Reduced reproductive success	Sullivan and Payne (1988)
Avian predation	Reduced reproductive success	Sullivan and Payne (1988)
Vandalism	Death of adult birds	Vermeer (1969)
Increase in shallow water due to coastal erosion and crawfish farming	Increased health of birds	Russell (1995)
Preservation of nesting sites by education and refuges	Increase in reproduction	Russell (1995)

Habitat Requirements

- Within Louisiana Great Blue Heron colonies are most frequently found in swamp forests, and occasionally in fresh marsh shrubs (Portnoy 1977).
- Great Blue Herons feed in fresh to saline marshes and can even be found feeding in the surf. Prey include a wide range of insects, fish, amphibians, reptiles, and mammals (Hankock and Kushlan 1984).

[1] This is mostly a problem in the northern United States.

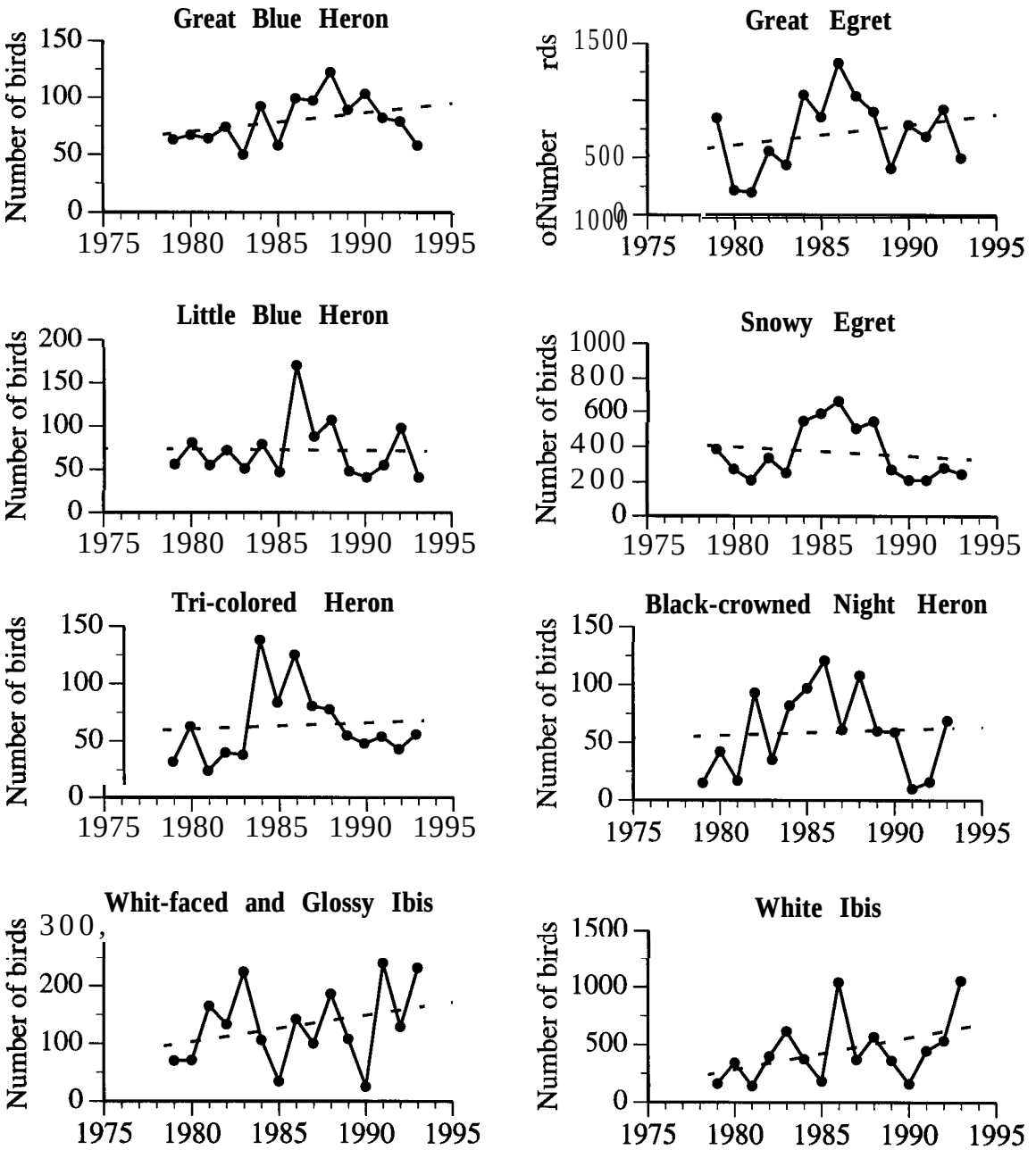

Figure 6.89. Number of wintering wading-birds per survey along the LOOP pipeline corridor in southwestern Barataria Basin. Dashed line represents the fitted linear regression, however only the trends for the Ibis species are significant.

Species Recommendations

Nationally recognized important colonies for this species occur within the BTES northeast of Amelia (C-005) and south of Luling (B-106, Spendelow and Patton 1988). Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between February 15 and August 1.

Great Egret
Casmerodius albus

Status

- The BTES contained 3,180 breeding birds in 1994 (Carloss 1995).
- Louisiana had 43,144 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average of 74,754 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).
- Eastern United States had an average of 114,155 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- The LOOP corridor in western Barataria basin contains a stable wintering population (Figure 6.89).
- Louisiana has a stable nesting population (Martin and Lester 1991).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Human disturbance	Decreasing population	Kelly et al. (1993)
Habitat loss	Decreasing population	Kelly et al. (1993)

Habitat Requirements

- Within Louisiana Great Egrets nest abundantly in swamp forests, fresh and saline marsh shrubs, spoil banks, and barrier islands (Portnoy 1977).

- Great Egrets feed in fresh to saline marshes. Prey taken is extremely diverse and includes a wide range of insects, fish, amphibians, reptiles, mammals, and small birds. However, fish usually comprise the bulk of the diet (Hankock and Kushlan 1984).

Species Recommendations

One nationally recognized important colony for this species occurs within the BTES south of Luling (B-106, Spendelow and Patton 1988). Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between February 15 and August 1.

Snowy Egret
Egretta thula

Status

- The BTES contained 2,139 breeding birds in 1994 (Carloss 1995).

- Louisiana had 18,992 breeding adults in 1990 (Martin and Lester 1991).

- The Gulf Coast had an average of 112,047 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

- Eastern United States had an average of 159,479 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- The LOOP corridor in western Barataria basin contains a stable wintering population (Figure 6.89).

- Louisiana has a stable nesting population (Martin and Lester 1991).

- New Orleans Christmas counts show increasing wintering populations since the early 1970s (Purrington 1995b).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Human disturbance	Decreasing population	Kelly et al. (1993)
Habitat loss	Decreasing population	Kelly et al. (1993)
Plume hunting	Devastating populations	Hancock and Kushlan (1984)
DDE contamination	Reproductive failure	Hancock and Kushlan (1984)
Competition with Cattle Egret	Reduced reproduction	Burger (1978)

Habitat Requirements

- Snowy Egrets nest abundantly in shrub heronries in swamps and marshes (Portnoy 1977).

- Snowy Egrets feed in fresh to saline marshes. They feed mainly on shrimp, but small fish, fiddler crabs, mollusks, aquatic insects, frogs, and crayfish are also eaten (Hankock and Kushlan 1984).

Species Recommendations

Spendelow and Patton (1988) recognized the importance of the rookeries at Lake Boeuf (B-91, B-093, B-095, B-096, B-097, and B-098) for the continental population of this species. Efforts should be made to protect these colonies. Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between March 1 and August 1.

Little Blue Heron
Egretta caerulea

Status

- The BTES contained 4,140 breeding birds in 1994 (Carloss 1995).

- Louisiana had 23,040 breeding adults in 1990 (Martin and Lester 1991).

- The Gulf Coast had an average of 85,790 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

- Eastern United States had an average of 101,944 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- The LOOP corridor in western Barataria basin contains a stable wintering population (Figure 6.89).
- Louisiana has a stable nesting population (Martin and Lester 1991).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Competition with Cattle Egret	Reduced reproduction	Spendelow and Patton (1988)

Habitat Requirements

- Little Blue Herons nest abundantly in shrub heronries in swamps (Portnoy 1977)
- Little Blue Herons feed mostly within the fresh marsh. The diet consists of fish, insects, frogs, and crayfish. However, in Louisiana fish dominates the diet (Hankock and Kushlan 1984).

Species Recommendations

Spendelow and Patton (1988) recognized the importance of the rookeries at Lake Boeuf (B-91, B-093, B-095, B-096, B-097, and B-098) and Lac des Allemands (B-108, B-109, and B-110) for the continental population of this species. Efforts should be made to protect these colonies. Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between March 1 and August 1.

Tri-colored Heron
Egretta tricolor

Status

- The BTES contained 2,180 breeding birds in 1994 (Carloss 1995).

- Louisiana had 22,917 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average of 150,485 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).
- Eastern United States had an average of 178,826 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- The LOOP corridor in western Barataria basin contains a stable wintering population (Figure 6.89).
- Louisiana has a stable nesting population (Martin and Lester 1991).
- New Orleans Christmas counts indicate increasing wintering populations since the early 1970s (Purrington 1995b).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

- Tri-colored Herons nest most abundantly on small salt marsh islands, but breeding also occurs in swamps, fresh and brackish marshes, and spoil islands (Portnoy 1977).
- The Tri-colored Heron is a coastal bird of shallow marshes and shores, using mudflats and shallow bays to feed. Tri-colored Heron prey consists mainly of fish, although amphibians, crustaceans, gastropods, and insects are also taken (Hankock and Kushlan 1984).

Species Recommendations

Spendelow and Patton (1988) recognized the importance of the rookeries at Raccoon Point (B-020), Northwest Island in Timbalier Bay (B-030), Queen Bess (A-019), and one other island in Barataria Bay (A-028). These four islands represented 37% of the continental breeding population in the late 1970s. However, currently only Raccoon Point remains as an important colony for Tri-colored Herons within the BTES (Martin and Lester 1991). Efforts should be made to protect this colony. Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between March 1 and August 1.

Reddish Egret
Egretta rufescens

Status

- No breeding adults were observed in the BTES in 1994 (Carloss 1995).
- Louisiana had 38 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average of 3,819 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).
- Species of special concern in Louisiana.

Trends

- Louisiana has a declining nesting population (Martin and Lester 1991).

Causes of Change

Cause	Effect	Source
Plume hunting	Decline in population	Hancock and Kushlan (1984)
Loss of barrier island habitat	Decline in population	Hawes (1995)

Habitat Requirements

- Reddish Egrets are found nesting in Black Mangrove thickets on small marsh islands or behind barrier beaches (Portnoy 1977).
- The Reddish Egret feeds on open marine flats and shorelines. It feeds on minnows, killifish, and pinfish (Hankock and Kushlan 1984).

Species Recommendations

The major colonies in Louisiana of this species are located outside of the BTES along the Chandeleur Islands (Spendelow and Patton 1988). Since this species feeds in the very shallow tidal pools of barrier islands, it might benefit from barrier island restoration projects. The 1989 freeze, which killed many of the mangroves used for nesting by the Reddish Egret, might be responsible for the very small nesting population in 1990 observed by Martin and Lester (1991). Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between March 1 and August 1.

Cattle Egret
Bubulcus ibis

Status

- The BTES contained 2,930 breeding birds in 1994 (Carloss 1995).
- Louisiana had 29,954 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average of 170,456 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).
- Eastern United States had an average of 439,363 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- Louisiana has a stable nesting population (Martin and Lester 1991).
- BBS indicates a significant annual continental increase of 1.6%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Severe winters	Declining populations	Telfair (1983)
Birds shot (mostly in Mexico)	Major source of mortality of birds banded in Texas	Telfair (1983)
Pesticides	Declining populations	Mullie et al. (1992)

Habitat Requirements

- Cattle Egrets nest abundantly in shrubs in freshwater swamps and marshes, and are occasionally found in brackish and saline heronries (Portnoy 1977).
- The Cattle Egret feeds in agricultural and residential grasslands and its prey consists mostly of insects and spiders, although amphibians are occasionally consumed as well.

Species Recommendations

One of the largest colonies of this species is located at Lac des Allemands (B-109; Spendelow and Patton 1988). This species has been expanding its range worldwide and was first observed breeding in Louisiana in 1956 (Portnoy 1977). Cattle Egrets start nesting later than the other heron species in Louisiana (Portnoy 1977), and therefore competition with Snowy Egrets and Little Blue Herons for nesting space is probably negligible. This species' feeding practices in agricultural fields make it susceptible to pesticides. Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between April 1 and September 1.

Black-crowned Night Heron
Nycticorax nycticorax

Status

- The BTES contained 656 breeding birds in 1994 (Carloss 1995).
- Louisiana had 5,988 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average of 19,110 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).
- Eastern United States had an average of 48,336 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- The LOOP corridor in western Barataria basin contains a stable wintering population (Figure 6.89).
- Louisiana has a stable nesting population (Martin and Lester 1991).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

- Black-crowned Night Herons nest most abundantly in mangrove heronries. Nests were built close to the ground deep within mangrove thickets (Portnoy 1977), but nests were also found in swamp-forest and fresh marsh colonies.

- The Black-crowned Night Heron feeds mostly on fish, amphibians, and insects, but its diverse diet also includes crustaceans, mollusks, spiders, small mammals, and birds (Hankock and Kushlan 1984).

Species Recommendations

Spendelow and Patton (1988) recognized the importance of the rookeries at Raccoon Point (B-20), and one island in Barataria Bay. Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between March 1 and August 1.

White Ibis
Eudocimus albus

Status

- The BTES contained 470 breeding birds in 1994 (Carloss 1995).
- Louisiana had 73,775 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average of 106,300 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).
- Eastern United States had an average of 200,765 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- The LOOP corridor in western Barataria basin contains an increasing wintering population (Figure 6.89).
- Louisiana has a stable nesting population (Martin and Lester 1991).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

- White Ibis nests abundantly in trees and shrubs in the swamp, mangrove shrubs in the salt marsh, and willow shrubs on spoil banks (Portnoy 1977).

Species Recommendations

Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between April 1 and September 1.

White-faced Ibis and Glossy Ibis
Plegadis chichi and *Plegadis falcinellus*

Status

- The BTES contained 761 breeding birds in 1994 (Carloss 1995).
- Louisiana had 6,255 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average of 23,511 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- The LOOP corridor in western Barataria basin contains an increasing wintering population (Figure 6.89).
- Louisiana has a stable nesting population (Martin and Lester 1991).
- BBS indicates a significant continental increase of 19.5%/yr, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

- These birds nest most commonly on salt marsh islands where their thick mound-like nests are build directly on smooth cordgrass (Portnoy 1977).

Causes of Change

Cause	Effect	Source
Pesticides	Declining population	Spendelow and Patton (1988)
Preservation of nesting areas due to education and refuges	Increased reproduction	Russell (1995)

Species Recommendations

These two species are only distinguishable with careful observations through binoculars and could not be distinguished during aerial nesting and wintering surveys. The White-faced Ibis is the most common species of the two in Louisiana. Colonies in Barataria Bay contain significant portions of the Louisiana breeding population (Spendelow and Patton 1988). Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between April 1 and September 1.

Roseate Spoonbill
Ajaia ajaja

Status

- Species of special concern in Louisiana.
- The BTES contained 100 breeding birds in 1994 (Carloss 1995).
- Louisiana had 1,919 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average of 4,185 breeding adults between 1976 and 1982.
- Eastern United States had an average of 5,669 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- Louisiana has an increasing nesting population (Martin and Lester 1991).

Causes of Change

Cause	Effect	Source
Human disturbance	Colony abandonment	Allen (1966)
Illegal take	Death of adults	Allen (1966)
Raccoon predation	Colony abandonment	Allen (1966)
Nest parasites	Colony abandonment	Allen (1966)
Severe freezes	Adult mortality	Russell (1995)
Adaptation to feeding in rice fields	Increased survival	Russell (1995)

Habitat Requirements

- Roseate Spoonbills have only recently started nesting within the BTES. The first breeding pairs were found in 1990 at Raccoon Island, and currently they also nest in the colony at the mouth of Bayou Lafourche which was discovered in 1991.
- Roseate Spoonbills feed mostly on small fish like minnows and killifish, but insects, crustaceans, mollusks, and plant materials are also eaten (Allen 1966).

Species Recommendations

Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between April 1 and August 1.

WATERFOWL

Snow Goose
Chen caerulescens

Status

- Small flocks are occasionally observed wintering in western Terrebonne Parish (Art Brasdan pers. comm.).

- The mid-continental breeding population consisted of 2,200,800 birds in 1993 (USFWS and CWS 1994).

- The North American breeding population consisted of 2,505,300 birds in 1993 (USFWS and CWS 1994).

Trends

- The mid-continental breeding population has been stable for the last 10 years (USFWS and CWS 1994).

Causes of Change

Cause	Effect	Source
Severe weather at breeding grounds/ late snow melt	Reduced reproduction	Bellrose (1976)
Habitat change	Change in use of wintering grounds	Bellrose (1976)

Habitat Requirements

- At one time, wintering of the blue phase of this species was largely restricted to southeastern Louisiana, while the white phase wintered in western Louisiana and Texas. However since the mid 1950s the color phases have become more and more mixed. Since the early 1970s, geese started to winter more in the Midwest and in the rice fields north of the western Louisiana coastal zone (Bellrose 1976).

- Snow Geese traditionally grazed on sedges and grasses, and within Louisiana showed a preference for Olney's three-square. However, since the 1960s large amounts of

agricultural food sources, such as grain and stubble of corn and rice have been used (Bellrose 1976).

Mallard
Anas platyrhynchos

Status

- The North American breeding population consisted of 6,980,100 birds in 1994 (USFWS and CWS 1994).

- Within western Barataria basin an average of 1.78 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The North American breeding population has been stable over the last 40 years (USFWS and CWS 1994). However in the last 20 years the population has shown a significant decreasing trend (see Figure 6.90).

- This decreasing trend in the last 15 years was also observed on the LOOP surveys in southwestern Barataria (Figure 6.90).

- LDWF surveys showed no significant trend (Figure 6.90).

- BBS indicates a significant annual continental increase of 1.8%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Hunting	Death of adults	Bellrose (1976)
Increasing use of agricultural fields	Reduced mortality	Bellrose (1976)
Wintering habitat loss	Decreased recruitment	Allen (1986)

Habitat Requirements

- Mallards feed almost completely on vegetable matter. The dominant natural food sources are seeds from a variety of freshwater grasses and sedges, smartweed (*Polygonum* sp.), and submerged aquatics. They also eat acorns, and within Louisiana rice has become a major food source for Mallards (Bellrose 1976). Agricultural grains are eaten by Mallards, but are not a complete substitute for natural foods (Allen 1986).

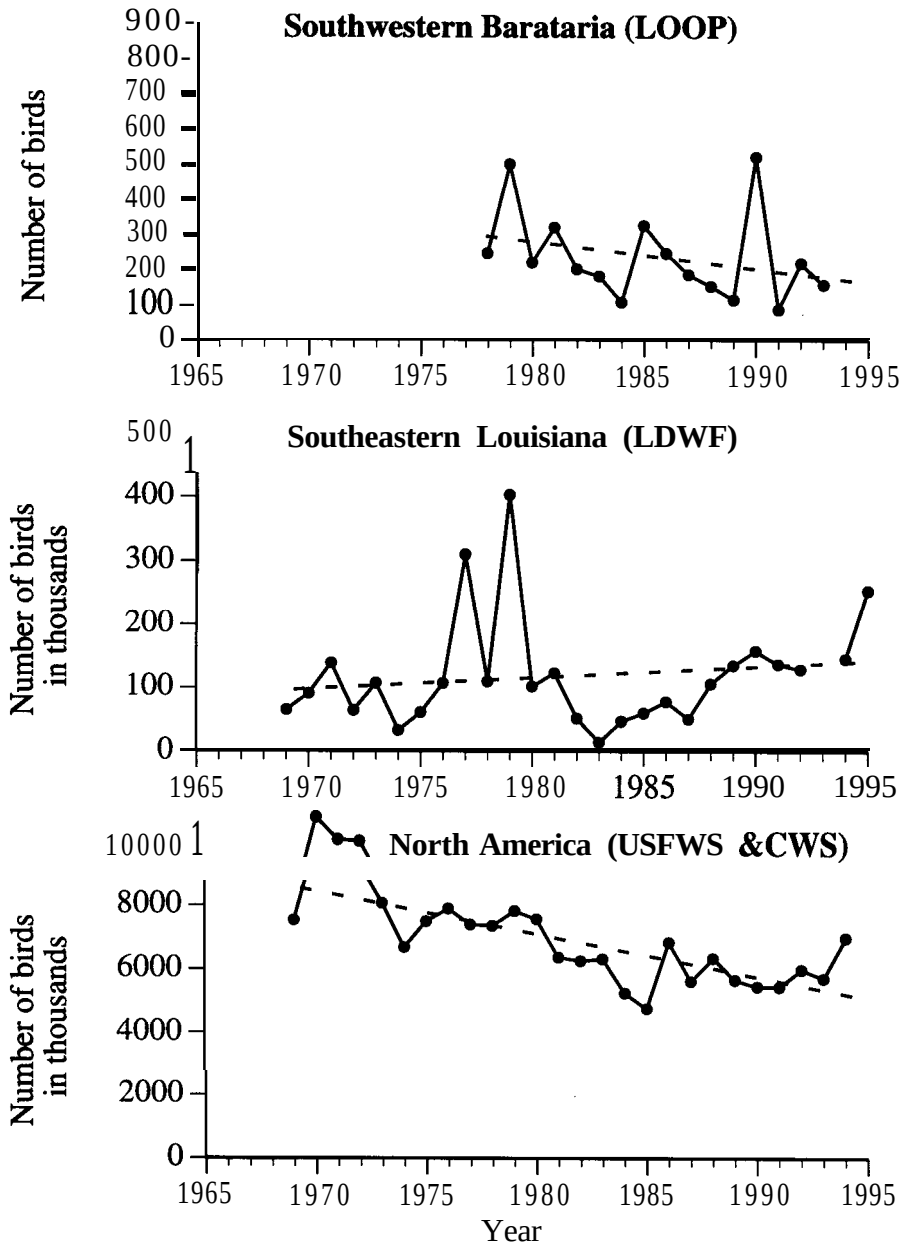

Figure 6.90. Mallard population trends. Dashed line represents the fitted linear regression, however only the trend for the North American breeding population is significant.

- Within southwestern Barataria basin Mallards were found in greatest densities in the fresh (0.031 birds per ha) and brackish (0.030 birds per ha) marshes, and were rarely observed in the saline (0.003 birds per ha) marshes (data analysis modified from Visser et al. 1994).

- Allen (1986) stresses the importance of irregularly flooded bottomland hardwoods as habitat for Mallards.

Northern Pintail
Anas acuta

Status

- The North American breeding population consisted of 2,972,300 birds in 1994 (USFWS and CWS 1994).

- Within western Barataria basin an average of 0.26 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The North American breeding population has been declining significantly over the last 40 years (USFWS and CWS 1994).

- This decreasing trend in the last 15 years was also observed on the LOOP surveys in southwestern Barataria (Figure 6.91), especially when the years of construction on the pipeline (1979–80) are removed from the data set.

- LDWF surveys showed no significant trend (Figure 6.91).

- BBS indicates a significant annual continental decline of 6.4%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Bird predation	Reduced reproductive success	Bellrose (1976)
Raccoon predation	Reduced reproductive success	Bellrose (1976)
Agriculture practices	Increased mortality at nesting sites	Bellrose (1976)
Winter habitat decline	Reduced recruitment	Raveling and Heitmeyer (1989)

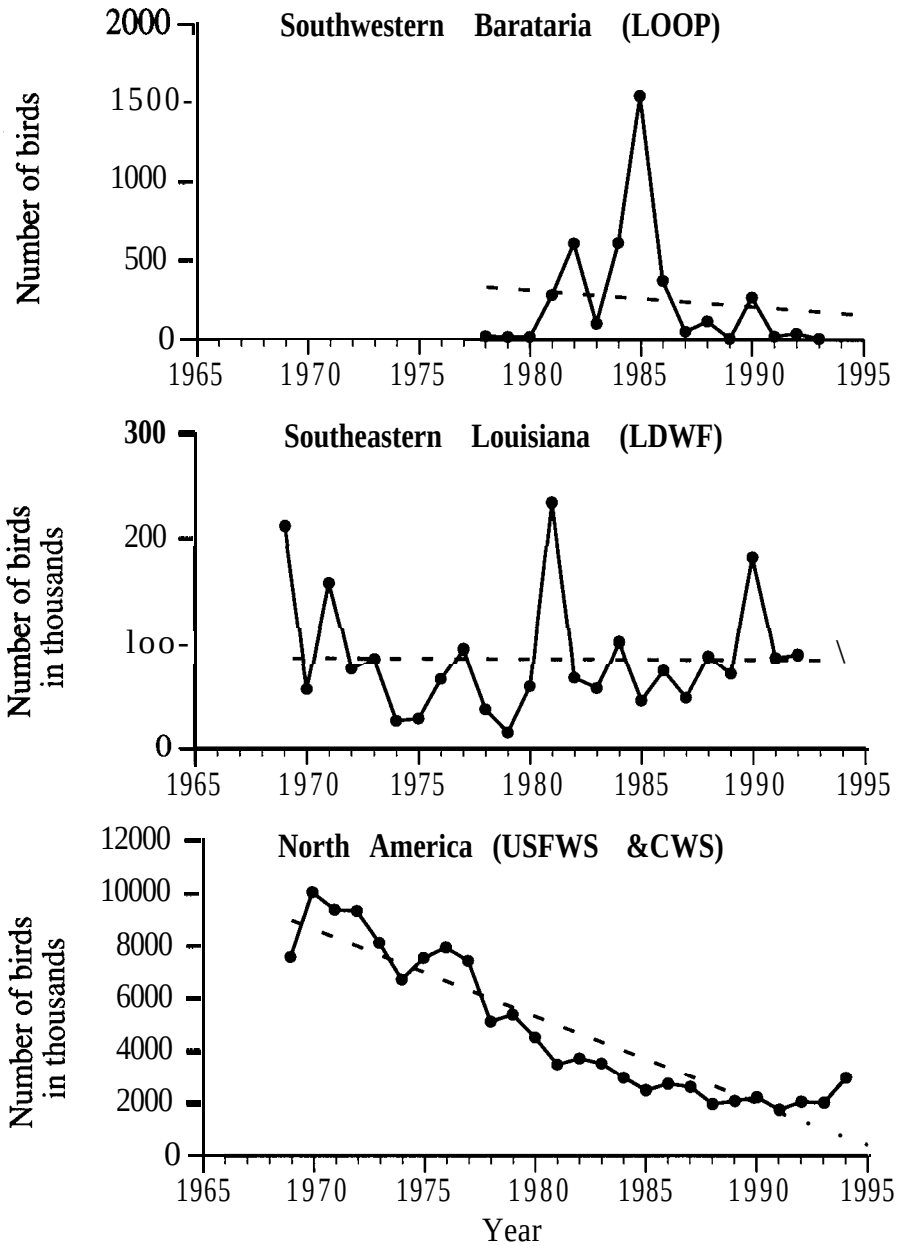

Figure 6.91. Northern Pintail population trends. Dashed line represents the fitted linear regression, however only the trend for the North American breeding population is significant.

Habitat Requirements

- Northern Pintails feed almost completely on vegetable matter. The dominant food sources are seeds from a variety of freshwater grasses and sedges, smartweed (*Polygonum* sp.), submerged aquatics, and agricultural grains (Bellrose 1976).

- Within southwestern Barataria basin Northern Pintails were found in greatest densities in the brackish (0.057 birds per ha) marshes, and were rarely observed in the fresh (0.004 birds per ha) and saline (0.006 birds per ha) marshes (data analysis modified from Visser et al. 1994).

- Although 37% of the continental pintail population winters along the Gulf Coast, the BTES is not one of the major wintering grounds for this species (Howard and Kantrud 1986).

Blue-winged Teal
Anas discors

Status

- The North American breeding population consisted of 4,616,200 birds in 1994 (USFWS and CWS 1994).

- Within western Barataria basin an average of 3.75 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The North American breeding population has been stable over the last 40 years (USFWS and CWS 1994).

- LDWF surveys showed no significant trend (Figure 6.92).

- LOOP surveys showed no significant trend (Figure 6.92).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Mammal predation	Reduced reproductive success	Bellrose (1976)

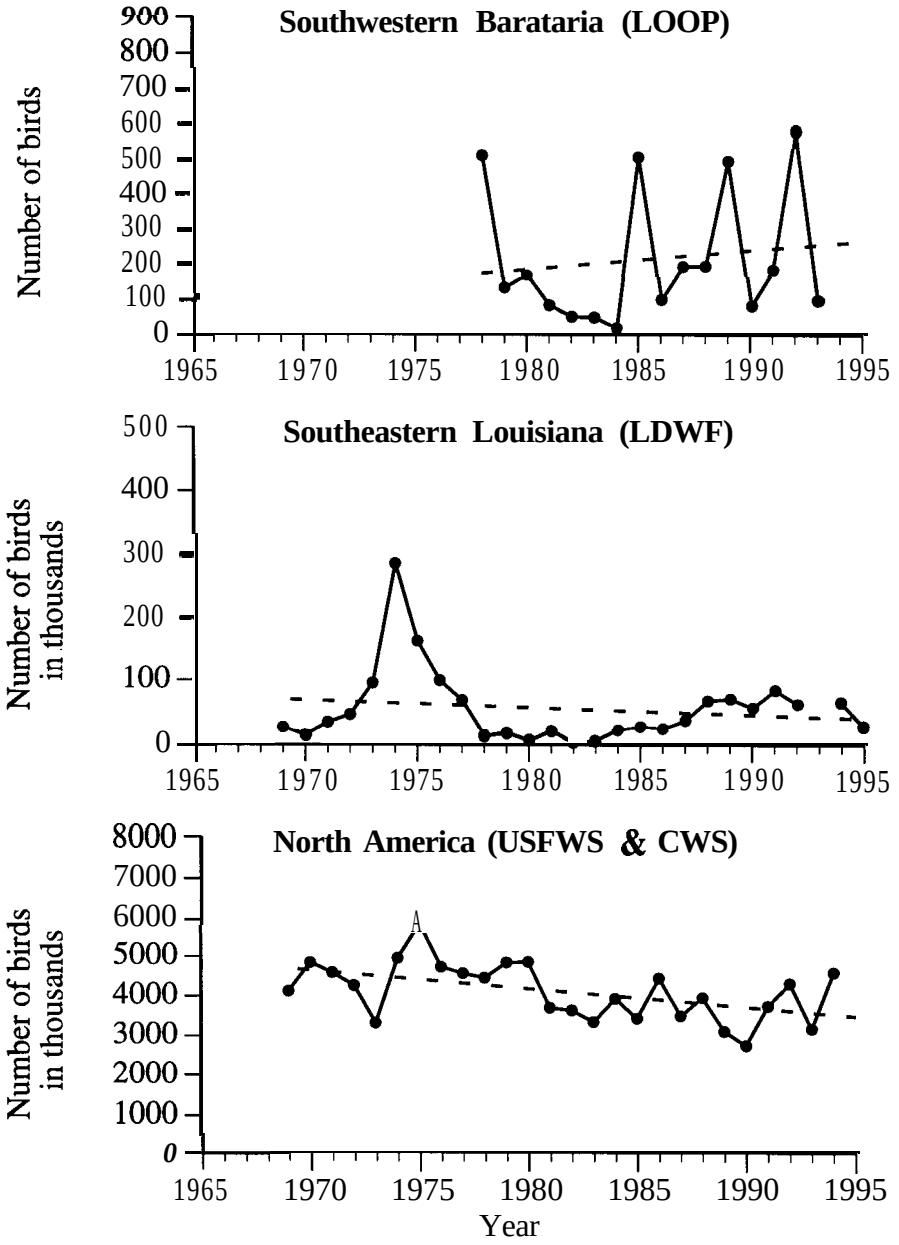

Figure 6.92. Blue-winged Teal population trends. Dashed line represents the fitted linear regression, however none of the population trends is significant.

Habitat Requirements

- The diet of Blue-winged Teal consists of three quarters plant food and one quarter animal food. Plant food consists mostly of seeds of sedges, submerged aquatics, grasses, and knotweeds. The animal food consists of insects and mollusks (Bellrose 1976).

- Within southwestern Barataria basin Blue-winged Teal were found in greatest densities in fresh marshes (0.060 birds per ha) followed by brackish marshes (0.043 birds per ha), and had lowest densities in the saline marshes (0.015 birds per ha) (data analysis modified from Visser et al. 1994).

Green-winged Teal
Anas crecca

Status

- The North American breeding population consisted of 2,108,400 birds in 1994 (USFWS and CWS 1994).

- Within western Barataria basin an average of 4.42 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The North American breeding population has been stable over the last 40 years (USFWS and CWS 1994).

- LDWF surveys showed no significant trend (Figure 6.93).

- LOOP surveys observed an increasing trend in the last 15 years in southwestern Barataria (Figure 6.93), however, this trend disappears when the years of construction on the pipeline (1979–80) are removed from the data set.

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Predation	Reduced reproductive success	Bellrose (1976)

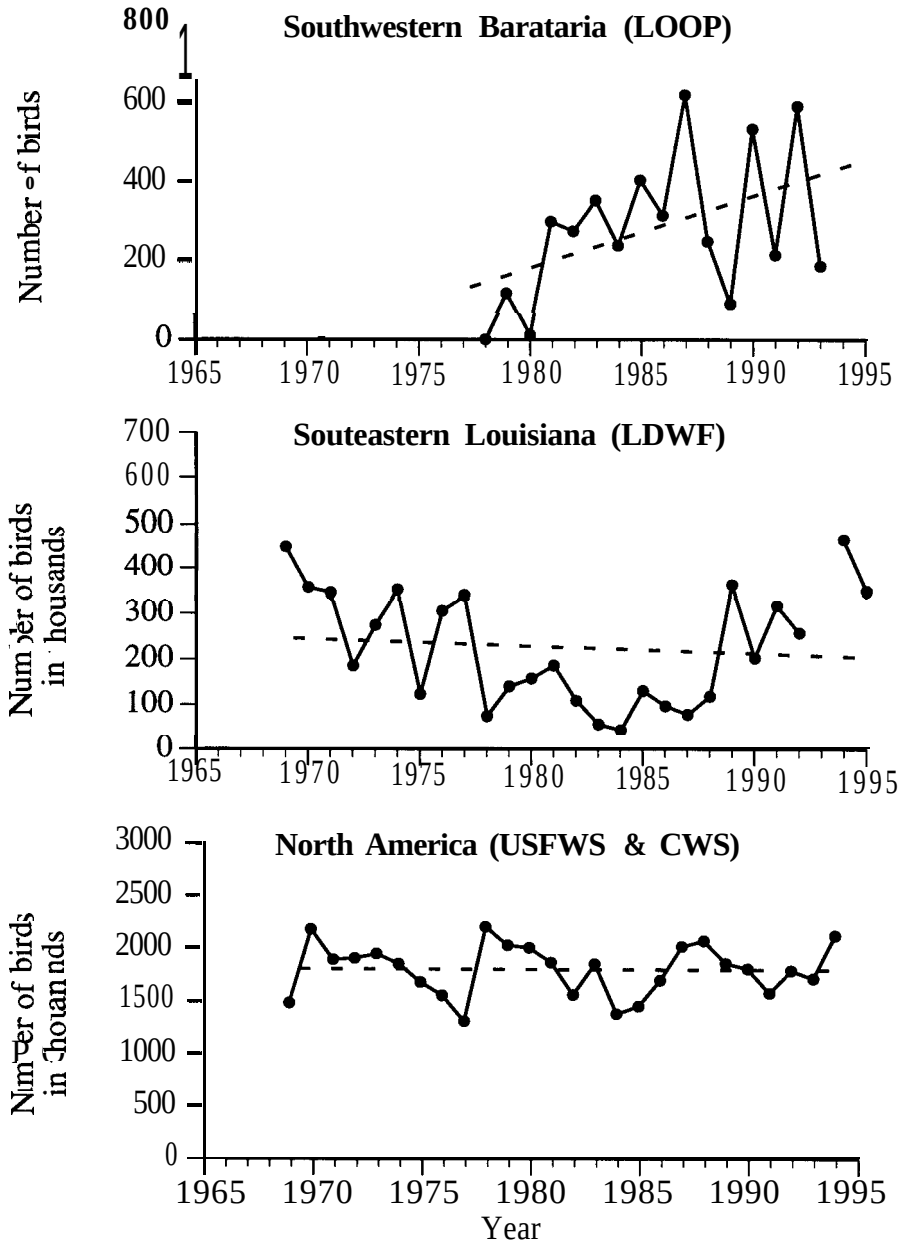

Figure 6.93. Green-winged Teal population trends. Dashed line represents the fitted linear regression, however only the trend for the wintering population in southwestern Barataria is significant.

Habitat Requirements

- Green-winged Teal prefer to feed on mudflats where they pick up seeds of sedges, millets, knotweeds, and waterhemp. When mudflats are unavailable they feed in marshes and shallow ponds where they consume vegetative parts of submerged aquatics and duckweed (Bellrose 1976).

- Within southwestern Barataria basin Green-winged Teal were found in greatest densities in fresh marshes (0.036 birds per ha) followed by brackish marshes (0.029 birds per ha), and had lowest densities in the saline marshes (0.015 birds per ha) (data analysis modified from Visser et al. 1994).

American Wigeon
Anas americana

Status

- The North American breeding population consisted of 2,382,300 birds in 1994 (USFWS and CWS 1994).

- Within western Barataria basin an average of 1.65 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The North American breeding population has been stable over the last 40 years (USFWS and CWS 1994). However, the population has been decreasing in the last 20 years (Figure 6.94).

- LDWF surveys showed no significant trend (Figure 6.94).

- LOOP surveys showed no significant trend (Figure 6.94).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Predation	Reduced reproductive success	Bellrose (1976)

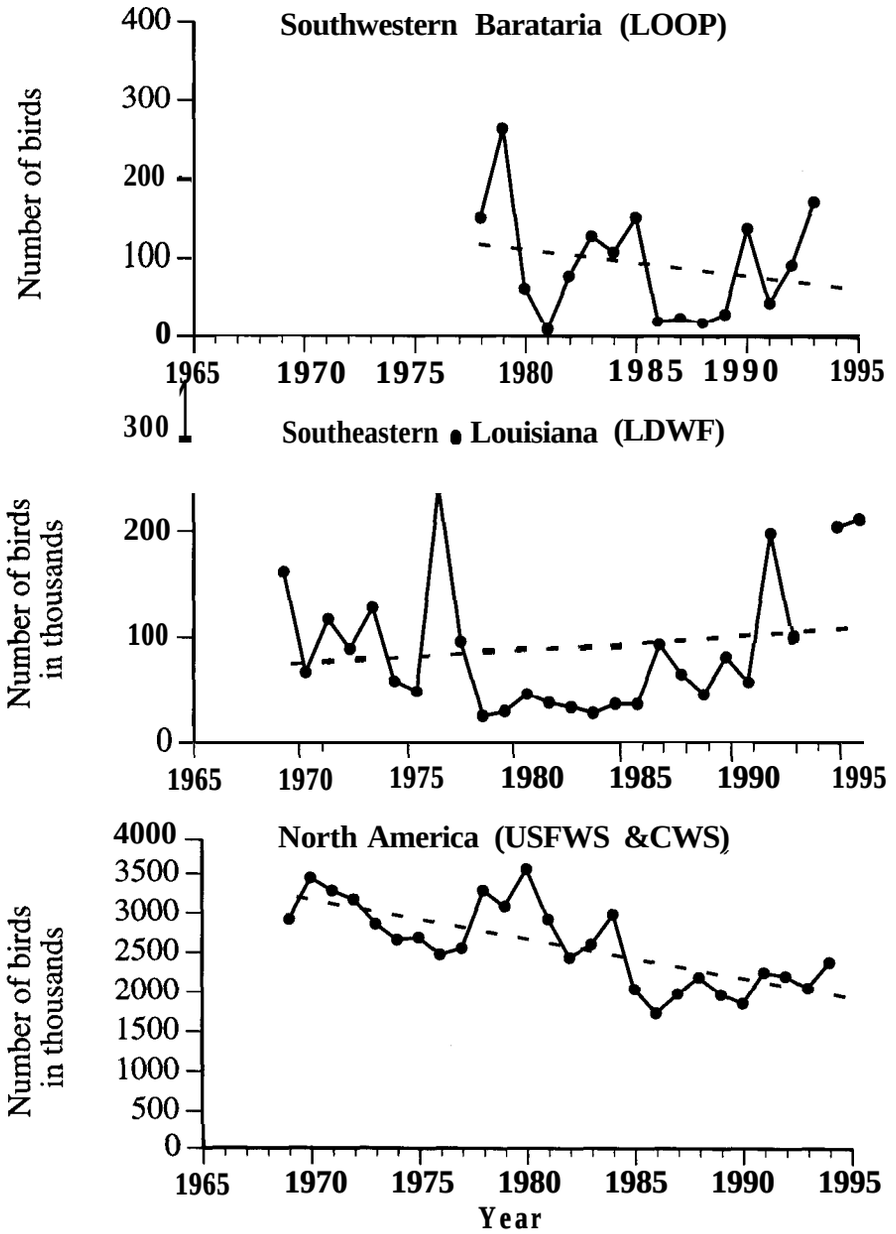

Figure 6.94. American Wigeon population trends. Dashed line represents the fitted linear regression, however only the trend for the North American breeding population is significant.

Habitat Requirements

- American Wigeons graze mostly on submerged aquatics. When these are absent seeds of grasses, smartweed, and buttonbush are eaten. More recently American Wigeon have been observed using waste corn, pasture grass, and green cultivated crops (Bellrose 1976).

- Within southwestern Barataria basin American Wigeon were found in greatest densities in the brackish (0.026 birds per ha) marshes, and were rarely observed in the fresh (0.007 birds per ha) and saline (0.003 birds per ha) marshes (data analysis modified from Visser et al. 1994).

Northern Shoveler
Anas clypeata

Status

- The North American breeding population consisted of 2,912,000 birds in 1994 (USFWS and CWS 1994).

- Within western Barataria basin an average of 1.96 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The North American breeding population has been stable over the last 40 years (USFWS and CWS 1994). However, the population has been increasing in the last couple of years.

- LDWF surveys showed no significant trend (Figure 6.95). However, the wintering population was extremely low during the 1980s and has been increasing in the last five years.

- LOOP surveys observed an increasing trend in the last 15 years in southwestern Barataria (Figure 6.95).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Skunk predation	Reduced reproductive success	Bellrose (1976)

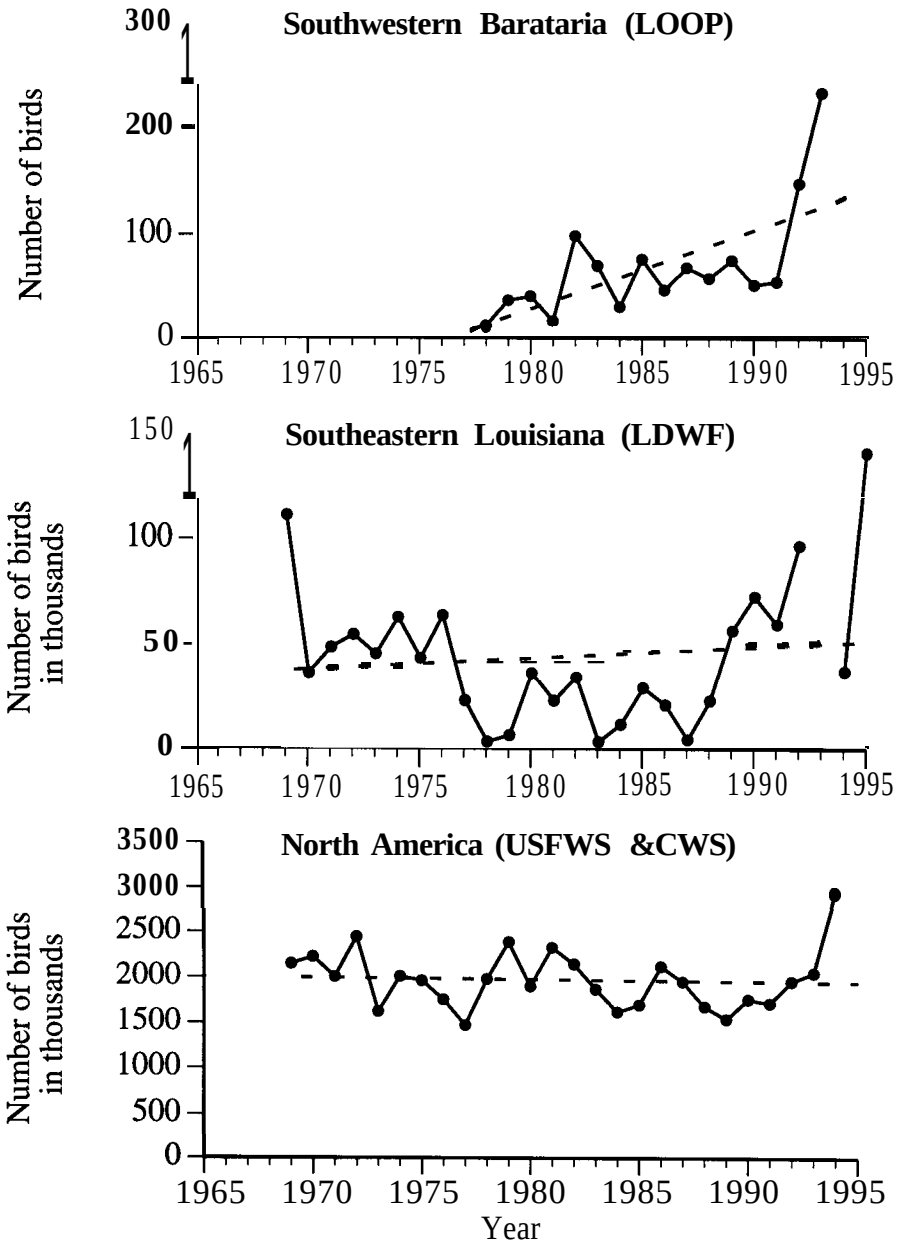

Figure 6.95. Northern Shoveler population trends. Dashed line represents the fitted linear regression, however only the trend for the wintering population in southwestern Barataria is significant.

Habitat Requirements

- Northern Shovelers feed in both deep and shallow water. In deep water they feed on the surface on plankton. In shallow water they feed mostly on seeds from a variety of freshwater grasses and sedges, smartweed (*Polygonum* sp.), and submerged aquatics (Bellrose 1976).

- Within southwestern Barataria basin Northern Shovelers were found in greatest densities in the brackish (0.020 birds per ha) marshes, and were rarely observed in the fresh (0.002 birds per ha) and saline (0.003 birds per ha) marshes (data analysis modified from Visser et al. 1994).

Gadwall
Anas strepera

Status

- The North American breeding population consisted of 2,318,300 birds in 1994 (USFWS and CWS 1994).

- Within western Barataria basin an average of 46.84 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The North American breeding population has significantly increased over the last 40 years (USFWS and CWS 1994). However, most of this increase occurred between 1955 and 1965, since 1970 the population has been relatively stable, except for the slight increase during the last five years (Figure 6.96).

- LDWF surveys showed no significant trend (Figure 6.96). However, the wintering population was low during the 1980s and has been increasing in the last five years.

- LOOP surveys observed an increasing trend in the last 15 years in southwestern Barataria (Figure 6.96), with most of the increase occurring in the early 1990s, similar to the Southeast Louisiana and national trends.

- BBS indicates a significant annual continental increase of 3.9%, 1966–1993 (Peterjohn et al. 1994).

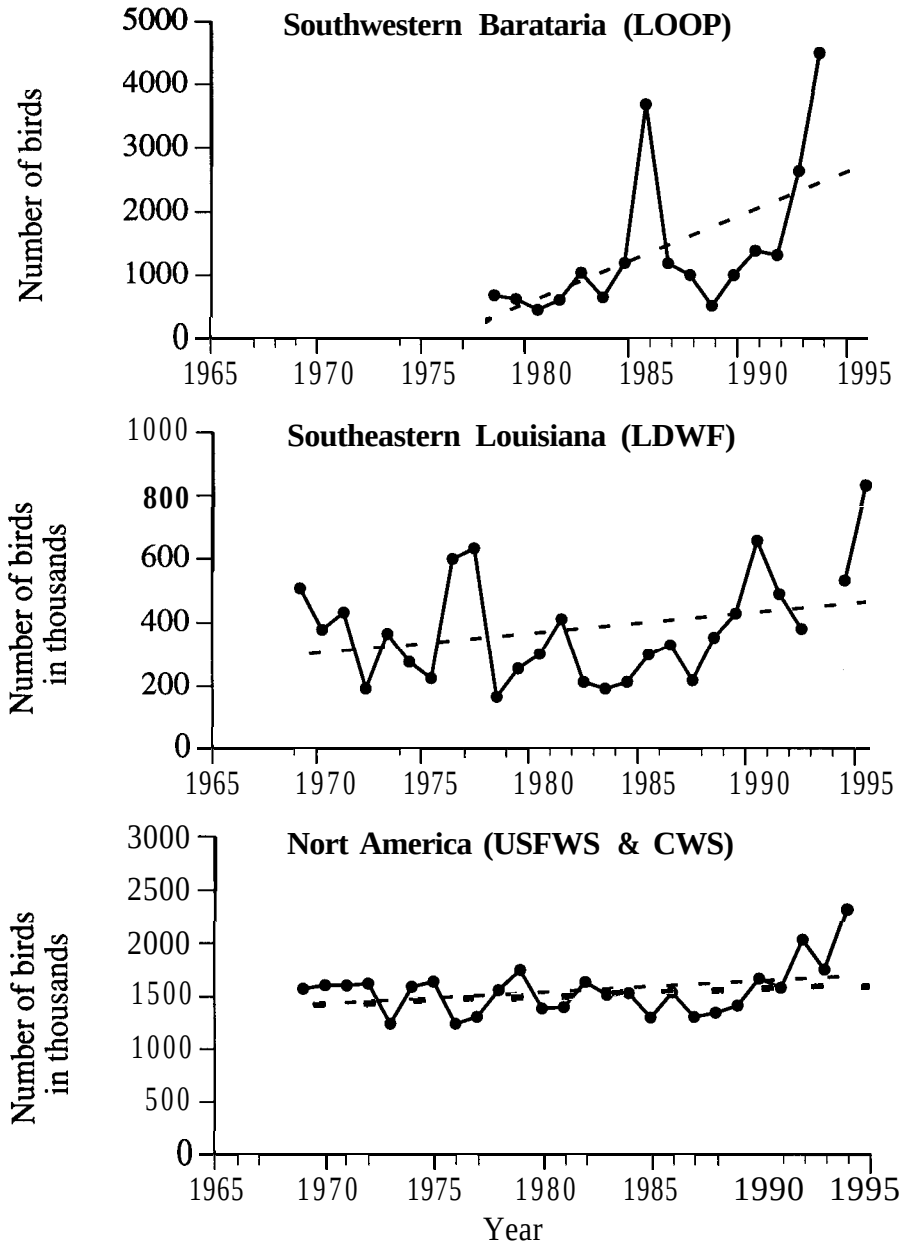

Figure **6.96.** Gadwall population trends. Dashed line represents the fitted linear regression, however only the trend for the wintering population in southwestern Barataria is significant.

Causes of Change

Cause	Effect	Source
Predation	Reduced reproductive success	Bellrose (1976)

Habitat Requirements

- Three-fourths of the North American population winters or travels through Louisiana.
- Gadwalls graze mostly on submerged aquatics and filamentous algae. When these are absent seeds of grasses, smartweed, and buttonbush are eaten (Bellrose 1976).
- Within southwestern Barataria basin Gadwall were found in greatest densities in the brackish (0.390 birds per ha) marshes, and were less frequently observed in the fresh (0.059 birds per ha) and saline (0.056 birds per ha) marshes (data analysis modified from Visser et al. 1994).

Mottled Duck
Anas fulvigula

Status

- The Louisiana population consisted of 75,000 birds in January 1995 (LDWF 1995).
- Within western Barataria basin an average of 0.97 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- LDWF surveys showed a slightly increasing trend over the last 25 years (Figure 6.97).
- LOOP surveys observed significant increase in the last 15 years in southwestern Barataria (Figure 6.97).
- BBS indicates a significant annual continental decline of 6.2%, 1966–1993 (Peterjohn et al. 1994).

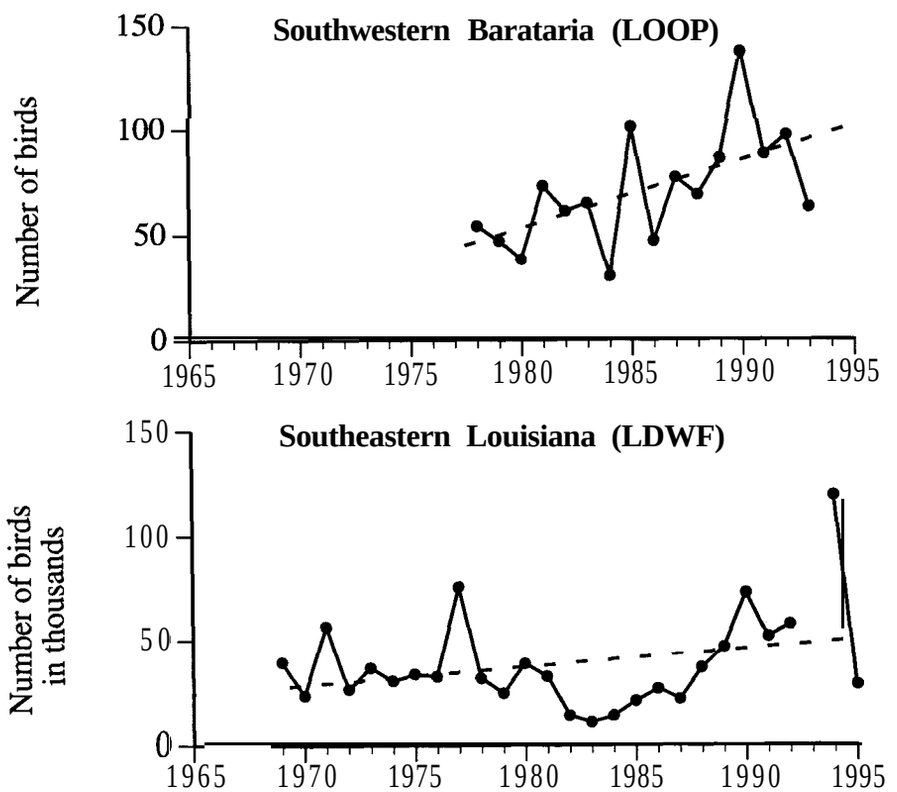

Figure 6.97. Mottled Duck population trends. Dashed line represents the fitted linear regression, however only the trend for the wintering population in southwestern Barataria is significant.

Causes of Change

Cause	Effect	Source
Raccoon predation	Reduced reproductive success	Bellrose (1976)
Extension of breeding range	Increased population	Bellrose (1976)
Habitat improvement	Increased population	Bellrose (1976)

Habitat Requirements

- Mottled Ducks are the only resident waterfowl species in the coastal marshes of Louisiana.

- Food of the Mottled Duck consists of half vegetable matter and half animal matter. The vegetable matter consists mostly of seeds from grasses, sedges, and submerged aquatics, while the animal matter consists mostly of insects, fish, snails, and crawfish (Bellrose 1976).

- Within southwestern Barataria basin Mottled Ducks were found in greatest densities in the fresh (0.012 birds per ha) and brackish (0.014 birds per ha) marshes, and were less frequently observed in the saline (0.003 birds per ha) marshes (data analysis modified from Visser et al. 1994).

- Ducklings only survive when raised in water with a salinity less than 9 ppt. (Moorman et al. 1991)

Wood Duck
Aix sponsa

Status

- The United States population was estimated at 2,728,365 birds between 1980 and 1985 (Bellrose and Holm 1994).

- The Louisiana population was estimated at 134,346 birds between 1980 and 1985 (Bellrose and Holm 1994).

Trends

- The North American Wood Duck harvest has significantly increased over the last 30 years. However, most of this increase occurred in the 1970s and in the last ten years the population has stabilized. The population is currently constrained by the availability and quality of habitat (Bellrose and Holm 1994).

- The Louisiana Wood Duck harvest has significantly increased between 1959 and 1987 (Bellrose and Holm 1994).

- BBS indicates a significant continental increase of 6.3%/yr, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Increasing cavity density	Increased nest success	Bellrose and Holm (1994)
Predation by snakes	Reduced nest success	Bellrose and Holm (1994)
Predation by raccoons	Reduced nest success	Bellrose and Holm (1994)
Competition for nest cavities with squirrels and raccoons	Reduced nest success	Bellrose and Holm (1994)
Lead poisoning	Death of adults	Bellrose and Holm (1994)
Parasites and disease through predation	Death of adults	Bellrose and Holm (1994)

Habitat Requirements

- The swamp forests and bottomland hardwood forests of Barataria and Terrebonne basins have medium densities of breeding Wood Ducks and this is the most important habitat type for this species especially when located along streams (Bellrose and Holm 1994).

- Within the breeding range availability of suitable nesting cavities is often the limiting factor on population size (Bellrose and Holm 1994).

- Within Louisiana the food of the Wood Duck consists primarily of acorns, augmented by seeds of pecans and snowbell as well as duckweed. Animal matter accounted for only 0.5% of the food ingested. However, ducklings require animal food which consists mostly of insects (Bellrose and Holm 1994).

- Sixty-two percent of the Wood Duck harvested in Louisiana are migratory ducks (Bellrose and Holm 1994).

Species Recommendations

- Cypress swamps do not become suitable for nesting until they are at least 60 years old. This is the age at which trees become large enough to provide suitable size nesting cavities (Bellrose and Holm 1994). Therefore preservation of forests suitable for Wood Duck nesting should be encouraged. Most cypress swamps within the BTES are this age since most harvesting occurred in the early part of this century. Younger forests can be restored for Wood Duck use through the use of artificial nest cavities (nest boxes).

Lesser Scaup and Greater Scaup
Aythya affinis and *Aythya marila*

Status

- The North American breeding population consisted of 4,529,000 birds in 1994 (USFWS and CWS 1994).

- Within western Barataria basin an average of 1.63 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The North American breeding population has been stable over the last 40 years (USFWS and CWS 1994), although a slight decreasing trend was observed in the last 25 years (Figure 6.98).

- LDWF surveys showed no significant trend (Figure 6.98).

- LOOP surveys observed no significant trend (Figure 6.98).

- BBS indicates no significant continental trend for Lesser Scaup, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Skunk predation	Reduced reproductive success	Bellrose (1976)

Habitat Requirements

- More than half of the North American Scaup winter in Louisiana. They concentrate in Lake Pontchartrain, Lake Borgne, coastal bays, and the open waters of the Gulf of Mexico (Bellrose 1976).

- Scaup feed on clams, snails, and crabs, when feeding off the Louisiana coast. Inland they consume fish, crustaceans, plant parts, and seeds (Bellrose 1976).

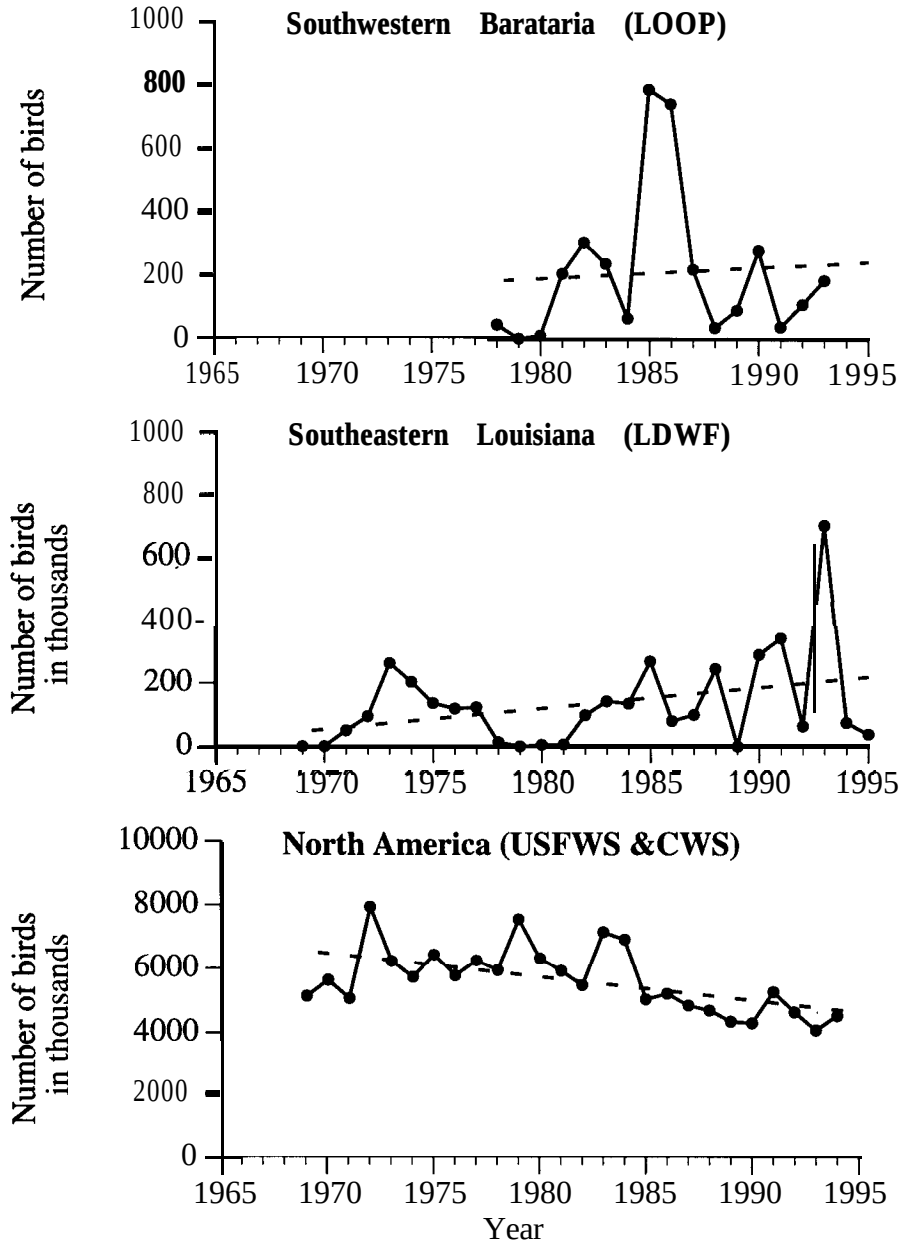

Figure 6.98. Lesser and Greater Scaup population trends. Dashed line represents the fitted linear regression, however none of the population trends is significant .

- Within southwestern Barataria basin Scaup were found in greatest densities in the fresh (0.022 birds per ha) and brackish (0.024 birds per ha) marshes, and were less frequently observed in the saline (0.007 birds per ha) marshes (data analysis modified from Visser et al. 1994).

Ring-necked Duck
Aythya collaris

Status

- The Louisiana wintering population consisted of 88,000 birds in January 1995. Of these, only 10,000 wintered in southeastern Louisiana (LDWF unpublished data).

- Within western Barataria basin an average of 0.01 birds per 100 ha were observed wintering in 1992-93 (Visser et al. 1994).

Trends

- LDWF surveys showed a small increase over the last 25 years (Figure 6.99). However this was caused by the extremely large populations in the late 1980s which might have been caused by the relatively cold winters in these years. During cold winters a larger fraction of the population migrates south than during mild winters.

- LOOP surveys showed no significant trend (Figure 6.99).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Severe weather at breeding grounds	Reduced reproduction	Bellrose (1976)
Favorable hunting conditions	Decreasing population	Bellrose (1976)
Predation	Reduced reproduction	Bellrose (1976)

Habitat Requirements

- Almost one quarter of the continental Ring-necked Duck population winters in Louisiana (Bellrose 1976).

- Food of the Ring-necked Duck consists mostly of seeds from submerged aquatics, sedges, and smartweed. However leafy structures of submerged aquatics and

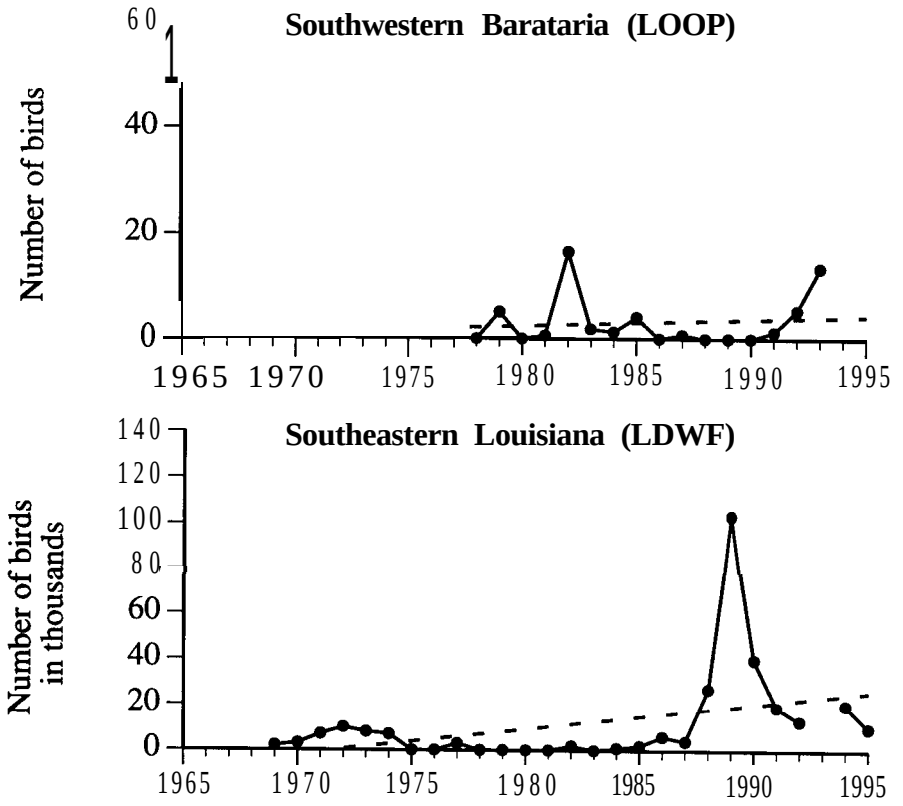

Figure 6.99. Ring-necked Duck population trends. Dashed line represents the fitted linear regression, however none of the population trends is significant.

duckweed as well as snails, clams, and insects are also used (Bellrose 1976). Feeding occurs most frequently in shallow (< 2 m deep) water.

- Within southwestern Barataria basin Ring-necked Ducks were found in greatest densities in the fresh marsh (0.004 birds per ha), followed by saline marsh (0.003 birds per ha), and were infrequently observed in the brackish marsh (data analysis modified from Visser et al. 1994).

Hooded Merganser
Lophodytes cucullatus

Status

- The North American breeding population averaged 120,000[1] birds between 1970 and 1979 (USFWS 1994).

- Within western Barataria basin an average of 0.37 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- LOOP surveys observed a significant increase in the wintering population in the last 15 years (Figure 6.100).

- BBS indicates a significant annual continental increase of 6.1%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Drainage of swamps	Population decrease	Bellrose (1976)

Habitat Requirements

- Hooded Mergansers feed on small fish, crustaceans, aquatic insects, insect larvae, and clams (Bellrose 1976).

[1] Data were reported for all Mergansers as 1,500,000 birds. We used Bellrose's (1976) estimate that 8% of all Mergansers are Hooded Mergansers to arrive at the 120,000 bird number.

- Within southwestern Barataria basin Hooded Mergansers were found in greatest densities in the saline (0.0018 birds per ha) marsh followed by the brackish

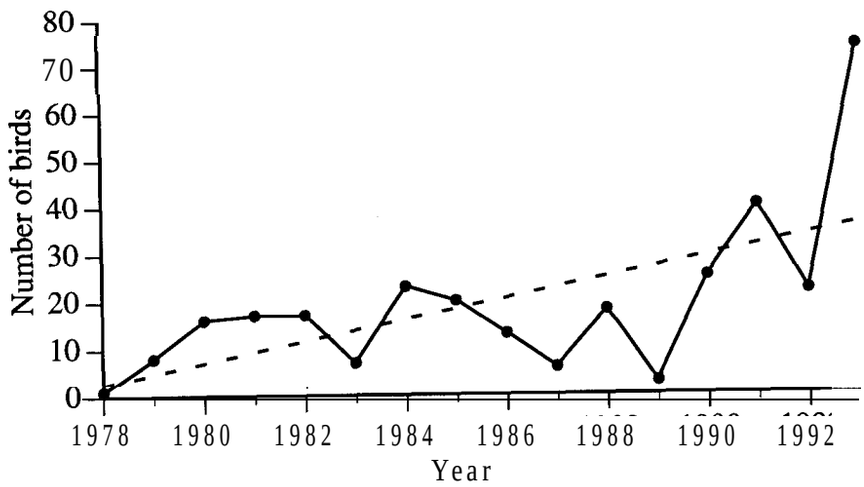

Figure 6.100. Hooded Merganser wintering population in southwestern Barataria. Dashed line represents the fitted linear regression.

(0.0004 birds per ha) marshes, and were rarely observed in the fresh marshes (data analysis modified from Visser et al. 1994). They are generally found in intermediate-size water bodies (i.e., Lake Jesse and South Lake).

Red-breasted Merganser
Mergus serrator

Status

- The North American breeding population averaged 372,600[1] birds between 1970 and 1979 (USFWS 1994).

- Within western Barataria basin an average of 0.63 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- LOOP surveys observed a significant increase in the wintering population in the last 15 years (Figure 6.101).

- BBS indicates a significant annual continental decline of 5.7%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

- Red-breasted Mergansers feed on small fish and crustaceans (Bellrose 1976).

- Within southwestern Barataria basin Red-Breasted Mergansers were found in greatest densities in the saline (0.0037 birds per ha) marsh followed by the brackish (0.0017 birds per ha) marshes, and were infrequently observed in the fresh (0.0007 birds per ha) marshes (data analysis modified from Visser et al. 1994). They are generally found in intermediate-size water bodies (i.e., Lake Jesse and South Lake).

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[1] Data were reported for all Mergansers as 1,500,000 birds. We used Bellrose's (1976) estimate that 25% of all Mergansers are Red-breasted Mergansers to arrive at the 372,600 bird number.

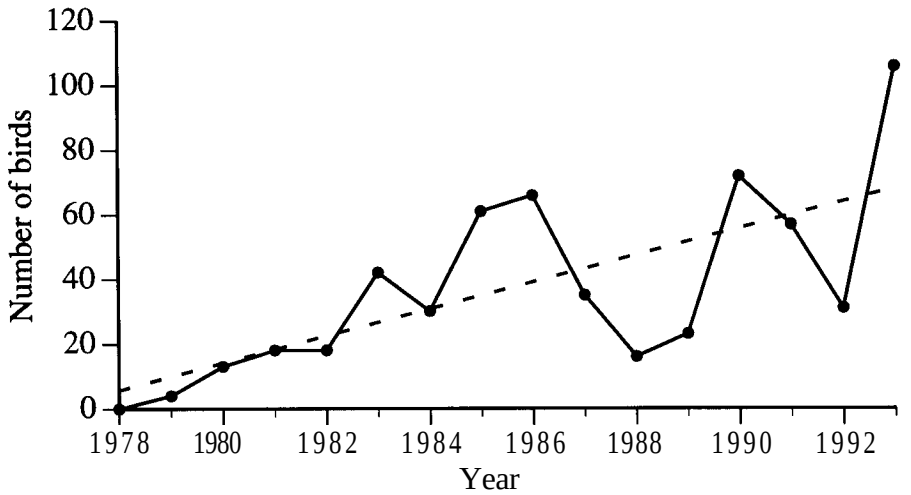

Figure 6.101. Red-breasted Merganser wintering population in southwestern Barataria. Dashed line represents the fitted linear regression.

OTHER WETLAND BIRDS

Anhinga
Anhinga anhinga

Status[1]

- Louisiana had 245 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average population of 2,622 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).
- The United States had an average population of 4,459 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- The Louisiana nesting population is stable (Martin and Lester 1991).
- New Orleans Christmas bird counts (NOCBCs) show increasing wintering populations (Purrington 1995b).

Habitat Requirements

- Anhingas nest in fresh marshes and swamps in Louisiana (Portnoy 1977).
- Anhingas have been found breeding (but are not restricted to) in the following wading-bird colonies within the BTES: B-078, B-085, B-086, B-102, B-105, B-106, B-110, B-113, B-116, B-118, C-009, C-010, and C-012 (see Figure 3.12 and Martin and Lester 1991).
- Anhingas feed mostly on small freshwater fish but aquatic insects, crayfish, frogs, snakes, and young alligators are also taken (Terres 1980).

Species Recommendations

Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and restriction of human activities in and near the colony to July 1 through March 1.

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[1] The following are probably all severe underestimates, since most Anhingas nest in freshwater areas, which were not all included in these coastal surveys.

Double-crested Cormorant
Phalacrocorax auritus

Status

- The United States had an average population of 59,534 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).
- Within western Barataria basin an average of 2.59 birds per 100 ha were observed wintering in 1992–93 (data analysis modified from Visser et al. 1994).

Trends

- The U.S. breeding population is increasing (Spendelow and Patton 1988).
- The Canadian breeding population is increasing (Weseloh and Ewins 1994).
- The LOOP corridor in western Barataria basin contains an increasing wintering population (Figure 6.102).
- NOCBCs show dramatically increasing wintering populations (Purrington 1995b).
- BBS indicates a significant annual continental increase of 5.5%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
DDE	Decreasing population	Weseloh and Ewins (1994)
Human persecution	Decreasing population	Weseloh and Ewins (1994)
Increasing prey near breeding sites	Increasing population	Weseloh and Ewins (1994)
Feeding at catfish farms	Increased winter survival	Weseloh and Ewins (1994)
Use of irrigation reservoirs for breeding and feeding	Increasing population	Findholt (1988)

Habitat Requirements

- Double-crested Cormorants rarely nest within southern Louisiana.

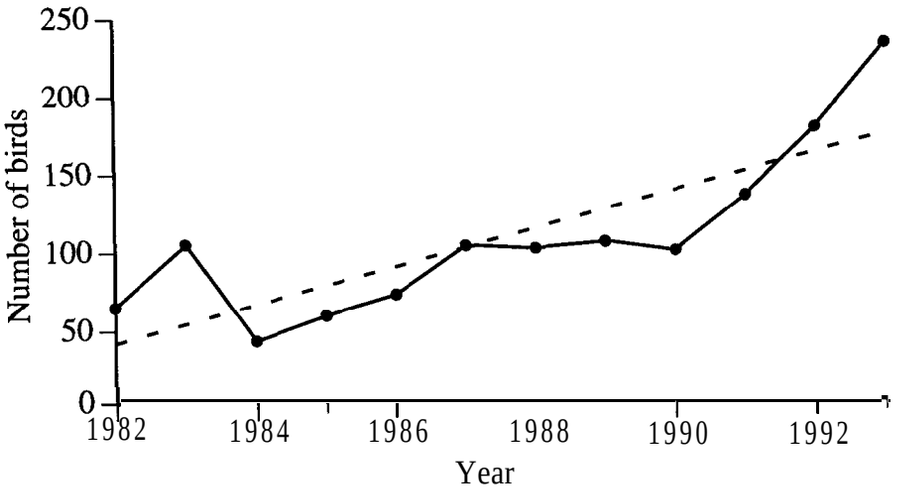

Figure 6.102. Double-crested Cormorant wintering population in southwestern Barataria. Dashed line represents the fitted linear regression.

- Double-crested Cormorants feed mostly on small fish but crustaceans, amphibians, reptiles, and mollusks are also taken (Terres 1980).

- Within southwestern Barataria basin Double-crested Cormorants were found in greatest densities in the fresh (0.020 birds per ha) marshes, and were less frequently observed in the brackish (0.011 birds per ha) and saline (0.009 birds per ha) marshes (data analysis modified from Visser et al. 1994).

Species Recommendations

Double-crested Cormorants rarely nest within the BTES, and management should be for wintering habitat.

American White Pelican
Pelicanus erythrorhynchos

Status

- National Audubon Society Blue List

- The United States had an average population of 44,598 breeding adults between 1979 and 1981 (Spendelow and Patton 1988).

- Within western Barataria basin an average of 11.88 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The LOOP corridor in western Barataria basin contains a stable wintering population (Figure 6.103).

- BBS indicates a significant annual continental increase of 3.1% 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Human persecution	Decreasing population	Terres (1980)
Insecticides	Decreasing population	Terres (1980)

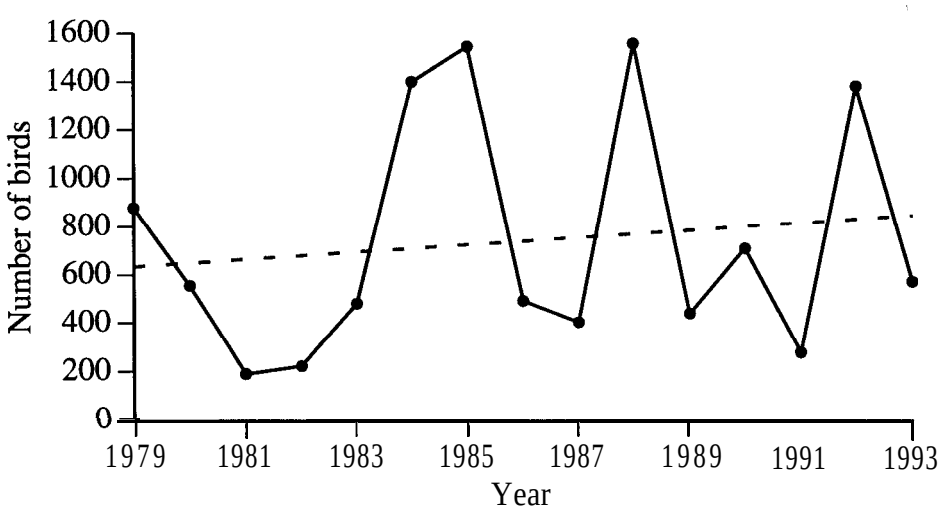

Figure 6.103. White Pelican wintering population in southwestern Barataria. Dashed line represents the fitted linear regression, although this trend is not significant.

Habitat Requirements

- White Pelicans do not nest within southern Louisiana, but large breeding colonies exist in Texas.
- White Pelicans feed mostly on small fish, but crayfish and salamander are also taken (Terres 1980).
- Within southwestern Barataria basin White Pelicans were found in greatest densities in the brackish (0.120 birds per ha) and saline (0.097 birds per ha) marshes, and were less frequently observed in the fresh (0.030 birds per ha) marshes (data analysis modified from Visser et al. 1994).

Yellow-crowned Night-Heron
Nycticorax violaceus

Status[1]

- The BTES contained 325 breeding birds in 1994 (Carloss 1995).
- Louisiana had 141 breeding adults in 1990 (Martin and Lester 1991).
- The Gulf Coast had an average of 273 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).
- Eastern United States had an average of 1,881 breeding adults between 1976 and 1982 (Spendelow and Patton 1988).

Trends

- Louisiana has a stable nesting population (Martin and Lester 1991).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

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[1] These are minimal estimates since Yellow-crowned Night Herons mostly nest within small colonies scattered throughout the swamp forest and along spoil banks (Portnoy 1977). Not all of these colonies were surveyed during these surveys of coastal wading birds.

Habitat Requirements

- Yellow-crowned Night-Herons mainly nest in small scattered colonies within the swamp forest, but they were also found in fresh marsh shrub and spoil bank colonies (Portnoy 1977).

- The diet of the Yellow-crowned Night-Heron consists mostly of crustaceans such as fiddler crabs and crayfish, but fish, amphibians, and insects are also eaten (Hankock and Kushlan 1984).

Species Recommendations

Martin and Lester (1991) recommend a buffer zone of 300 m around colonies and no activities in or near the colony between March 15 and September 1.

Least Bittern
Isobrychus exilis

Trends

BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

- The Least Bittern is a summer resident in Louisiana and its habitat consists of densely vegetated fresh marshes containing some shrubs (Hankock and Kushlan 1984).

- The Least Bittern feeds mostly on small fish, but crustaceans, amphibians, small mammals, and insects are also taken (Hankock and Kushlan 1984). Nests in intermediate and brackish marsh.

American Bittern
Botaurus lentiginosus

Trends

- It is generally agreed that American Bittern numbers have significantly decreased in the United States since the 1960s (Purrington 1995b).

- BBS indicates a significant annual continental decline of 3.3%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

- The American Bittern uses fresh to brackish marshes with tall vegetation such as cattails and bullrushes (Hankock and Kushlan 1984). However, there are no records of this species breeding in southeastern Louisiana (Purrington 1995b).

- The American Bittern feeds mostly on fish, but crustaceans, amphibians, insects, small mammals, and snakes are also taken (Hankock and Kushlan 1984).

American Coot
Fulica americana

Status

- Louisiana had an estimated population of 1,117,000 wintering adults in 1994 (LDWF 1995).

- Southeastern Louisiana had an estimated population of 800,000 wintering adults in 1994 (LDWF 1995).

- Within western Barataria basin an average of 25.16 birds per 100 ha were observed wintering in 1992–93 (Visser et al. 1994).

Trends

- The North American population of breeding American Coots has been stable, but the number of breeding American Coots has recently increased in British Columbia (Lang 1991).

- The LOOP corridor in western Barataria basin contains a significantly increasing wintering population (Figure 6.104).

- LDWF records show a slight decrease in the population (Figure 6.104).

- NOCBCs show increasing wintering populations since the mid 1960s (Purrington 1995b).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

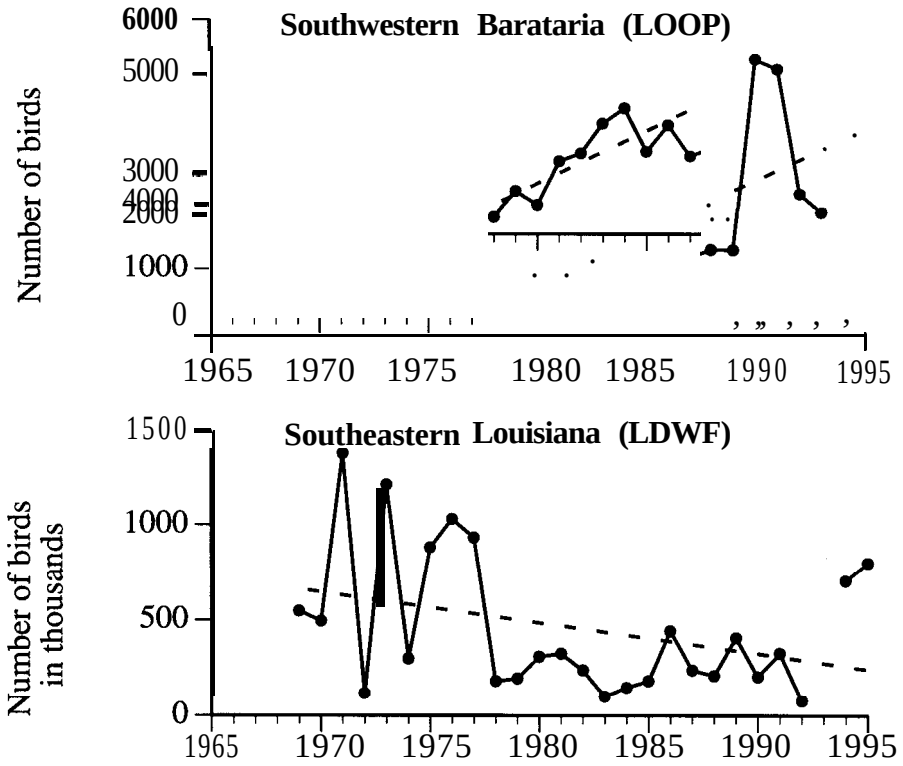

Figure 6.104. American Coot population trends. Dashed line represents the fitted linear regressions, however only the trend for the southwestern Barataria wintering population is significant.

Causes of Change

Cause	Effect	Source
Drought at breeding sites	Decreasing population	Sutherland (1991)
Late freezes at breeding sites	Death of adults	Terres (1980)

Habitat Requirements

- American Coots mostly graze on submerged aquatic vegetation, but small fish, tadpoles, snails, and aquatic insects are also taken (Terres 1980).

- Within southwestern Barataria basin American Coots were found in greatest densities in the fresh (0.458 birds per ha) marshes, and were less frequently observed in the brackish (0.114 birds per ha) and saline (0.004 birds per ha) marshes (data analysis modified from Visser et al. 1994).

Common Moorhen
Gallinula chloropus

Status

Within western Barataria basin an average of 0.034 birds per 100 ha were observed wintering in 1992–93 (data analysis modified from Visser et al. 1994).

Trends

- The LOOP corridor in western Barataria basin contains a stable wintering population (Figure 6.105).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

- Common Moorhens nest within the fresh marshes of the BTES. The nest is placed in thick vegetation, either a few inches above the water or sometimes floating on it (Lowery 1974).

- Common Moorhens mostly graze on aquatic vegetation, but snails and insects are also taken (Terres 1980).

- Within southwestern Barataria basin Common Moorhens were found in greatest densities in the fresh (0.0057 birds per ha) marshes, and were less frequently

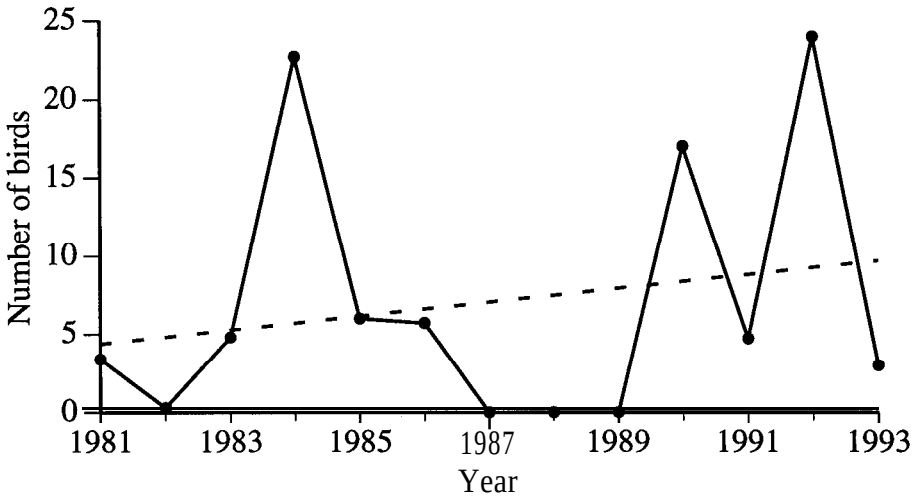

Figure 6.105. Common Moorhen wintering population in southwestern Barataria. Dashed line represents the fitted linear regression, although this trend is not significant.

observed in the brackish (0.0002 birds per ha) and saline (0.0002 birds per ha) marshes (data analysis modified from Visser et al. 1994).

Belted Kingfisher
Ceryle alcyon

Status

- Common in the BTES in winter; may breed in BTES (Muth 1995).
- One of the most widespread North American land birds (Hamas 1994).

Trends

- BBS suggest an annual continental decline of 1.1% for 1982–1992 and a stable population 1969–1979 (Hamas 1994).

Habitat Requirements

Banks of water bodies where the surface is unobstructed by vegetation and prey are visible. Requires earthen banks to excavate for nesting (Hamas 1994).

Species Recommendations

- Continued enforcement of migratory bird laws to prevent shooting (Hamas 1994).
- Nontoxic removal of water hyacinth could increase food supply and foraging habitat.

Fish Crow
Corvus ossifragus

Status

Common to abundant BTES resident (Purrington 1995b).

Trends

- NOCBCs have undergone a 10-fold increase since the early 1960s but this trend should not be extrapolated to the BTES (Purrington 1995b).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Coastal marshes, farmlands, bayou sides, rivers, islands, dumps, waterbird colonies (Lowery 1974b, Farrand 1983).

Seaside Sparrow
Ammodramus maritimus

Status

- Common to very common resident (Purrington 1995b).
- A maritime wetland specialist.
- Indicator species for the ecological integrity of certain types of coastal marshes.
- A migratory nongame bird of management concern (Post and Greenlaw 1994).

Trends

- In Florida, one subspecies has become extinct and another is in danger of becoming extinct.
- East Coast subpopulations are becoming increasingly isolated. Local declines are expected to result in regional extirpation along Florida's Atlantic coast (Post and Greenlaw 1994).
- BBS indicates a significant annual continental increase of 2.6%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

- Within suitable marsh habitat populations are negatively affected by flooding associated with storms and hurricanes and by marsh fires.
- Loss of suitable marsh habitat through filling, draining, diking, and pollution adversely affects local population (Post and Greenlaw 1994).

Habitat Requirements

- Salt and brackish tidal marshes with nesting sites above high tides and openings in vegetation for foraging. Eats seeds, insects, spiders, mollusks, amphipods, decapods, and marine worms (Post and Greenlaw 1994).

Species Recommendations

Habitat protection and enhancement (Post and Greenlaw 1994).

RAPTORS

Bald Eagle
Haliautus leucocephalus

Status

- Rare BTES breeding bird; rare to casual winter visitor.
- At least six active Bald Eagle nests in southeastern Louisiana (Purrington 1995b).
- According to the 1993–1994 LDWF surveys, there are 132 nesting territories in Louisiana, in which there were 90 active nests.
- Formerly listed as endangered in the lower 48 states except Washington, Oregon, Minnesota, Wisconsin, and Michigan, where it is listed as threatened. Not at risk in Alaska and Canada (U.S. Fish and Wildlife Service 1995a).
- Officially downlisted to threatened in the lower 48 states in June 1995.

Trends

- Formerly a common resident over most of Louisiana in the early 1900s, especially near water bodies in south Louisiana (Dugoni 1975).
- Apparently much less abundant in Louisiana than formerly (Lowery 1974b).
- BBS indicates a significant annual continental increase of 9.9%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Early declines due to pesticides, poisoning, illegal take, habitat destruction, and human disturbance (Dugoni 1975). Recovery due to protection under Endangered Species Act.

Habitat Requirements

Nests in the top of tall trees near shores. Seldom found far from water. Eats mainly fish. Will consume carrion (Lowery 1974b). In Louisiana, catfish and coots make up the bulk of the eagle's diet, but it will also consume waterfowl, nutria, turtles, and road kills (Dugoni 1975).

Species Recommendations

- Preserve, restore, enhance, and acquire nesting habitats.
- Protect nesting sites from human disturbance.
- Continue to reduce influx of toxins into habitat.

Northern Harrier
Cicus cyaneus

Status

Common in winter (Purrington 1995b).

Trends

- Numbers have been very nearly constant over the past 30 years in southeast Louisiana, and by inference in the BTES (Purrington 1995a).
- BBS indicates a significant annual continental decline of 1.0%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Marshes, fields, grasslands. Preys on a variety of animals (Farrand 1983).

Cooper's Hawk
Accipiter cooperii

Status

- Quite uncommon within the basin in winter (Purrington 1995b); breeds sparingly in southeast Louisiana and the BTES, but is very scarce (Purrington 1995a).

- Listed as threatened or endangered in several eastern states (Rosenfield and Bielefeldt 1993).

Trends

- Recent modest increase in southeast Louisiana is quite real (Purrington 1995a).
- As eastern U.S. breeding populations declined, became scarce in the BTES. In recent years, there has been a definite, modest increase (Purrington 1995b).
- Stable and common in western United States.
- In mid 1900s some eastern populations had significant declines.
- Breeding populations showing signs of local recovery in some areas (Rosenfield and Bielefeldt 1993).
- BBS indicates a significant annual continental increase of 7.2%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Previously shot	Local population declines	Rosenfield and Bielefeldt (1993)
Organochlorine pesticides (especially DDT)	Declines in reproductive success and possible migration counts	Rosenfield and Bielefeldt (1993)
Banning of DDT	Increased reproductive success	Hawes (1995)

Habitat Requirements

Breeds throughout much of the United States, southern Canada, and northern Mexico in extensive forests and smaller woodlots of deciduous, coniferous, and mixed pine–hardwoods. Also breeds in pine plantations and suburban areas. Mainly feeds on medium size birds and rodent size mammals (Rosenfield and Bielefeldt 1993).

Species Recommendations

- Continued concern for long-term effects of pesticides (Rosenfield and Bielefeldt 1993).
- Continued public education and enforcement of conservation measures.

Red-shouldered Hawk
Buteo lineatus

Status

- Common resident of basin (Purrington 1995b)
- Listed as endangered, threatened, rare, or of special concern in several northern states (Crocoll 1994)

Trends

- NOCBCs essentially constant since the 1950s, at about 0.5 individuals counted per hour (Purrington 1995b).
- Local, once common to abundant, populations have apparently declined in the northern U.S. during the last 200 years.
- Significant decline between 1946 and 1986 in migratory counts (Crocoll 1994)
- BBS indicates a significant continental increase of 2.4%/yr, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Deforestation	Loss of habitat	Crocoll (1994)
Intraspecies competition for nesting sites in altered forests	May be being replaced by Red-tailed Hawk	Crocoll (1994)
Human removal of nesting young for falconry	Local population reduction	Crocoll (1994)

Habitat Requirements

Large areas of contiguous forests are believed to be ideal breeding habitat. Division of forests into smaller plots or creating small openings allows certain hawks and owls to outcompete the Red-shouldered Hawk for nesting sites (Crocoll 1994).

Red-tailed Hawk
Buteo jamaicensis

Status

- Common in winter in the BTES; uncommon and local BTES breeder (Muth 1995).
- One of the commonest North American birds of prey (Preston and Bean 1993).

Trends

- Since 1960 NOCBCs have been essentially constant at about 0.6 birds counted per hour (Purrington 1995b).
- Generally increasing in North America. NOCBC data show a 33% increase between the early 1970s and 1980s (Preston and Bean 1993).
- BBS indicates a significant annual continental increase of 2.9%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Cause	Effect	Source
Deforestation in eastern U.S.	Increased habitat and food supply	Preston and Bean (1993)
Fire suppression in western U.S.	Increased habitat and food supply	Preston and Bean (1993)

Habitat Requirements

Open areas with elevated perch sites in a wide variety of altitudes and habitats. Diet consists mainly of a wide variety of small to medium sized mammals, birds and snakes (Preston and Bean 1993).

Species Recommendations

- Maintain suitable perch sites in current habitat.
- Continued public education efforts to prevent shooting.

- Rigorous enforcement of current conservation laws (Preston and Bean 1993).

Peregrine Falcon
Falco peregrinus

Status

- Uncommon to rare in winter in the BTES (Purrington 1995b).
- Listed as endangered by similarity of appearance to the American Peregrine Falcon (USFWS 1995b).

Trends

- The U.S. Fish and Wildlife Service is currently considering removal of the listing of the Peregrine Falcon as endangered by similarity of appearance because it is considering the removal of the subspecies (American Pelegrine Falcon) from the endangered and threatened list.
- Declined precipitously in North America from 1946 to the early 1970s.
- Has exhibited increases over much of its range from the mid 1970s to present (USFWS 1995b).

Causes of Change

Declines were due to exposure to organochlorine pesticides which caused egg shell thinning and reproductive failure. Recoveries were due to restrictions on the use of organochlorine pesticides in the U.S. and Canada and to the release of captive-reared young (USFWS 1995b).

Habitat Requirements

In Louisiana, only near the coast (Lowery 1974b). Feeds primarily on medium-sized birds. Nests outside of the BTES on ledges, small caves on cliffs, on river slopes, and occasionally in human-made structures in large cities. Frequents lakes, rivers, marshes, and coasts where prey is abundant (Farrand 1983).

Species Recommendations

Continued restriction of use of organochlorine pesticides.

American Kestrel
Falco sparverius

Status

Common in winter in the BTES; rare BTES breeder (Purrington 1995b).

Trends

- May have declined since the 1950s. NOCBCs essentially constant since 1960, at about 0.6 birds counted per hour (Purrington 1995b).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Widely distributed in forest openings, marshes, grasslands, desert, agricultural land, and suburban and urban areas. Eats insects and small birds and mice (Farrand 1983).

Barn Owl
Tyto alba

Status

- Uncommon BTES resident (Purrington 1995b).
- Most widespread of all owl species.
- Among the most widely distributed land birds.
- Listed as endangered in six midwestern states. Listed as a species of special concern in nine other states (Marti 1992).

Trends

- Probably expanded in size and abundance from 1700–1960s.
- Drastic decline in population in the midwestern U.S. in last 20 years (Marti 1992).
- BBS indicates a significant annual continental decline of 3.3%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

- Early increase associated with habitat created by European colonization of North America.
- Midwestern declines probably associated with changes in agriculture practices that include availability of prey and nesting sites.
- Pesticides cause eggshell thinning (Marti 1992).

Habitat Requirements

Grasslands, deserts, marshes, and agricultural fields. Nests in hollow trees, cavities in cliffs and riverbanks, human structures, and nest boxes. Feeds on small rodents (Marti 1992).

Species Recommendations

Provide nesting boxes or leave nesting sites (Marti 1992).

Barred Owl
Strix varia

Status

- Common to abundant BTES resident (Purrington 1995b).
- Commonest owl in Louisiana (Lowery 1974b).

Trends

BBS indicates a significant annual continental increase of 3.9%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Prefers wooded swamps and deep forests. In Louisiana expected resident in any "sizeable" wooded area. Prefers to nest in tree cavities. Eats rats, mice, other small mammals, birds, frogs and crayfish (Lowery 1974b, Farrand 1983).

SHOREBIRDS

Piping Plover
Charadrius melodus

Status

- Uncommon regular BTES migrant; uncommon to rare in winter in the BTES (Purrington 1995a).
- Never seen away from sand flats near the Gulf beach (Purrington 1995b).
- Listed as endangered in Canada and the U.S. Great Lakes, and as threatened elsewhere in the United States (Haig 1992).

Trends

- Considered stable in the BTES by birders over the last 10–20 years (Purrington 1995b).
- Atlantic population stable.
- Great Lakes population declining.
- Northern Great Plains population may be declining (Haig 1992).

Causes of Change

- Harassment of birds and nests by people, dogs, and vehicles.
- Destruction of beach habitat.
- Predation by dogs and cats introduced into formerly pristine beaches.
- Inappropriate water level regulation associated with nesting habitat (Haig 1992).

Habitat Requirements

Winters in the BTES on beaches, mudflats, sandflats, barrier islands, and spoil banks. Breeds outside the BTES in beaches, alkali wetlands, spoil banks, and islands. Feeds on invertebrates (Haig 1992). The BTES barrier islands and "sandy" headlands are extremely important wintering areas.

Species Recommendations

Study and preserve important BTES winter habitat requirements (Haig 1992).

Semipalmated Sandpiper
Calidris pusilla

Status

- Regular to common BTES migrant.
- Abundant (Grotto-Trevor 1992).

Trends

- Experienced a rapid decline in the late 1800s to 1916, then began recovery.
- Currently stable (Grotto-Trevor 1992).

Causes of Change

- Overharvest by market hunters caused early decline.
- Recovery the result of Migrator Bird Convention of 1916 (Grotto-Trevor 1992).

Habitat Requirements

Nests near water in low and subarctic tundra. Stays in sparsely or unvegetated shallow water areas. Winters in shallow lagoons and mud flats. Eats mainly fresh and saltwater benthic invertebrates (Grotto-Trevor 1992).

Western Sandpiper
Calidris mauri

Status

- Common to abundant in the BTES in winter (Purrington 1995b).
- One of the commonest shorebirds of the Western Hemisphere (Wilson 1994).

Causes of Change

Taken by market hunters until Migratory Bird Convention in 1916 and Act in 1918 (Wilson 1994).

Habitat Requirements

Breeds in subarctic and low Arctic from coast to uplands where there is a proximity of elevated nesting areas to wetlands. Migratory stopovers in intertidal mudflats and the margins of lakes and ponds. Winters in coastal areas. Eats crustaceans, insects, and mollusks (Wilson 1994).

Species Recommendations

Protect wintering areas from loss, degradation, human disturbance, and oil spills (Wilson 1994).

Common Snipe
Gallinago gallinago

Status

Fairly common in winter in the BTES (Purrington 1995b).

Trends

- Not as common as formerly. NOCBCs have increased after a minimum in the early 1970s (Purrington 1995b).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Marshes, grassy meadows, and lakeshores (Lowery 1974b).

American Woodcock
Scolopax minor

Status

- Uncommon to locally common in winter in the BTES (Purrington 1995b).

- Widely distributed in eastern North America.
- Popular game bird (Keppie and Whiting, Jr. 1994).

Trends

- Generally declining.
- Locally increasing.
- Range may be expanding northward and westward (Keppie and Whiting, Jr. 1994).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

- Loss of habitat responsible for declining abundance.
- Habitat enhancement/creation responsible for local increases.
- Accumulation of pesticides and herbicides sprayed into forest habitats may be causing declines in reproductive success (Keppie and Whiting, Jr. 1994).

Habitat Requirements

Open forests and old fields. Eats mainly earthworms (Keppie and Whiting, Jr. 1994).

Species Recommendations

Enhance, create, or restore habitat (Keppie and Whiting, Jr. 1994).

OTHER RESIDENT BIRDS

Wild Turkey
Melagrio gallopavo

Status

- Rare to locally common BTES resident (Purrington 1995b).
- Formerly common in Louisiana at the time of first European settlement (Lowery 1974b).

- Re-established throughout its former range in North America and established outside of its former range in portion of North America (Eaton 1992).

Trends

- Locally extirpated from portions of Mexico before Spanish conquest.
- Locally extirpated from substantial portions of its U.S. range by 1900.
- Forty-nine states had huntable populations by 1991.
- Transplanting programs completed in 12 states by 1992.
- Projected that all suitable habitat will be restocked by 2000 (Eaton 1992).

Causes of Change

Early decline was caused by overhunting and habitat loss. Recovery due to restocking; habitat preservation, restoration and enhancement; and controlled hunting (Eaton 1992).

Habitat Requirements

Breeds in forests and swamps, clearings, farms, plantations, prairies, grasslands. Eats acorns, seeds of grasses, fleshy fruits, pine meat, and vegetative parts of perennial plants (Eaton 1992).

Rock Dove
Columba livia

Status

- Introduced into North America in early 17th century, now a very common resident in basin (Purrington 1995b).
- Considered a pest in some urban settings.

Trends

Population in central United States stable, increasing in eastern and western range, 1966–1979 (Johnston 1992).

Causes of Change

- Bird benefits from increased urbanization.

Habitat Requirements

Roosts and nests in crevices, caves, cliffs, farm and ornate buildings, and skyscrapers. Eats seeds and fruits (Johnston 1992).

Species Recommendations

"No thoughts of conservation" (Johnston 1992).

Mourning Dove
Renaida macrura

Status

- Very common to abundant resident in the BTES (Purrington 1995b).
- Among the most abundant terrestrial north and middle American birds and the leading North American game bird (Mirarchi and Baskett 1994).

Trends

- Breeding populations largely stable over the last 28 years in the eastern United States.
- Some breeding populations in central United States have experienced an annual 1.5% decline over the last 28 years.
- Breeding populations in western United States have experienced an annual 1.6–3.7% decline over the last 28 years.
- Range and abundance have increased since European colonization of North America (Mirarchi and Baskett 1994).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

- Generally benefited from human changes to the North American landscape, especially the removal of the dense virgin forests.
- Pesticides and ingestion of lead shot have caused local mass mortalities.
- Recent changes in land use patterns (such as intensive agriculture, urbanization, shift from seed crops) as well as intensive use of pesticides may be responsible for some local declines (Mirarchi and Baskett 1994).

Habitat Requirements

Nests in open woodlands, forest edge, prairie biomes, suburban and urban trees and shrubs. Feeds mostly on seeds (Mirarchi and Baskett 1994).

Species Recommendations

- Maintain existing habitat.
- Increased plantings of trees and shrubs in urban and suburban areas.
- Limit use of pesticides.

Red-bellied Woodpecker
Melanerpes carolinus

Status

Common BTES resident (Purrington 1995b).

Trends

- Anecdotal evidence and NOCBCs suggest a slow decline in numbers since the 1960s (Purrington 1995b).
- BBS indicates a significant annual continental increase of 0.6%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Wet woodlands, pinewoods, parks, orchards, and gardens. Nests in cavities excavated in dead snags. Eats insects, fruits, nuts, and berries (Farrand 1983).

Downy Woodpecker
Picoides pubescens

Status

Common BTES resident (Purrington 1995b).

Trends

- NOCBCs declined in the early 1970s to a minimum of only nine in 1975. The 1980s NOCBCs show a three-fold increase over the minimum (Purrington 1995b).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Treed areas from woodlands to orchards, parks and urban and suburban gardens. Nests usually excavated in decaying limbs. Forages on the trunks of trees (Lowery 1974, Farrand 1983).

Pileated Woodpecker
Dryocopus pileatus

Status

Uncommon to fairly common BTES resident (Purrington 1995b).

Trends

- Became rare in United States before 1900.

- Began a recovery in North America in 1920–30 which is continuing in terms of abundance and range.

- BBS suggest a significant increase in eastern United States and Canada and no change in central and western United States, 1966–1991 (Bull and Jackson 1995).

- BBS indicates a significant annual continental increase of 2.0%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

- Deforestation and hunting were responsible for pre-1900 decline.
- Recovery in 1920–30s attributed to protection by management, reforestation, and abandonment of farms.
- Increases in the 1950s may have been aided by increases in insect supply and dead trees (for nesting) associated with mortality of American Elms from Dutch Elm disease (Bull and Jackson 1995).

Habitat Requirements

Older growth forests or younger forests with scattered, large, dead trees. Roosts in live and dead hollow trees or vacated nest cavities at night and during bad weather. Eats insects, especially carpenter ants and woodboring beetle larvae. Also eats wild fruit and nuts.

Species Recommendations

Leave large diameter trees and avoid forest fragmentation (Bull and Jackson 1995).

American Crow
Corvus brachyrhyncos

Status

Common to abundant BTES resident (Purrington 1995b).

Trends

- NOCBCs essentially unchanged since 1960 (Purrington 1995b).
- BBS indicates a significant annual continental increase of 0.7%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Open and semi-open habitats. Nests in trees (Lowery 1974b, Farrand 1983).

Carolina Chickadee

Parus carolinensis

Status

Common BTES resident (Purrington 1995b).

Trends

- NOCBCs declined during the 1960s, reached a minimum in the early 1970s, and have increased since about 1972 (Purrington 1995b).

- BBS indicates a significant annual continental decline of 0.7%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Decline in 1960s could be due to the severe freeze of 1962 (Purrington 1995b).

Habitat Requirements

Almost any wooded area (Lowery 1974b).

Tufted Titmouse
Parus bicolor

Status

- Uncommon to common resident in the BTES (Purrington 1995b).

- Common in eastern North American deciduous forests (Grubb and Pravosudov 1994).

Trends

Northern range has expanded during the last 50 years (Grubb and Pravosudov 1994).

Causes of Change

Range expansion may be due to maturation of forests, an increase in winter bird feeding, or climate change (Grubb and Pravosudov 1994).

Habitat Requirements

Mostly deciduous forest; can use mixed deciduous-coniferous forests, swamps, parks, and suburban areas. Breeds in natural tree cavities. Eats insects and seeds. Visits feeders.

Species Recommendations

Avoid excessive tree felling to assure sufficient tree cavities for nesting (Grubb and Pravosudov 1994).

Carolina Wren
Thryothorus ludovicianus

Status

- Common to very common BTES resident (Purrington 1995b).
- One of the commonest Louisiana residents (Lowery 1974b).

Trends

- NOCBCs have been stable since 1960 (Purrington 1995b).
- BBS indicates a significant annual continental increase of 0.9%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Undergrowth: honeysuckle, greenbriar, and brush pits (Farrand 1983).

Blue-gray Gnatcatcher
Polioptila caerulea

Status

- Uncommon BTES resident and common BTES migrant (Purrington 1995b).
- Most widespread North American kinglet (Ellison 1992).

Trends

- Undergoing a northeastern expansion of its breeding territory that began in the 1920s.
- No significant population abundance trends (Ellison 1992).

- **!** BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Severe winters appear to have local negative impacts (Ellison 1992).

Habitat Requirements

Breeds commonly in a wide range of watered, broad-leaved, wooded habitats from shrublands to mature forests. Winters in a wide range of habitats from swamps to pine flatwoods to orchards to ornamental plantings. Eats mostly small insects and spiders (Ellison 1992).

Species Recommendations

Habitat preservation (Ellison 1992).

Northern Mockingbird
Mimus polyglottos

Status

- Very common BTES resident (Purrington 1995b).
- Widely distributed year round resident throughout the continental United States, with greatest densities in Texas and Florida.
- Introduced and established in Hawaii, Oregon, San Francisco, central Canada, and coastal Maine (Derrickson and Breitwisch 1992).

Trends

- NOCBCs suggest decline, but the data are too sparse to permit a definite conclusion (Purrington 1995b).
- Formerly locally reduced or decimated in United States by caged bird trade and egg collecting, 1700s through early 1900s.
- Repopulated southern natural range by 1940.
- Currently northern limit of range expanding.
- Significant decline in continental abundance at 1.8% per year, 1966–1987 (Derrickson and Breitwisch 1992).

- BBS indicates a significant annual continental decline of 1.0%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Range expansion associated with favorable habitats created by human alterations of the natural landscape (Derrickson and Breitwisch 1992).

Habitat Requirements

Prefers parklike, cultivated, and mowed landscapes and second growth, open forests. An omnivore feeding mainly on anthropoids, fruits, and earthworms (Derrickson and Breitwisch 1992).

Species Recommendations

Plantings of ornamental shrubs and trees in suburban and urban settings.

Loggerhead Shrike
Lanius ludovicianus

Status

Common BTES resident (Purrington 1995b).

Trends

- NOCBCs constant since the 1960s. Interesting case in that local populations have remained very nearly constant, when populations in the north and northeast have crashed (Purrington 1995a).

- Declined dramatically in the northeastern U.S. (Purrington 1995b).

- BBS indicates a significant annual continental decline of 3.5%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Eats insects, small mammals, and small birds (Lowery 1974b).

European Starling
Sturnus vulgaris

Status

Introduced, abundant BTES resident (Purrington 1995b).

Trends

- Introduced to United States in 1890 (Lowery 1974b).
- The first specimen was taken in the BTES in 1926 (Purrington 1995b).
- Continues to increase in southeast Louisiana (Purrington 1995a).
- BBS indicates a significant annual continental decline of 1.0%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Nests in tree cavities and nesting boxes. Usurps nesting cavities of native birds such as Red-headed Woodpecker. Occupies a variety of habitats: farmlands, cities, woodlands, dumps. Eats insects (Lowery 1974b, Farrand 1983).

Northern Cardinal
Cardinalis cardinalis

Status

Very common BTES resident (Purrington 1995b) except for coastal marshes and deepest inland swamps (Lowery 1974b).

Trends

- NOCBCs underwent a local steady decline to one-fourth the numbers of the early 1960s until 1974. Has since seemingly increased (Purrington 1995b).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Extensive nest parasitism by Bronzed Cowbirds (Purrington 1995a).

Habitat Requirements

Bushy undergrowth (Farrand 1983).

Rufous-sided [eastern] Towhee
Pipilo erythrophthalmus

Status

Common BTES resident (Purrington 1995b).

Trends

NOCBCs declined locally from about 1960 to 1972, then stabilized (Purrington 1995b).

Habitat Requirements

Bushy habitats, woodland edges, thickets, shrubs.

Eastern Meadowlark
Sturnella magna

Status

- Common BTES resident (Purrington 1995b).
- One of the most widely distributed songbirds (Lanyon 1995).

Trends

- NOCBCs essentially unchanged since the 1960s (Purrington 1995b).
- BBS indicate a general, continental decline, 1966–1991 (Lanyon 1995).

Causes of Change

Loss of suitable nesting habitat due to urbanization or adoption of intensive agricultural practices (Lanyon 1995).

Habitat Requirements

Breeds in grasslands, pastures and croplands with weedy borders, roadsides, and parks. In winter will use open country including cultivated fields, feedlots, and marshes. Eats crickets, grasshoppers, caterpillars, cutworms, and grubs. Also eats seeds of weeds and wild fruits (Lanyon 1995).

Species Recommendations

Employ land use practices that provide suitable nesting habitat and protect nesting areas from mowing during nesting (Lanyon 1995).

Brown-headed Cowbird
Molothrus ater

Status

- Common BTES resident (Purrington 1995b).
- Common in United States, southern Canada, and northern Mexico (Lowther 1993).

Trends

- In the New Orleans area the Brown-headed Cowbird has been largely replaced by the Bronzed Cowbird. This local trend probably not indicative of the BTES (Purrington 1995a).
- Formerly limited to short-grass plains, but have greatly expanded their range and are presently common where they did not formerly exist.
- BBS shows populations increases in six states, decreases in 14 states and Ontario (Lowther 1993).

Causes of Change

Benefits from human activity which results in deforestation and forest fragmentation (Lowther 1993).

Habitat Requirements

Breeds woodland edges, brushy thickets, prairies, fields, pastures, orchards, suburban areas. Generalized brood parasite showing preference for wood/field ecotones. Eats seeds and arthropods (Lowther 1993).

Species Recommendations

- Give special attention to Cowbirds (especially females) when monitoring local bird populations.
- Consider land use practices that encourage contiguously forested areas and minimize edge effect and Cowbird feeding areas.
- Trapping of the Brown-headed Cowbird may help relieve some hosts of some brood parasitism, but should be viewed as a stop-gap measure (Lowther 1993).

House Finch
Carpodacus mexicanus

Status

Expanding into the BTES (Purrington 1995b).

Trends

- First recorded in 1990 in the BTES. Expected to become regular in the BTES within five years (Purrington 1995b).
- Now breeding in southeast Louisiana (Purrington 1995a).

Habitat Requirements

Open areas, suburban environments. Forages from treetops to ground (Farrand 1983).

House Sparrow
Passer domesticus

Status

Introduced, common to abundant BTES resident (Purrington 1995b).

Trends

- Introduced to United States in 1850.
- First recorded in southeast Louisiana in 1874.
- Maximum numbers probably reached before automobiles replaced horses for transportation.
- NOCBCs declined from the 1950s until about 1970 (Purrington 1995b).

Habitat Requirements

Urban and suburban areas, farmlands (Lowery 1974b). Mainly vegetarian. In spring, eats budding branches and fruit. In winter, consumes urban and suburban refuse and grain from rural storage facilities (Farrand 1983).

OTHER MIGRATING BIRDS

Yellow-billed Cuckoo
Coccyzus americanus

Status

- Common to sometimes abundant BTES migrant (Purrington 1995b).
- Common breeder in summer (Muth 1995).
- In migration at times the most common bird in the coastal woods, sometimes numbering dozens to hundreds (Purrington 1995b).

Trends

- Strong indications that it has declined greatly as a BTES breeding bird.
- In a general decline in North America (Purrington 1995b).
- BBS indicates a significant annual continental decline of 1.4%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Habitat loss to agriculture (Rodenhouse et al. 1993).

Habitat Requirements

Woodlands, forest edges, thickets, orchards, and farmlands. Eats caterpillars and insects (Lowery 1974b, Farrand 1983).

Tree Swallow
Tachycineta bicolor

Status

Common to abundant in summer in the BTES (Purrington 1995b).

Trends

Continental increase over the last 25 years (Robertson et al. 1992).

Habitat Requirements

Frequents open fields, marshes, ponds, lakes, and wetlands margins. Nests in holes excavated in dead trees by other birds or in artificial cavities. Mainly eats insects. Can subsist on seeds and berries (Robertson et al. 1992).

Species Recommendations

- **!** Continue to monitor the effects of pesticides
- **!** Leave dead trees standing in forest for hole builders and nesters (Robertson et al. 1992).

House Wren
Troglodytes aedon

Status

Common in winter in the BTES (Purrington 1995b).

Trends

- NOCBCs declined during the early 1960s to mid 1970s, but have since increased (Purrington 1995b).

- BBS indicates a significant annual continental increase of 1.5%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Thickets, woodland openings, prairies, human habitations.

Ruby-crowned Kinglet
Regulus calendula

Status

Very common in winter in the BTES (Purrington 1995b).

Trends

- Breeding birds showed significant decline in abundance in eastern Canada and a significant increase in northern plains states, 1968–1977.

- May be locally extinct on Guadalupe Island (off Baja, California), and/or on Mount Pinos and/or the San Gabriel and San Jacinto Mountains in California (Ingole and Wallace 1994).

Causes of Change

Breeding birds may be adversely affected by logging and wildfire (Ingold and Wallace 1994).

Habitat Requirements

Nests in a variety of coniferous forests near water. Migrates through a great variety of habitats including coniferous forests, floodplains, old fields, and suburban yards. Winters in a great variety of forests, treed fields, and thickets. Feeds on insects and spiders year round and on fruit, seeds, and vegetable matter when nonbreeding (Ingold and Wallace 1994).

Hermit Thrush
Catharus guttatus

Status

Uncommon in winter in the BTES (Purrington 1995b).

Trends

- NOCBCs have declined since the early 1970s compared to a peak in the 1960s (Purrington 1995b).
- Common in winter in Louisiana (Lowery 1974b).
- BBS indicates a significant annual continental increase of 1.4%, 1966–1993 (Peterjohn et al. 1994).

American Robin
Turdus migratoius

Status

Abundant in winter in the BTES; breeding locally in the BTES (Purrington 1995b).

Trends

- NOCBCs surprisingly variable, ranging from 1 up to 20–100 birds counted per hour (Purrington 1995b).
- BBS indicates a significant annual continental increase of 0.9%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Originally a forest species, has adapted to open suburban areas, forest borders, pastures, orchards, and parks (Farrand 1983).

Brown Thrasher
Toxostoma rufum

Status

Common in winter in the BTES; breeds locally and sparingly in the BTES (Purrington 1995b).

Trends

A steady decline in NOCBCs from the early 1960s to the late 1970s. A recent recovery is possible (Purrington 1995b).

Water Pipit
Anthus spinoleeta

Status

Uncommon to common in winter in the BTES (Purrington 1995b).

Trends

May be much less common in the BTES than a decade or two ago (Purrington 1995b).

Causes of Change

Loss of habitat (Purrington 1995b).

Habitat Requirements

Open country in winter and fall migration. Arctic tundra and above the tree line in Rockies in summer.

Orange-crowned Warbler
Vermivora cleata

Status

- Common in winter in the BTES (Purrington 1995b).
- Continental population relatively stable. Often numerous in suitable habitat.
- Reestablished on Santa Barbara Island and in the Santa Rosa Mountains, California.
- Locally extinct along one California river where formerly abundant (Sogge et al. 1994).

Trends

No significant trends in BBS data (Sogge et al. 1994).

Causes of Change

Suitability of breeding habitat in California may regulate abundance (Sogge et al. 1994).

Habitat Requirements

Streamside thickets and woodland groves with forests with understory vegetation. Feeds on invertebrates (Sogge et al. 1994).

Chestnut-sided Warbler
Dendroica pensylvanica

Status

Uncommon BTES migrant (Purrington 1995b).

Trends

- Less common than formerly in the BTES (Purrington 1995b).
- In eastern North America has benefited from land uses that result in abandoned farms which revert to old fields (Farrand 1983).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Black-throated Green Warbler
Dendroica virens

Status

- Common migrant in the BTES (Purrington 1995b).
- Sometimes the most common breeder in northeastern coniferous forest (Morse 1993).

Trends

- Continental population stable during first 25 years of BBS, then annual declines of from 3.2% to 0.8%, 1978–1991. Decline not constant across continent.
- Stable along the Maine coast.

- Expected to decline in foreseeable future.
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Decline in abundance expected from deforestation of Mexican habitat.

Habitat Requirements

Mature to middle-aged or second growth coniferous to deciduous forests and in cypress swamps. Feeds largely on insects, especially non-hairy caterpillars. During migration, eats berries.

Species Recommendations

Maintain larger tracts of forested habitat.

Habitat Requirements

Encourage second growth forests

Blackburnian Warbler
Dendroica fusca

Status

- Uncommon to common migrant in the BTES (Purrington 1995b).
- Stable (Morse 1994).

Trends

- Probably a historic decline.
- Possible future declines (Morse 1994).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

- Historic decline is due to deforestation and chlorinated hydrocarbon pesticides.
- Future decline expected from tropical deforestation (Morse 1994).

Habitat Requirements

Nests in mature coniferous and coniferous/deciduous forests. Winters in tropical forests. Eats insects and spiders and some fruit (Morse 1994).

Cerulean Warbler
Dendroica caerulea

Status

Uncommon BTES migrant (Purrington 1995b).

Trends

- Seems less numerous than 25 years ago (Purrington 1995b).
- BBS indicates a significant annual continental decline of 4.2%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Mature, open deciduous forests in bottomland swamps and wooded hillsides along streams (Farrand 1983).

Prothonotary Warbler
Protonotarica citrea

Status

Common in the BTES in summer (Purrington 1995b); common migrant in the BTES (Muth 1995).

Trends

BBS indicates a significant annual continental decline of 1.5%, 1966–1993 (Peterjohn et al. 1994).

Habitat Requirements

Most common in swamps and bottomland hardwoods. Can be found in wooded suburban areas, but never far from a water body. Prefers to nest in cavities (Lowery 1974b).

Ovenbird
Seirus aurocapillus

Status

Common BTES migrant (Purrington 1995b).

Trends

- Breeding population declined at 1% per year, 1978–1987. From 1988–89, breeding populations declined at the periphery of its range and increased in the center (Van Horn and Donovan 1994).

- BBS indicates a significant annual continental increase of 0.5%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Fragmentation of North American forests used for breeding results in greater predation and nest parasitism by cowbirds. In fragmented forests, males may be less likely to establish territories or attract mates (Van Horn and Donovan 1994).

Habitat Requirements

Large, contiguous forests. Feeds on invertebrates in forests (Van Horn and Donovan 1994).

Species Recommendations

Study the use of wintering habitats (Van Horn and Donovan 1994).

Hooded Warbler
Wilsonia citrina

Status

Common in summer in the BTES (Purrington 1995b).

Trends

- U.S. breeding population shows no significant trend, 1966–1988.
- Threatened in Canada (Evans Ogden and Stutchberry 1994).
- BBS indicates a significant continental increase of 1.6%/yr, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Forest fragmentation on breeding grounds likely results in increased predation and Cowbird nest parasitism. These two factors control local abundance (Evans Ogden and Stutchberry 1994).

Habitat Requirements

Breeds most successfully in mature or selectively logged mixed hardwoods or cypress swamps with shrub understory for nesting. Winter habitat ranges from brushy fields, shrub, second growth, and mature forests (Evans Ogden and Stutchberry 1994).

Species Recommendations

- Preserve existing habitat, avoid further forest fragmentation.
- Encourage forest maturation.
- Use selective logging rather than clearcutting.
- Study nonbreeding habitat (Evans Ogden and Stutchberry 1994).

Blue Grosbeak
Guiraca caerulea

Status

- Common to abundant migrant in the BTES (Purrington 1995b).
- Scarce, but widespread breeder outside BTES (Ingold 1993).

Trends

U.S. breeding populations increased, 1965–1979. From 1982–1991, it increased its northern range, but declined drastically in Florida, Missouri, and Pennsylvania (BBS in Ingold 1993).

Habitat Requirements

From mature long-leaf pine forests to forest edge to old fields to deserts to streamside habitats. Eats insects, snails, and seeds (Ingold 1993).

Indigo Bunting
Passerina cyanea

Status

- Common to abundant BTES migrant; uncommon to common summer in the BTES (Purrington 1995b).
- North American adult population estimated to vary between 10–20 to 40 million pairs (BBS in Payne 1992).

Trends

- U.S. population increasing in abundance and range, although there are some local extinctions (Payne 1992)
- BBS indicates a significant annual continental decline of 0.6%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Decline locally with maturation of forests, intensification of agricultural practices, mowing of fields and roadsides, and urbanization (Payne 1992)

Habitat Requirements

Brushy, weedy habitats in disturbed lands and along right of ways. Open deciduous woods, old fields, and swamps. Eats spiders, insects, seeds, and berries during breeding season. Mainly seeds in winter (Payne 1992).

Species Recommendations

- Discourage frequent mowing of roadsides.
- Encourage old fields (Payne 1992).

Savannah Sparrow
Passerculus sandwichensis

Status

- Common in winter in the BTES (Purrington 1995b).
- Abundant and widespread in open North American habitats (Wheelwright and Rising 1993).

Trends

- No trends in U.S. population since 1868, but has probably increased since early European colonization. Currently local abundance is very variable and this bird has become locally extinct in some areas (Wheelwright and Rising 1993).
- BBS indicates a significant annual continental decline of 0.8%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Annual abundance affected by food availability and storms. Deforestation has probably resulted in increase. Local extinctions and declines in abundance associated with urbanization and reversion of farmlands to forests (Wheelwright and Rising 1993).

Habitat Requirements

Open country, such as meadows, pastures, roadsides, salt marshes, and coastal estuaries. Feeds on small seeds, fruits, and insects in winter. During breeding season feeds on insects, spiders, crustaceans, small mollusks, seeds, and fruits (Wheelwright and Rising 1993).

Sharp-tailed Sparrow
Ammodramus caudacutus

Status

Common in winter in the BTES (Purrington 1995b).

Trends

- Continental populations probably in a state of decline.
- Where studied on the Atlantic coast, populations were found to be persistent (Greenlaw and Rising 1994).
- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Loss and degradation of marsh habitat (Greenlaw and Rising 1994).

Habitat Requirements

In winter, coastal marshes and occasionally cattail. In breeding season inland freshwater marshes, meadows, wet grasslands, and along major rivers. Also uses fresh to salt marshes along the coastal breeding areas. Eats mainly insects, spiders, and amphipods. Some seeds (Greenlaw and Rising 1994).

Species Recommendations

- Protect and preserve existing wetlands habitat.
- Conduct periodic population surveys (Greenlaw and Rising 1994).

White-throated Sparrow
Zonatrichia albicallis

Status

- Common in the BTES in winter (Purrington 1995b).

- North American population estimated at 10–20 million birds.

- Common throughout much of its range in North America and at feeders during migration (Falls and Kopachena 1994).

Trends

- BBS indicates a significant annual continental decline of 1.3%, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Intensive agriculture and maturation of second growth forest cause local population declines through loss of habitat (Falls and Kopachene 1994).

Habitat Requirements

Breeds in open forests with low, dense understory. In migration and winter uses poorly drained shrubby growths of willow and dogwood. In winter also uses weedy fields, parks, and shrubby suburban and urban areas. In winter, late summer, and fall, eats mainly seeds, fruits, and some insects. In summer, eats insects, greens, and fruits (Falls and Kopachene 1994).

Bronzed Cowbird
Molothrus aeneus

Status

Uncommon to common in summer; uncommon to rare in winter (Purrington 1995b).

Trends

- Began a range expansion at least at the beginning of the twentieth century. First noted in Arizona in 1909, New Mexico in 1947, California in 1951, and Louisiana in 1961 (Lowther 1995).

- BBS indicates no significant continental trend, 1966–1993 (Peterjohn et al. 1994).

Causes of Change

Benefits from the agricultural practices that clear original vegetation and/or implement irrigation (Lowther 1995).

Habitat Requirements

Open fields and shrubby areas, parks, agricultural lands, urban and suburban areas. Eats seeds and arthropods (Lowther 1995).

Species Recommendations

Study the impact of Bronzed Cowbird nest parasitism of other birds (Lowther 1995).

American Goldfinch
Carduelis tristis

Status

- Common to abundant in the BTES in winter (Purrington 1995b).
- Abundant and widely distributed in temperate North America (Middleton 1993).

Trends

BBS suggests populations declining throughout eastern North America. Stable in western North America (Middleton 1993).

Habitat Requirements

Weed fields, floodplains, cultivated lands, roadsides, orchards, and gardens. Prefers seeds of composites. Also eats seeds of other annual plants, small seeds of various trees, and insects when encountered (Middleton 1993).

Species Recommendations

- Gather precise population data.
- Monitor long-term trends (Middleton 1993).

MAMMALS

COMMON MUSKRAT
Ondatra zibethicus

Status

- An average of 256,652 pelts were harvested each year in the BTES[1] between 1978 and 1983 (Linscombe and Kinler 1985).

- An average of 507,763 pelts were harvested each year in Louisiana between 1978 and 1983 (Linscombe and Kinler 1985).

Trends

Brackish and saline marshes in southwestern Barataria supported a population boom in 1991 and 1992 (Figure 6.106). However, the population in the fresh-intermediate marshes seems to be declining.

Causes of Change

Cause	Effect	Source
Competition with nutria	Decreasing population	Lowery (1974a)
Rice culture	Increasing population	Lowery (1974a)
Predation	Death of individuals	Lowery (1974a)
Trapping	Decreasing population	Lowery (1974a)
Extreme water levels	Decreasing population	O'Neil (1949)
Hurricanes	Decreasing population	O'Neil (1949)
Habitat destruction	Decreasing population	O'Neil (1949)

Habitat Requirements

Within the Louisiana deltaic plain, Muskrats are found in greatest densities in the brackish marshes (0.88 animals harvested/ha), followed by the intermediate marshes (0.40 animals harvested/ha), and fresh marshes (0.15 animals harvested/ha). Muskrats are rarely found within the swamp (0.05 animals harvested/ha) (Linscombe and Kinler 1985). In southwestern

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[1] Total harvest from Terrebonne, Lafourche, St. Charles, and Jefferson parishes plus half the harvest from Plaquemines Parish.

Barataria, the saline marsh is also an important habitat having nest densities comparable to those of the brackish marsh (Figure 6.106). Palmisano

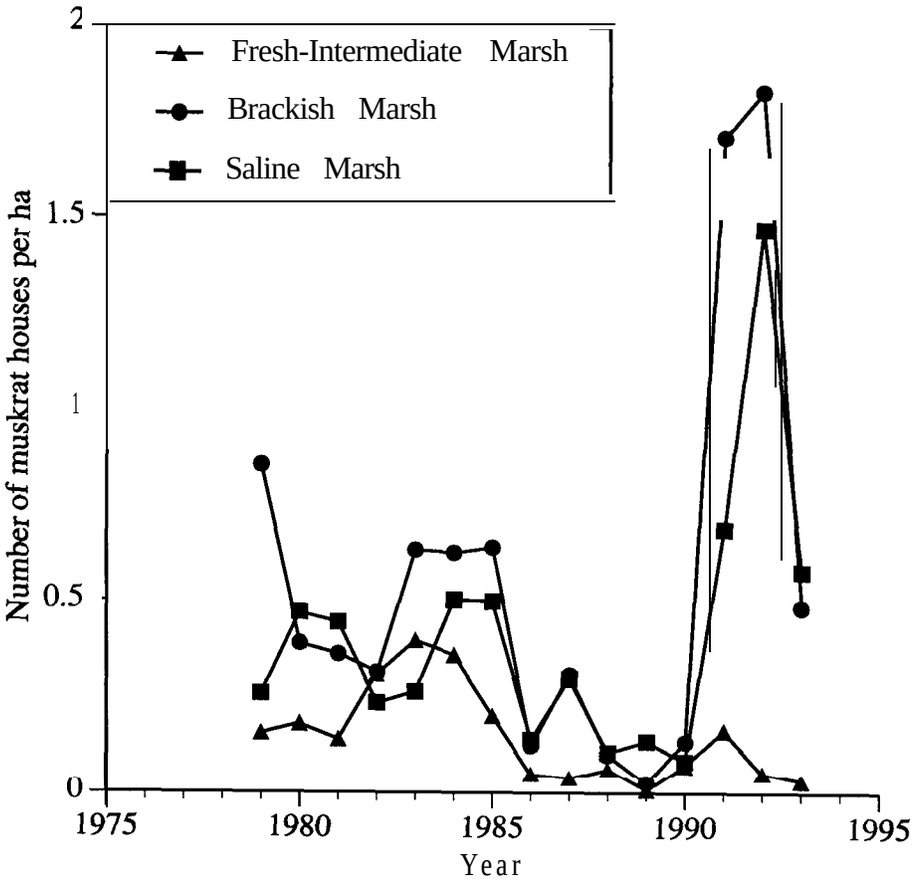

Figure 6.106. Trends in Muskrat house densities by marsh type in southwestern Barataria, 1979-1993.

(1972) found for southeastern Louisiana that the highest densities of Muskrat houses occurred in brackish marshes (0.87 houses/ha [1]) followed by saline marshes (0.37 houses/ha) and intermediate marshes (0.21 houses/ha), and lowest densities in the fresh marshes (0.06 houses/ha).

Muskrats are almost entirely vegetarian and feed on many grasses and sedges, but three-cornered sedge (*Scirpus olneyi*) marsh is considered their preferred habitat. For a complete list of plant foods eaten by muskrat see O'Neil (1949).

Species Recommendations

Close monitoring of Common Muskrat populations is recommended. Although populations are much reduced compared to the first half of this century, the potential for population explosion exists. Population explosions might lead to locally severe habitat destruction, especially in the brackish marshes.

Nutria
Myocastor coypus

Status

- An average of 599,097 pelts were harvested each year in the BTES [2] between 1978 and 1983 (Linscombe and Kinler 1985).

- An average of 1,176,540 pelts were harvested each year in Louisiana between 1978 and 1983 (Linscombe and Kinler 1985).

Causes of Change

Cause	Effect	Source
Predation	Death of young animals	Lowery (1974a)
Alligator predation	Death of adults	Lowery (1974a)
Extremely cold weather	Population decrease	Gosling (1980)
Trapping	Population decrease	Gosling (1980)

[1] Average over five surveys (1969–71).

[2] Total harvest from Terrebonne, Lafourche, St. Charles, and Jefferson parishes plus half the harvest from Plaquemines Parish.

Habitat Requirements

Within the Louisiana deltaic plain, Nutria are found in greatest densities in the fresh marshes (1.45 animals harvested/ha), followed by the intermediate marshes (0.82 animals harvested/ha), and swamps (0.75 animals harvested/ha). Nutria are found in lowest densities within the brackish marshes (0.54 animals harvested/ha) (Linscombe and Kinler 1985), and salt marshes where they are seldom harvested.

Nutria are entirely vegetarian and feed on many marsh plants (Coreil et al. 1988) and crops such as sugarcane and rice (Lowery 1974a).

Species Recommendations

Close monitoring of Nutria populations is recommended. Due to the large amount of damage caused by Nutria eat-outs, efforts should be made to control the population of this introduced species.

Northern Raccoon
Procyon lotor

Status

- An average of 32,773 pelts were harvested each year in the BTES[1] between 1978 and 1983 (Linscombe and Kinler 1985).

- An average of 214,652 pelts were harvested each year in Louisiana between 1978 and 1983 (Linscombe and Kinler 1985).

Causes of Change

Cause	Effect	Source
Predation by coyote and dog	Death of young animals	Lowery (1974a)
Traffic	Death of individuals	Lowery (1974a)

Habitat Requirements

[1] Total harvest from Terrebonne, Lafourche, St. Charles, and Jefferson parishes plus half the harvest from Plaquemines Parish.

Within the Louisiana deltaic plain, raccoons are found in greatest densities in the swamp (0.10 animals harvested/ha), followed by the fresh and brackish marshes (0.06 animals harvested/ha), and are least dense in the intermediate marshes (0.03 animals harvested/ha) (Linscombe and Kinler 1985).

Raccoons build their dens in tree hollows, which are often 10 to 15 m above the forest floor (Lowery 1974a). During high tides in coastal marshes, raccoons take refuge on spoilbanks, oil platforms, and floating debris (Peterson n.d.). The diet of the raccoon is varied and in the coastal marshes includes crawfish, crabs, snails, clams, frogs, and insects. They also eat tender shoots and buds of plants, and can also do considerable damage to corn and other planted vegetable crops.

Species Recommendations

Close monitoring of Northern Raccoon populations is recommended. Management of the Northern Raccoon should concentrate on the preservation of swamp-forest habitat.

North American Mink
Mustela vison

Status

- An average of 8,550 pelts were harvested each year in the BTES[1] between 1978 and 1983 (Linscombe and Kinler 1985).

- An average of 41,025 pelts were harvested each year in Louisiana between 1978 and 1983 (Linscombe and Kinler 1985).

Causes of Change

Cause	Effect	Source
Predation by alligators	Death of adults	Lowery (1974a)

Habitat Requirements

Within the Louisiana deltaic plain, Mink are found in greatest densities in the swamp (0.026 animals harvested/ha), followed by the fresh marshes (0.014 animals harvested/ha), and are

[1] Total harvest from Terrebonne, Lafourche, St. Charles, and Jefferson parishes plus half the harvest from Plaquemines Parish.

least dense in the intermediate and brackish marshes (0.011 animals harvested/ha; Linscombe and Kinler 1985). The much higher density in the swamp is attributed to the greater availability of dens (usually in hollows under trees) and prey. In the marsh, muskrat houses are used as dens.

Mink eat fish, crabs, crayfish, frogs, mice, rats, rabbits, and occasionally birds. However, in Louisiana their favorite food is the crayfish (Lowery 1974a). Any habitat near water with sufficient prey available year round may be suitable (Allen 1984).

Species Recommendations

Close monitoring of North American Mink populations is recommended. Management of North American Mink should concentrate on the preservation of swamp-forest habitat.

Nearctic River Otter
Lutra canadensis

Status

- An average of 2,885 pelts were harvested each year in the BTES[1] between 1978 and 1983 (Linscombe and Kinler 1985).

- An average of 7,518 pelts were harvested each year in Louisiana between 1978 and 1983 (Linscombe and Kinler 1985).

Habitat Requirements

Within the Louisiana deltaic plain, Otters are found in greatest densities in the brackish (6.62 animals harvested/100 ha) and intermediate (5.84 animals harvested/100 ha) marshes, followed by the swamp (3.23 animals harvested/100 ha) and fresh marshes (2.98 animals harvested/100 ha) (Linscombe and Kinler 1985).

Otters feed mainly on fish, but frogs, turtles, snakes, crayfish, crabs, birds, rats, and mice are also taken (Chanin 1985, Mason and MacDonald 1986).

Species Recommendations

Close monitoring of Nearctic River Otter populations is recommended. Management should concentrate on the preservation of brackish and intermediate marsh habitat.

Louisiana Black Bear
Ursus americanus luteolus

Status

- Federally listed as threatened.

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[1] Total harvest from Terrebonne, Lafourche, St. Charles, and Jefferson parishes plus half the harvest from Plaquemines Parish.

- Population estimates range in accuracy from crude to little more than intuition (*Federal Register* 57(4):591, 1992).

- Six tagged females live in the BTES area in Point Coupee Parish, but have not been breeding recently. No males have been observed in this area. In addition, young males travel along the Intracoastal Waterway in western Terrebonne Parish (Davidson 1995).

Trends

Unknown.

Causes of Change

Cause	Effect	Source
Traffic	Death of adults	Lowery (1974a)
Illegal take	Death of adults	Lowery (1974a)
Habitat loss	Population decrease	Weaver et al. (1991)

Habitat Requirements

Bears are usually confined to bottomland hardwood forests. Bears are omnivorous, occasionally eating mice and squirrels, but the main part of their diet consists of oak mast, corn, muscadines, blackberries, and honey when available (Lowery 1974a).

Species Recommendations

Close monitoring of Louisiana Black Bear populations is recommended. Management of Louisiana Black Bear should concentrate on the preservation of bottomland hardwood habitat.

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APPENDIX A

Table A.1. Ecological classification of fishes recorded from Barataria and Terrebonne basins.

		Barataria	Terrebonne
FRESHWATER (37 species)			
Acipenseridae			
*Acipenser oxyrinchus**	Atlantic sturgeon	X	
Lepisosteidae			
Lepisosteus oculatus	Spotted gar	X	X
L. osseus	Longnose gar	X	X
L. spatula	Alligator gar	X	X
Amiidae			
Amia calva	Bowfin	X	X
Clupeidae			
Alosa alabamae	Alabama shad	X	
A. chrysochloris	Skipjack herring	X	X
Dorosoma cepedianum	Gizzard shad	X	X
D. petenense	Threadfin shad	X	X
Esocidae			
Esox niger	Chain pickerel	X	
Cyprinidae			
Notemigonus crysoleucas	Golden shiner	X	
Cyprinus carpio	Common carp		X
Ictaluridae			
Ameiurus melas	Black bullhead		X
A. natalis	Yellow bullhead	X	
Ictalurus furcatus	Blue catfish	X	X
I. punctatus	Channel catfish	X	X
Pylodictis olivaris	Flathead catfish	X	

		Barataria	Terrebonne
Aphredoderidae			
Aphredoderus sayanus	Pirate perch	X	
Fundulidae			
Fundulus chrysotus	Golden topminnow	X	
Poeciliidae			
Gambusia affinis	Mosquitofish	X	X
Heterandria formosa	Least killifish	X	X
Poecilia latipinna	Sailfin molly	X	X
Moronidae			
Morone mississippiensis	Yellow bass	X	
M. saxatilis	Striped bass	X	
Elassomidae			
Elassoma zonatum	Banded pygmy sunfish	X	
Centrarchidae			
Lepomis cyanellus	Green sunfish	X	
L. gulosus	Warmouth	X	X
L. humilis	Orangespotted sunfish	X	
L. macrochirus	Bluegill	X	X
L. marginatus	Dollar sunfish	X	
L. microlophus	Redear sunfish	X	
L. miniatus	Redspotted sunfish	X	X
L. symmetricus	Bantam sunfish	X	
Micropterus salmoides	Largemouth bass	X	X
Pomoxis annularis	White crappie	X	X
P. nigromaculatus	Black crappie	X	

		Barataria	Terrebonne
ESTUARINE (24 species)			
Sciaenidae			
Aplodinotus grunniens	Freshwater drum	X	
Cyprinodontidae			
Cyprinodon variegatus	Sheepshead minnow	X	X
Fundulidae			
Adinia xenica	Diamond killifish	X	X
Fundulus grandis	Gulf killifish	X	X
F. jenkinsi	Saltmarsh killifish	X	X
F. pulvereus	Bayou killifish	X	X
F. similis	Longnose killifish	X	X
Lucania parva	Rainwater killifish	X	X
Atherinidae			
Membras martinica	Rough silverside	X	X
Menidia beryllina	Inland silverside	X	X
Syngnathidae			
Syngnathus scovelli	Gulf pipefish	X	X
Sparidae			
Lagodon rhomboides	Pinfish	X	X
Eleotridae			
Dormitator maculatus	Fat sleeper	X	X
Eleotris pisonis	Spinycheek sleeper	X	
Gobiidae			
Evorthodus lyricus	Lyre goby	X	X
Gobioides broussoneti	Violet goby	X	X
Gobionellus boleosoma	Darter goby	X	X

		Barataria	Terrebonne
G. oceanicus	Highfin goby	X	X
G. shufeldti	Freshwater goby	X	X
Gobionellus smaragdus	Emerald goby		X
Gobiosoma bosc	Naked goby	X	X
G. robustum	Code goby	X	
Microgobius gulosus	Clown goby	X	X
M. thalassinus	Green goby	X	X
Soleidae			
Trinectes maculatus	Hogchoker	X	X
ESTUARINE-MARINE (26 species)			
Elopidae			
Elops saurus	Ladyfish	X	X
Megalops atlanticus	Tarpon	X	
Clupeidae			
Brevoortia patronus	Gulf menhaden	X	X
Engraulidae			
Anchoa mitchilli	Bay anchovy	X	X
Ariidae			
Arius felis	Hardhead catfish	X	X
Bagre marinus	Gafftopsail catfish	X	X
Gobiesocidae			
Gobiesox strumosus	Skilletfish	X	X
Belonidae			
Strongylura marina	Atlantic needlefish	X	X
Syngnathidae			
Syngnathus floridae	Dusky pipefish	X	

		Barataria	Terrebonne
S. louisianae	Chain pipefish	X	X
Carangidae			
Oligoplites saurus	Leatherjacket	X	X
Gerreidae			
Eucinostomus argenteus	Spotfin mojarra	X	X
Sparidae			
Archosargus probatocephalus	Sheepshead	X	X
Sciaenidae			
Bairdiella chrysoura	Silver perch	X	X
Cynoscion arenarius	Sand seatrout	X	X
C. nebulosus	Spotted seatrout	X	X
Leiostomus xanthurus	Spot	X	X
Micropogonias undulatus	Atlantic croaker	X	X
Pogonias cromis	Black drum	X	X
Sciaenops ocellatus	Red drum	X	X
Stellifer lanceolatus	Star drum	X	X
Ephippidae			
Chaetodipterus faber	Atlantic spadefish	X	X
Mugilidae			
Mugil cephalus	Striped mullet	X	X
Bothidae			
Citharichthys spilopterus	Bay whiff	X	X
Paralichthys lethostigma	Southern flounder	X	X
Soleidae			
Achirus lineatus	Lined sole	X	X

		Barataria	Terrebonne
MARINE (121 species)			
Carcharhinidae			
Carcharhinus leucas	Bull shark	X	X
Carcharhinus limbatus	Blacktip shark		X
Carcharhinus plumbeus	Sandbar shark		X
Rhizopriondon terraenovae	Atlantic Sharpnose shark	X	X
Pristidae			
Pristis pectinata	Smalltooth stingray	X	
Dasyatidae			
Dasyatis americana	Southern stingray	X	X
D. sabina	Atlantic stingray	X	X
D. say	Bluntnose stingray		X
Rhinoptera bonasus	Cownose ray		X
Albulidae			
Albula vulpes	Bonefish	X	X
Anguillidae			
*Anguilla rostrata**	American eel	X	X
Congridae			
Hildebrandia flava	Yellow conger	X	
Paraconger caudilimbatus	Margintail conger	X	
Ophichthidae			
Bascanichthys bascanium	Sooty eel		X
Echiophis punctifer	Snapper eel		X
Gordiichthys irretitus	Horsehair eel	X	

		Barataria	Terrebonne
Myrophis punctatus	Speckled Worm eel	X	X
Ophichthus gomesi	Shrimp eel	X	X
O. ocellatus	Palespotted eel	X	
Clupeidae			
Harengula jaguana	Scaled sardine	X	X
Opisthonema oglinum	Atlantic thread herring	X	X
Engraulidae			
Anchoa cubana	Cuban anchovy	X	
A. hepsetus	Striped anchovy	X	X
A. lyolepis	Dusky anchovy	X	X
Synodontidae			
Synodus foetens	Inshore lizardfish	X	X
Batrachoididae			
Opsanus beta	Gulf toadfish	X	X
O. pardus	Leopard toadfish	X	
Porichthys plectrodon	Atlantic midshipman	X	X
Antennariidae			
Antennarius radiatus	Singlespot frogfish	X	
Histrio histrio	Sargassumfish	X	X
Ogcocephalidae			
Ogcocephalus radiatus	Polka-dot batfish	X	
Gadidae			
Urophycis cirrata	Gulf hake	X	
U. floridana	Southern hake	X	X
U. regia	Spotted hake	X	

		Barataria	Terrebonne
Bythitidae			
Gunterichthys longipenis	Gold brotula	X	X
Ophidiidae			
Lepophidium brevibarbe	Blackedge cusk-eel	X	X
Ophidion welshi	Crested cusk-eel	X	X
Exocoetidae			
Cypselurus melanurus	Atlantic flyingfish	X	
Hirundichthys affinis	Fourwing flyingfish	X	
H. rondeleti	Blackwing flyingfish	X	
Hyporhamphus meeki	Halfbeak	X	X
Prognichthys gibbifrons	Bluntnose flyingfish	X	
Syngnathidae			
Hippocampus erectus	Lined seahorse	X	
H. reidi	Longsnout seahorse		X
H. zosterae	Dwarf seahorse	X	
Serranidae			
Centropristis philadelphica	Rock sea bass	X	X
Pomatomidae			
Pomatomus saltatrix	Bluefish	X	X
Rachycentridae			
Rachycentron canadum	Cobia	X	X
Echeneidae			
Echeneis naucrates	Sharksucker	X	X

		Barataria	Terrebonne
Carangidae			
Alectis ciliaris	African pompano	X	
Caranx crysos	Blue runner	X	X
C. hippos	Crevalle jack	X	X
C. latus	Horse-eye jack	X	X
Chloroscombrus chrysurus	Atlantic bumper	X	X
Hemicaranx amblyrhynchus	Bluntnose jack	X	
Selene setapinnis	Atlantic moonfish	X	X
S. vomer	Lookdown	X	X
Seriola dumerili	Greater amberjack		X
Seriola zonata	Banded rudderfish	X	
Trachinotus carolinus	Florida pompano	X	X
T. falcatus	Permit	X	X
Trachurus lathami	Rough scad	X	
Coryphaenidae			
Coryphaena hippurus	Dolphin	X	X
Lutjanidae			
Lutjanus analis	Mutton snapper		X
Lutjanus apodus	Schoolmaster	X	
L. griseus	Gray snapper	X	X
L. synagris	Lane snapper	X	X
Lobotidae			
Lobotes surinamensis	Tripletail	X	X

		Barataria	Terrebonne
Gerreidae			
Diapterus auratus	Irish pompano		X
D. plumieri	Striped mojarra	X	
Eucinostomus gula	Silver jenny	X	X
E. melanopterus	Flagfin mojarra	X	X
Gerres cinereus	Yellowfin mojarra	X	X
Haemulidae			
Orthopristis chrysoptera	Pigfish	X	X
Sciaenidae			
Cynoscion nothus	Silver seatrout	X	X
Larimus fasciatus	Banded drum	X	X
Menticirrhus americanus	Southern kingfish	X	X
M. littoralis	Gulf kingfish	X	X
M. saxatilis	Northern kingfish	X	X
Kyphosidae			
Kyphosus sectatrix	Bermuda club		X
Pomacentridae			
Abudeduf saxatilis	Sergeant major		X
Mugilidae			
Mugil curema	White mullet	X	X
Sphyraenidae			
Sphyraena barracuda	Great barracuda	X	X
S. borealis	Northern sennet	X	X
S. guachancho	Guaguanche	X	
Polynemidae			
Polydactylus octonemus	Atlantic threadfin	X	X
Uranoscopidae			

Astroscopus y-graecum	Southern stargazer	X	X
		Barataria	Terrebonne
Blenniidae			
Chasmodes bosquianus	Striped blenny	X	X
Hypleurochilus geminatus	Crested blenny	X	X
Hypsoblennius ionthas	Freckled blenny	X	X
Eleotridae			
Erotelis smaragdus	Emerald sleeper	X	X
Gobiidae			
Bathygobius soporator	Frillfin goby	X	X
Microdesmidae			
Microdesmus longipinnis	Pink wormfish	X	
Trichiuridae			
Trichiurus lepturus	Atlantic cutlassfish	X	X
Scombridae			
Scomberomorus cavella	King mackerel	X	X
S. maculatus	Spanish mackerel	X	X
Stromateidae			
Hyperoglyphe bythites	Black driftfish	X	X
Nomeus gronovii	Man-o-war fish		X
Peprilus alepidotus	Harvestfish	X	X
P. burti	Gulf butterfish	X	X
Triglidae			
Prionotus longispinosus	Bigeye searobin	X	X
P. roseus	Bluespotted searobin	X	
P. rubio	Blackwing searobin	X	X
P. scitulus	Leopard searobin	X	X
P. tribulus	Bighead searobin	X	X

Bothidae			
Ancylopsetta dilecta	Three-eye flounder	X	
		Barataria	Terrebonne
A. quadrocellata	Ocellated flounder	X	X
Citharichthys macrops	Spotted whiff	X	
Etropus crossotus	Fringed flounder	X	X
Paralichthys squamilentus	Broad flounder	X	X
Soleidae			
Gymnachirus melas	Naked sole		X
Cynoglossidae			
Symphurus civitatus	Offshore tonguefish	X	X
S. plagiusa	Blackcheek tonguefish	X	X
Balistidae			
Aluterus schoepfi	Orange filefish	X	
A. scriptus	Scrawled filefish	X	
Canthidermis sufflamen	Ocean triggerfish	X	
Monacanthus hispidus	Planehead filefish	X	
Tetraodontidae			
Lagocephalus laevigatus	Smooth puffer	X	X
Sphoeroides parvus	Least puffer	X	X
Diodontidae			
Chilomycterus schoepfi	Striped burrfish	X	X
Molidae			
Mola mola	Ocean sunfish	X	

* Diadromous life cycle (see McDowall 1987)

Data synthesized from Adkins and Bourgeois (1982), Adkins and Bowman (1976), Adkins et al. (1979), Allen (1979), Barrett et al. (1978), Chambers (1980), Forman (1968), Guillory (1982), Perret et al. (1971), Perry (1979), Ruebsamen (1972), Sabins and Truesdale (1974), Swanson (1991),

Thompson (1988), Thompson and Forman (1987), and Wagner (1973). Nomenclature follows Robins et al. (1991).

Table A.2. Amphibians of the Barataria-Terrebonne estuarine system (after Dundee and Rossman 1989).

Order *Caudata* SALAMANDERS AND NEWTS

Family *Ambystomatidae* MOLE SALAMANDERS

MARBLED SALAMANDER *(Ambystoma opacum)*

SMALL-MOUTHED SALAMANDER *(Ambystoma texanum)*

Family *Amphiumidae* AMPHIUMAS

CONGO "EEL," also called THREE-TOED *AMPHIUMA*
(Amphiuma tridactylum)

Family *Plethodontidae* WOODLAND SALAMANDERS

DUSKY SALAMANDER *(Desmognathus fuscua)*

DWARF SALAMANDER *(Eurycea quadridigitata)*

Family *Salamandridae* NEWTS

EASTERN NEWT *(Notophthalmus viridescens)*

Family *Sirenidae* SIRENS

LESSER SIREN *(Siren intermedia)*

Order *Anura* FROGS AND TOADS

Family *Bufonidae* TOADS

GULF COAST TOAD (*Bufo valliceps)*

WOODHOUSE'S TOAD (*Bufo woodhousei)*

Family *Hylidae* TREEFROGS

NORTHERN CRICKET FROG *(Acris crepitans)*

BIRD-VOICED TREEFROG *(Hyla avivoca)*

COPE'S GRAY TREEFROG *(Hyla chrysoscelis)*

GRAY TREEFROG *(Hyla versicolor)*

GREEN TREEFROG *(Hyla cinerea)*

SPRING PEEPER *(Hyla crucifer)*

SQUIRREL TREEFROG *(Hyla squirella)*

STRIPED CHORUS FROG *(Pseudacris triseriata)*

Family *Microhylidae* NARROW-MOUTHED TOADS

EASTERN NARROW-MOUTHED TOAD *(Gastrophryne carolineus)*

Family *Ranidae* TRUE FROGS

BULLFROG *(Rana catesbeiana)*

GREEN FROG *(Rana clamitans)*

PIG FROG *(Rana grylio)*

SOUTHERN LEOPARD FROG *(Rana sphenocephala)*

Table A.3. Reptiles of the Barataria-Terrebonne estuarine system (after Dundee and Rossman 1989).

Order *Testudines* TURTLES, TORTOISES, AND TERRAPINS

Family *Cheloniidae* HARD-BACKED SEA TURTLES

LOGGERHEAD* *Caretta caretta*

GREEN TURTLE* *Chelonia mydas*

HAWKSBILL* *Eretmochelys imbricata*

ATLANTIC RIDLEY *Lepidochelys kempi*

Family *Chelydridae* SNAPPING TURTLES

SNAPPING TURTLE *Chelydra serpentina*

ALLIGATOR SNAPPING TURTLE *Macroclemys temminckii*

Family *Dermochelyidae* LEATHER-BACKED SEATURTLES

LEATHERBACK *Dermochelys coriacea*

Family *Emydidae* LAND AND FRESHWATER

PAINTED TURTLE *Chrysemys picta*

CHICKEN TURTLE *Deirochelys reticularia*

MISSISSIPPI MAP TURTLE *Graptemys kohnii*

FALSEMAP TURTLE *Graptemys pseudogeographica*

DIAMOND-BACKED TERRAPIN *Malaclemys terrapin*

RIVER COOTER *Pseudemys concinna*

COOTER *Pseudemys floridana*

EASTERN BOX TURTLE *Terrapene carolina*

SLIDER *Trachemys scripta*

Family *Kinosternidae* MUD AND MUSK TURTLES

EASTERN MUD TURTLE *Kinosternon subrubrum*

RAZOR-BACKED MUSK TURTLE *Sternotherus carinatus*

COMMON MUSK TURTLE *Sternotherus odoratus*

Family *Trionychidae* SOFT-SHELLED TURTLES

SMOOTH SOFTSHELL *Apalone mutica*

SPINY SOFTSHELL *Apalone spinifera*

Order *Squamata* LIZARDS AND SNAKES

Family *Anguidae*

SLINDER GLASS LIZARD *Ophisaurus attenuatus*

EASTER GLASS LIZARD *Ophisaurus ventralis*

Family *Iguanidae*

GREEN ANOLE *Anolis carolinensis*

Family *Scinaidae*

FIVE-LINED SKINK *Eumeces fasciatus*

BROAD-HEADED SKINK *Eumeces laticeps*

GROUND SKINK *Scincella lateralis*

Family *Colubridae*

RACER *Coluber constrictor*

RING-NECKED SNAKE *Diadophis punctatus*

CORN SNAKE *Elaphe guttata*

RAT SNAKE *Elaphe obsoleta*

MUD SNAKE *Farancia abacura*

EASTERN HOG-NOSED SNAKE *Heterodon platyrhinos*

COMMON KINGSNAKE *Lampropeltis getulus*

MILK SNAKE *Lampropeltis triangulum*

SALTMARSH SNAKE *Nerodia clarkii*

WESTERN GREEN WATER SNAKE *Nerodia cyclopion*

PLAIN-BELLIED WATER SNAKE *Nerodia erythrogaster*

SOUTHERN WATER SNAKE *Nerodia fasciata*

DIAMOND-BACKED WATER SNAKE *Nerodia rhombifera*

ROUGH GREEN SNAKE *Opheodrys aestivus*

GRAHAM'S CRAYFISH SNAKE *Regina grahamii*

GLOSSY CRAYFISH SNAKE *Regina rigida*

BROWN SNAKE *Storeria dekayi*

WESTERN RIBBON SNAKE *Thamnophis proximus*

COMMON GARTER SNAKE *Thamnophis sirtalis*

Family *Viperidae*

COPPERHEAD *Agkistrodon contortrix*

COTTONMOUTH *Agkistrodon piscivorus*

TIMBER RATTLESNAKE *Crotalus horridus*

PYGMY RATTLESNAKE *Sistrurus miliarius*

Order *Crocodylia* CROCODILIANS

Family *Crocodylidae*

AMERICAN ALLIGATOR *Alligator mississippiensis*

*These three seaturtles are presumed to occur along the BTES coast.

Table A.4. Estimated current relative abundance of birds recorded in the Barataria-Terrebonne National Estuarine System (derived from R. D. Purrington, 1995. Modifications suggested by David Muth, Jean Lafitte National Historic Park and Preserve, are incorporated and indicated with an "*".).

Relative abundance in decreasing order: abundant, very common, common, rather common, fairly common, occasional, present, regular, uncommon, quite uncommon, very uncommon, almost rare, rare, very rare, casual, accidental, locally extinct, and extinct.

The term "erratic" is used to describe a species that may be common one year and absent the next. Common and scientific names from Farrand (1983).

Order *Gaviiformes*

Family *Gaviidae* LOONS

COMMON LOON (*Gavia immer*)
Uncommon to regular in winter

Order *Podicipediformes*

Family *Podicipedidae* GREBES

HORNED GREBE (*Podiceps auritus*)
Rare to uncommon in winter

PIED-BILLED GREBE (*Podilymbus podiceps*)
Common in winter; uncommon to rare breeding bird

EARED GREBE (*Podiceps nigricollis*)
Occasional in winter

Order *Pelicaniformes*

Family *Pelicanidae* PELICANS

AMERICAN WHITE PELICAN *(Pelecanus erythrorynchus)*
Common in winter, non-breeders present in summer

BROWN PELICAN *(Pelecanus occidentalis)*
Formerly locally extinct. Reintroduced, now resident and increasing

Family *Phalacrocoracidae* CORMORANTS

DOUBLE-CRESTED CORMORANT *(Phalacrocorax auritus)*
Common in winter

OLIVACEOUS CORMORANT *(Phacrocorax olivaceous)*
Casual visitor

Family *Anhingidae* ANHINGAS

ANHINGA *(Anhinga anhinga)*
Fairly common in breeding season; rare in winter

Family *Fregatidae* FRIGATEBIRDS

MAGNIFICENT FRIGATE-BIRD (*Fregata magnificens*)
Uncommon to fairly common in summer (non-breeding)

Order *Ciconiformes*

Family *Ardeidae* HERONS AND BITTERNS

AMERICAN BITTERN *(Botaurus lentiginosus)*
Uncommon in winter

LEAST BITTERN *(Ixobrychus exillis)*
Uncommon to common in summer

GREAT BLUE HERON *(Ardea herodias)*
Common resident

GREAT EGRET *(Casmerodius albus)*
Common to abundant resident

SNOWY EGRET *(Egretta thusla)*
Common to abundant resident

LITTLE BLUE HERON *(Egretta caerulea)*
Common to abundant resident

TRI-COLORED HERON *(Egretta tricolor)*
Common to abundant resident

REDDISH EGRET *(Egretta rufescens)*

Rare to uncommon resident

CATTLE EGRET *(Bubulcus ibis)*
Common to abundant resident

GREEN- BACKED HERON *(Butorides striatus)*
Uncommon to common in summer; rare, but regular, in winter

BLACK-CROWNED NIGHT HERON *(Nycticorax nycticorax)*
Uncommon to common resident

YELLOW-CROWNED NIGHT-HERON *(Nycticorax violacea)*
Common in summer; rare in winter

Family *Threskiornithidae* IBISES AND SPOONBILLS

WHITE IBIS *(Eudocimus albus)*
Common to abundant resident

GLOSSY IBIS *(Plegadis falcinellus)*
Uncommon resident

WHITE-FACED IBIS *(Plegadis chihi)*
Uncommon to common resident

ROSEATE SPOONBILL *(Ajaia ajaia)*
Rare to uncommon resident; rare post-breeding visitor in summer and fall

Family *Ciconiidae* STORKS

WOOD STORK *(Mycteria americana)*
Casual post-breeding visitor

Order *Anseriformes*

Family *Anatidae* SWANS, GEESE, DUCKS

FULVOUS WHISTLING-DUCK *(Dendrocygna bicolor)*
Casual in winter

BLACK-BELLIED WHISTLING DUCK *(Dendrocygna autumnalis)*
Accidental

TRUMPETER SWAN *(Cygnus buccinator)*
Extinct locally

WHITE-FRONTED GOOSE *(Anser albifrons)*

Rare to uncommon in winter

SNOW GOOSE *(Chen caerulescens)*
Uncommon to common in winter

CANADA GOOSE *(Branta canadensis)*
Uncommon to rare in winter

WOOD DUCK *(Aix spons)*
Common resident

GREEN-WINGED TEAL *(Anas crecca)*
Regular to common in winter

AMERICAN BLACK DUCK *(Anas rubripes)*
Rare to occasional in winter

MOTTLED DUCK *(Anas fulvigula)*
Common resident

MALLARD *(Anas platyrhynchos)*
Common in winter

NORTHERN PINTAIL *(Anas acuta)*
Uncommon to common in winter

BLUE-WINGED TEAL *(Anas discors)*
Abundant migrant; common winter visitor; occasional in summer

CINNAMON TEAL *(Anas cyanoptera)*
Occasional to accidental in winter

NORTHERN SHOVELER *(Anas clypeata)*
Common in winter

GADWALL *(Anas strepera)*
Common to abundant in winter

EURASIAN WIGEON *(Anas penelope)*
Accidental in winter

AMERICAN WIGEON *(Anas americana)*
Common to abundant in winter

CANVASBACK *(Aythya valisineria)*

Uncommon to rare in winter

REDHEAD *(Aythya americana)*
Uncommon in winter

RING-NECKED DUCK *(Aythya collaris)*
Uncommon to common in winter

GREATER SCAUP *(Aythya marila)*
Uncommon in winter

LESSER SCAUP *(Aythya affinis)*
Common to abundant in winter

KING EIDER *(Somateria spectibilis)*
Accidental

HARLEQUIN DUCK *(Histrionicus histrioniucs)*
Accidental

OLDSQUAW *(Clangula hyemalis)*
Uncommon to rare in winter

BLACK SCOTER *(Melanitta nirgra)*
Rare in winter

SURF SCOTER *(Melanitta perspicillata)*
Rare in winter

WHITE-WINGED SCOTER *(Melanitta fusca)*
Casual in winter

BUFFLEHEAD (*Bucephala albeola*)
Uncommon in winter

COMMON GOLDENEYE *(Bucephala clangula)*
Uncommon in winter

HOODED MERGANSER *(Lophodytes cucullatus)*
Uncommon to occasional in winter; may breed in BTS, but no direct evidence

COMMON MERGANSER *(Mergus merganser)*
Rare to accidental in winter

RED-BREASTED MERGANSER *(Mergus serrator)*
Uncommon to common in winter

RUDDY DUCK *(Oxyura jamaicensis)*
Uncommon in winter

Order *Facloniiformes*

Family *Cathartidae* VULTURES

BLACK VULTURE *(Coragyps atratus)*
Uncommon to common resident and breeding bird

TURKEY VULTURE *(Cathartes aura)*
Common resident and breeding bird

Family *Accidpitridae* HAWKS, HARRIERS

OSPREY *(Pandion haliaetus)*
Uncommon migrant; uncommon to rare in winter; local* breeder

AMERICAN SWALLOW-TAILED KITE *(Elanoides forficatus)*
Uncomon migrant; rare and local breeder in summer*

WHITE-TAILED KITE *(Elanus caeruleus)*
Rare in winter and apparently breeding in BTS

MISSISSIPPI KITE *(Ictinia misissippiensis)*
Common in summer

BALD EAGLE *(Haliaeetus leucocephalus)*
Rare breeding bird but breeding population increasing; rare to casual winter visitor

NORTHERN HARRIER *(Circus cyaneus)*
Common winter visitor

SHARP-SHINNED HAWK *(Accipiter striatus)*
Uncommon in winter; fairly common migrant*

COOPER'S HAWK *(Accipiter cooperii)*
Quite uncommon in winter; uncommon migrant; rare breeder*

RED-SHOULDERED HAWK *(Buteo lineatus)*
Common resident

BROAD-WINGED HAWK *(Buteo platypterus)*
Common migrant; uncommon local breeder*; casual in winter

SWAINSON'S HAWK *(Buteo swainsoni)*
Casual fall migrant or winter visitor

RED-TAILED HAWK *(Buteo jamaicensis)*
Common in winter; uncommon and local breeder*

ROUGH-LEGGED HAWK *(Buteo lagopus)*
Accidental winter visitor*

AMERICAN KESTREL *(Falco sparverius)*
Common in winter; rare breeder*

MERLIN (*Falco columbarius*)
Uncommon to almost rare in winter

PEREGRINE FALCON *(Falco peregrinus)*
Uncommon to rare in winter

Order *Galiformes*

Family *Phasianidae* **PHEASANTS, GROUSE, QUAILS**

NORTHERN BOBWHITE (*Colinus virginianus*)
Rare to uncommon resident

WILD TURKEY (*Meleagris gallopavo*)
Rare to common (locally) resident

Order *Gruiformes*

Family *Rallidae* RAILS, GALLINULES, COOTS

YELLOW RAIL (*Coturnicops novaboracensis*)
Rare in winter

BLACK RAIL *(Laterallus jamaicensis)*
Rare in winter

KING RAIL (*Rallus elegans*)
Rather common resident

CLAPPER RAIL *(Rallus longirostris)*
Common resident

VIRGINIA RAIL *(Rallus limicola)*
Uncommon in winter

SORA *(Porzana carolina)*
Uncommon to fairly common in winter

PURPLE GALLINULE *(Porphyrula martinica)*
Uncommon in summer; rare in winter

COMMON MOORHEN *(Gallinula chloropus)*
Common resident

AMERICAN COOT (*Fulica americana*)
Common to abundant in winter; rare to uncommon in summer

Order *Charadriiformes*

Family *Charadriidae* PLOVERS

BLACK-BELLIED PLOVER *(Pluvialis squatarola)*
Common to very common in winter; common migrant; uncommon summer visitor*

LESSER GOLDEN PLOVER *(Pluvialis dominica)*
Uncommon to common spring migrant; occasional fall migrant

MONGOLIAN PLOVER *(Charadrius mongolus)*
Accidental migrant*

SNOWY PLOVER *(Charadrius alexandrinus)*
Rare migrant; rare in winter

WILSON'S PLOVER *(Charadrius wilsonia)*
Common in summer; uncommon to rare in winter

SEMIPALMATED PLOVER *(Charadrius semipalmatus)*
Uncommon to common migrant; uncommon in winter

PIPING PLOVER *(Charadrius melodus)*
Uncommon to common migrant; uncommon to rare in winter

KILLDEER *(Charadrius vociferus)*
Very common to abundant resident

Family *Haematopodidae* OYSTERCATCHERS

AMERICAN OYSTERCATCHER *(Haematopus palliatus)*
Locally rare in summer

Family *Recurvirostridae* AVOCETS AND STILTS

BLACK-NECKED STILT *(Himantopus mexicanus)*
Common to very common in summer; uncommon in winter

AMERICAN AVOCET *(Recurvirostra anericana)*
Rare to uncommon in winter

Family *Scolopacidae* SANDPIPERS

GREATER YELLOWLEGS *(Tringa melanoleuca)*
Common in winter; probably can be found in every month (nonbreeders)

LESSER YELLOWLEGS *(Tringa flavipes)*
Very common in winter; probably can be found in every month (nonbreeders)

SOLITARY SANDPIPER *(Tringa solitaria)*
Uncommon to sometimes common migrant

WILLET *(Catoptrophorus semipalmatus)*
Common to very common resident

SPOTTED SANDPIPER *(Actitus macularia)*
Common in winter

UPLAND SANDPIPER *(Bartramia longicauda)*
Uncommon migrant

ESKIMO CURLEW *(Numenius borealis)*
Possibly EXTINCT

WHIMBREL *(Numenius phaeopus)*
Rare winter visitor

LONG-BILLED CURLEW *(Numenius borealis)*
Occasional to accidental migrant*

HUDSONIAN GODWIT *(Limosa haemastica)*
Occasional migrant

MARBLED GODWIT *(Limosa fedoa)*
Common to uncommon migrant; uncommon to rare in winter; casual in summer

RUDDY TURNSTONE *(Arenaria interpres)*
Common in winter

RED KNOT *(Calidris canutus)*
Uncommon to rare in winter; common migrant*

SANDERLING *(Calidris alba)*
Very common in winter; uncommon to rare in summer; common migrant*

SEMIPALMATED SANDPIPER *(Calidris pusilla)*
Regular to common migrant

WESTERN SANDPIPER *(Calidris mauri)*
Common to adundant in winter; abundant migrant*

LEAST SANDPIPER *(Calidris minutilla)*
Very common in winter; probably found in every month; common migrant*

WHITE-RUMPED SANDPIPER *(Calidris fuscicollis)*
Uncommon to common spring migrant

BAIRD'S SANDPIPER *(Calidris bairdii)*
Rare to occasional migrant

PECTORAL SANDPIPER *(Calidris melanotos)*
Common migrant

PURPLE SANDPIPER *(Calidris maritima)*
Accidental in winter

DUNLIN *(Calidris alpina)*
Common to very common in winter

CURLEW SANDPIPER *(Calidris ferruginea)*
Accidental migrant*

STILT SANDPIPER *(Calidris himantopus)*
Common to very common migrant

BUFF-BREASTED SANDPIPER *(Tryngites subruficollis)*
Uncommon migrant

SHORT-BILLED DOWITCHER *(Limnodromus griseus)*
Abundant migrant; common in winter

LONG-BILLED DOWITCHER *(Limnodromus scolopaceus)*
Common migrant; regular to common in winter

COMMON SNIPE *(Gallinago gallinago)*
Fairly common in winter

AMERICAN WOODCOCK *(Scolopax minor)*
Uncommon to locally common in winter

WILSON'S PHALAROPE *(Phalaropus tricolor)*
Uncommon migrant

RED-NECKED PHALAROPE *(Phalaropus lobatus)*
Accidental fall migrant*

RED PHALAROPE *(Phalaropus fulicaria)*
Accidental fall migrant*

Family *Laridae* GULLS, TERNS, AND SKIMMERS

LAUGHING GULL *(Larus atricilla)*
Abundant resident

FRANKLIN'S GULL *(Larus pipixcan)*
Uncommon to rare fall migrant; rare to casual in spring

BONAPARTE'S GULL (*Larus philadephia*)
Common in winter

RING-BILLED GULL *(Larus delawarensis)*
Abundant in winter; uncommon to rare in summer

HERRING GULL *(Larus argentatus)*
Abundant in winter

THAYER'S GULL *(Larus thayeri)*
Rare in winter

LESSER BLACK-BACKED GULL *(Larus fuscus)*
Rare winter visitor

GLAUCOUS GULL *(Larus hyperboreus)*
Casual in winter

GREAT BLACK-BACKED GULL *(Larus marinus)*
Rare in winter

SABINE'S GULL *(Xema sabini)*
Accidental migrant*

GULL-BILLED TERN (*Sterna nilotica*)

Uncommon resident

CASPIAN TERN *(Sterna caspia)*
Common resident

ROYAL TERN *(Sterna maxima)*
Very common to abundant resident

SANDWICH TERN *(Sterna sandvicensis)*
Abundant summer nester; uncommon to rare in winter

COMMON TERN *(Sterna hirundo)*
Common late spring migrant; uncommon to rare in winter

FORSTER'S TERN *(Sterna forsteri)*
Common resident

LEAST TERN *(Sterna antillarum)*
Common to locally abundant summer nester

BRIDLED TERN *(Sterna anaethetus)*
Erratic

SOOTY TERN *(Sterna fuscata)*
Erratic

BLACK TERN *(Chlidonias niger)*
Regular non-breeding in summer; erratic in winter

BLACK SKIMMER *(Rynchops niger)*
Common resident

Order *Columbiformes*

Family *Columbidae* DOVES AND PIGEONS

ROCK DOVE *(Columba livia)*
Very common resident

EURASIAN COLLARED DOVE *(Streptopelia decaocto)*
Introduced; uncommon, but increasing

WHITE-WINGED DOVE *(Zenaida asiatica)*
Uncommon to rare in winter; possibly a casual breeder

MOURNING DOVE *(Zenaida macroura)*
Very common to abundant resident

PASSENGER PIGEON *(Ectopistes migratorius)*
EXTINCT

COMMON GROUND DOVE *(Columbina passerina)*
Rare in winter

Family *Psittacidae* PARAKEETS

CAROLINA PARAKEET *(Consuropsis carolinensis)*
EXTINCT

Order *Cuculiformes*

Family *Cuculidae* CUCKOOS AND ALLIES

BLACK-BILLED CUCKOO (*Cocyzus erythropthalmus*)
Quite uncommon to uncommon migrant

YELLOW-BILLED CUCKOO *(Coccyzus americanus)*
Common to abundant migrant; common breeder in summer*

GROOVE-BILLED ANI *(Crotophaga sulcirostris)*
Uncommon to rare in winter

Order *Strigiformes*

Family *Tytonidae* BARN-OWLS

COMMON BARN-OWL *(Tyto alba)*
Uncommon resident

Family *Strigidae* TYPICAL OWLS

EASTERN SCREECH-OWL *(Otus asio)*
Common resident

GREAT HORNED OWL *(Bubo virginianus)*
Uncommon to fairly common resident

SNOWY OWL (*Nyctea sadica*)
Accidental visitor

BURROWING OWL *(Athene cunicularia)*
Rare in winter

BARRED OWL *(Strix varia)*
Common to abundant resident

SHORT-EARED OWL *(Asio flammeus)*
Rare in winter

Order *Caprimulgiformes*

Family *Caprimulgidae* NIGHTJARS

LESSER NIGHTHAWK *(Chordeiles acutipennis)*
Very rare to occasional migrant; very rare to occasional in winter*

COMMON NIGHTHAWK *(Chordeiles minor)*
Common in summer; rare in winter*

CHUCK-WILL'S-WIDOW *(Caprimulgus carolinensis)*
Uncommon migrant; rare in winter*

WHIP-POOR-WILL *(Caprimulgus vociferus)*
Uncommon to rare migrant; very rare in winter*

Order *Apodiformes*

Family *Apodidae* SWIFTS

CHIMNEY SWIFT (*Chaetura pelagica*)
Very common in summer*

Family *Trochilidae* HUMMINGBIRDS

BROAD-BILLED HUMMINGBIRD *(Cyanthus latirostris)*
Accidental

BUFF-BELLIED HUMMINGBIRD *(Amazilla yucatanensis)*

Uncommon to rare in winter visitor (feeders)

BLUE-THROATED HUMMINGBIRD *(Lampornis clemenciae)*
Accidental

RUBY-THROATED HUMMINGBIRD *(Archilochus colubris)*
Common in summer; casual winter visitor; most frequently seen of the BTS hummingbirds in field and feeders

BLACK-CHINNED HUMMINGBIRD *(Archilochus alexandri)*
Uncommon to rare winter visitor (feeders and occasionally in field)

CALLIOPE HUMMINGBIRD *(Stellula calliope)*
Rare or casual winter visitor

BROAD-TAILED HUMMINGBIRD *(Selasphorus platyceras)*
Rare or casual winter visitor

RUFOUS HUMMINGBIRD (*Selasphorus rufus)*
Uncommon winter visitor (feeders and occasionally in field)

ALLEN'S HUMMINGBIRD (*Selasphorus sasin*)
Rare or casual winter visitor

Order *Coraciiformes*

Family *Alcedinidae* KINGFISHERS

BELTED KINGFISHER *(Ceryle alcyon)*
Common in winter; may breed*

Order *Piciformes*

Family *Picidae* WOODPECKERS

RED-HEADED WOODPECKER *(Melanerpes erythrocephalus)*
Rare resident*

RED-BELLIED WOODPECKER *(Melanerpes carolinus)*
Common resident

YELLOW-BELLIED SAPSUCKER *(Sphyrapicus varius)*
Common in winter

DOWNY WOODPECKER *(Picoides pubescens)*
Common resident

HAIRY WOODPECKER (*Picoides villosus*)
Uncommon to common resident

NORTHERN FLICKER *(Colaptes auratus)*
Common to very common in winter; uncommon to rare breeder

PILEATED WOODPECKER *(Dryocopus pileatus)*
Uncommon to fairly common resident

IVORY-BILLED WOODPECKER *(Campephilus principalis)*
Likely EXTINCT

Order *Passeriformes*

Family *Tyrannidae* FLYCATCHERS

OLIVE-SIDED FLYCATCHER *(Contopus borealis)*
Uncommon fall migrant

EASTERN WOOD PEWEE *(Contopus virens)*
Common to very common migrant; uncommon nesting bird

YELLOW-BELLIED FLYCATCHER *(Empidonax flaviventris)*
Uncommon migrant

ACADIAN FLYCATCHER *(Empidonax virescens)*
Common in summer

LEAST FLYCATCHER (*Empidonax minimus*)
Probable uncommon migrant

CORDILLERAN FLYCATCHER *(Empidonax difficilis)*
Accidental visitor

EASTERN PHOEBE *(Sayornis phoebe)*
Common in winter

VERMILLION FLYCATCHER (*Pyrocephalus rubinus*)
Rare fall migrant; rare winter visitor

ASH-THROATED FLYCATCHER (*Myiarchus cinerascens*)
Rare winter visitor

GREAT-CRESTED FLYCATCHER *(Myiarchus crinitus)*
Common in summer

BROWN-CRESTED FLYCATCHER *(Myiarchus tyrannulus)*
Rare to casual winter visitor

SULPHUR-BELLIED FLYCATCHER *(Myiodynastes luteiventris)*
Accidental

TROPICAL KINGBIRD *(Tyrannus melancholicus)*
Accidental

COUCH'S KINGBIRD *(Tyrannus couchii)*
Accidental

WESTERN KINGBIRD *(Tyrannus verticalis)*
Rare to very uncommon migrant; rare to very common winter visitor*

EASTERN KINGBIRD *(Tyrannus tyrannus)*
Common to very common in summer

GRAY KINGBIRD *(Tyrannus dominicensis)*
Occasional visitor in spring

SCISSOR-TAILED FLYCATCHER *(Tyrannus forficatus)*
Rare visitor, mostly in fall

Family *Alaudidae* LARKS

HORNED LARK *(Eremophila alpestris)*
Occasional in winter

Family *Hirundinidae* SWALLOWS

PURPLE MARTIN *(Progne subis)*
Common to abundant in summer

TREE SWALLOW *(Tachycineta bicolor)*
Common to abundant in winter

NORTHERN ROUGH-WINGED SWALLOW *(Stelgidopteryx serripennis)*
Common to uncommon migrant; rare in winter; possible breeder

BANK SWALLOW *(Riparia riparia)*
Common to uncommon migrant

CLIFF SWALLOW (*Hirundo pyrshonota*)
Rare to uncommon migrant; probably expanding and may already be breeding in BTS

BARN SWALLOW *(Hirundo rustica)*
Common in summer

Family *Corvdae* JAYS AND CROWS

BLUE JAY *(Cyanocitta cristata)*
Common resident

AMERICAN CROW *(Corvus brachyrhyncos)*
Common to abundant resident

FISH CROW *(Corvus ossifragus)*
Common to abundant resident

Family *Paridae* CHICKADEES AND TITMICE

CAROLINA CHICKADEE *(Parus carolinensis)*
Common resident

TUFTED TITMOUSE *(Parus bicolor)*
Uncommon to common resident

Family *Certhiidae* CREEPERS

BROWN CREEPER *(Certhia americana)*
Uncommon to rare in winter

Family *Troglodytidae* WRENS

CAROLINA WREN *(Thryothorus ludovicianus)*
Common to very common resident

BEWICK'S WREN *(Thryomanes bewickii)*
Occasional in winter

HOUSE WREN *(Troglodytes aedon)*
Common in winter

WINTER WREN *(Troglodytes troglodytes)*
Uncommon in winter

SEDGE WREN *(Cisothorus platensis)*
Common in winter

MARSH WREN *(Cisothorus palustris)*
Common to uncommon resident

Family *Muscicapidae* OLD WORLD WARBLERS AND THRUSHERS

GOLDEN-CROWNED KINGLET *(Regulus satrapa)*
Uncommon in winter

RUBY-CROWNED KINGLET *(Regulus calendula)*
Very common in winter

BLUE-GRAY GNATCATCHER *(Polioptila caerulea)*
Uncommon resident; common migrant

EASTERN BLUEBIRD *(Sialia sialis)*
Uncommon resident

VEERY *(Catharus fuscescens)*
Common to uncommon migrant

GRAY-CHEEKED THRUSH *(Catharus minimus)*
Common migrant

SWAINSON'S THRUSH *(Catharus ustulatus)*
Common to abundant migrant

HERMIT THRUSH *(Catharus guttatus)*
Uncommon in winter

WOOD THRUSH *(Hylocichla mustelina)*
Uncommon to common resident; fairly common migrant

AMERICAN ROBIN *(Turdus migratorius)*
Abundant in winter; may breed locally*

VARIED THRUSH *(Ixoreus naevius)*
Accidental visitor

Family *Mimidae* MIMIC THRUSHES

GRAY CATBIRD *(Dumetella carolinensis)*
Common to abundant migrant; uncommon in winter; occasional local breeder

NORTHERN MOCKINGBIRD *(Mimus polyglottos)*
Very common resident

SAGE THRASHER *(Oreoscoptes montanus)*
Occasional visitor

BROWN THRASHER *(Toxostoma rufum)*
Common in winter; breeds locally and sparingly

Family *Motacillidae* PIPITS

WATER PIPIT *(Anthus spinoletta)*
Uncommon to common in winter

SPRAGUE'S PIPIT *(Anthus spragueii)*
Rare in winter

Family *Bombycillidae* WAXWINGS

CEDAR WAXWING *(Bombycilla cedrorum)*
Common in winter

Family *Laniidae* SHRIKES

LOGGERHEAD SHRIKE *(Lanius ludovicianus)*
Common resident

Family *Sturnidae* STARLINGS

EUROPEAN STARLING *(Sturnus vulgaris)*
Introduced, abundant resident

Family *Vireonidae* VIREOS

WHITE-EYED VIREO *(Vireo griseus)*
Common in summer; uncommon in winter; abundant migrant*

BELL'S VIREO *(Vireo bellii)*
Accidental in winter*

SOLITARY VIREO *(Vireo solitarius)*
Uncommon to common winter visitor

YELLOW-THROATED VIREO *(Vireo flavifrons)*
Common migrant; erratic in winter; uncommon breeder*

WARBLING VIREO *(Vireo gilvus)*
Very uncommon to almost rare migrant*

PHILADELPHIA VIREO *(Vireo philadelphicus)*
Uncommon spring migrant; occasionally common fall migrant

RED-EYED VIREO *(Vireo olivaceous)*
Very common in summer; often abundant migrant

BLACK-WHISKERED VIREO *(Vireo altiloquus)*
Casual migrant; possibly occasionally nesting

Family *Emberizidae* WOOD WARBLERS, TANAGERS, GROSBEAKS, SPARROWS, BLACKBIRDS, ORIOLES

BACHMAN'S WARBLER *(Vermivora bachmanii)*
Possibly EXTINCT

BLUE-WINGED WARBLER *(Vermivora pinus)*
Uncommon to common migrant

GOLDEN-WINGED WARBLER *(Vermivora chrysoptera)*
Uncommon migrant

TENNESSEE WARBLER *(Vermivora peregrina)*
Common to very common migrant

ORANGE-CROWNED WARBLER *(Vermivora celata)*
Common in winter

NASHVILLE WARBLER *(Vermivora ruficapilla)*
Rare fall migrant, occasional spring migrant

LUCY'S WARBLER *(Vermivora luciae)*
Accidental winter visitor

NORTHERN PARULA *(Parula americana)*
Very common migrant; very common in summer

YELLOW WARBLER *(Dendroica petchia)*
Uncommon to common spring migrant; very common to sometimes abundant fall migrant

CHESTNUT-SIDED WARBLER *(Dendroica pensylvanica)*
Uncommon migrant

MAGNOLIA WARBLER *(Dendroica magnolia)*
Common migrant

CAPE MAY WARBLER *(Dendroica tigrina)*
Rare spring migrant

BLACK-THROATED BLUE WARBLER *(Dendroica caerulescens)*
Rare migrant

YELLOW-RUMPED WARBLER *(Dendroica coronata)*
Very common to abundant in winter

BLACK-THROATED GRAY WARBLER *(Dendroica nigrescens)*
Casual in winter

HERMIT WARBLER *(Dendroica occidentalis)*
Accidental

BLACK-THROATED GREEN WARBLER *(Dendroica virens)*
Common migrant

BLACKBURNIAN WARBLER *(Dendroica fusca)*
Uncommon to common migrant

YELLOW-THROATED WARBLER *(Dendroica dominica)*
Common in summer

PINE WARBLER *(Dendroica pinus)*
Regular in winter*

PRAIRIE WARBLER *(Dendroica discolor)*
Regular fall migrant; uncommon spring migrant

PALM WARBLER *(Dendroica palmarum)*
Uncommon in winter

BAY-BREASTED WARBLER *(Dendroica castanea)*
Common late spring migrant; uncommon to occasionally common fall migrant

BLACKPOLL WARBLER *(Dendroica striata)*
Uncommon to common spring migrant

CERULEAN WARBLER *(Dendroica caerulea)*
Uncommon migrant

BLACK-AND-WHITE WARBLER *(Mniotilta varia)*
Common migrant; rare in winter

AMERICAN REDSTART *(Setophaga ruticilla)*
Common migrant; uncommon in summer; may breed locally*

PROTHONOTARY WARBLER *(Protonotaria citrea)*
Common in summer; common migrant*

WORM-EATING WARBLER *(Helmitheros vermivorus)*
Uncommon to common migrant

SWAINSON'S WARBLER *(Limnothlypsis swainsonii)*
Uncommon in summer; uncommon migrant*

OVENBIRD *(Seiurus aurocapillus)*
Common migrant; rare in winter*

NORTHERN WATERTHRUSH *(Seiurus novaboracensis)*
Common migrant; very uncommon in winter*

LOUISIANA WATERTHRUSH *(Seiurus motacilla)*
Uncommon migrant

KENTUCKY WARBLER *(Oporornis formosus)*
Uncommon to common migrant; uncommon to common in summer

MOURNING WARBLER *(Oporornis philadelphia)*
Rare fall migrant

MACGILLIVRAY'S WARBLER *(Oporornis tolmiei)*
Accidental*

COMMON YELLOWTHROAT *(Geothlypis trichas)*
Common to abundant resident; common to abundant migrant*

HOODED WARBLER *(Wilsonia citrina)*
Common in summer; common migrant*

WILSON'S WARBLER (*Wilsonia pusilla*)
Regular uncommon to rare winter visitor; somewhat more common migrant

CANADA WARBLER *(Wilsonia canadensis)*
Uncommon fall migrant; rare spring migrant

YELLOW-BREASTED CHAT *(Icteria virens)*
Fairly common in summer; uncommon to rare migrant

SUMMER TANAGER *(Piranga rubra)*
Common migrant; uncommon in summer*

SCARLET TANAGER *(Piranga olivacea)*
Fairly common migrant

WESTERN TANAGER *(Piranga ludoviciana)*
Rare visitor in fall and winter

NORTHERN CARDINAL *(Cardinalis cardinalis)*
Very common resident

ROSE-BREASTED GROSBEAK *(Pheucticus ludovicianus)*
Fairly common migrant

BLACK-HEADED GROSBEAK *(Pheucticus melanocephalus)*
Rare visitor in fall and winter

BLUE GROSBEAK *(Guiraca caerulea)*
Common to abundant migrant; casual winter visitor near coast*

INDIGO BUNTING *(Passerina cyanea)*
Common to abundant migrant; uncommon to common in summer; casual winter visitor

PAINTED BUNTING *(Passerina ciris)*
Common in summer; casual winter visitor

DICKCISSEL *(Spiza americana)*
Rare migrant; casual winter visitor; possibly rare BTS breeder

RUFOUS-SIDED [EASTERN] TOWHEE *(Pipilo erythrophthalmus)*
Common resident

CHIPPING SPARROW *(Spizella passerina)*
Common in winter

CLAY-COLORED SPARROW *(Spizella pallida)*
Rare fall migrant

FIELD SPARROW (*Spizella pusilla*)
Uncommon in winter

VESPER SPARROW *(Pooecetes gramineus)*
Uncommon in winter

LARK SPARROW *(Chondestes grammacus)*
Uncommon fall migrant; rare winter visitor

LARK BUNTING *(Calamospiza melanocorys)*
Accidental

SAVANNAH SPARROW *(Passerculus sandwichensis)*
Common in winter

GRASSHOPPER SPARROW *(Ammodramus savannarum)*
Uncommon in winter

LECONTE'S SPARROW (*Ammodramus leconteii*)
Uncommon in winter

SHARP-TAILED SPARROW *(Ammodramus caudacutas)*
Common in winter

SEASIDE SPARROW *(Ammodramus maritima)*
Common to very common resident

FOX SPARROW *(Passerella iliaca)*
Casual to rare in winter

SONG SPARROW *(Melospiza melodia)*
Common in winter

LINCOLN'S SPARROW *(Melospiza lincolnii)*
Uncommon to rare in winter

SWAMP SPARROW *(Melospiza georgiana)*
Very common to abundant in winter

WHITE-THROATED SPARROW *(Zonotrichia albicollis)*
Common in winter

GOLDEN-CROWNED SPARROW *(Zonotrichia atricapilla)*
Accidental

WHITE-CROWNED SPARROW (*Zonotrichia leucophrys*)
Uncommon in winter

BOBOLINK *(Dolichonyx oryzivorus)*
Uncommon to sometimes common spring migrant; rare in fall

RED-WINGED BLACKBIRD *(Agelaius phoeniceus)*
Abundant resident

EASTERN MEADOWLARK *(Sturnella magna)*
Common resident

YELLOW-HEADED BLACKBIRD *(Xanthocephalus xanthocephalus)*
Casual to rare visitor, mostly in fall

RUSTY BLACKBIRD *(Euphagus carolinus)*
Uncommon to common in winter

BREWER'S BLACKBIRD *(Euphagus cyanocephalus)*
Very uncommon in winter*

BOAT-TAILED GRACKLE *(Quiscalus major)*
Common to very common resident

COMMON GRACKLE *(Quiscalus quiscula)*
Very common to abundant resident

SHINY COWBIRD *(Molothrus bonariensis)*
Accidental

BRONZED COWBIRD *(Molothrus aeneus)*
Uncommon to common in summer; uncommon to rare in winter

BROWN-HEADED COWBIRD *(Molothrus ater)*
Common resident

ORCHARD ORIOLE *(Icterus spurius)*
Common to very common migrant; fairly common in summer;

BALTIMORE ORIOLE *(Icterus galbula galbula)*
Common migrant; rare breeder; rare in winter*

BULLOCK'S ORIOLE *(Icterus galbula bullockii)*
Almost rare to rare winter visitor

SCOTT'S ORIOLE *(Icterus parisorum)*
Accidental in winter

Family *Fringillidae* FINCHES

PURPLE FINCH *(Carpodacus purpureus)*
Erratic in winter

HOUSE FINCH *(Carpodacus mexicanus)*
Invading, expanding into region

RED CROSSBILL *(Loxia curvirostra)*
Accidental

PINE SISKIN *(Carduelis pinus)*
Uncommon and erratic winter visitor

LESSER GOLDFINCH *(Carduelis psaltria)*

Accidental

AMERICAN GOLDFINCH *(Carduelis tristis)*
Common to abundant in winter

EVENING GROSBEAK *(Coccothraustes vesperitinus)*
Casual and erratic

Family *Passeridae* OLD WORLD SPARROWS

HOUSE SPARROW *(Passer domesticus)*
Common to abundant resident

Table A.5. Mammals of the Barataria-Terrebonne estuarine system (after Lowery 1974a). This table includes mammals now at least locally extinct but present when the French first began to colonize Louisiana in 1699.

Order *Marsupialia*

Family *Dipelphidae* OPOSSUMS

VIRGINIA OPOSSUM *(Didelphis virginiana)*

Order *Insectivora*

Family *Soricidae* SHREWS

LEAST SHREW *(Cryptotis parva)*

Order *Chiroptera*

Family *Vespertilionidae* VESPERTILIONID BATS

SOUTHEASTERN MYOTIS *(Myotis austroriparius)*

EASTERN PIPISTRELLE *(Pipistrellus subflavus)*

BIG BROWN BAT *(Eptesicus fuscus)*

RED BAT *(Lasiurus borealis)*

SEMINOLE BAT *(Lasiurus seminolus)*

HOARY BAT *(Lasiurus cinereus)*

NORTHERN YELLOW BAT *(Lasiurus intermedius)*

EVENING BAT *(Nycticeius humeralis)*

RAFINESQUE'S BIG-EARED BAT *(Plecotus rafinesquii)*

Family *Molossidae* FREE-TAILED BATS

BRAZILIAN FREE-TAILED BAT *(Tadarida brasiliensis)*

Order *Edentata*

Family *Dasypodidae* ARMADILLOS

NINE-BANDED ARMADILLO *(Dasypus novemcinctus)*

Order *Lagomorpha*

Family *Leporidae* HARES AND RABBITS

EASTERN COTTONTAIL *(Sylvilagus floridanus)*

SWAMP RABBIT *(Sylvilagus aquaticus)*

Order *Rodentia*

Family *Sciuridae* SQUIRRELS

GRAY SQUIRREL *(Sciurus carolinensis)*

FOX SQUIRREL *(Sciurus niger)*

SOUTHERN FLYING SQUIRREL *(Glaucomys volans)*

Family *Castoridae* BEAVERS

AMERICAN BEAVER *(Castor canadensis)*

Family *Cricetidae* NEW WORLD RATS AND MICE

MARSH RICE RAT *(Oryzomys palustris)*

EASTERN HARVEST MOUSE *(Reithrodontomys humulis)*

FULVOUS HARVEST MOUSE *(Reithrodontomys fulvescens)*

WHITE-FOOTED MOUSE *(Peromyscus leucopus)*

COTTON MOUSE *(Peromyscus gossypinus)*

HISPID COTTON RAT *(Sigmodon hispidus)*

EASTERN WOOD RAT *(Neotoma floridana)*

WOODLAND VOLE *(Microtus pinetorum)*

COMMON MUSKRAT *(Ondatra zibethicus)*

Family *Muridae* INTRODUCED, OLD WORLD RATS AND MICE

ROOF RAT *(Rattus rattus)*

NORWAY RAT *(Rattus norvegicus)*

HOUSE MOUSE *(Mus musculus)*

Family *Capromyidae* INTRODUCED, COYPUS AND HUTIAS

NUTRIA *(Myocastor coypus)*

Order *Cetacea*

Family *Delphinidae* PORPOISES AND DOLPHINS

BOTTLE-NOSED DOLPHIN *(Tursiops truncatus)*

SHORT-FINNED PILOT WHALE *(Globicephala macrorhyncha)*

Order *Carnivora*

Family *Canidae* FOXES, WOLVES, AND COYOTES

COYOTE *(Canis latrans)*

RED WOLF *(Canis rufus)*

RED FOX *(Vulpes fulva)*

GRAY FOX *(Urocyon cinereoargenteus)*

Family *Ursidae* BEARS

AMERICAN BLACK BEAR *(Euarctos americanus)*

Family *Procyonidae* RACCOONS

NORTHERN RACCOON *(Procyon lotor)*

Family *Mustelidae* MUSTELIDS

LONG-TAILED WEASEL *(Mustela frenata)*

NORTH AMERICAN MINK *(Mustela vison)*

STRIPED SKUNK *(Mephitis mephitis)*

NEARCTIC RIVER OTTER *(Lutra canadensis)*

Family *Felidae* CATS

COUGAR *(Felis concolor)*

BOBCAT *(Lynx rufus)*

Order *Artiodactyla*

Family *Cervidae* DEER

WHITE-TAILED DEER *(Odocoileus virginianus)*

Family *Bovidae* BOVIDS

BISON *(Bison bison)*