

Briefing Paper on Galveston Bay Plan Action Items
Habitat Protection

Jim Lester, PhD. And Lisa Gonzalez
Houston Advanced Research Center
Galveston Bay Status and Trends Project
Funded by the TCEQ, Galveston Bay Estuary Program
July 2005

Overview

Goals of the Galveston Bay Plan

- Expand areas and restore quality of wetland habitats.
- Halt the conversion of wetlands to other uses.
- Acquire existing wetlands and encourage preservation.
- Restore and create colonial bird nesting sites.
- Selectively moderate erosional impacts.

The Galveston Bay Estuary Program (GBEP) is a program of the Texas Commission on Environmental Quality (TCEQ). GBEP successfully works with a variety of partners and stakeholders to facilitate implementation of goals and objectives outlined in The Galveston Bay Plan (The Plan). The Plan is a Comprehensive Conservation and Management Plan (CCMP) for the Galveston Bay ecosystem, developed as a part of the National Estuary Program process. The Plan was developed by building consensus among citizens, industry, business, development, academia, and government.

The Plan places a high priority on protection of habitat for the naturally occurring plants and wildlife that make up the ecosystems of the Lower Galveston Bay watershed. Loss of habitat such as wetlands, riparian areas along stream banks, coastal prairies, and seagrass meadows directly affects fish and wildlife populations through the loss of vital nursery, nesting and foraging areas. Diverse plant populations are vital components of healthy habitats; that species diversity is lost when habitat is altered. Habitat loss also limits the ability of the bay ecosystem to absorb flood waters and assimilate pollutants.

The Plan sets goals that include the protection, restoration and creation of wetland habitat to preclude net losses. Net loss of wetlands occurs when overall losses in wetland acreage are greater than gains in wetland acreage. Wetlands have ecological value in terms of wildlife habitat, flood mitigation and improvement of water quality. Wetlands, as defined by the guidelines issued by the Army Corps of Engineers (ACE), have special legal status and are protected by a system of permitting and mitigation for losses. Although the current national policy is to avoid net loss of wetlands by protecting them with a permitting system, there has been a large loss of wetland acreage in the Galveston Bay watershed over the historical record.

The wetland permitting system does not currently cover all types of wetlands found in the Galveston Bay watershed and does not cover other types of habitat that have special significance for management agencies overseeing Galveston Bay. The wet prairies of the Gulf Coast are

actually wetland complexes that have significance for stormwater flow and wildlife habitat, but are not currently considered under the ACE's jurisdiction.

Seagrass meadows, formed by submerged aquatic grasses primarily in Trinity, West and Christmas Bays, have special ecological significance and are targets of restoration efforts in the Galveston Bay system. Seagrass meadows are preferred habitat for many juvenile fish and shellfish and provide food for threatened and endangered species of sea turtles.

Oyster reefs are a significant ecological feature of Galveston Bay that has commercial importance as well. The Texas Parks and Wildlife Department (TPWD) estimates that statewide commercial landings of Eastern oysters (*Crassostrea virginica*) neared \$15 billion in ex-vessel value in 2004. In addition to their economic value, oysters filter algae and organic particles out of the water. The more oysters, the greater the clarity of the water. Oysters also form consolidated reefs that act as habitat for other estuarine organisms. Because of their ecological and economic importance oyster reefs are an ecosystem also targeted for restoration and creation.

Migratory songbirds and waterfowl receive special protection under treaties and hunting regulations. Habitat for ducks and geese has been increased through the development of National Wildlife Refuges (NWRs) in the Lower Galveston Bay watershed. NWRs also benefit other types of birds and wildlife that share habitat requirements. Colonial nesting waterbirds (egrets, herons, and others) are a significant feature of the Galveston Bay ecosystem. Their numbers are monitored and efforts have been made to protect and create nesting habitat for them.

The historical trends in loss of various types of habitat are examined below. Several of the habitat types that are declining in the region are targeted for restoration and creation. These include freshwater wetlands of several types: fringing marsh in brackish water, submerged aquatic vegetation (seagrass), oyster reef, and bird nesting habitat.

In addition to habitat creation and restoration, some habitats are degraded by human activities or the consequences of those activities, particularly invasion by exotic species which have the potential to damage the ecology of the bay system. In accordance with The Plan, GBEP is facilitating the prevention and control of exotic plants and animals introduced accidentally or intentionally by humans.

When European settlers arrived in the Galveston Bay region, there were no navigational channels and no hard structures in and around the bay, except oyster reefs. Since that time, dredging activity has removed millions of cubic yards of sediment and created large dredge disposal islands, e.g. Pelican Island and Atkinson Island. Maintaining the Houston, Galveston and Texas City ship channels requires nearly continuous dredging with potential adverse impacts. The Plan calls for reducing those adverse impacts and increasing the beneficial uses of the sediment removed. To this end, several major habitat creation projects have been conducted to produce fringing marsh and waterbird nesting habitat using the dredged material.

Historical trends

Freshwater and Fringing Marsh

Habitat for native wildlife has been directly impacted by the conversion of land from its natural state to residential, commercial or industrial use. Every acre of developed land reduces native habitat and has an impact beyond the area of developed land through pollution, noise, light, microclimate changes, etc. Wetland habitats in the Galveston Bay watershed declined by more than 30,000 acres between 1953 and 1989 (White et al., 1993). An additional 2,913 acres of estuarine marsh (Webb, 2005) and 9,124 acres of freshwater marsh (Jacob and Lopez, 2005) have been lost between 1992 and 2002.

Seagrass

In the Galveston Bay system, seagrass historically flourished in four locations: the Trinity River delta, the western shore of Galveston Bay between Seabrook and San Leon, the southern shore of West Bay, and Christmas Bay. Between the 1950s and late 1980s, approximately 1,700 acres of seagrass meadows were lost. By 1990, seagrass meadows were extirpated from West Bay and the western shore of Galveston Bay proper. By the mid-1990s, seagrass meadows were limited only to Christmas Bay and upper Trinity Bay and amounted to less than 300 acres. Since that time, an area of more than 100 acres adjacent to the Galveston Island State Park in West Bay has been restored.

Oyster Reefs

Oysters are extremely prolific and will establish a reef in any place where conditions are suitable and larvae are transported. When Houston was first settled, an ancient oyster reef separated Galveston Bay into upper and lower parts. This reef stretched from Smith Point on the eastern end to Eagle Point on the western end and had only one small gap through which shallow draft boats could pass. There were extensive oyster reefs throughout Trinity, East and West Bays as well. In the latter half of the 19th century, oyster shell became a construction material and was commercially harvested. In the first half of the 20th century, oyster shell became an industrial commodity and oyster shell dredging intensified. Millions of cubic yards of oyster shell were removed from the bay, some of it from living reefs. This practice greatly reduced the area covered by oyster reef habitat, but was prohibited in 1969. Since 1969, oyster reef area has been increasing and some oyster reef has been created by shell placement.

Open Bay Bottom

Open bay bottom is not a habitat that receives special consideration or any efforts at restoration or improvement. However, the practice of open water disposal of dredge material from channel and shell dredging resulted in covering the benthic ecosystem with smothering layers of mud. Historical practices reduced the productivity of the benthic ecosystem by killing large areas. Avoidance of open water dredge disposal has improved the survival of bottom dwelling creatures that support wildlife. However, the practice of harvesting shrimp and fish by trawling also damages the organisms in the upper layer of the soft bottom and continues to date.

Bird Nesting Habitat

One of the attractions that Galveston Bay holds for tourists is the abundance of birds. Two general feeding types are common to the birds that feed and breed around the bay: open water fishers, like terns and brown pelicans, and marsh-edge hunters, like herons and egrets. Each species requires two types of habitat, terrestrial habitat for nesting and aquatic habitat for feeding. Nesting activity is particularly vulnerable to disturbance and predation. Islands are popular nesting habitat because they tend to have fewer disturbances. Disposal of dredge material has increased the number and size of islands in some parts of the bay system; however, other historical islands have disappeared, e.g. Redfish Island near Eagle Point and the cluster of islands called the Vingt-uns near Smith Point. Provision of nesting habitat is the strongest justification for creation of islands in the bay using dredge material.

Development Practices

150 years ago, every tributary of the bay was lined with riparian forest and these forests were separated by a wet prairie that contained pothole wetlands during the wet seasons. Development has proceeded to replace much of the riparian forest and the coastal prairie with buildings and roads. Many Houston-area tributaries have been straightened and some tributaries, such as Brays Bayou have been lined with concrete.

Current Status of Habitat in the Galveston Bay Watershed

Land Conversion

The use of land in Galveston Bay's surrounding watershed has a profound effect on the resources of the estuary. The amount of developed land (commercial, residential, and agricultural) in a watershed directly affects the amount of available wildlife habitat, the volume of surface runoff, and the types and amounts of nonpoint source contaminants flowing into tributaries and Galveston Bay. Figure 1 below, created by the Galveston Bay Indicators Project, shows how much land in the five counties around the bay is still available for habitat. Land use was classified into nine categories by the Houston-Galveston Area Council (H-GAC) in 2003 using 2001 and 2002 Landsat images (30-meter resolution) of the Houston metropolitan area. The classification categories used for comparison of developed and undeveloped land are:

Developed Land:

- *High intensity developed land* (Contains little or no vegetation.)
- *Low intensity developed land* (Contains substantial amounts of constructed surface mixed with substantial amounts of vegetated surface.)
- *Cultivated land* (Includes cropland, orchards and nurseries.)

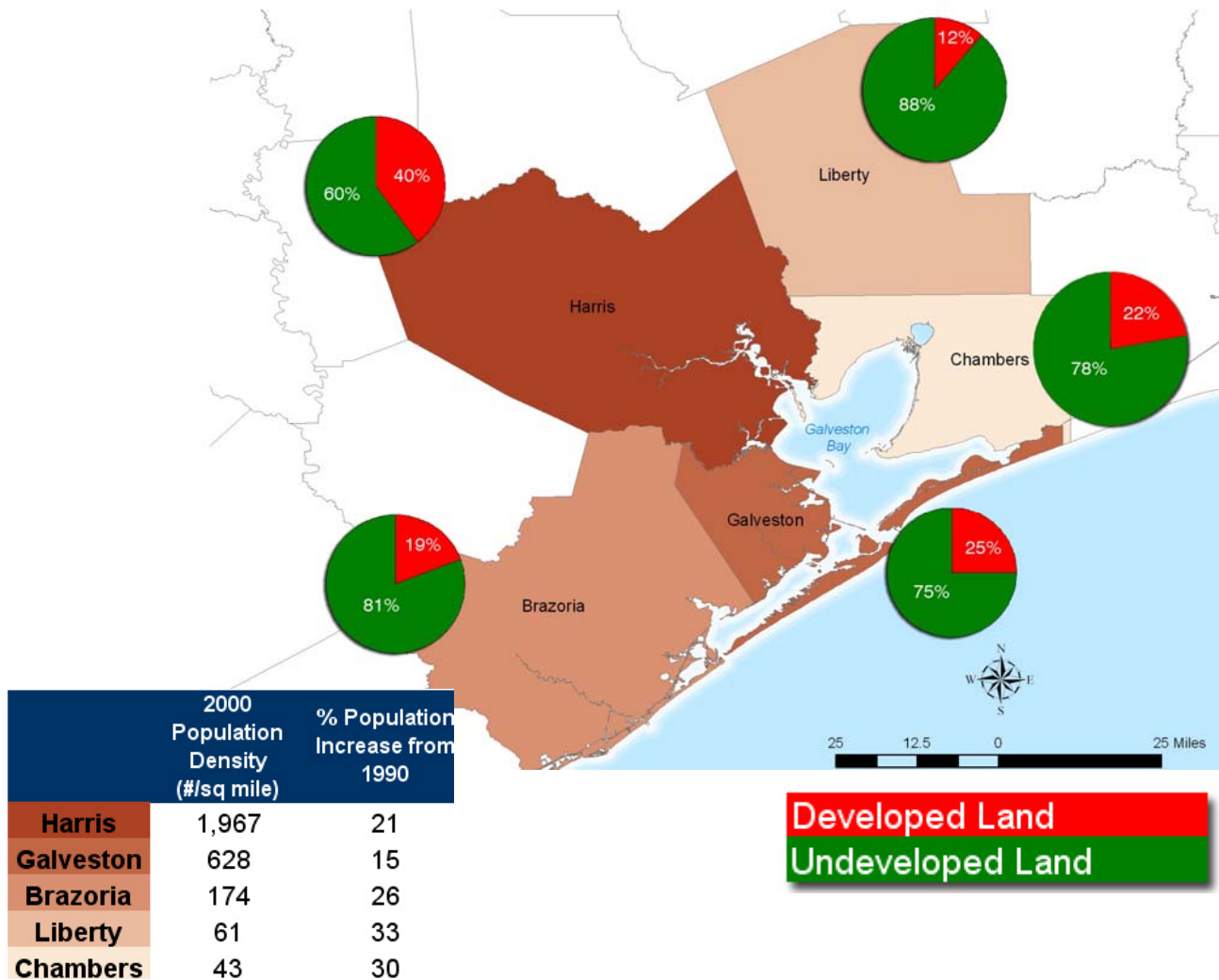
Undeveloped Land:

- *Grassland* (Includes lawns, golf courses, areas converted to grassland, pastures, and prairies.)
- *Woody land* (Includes non-agricultural trees and shrubs.)
- *Woody wetland*
- *Non-woody wetland*
- *Bare / transitional land*

Acreage for the two categories (developed land and undeveloped land) was calculated for each county and divided by the total acreage of each county.

The counties in the figure are shaded according to population density. The figure also includes numbers describing population growth. The combined graphic of percent land cover, population density, and population growth shows that while the densely populated counties of Harris and Galveston have the greatest percentage of developed land, the more sparsely populated counties of Brazoria, Chamber, and Liberty are experiencing the greatest population growth. Habitat losses seen in Harris and Galveston counties could eventually be seen in the other three counties around Galveston Bay if population and land development patterns continue.

Figure 1. The pie charts represent two classes of land use in the five counties surrounding Galveston Bay as a percentage of total land classified. Shaded counties correspond to population density in table inset. Figure created by the Galveston Bay Indicators Project, Houston Advanced Research Center. Data source: H-GAC Clean Rivers Program 2003 Land Use Data and U.S. Census Bureau.



The Galveston Bay Estuary is surrounded by a watershed that is home to the fourth largest city in the Nation. Population in the region is on the increase as is the development associated with the construction of new homes and businesses. Like many large metropolitan areas, development is not limited to the urban city center. People are drawn to the suburbs in pursuit of quality of life that often is rooted in the landscape. As people and development are drawn to the suburbs of Houston and Galveston, the landscape which attracts them is altered. Ecosystems that support valuable ecological services such as wildlife habitat, flood protection, and stream buffers are converted into urban and suburban developments. In many cases, the ecological services provided prior to habitat alteration are lost or reduced. The loss and fragmentation of habitat in the watershed directly affects the populations of plants and animals in the Bay.

A 2005 freshwater wetland assessment project funded by the GBEP used GIS analyses to assess wetland loss for the years 1992-2002. Figure 2 shows the results of that analysis. Jacob and Lopez (2005) determined that the Lower Galveston Bay Watershed has lost at least 3.1% of its freshwater wetland acreage since 1992. Harris County experienced the greatest loss (nearly 13%), most between the years 2000 and 2002. Jacob and Lopez estimate that rates of freshwater wetland loss will occur on a large scale in Brazoria, Fort Bend, and Galveston counties in the coming years.

Figure 2. Total freshwater wetland loss in the Lower Galveston Bay Watershed, 1992-2002. Green areas are undeveloped wetlands as of 2002. Red areas are developed or filled wetlands. Map created by: Jacob and Lopez, 2005.

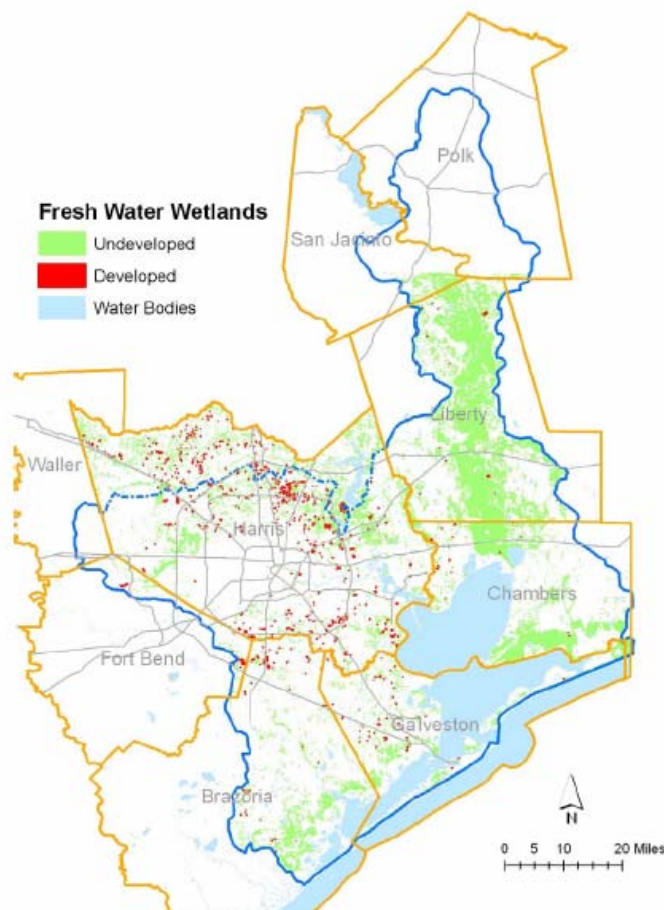
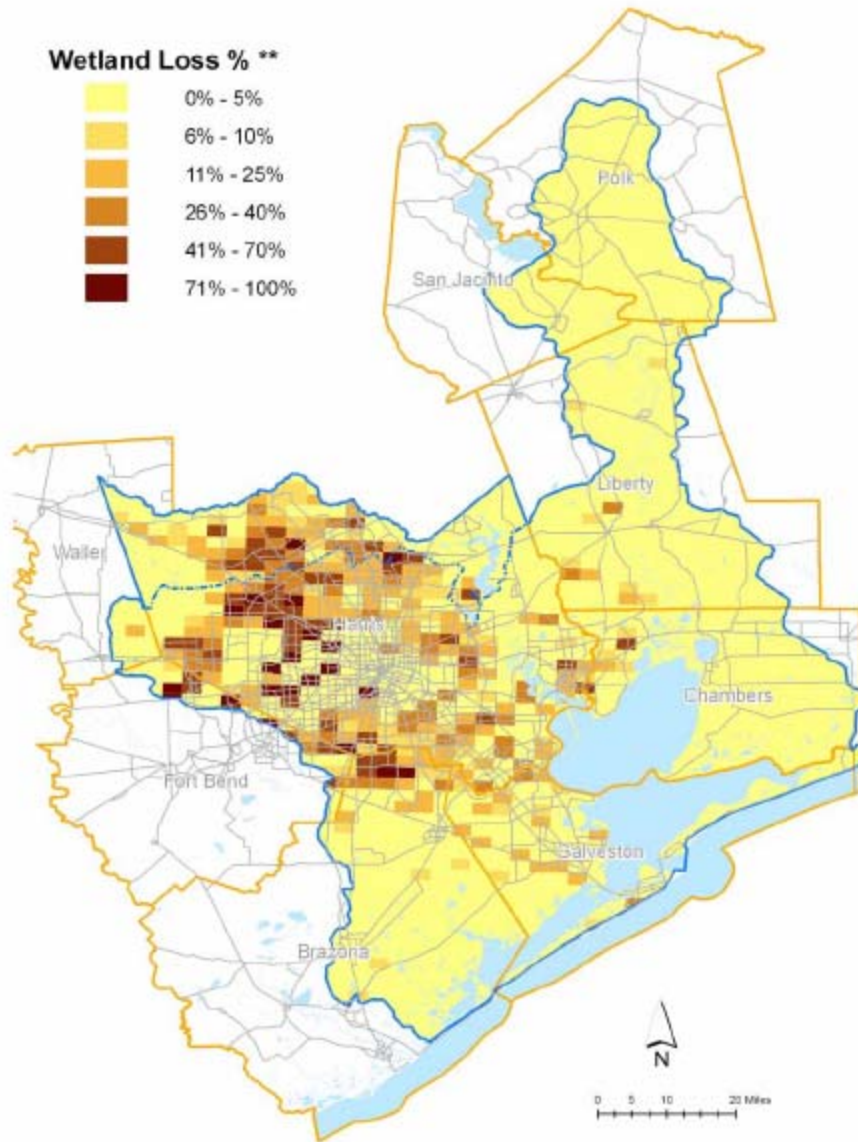


Figure 3. Freshwater wetland loss in the Lower Galveston Bay Watershed as a percentage of individual cell areas (2.5 by 1.6 mile cells). Map created by: Jacob and Lopez, 2005.



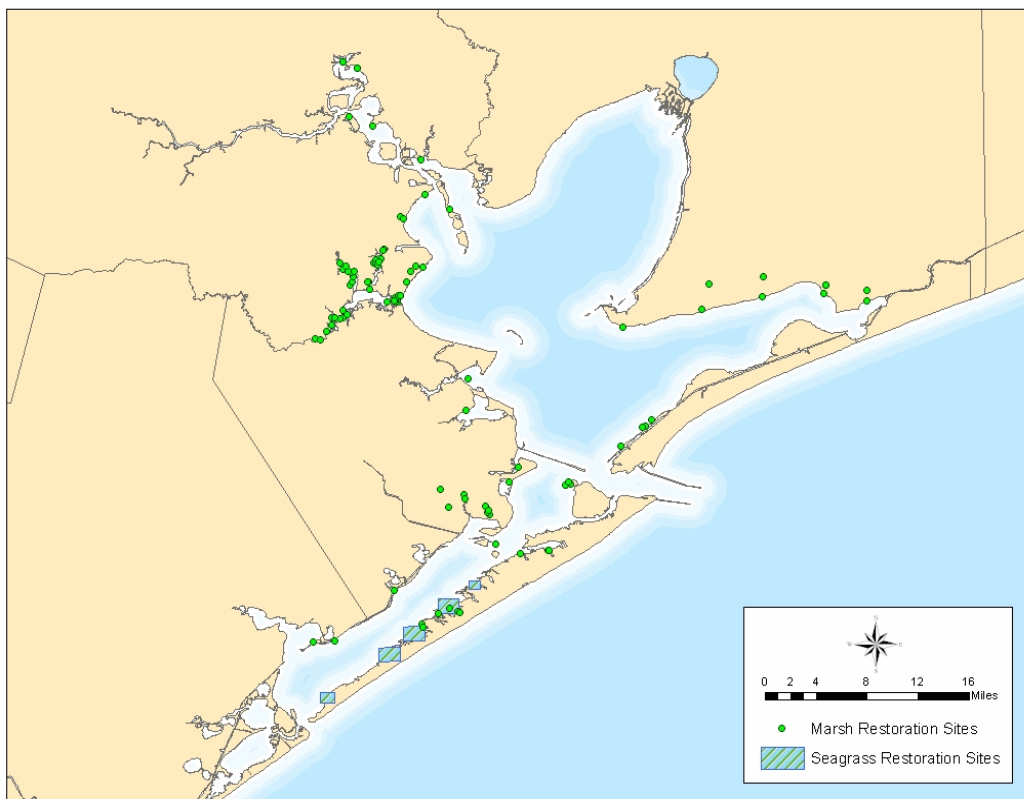
Restoration

When assessing the quantity and quality of important habitats in an estuary's watershed, one must not stop with an assessment of habitat loss. One must also assess the rate at which new habitats are created through habitat restoration and mitigation. *The Galveston Bay Plan* identifies habitat loss as a priority issue for Galveston Bay and proposes to increase the acreage of wetland habitats as well as restore the quality of degraded habitats in the watershed. Specifically, *The Plan* recommends the restoration of 15,000 acres of wetlands by the year 2005. This includes 1,400 acres of seagrass or submerged aquatic vegetation (SAV), 5,000 acres of fresh marsh, and 8,600 acres of estuarine emergent marsh.

A number of agencies and organizations in the Lower Galveston Bay Watershed are active in the arena of habitat restoration and mitigation. Available GIS data sets describing fringing wetland and SAV restoration sites were obtained from the NOAA Fisheries Galveston Laboratory, the TPWD Coastal Fisheries Division, the Galveston Bay Foundation, and the US Fish and Wildlife Service Texas Coastal Program. The data layers were combined to create the habitat restoration site map in the Figure below.

This graphic depicts the locations of 103 fringing marsh and SAV restoration sites planted in the Lower Galveston Bay watershed since 1973. Data describing the acreage and date of restoration site plantings are currently incomplete.

Figure 4. Locations of 103 fringing marsh and SAV restoration sites planted in the Lower Galveston Bay watershed since 1973. Map created by the Galveston Bay Indicators Project, Houston Advanced Research Center. Data source: Dr. Geoffrey Matthews, National Marine Fisheries Service Galveston Laboratory; US Fish and Wildlife Service Texas Coastal Program, and the Texas Parks and Wildlife Department.



Although marsh and seagrass sites are the highest priorities for restoration under *The Galveston Bay Plan*, there are efforts to restore or create additional habitat in the forms of oyster reefs and bird nesting islands. Both intertidal and submerged oyster reef creation has been implemented. It is too early to assess the long-term success of current approaches to oyster reef creation. Creation of bird nesting habitat was included among the beneficial uses of dredge material from the widening and deepening of the Houston Ship Channel. Creation of spoil islands is usually

followed by nesting activity; however, the impact of this nesting activity on adult abundance of the nesting species has not yet been determined.

Habitat Management Activities

Texas is a state that has great reverence for private property rights. While the wildlife is considered the property of the state, the habitat of that wildlife on private property is not protected by any state law. Wetland habitat that occurs on private property is subject to regulation by Section 10 of the Rivers and Harbors Act (1899) and Section 404 of the Clean Water Act (1972). Under some circumstances, the Endangered Species Act (ESA) may protect Critical Habitat. Habitat protection under the ESA is managed by the U.S. Fish and Wildlife Service (FWS) and National Oceanic and Atmospheric Administration (NOAA) Fisheries. Species identified as endangered in the bay system are Brown Pelican, Atwater's Prairie Chicken, piping plover, and all species of sea turtle. Reddish egret and white-faced ibis are considered threatened and nest in rookeries around Galveston Bay.

The ACE is responsible for issuing permits under Sections 10 and 404 to destroy wetlands and for determining what mitigation will be required to offset any permitted destruction. Other federal agencies, state natural resource agencies and the public are given the opportunity to comment on permit applications. Few permits are denied if they meet procedural requirements, but permits often include mitigation requirements. There is considerable debate about the ecological equivalence of natural and created wetlands. Thus, most mitigation projects are more than twice the area of the natural wetland destroyed. In 2001, a U.S. Supreme Court ruling known as SWANCC limited the ACE's jurisdiction to only those wetlands that border navigable waters of the United States. This ruling removed all "isolated" or freshwater wetlands including pothole complexes from the protection of the ACE permitting process.

The Clean Water Act (CWA) is primarily aimed at protecting the quality of water for human health. In addition, water bodies can be declared impaired if they become less suitable for aquatic life. In other words, aquatic habitat is protected under the CWA from pollution that harms the organisms that live in the water. Water bodies that are impaired for aquatic life use are listed on the 303(d) list of impaired waters determined by TCEQ. Figure 4 shows all of the waters in the lower Galveston Bay watershed listed as impaired for aquatic life. Waters recognized as impaired under the CWA are subject to special regulations and the development of a Total Maximum Daily Load study intended to identify ways of restoring the water quality.

When non-point source (NPS) pollution is the cause of habitat degradation, there are few regulatory strategies that can be effectively employed. Treatment of storm water can be required in large municipalities, but much of the storm water comes from unincorporated land.

Figure 5. Map depicting stream segments listed on the 2002 Texas 303d List as being impaired for the Aquatic Life Use. Map created by: NBII Central Southwest Gulf Coast Information Node, Houston Advanced Research Center.



Regulation of Aquatic Nuisance Species and Ballast Water

The zebra mussel is a very expensive nuisance to communities and industries around the Great Lakes and Mississippi River. It awakened the country to the need to regulate introduction of aquatic nuisance species. The Coast Guard has responsibility for implementing the regulations on ballast water exchange by shipping vessels. The Texas Department of Agriculture regulates the transport, sale and possession of some exotic invasive plant species that inhabit aquatic, wetland or other habitats in and around Galveston Bay. The Texas Parks and Wildlife Department (TPWD) regulates exotic fish and invertebrates that are considered potentially harmful to aquatic ecosystems and are listed as prohibited. Although some pathways and species are subject to regulation, there are still many opportunities for exotic species to be introduced into Galveston Bay and surrounding habitats without violating any law or regulation.

Non-regulatory Efforts

While the regulatory system managed by the ACE is intended to ensure against net loss of regulated wetlands, there are other approaches that have been adopted by public agencies to protect this and other types of habitats. The most reliable and permanent of those approaches is purchase of land for public ownership. The Plan encourages this form of habitat protection. The

FWS has acquired large tracts of land bordering East Bay and Christmas Bay in the Lower Galveston Bay watershed for National Wildlife Refuges. The TPWD manages a large tract on Galveston Island as a state park. The ACE manages large tracts near the mouth of the Trinity River and upstream of Houston on Buffalo Bayou. In addition, counties and cities in the watershed have acquired land and set it aside for conservation and nature recreation.

The state of Texas owns the land under Galveston Bay. It leases some of it to oyster harvesters and some to oil and gas exploration and production companies. Private organizations and individuals are also engaged in the protection and restoration of habitat around Galveston Bay. Organizations such as Armand Bayou Nature Center, Audubon Society, Galveston Bay Foundation and Scenic Galveston own and manage large tracts of land specifically to protect ecological function. Volunteers of these and similar organizations work with agencies, including GBEP to restore habitat on public and private land. Most of the restoration work is aimed at wetland habitat. Some projects have focused on other habitat types, including creation of oyster reef by shell placement and restoration of coastal prairie by removal of invasive species.

A few tracts of land have been secured specifically as habitat for endangered species. For example, The Nature Conservancy manages property north of Texas City as habitat for the endangered Atwater's prairie chicken. One species using the Audubon property near the North Jetty at the mouth of Galveston Bay is the endangered piping plover.

Educational campaigns exist for reduction of nonpoint source pollution and may be having some success. Clean-up projects that remove trash from fringing habitat and tributaries, such as Trash Bash, are managed as educational programs.

Harris County Flood Control and others who create floodwater detention ponds are interested in designing components of the flood mitigation system that contribute to water quality and habitat by incorporating permanent wetlands into the design. Wet bottom detention ponds and other wetland features are being added to the drainage system in Harris and adjoining counties. Studies are planned to determine the effectiveness of these features in improving water quality. They will increase the amount of habitat for some wetland species.

Effectiveness

Regulatory efforts to protect and increase habitat are primarily focused on fringing wetlands, or wetlands that have a direct connection to navigable waters. It is common practice of ACE to mitigate the destruction of natural wetlands with twice the area of created wetlands and more in some cases. Despite the mitigation requirement, there does not appear to be a reversal of the trend in wetland loss. There are a number of contributing factors, including relative sea level rise and continued land development. As long as habitat is converted for human use at rates that exceed those of habitat creation, the effectiveness of the regulatory process that has been implemented for many years will be very much in doubt.

Similar conclusions could be reached for the regulation of habitat for threatened and endangered species. Some species are increasing, e.g. brown pelican, and some continue to decrease, e.g. Atwater's prairie chicken.

Non-regulatory approaches by various organizations or partnerships seem to be more effective in reversing local trends of habitat loss. Stewardship of habitat by the FWS, Armand Bayou Nature Center, Scenic Galveston, Galveston Bay Foundation, and others appears to offer long-term solutions for habitat protection. It is not clear that enough habitat is protected by ownership of conservation organizations to protect the productivity and diversity of the Galveston Bay system.

Conclusion

The acreage of developed land in the Galveston Bay watershed continues to increase. This conversion of undeveloped land to developed land reduces the quantity of available terrestrial habitat. A similar, but less intensive, process goes on in the waters of the bay and tributaries. Conversion of bayous to drainage systems and portions of the Bay to shipping channels, docks, marinas, etc. takes these areas out of the habitat/undeveloped category. Some of these reductions of habitat are accompanied by mitigation efforts to replace the habitat lost, especially if regulated wetland habitat is destroyed. In addition, GBEP and its partners are engaged in protection, restoration and creation efforts designed to increase primarily marsh and seagrass habitat by more than 40% above 1995 levels. Unfortunately, there is no comprehensive assessment system to determine how the quantity and quality of habitat is changing over time. The number of habitat protection and creation projects has increased and they are having beneficial effects. However, we do not know exactly how much progress has been made toward the Galveston Bay Plan goal.

References

Jacob, John and Ricardo Lopez. 2005. Freshwater, Non-tidal Wetland Loss Lower Galveston Bay Watershed 1992-2002: A Rapid Assessment Method Using GIS and Aerial Photography. Galveston Bay Estuary Program, Webster, Texas, 62 pp.

White, W.A., T.A. Tremblay, E.G. Wermund, Jr., and L.R. Handley. 1993. Trends and status of wetland and aquatic habitats in the Galveston Bay system, Texas. Galveston Bay National Estuary Program Publication GBNEP-31. Webster, Texas.

Webb, J.W. 2005. Galveston Bay: Estuarine and Marine Habitat Change Analysis. Galveston Bay Estuary Program, Webster, Texas, 35 pp.