water (especially by subsidence), has resulted in serious losses at Virginia Point and the associated area around Jones Lake; at Armand Bayou; along the lower San Jacinto River valley; and in the Trinity River delta. Shifting of the ground due to faults has drowned well over 1,200 acres of marsh on Bolivar Peninsula. Erosion has probably taken another 2,400 aces of marsh. Permanent impoundments (such as a power plant cooling pond) have converted at least 2,000 acres of marsh to shallow open water. These losses have been partially compensated by marsh development due to subsidence of transitional areas (inland of East and West Bays and on Galveston Island) and by artificial water management of coastal marshes and the spread of marsh grasses to formerly unvegetated areas.

Another loss to estuarine wetlands that may be at least as severe as the losses discussed above is isolation of marsh from the estuarine system. The 1936 conversion of Turtle Bay to Lake Anahuac, a freshwater storage area, isolated 10,000 acres of estuarine wetlands. Levees for waterfowl management in the Trinity River delta and hurricane protection for Texas City are examples of partial isolation that has affected the character of estuarine wetlands, moving them toward freshwater habitats.

Submerged Underwater Vegetation Losses in Galveston Bay

Submerged grasses declined radically since the 1950's, from 2,500 acres to approximately 700 acres. Ruppia can still be found in beds around the periphery of Trinity Bay. There have been complete losses of grass beds in Galveston Bay, likely due to hurricane storm surges, and West Bay, due to development of the shoreline for residential expansion, wastewater discharges, dredging, and boat traffic. The practice of ***open bay dredge disposal*** (scattering silt dredged from the bottom of channels over wide expanses of bay bottom) is frequently cited as a major cause of declining seagrass beds. The dragging of shrimp trawls over the bottom and through seagrass beds may also take a toll.

Changes in Forested Wetlands

Forested wetlands have increased at the expense of marsh and prairie lands as a result of the introduction of **Chinese tallow** (*Sapium sebiferum*, Roxb.), an exotic species of tree that chokes out native marsh and prairie vegetation and encourages recruitment of trees into coastal prairies and wetlands. Some wetlands have been changed to scrub shrub or forested wetlands due to tallow invasion. Conversion of marshes and prairies to forest eliminates habitat for some species of resident, migratory and wintering birds requiring open prairie and wetlands. Chinese tallow is not a desirable species for wildlife habitat, and is extremely difficult to eradicate. Other, desirable forested wetlands, especially areas along small coastal streams, have been cleared extensively for local flood control.

Wetland Values

Wetlands are essential nursery and feeding areas. Researchers have shown a clear relationship between the amount of intertidal vegetation in the estuary and the yield of shrimp caught close to the shoreline. Another study found a significant preference in the use of emergent marsh over unvegetated shallows by brown shrimp, grass shrimp, and blue crab, with densities 5 to 10 times greater in the marsh. A 1992 study for the Galveston Bay National Estuary Program (GBNEP) found declining trends in colonial waterbirds that feed at the marsh-bay interface, suggesting recent reductions in tidal marsh habitat and/or marsh prey species may have affected bird populations.

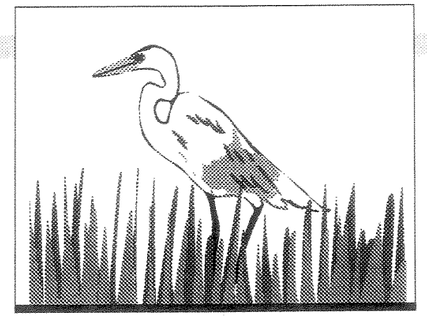
This fact sheet is one of a series produced through a cooperative agreement between the Galveston Bay Foundation and the U.S. Fish and Wildlife Service. The information in this series was developed by authors from the Galveston Bay Foundation, National Marine Fisheries Service, Sea Grant College Program, Texas Natural Resource Conservation Commission, Texas Parks and Wildlife Department, Texas Water Development Board and the U.S. Fish and Wildlife Service.

The Galveston Bay Foundation is a nonprofit organization whose mission is to preserve and enhance the Bay for its multiple uses through education, conservation, research and advocacy. The mission of the U.S. Fish and Wildlife Service is to conserve, protect and enhance the nation's fish and wildlife and their habitats for the continuing benefit of the American people.

For more information, contact the Galveston Bay Foundation at 17324-A Highway 3; Webster, Texas 77598, or call 713/332-3381.

Wetlands of the Galveston Bay System

Anchoring the Bay's Food Chain



Until recently, many wetlands were considered wastelands. Wetlands provide habitat for numerous species of plants and animals, filter the water, and prevent shoreline erosion. Research and experience have shown that wetlands are fragile, essential parts of our environment. They are an integral part of the health of the entire Galveston Bay system.

Why are Wetlands Important?

Wetlands have numerous values: protecting shorelines, filtering excess organic material and nutrients from low quality water (i.e., wastewater treatment) and using them for plant growth; and providing habitat for fish and wildlife. The roots of wetland plants stabilize the soil and absorb nutrients. These plants provide food for ***herbivores*** (vegetarian animals) and ***detritivores*** (animals which eat ***detritus***, or decaying organic matter). Lower ***intertidal marshes*** (marshes that lie between high and low tide lines) provide a hiding place for juvenile finfish as well as shrimp, crabs and other invertebrates. A well-developed stand of emergent marsh is effective for breaking waves and preventing the gradual erosion of a shoreline. In tributaries, wetlands aid in groundwater recharge and flood control by storing excess water.

What is a Wetland?

In simple terms, ***wetlands*** are transitional areas between land and aquatic ecosystems, where the water table is usually at or near the surface, or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: 1) the land supports predominantly ***hydrophytes*** (plants growing in water or soil that is at least periodically deficient in oxygen due to excessive water) at least part of the time, 2) the ***substrate*** (foundation surface) is primarily undrained ***hydric soil*** (soil that is wet long enough to periodically produce anaerobic, or low-oxygen conditions), and/or 3) the substrate is non-soil, and is saturated with water or covered by shallow water for a portion of the growing season each year.

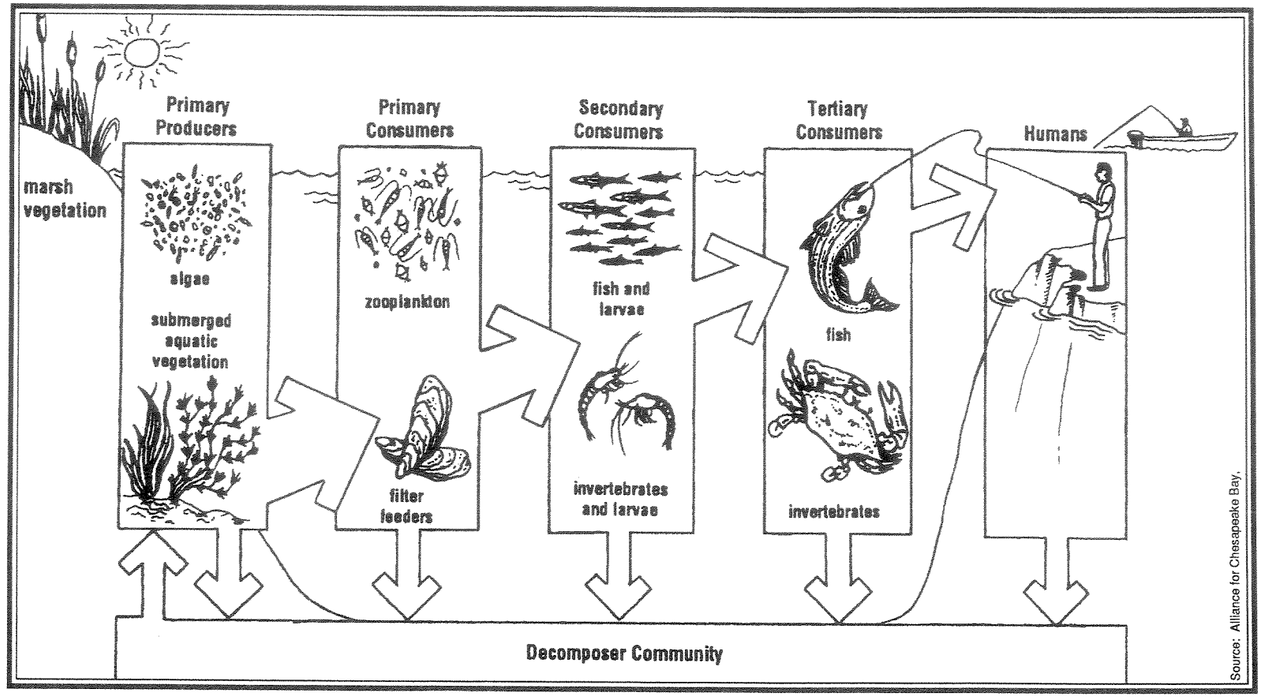
The term wetland includes many different habitats that fall into one of five categories: 1) areas with hydric soils and hydrophytes, commonly known as marshes, swamps or bogs, 2) areas without hydrophytes, but with hydric soils, including flats where water, wave and mineral conditions prevent the growth of hydrophytes, 3) areas without hydrophytes but hydric soils are present, such as margins of impoundments, or areas where excavations have allowed hydrophytes to become established, but hydric soils haven't developed, 4) areas without soil, but with hydrophyte, such

as underwater seagrass beds or seaweed-covered portions of rocky shores, and 5) wetlands without either hydrophytes or soils, which would include gravel beaches or rocky shores.

Wetland plants may be ***herbs*** (grasses and leafy plants without woody tissue), shrubs or trees. Most wetland herbs, whether they live completely under water or emerge from it, usually live for a number of years, with the roots surviving through the winter giving rise to new shoots each spring.

Emergent wetlands may extend from the shore inland as narrow fringes of **smooth cordgrass** (*Spartina alterniflora*) salt marsh or as broader expanses of brackish or fresh marsh. There is a transitional area to uplands at the highest elevations of the marsh. Emergent wetlands can range from high salinity to brackish water, to fresh water. Brackish marsh comprises up to 70 percent of the marshes in the Galveston Bay system, while only five to ten per cent are freshwater.

Brackish marshes are usually saltmeadows of **marshhay cordgrass** (*Spartina patens*) with or without varying amounts of **bulrushes** (*Scirpus* sp.), short grasses (*Distichlis* sp. and *Paspalum* sp.) and small woody plants, such as **sea oxeye daisy** (*Borrichia frutescens*). **Gulf cordgrass** (*Spartina spartinae*) is a widespread component of the lower coastal prairies, transitional zones between marshes and uplands, and also occurs in adjacent brackish marshes. Gulf cordgrass is also found on rather high coastal prairie topography. Stands of woody plants (*Iva* spp. and *Baccharis* spp.) may predominate in brackish marshes at their highest elevations where the transition to uplands begins.



Several varieties of plants can be found in salt marshes. Smooth cordgrass, with or without patches of **blackrush** (*Juncus roemerianus*), is very common in the Galveston Bay system. Fields of **saltgrass** (*Distichlis spicata*) are also common around parts of the Bay. Finally, salt marshes may include salt flats as a result of salts accumulating in the soil when exposed to air. These tidal flats are characterized by very salt-tolerant plants such as **glasswort** (*Salicornia*) and **saltwort** (*Batis*).

Submerged vegetation--the seagrasses--are found in shallow water at a few secluded areas where the water is usually warm and clear. None of these species are "true" grasses, or members of the *Gramineae* family of true grasses. They are called grasses because the stems bear grass-like leaves and rhizomes. **Widgeon grass** (*Ruppia maritima)* is found scattered along the northern and eastern shore of Trinity Bay. Widgeon grass is unique in that it produces small clusters of tiny flowers which rise above the surface of the water.

In Christmas Bay and its associated water bodies, several seagrasses occur, including the dominant **clovergrass** (*Halophila engelmannii*), **shoalgrass** (*Halodule wrightii*), and **turtlegrass** (*Thalassia testudinum*). At one time these grasses occurred extensively in the Christmas Bay area, along the shores of West Bay, and along the west shore of Galveston Bay in the Clear Lake area, but have largely disappeared everywhere but Christmas Bay.

Most forested wetlands of the Galveston Bay system are associated with tidally-influenced rivers. They include the swamps in the Trinity River delta and the ***riparian*** (river bank) forests along coastal streams. Forests also occur in low lying areas on the coastal prairie. These wetlands are especially valuable for migrating songbirds and resident bird species.

Emergent Wetland Losses in the Galveston Bay System

Emergent marshes normally occupy about 61% of the shoreline of an estuarine system. Wetlands rarely survive for any length of time unless they develop in a relatively passive environment. Human activities contributing to wetlands losses include dredging for navigation, flood control, and mineral extraction; filling for dredge spoil disposal or residential and commercial development; construction of levees and dams; and draining for conversion to other land uses such as agriculture. Erosion by large ship wakes or wind-driven waves, natural or man-made isolation of wetlands, and ***subsidence*** (lowering of the land surface due to withdrawal of water and petroleum products from below the surface) also contribute to wetland changes. Creation of an abrupt shoreline with bulkheads and seawalls also destroys wetlands, and may not be as stable as natural marshes.

From the 1950's to 1989, the general trend in the distribution of emergent ***estuarine*** (brackish water) and ***palustrine*** freshwater) marshes in the Galveston Bay system was one of net loss. Of the 165,000 acres of emergent wetlands in the Galveston Bay system in the 1950's, about 21 per cent (35,100 acres) has been lost. Total "gross" loss in emergent vegetation exceeded 88,500 acres, some of which was offset by gains in emergent wetlands in other areas, usually in transitional areas on the edges of existing wetlands, or where marsh vegetation spread over intertidal flats. However, while newly established wetlands provide some measure of offset to net wetland losses in terms of area, there is not necessarily a corresponding offset in terms of immediate functional value. Several years of development may be necessary for newly formed marshes to become functionally equivalent to older marshes. The vast majority of the net loss in Galveston Bay (over 26,400 acres) has been caused by conversion of coastal marsh to open water and flats. Although a variety of causes exist, a major contributing factor in this change is sea-level rise resulting from subsidence. The wetlands in subsided areas ultimately "drown," and are replaced by open water or barren underwater flats.

Approximately 7,000 acres were lost to filling for development and dredged material disposal. Most wetland losses from federal projects have been caused by dredged material disposal in East and West Bays. Permitted losses from activities conducted under section 404 of the Clean Water Act have occurred along the shoreline of the more populated areas of Galveston Island and the west shoreline of Galveston Bay.

Conversion of marsh to open