TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Read All About the Galveston Bay Estuary

Galveston Bay

Discover a Treasure in Your Own Backyard

The Galveston Bay region is experiencing explosive growth. In the next 30 years, the population in the five-county area surrounding the bay is expected to increase by nearly 60 percent—from 4.4 million in 2005 to 6.9 million in 2035.

Rapid growth presents many challenges to the bay and for the Galveston Bay Estuary Program, a nonregulatory program created to protect and restore the Bay for use by current and future generations.

The Estuary Program and its partners—which include local governments, nonprofit conservation organizations, industry, bay-area residents, recreational fishermen, commercial fishermen, state and federal resource agencies, and others—work to maintain and improve water quality, restore wetlands, protect unique habitats, and ensure seafood safety. Through cooperative and collective efforts, the participants have made notable progress in preserving Galveston Bay's ecological and economic health.

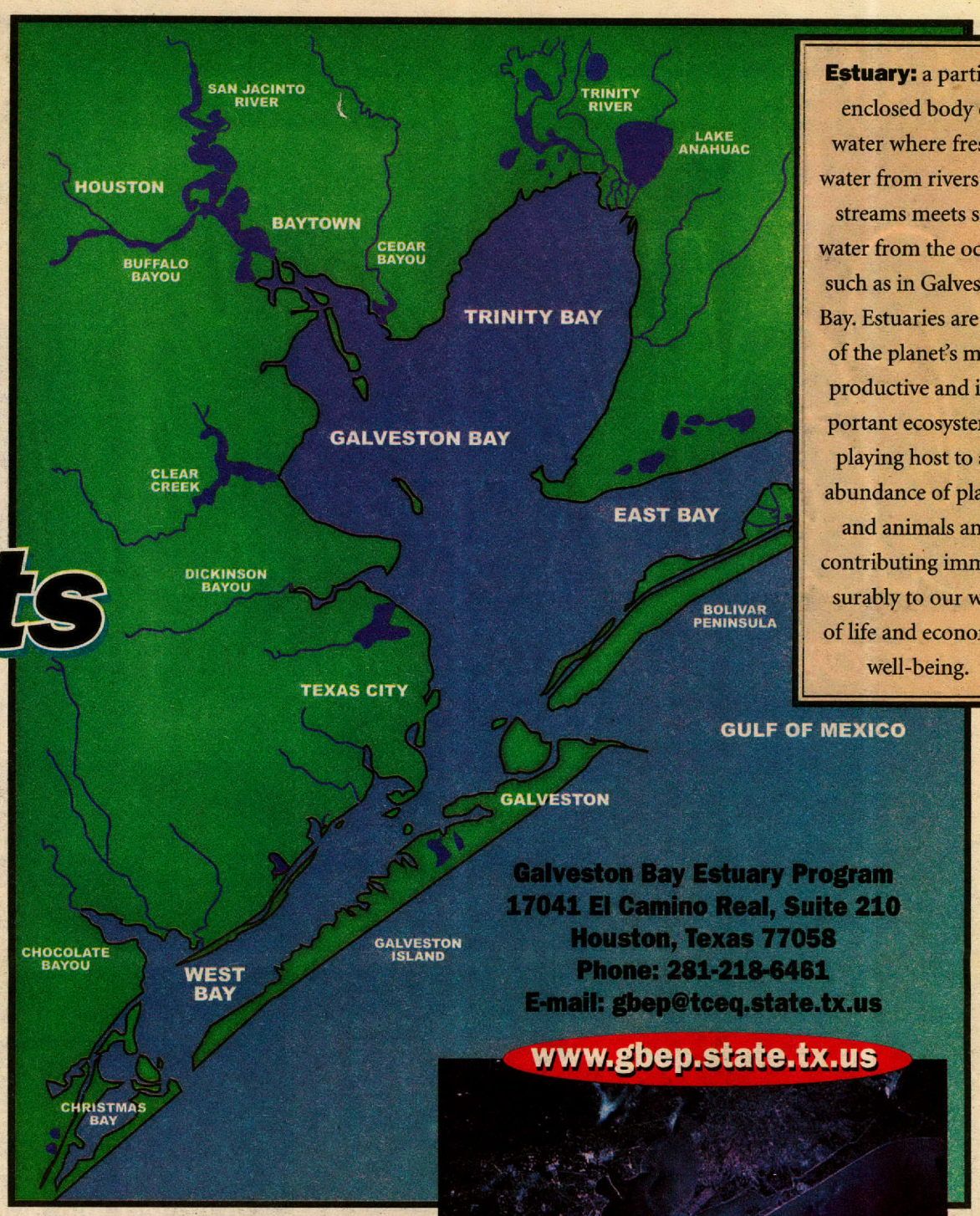
Galveston Bay Estuary Program

GALVESTON BAY ESTUARY PROGRAM

A PROGRAM OF THE TCEQ

Contents

Welcome to *Galveston Bay.* This publication celebrates the many popular and unique features of the Galveston Bay estuary and highlights the safeguards that are needed to ensure that the estuary will remain a treasure for future generations.



Estuary: a partially enclosed body of water where freshwater from rivers and streams meets salt water from the ocean, such as in Galveston Bay. Estuaries are one of the planet's most productive and important ecosystems, playing host to an abundance of plants and animals and contributing immeasurably to our way of life and economic well-being.

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Photo by NASA

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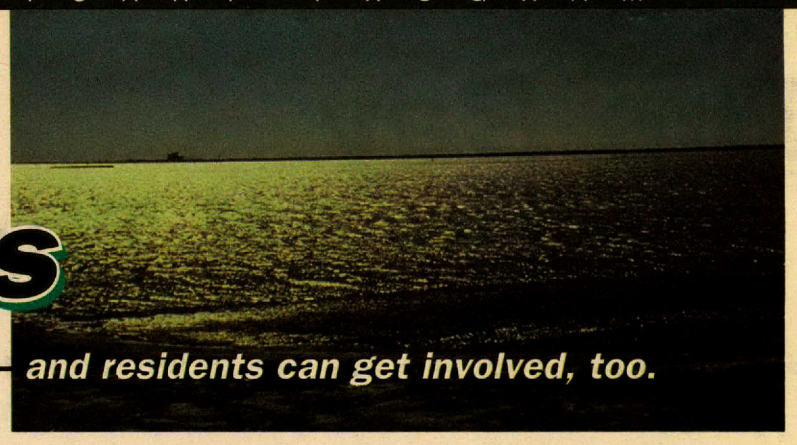
Investing in Natural Assets



There is a wide network of support for Galveston Bay—and residents can get involved, too.

Galveston Bay is at the heart of the Houston-Galveston region's beauty and prosperity. The bay's open waters are connected to a vast system of creeks, streams, and bayous—rich, productive habitats that support a diversity of wildlife.

The bay's natural resources sustain many commercial enterprises. In fact, the environmental, recreational, and economic resources in the Houston-Galveston region are important to the entire state.

With new residents arriving every day, it's helpful to remind everyone about the ecological and economic value of Galveston Bay, the challenges it faces, and what can be done to protect it.

Support network

The Galveston Bay Estuary Program and its public and private partners are actively engaged in maintaining and improving water quality and conserving and restoring natural habitats. That's because excellent water quality and a wide variety of habitats are essential to protecting public health, maintaining the ecological health of the bay system, and supporting commercial and recreational uses.

Fortunately, the water quality of Galveston Bay is relatively good, particularly in the open bay, where a healthy, productive system sustains recreational and commercial fishing, boating, swimming, and other aquatic activities.

At the same time, however, the water quality of the bay's urban tributaries has been adversely affected by numerous industrial and municipal sources. Pollution entering waterways from urban areas has resulted in seafood advisories and closures of shellfish beds. Recreational opportunities have been restricted along stretches of some bayous.

The Galveston Bay watershed still supports many unique and thriving habitats, including saltwater marshes, freshwater and prairie wetlands, and coastal forests. However, the bay's habitats have suffered over the years. For example, the bay's watershed has lost significant amounts of wetlands and other habitats to subsidence, erosion, and development.

Getting involved

Action by individuals is essential. Area residents can take a leading role in maintaining a clean, healthy environment, both by taking action on their own and by participating in public-private partnerships that support the bay's natural resources.

Here are a few things you can do to improve Galveston Bay.

- **Reduce your impact on water quality.** Avoid dumping oil or other chemicals down storm drains. If you use fertilizer and pesticides, apply them properly. Ensure that your septic system is functioning properly with an annual inspection and cleanout.
- **Conserve water.** Landscape with native plants. Water your lawn conservatively and prevent water from running into the streets. Fix leaky toilets and faucets, and purchase low-water-use fixtures and appliances.
- **Involve children.** Help the next generation appreciate Galveston Bay by taking children fishing, crabbing, bird-watching, canoeing, or boating. Take advantage of opportunities for environmental education that are offered by schools and organizations.
- **Volunteer.** Participate in organized activities such as marsh-planting projects, trash cleanups, and workshops on conservation landscaping.

Learn more about these suggestions in the following pages and on the Galveston Bay Estuary Program's citizen and volunteer page at <www.gbep.state.tx.us>. There you will find links to more information and to organizations with which you can volunteer to protect bay habitat. Or just call the Galveston Bay Estuary Program at 281-218-6461 for more information.

Although the bay area serves different people in different ways, it belongs to everyone. Galveston Bay is resilient and can sustain its many uses for future generations to enjoy as long as local communities work toward common goals with a common vision.

Photo by M.D. Anderson

Volunteering is one of many ways you can get involved in protecting your community and Galveston Bay. Here, volunteers pick up trash on Little White Oak Bayou, near downtown Houston.

The Bay Does All That?

Galveston Bay supports our way of life, and the nation's economy, in many ways.

The Galveston Bay area supports an amazing array of uses—popular activities such as recreation and tourism, as well as a variety of industrial activities, from oil and gas extraction and petrochemical manufacturing to fishing and shipping.

These waters support an array of plant and animal life. Visitors travel many miles to fish in Galveston Bay, and birders from around the world come to the region to observe some 500 bird species, many of them migratory. The estuary offers other recreational opportunities that draw thousands of people each year to enjoy area beaches, canoe in tree-shaded bayous, and see the wildlife.

The multitude of activities encompassed within the shoreline of the bay and its bayou tributaries are of major importance to the economy and the quality of life in the area.

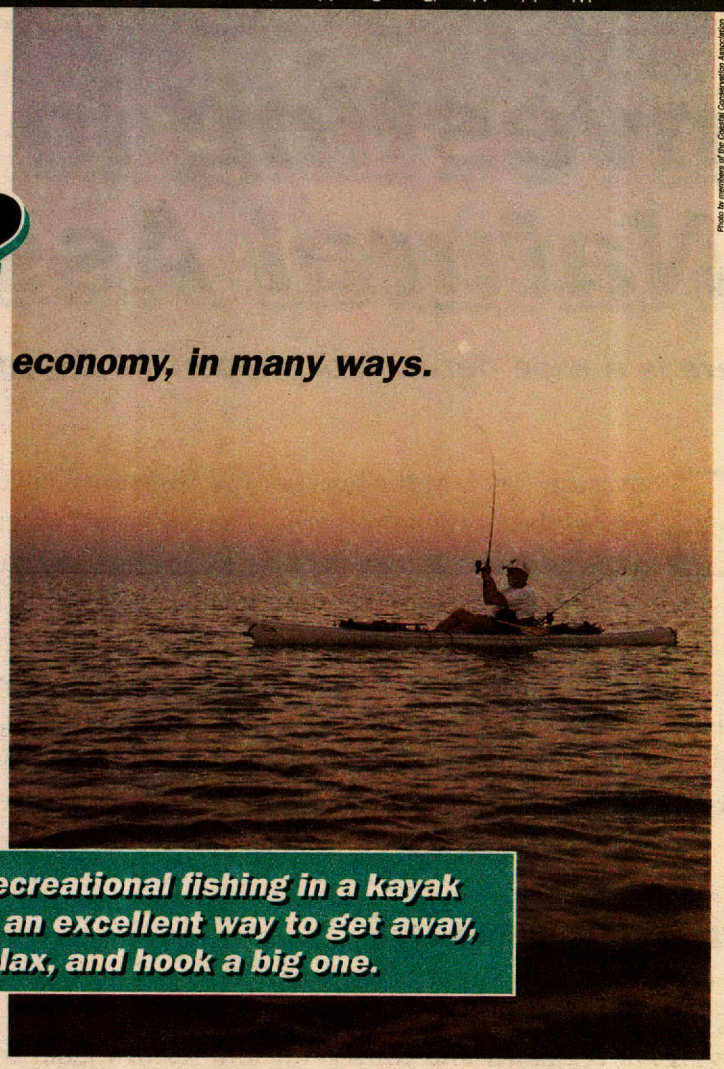


Photo by members of the Coastal Conservation Association

Recreational fishing in a kayak is an excellent way to get away, relax, and hook a big one.

Birdwatching around the bay. The bay has several excellent birdwatching spots. Bald eagles and overwintering waterfowl can be seen at the Wallisville Lake Project *(IH 10 East access road near Trinity River Bridge)*. Bolivar Flats Shorebird Sanctuary is one of the best places in the nation to see shorebirds *(Bolivar Beach and Park, off Loop 108)*. Smith Point is one of the best places in the nation to view migrating hawks in the fall, as well as numerous migratory songbirds in both spring and fall *(Observation Tower at Robbins Park near Anahuac)*.

Did you know?

In terms of seafood, Galveston Bay ranks as the second most productive estuary in the United States, behind only Chesapeake Bay.

At 600 square miles, Galveston Bay is the largest estuary on the Texas coast and the seventh largest in the United States.

About half of U.S. petrochemical production and almost one-third of its petroleum refining can be found within the five counties in the bay area (Harris, Galveston, Liberty, Chambers, and Brazoria).

The Port of Houston—the sixth largest in the world—is the largest U.S. port in foreign tonnage, and the second largest in domestic tonnage.

Galveston Bay has the third largest concentration of recreational boats in the United States. About 90,000 pleasure boats operate in the bay area—hence the title Boating Capital of Texas.

Galveston Bay generates one-third of the state's commercial fishing income. More blue crabs are commercially harvested in these waters than in any other Texas estuary. The bay produces more oysters than any other single body of water in the United States.

Recreational fishing in the bay and associated activities generate $2.8 billion annually.

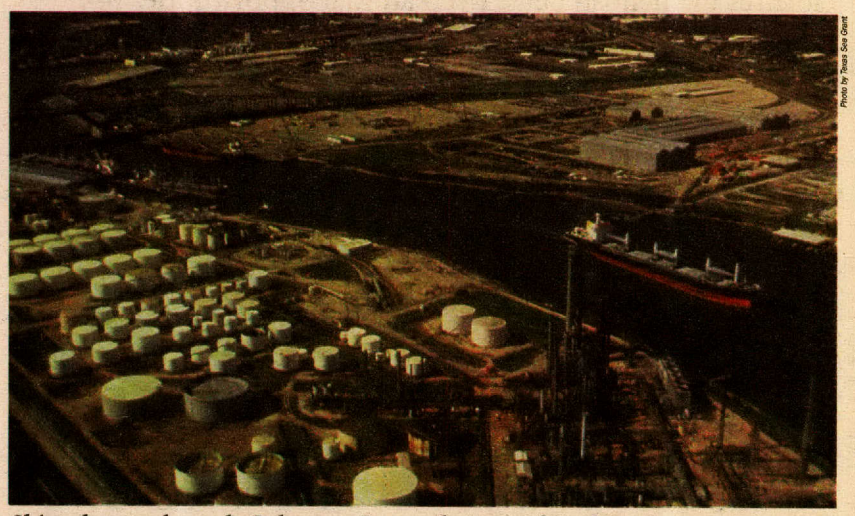


Photo by Texas Sea Grant

Ships that go through Galveston Bay to the Port of Houston bring products to our region from around the world. The port ranks among the largest in the world in tonnage of both foreign and domestic goods.

Nature's Nursery

Rainwater runoff from as far away as Dallas–Fort Worth affects Galveston Bay.

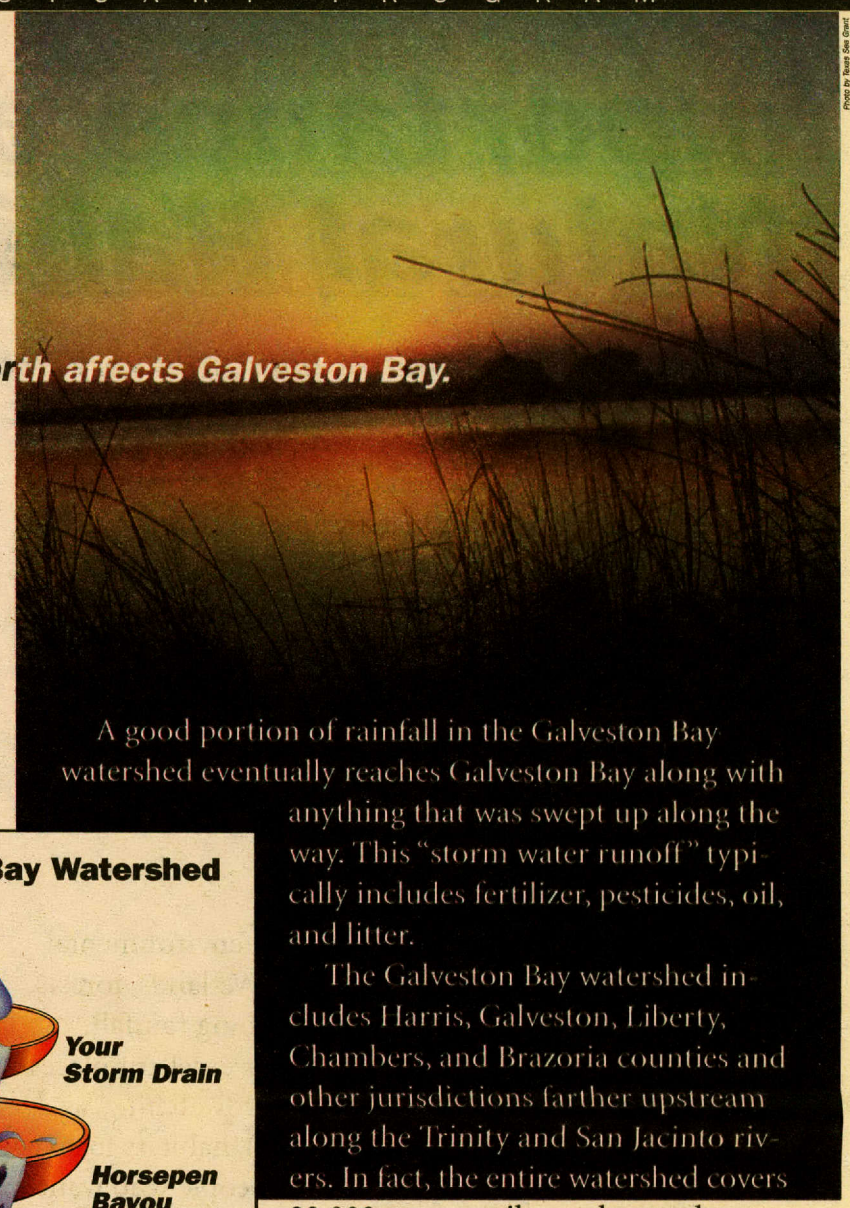


Photo by Texas Sea Grant

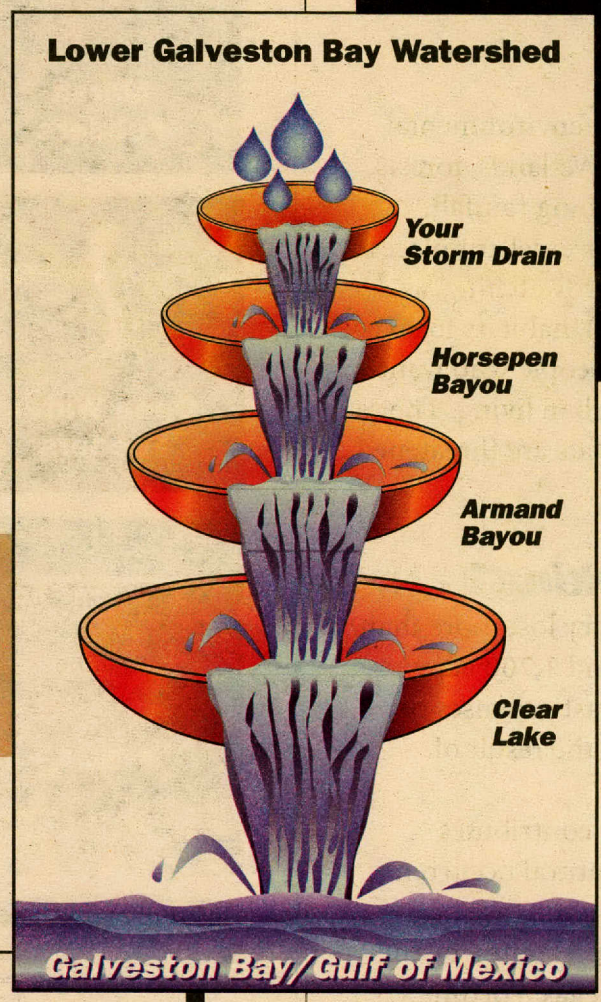
Freshwater flowing from rivers, bayous, and streams, blending with salty seawater from the Gulf of Mexico, forms the Galveston Bay estuary. The mixing of the two kinds of water results in a rich environment that plays host to an abundance of plants and animals. Many marine organisms—such as shrimp, oysters, crabs, and numerous fish species—find food and shelter in the estuary during their juvenile phase. Without the estuary, the seafood industry would disappear from the region, and recreational anglers would return home with empty stringers.

What is a watershed?

Where does rain go after it falls to the ground? Much is absorbed by lawns and fields or taken up by trees and plants. But rainfall also flows overland into ditches and storm drains, ending up in bayous, streams, and rivers. The land over which water drains to a particular body of water is called a watershed.

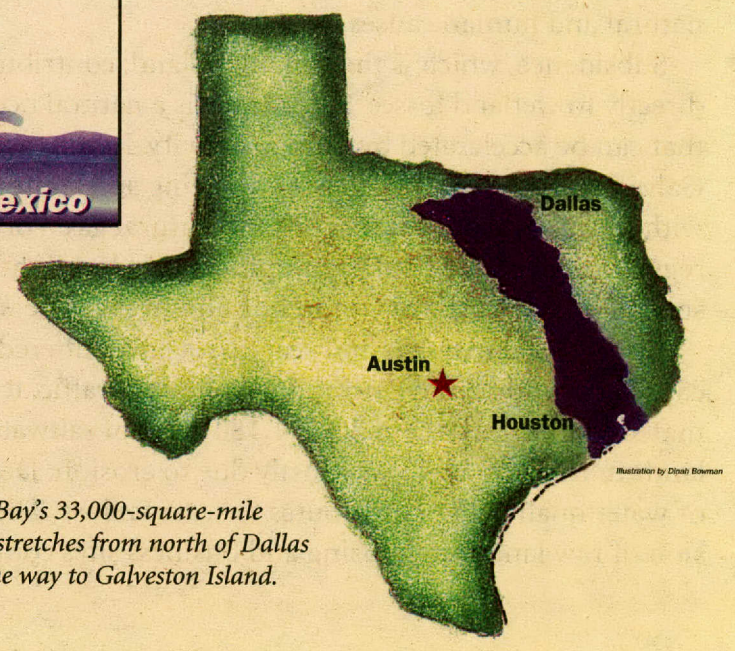
Watershed: a geographic area in which water, sediments, and dissolved materials drain to a common water body, such as a creek, bayou, lake, or bay.

On the prowl for an alligator. The Galveston Bay region offers several opportunities to view alligators. See alligators in their native habitat along the trails of the Brazoria National Wildlife Refuge (*off FM 2004 or CR 227*) or Fort Anahuac Park (*one mile south of the city of Anahuac*). To see one up close, visit the Eddie V. Gray Wetlands Center (*1724 Market St., Baytown*) or attend Anahuac's annual Gatorfest.



A good portion of rainfall in the Galveston Bay watershed eventually reaches Galveston Bay along with anything that was swept up along the way. This "storm water runoff" typically includes fertilizer, pesticides, oil, and litter.

The Galveston Bay watershed includes Harris, Galveston, Liberty, Chambers, and Brazoria counties and other jurisdictions farther upstream along the Trinity and San Jacinto rivers. In fact, the entire watershed covers 33,000 square miles and extends as far north as Dallas–Fort Worth. The "lower" Galveston Bay watershed covers 4,238 square miles downstream of two major reservoirs—Lake Houston on the San Jacinto River and Lake Livingston on the Trinity River. The lower watershed directly contributes much of what ends up in the bay system.



Galveston Bay's 33,000-square-mile watershed stretches from north of Dallas south all the way to Galveston Island.

Importance of Natural Habitat

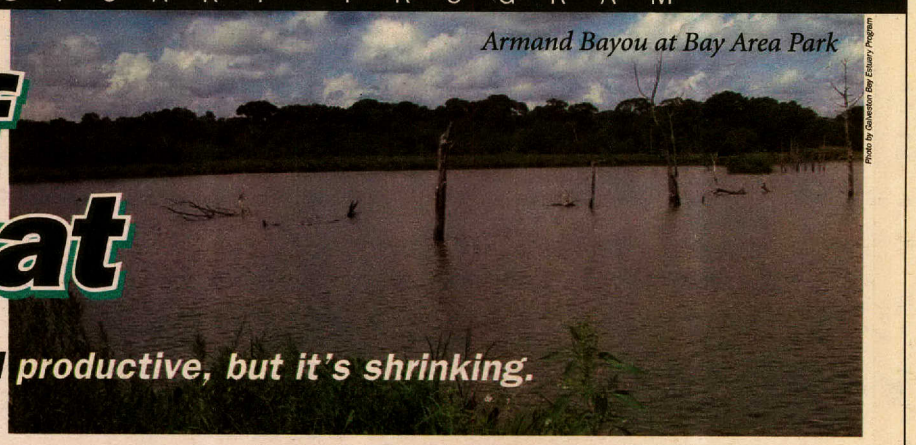

Armand Bayou at Bay Area Park

Photo by Galveston Bay Estuary Program

The Galveston Bay estuary's habitat is very rich and productive, but it's shrinking.

A habitat is much like a home, providing food and shelter. In the wild, habitats support a rich diversity of plant and animal life. In a wetland habitat, for example, small fish and shrimp hide and feed in the seagrasses and salt marshes. In turn, larger fish and birds prowl the salt marshes in search of small fish and shrimp to eat.

The Galveston Bay estuary is a rich ecosystem featuring many different types of habitat. That's why the bay is one of the most productive estuaries in the United States.

The role of habitat

Wetlands and other habitats act as a natural environmental cleanser by filtering pollutants from water. Wetlands, forests, and grasslands help control floods by absorbing rainfall.

Besides fishing, wildlife habitats also offer excellent places for crabbing, hunting, boating, kayaking, birdwatching, and wildlife photography. Finally (and critically), habitats form a peaceful retreat of beauty and solitude for people who want to momentarily escape the hectic pace of urban living. The reality, however, is that many important habitats are threatened or already lost.

Why is the habitat shrinking?

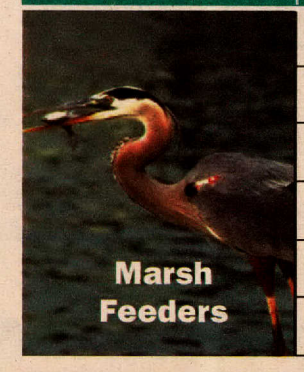
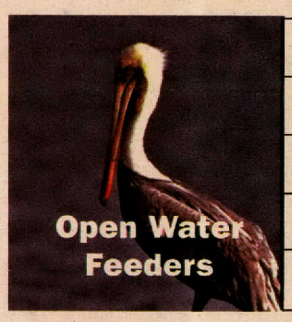
From 1950 to 1990, the Galveston Bay estuary lost more than 30,000 acres (19 percent) of its wetlands and 1,700 acres (70 percent) of its seagrasses. In addition, vast expanses of coastal prairies and forests have vanished—the result of natural and human causes.

Subsidence, which is the sinking of land, contributes directly to wetland losses. Subsidence is a natural occurrence that can be accelerated by human activity. In the case of the Galveston Bay area, subsidence was being accelerated by the withdrawal of groundwater, oil, and natural gas. Fortunately, regulation of groundwater pumping has reduced the rate of subsidence along the bay shoreline and in the watershed.

Also, coastal marshes and seagrasses have suffered erosion caused by waves from storms and shipping traffic. It is estimated that from 1995 to 2002, 1,180 acres of saltwater wetlands in this area was lost, mostly due to erosion. Degradation of water quality also contributes to seagrass loss. The conversion of raw land into housing and business sites continues to reduce habitat. From 1992 to 2002, the watershed lost an additional 9,120 acres of freshwater wetlands to development.

Moreover, the breakup of large expanses of habitat affects the estuary and surrounding watershed. This "fragmentation," as scientists call it, disturbs wildlife that requires large tracts of land for survival, and leaves wildlife vulnerable to predators. Highways, subdivisions, and commercial and industrial centers have fragmented many of the region's natural areas.

Twenty-Year Trends for Popular Recreational Birding and Fishing Species that Inhabit Galveston Bay

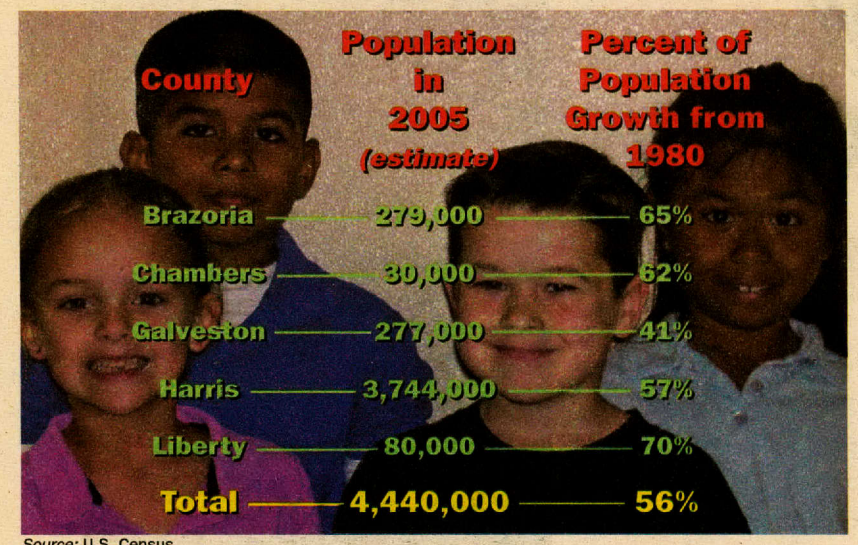
Feeding Guild	Bird Species	20 Year Trend
 Marsh Feeders	Great Blue Heron	Declining
	Reddish Egret	Stable
	Roseate Spoonbill	Stable
	Snowy Egret	Stable
	Tricolored Heron	Declining
	White Ibis	Stable
 Open Water Feeders	Black Skimmer	Stable
	Brown Pelican	Increasing
	Least Tern	Stable
	Royal Tern	Stable
	Sandwich Tern	Stable

	Fish Species	20 Year Trend
	Black Drum	Stable
	Red Drum	Stable
	Sand Seatrout	Stable
	Southern Flounder	Declining
	Speckled Seatrout	Increasing

Increasing | Stable | Declining

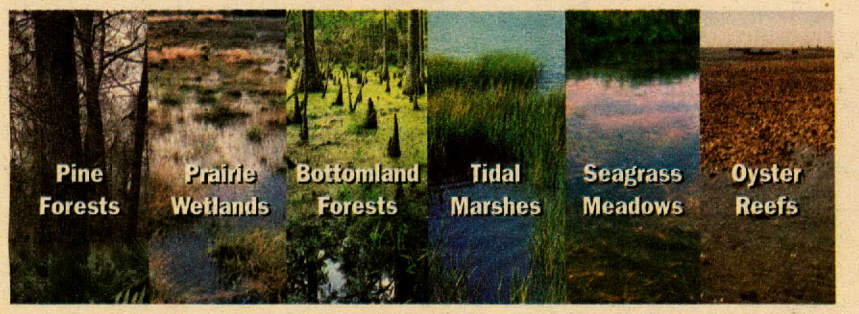
Sources: Texas Parks and Wildlife Department; U.S. Fish and Wildlife Service; Galveston Bay Indicators Project, Houston Advanced Research Center.

Population Total in the Year 2005 and Percent Growth from 1980



Source: U.S. Census

What are some important habitats in the bay area?



Pine forests, which form the southwestern portion of the East Texas "Piney Woods," are home to a large number of native plants, insects, mammals, birds, and reptiles. The endangered red-cockaded woodpecker resides there.

Prairies and **prairie wetlands** are important habitats for many migratory and resident bird species, including the endangered Attwater's prairie chicken, and especially for waterfowl, as well as for reptiles and amphibians.

Bottomland forests and **freshwater marshes** are found along rivers and bayous. They provide important habitat for migratory and resident birds, mammals, amphibians, and reptiles. This habitat absorbs or holds excess rainfall, serving to prevent flooding. It also filters surface storm water runoff, serving to protect water quality in area bayous and the bay.

Tidal marshes are found along bays and tidal reaches of bayous in the transition area between land and water. Tidal marshes serve as essential habitat for fish, crabs, shrimp, and other aquatic creatures, as well as for coastal birds. The marshes also help stabilize shorelines.

Seagrass meadows, which are located in shallow, protected areas in bays and bayous, serve as an important habitat for aquatic creatures. This habitat requires clear water so that sunlight can penetrate to the bottom.

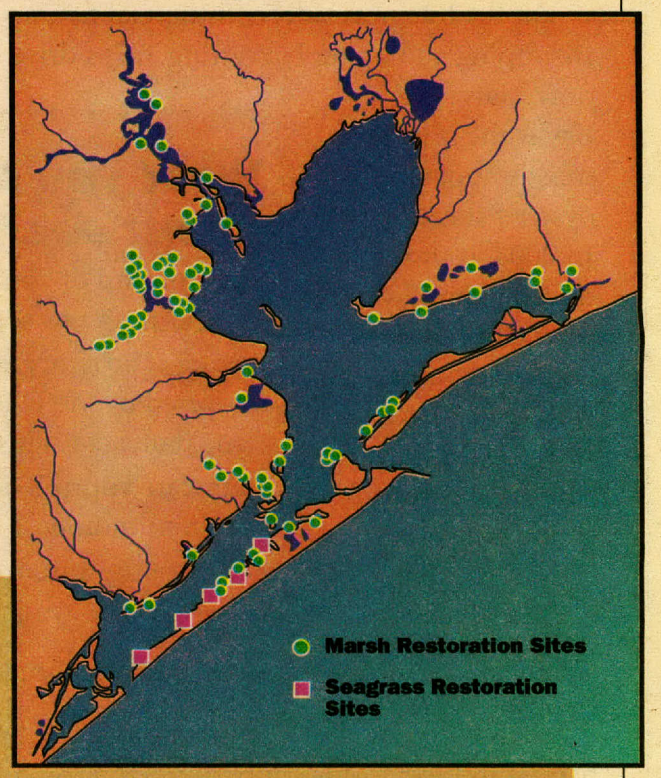
Oyster reefs are a valuable resource because of the seafood they produce. Oyster reefs form important structures in the bay and serve as sources of food and shelter for other organisms.

What the Estuary Program is doing

The Estuary Program and its partners are working to measure the extent of habitat loss, conserve remaining habitats, and offset losses by protecting and restoring important coastal habitats.

- Since 1995, an estimated 8,000 acres of wetlands and important coastal habitats have been protected or restored by the Estuary Program and its partners.
- The Beneficial Uses Group, a multi-agency team, has successfully used material from maintenance dredging of the Houston Ship Channel to restore more than 2,000 acres of wetlands, bird-nesting uplands, and oyster reef.
- Reliant Energy, Texas Genco II, the Estuary Program, and other restoration partners have been successful in maintaining a nursery that produces 350,000–500,000 wetland plants each year. Thanks to this work, restoration projects no longer have to take plants from established wetlands or purchase plants, thereby lowering the cost of restoration.

Marsh & Seagrass Restoration Sites



Since 1995, public-private partnerships have restored an estimated 8,000 acres of vital habitat throughout the Galveston Bay region.

Sources: Galveston Bay Indicators Project, Houston Advanced Research Center; Galveston Laboratory, National Marine Fisheries Service; Texas Coastal Program, U.S. Fish and Wildlife Service; Texas Parks and Wildlife Department.

What you can do for habitats!

- Volunteer for Marsh Mania, an annual wetland restoration project sponsored by the Galveston Bay Foundation. Participants help replant wetlands.
- Support local and state land-conservation efforts and land-trust organizations that are dedicated to protecting natural open spaces, maintaining wildlife habitat, and restoring recreational trails.
- Support local government initiatives that protect green spaces for public use and wildlife habitat, improving the quality of life for the bay community.
- Create a habitat oasis on your property by planting native vegetation.

Seafood Is Key to Local Economy

The continued safety of eating seafood is an important goal.

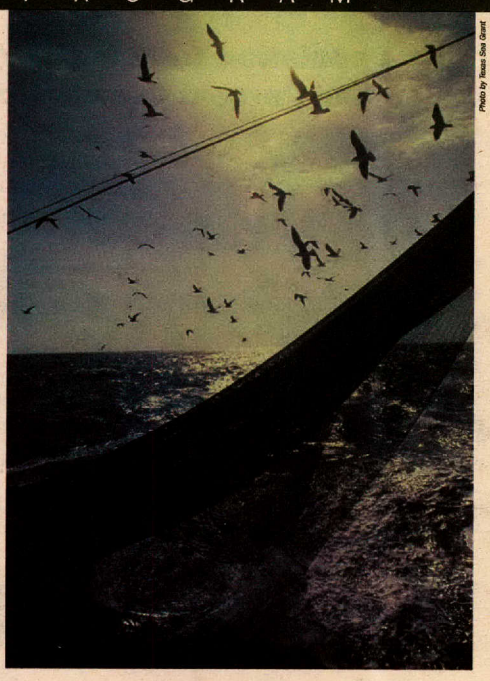


Photo by Texas Sea Grant

Seafood from Galveston Bay is important to the region's economy. The bay accounts for one-third of the state's commercial fishing and over half of its recreational fishing.

It is no surprise that Galveston Bay is a popular place to fish. In 2004, more than 235,000 fishing licenses were issued in the five counties surrounding the bay. The recreational fishing industry in the bay area is valued at $2.8 billion.

On the business side, commercial fishing, which includes shrimping and oyster harvesting, helps drive the region's economy. Galveston Bay is the state's most important oyster fishery. In 2004, it produced 4.8 million pounds of oysters with a dockside wholesale value of $13.1 million. About one-third of the blue crabs caught commercially in Texas are harvested in Galveston Bay, more than in any other Texas estuary. The bay's commercial fishing industry adds approximately $350 million each year to the economy.

What you can do about seafood safety!

- Be mindful of your health status before consuming raw seafood.
- Respect advisory signs marking the areas covered by the DSHS advisories, and report any damaged signs.
- Educate yourself and others about seafood contamination.
- Reduce the amount of runoff pollution coming from your yard or business.

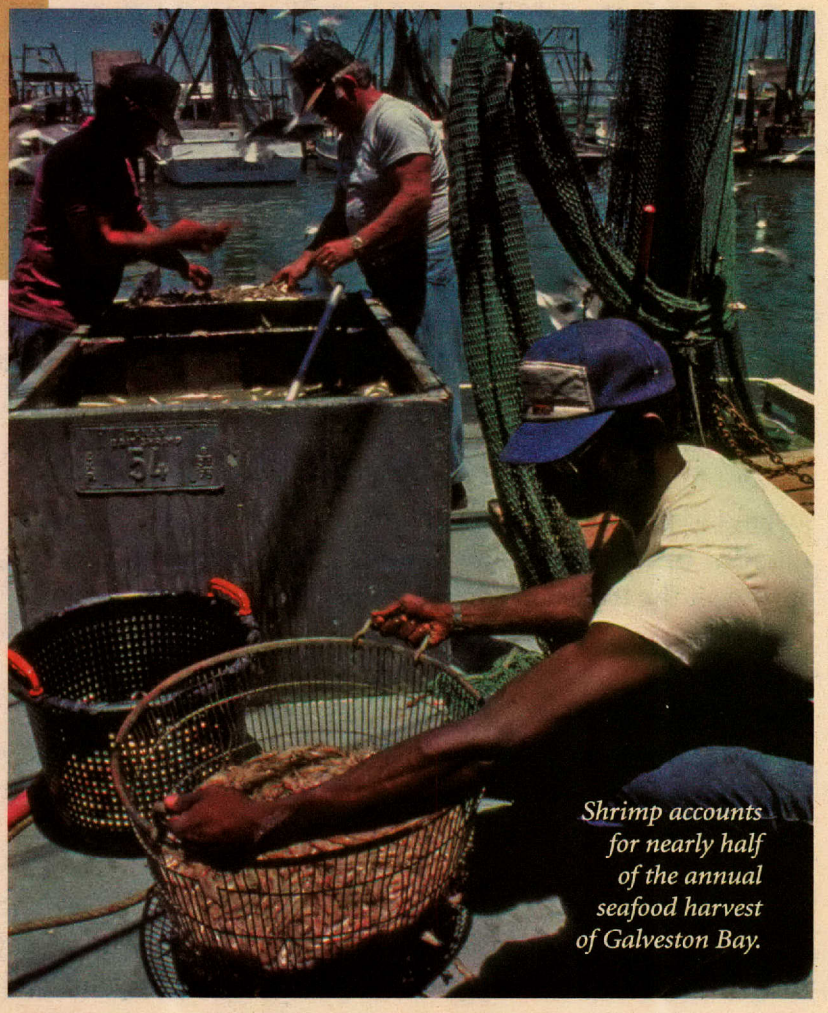
Is some seafood off limits?

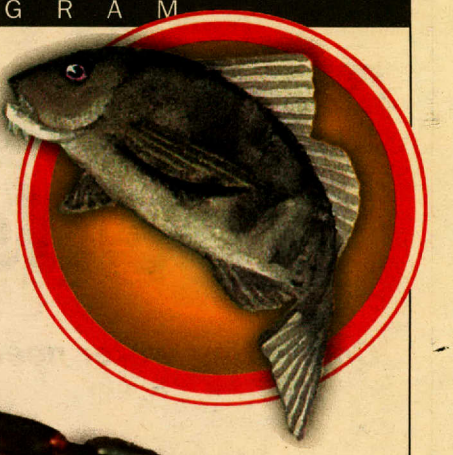
While most of the seafood from Galveston Bay is safe to eat, contamination of fish and shellfish in some areas of Galveston Bay and its tributaries poses a health risk to consumers. The contaminants could be either chemicals or disease-causing organisms.

The Texas Department of State Health Services (DSHS) tests fish and shellfish for environmental contaminants and determines if consuming fish or shellfish from the bay may pose a health risk. The advisories it issues are intended to help fishermen make informed decisions as to whether they or their family should consume fish or shellfish they catch.

Oysters present a special safety concern because they are often eaten raw. Oysters filter and ingest bacteria from the water as they feed. If a water body contains harmful bacteria, these pathogens can become concentrated in oysters. The DSHS uses very strict standards to assess oyster-harvesting areas. Areas not meeting the standards are closed to both recreational and commercial harvesters. Oyster beds near the mouth of tributaries that drain urban areas, where the effects of human activities are most pronounced, are more susceptible to contamination, and therefore often closed to harvesting.

For the latest seafood advisories, consult <www.gbep.state.tx.us>.


Shrimp accounts for nearly half of the annual seafood harvest of Galveston Bay.



Check It Out!

Crabbing hot spots around the bay. Blue crabs can be caught in nearly any shallow tidal marsh or slough. The marshes of Apfel Park on Galveston Island are very popular (*Apfel Park on East Seawall Blvd.*). The Scenic Galveston Estuarial Corridor features a large expanse of accessible marshes with lots of crabs (*the corridor is accessible along either feeder road of IH 45 on the mainland, north of the Galveston Causeway).*

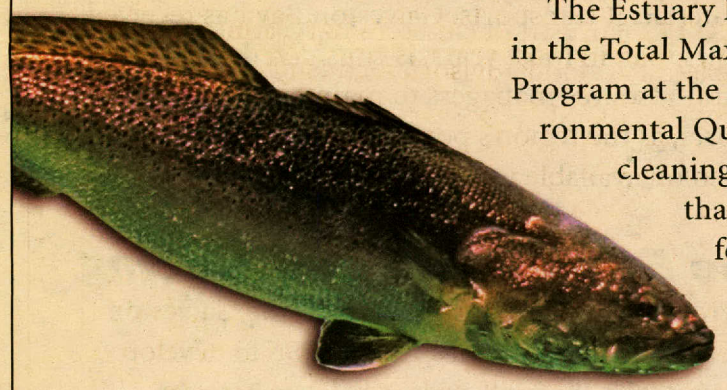
What the Estuary Program is doing

The Estuary Program, with its state and federal partners, continues to collect and analyze fish tissue and other data from the bay to determine whether current health advisories should be expanded or additional advisories issued.

The Estuary Program also participates in the Total Maximum Daily Load (TMDL) Program at the Texas Commission on Environmental Quality. TMDLs are a tool for cleaning up impaired water bodies—that is, those that do not meet federal standards for water quality. A TMDL cleanup project for dioxins is under way at the upper Houston Ship Channel, as well as a study of PCB levels. Dioxin and PCBs are generic terms for a group of toxic and environmentally persistent compounds.

Check It Out!

Wetland-restoration and educational sites around the bay. Galveston Island State Park features one of the largest wetland restoration sites in Texas, as well as many interpretive and informational signs. (*Follow FM 3005 on Galveston Island west to the state park.*)



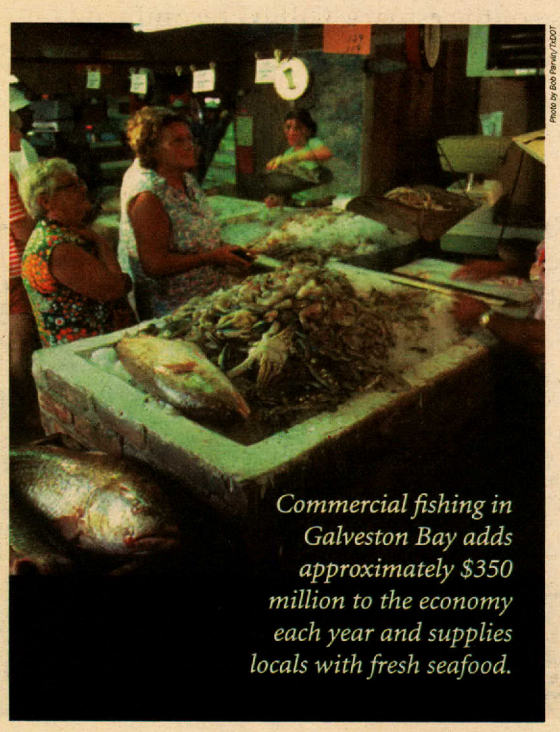


Photo by Bob Perrelli/TxDOT

Commercial fishing in Galveston Bay adds approximately $350 million to the economy each year and supplies locals with fresh seafood.

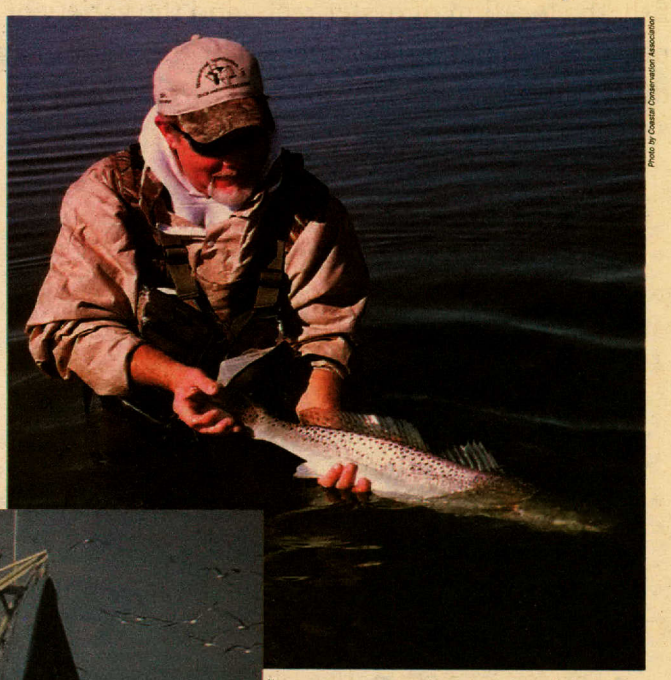


Photo by Coastal Conservation Association

Recreational fishing, valued at $2.8 billion, is an important contributor to the local economy.

Photo by Texas Sea Grant

A local shrimp boat returning to dock with a day's catch.

The Bay Needs Water, Too


Photo by Jack Lawrence/TxDOT

Competing water needs can reduce the quantity of freshwater available for the bay.

Families need freshwater for drinking, bathing, and cooking. Industry needs water for manufacturing, cooling, and refining. Farmers need water for livestock and crop irrigation. Freshwater is also critical to the bay's health. When the supply of freshwater is limited, however, the needs of people and the bay can clash.

More than half of the freshwater that ends up in Galveston Bay comes from the Trinity River. The remainder comes from the San Jacinto River, bayous that crisscross the region, and, of course, from rainfall.

Why do bay resources rely on freshwater?

A reduction in the amount of freshwater that reaches the bay can change the bay's salinity (how salty the water is), altering its ecology. The growth and survival of young fish and shellfish, the location of oyster reefs, and the variety of aquatic plants are all potentially affected by the amount and timing of the freshwater flows into the bay.

What you can do to help the bay meet its freshwater needs—while saving money, too.

- Get to know water conservation programs such as those developed by the Texas Water Development Board. Visit <www.twdb.state.tx.us>.
- Ensure that your home does not have leaking plumbing fixtures.
- Landscape with native plants that consume less water, such as those promoted in Texas Parks and Wildlife's Backyard Habitat Program. Visit <www.tpwd.state.tx.us>.
- Adopt landscape water-conservation practices such as drip sprinklers, rain barrels, and mulching. Water your yard primarily at dawn or dusk to minimize evaporation.

Freshwater inflows are also a source of nutrients and sediments. Like the human body, the bay needs the correct balance of nutrients. Excessive nutrients are a bad thing, but too little can hurt the bay as well. Microscopic aquatic plants, or phytoplankton, require nutrients and sunlight to grow. Phytoplankton provides a foundation for the aquatic food chain—small animals, such as oysters, feed on plankton, and larger animals feed on small animals.

Sediments—primarily clay and sand—are also carried into the bay by rivers and streams. These sediments help to maintain and expand marshes. The loss of sediments from reduced freshwater inflows can have a profound effect on marshes and the organisms that use them.

The health of the bay would suffer greatly without freshwater and the materials it transports. Galveston Bay has received a level of inflows that, in most years, is considered sufficient by many natural-resource managers to maintain a healthy estuary. However, as the region's population swells, so do the demands placed on available water supplies.

What the Estuary Program is doing

The Estuary Program and its partners formed the Galveston Bay Freshwater Inflows Group (GBFIG) in 1996 to develop management strategies that will strike a balance between human needs and those of the estuary. GBFIG recommendations have been incorporated in the state's regional water planning efforts. Also, the TCEQ and several other state agencies are participating in a legislatively mandated study of freshwater inflows.

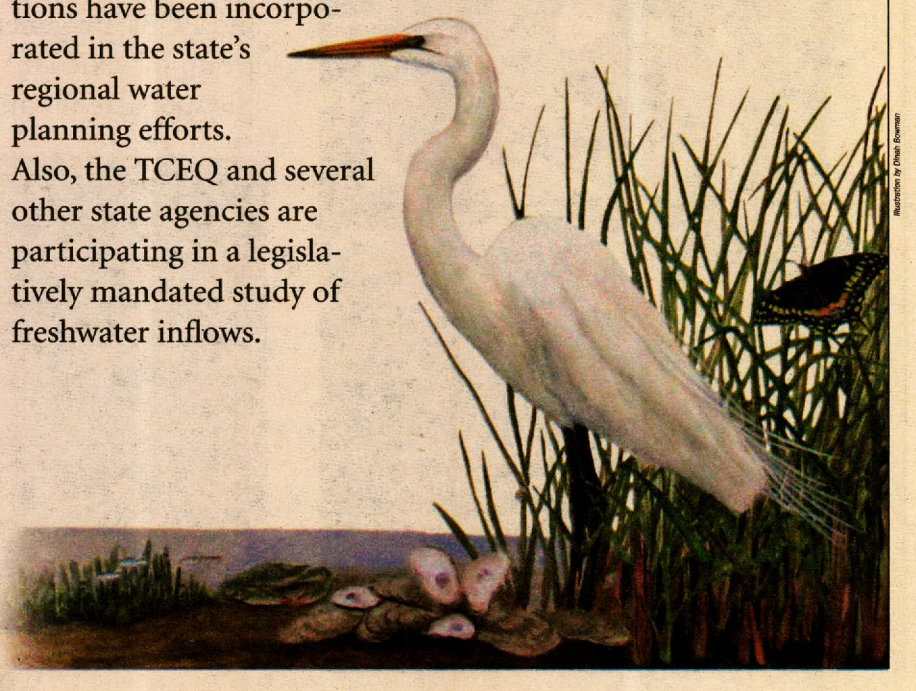


Illustration by Dinah Bowman

A Wealth of Wildlife

Biodiversity is evidence of a healthy bay.

Galveston Bay features an abundance of wildlife species—barnacles and bald eagles, oysters and otters, redfish and red-eared sunfish, bottle-nosed dolphins and bobcats. Wildlife holds an intrinsic value that can hardly be denied by anyone who's ever caught a glimpse of a deer deep in the woods or a sea turtle in the sands of San Luis Pass.

Wildlife has economic value as well, and not just for recreational and commercial fishing. Nature tourism—such as wildlife watching and birdwatching, photography, nature study, backpacking, hiking, boating, camping, rafting, biking, climbing, and visiting parks—is the fastest growing segment within the tourism industry, according to the Economic Development and Tourism division of the Office of the Governor. The upper Texas coast is one of the country's premier birdwatching destinations, especially during spring and fall migrations.

Protecting the diversity, or variety, of species is critical. Diversity is one of the main factors used to determine whether the bay is healthy. Having healthy populations of a number of different plant and animal species suggests that their needs for good water quality, productive habitat, and ample food are being met. While diversity is an indicator of ecosystem health, it benefits us by supporting recreational angling, commercial fishing, and ecotourism.

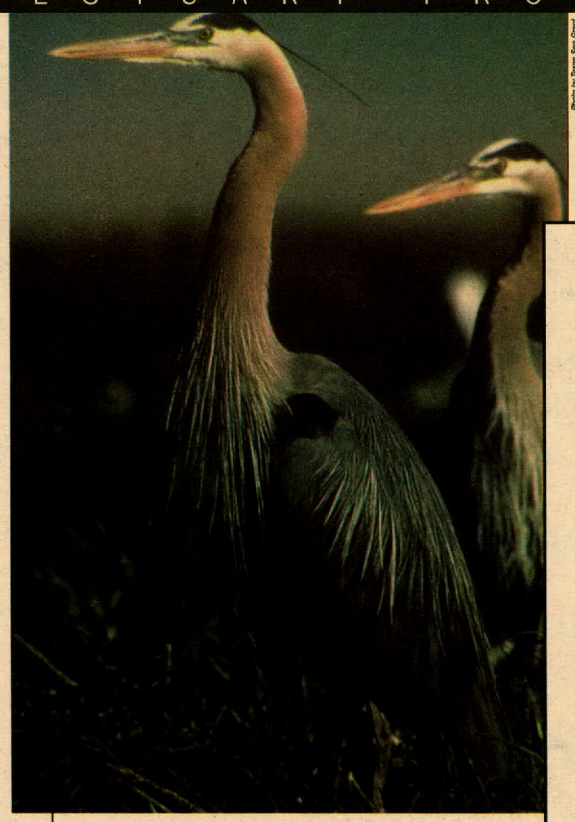


Photo by Texas Sea Grant

Fishing hot spots around the bay. The bay features outstanding year-round fishing opportunities. The Texas City Dike features numerous access points as well as a pier on the end of the dike (*Dike Road, off Bay St. and Eighth Ave., in Texas City*). The San Luis Pass Pier is an excellent place to catch fish year-round (*base of the FM 3005 bridge, just west of Galveston Island*). Rollover Pass is a great place to catch flounder in the fall (*Highway 87, on Bolivar Peninsula*).

Natural-resource managers regularly track the population of Galveston Bay species, such as oysters; white, pink, and brown shrimp; blue crabs; speckled trout, black drum, redfish, and sand trout; and black skimmer, roseate spoonbill, brown pelican, and reddish egret.

Analyses of bay conditions suggest that fish populations overall are doing well. The Texas Parks and Wildlife Department

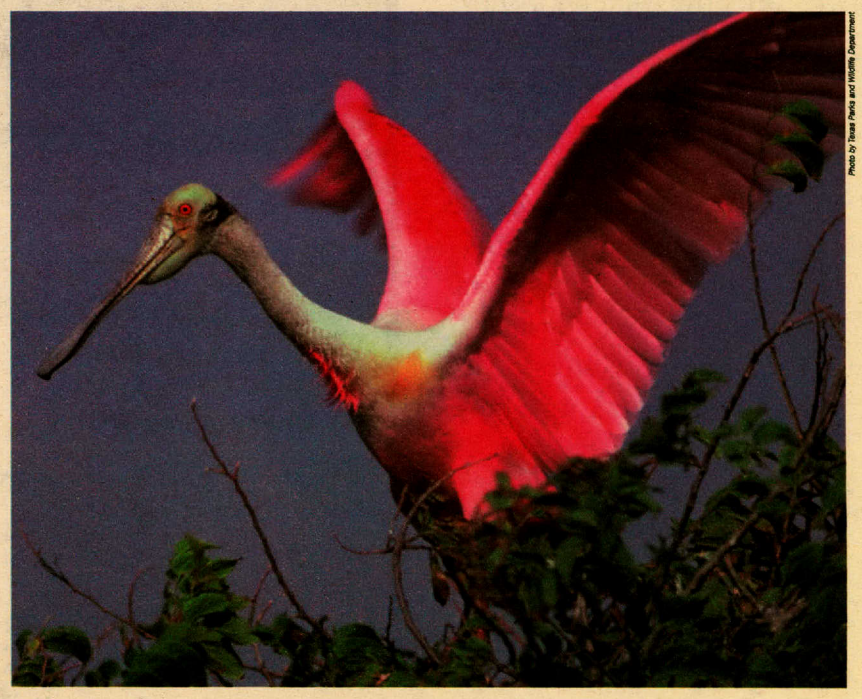


Photo by Texas Parks and Wildlife Department

Good News

The Comeback of the Brown Pelican

In 1918, the estimated population of brown pelicans on the Texas coast was 5,000. By that time, fishermen—who saw the brown pelican as competition—had already killed many of them. Later in the century, pesticide pollution reduced their rate of reproduction and led to further declines. By the late 1960s, fewer than 10 pairs bred each year along the coast, and none in Galveston Bay, leading to their designation in Texas as endangered.

Fortunately, recovery efforts are succeeding. More than 1,800 pairs of brown pelicans are nesting in four established colonies around Galveston Bay, indicating a baywide population of well over 5,000 birds.

The National and the Houston Audubon societies have worked with state and federal resource agencies to protect and enhance the nesting habitat of brown pelicans and other colonial nesting waterbirds. Protection has meant controlling erosion at nesting islands, removing predators, and posting signs to discourage visitors from disturbing the sites.

has enacted regulations intended to increase the numbers of large speckled trout. Shellfish populations (shrimp, oysters, crabs) also appear to be sound.

While the brown pelican continues a remarkable recovery from the verge of extinction, several types of colonial waterbirds are in decline. Colonial waterbirds are species that congregate to nest and are dependent upon aquatic habitats for feeding. Of particular concern are the open-water-feeding black skimmer and the marsh-feeding great blue heron, reddish egret, and tri-colored heron. Some experts attribute the decline to habitat destruction or disturbance of nesting sites. For successful nesting, these birds require shrubs and trees (in the case of the herons and egret) or stretches of beach (the black skimmer) on undisturbed bay islands and shorelines. (See page 6 for 20-year trends in bird populations.)

What the Estuary Program is doing

The Estuary Program gathers and analyzes information to determine how certain species of critical concern are faring. See <www.gbep.state.tx.us>.

The Estuary Program restores habitat and is working to manage other serious threats to species' health and diversity, such as harmful exotic species, reduced freshwater inflows, and degraded water quality.

What you can do to support biodiversity!

- Support local initiatives for creating or preserving green spaces.
- Be aware of fishing and hunting regulations. Practice catch-and-release fishing.
- Be careful not to disturb sensitive habitats such as bird-nesting sites.
- Landscape with native or well-adapted plants and grasses, to reduce the need to use fertilizers and pesticides.
- If using fertilizers and pesticides, use as little as possible—closely follow the manufacturer's instructions.
- Properly dispose of used oil and household chemicals.

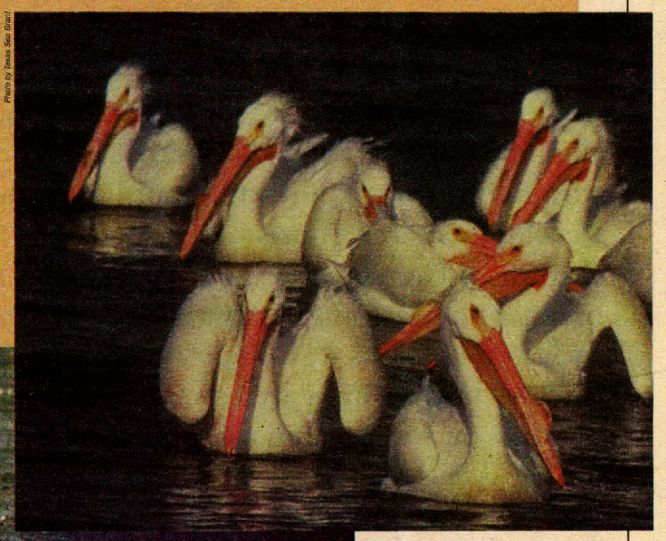


Photo by Texas Sea Grant

See a dolphin in the wild.
See a dolphin riding in the bow wake of a ship or feeding in the bay by visiting the end of the Texas City Dike (*Dike Road, off Bay St. and Eighth Ave., in Texas City*), visiting San Luis Pass County Park (*base of the FM 3005 bridge, just west of Galveston Island*), or taking a ride on the Bolivar Ferry from Galveston Island to the Bolivar Peninsula (*Highway 87 at east end of Galveston Island*).

Photo by Jamey Tidwell/ Texas Sea Grant

Dolphins, at the top of the bay's food chain, serve as indicators of the overall health of the ecosystem.

Good News

Waterbirds Flock to Island Living

Beneficial use of dredge material from the 51-mile deepening and widening of the Houston Ship Channel has created almost 2,000 acres of habitat, including several bird islands, 10 wetland marshes, and 100 acres of oyster reefs.

All evidence suggests that this effort is working. As of 2005, an estimated 8,400 breeding pairs of eight species of colonial waterbirds, such as herons and egrets, representing almost one-quarter of the baywide population, were nesting on six artificial habitats created from dredge material.

As deepening and widening of the ship channel continues, the project partners are committed to creating thousands more acres of habitat over the coming decades.

Below the Surface

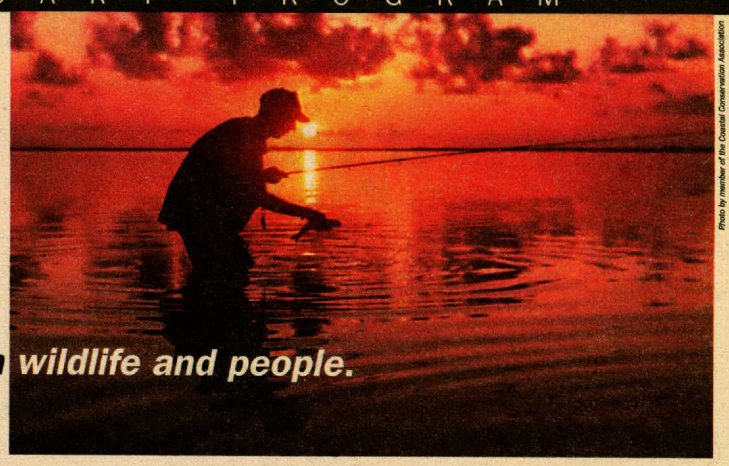


Photo by member of the Coastal Conservation Association

The quality of bay water and bottom sediment affects both wildlife and people.

The bay's waters—with notable exceptions—are considered generally healthy. However, as population and urban development continue to expand in the Houston-Galveston region, so does the potential for water contamination.

The bay's water quality problems are concentrated in urban tributaries where residential, commercial, and industrial land uses are most dense.

Where does water pollution come from?

Most of the pollution that enters Galveston Bay comes from countless small, diffuse sources in the watershed, such as yards, vehicles, and streets. Storm water runoff can sweep up excess fertilizer or pesticides from neighborhoods, a Styrofoam cup floating down the street, oil from a leaky car, bacteria from leaky sewer lines, or particles deposited from the air. The term *nonpoint source* refers to pollutant discharges that originate from diffuse points. Contrary to popular belief, storm water is not treated before it enters area bayous and Galveston Bay.

The other common source of pollution is discharges from specific locations, called *point sources*, such as municipal wastewater treatment facilities or industrial sites. Such dischargers must adhere to stringent requirements set out in permits issued by the TCEQ.

What are the effects of pollution?

Pollution degrades water and sediment quality, and can eventually harm wildlife and people. Here are some examples:

Excess nutrients. Excess nutrients in our waterways reduce the oxygen available in water for fish to breathe, and can ultimately lead to fish kills. Nutrients not absorbed by plants and grass when they are fertilized are washed away by rainfall and transported to the local stream. These excess nutrients stimulate overgrowth of plants in the receiving stream. When the plants die, they decay and consume the oxygen that would normally be available for fish.

Elevated bacteria levels. Often, the source of bacteria is improper treatment of sewage wastes from failing septic systems, damaged or improperly connected sewer lines, or poorly maintained wastewater treatment plants. Bacteria also come from boaters' waste, pets, livestock, and wildlife. Some types of bacteria that occur naturally can bloom to harmful levels under specific environmental conditions. Increased bacteria levels are a potential health hazard when people come in direct contact with contaminated water or consume contaminated oysters.

Trends in Nutrient and Chlorophyll *a* Concentrations for Galveston Bay and Local Tributaries Measured Against the State's Screening Levels

Subbays	1970s	1980s	1990s	2000s
Upper & Lower Galveston Bay	Moderate	Moderate	Moderate	Moderate
Trinity Bay	Moderate	Moderate	Moderate	Moderate
East Bay	Moderate	Good	Good	Good
West Bay	Moderate	Good	Good	Good
Christmas Bay	Moderate	Very Good	Very Good	Good

Tributaries	1970s	1980s	1990s	2000s
Trinity River	Good	Very Good	Very Good	Good
San Jacinto River	Moderate	Good	Very Good	Very Good
Buffalo Bayou	Poor	Poor	Moderate	Poor
Houston Ship Channel	Poor	Poor	Moderate	Moderate
Clear Creek/Lake	Moderate	Moderate	Good	Good
Armand Bayou	Moderate	Poor	Good	Moderate
Dickinson Bayou/Bay	Moderate	Good	Very Good	Very Good
Chocolate Bayou/Bay	Good	Very Good	Very Good	Very Good
Bastrop Bayou	Moderate	Very Good	Very Good	Good

Sources: Texas Commission on Environmental Quality; Galveston Bay Indicators Project, Houston Advanced Research Center.

Rating	% Above Screening Level
Very Good	0–5
Good	6–15
Moderate	16–30
Poor	> 30

Does the bay's brown water mean it is polluted?

The brown color seen in the bay is often a natural condition—a result of sediment particles in the water. Since the bay is shallow, typically only a few feet to 10 feet deep, and subject to continual churning caused by winds and tides, the water often becomes cloudy with sediment particles that have been stirred up.

Litter. Discarded refuse is not just unsightly—it is harmful to wildlife. Sea turtles and dolphins can be injured by mistaking plastic grocery bags for food—to them the bags look like jellyfish.

Eroded soil and sediment. Erosion along bayous and rivers has the potential to blanket wetland habitats that are essential to fish and shellfish. Normal erosion and sedimentation are parts of a natural cycle that sends sediment into the bay, where it settles to build critical habitat such as mudflats and wetland marshes. However, erosion from activities such as land clearing and poorly managed construction sites degrades the biological community, transports contaminants, and increases the need for maintenance dredging of channels.

Contaminants. Inorganic toxic contaminants such as heavy metals (nickel, cadmium, and lead) and organic chemicals (herbicides, pesticides, and industrial chemicals) directly harm fish, wildlife, and people when allowed to reach bayous and the bay. Contaminants stored in sediments later become a problem when the sediments are stirred up. These pollutants eventually make their way up the food chain and into the fish and shellfish.

Tracking levels of nutrients

Data from the last four decades show the number of times that nutrient levels in certain parts of the bay have been too high as compared with typical nutrient levels in other Texas estuaries.

In excessive amounts, nitrogen and phosphorus result in high levels of chlorophyll *a*, which is an indicator of algae growth. Decomposition of large amounts of algae in a body of water can reduce the amount of oxygen available for fish.

While many areas have improved since passage of state laws and the federal Clean Water Act in 1972, most areas only scored "good" or "moderate," suggesting that nutrients remain a problem for water quality in the region. Also, as the population

Good News

A New Take on Storm Water

A new approach to handling storm water has emerged from the shadows of Houston's skyscrapers.

The traditional approach to managing storm water has been to move it as quickly as possible from city streets to a nearby ditch or bayou. Our bayous and ditches are receiving water faster and in greater abundance than ever before, and at times are being filled beyond capacity.

Now, many communities are installing multiple-use storm water detention basins. These newly designed basins not only help alleviate flooding by holding storm water before it is released, but also provide other assets to the community.

Detention basins are being lined with wetland plants to help remove pollution, improve water quality, and offer sanctuary for fish and wildlife. Nearby residents gain recreational opportunities, too. Some basins are enhanced with new trails and educational signs for children and adults.

This new approach helps preserve water quality by removing the pollution that storm water picks up as it flows from yards, parking lots, and streets, and into the detention basins, before entering Galveston Bay.

The Brays Bayou Urban Wetland Project, one of several such efforts, is located in Mason Park, east of downtown Houston. It features a treatment wetland, a tidally influenced wetland, and interpretive signs on the banks of the bayou.

What you can do to maintain and improve water quality!

- Do not tolerate leaking or overflowing sewer lines that you see in your neighborhood. Call in your observations to local authorities.
- Reduce or eliminate use of lawn chemicals and fertilizers. Reduce water-thirsty turfs with native and drought-tolerant plants. Leave grass clippings on the lawn to enrich the soil.
- Never pour oil or chemicals into storm sewers. Most oil pollution in coastal waters comes not from commercial-tanker spills but from storm water runoff, dumping, and small spills.
- Volunteer for a Trash Bash or other litter-removal program.
- Reduce, reuse, or recycle used oil, batteries, tires, and household and outdoor chemicals. Many communities hold collections of household hazardous waste.
- Encourage recreational boaters to use pump-out facilities at marinas instead of dumping into the bay.
- Participate in a public meeting. For example, the TCEQ's TMDL stakeholder-group meetings are open to the public, as are many meetings of the Houston-Galveston Area Council.

Trends in Fecal Coliform Bacteria Concentrations for Galveston Bay and Local Tributaries Measured Against the State's Screening Levels

Subbays	1970s	1980s	1990s	2000s
Upper & Lower Galveston Bay				
Trinity Bay				
East Bay				
West Bay				
Christmas Bay				

Tributaries	1970s	1980s	1990s	2000s
Trinity River				
San Jacinto River				
Buffalo Bayou				
Houston Ship Channel				
Clear Creek/Lake				
Armand Bayou				
Dickinson Bayou/Bay				
Chocolate Bayou/Bay				
Bastrop Bayou				

Sources: Texas Commission on Environmental Quality; Galveston Bay Indicators Project, Houston Advanced Research Center.

Rating	% Above Screening Level
Very Good	0
Good	1–9
Moderate	10–25
Poor	> 25

and commercial activities grow, nutrient loads could increase.

Trends in bacteria levels

The bay and its tributaries have been evaluated over four decades for levels of fecal coliform, which is an indicator used to monitor the health risk associated with bacterial contamination. Data indicate that open bay areas are "good," but levels in the tributaries continue to be "poor."

What the Estuary Program is doing

The Estuary Program has been working with the Harris County Flood Control District, Texas Sea Grant, and the City of Houston to evaluate "best management practices" that show the potential to protect water quality. Examples of cost-effective pollution-prevention practices are vegetative buffers along waterways and ponds, and detention basins supplemented with wetlands to treat runoff.

The program has also helped communities initiate local watershed-protection programs to protect and improve water quality. This includes supporting the TCEQ's efforts to manage water quality through the development of total maximum daily loads, which address impaired water bodies.

Other projects include:

- Workshops for local governments and developers to prevent construction-related pollution and identify sustainable development practices beneficial to the economy and the environment.
- Trash cleanups to beautify bayous and shorelines. In the last 12 years, from 1994 to 2005, 50,000 volunteers have collected 1,558 tons of trash and 2,400 tires in waterways from Galveston to Conroe.

Good News

Living Museums

The Houston-Galveston area is home to two of the four state-designated coastal preserves in Texas. The Christmas Bay and Armand Bayou coastal preserves are remnant habitats—the best available examples of Galveston Bay and its tributaries as they existed before human occupation.

The Armand Bayou Coastal Preserve is located in southeastern Harris County, on a stretch of Armand Bayou. The preserve's 319 acres are home to the American alligator, osprey, river otter, and a variety of fish and other wildlife. The 2,500-acre Armand Bayou Nature Center surrounds the preserve.

The Christmas Bay Coastal Preserve lies in the southwestern portion of Galveston Bay, in Brazoria County. The 5,660-acre site is a nearly pristine secondary bay composed of seagrass meadows, oyster reefs, and coastal marshes. These habitats serve as vital breeding, nursery, and foraging areas for a rich diversity of finfish, shellfish, colonial nesting birds, and migratory waterfowl.

The coastal preserve program is a vital link in protecting unique biological communities on the Texas coast.

Catch a ride on the water.

A ride on the free Bolivar Ferry from Galveston Island to the Bolivar Peninsula provides a great opportunity to see bottlenose dolphins and the bay's feathered inhabitants. You can also marvel at large ocean-going ships, sail boats, and other watercraft on your 20-minute trip across the bay. You can park your car and ride, or drive your car onto the ferry. (*Highway 87 at east end of Galveston Island.*)

The Galveston Bay Estuary Program

The Estuary Program of the Texas Commission on Environmental Quality was established in 1989 to develop a comprehensive conservation management plan for Galveston Bay. The program represents a partnership of local, state, and federal governments, business and industry, conservation organizations, bay user groups, federal and state resource agencies, and citizens.

All of these partners work together to implement the Galveston Bay Plan. By pooling resources—both funding and expertise—the Estuary Program enhances the capacities of all those working to protect the bay.

The Estuary Program is dedicated to preserving Galveston Bay for generations to come. Its goal is comprehensive ecosystem management through partnerships and preservation of the bay's multiple uses. The guiding principles are sound science and consensus.

The TCEQ and the Estuary Program wish to express gratitude for the time and expertise donated by the many partners and participants who have worked to:

- restore and protect thousands of acres of vital habitat
- secure conservation of parks and natural areas
- plant trees and native plants in parks and natural areas
- improve the water quality of bayous and create recreational opportunities
- save at-risk species and their habitats
- manage bay fisheries to support sustainable recreational and commercial fishing
- help communities improve their environment and quality of life through initiatives to preserve open space and create parks
- supply small businesses with innovative methods for reducing pollution
- supply facilities for proper disposal of household hazardous waste
- host community-based trash cleanups
- create opportunities for children to learn about the bay and its living resources through educational programs and hands-on learning experiences

Galveston Bay was produced by the Galveston Bay Estuary Program, a nonregulatory program located in southeastern Houston and administered by the Texas Commission on Environmental Quality, with funding from the U.S. Environmental Protection Agency. The TCEQ strives to protect our state's human and natural resources consistent with sustainable economic development.

For more information about any of the topics in this publication, contact the Galveston Bay Estuary Program at 281-218-6461, or visit <www.gbep.state.tx.us>.

Contact information:

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Web site: www.gbep.state.tx.us

The Galveston Bay Council

The Estuary Program's commitment to balanced decision-making is reflected in the diversity of members on the Galveston Bay Council—the advisory committee that guides implementation of the comprehensive conservation-management plan for Galveston Bay. The council includes representatives of seven federal agencies, nine state agencies, nine regional and local governments, seven citizens' groups, seven private-sector organizations, and two academic organizations.

Surf the Web to Protect Galveston Bay

Visit the Galveston Bay Estuary Program's web site at <www.gbep.state.tx.us> for information. You can also find a link to its citizen and volunteer page to learn how you can protect the bay. You will discover everything from volunteer opportunities, to data and mapping, to links to other helpful web sites. You can also call the Estuary Program at 281-218-6461 for more info!

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Paddle and float the cypress swamp. Take your canoe or kayak to the Wallisville Lake Project and enjoy the largest cypress swamp on the Texas coast. A hand-launch canoe and kayak area is located at Cedar Hill Park, about 30 miles east of Houston. (*From IH 10, take FM 563 north to Lake Charlotte Road, then west to the park.*)