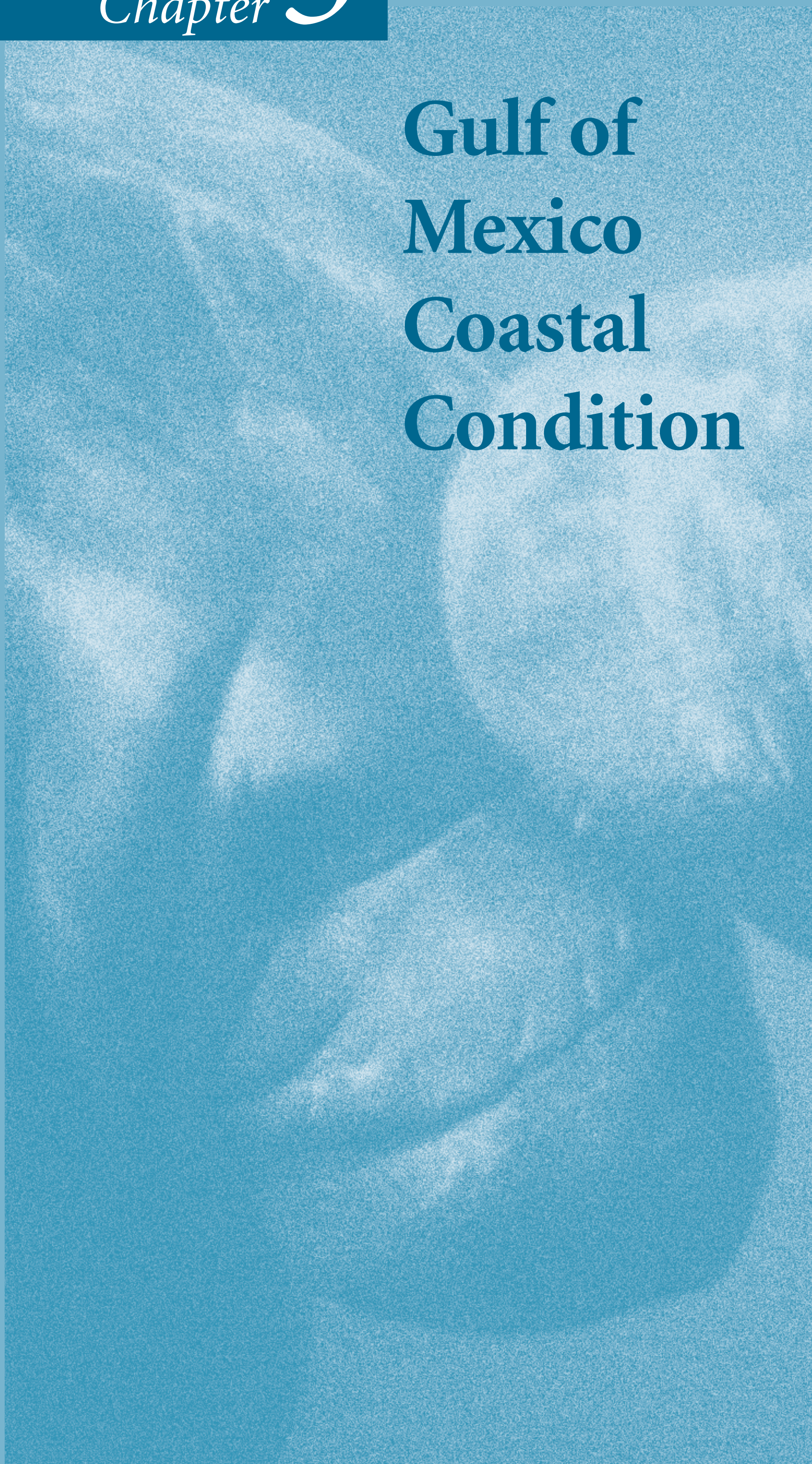
Chapter 5

Gulf of Mexico Coastal Condition



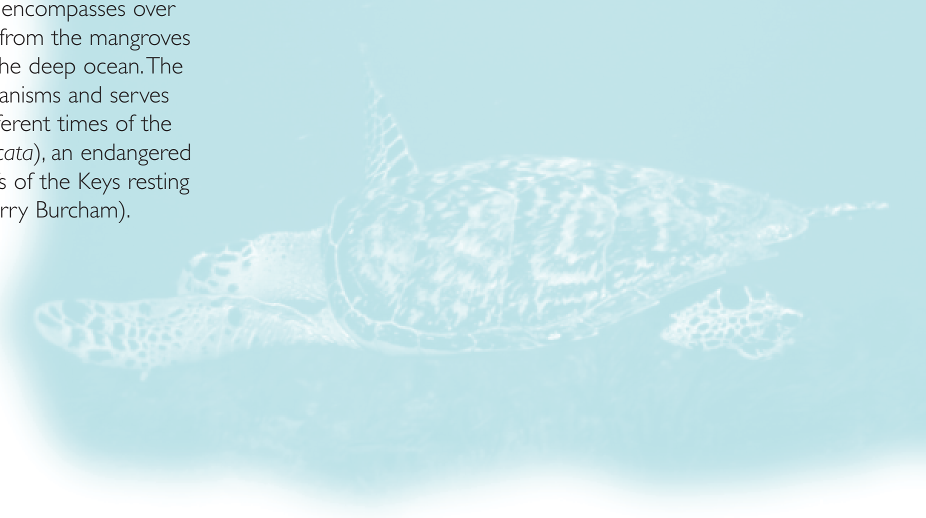
Chapter 5

Gulf of Mexico Coastal Condition

The Florida Keys National Marine Sanctuary is visited by several marine mammal species, including the endangered West Indian manatee (Photo: Laurel Canty-Ehrlich).

The overall condition of Gulf Coast estuaries is fair to poor (Figure 5-1). From 1991 to 1995, EMAP collected environmental stressor and response data from 500 locations from Florida Bay, Florida, to Laguna Madre, Texas. Fifty-one percent of the assessed estuaries of the Gulf of Mexico were in good ecological condition, meaning that, in the most stressful period of the year, neither environmental stressors (nutrients, contaminants, etc.) nor aquatic life communities showed any signs of degradation (Figure 5-2). Another 37% showed indications of poor aquatic life conditions and 27% were impaired for human uses.

Gulf of Mexico estuaries (Figure 5-3) provide critical feeding, spawning, and nursery habitats for a rich assemblage of fish, wildlife, and plant species. Hundreds of species of birds, recreational and commercial fish and shellfish species, native cypress and mangroves, and threatened and endangered species such as sea turtles, Gulf sturgeon, beach mice, and manatees can be found in Gulf estuary habitats. These estuaries support



The Florida Keys National Marine Sanctuary encompasses over 2,800 square nautical miles of ocean waters from the mangroves and beaches of the Keys all the way out to the deep ocean. The Sanctuary is home to a wide diversity of organisms and serves as a resting place for migrating animals at different times of the year. The hawksbill turtle (*Eretmochelys imbricata*), an endangered species, can occasionally be seen on the reefs of the Keys resting or feeding on sponges and jellyfish (Photo: Jerry Burcham).

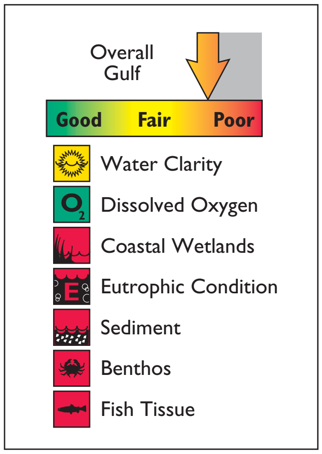


Figure 5-1. The overall condition of Gulf of Mexico coastal resources is fair to poor.

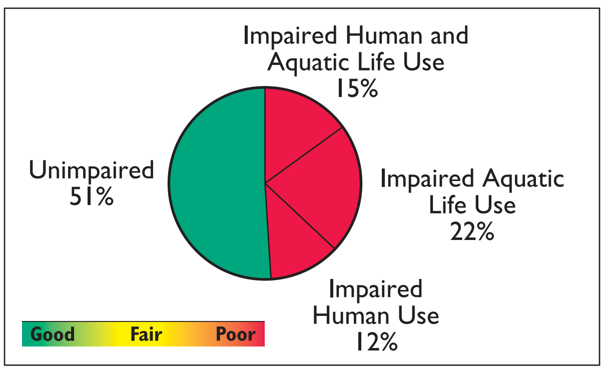


Figure 5-2. The condition of estuaries on the Gulf of Mexico Coast; estimates ±6% based on 5 years of sampling (U.S. EPA/EMAP).

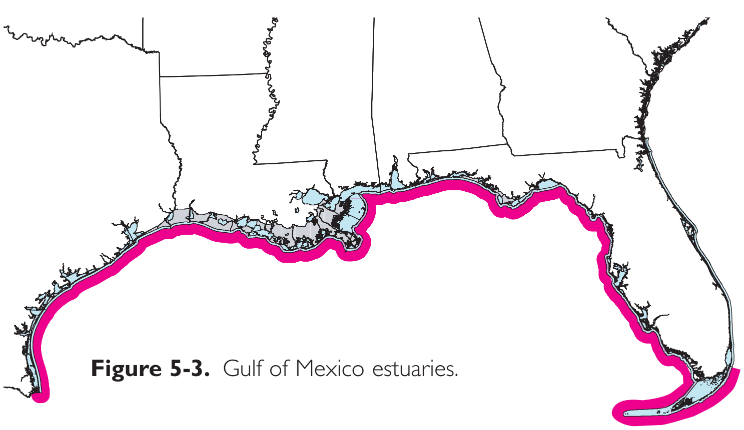


Figure 5-3. Gulf of Mexico estuaries.

submerged aquatic vegetation communities that stabilize shorelines from erosion, reduce nonpoint source loadings, improve water clarity, and provide habitat.

The population of coastal counties along the Gulf Coast increased 52% between 1970 and 1990 (U.S. Bureau of the Census, 1996). Despite the increasing human impacts on the Gulf Coast, relatively little attention has been focused on the environmental concerns of the Gulf of Mexico estuaries or upon the condition of its estuarine resources. EMAP focused its coastal monitoring efforts on the Gulf of Mexico estuaries from 1991 to 1999 (Macauley et al., 1999; U.S. EPA, 1999). The Joint Gulf States Comprehensive Monitoring Program (GMP, 2000) began in 2000 in conjunction with EPA's Coastal 2000 Program. In addition, since the late 1980s, NOAA's NS&T Program has collected contaminant bioavailability and sediment toxicity data from several Gulf of Mexico locations (Long et al., 1996).

Coastal Monitoring Data

Water Clarity

Water clarity in Gulf Coast estuaries is fair. Water clarity was estimated by light penetration through the water column. For approximately 22% of the waters in Gulf of Mexico estuaries, less than 10% of surface light penetrated to a depth of 1 meter (Figure 5-4).

Dissolved Oxygen

Dissolved oxygen conditions in Gulf Coast estuaries are generally good, except in a few highly eutrophic regions. EMAP estimates for Gulf of Mexico estuaries show that about 4% of the bottom waters in the Gulf estuaries have hypoxic conditions or low dissolved oxygen (<2 ppm) on a continuing basis in late summer (Figure 5-5). These areas are largely associated with Chandeleur and Breton Sounds in Louisiana, some shoreline regions of Lake Pontchartrain, northern Florida Bay, and small estuaries associated with Galveston Bay, Mobile Bay, Mississippi Sound, and the Florida panhandle.

While hypoxia resulting from anthropogenic activities is a relatively local occurrence in Gulf of Mexico estuaries, accounting for less than 5% of the estuarine bottom waters, the occurrence of hypoxia in the Gulf's shelf waters is much more significant (Figure 5-6). The Gulf of Mexico hypoxic zone is the largest zone of anthropogenic, or human-caused, coastal hypoxia in the Western Hemisphere (CAST, 1999). Since 1993, midsummer bottom water hypoxia in the northern Gulf of Mexico has been larger than 3,861 square miles, and in 1999, it reached 7,722 square miles (CENR, 2000) (Figure 5-7). This hypoxia occurs in

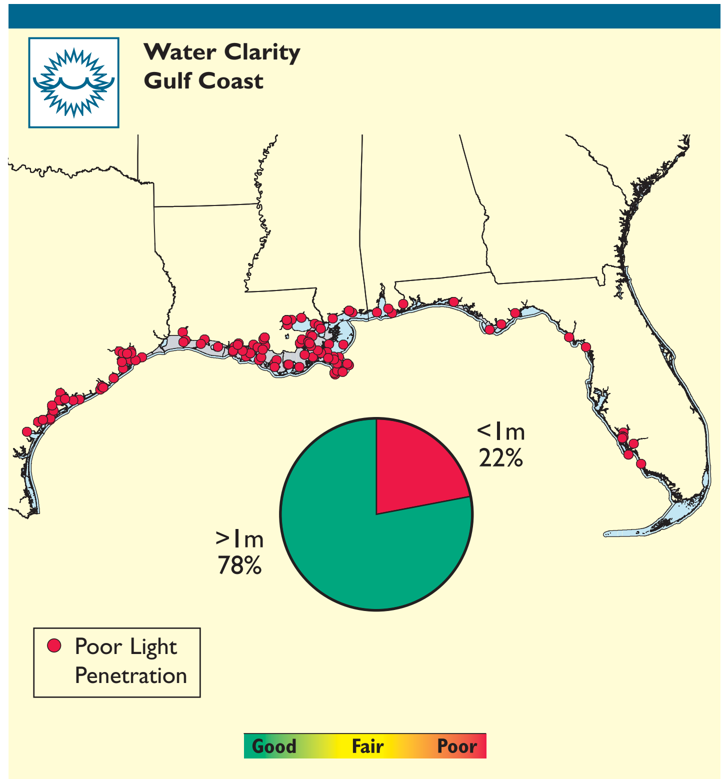


Figure 5-4. Light penetration data and locations for sites with <10% light penetration along the Gulf Coast (U.S. EPA/EMAP).

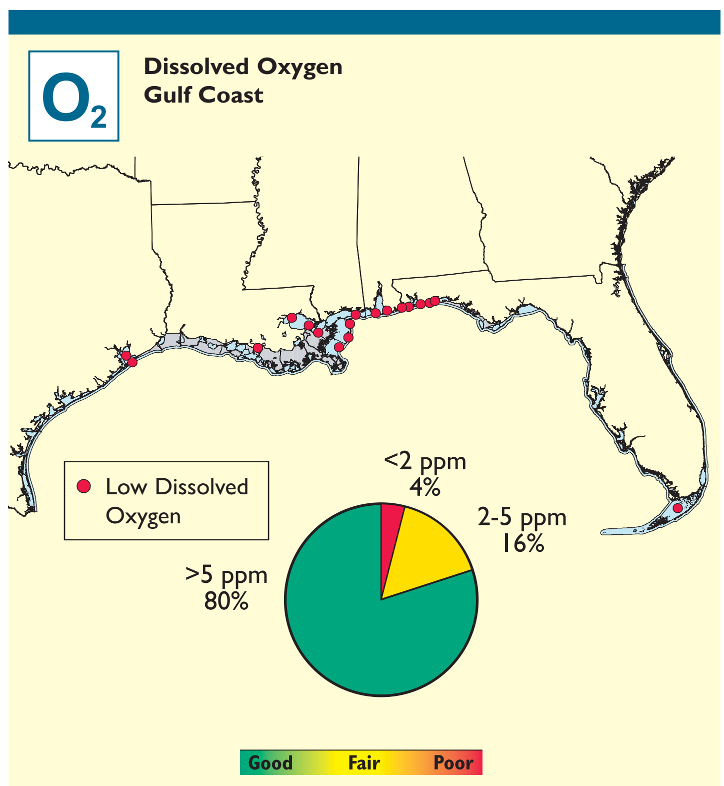


Figure 5-5. Dissolved oxygen data and locations for sites with less than 2 ppm for the Gulf Coast (U.S. EPA/EMAP).

Figure 5-6. Mississippi-Atchafalaya River Basin and Gulf of Mexico hypoxic zone.

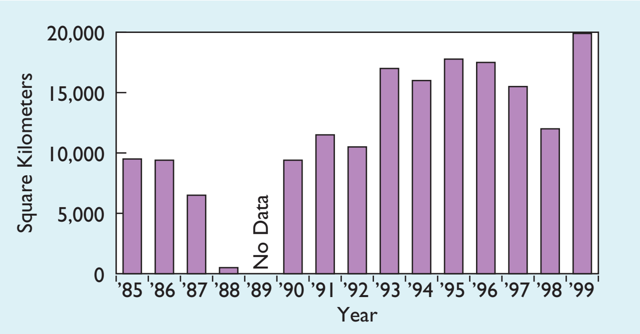


Figure 5-7. Areal extent of mid-summer hypoxia in the Gulf of Mexico (1985-1999) (CENR, 2000).

the Gulf of Mexico waters receiving flow from the Mississippi-Atchafalaya River Basin and results from (1) nutrients delivered from the watershed that foster large-scale phytoplankton production in shelf waters or (2) decomposition of organic material delivered from that watershed. Sediment cores from the hypoxic zone show that shelf algal reproduction was significantly lower in the first half of the 20th century, suggesting that anthropogenic changes to the basin and its discharges have resulted in the increased hypoxia (CENR, 2000).

Since 1980, the basins providing discharge to this portion of the Louisiana shelf have averaged nearly 2 million tons of nitrogen to the Gulf annually. Increases have been observed since the 1950s, primarily of nitrate nitrogen with total nitrate flux tripling from the 1960s and 1970s to the 1980s and 1990s. Over half of the nitrogen load comes from nonpoint sources north of the confluence of the Ohio and Mississippi Rivers, with much of the loading coming from the drainage of agricultural lands (CENR, 2000). Gulf of Mexico ecosystems and fisheries are affected by the widespread hypoxia. Mobile organisms leave the hypoxic zone for more oxygen-rich waters, and those that cannot leave frequently die.

Estimates of Gulf of Mexico hypoxia have not been included in the estimates of Gulf estuarine hypoxia. Thus, a determination of a low proportion of estuarine bottom waters having hypoxic conditions and, consequently, a "good" rating in estuaries for dissolved oxygen should not be indicative of offshore conditions. Using similar standards (similar to those for estuarine waters), Gulf of Mexico shelf bottom waters would be rated "poor" for dissolved oxygen conditions.

Much of this discussion of Gulf hypoxia is taken from six science topic reports and an integrated scientific assessment of Gulf of Mexico hypoxia produced by the National Science and Technology Council Committee on Environment and Natural Resources (CENR, 2000). The six topic reports underwent rigorous peer review with oversight by an independent editorial board. The report, integrated assessment, and the comments are available on the Internet at http://www.nos.noaa.gov/products/pubs_hypox.html. The Council for Agricultural Science and Technology (CAST) also produced a report that provides recommendations to help better understand all aspects of hypoxia in the Gulf of Mexico and to decrease the Gulf hypoxic zone. This report is available on the Internet at http://www.cast-science.org/castpubs.htm. Specific action to address this environmental issue is highlighted in this chapter.

Coastal Wetland Loss

The coastal wetlands indicator for the Gulf of Mexico receives a score of poor. Wetland losses along the Gulf of Mexico from the 1780s to 1980s are among the highest in the nation (Figure 5-8). Losses over the 200-year

Coastal Wetland Habitat Loss from 1780 to 1980

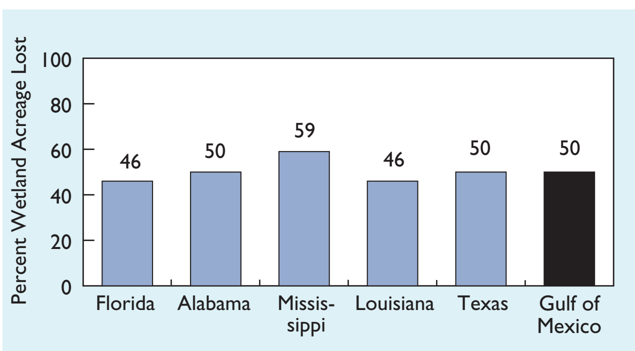


Figure 5-8. Percent wetland habitat loss from 1780 to 1980 by state and for the Gulf of Mexico region overall (Dahl, 1990; Turner and Boesch, 1988).

timespan were 50% throughout the Gulf and ranged from 46% declines in Florida and Louisiana (although the absolute losses in these states were the highest) to a 59% decline in Mississippi. During the 1970s to 1980s, the Gulf lost 5% of its wetlands, with the largest declines seen in Texas (Figure 5-9). Not all of the wetland losses in the Gulf of Mexico are due to coastal development. Sea-level rise, coastal subsidence, and interference with normal erosional/depositional processes also contribute to wetland loss.

The red mangrove (*Rhizophora mangle*), the colonizing mangrove, is the largest of the mangroves and is usually the first tree found when coming ashore in the Florida Keys. The red mangrove has prop roots often characterized as "walking" roots due to their resemblance to a person's legs while walking. The black mangrove (*Avicennia germinanas*) is found upland of the red mangrove. This tree has pneumataphores, aerial roots that resemble limbs growing upwards, that assist the tree in obtaining oxygen in its anaerobic substrate. The white mangrove (*Laguncularia racemosa*) grows farther inland and is not continuously inundated with saltwater. It does feel the effects of the salty environment though, and has two pores at the base of its leaves that excrete the excess salt (Photo: Florida Keys NMS).

Coastal Wetland Habitat Loss from 1970 to 1980

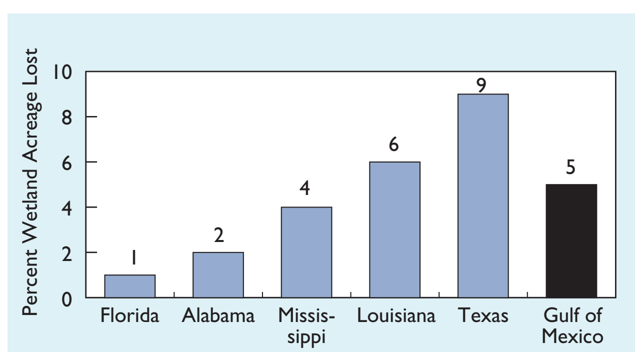


Figure 5-9. Percent decline in acreage of wetlands from the 1970s to 1980s by state and for the Gulf of Mexico region overall (Hefner et al., 1994).

Eutrophic Condition

The condition of Gulf Coast estuaries as measured by eutrophic condition is poor. Expression of eutrophic condition was high in 38% of the area in Gulf estuaries (Figure 5-10). The symptoms of eutrophic condition are expected to increase in over half of Gulf of Mexico estuaries by 2020.

High expressions of chlorophyll *a* were determined for about 30% of the estuarine area of the Gulf of Mexico. The areas with high chlorophyll *a* were largely in Louisiana, Laguna Madre, Tampa Bay, and Charlotte Harbor (Figure 5-11).

One area worthy of discussion is Florida Bay, which has a high eutrophic condition but low chlorophyll *a*. Concentrations of about 50 μg/L were used to classify an estuary as having a high concentration of chlorophyll *a*. Chlorophyll *a* concentrations in Florida Bay as low as 20 μg/L have been shown to be potentially eutrophic due to the physical, chemical, and ecological dynamics of that system.

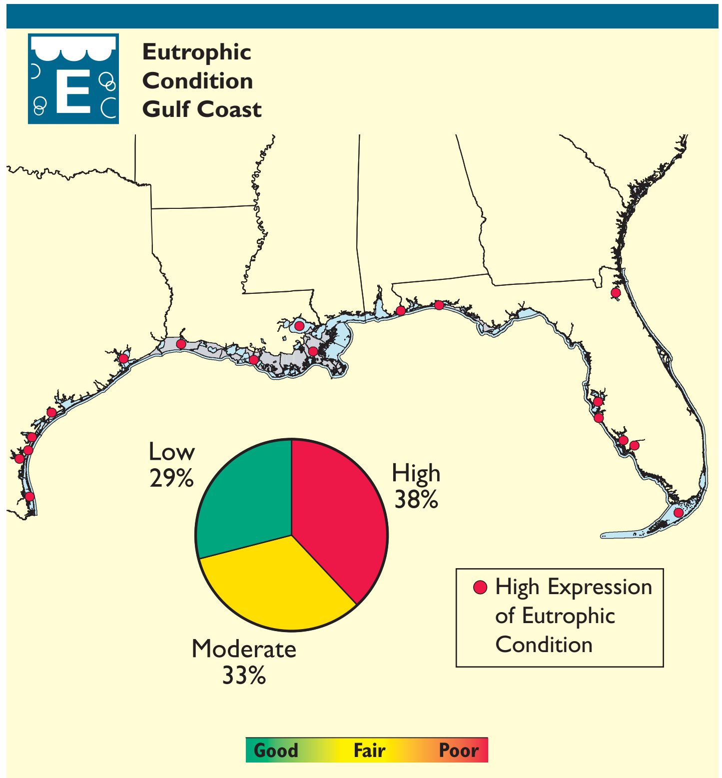


Figure 5-10. Eutrophic condition data and locations of estuaries with high expression eutrophic condition along the Gulf Coast (NOAA/NOS).

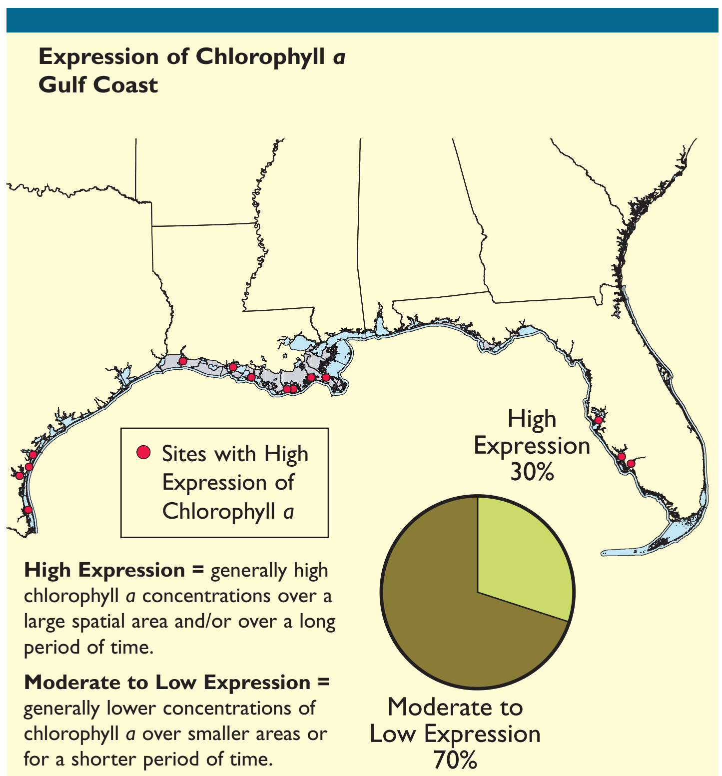
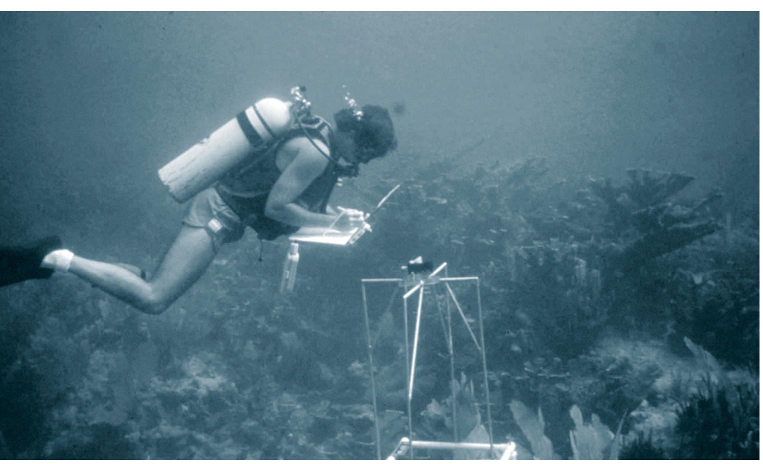


Figure 5-11. Chlorophyll *a* data in surveyed estuaries along the Gulf Coast and locations of estuaries with high expressions of chlorophyll *a* (NOAA/NOS).



Scientists from other local, state, regional, and national governmental resource protection agencies, universities, and nongovernment organizations conduct much of the research in the Florida Keys National Marine Sanctuary. In this picture, photomonitoring of the corals is being done as part of a long-term monitoring program used to indicate changes and trends in the health of the coral reef (Photo: Mike White, Florida Keys NMS).

A National Strategy To Address Hypoxia in the Gulf of Mexico

The best current science indicates that excessive nutrient input, particularly nitrogen, from the 31-state Mississippi/Atchafalaya River Basin contributes to the annual formation of a hypoxic zone in the northern Gulf of Mexico. This low-oxygen condition, which threatens the vast ecological habitat, has averaged about 5,405 square miles over the past 5 years (1995-2000). Detailed information on the size of the hypoxic zone and nitrogen inputs from almost two-thirds of the United States is presented in this chapter. Concern over the environmental and economic impacts of this annual event has led to a national effort to assess and address the causes and solutions for reducing its adverse effects.

In 1998, Congress passed the Harmful Algal Bloom and Hypoxia Research and Control Act, which contained specific requirements for addressing Gulf of Mexico hypoxia. The first requirement was to produce an integrated assessment of causes and consequences, and the second was to produce a plan of action to reduce, mitigate, and control hypoxia. As a result of this legislation, NOAA, as directed by the National Science and Technology Council, led a scientific assessment team to investigate the causes and effects of the hypoxic zone as well as approaches for reducing its size and consequences. Teams with experts from within and outside the government developed and produced six interrelated, peer-reviewed reports that became the foundation for the overall integrated assessment published in May 2000.

To fulfill the second requirement, the National Science and Technology Council requested that an existing group, the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, lead the effort for developing the plan of action. EPA provided leadership for this Task Force, which included senior management members from 9 states, 2 tribes, and 10 federal agencies. Using the information provided in the scientific assessment along with other supplemental information, the Task Force produced a draft action plan that is available on the Internet at http://www.epa.gov/msbasin/fr-actionplan.html).

Following an October 2000 meeting in Baton Rogue, Louisiana, the Task Force finalized the action plan for delivery to the White House and ultimately to Congress. The final action plan includes a coastal goal for reducing the 5-year running average areal extent of the Gulf of Mexico hypoxia to less than 1,930 square miles by the year 2015. This will be accomplished through implementation of specific, practical, and cost-effective voluntary actions by all partners within the Basin aimed at achieving a 30% reduction (from the average discharge in the 1980-1996 time frame) in nitrogen discharges to the Gulf. Approaches for accomplishing the reductions include creating and restoring wetlands, increasing the efficiency of agricultural and urban non-point-source nutrient management practices, upgrading sewage treatment facilities for nitrogen removal, and continuing research and monitoring efforts within the Mississippi River Basin and the Gulf of Mexico. These efforts will all contribute to overall improved water quality within the Mississippi River Basin and reduction of the hypoxic condition in the Gulf of Mexico.

Sediment Contaminants

The condition of Gulf Coast estuaries as measured by sediment contaminants is poor. Sediment contaminant concentrations were rarely observed at greater than ERM guidelines (Long et al., 1996), but northern Galveston Bay and the Brazos River in Texas showed high sediment contaminant concentrations. EMAP reported that ERL guidelines were exceeded for all of the major groups of sediment contaminants, albeit at very low rates (less than 1% of area) for PAHs and PCBs (Figure 5-12). There are greater ERL exceedances for pesticides (43%) and heavy metals (32%), although most of the pesticide ERL exceedances are for dieldrin and endrin (both pesticides have ERL levels approximating their detection limits). The next pesticides with the largest areal exceedances of their ERL values are DDT (a chemical banned since 1972) at 12% and chlordane at 4%.

However, while concentrations of all sediment contaminants are relatively low, enrichment rates for Gulf of Mexico estuarine sediments range from 34% (heavy metals) to nearly 99% (PAHs and PCBs) (Figure 5-13).

Sediment Contaminant Criteria

ERM (Effects Range Medium) – The concentration of a contaminant that will result in ecological effects approximately 50% of the time based on literature studies.

ERL (Effects Range Low) – The concentration of a contaminant that will result in ecological effects about 10% of the time based on literature studies.

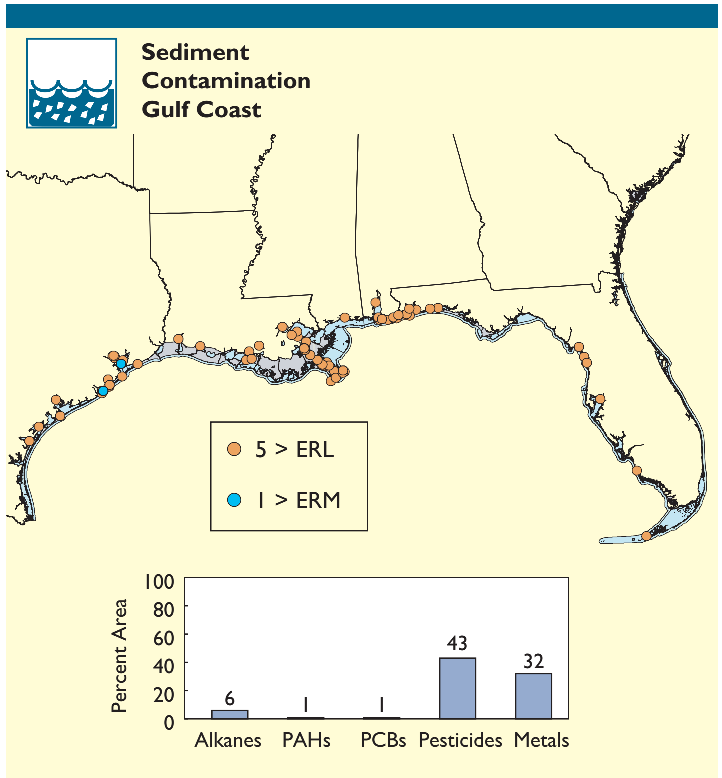


Figure 5-12. Sediment contamination for sampled sites and locations of sites with 5 > ERL or 1 > ERM along the Gulf Coast. (U.S. EPA/EMAP).

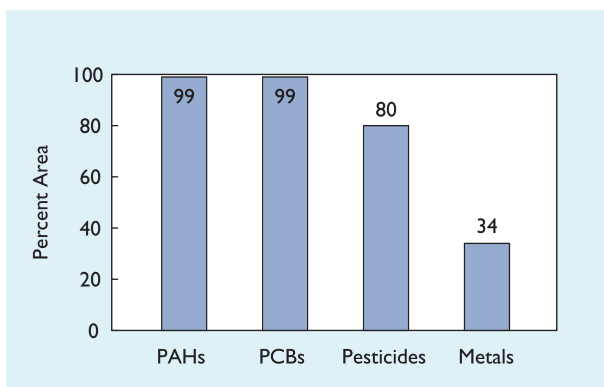


Figure 5-13. Sediment enrichment rates in Gulf of Mexico estuaries.

Benthic Condition

The condition of benthic indicators in Gulf Coast estuaries is poor. Benthic index estimates (Engle and Summers, 1999) based on EMAP surveys indicate that 23% of the estuarine area has degraded benthic resources (Figure 5-14). Of the 9,932 mi^2 in the Louisianian Province (Tampa Bay, Florida, to Laguna Madre, Texas) and of the 2,054 mi^2 of the West Indian Province located along the Gulf Coast, over 4,247 mi^2 were ecologically degraded with respect to benthos. Examination of the distributions of the benthic index in the three sampling strata within the Gulf of Mexico (large estuaries, large rivers, and small estuaries/rivers) showed that the Mississippi River had the largest proportion of its estuarine bottom area represented by poorer than expected benthic communities (82%), while large estuaries had the smallest proportional representation (18%). With the exception of the Big Bend and Ten Thousand Islands regions of Florida, most Gulf of Mexico estuarine regions showed some level of benthic degradation.

For the locations that showed poor benthic community quality, the co-occurrence of poor environmental quality (exposure) is shown in Figure 5-15. Of the 23% of the Gulf of Mexico estuarine area that had poor benthos, 70% also showed contaminated sediments, 1% showed sediment toxicity, 7% showed hypoxia, and 12% showed poor light conditions (high levels of total suspended solids). Only 10% of the locations that showed poor benthic community conditions had no sediment or water quality degradation. These locations

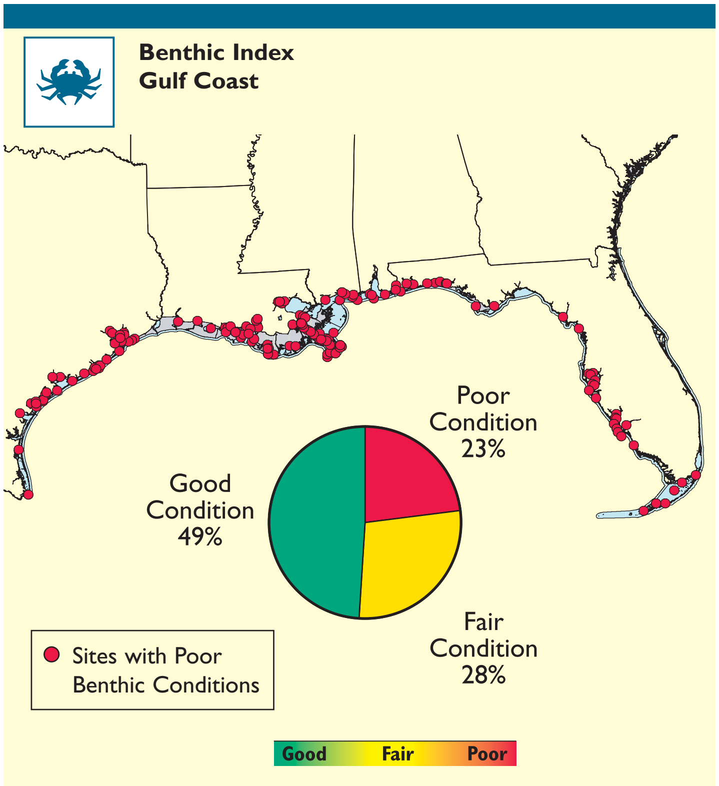


Figure 5-14. Benthic index condition data and locations with poor benthos along the Gulf Coast (U.S. EPA/EMAP).

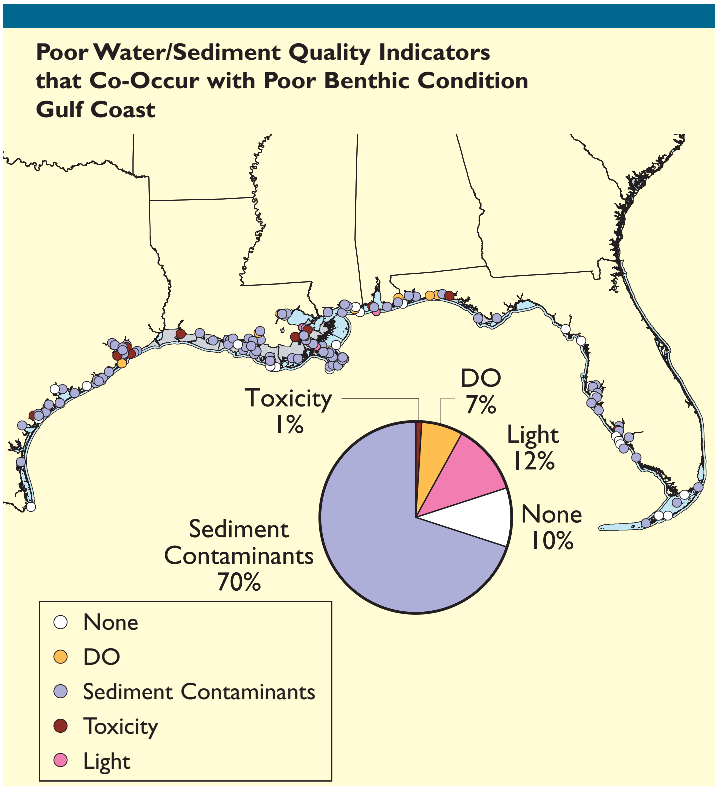


Figure 5-15. Indicators of poor water/sediment quality that co-occur with poor benthic condition in Gulf of Mexico estuaries (U.S. EPA/EMAP).

were spread throughout the five Gulf of Mexico states, although several of these sites are suspected of having poor nutrient water quality.

Sediment toxicity from EMAP and NOAA bioeffects data show that small proportions of Gulf of Mexico sediments are toxic (6% of sediments causing greater than 20% mortality in test organisms) (Figure 5-16). NOAA bioeffects surveys of Tampa Bay, Apalachicola Bay, St. Andrews Bay, Choctawhatchee Bay, Pensacola Bay, and Sabine Lake showed less than 1% of sediments to be toxic. EMAP surveys generally confirm these findings, although their surveys showed toxicity associated with Choctawhatchee River sediments, Bayou Texar in Pensacola Bay, and the Sabine Lake Canal. In addition, EMAP showed toxic sediments in several

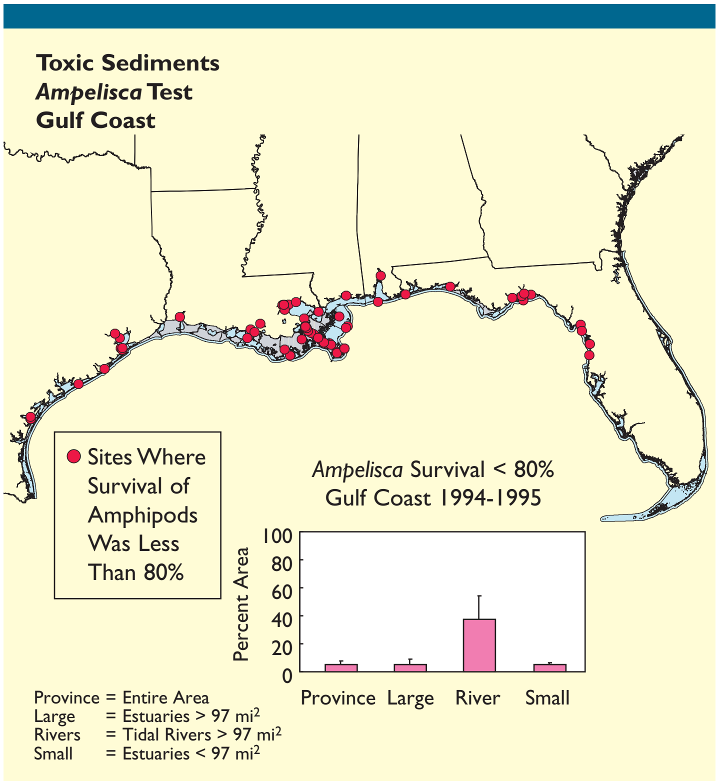


Figure 5-16. Amphipod data and locations with toxicity > 20% along the Gulf Coast (U.S. EPA/EMAP).

Big Bend, Florida, estuaries, lower Mississippi River and Atchafalaya River sediments, portions of Galveston Bay, western Lake Pontchartrain, as well as several other small estuarine systems in the Gulf of Mexico.

Fish Tissue Contaminants

The condition of Gulf Coast estuaries based on fish tissue contaminants is poor. Based on FDA limits for 15 of the 49 contaminants examined by EMAP, contaminant concentrations in edible fish and shellfish were low for all pesticides tested. However, guidance concentrations for metals were exceeded in all species examined. Concentrations of arsenic, chromium, copper, and selenium exceeded guidance values for 4% of shrimp, 9% of Atlantic croaker, and 32% of catfish. An estimated 20% of fish examined contained concentrations of metals exceeding guidance criteria (Figure 5-17), although 80% of these exceedances were for arsenic (16% of fish examined). Arsenic found in fish and shellfish is almost completely altered into organic arsenobetaines that are not toxic to humans. Thus, only about 4% of fish examined showed elevated levels of contaminants, with about 3% of catfish, 4% of shrimp, and 5% of croakers (Figure 5-18) showing elevated concentrations in edible tissues.

Less than 1% of the approximately 64,100 fish examined from the region had visible pathologies (Fournie et al., 1996) (Table 5-1). External pathologies were prevalent in upper trophic level fish (e.g., sea trout and permit) (1%), while demersal species exhibited an incidence of external pathologies in about 0.5% of the fish

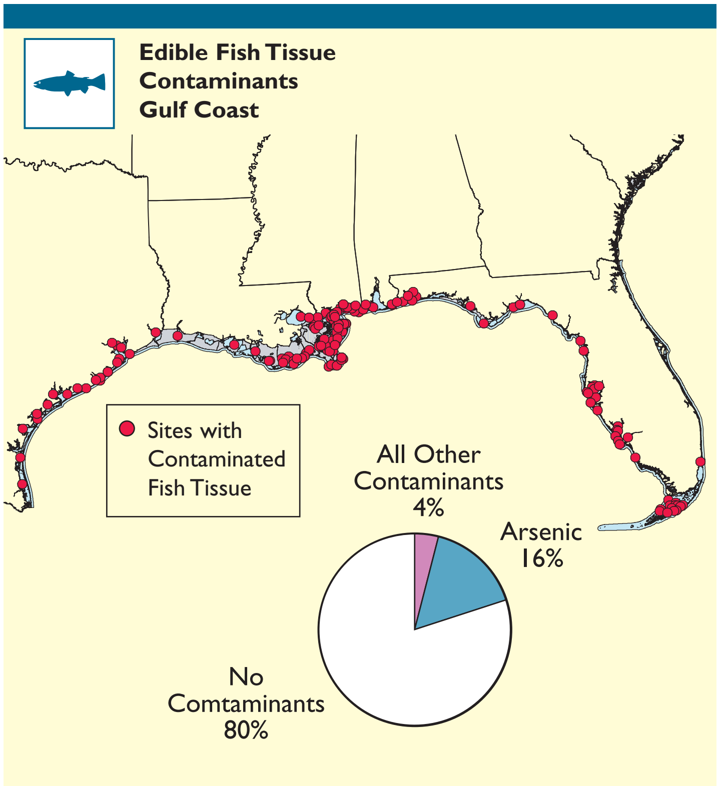


Figure 5-17. Contaminants in fish tissue, including arsenic (U.S. EPA/EMAP).

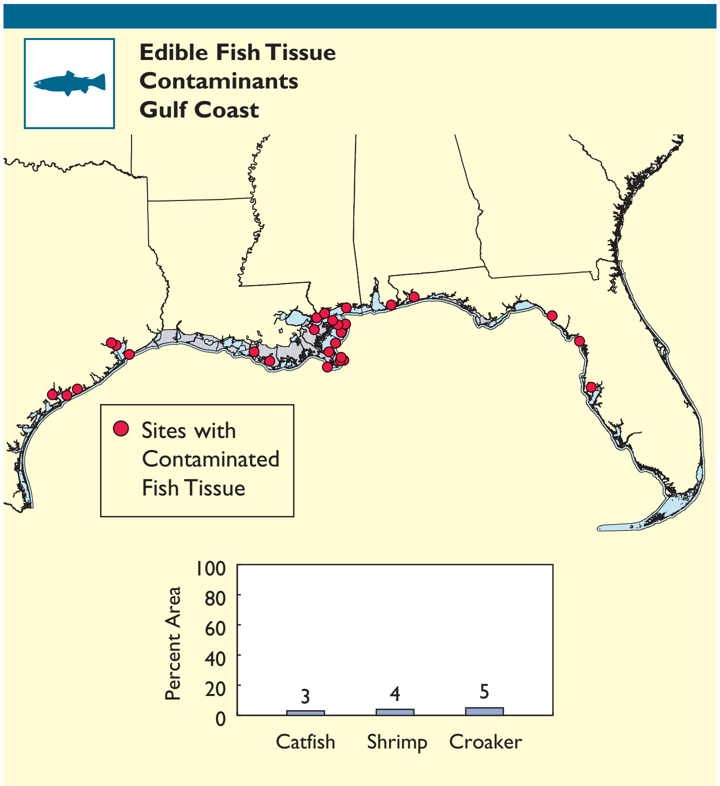


Figure 5-18. Contaminants in fish tissue, not including arsenic (U.S. EPA/EMAP).

examined. The estimation error associated with these percentages is about 0.0001%.

In summary, ecological conditions in the Gulf of Mexico show that about 50% of estuaries are in good condition. The remaining 50% are showing some signs of degradation; however, these signs are generally being seen in benthic communities and often represent chronic effects (e.g., changes in biodiversity and community structure) due to prolonged exposures to low levels of contaminants, increasing nutrients, and habitat degradation. While the level of estuarine degradation in Gulf of Mexico estuaries is low, it occurs relatively frequently and must be measured periodically to ensure that increasing degradation does not occur. Programs like the Joint Gulf States Comprehensive Monitoring Program jointly sponsored by the Gulf of Mexico states and EPA's Gulf of Mexico Program and Coastal 2000 will provide this continuing surveillance.

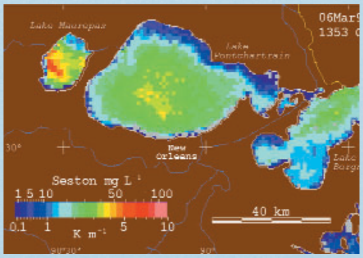
Table 5-1. Number of Fish with Gross Pathologies in Gulf of Mexico Estuaries

Group	Number of Pathologies	Number of Fish	Percent with Pathologies	Standard Error of Estimate
Demersal	198	44,781	0.442	0.000
Upper Trophic	43	4,179	1.028	0.002
Commercial/ Recreational	151	14,217	1.062	0.000
Pelagic	163	13,299	1.225	0.000

Lake Pontchartrain, Louisiana's Troubled Urban Estuary

Concentrated rapid population growth in the area between Lake Pontchartrain and the Mississippi River began nearly 300 years ago with the influx of European settlers. Development and urbanization in the New Orleans area is projected to continue and place even greater stress on the Pontchartrain Basin environment. Today, the Basin faces many challenges, including continued loss of wetlands and estuarine habitats, pollution of water and sediments, and potential impacts on the circulation patterns of Lake Pontchartrain from future freshwater diversions from the Mississippi River. The U.S. Geological Survey conducts a number of long-term studies in Lake Pontchartrain to provide scientific information to help managers and planners deal with these environmental challenges.

The opening of the Bonnet Carré Spillway, which connects the Mississippi River to Lake Pontchartrain, serves as one example of the human-induced environmental challenges in the estuary. In March 1997, the Spillway was opened to help divert flood waters from the Mississippi into Lake Pontchartrain. Satellite imagery revealed an increase in suspended material in the lake as a result of the diversion of flood-waters. Below are images derived from the Advanced Very High Resolution Radiometer (AVHRR) instrument onboard National Oceanic and Atmospheric Administration polar-orbiting satellites. The images illustrate the increase in suspended material in the lake as a result of the diversion of floodwaters. Dark red indicates more suspended sediment.



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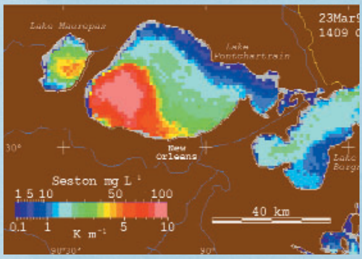
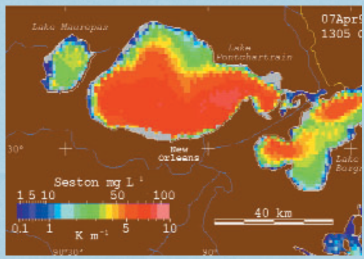


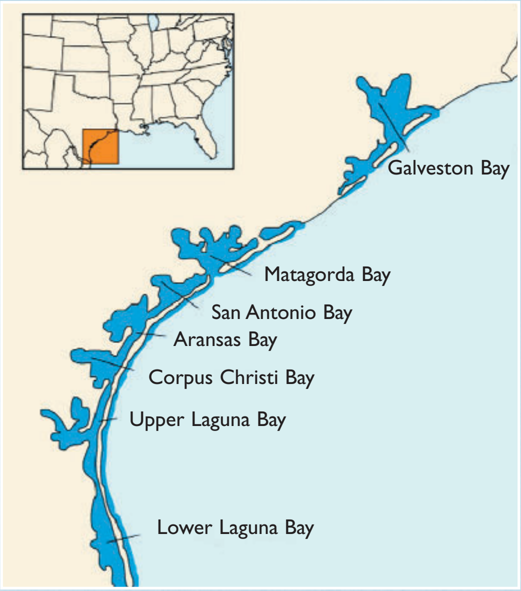
March 23,1997



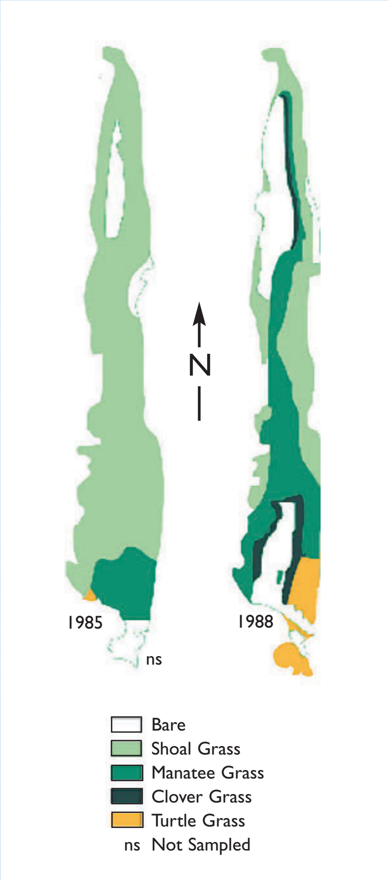
April 7,1997

Seagrass Meadows in Laguna Madre

Laguna Madre is a very shallow, naturally hypersaline (saltier than seawater) coastal body of water located in southern Texas near the Mexican border (see map). It covers over 600 square miles and averages only 2.5 feet in depth, but the deepest areas are over 5 feet deep. Seagrasses currently cover over 70% of both the upper and lower Laguna Madre. However, dramatic changes are taking place in the coverage and species composition of the seagrass communities.



The Texas coast.



Increased turbidity and changes in salinity are leading to dramatic changes in the seagrass meadows of the lower Laguna Madre (Onuf, 1995).

The upper Laguna Madre saw large increases in seagrass coverage from 1967 to 1988. Since 1988, seagrass meadows have been declining, particularly in the deeper areas of the lagoon. Current research suggests that recent declines are due to a persistent bloom of the phytoplankton *Aureoumbra lagunensis* (Texas brown tide). The bloom reduces water clarity and results in shading of deeper seagrasses, which are then unable to survive.

Seagrass coverage in the lower Laguna Madre is also declining, and species composition is changing rapidly. Historically, shoal grass (*Halodule wrightii*) dominated seagrass meadows in Laguna Madre. These meadows serve as overwintering grounds for redhead ducks (*Aythya americana*) that feed on shoal grass during the winter months. Since 1988, however, shoal grass coverage has been reduced 60% (left). Bare areas in the lagoon are increasing and shoal grasses are being replaced by manatee grass (*Syringodium filiforme*) and turtle grass (*Thalassia testudinum*). While declines appear largely due to brown tides, sediments suspended by maintenance dredging may have also contributed to reducing the amount of light reaching seagrasses and damaging the meadows.

Assessments and Advisories

Clean Water Act Section 305(b) and 303(d) Assessments

Gulf Coast states assessed 7,276 (48%) of the 15,316 square miles that make up the Gulf Coast estuaries for their 1998 305(b) reports. Although Florida reports water quality information for coastal waters for 305(b), it is not possible from that report to distinguish between Atlantic Coast and Gulf Coast listings, so 305(b) assessment information for Florida is included in its entirety in this section. Thirty-two percent of the assessed estuarine waters on the Gulf Coast fully support their designated uses, and 6% are threatened for one or more uses (Figure 5-19). The remaining 62% of assessed estuarine waters on the Gulf Coast are impaired by some form of pollution or habitat degradation. Individual use support for estuaries is shown in Figure 5-20.

Of the 2.5 million visitors to the Florida Keys each year, 17% participate in some type of fishing activity during their visit (Photo: Page Guill, Florida Keys NMS).

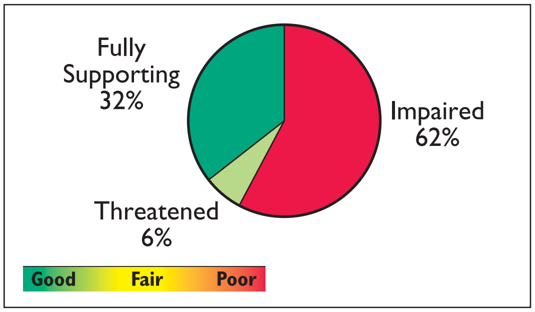


Figure 5-19. Water quality in assessed Gulf Coast estuaries (U.S. EPA).

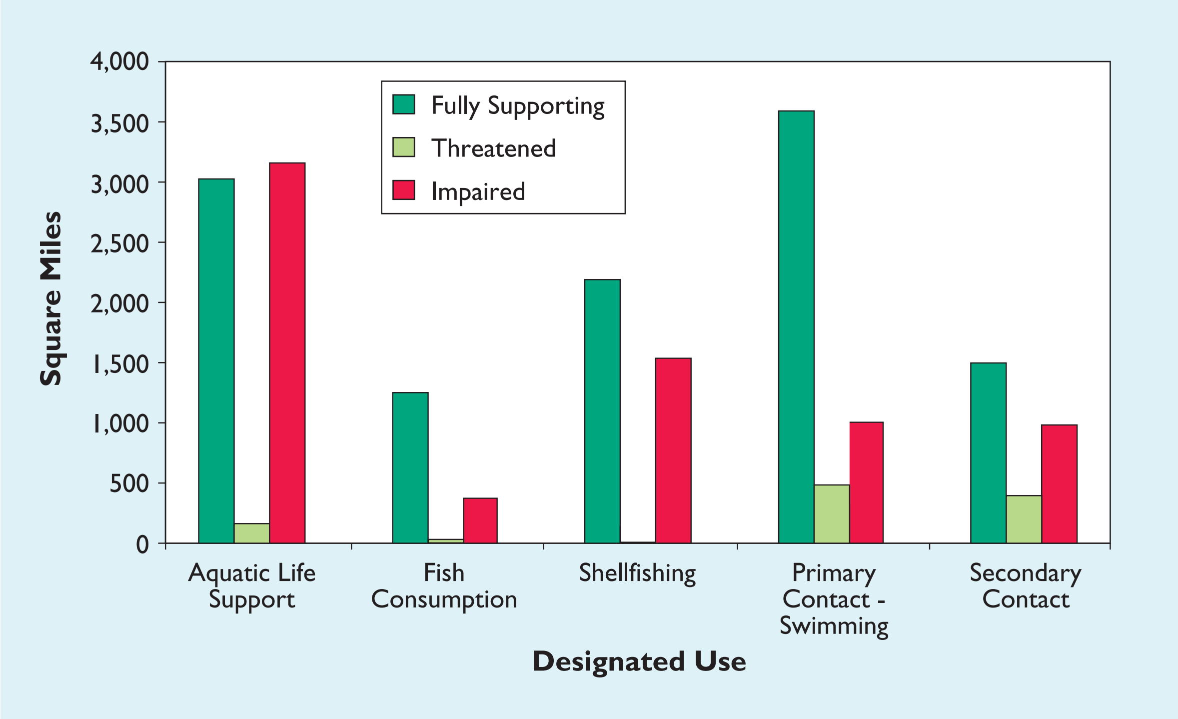


Figure 5-20. Individual use support for assessed estuaries on the Gulf Coast (U.S. EPA).

The Gulf Coast states assessed only 184 miles (0.02%) of their 10,063 coastal shoreline miles. Of the assessed shoreline miles, 60% fully support their designated uses, 2% are threatened for one or more uses, and 38% are impaired by some form of pollution or habitat degradation (Figure 5-21). Individual use support for assessed shoreline is shown in Figure 5-22.

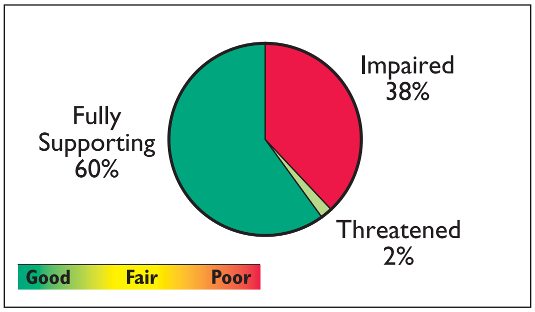


Figure 5-21. Water quality for assessed shoreline on the Gulf Coast (U.S. EPA).

The states reported the following individual use support for their assessed estuarine and coastal waters (Table 5-2).

Table 5-2. Individual Use Support for Assessed Coastal Waters Reported by Gulf Coast States under Section 305(b) of the Clean Water Act

Individual Uses	Estuaries Assessed as Impaired (mi^2)	Percent of Total Area Assessed (%)	Shoreline Assessed as Impaired (mi)	Percent of Total Shoreline Assessed (%)
Aquatic Life	3,144	50	0	0
Fish Consumption	356	21	0	0
Shellfish Harvesting	1,533	41	46	48
Swimming	997	20	26	31

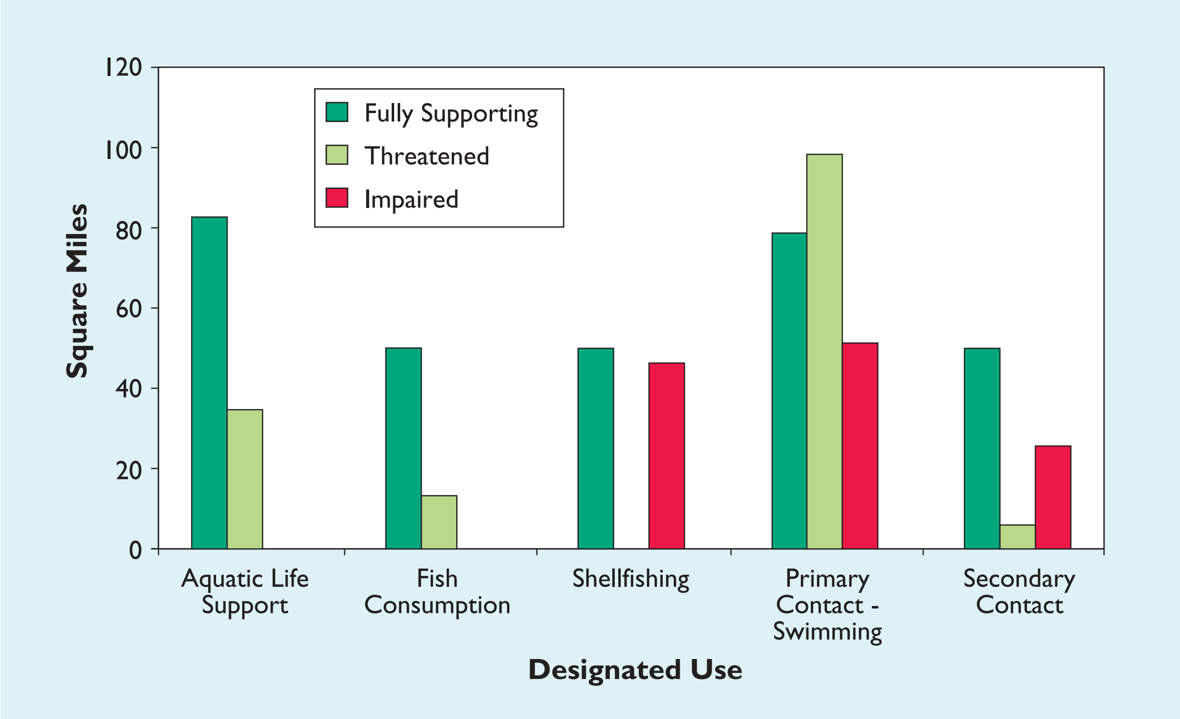


Figure 5-22. Individual use support for assessed shoreline on the Gulf Coast (U.S. EPA).

There are 233 waters located on the Gulf Coast that are listed as impaired under Section 303(d) of the Clean Water Act. The percentage of listed waters impaired by each of the major pollutant categories is shown in Figure 5-23.

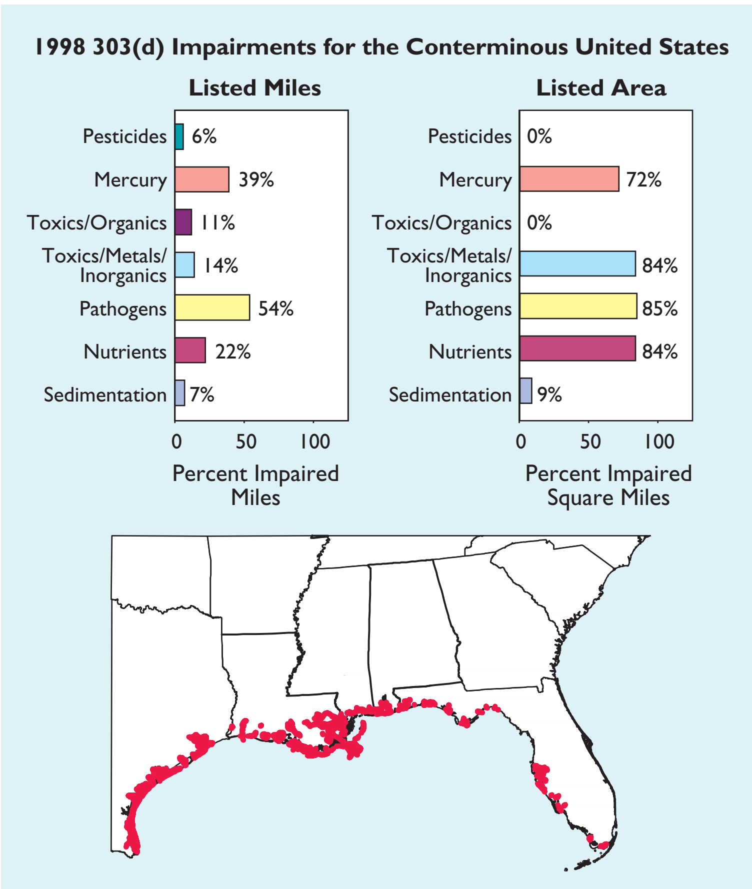


Figure 5-23. 1998 303(d) listed waters on the Gulf Coast and the percentage of listed waters impaired by the major pollutant categories (Note: A 303(d) listing may be impaired by multiple pollutants.) (U.S. EPA).

State Fish Consumption Advisories

In 2000, 14 fish consumption advisories were in effect for the estuarine and marine waters of the Gulf Coast. The majority of the advisories (10) were issued for mercury, and each of the five Gulf states had one statewide coastal advisory in effect for mercury in king mackerel (for fish greater than 39 inches). The statewide king mackerel advisories covered all coastal and estuarine waters in Florida, Mississippi, and Alabama, but covered only coastal waters in Texas and Louisiana. As a result of the statewide advisories, 100% of the coastal miles of the Gulf Coast were under advisory and 63.7% of the estuarine square miles were under advisory in 2000 (Figure 5-24).

Advisories placed on specific waterbodies included additional pollutants and fish species (Figure 5-25). For example, Bayou d'Inde in Louisiana, a small estuary, was under an

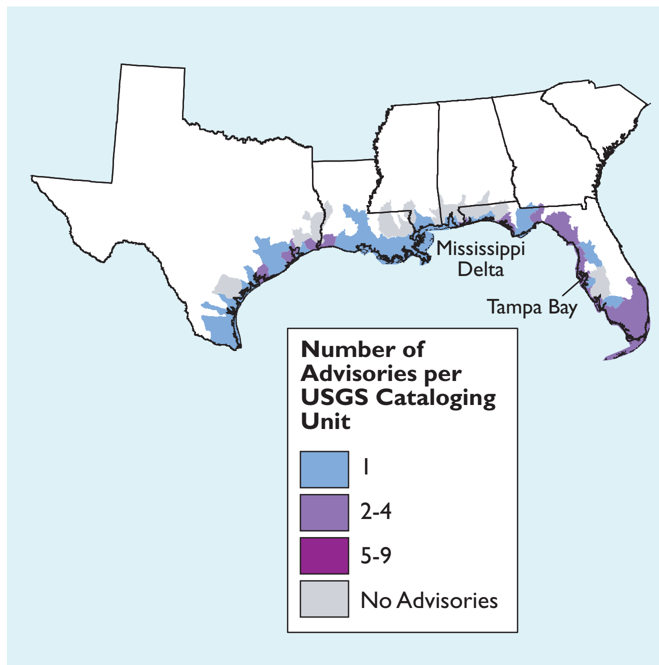


Figure 5-24. The number of fish consumption advisories active in 2000 (U.S. EPA NLFWA, 2000c).

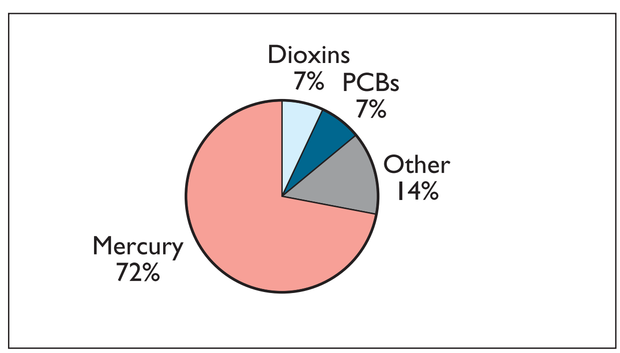


Figure 5-25. Percentage of estuarine and coastal marine advisories issued for each contaminant on the Gulf Coast (U.S. EPA NLFWA, 2000c).

advisory for all fish and shellfish due to the risk of contamination by PCBs, mercury, hexachlorobenzene, and hexachlorobutadiene. Florida had four additional mercury advisories, in addition to the statewide coastal advisory. In Texas, the Houston Ship Channel was under advisory for catfish and blue crabs due to the risk of contamination by dioxins/furans.

Classified Shellfish-Growing Waters

In the Gulf of Mexico region, 7.6 million acres (35% of the national total) were classified for shellfish harvest in 1995 (Figure 5-26). Of the classified acreage, 47% were approved and 53% were harvest-limited. Nationally, the Gulf Coast ranks first in the total amount of classified waters and last in the percentage of approved waters. Of the Gulf's classified acreage, 83% is located in estuarine waters and 17% in nonestuarine waters. The top three pollution sources affecting harvest limitation are upstream sources, individual wastewater treatment systems, and wildlife.

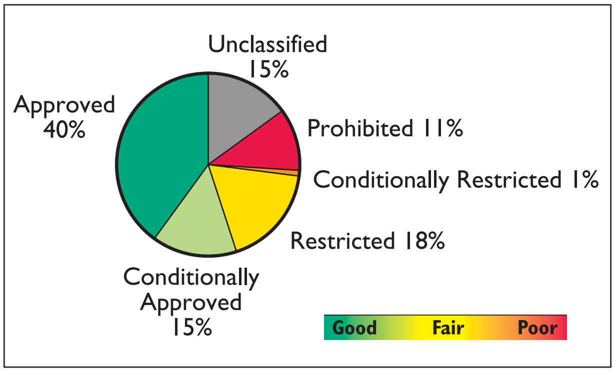


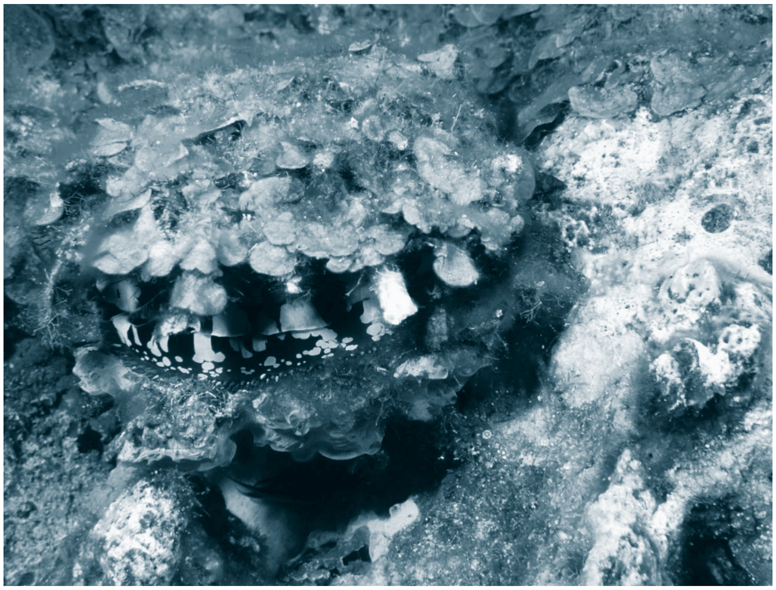
Figure 5-26. Classification of shellfish-growing waters in the Gulf of Mexico (1995 Shellfish Register, NOAA, 1997).

The Gulf's top shellfish species, the eastern oyster, was rated high or medium in abundance in 3 million acres (39% of the region's growing waters). Seventeen percent (517,459 acres) of eastern oysters are located in waters that do not allow direct harvesting (i.e., restricted, conditionally restricted, and/or prohibited).

Total classified acreage in the Gulf of Mexico has increased by over half a million acres since the 1990 Register. All of this new acreage is located in nonestuarine waters. Approved waters decreased slightly, from 48% in 1990 to 47% in 1995. All five Gulf of Mexico states reported a decline in classified acreage located in estuarine waters. At the same time, Florida and Louisiana each added over half a million acres of classified shellfish-growing areas in nonestuarine waters.

Summary of fish and shellfish under advisory for at least some part of the Gulf Coast:

Ladyfish	Shark	Shellfish
Catfish	King mackerel	Crab
Gafftopsail catfish	Spanish mackerel	Blue crab
Jack crevalle	Spotted sea trout	



Atlantic thorny-oyster (Spondylus americanus) are seen filter feeding on all three banks of the Flower Gardens as well as on the underwater structures of the platforms (photo: Frank and Joyce Burek).

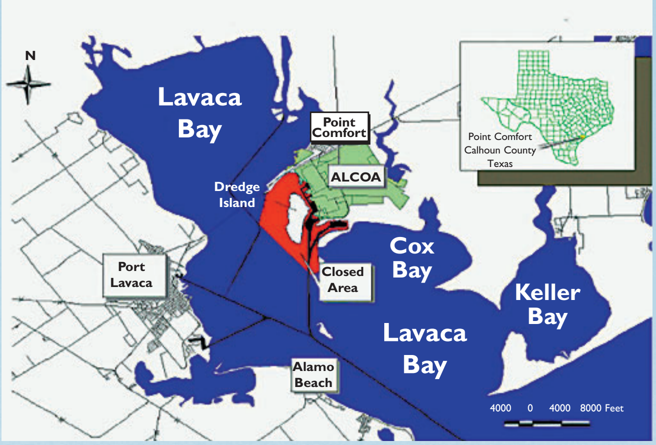
Mercury Contamination of Fishery Resources

Mercury cycles in the environment as a result of natural sources and human activities. It accumulates most efficiently in the aquatic food web, and many recreational and commercial fish species at the top of the food chain can accumulate high concentrations of mercury.

The Gulf of Mexico Program (GMP), a partnership of federal agencies, the Gulf states, citizens, and the private sector, was established to manage and protect resources of the Gulf and has recently released a collection of data on the occurrence of mercury in Gulf coastal fishery resources. The data were compiled from numerous sources, including fish tissue monitoring programs in all five Gulf states, EPA's EMAP, NOAA's NS&T Program, the National Marine Fishery Service, and the scientific literature.

The results of the GMP data summary show that three species (king mackerel larger than 39 inches, bluefish, and blacktip shark) have a Gulfwide mean mercury concentration between 0.81 and 1.0 ppm. Fish consumption advisories are issued at different levels in each state, but generally a mercury level of 1.0 ppm will trigger an advisory for the general public to limit consumption. Special populations, such as children and pregnant women, may be advised to limit consumption when mercury levels reach 0.5 ppm. Other species with mercury levels greater than 0.5 ppm include Spanish mackerel, jack crevalle, and sand sea trout. Find the Gulfwide Mercury in Tissue Database on the Internet at http://www.duxbury.battelle.org/gmp/hg.cfm.

Lavaca Bay, TX – A Case Study



Alcoa/Lavaca Bay Superfund Site.

The Aluminum Company of America (ALCOA) Point Comfort Operations (PCO) Plant is located in Calhoun County in southeast Texas near the city of Point Comfort. The Plant is bordered by Lavaca Bay on the west, and Cox Creek/Cox Lake on the east. From 1966 into the 1970s, ALCOA operated a chlorine-alkali plant that produced chlorine gas and sodium hydroxide. Part of this process involved the use of mercury cathodes. Wastewater containing mercury was discharged into Lavaca Bay through outfalls located on an offshore gypsum lagoon located on Dredge Island. Dredge spoils, contaminated with mercury, were disposed of in several areas on the site. Bay sediments are now contaminated with the waste mercury.

In March 1994, EPA and ALCOA signed an Administrative Order of Consent for ALCOA to conduct a Remedial Investigation, risk assessment, and feasibility study for the site. Major sampling conducted during the Remedial Investigation included an evaluation of sediments and surface water in the "Closed Area" of Lavaca Bay (see figure) and the remainder of Lavaca Bay (including Cox Lake, Cox Marsh, and portions of western Matagorda Bay) as well as sampling and analysis of finfish, shellfish, and prey items from Lavaca Bay. The primary contaminants of concern for the bay system include mercury and PAHs.

In April 1988, the Texas Department of Health (TDH) issued an order prohibiting the taking of finfish and crabs from the "Closed Area" of Lavaca Bay due to levels of mercury in fish tissue above Food and Drug Administration standards. In January 2000, the TDH reduced the size of the "Closed Area" based on the reductions of mercury contamination in fish tissue.

Following the completion of the Remedial Investigation, the feasibility study, and a baseline risk assessment, a Proposed Plan will provide the EPA's proposed remedial action for the site. The remedial action decided upon will be presented in a Record of Decision (ROD) following public meetings and public comment. The ROD will present the cleanup measures determined to be protective of human health and the environment. These cleanup measures should eventually result in TDH rescinding the Fish Closure order. This would enable the community to keep fish and shellfish from all areas of Lavaca Bay.

Beach Closures

Four of the five Gulf Coast states reported information about monitoring and beach closures to EPA in 1999 (Louisiana did not). Overall, a total of 85 beaches responded, with the majority of the respondents (85%) located in Florida. Of these 85 Gulf beaches, 79% (67 beaches) had a water quality monitoring program (Figure 5-27).

In Florida, 81% of the beaches responding reported that monitoring was conducted in 1999. It is estimated that at least 60 miles of beach coastline were covered by this monitoring. Ten beaches (14% of reporting beaches) on Florida's Gulf Coast reported closing at least once in 1999 (Figure 5-28). The primary reason for beach closures was elevated bacteria levels due to storm water and other runoff.

In Mississippi, only one coastal beach responded to EPA's survey. The Mississippi beach reported the existence of a monitoring program that covered the entire 40 miles of beach coastline and was partially closed twice in 1999. One beach in Louisiana, on the south shore of Lake Pontchartrain, was closed throughout the year in 1998 due to elevated bacterial levels from sanitary sewer overflows and pipe breaks. However, in 1999, no Louisiana beaches reported information to EPA.

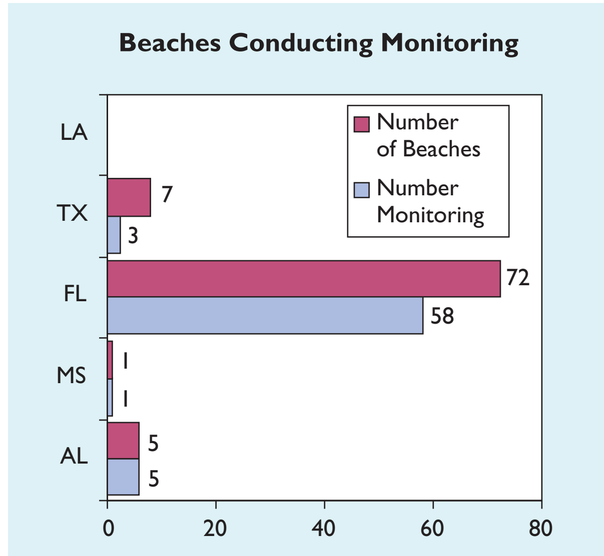


Figure 5-27. Number of beaches in each state that responded to the survey versus the number of beaches that are monitored (U.S. EPA).

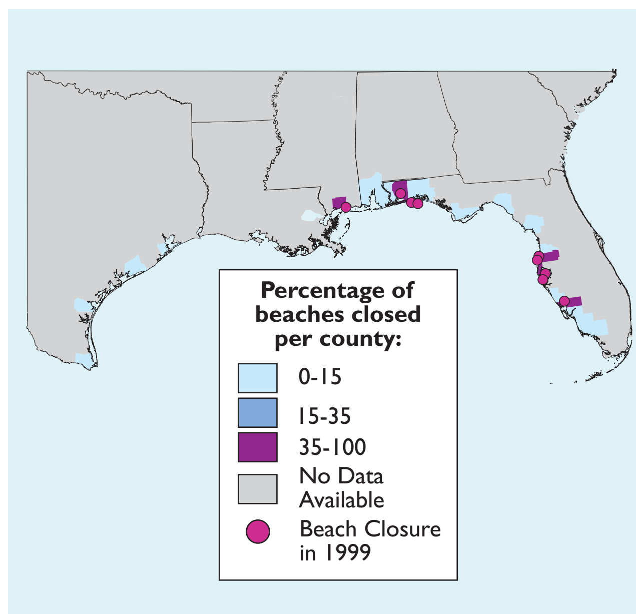


Figure 5-28. Locations of beaches for which information is available. Of the beaches submitting information, 13% were closed at least once in 1999.

Summary

Ecological conditions in Gulf estuaries are fair to poor (Figure 5-29). The primary problems in Gulf Coast estuaries in the 1990s are sediment contamination, wetland losses, poor benthic conditions, and high expression of eutrophic condition. Over 25% of sediments are enriched or exceed ERL guidance. Although this problem may be improving, benthic community degradation (23% of sediments), expression of eutrophic conditions (currently 32%), and wetland losses (currently about 5% per decade) are worsening. Unless these problems are addressed in the early 21st century, improvements in sediment contaminant quality will be overshadowed by decreases in the quality of biotic communities and increases in coastal eutrophication. Although eutrophic condition is an issue for many estuaries, dissolved oxygen conditions are good in Gulf of Mexico estuaries (excluding the hypoxia issues on the Gulf of Mexico shelf off of Louisiana). Fish condition is poor with several consumption advisories throughout the Gulf Coast. Because population growth in coastal areas along the Gulf of Mexico is expected to increase in the 21st century, many (if not all) of these environmental problems will be exacerbated in the next 10 to 20 years. The Gulf Coast of Florida alone is home to more than 4 million people and is currently experiencing explosive growth and development. Clearly this is a region of the country requiring continued monitoring and environmental programs to clean up existing problems and prevent the worsening of conditions throughout the Gulf.

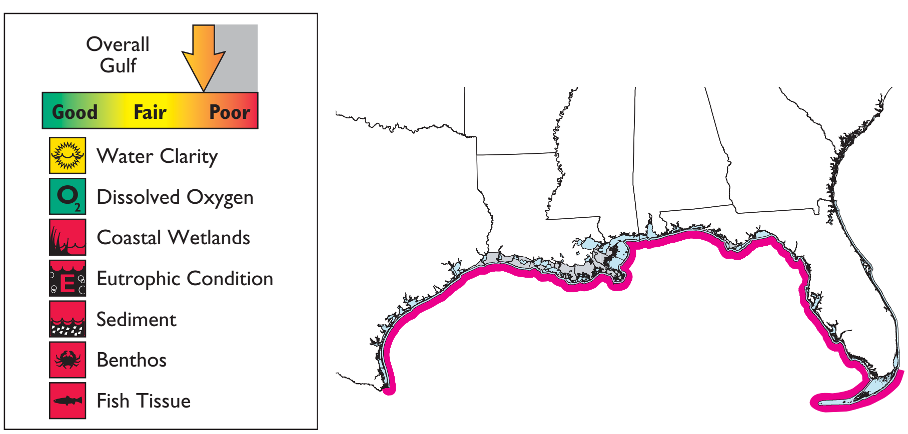
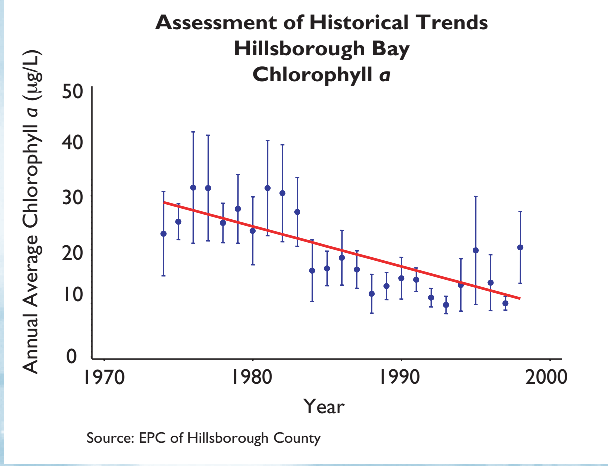


Figure 5-29. The overall condition of Gulf of Mexico coastal resources is fair to poor.

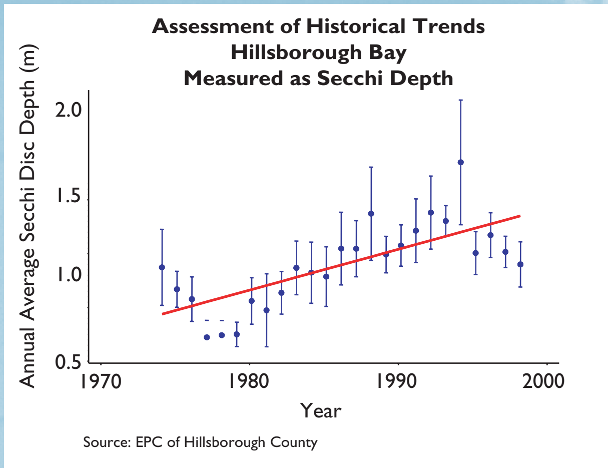
Habitat Improvements in the Gulf Coast – The Tampa Bay Estuary Program

In the late 1960s and early 1970s, the ecological condition of Tampa Bay declined dramatically. Polluted wastewaters, dredging and filling of habitat, and rapid development of the shoreline posed serious threats to the future of the bay. The Tampa Bay Estuary Program estimates that more than 40% of the seagrass meadow acreage was lost from 1950 to 1984. A centerpiece of Florida's Gulf Coast, Tampa Bay is home to more than 2 million residents, receives 8 million visitors each year, and contributes almost $5 billion annually to the area's economy (Liner et al., 1994).



Average annual concentration of chlorophyll *a* in Hillsborough Bay, a section of Tampa Bay, dropped steadily as wastewater management plans were implemented.

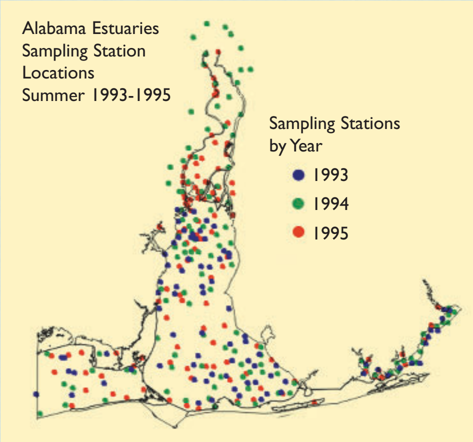
Initiatives to improve wastewater management and treatment led to dramatic improvements in water quality and, eventually, bay habitat. Beginning in 1984, the frequency and duration of phytoplankton blooms declined, water clarity and oxygen levels began to improve, and seagrasses began to recover. Improvements in water quality can be seen in long-term trends in chlorophyll *a*—a measure of the amount of phytoplankton in the water (top right). Reductions in chlorophyll *a* also correspond to increases in water clarity, presented here as Secchi depth (bottom right). Historical trends also show a marked recovery in seagrass meadows. Surveys record over 5,000 acres of recovered seagrass meadow in Tampa Bay since 1984. Although the rate of seagrass expansion has decreased in some areas of the bay in the last few years, current baywide expansion rates are approximately 350 acres of seagrass per year.



Water clarity improved throughout the 1980s and most of the 1990s in Hillsborough Bay.

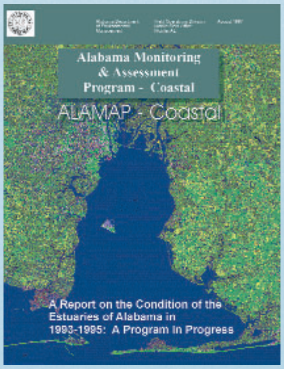
Alabama Environmental Monitoring and Assessment Program

In 1993, the Alabama Department of Environmental Management (ADEM) initiated an environmental monitoring and assessment program (ALAMAP-C) for Alabama's coastal waters. The goal of ALAMAP-C is to provide information on the overall health of the coastal environment and to track changes over time. ALAMAP-C has conducted annual surveys of estuaries to measure various coastal water quality parameters. Ecological health is assessed by investigating the spatial distribution of physical, biological, and chemical indicators of water quality. ALAMAP-C determines the portions of estuaries that support conditions favorable for both aquatic life and human use. ALAMAP-C also attempts to determine why certain areas may not be favorable for either aquatic life or human use.



ALAMAP-C sampling stations.

The overall sampling design and strategy for monitoring indicators of ecological condition was inspired by the U.S. Environmental Protection Agency's EMAP-Estuaries efforts in the Gulf of Mexico (see map). ALAMAP-C has successfully completed sampling efforts during the summer months of 1993-2000 in all of Alabama's near-coastal waters. During the period 1993-1999, ALAMAP-C investigated the ecological condition of Alabama's estuarine waters, including Mobile Bay, Perdido and Wolf Bays, the Alabama section of Mississippi Sound, and the tidal/delta portions of the Mobile and Tensaw Rivers. In 2000, ALAMAP-C became an integral part of EPA's Coastal 2000 Program and the Gulf of Mexico Program's Joint Gulf States Comprehensive Monitoring Program.



In 1998, ADEM published *A Report on the Condition of the Estuaries of Alabama in 1993-1995: A Program in Progress*, describing the initial years of the program. The 1998 report represents the first in a planned series of reports on the state of Alabama's coastal waters based on the information collected by ALAMAP-C. As the program progresses, subsequent reports will seek to strengthen the statistical certainty and provide a series of documents portraying the changing conditions of Alabama's coastal waters. In 2001, ADEM will publish the second in its series of continuing reports covering the years 1996 to 1999.