This document contains overall and specific condition of the Coastal Bend Bays and Estuaries Program from the National Estuary Program Coastal Condition Report. The entire report can be downloaded from
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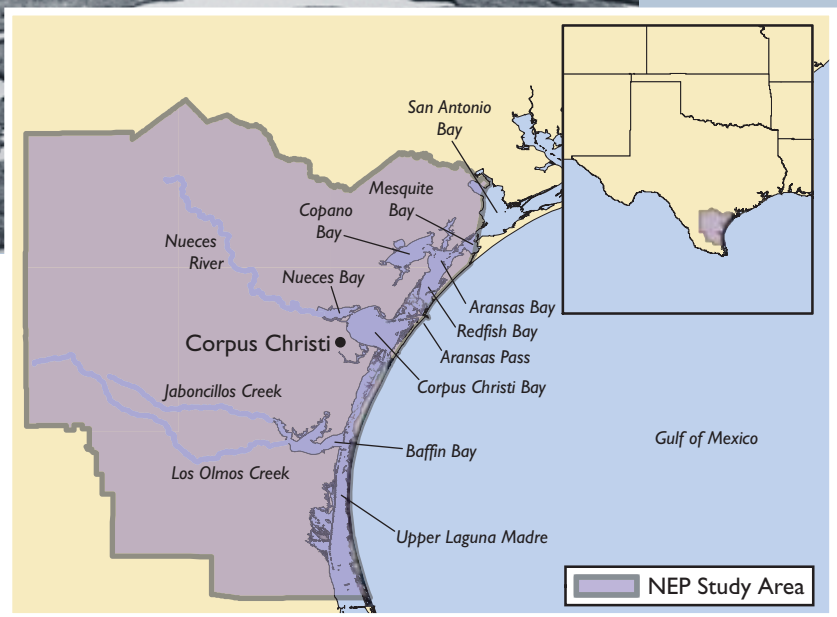
National Estuary Program Coastal Condition Report

Chapter 5: Gulf of Mexico National Estuary Program Coastal Condition, Coastal Bend Bays and Estuaries Program

June 2007

Coastal Bend Bays and Estuaries Program



www.cbbep.org

Background

The estuarine area of the Coastal Bend Bays and Estuaries Program (CBBEP) is located within an area known as the Coastal Bend and includes three of the seven estuaries found in Texas. The most northerly portion of the CBBEP study area encompasses the San Antonio, Mesquite, Redfish, Copano, and Aransas bays. The middle estuarine portion includes Nueces Bay and Corpus Christi Bay (the largest of the bays) and discharges into the Gulf of Mexico at Aransas Pass. The most southerly estuarine portion includes Upper Laguna Madre and Baffin Bay. The CBBEP study area includes 75 miles of Texas coastline and 515 mi^2 of water (CBBEP, 2005a). In addition to the tidal marshes and the barrier islands of the CBBEP estuarine area, this area also includes seagrass meadows, open bays, oyster and serpulid worm reefs, wind tidal flats, and freshwater marshes.

The CBBEP study area is an important resource for recreational, commercial, industrial, and residential uses. Popular for sportboat fishing, bird watching, and wind-surfing, the Bays also support a commercial fishing industry that harvests, on average, more than 8 million pounds of finfish, shrimp, and crab from the area's

estuarine waters (Tunnell et al., 1996). This area contains 40% of the state's total seagrass acreage, which provides nursery areas for fish and shellfish and habitat for other wildlife, including birds, sea mammals, and marine turtles (CBBEP, 1998). Corpus Christi Bay is the nation's fifth-largest port and holds the third-largest refinery and petrochemical complex in the United States (CBBEP, 2005a). Although the region's population was 550,000 in 1995, it is projected to be nearly 1 million people by 2050 (CBBEP, 1998).

Environmental Concerns

Fresh water is in short supply in semi-arid southern Texas, and because of the state's ever-increasing coastal population and growing industry, there will always be competing demands for this limited resource. Residential and business water use in this region is expected to increase by 50% by 2050, and industrial demand is expected to double (CBBEP, 1998). Fresh water is not only vital to the survival of the human population, but it is also closely tied to the survival of the entire ecosystem. Fresh water inflows provide three vital functions essential to an estuary. First, inflows blend with Gulf seawater to create a range of salinities in the Bays' waters. Second, inflows of surface runoff carry nutrients (nitrogen, phosphorus, and decomposing organic matter) that are essential to the productivity of estuarine ecosystems. Phytoplankton and large plants need these nutrients to survive, multiply, and provide food and nursery areas for a multitude of aquatic and terrestrial species. Lastly, inflows bring sediment to the estuaries, and these sediments are deposited as river waters slow down upon entering the Bays. Without the replenishing of these sediments, wave action would eventually wash away the existing wetlands. The annual streamflow for the Nueces River demonstrated a declining trend from 1940–1996 due to the construction of the Choke Canyon Reservoir, evaporative loss from the surface of the reservoir, increased water use in the river basin, and a long-term regional drought.

Population Pressures

The population of the 11 NOAA-designated coastal counties coincident with the CBBEP study area increased by 36% during a 40-year period, from 0.40 million people in 1960 to 0.55 million people in 2000 (Figure 5-63) (U.S. Census Bureau, 1991; 2001). This rate of population growth for the CBBEP study area was about one-fourth of the population growth rate of 133.3% for the collective Gulf Coast NEP-coincident counties and the second-lowest population growth rate of the Gulf Coast NEP study areas. In addition, the population density of these 11 coastal counties in 2000 was 53 persons/mi^2, which was the lowest density of any NEP study area in the Gulf Coast region (U.S. Census Bureau, 2001). Development and population pressures are less dramatic for this NEP study area, which serves as a center for commercial fishing and recreational activities for its coastal communities.

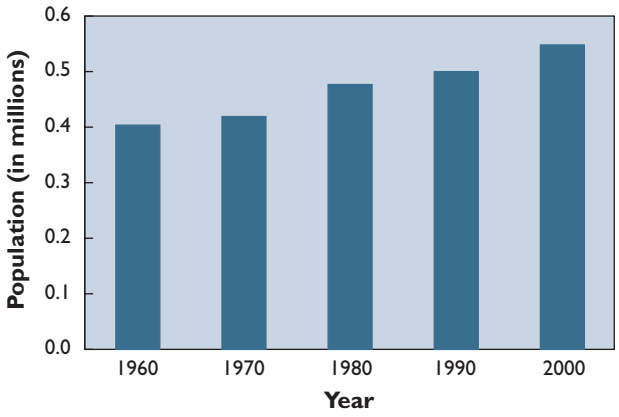


Figure 5-63. Population of NOAA-designated counties of the CBBEP study area, 1960–2000 (U.S. Census Bureau, 1991; 2001).

NCA Indices of Estuarine Condition—Coastal Bend Bays

The overall condition of the Coastal Bend Bays is rated poor based on the four indices of estuarine condition used by the NCA (Figure 5-64). The water quality index is rated fair, the sediment quality and fish tissue contaminants indices are rated poor, and the benthic index is rated fair to poor. Figure 5-65 provides a summary of the percentage of estuarine area rated good, fair, poor, or missing for each parameter considered. This assessment is based on data collected by the TPWD and NCA from 27 stations sampled in the Coastal Bend Bays in 2000 and 2001. Please refer to Tables 1-24, 1-25, and 1-26 (Chapter 1) for a summary of the criteria used to develop the rating for each index and component indicator.

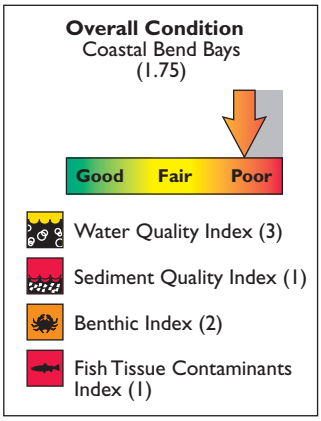


Figure 5-64. The overall condition of the CBBEP estuarine area is poor (U.S. EPA/NCA).

Water Quality Index

Based on NCA survey results, the water quality index for the Coastal Bend Bays is rated fair (Figure 5-66). This index was developed using NCA data on five component indicators: DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen. In NOAA's Estuarine Eutrophication Survey, the Coastal Bend Bays were listed as having medium to hypereutrophic chlorophyll *a* levels and low to high DIN and DIP concentrations, with elevated concentrations occurring in tidal freshwater areas (NOAA, 1997).

Dissolved Nitrogen and Phosphorus

The Coastal Bend Bays are rated good for DIN concentrations, with 99% of the estuarine area rated good for this component indicator. The Bays are rated fair for DIP concentrations, with 4% of the estuarine area rated poor, 46% of the area rated fair, and 50% of the area rated good for this component indicator.

Chlorophyll a

Chlorophyll *a* concentrations in the Coastal Bend Bays are rated good. Although only 5% of the estuarine area exhibited poor chlorophyll *a* concentrations, 40% of the estuarine area was rated fair for this component indicator, and 55% of the area was rated good.

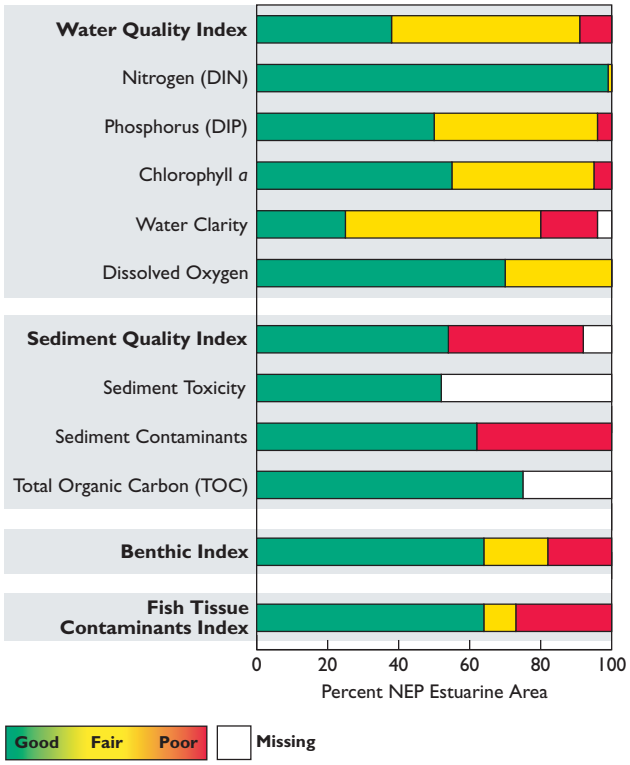


Figure 5-65. Percentage of NEP estuarine area achieving each ranking for all indices and component indicators — Coastal Bend Bays (U.S. EPA/NCA).

Water Clarity

Water clarity in the Coastal Bend Bays is rated fair because 16% of the estuarine area was rated poor for this component indicator. In Corpus Christi and Aransas bays, expectations for water clarity are similar to those for normally turbid estuaries, and water clarity was rated poor at a sampling site if light penetration at 1 meter was less than 10% of surface illumination. However, because one of the CBBEP's goals is to re-establish SAV beds in Upper Laguna

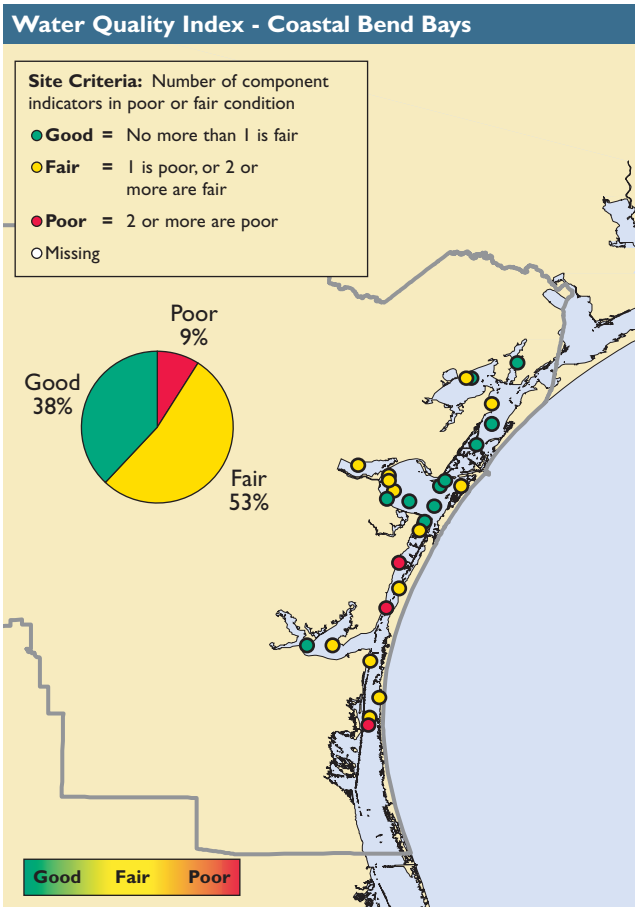


Figure 5-66. Water quality index data for the Coastal Bend Bays, 2000–2001 (U.S. EPA/NCA).

Madre and Baffin Bay, expectations for water clarity in these areas are high; therefore, water clarity was rated poor at a sampling sites in this area if light penetration at 1 meter was less than 20% of surface illumination.

Dissolved Oxygen | Dissolved oxygen conditions in the Coastal Bend Bays are rated good. NCA data show that 70% of the estuarine area was rated good for dissolved oxygen concentrations, 30% of the area was rated fair, and none of the area was rated poor.

Sediment Quality Index

The sediment quality index for the Coastal Bend Bays is rated poor because more than 15% of the estuarine area was rated poor for sediment quality (Figure 5-67). This index was developed using NCA data on three component indicators: sediment toxicity, sediment contaminants, and sediment TOC.

Sediment Toxicity | Sediment toxicity is rated good for the Coastal Bend Bays because none of the estuarine area was rated poor for this component indicator; however, NCA data on sediment toxicity were unavailable for 48% of the CBBEP estuarine area.

Sediment Contaminants | The Coastal Bend Bays are rated poor for sediment contaminant concentrations because 38% of the estuarine area was rated poor for this component indicator.

Total Organic Carbon | The Coastal Bend Bays are rated good for sediment TOC concentrations. None of the estuarine area was rated poor for this component indicator, and 75% of the area was rated good. NCA data on TOC concentrations were unavailable for 25% of the CBBEP estuarine area.

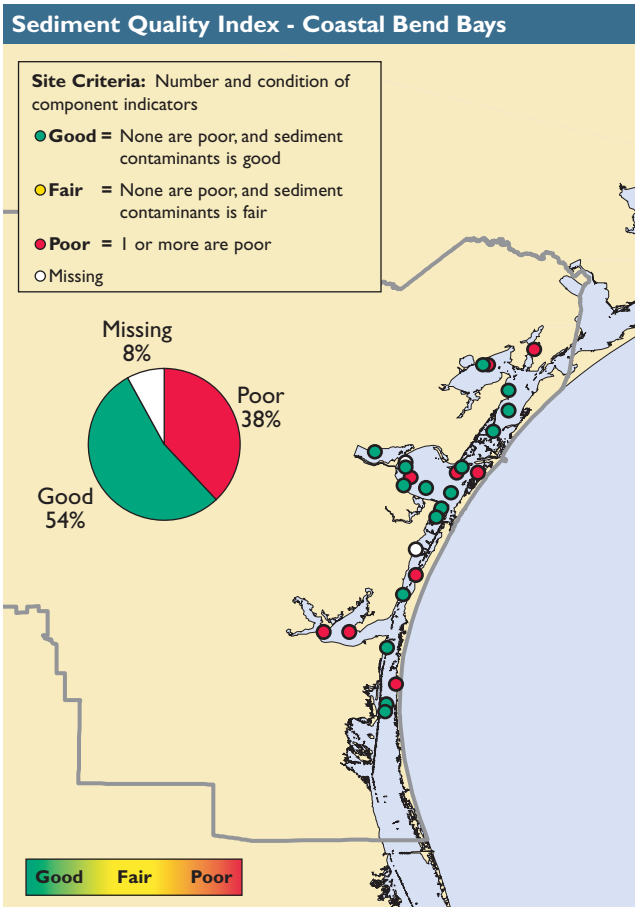


Figure 5-67. Sediment quality index data for the Coastal Bend Bays, 2000–2001 (U.S. EPA/NCA).

Benthic Index

Based on NCA survey data and the Gulf Coast Benthic Index, the condition of benthic invertebrate communities in the Coastal Bend Bays is rated fair to poor. Benthic index estimates indicate that 18% of the estuarine area had degraded benthic resources and was rated poor and another 18% was somewhat degraded and was rated fair (Figure 5-68).

Fish Tissue Contaminants Index

The fish tissue contaminants index for the Coastal Bend Bays is rated poor. Figure 5-69 shows that tissue concentrations exceeded the EPA Advisory Guidance values used in this assessment at 27% of all the stations sampled where fish were caught.

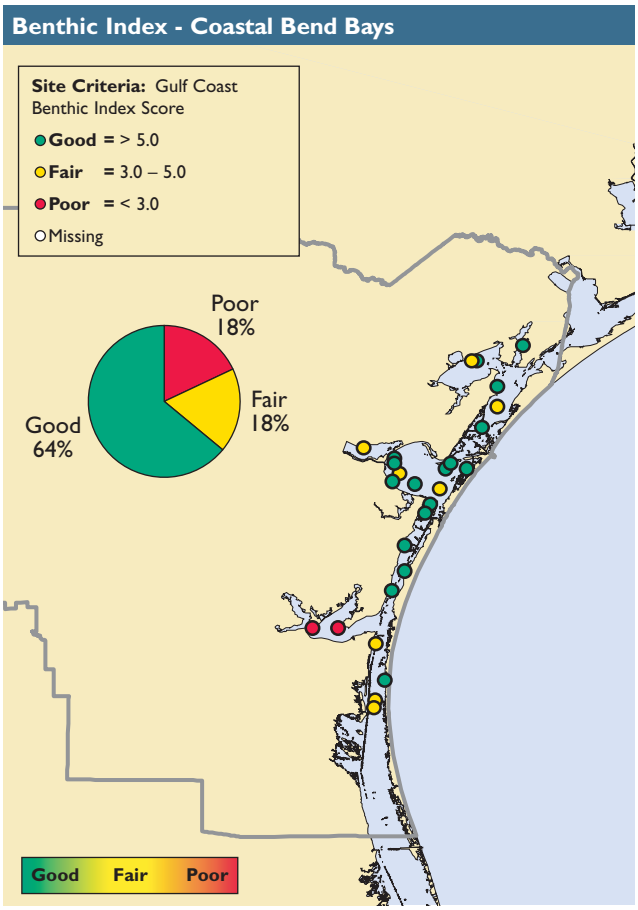


Figure 5-68. Benthic index data for the Coastal Bend Bays, 2000–2001 (U.S. EPA/NCA).

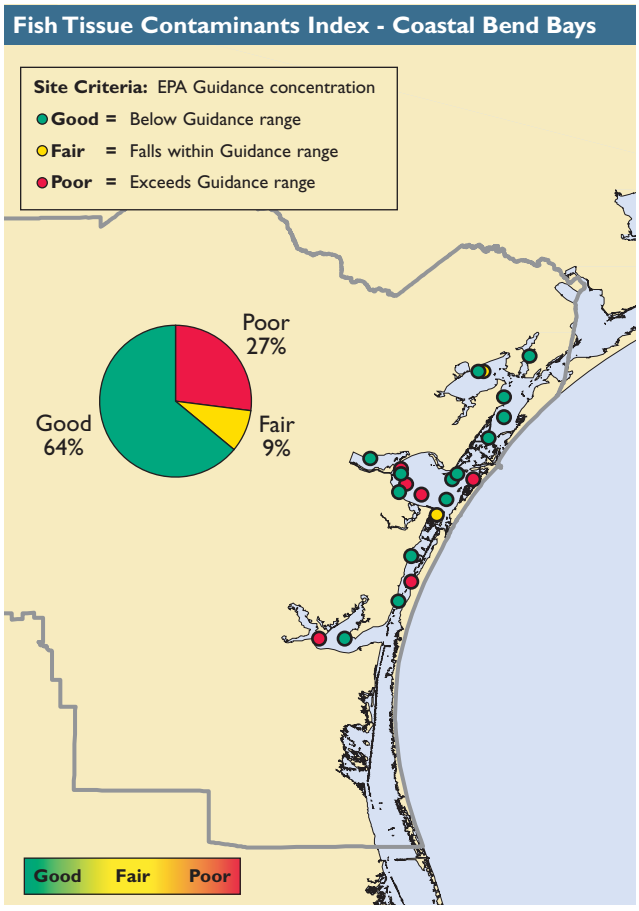


Figure 5-69. Fish tissue contaminants index data for the Coastal Bend Bays, 2000–2001 (U.S. EPA/NCA).

Coastal Bend Bays and Estuaries Program Indicators of Estuarine Condition

The CBBEP uses specific indicators to monitor the overall health of the estuarine area, and a scoring system is used to assign relative values for indicator measures. This system allows analysts to assess trends and identify the areas showing the greatest improvements. A summary of the key resources and the types of indicators used to monitor system-wide environmental trends is presented below.

Water and Sediment Quality

The CBBEP uses a number of indicators to monitor water quality in the study area, including temperature, salinity, dissolved oxygen, transparency, fluorescence, pH, nitrogen, ammonia, phosphorus, dissolved oxygen, sulfide, chlorophyll *a* and *b*, total suspended solids, and BOD. The program also tests waters for trace metals, organic compounds, and pathogens, including fecal coliform, *E. coli*, and *Enterococci*. The Inner Harbor, which is affected by wastewater discharges, exhibits high levels of several parameters, including ammonia nitrogen, organic compounds, TOC, metals, and fecal coliform. Other parameters, such as nitrate-nitrogen and phosphorus, are typically highest in regions affected by runoff and inflow. In general, levels of copper, nickel, and zinc are elevated throughout Corpus Christi Bay (Ward and Armstrong, 1997).

Hypoxic events have been documented every summer in the southeastern region of Corpus Christi Bay since 1988. When hypoxia occurs in the Bay, the low dissolved oxygen levels are limited to the waters within 3–6 feet of the Bay's bottom surface. Hypoxia is caused by a combination of respiration, low mixing potential, small tidal ranges, and high temperatures. The extent and intensity of hypoxic events in the Bays has been increasing over time, which corresponds to rising temperatures in the region during the past 20 years. These events are primarily due to the increase in temperature because nutrient levels in this area of the Bay have not increased (Morehead et al., 2002).

Freshwater flow affects the quality of surface waters in the estuary, and the CBBEP uses several freshwater-flow indicators to help assess water quality in the region. These indicators include the flux, volume, timing, and locations of freshwater flows (point and river sources) into the CBBEP area, as well as rainfall trends and freshwater demand. Annual precipitation rates range from 24 inches per year in the southern end of the study area to 40 inches per year in the northern end. Between 2% (at the southern end) and 10% (at the northern end) of this precipitation reaches the Bays as runoff. The non-point loadings of total nitrogen and total phosphorus to the Bays are largely driven by runoff from agricultural lands (Quenzer et al., 1998).

Sediment quality is also monitored in the CBBEP study area. The CBBEP assesses sediments for grain size, TOC, redox potential discontinuity, contaminant levels, and toxicity. The diversity of benthic communities and other benthic community indicators are also used to characterize sediment quality. Arsenic, cadmium, mercury, and zinc concentrations in Corpus Christi Bay sediments are generally elevated. The highest levels of common pesticides have been measured in Baffin and Copano bays (Ward and Armstrong, 1997). Elevated levels of PAHs, metals, pesticides, PCBs, and fecal coliform have also been measured in sediments collected near stormwater outfall sites and other areas of concern in the CBBEP study area (Carr et al., 1998).

Area fishermen participate in the Texas Abanded Crab Trap Removal Project by collecting derelict crab traps in area bays (CBBEP).

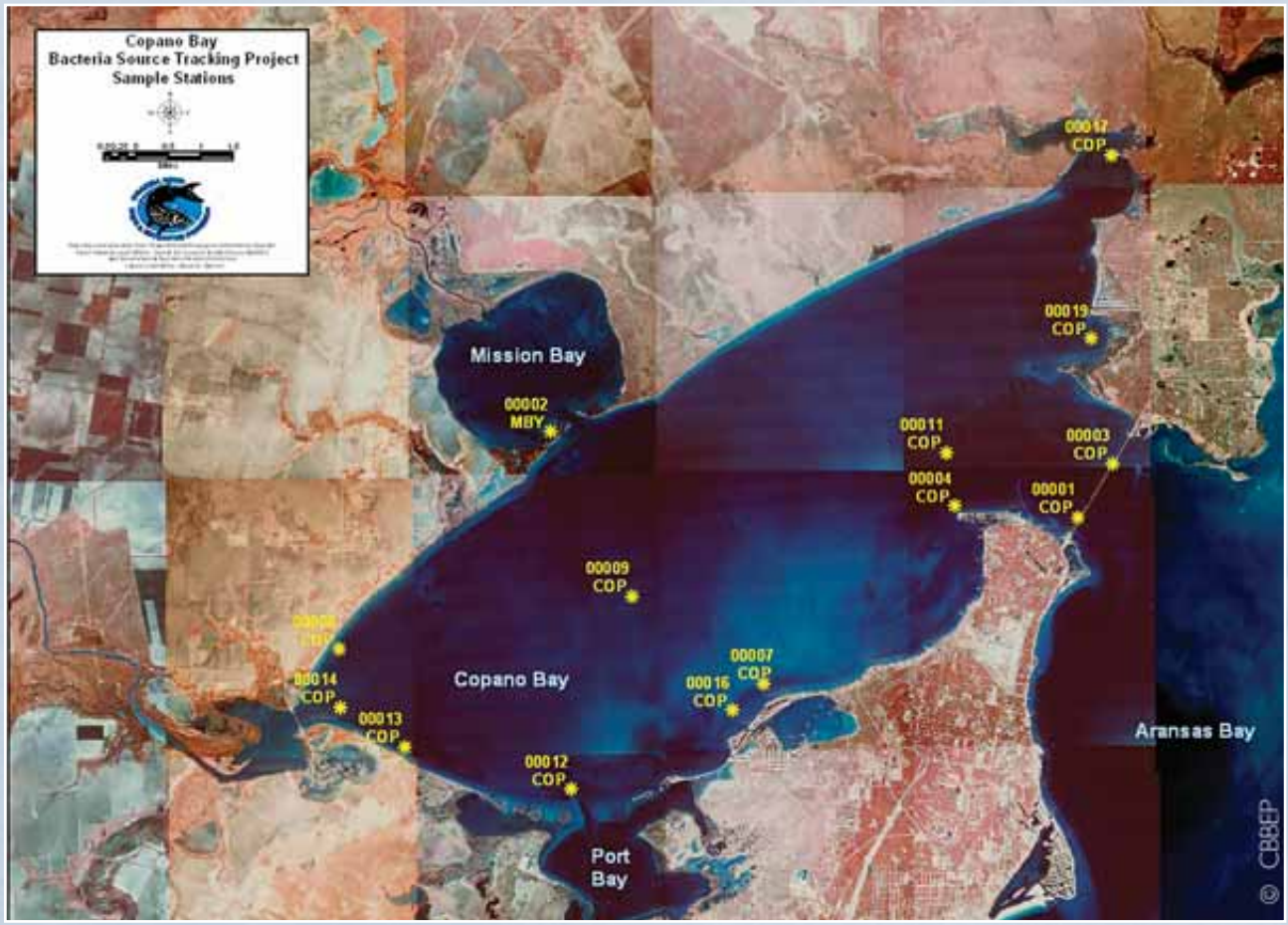
Coastal Bend Bays and Estuaries Program

HIGHLIGHT

CBBEP Bacteria Source Tracking in Copano Bay

In Copano Bay, there are a number of waterbody segments identified in Section 303(d) of the Clean Water Act that are listed as having high concentrations of coliform bacteria. The monitoring data used for this assessment are derived from various sources. The Texas DSHS collects data for use in assessing the health risks of exposure to bacteria in estuarine waters and for posting closures of shellfish harvesting areas. The TPWD and several academic research institutions, collect water quality monitoring data as contractors for the Regional Coastal Assessment Program. Monitoring data have shown that microbial contamination is occurring and that elevated concentrations of bacteria are usually present following heavy rainfall events; however, identifying the source or sources of the contamination is more difficult.

The CBBEP, TCEQ, the Texas DSHS, and Texas GLO are working with Dr. Joanna Mott at Texas A&M University/Corpus Christi, Center for Coastal Studies, to determine the source of bacterial contamination in Copano Bay through bacterial DNA source tracking and the development of a database of fecal samples collected from numerous animals within the watershed,



Copano Bay Bacteria Source Tracking Project sampling stations (CBBEP).

including humans. The University uses samples from 14 stations in Copano Bay that are part of the Texas DSHS Shellfish Sanitation Program. Filtration of these water samples yields isolated *E. coli* bacteria samples, which are then verified using BIOLOG. Isolates from these samples are also fingerprinted for their DNA by Pulse Field Gel Electrophoresis. In addition, antibiotic resistance profiling is also conducted on some of the *E. coli* samples. The goal of this sampling effort is to develop a screening tool that can be used to determine if the coliform bacteria are coming from human, domestic animal, or wildlife sources so that steps can be taken to reduce the contamination.

The results of this project will assist several state resource agencies in determining the source of bacteriological contamination to the Copano Bay area. The Texas DSHS can use this data to review needed changes to shellfish harvesting rules, and the TCEQ can use this same data to develop a TMDL for Copano Bay. In addition, a watershed model for coliform bacteria is being developed by the University of Texas, and data from the Copano Bay Source Tracking Project will be used to assist in model calibration. Since the project's inception in 2003, the two major rivers (Aransas and Mission rivers) discharging into Copano Bay have been added to the 303(d) list due to elevated levels of coliform bacteria. The CBBEP plans to extend this effort to identify and evaluate sources of coliform bacteria throughout the entire watershed with the hope of reducing microbial contamination of estuarine waters and protecting and maintaining healthy shellfishing resources.

Habitat Quality

Eight major tidally influenced habitats are represented in the CBBEP study area, including coastal marshes, wind tidal flats, seagrass meadows, open bays, oyster and serpulid worm reefs, barrier islands, and freshwater marshes. Loss of habitat in the study area results from the following contributing factors: conversion to other land uses, dredge-and-fill activities, natural erosion, altered freshwater inflow, and degraded water quality (CBBEP, 1998).

The CCBEP monitors the acreage of each key habitat. Although losses and gains have been observed for specific habitat types, habitat acreage has been fairly stable over time. Wind tidal flats have suffered the most significant losses in the study area (CBBEP, 2002). More than 24,500 acres of wind tidal flats were converted to other habitat classes between the 1950s and 1979 due to rising sea levels and dredge-and-fill activities. The most extensive losses were observed on Mustang Island, San Jose Island, and Harbor Island, and in the upper portion of the Laguna Madre-Corpus Christi estuarine complex (CBBEP, 1998; Withers and Tunnell, 1998).

Dredge-and-fill activities also alter the region's habitat. Maritime commerce is important to the CBBEP's regional economy, and dredging is required to maintain the region's more than 175 miles of navigable waterways, including the Intracoastal Waterway and the Corpus Christi and La Quinta Ship channels (Tunnell et al., 1996). Between 1958 and 1994, dredging was part of construction and maintenance activities for the Intracoastal Waterway and other shipping channels in Redfish Bay. During this time frame, more than 950 acres of seagrass were lost due to channel impacts and the deposition of dredged materials on seagrass beds (Pulich et al., 1997; CBBEP, 1998). Habitat for nesting birds can also be created when dredged materials are stacked high enough to create islands. For example, Pelican Island was created from dredged material and is now the largest brown pelican nesting area in Texas (CBBEP, 1998).

The CBBEP also measures habitat quality to assess the overall health and productivity of the estuarine area. Habitat quality can be affected by a variety of factors, including changes in circulation patterns from freshwater inflow alterations, dredge-and-fill activities, shoreline alterations, road construction, point and nonpoint discharges, and activities associated with oil and gas exploration. For example, historical brine discharges have degraded habitat at White's Point in Nueces Bay (CBBEP, 1998). Some of the indicators used to monitor the habitat quality of SAV include maximum depth and width of vegetative growth, shoot density, patchiness, vegetative species composition, and percent cover (CBBEP, 2002). Preliminary assessment activities indicate that certain habitat types in the CBBEP study area are stressed or at risk (CBBEP, 1998).

Black skimmer chicks exploring while the mother is out foraging for food (CBBEP).

Living Resources

The CBBEP assesses the quality and quantity of the living resources within the study area. The program monitors the area's fisheries and several species of concern, including species of birds, marine mammals, and sea turtles. The fishery indicators include the relative abundance of fish and shellfish; standing crops versus fishing pressure; CPUE for several species, including spotted seatrout and blue crab; commercial fish landings by type from within the system areas; TPWD creel surveys data; catch-and-release data; contaminant concentrations in edible tissue of fish and shellfish; and bacteria levels in the waters where the fish live. The program also monitors the population size and

reproduction statistics for birds, colonial bird nesting pairs, number of rookery sites visited or vandalized, the numbers of strandings and mortalities of marine mammals, number of strandings and sea turtle condition, and numbers of nesting sea turtles and turtle nests.

The varied habitats across the CBBEP study area support a wide range of finfish and shellfish species that are of commercial and recreational value. The area is also home to many resident and migratory birds and to marine mammals such as the bottlenose dolphin. Although the study area is one of the richest fishery areas in Texas, particularly for finfish, shrimp, and crab, data suggest that some population declines have occurred in species such as Atlantic croaker, summer flounder, Gulf menhaden, white shrimp, and blue crabs (Lacson and Lee, 1997). Benthic communities in some bays (Corpus Christi, Baffin, and Nueces bays) are characterized by low diversity, a dominance of pioneer species, and a high variance of community and physical variables (Montagna et al., 1998). Although the CBBEP area supports almost 500 species of birds, the nesting populations of colonial waterbirds, with the exception of the brown pelican, have declined. The FWS is concerned about two issues that impact migratory species: rapid habitat loss in Latin and South American countries and the need to preserve wooded riparian corridors and coastal prairies along the Gulf Coast. Some evidence also suggests that there is an increasing trend in the number of dolphin strandings. This issue is of particular concern for bottlenose dolphins (Tunnell et al., 1996).

Environmental Stressors

The CBBEP monitors several human indicators in the study area, including the length, area, and location of hardened shoreline, bulkheads, and other hydrological modifications; the number of vessels and amount of cargo crossing the Bays; and the number of oil and chemical spills in the region. Almost 200 miles of CBBEP shoreline are protected by seawalls and other man-made structures, whereas 1,118 miles remain in their natural state (White et al., 1998). Approximately 80,000 vessels annually cross the Coastal Bend Bays, and recent analysis indicates that the amount of freight transported and the number of vessels in CBBEP waters is increasing (CBBEP, 1998). More than 90% of the region's maritime cargo tonnage is composed of oil and petrochemicals. Although the number of oil and chemical spills in the region has decreased since 1990, some spills do occur (CBBEP, 1998). These spills have the potential to impact the region's water, sediment, and habitat quality, as well as to injure or kill fish and wildlife.

Current Projects, Accomplishments, and Future Goals

The CBBEP and its partners are actively collecting data that will provide a system-wide assessment of the environmental trends in the Coastal Bend Bays resulting from the cumulative effects of action implementation. Several CBBEP projects and numerous partner projects are underway to quantify changes to habitat, water and sediment quality, freshwater resources, commercial and recreational fisheries, species of concern, and shoreline management; however, several factors limit the CBBEP's ability to report on system-wide progress at this time. Some projects are still in progress, and results may not be available for some time. In addition, significant resources are being directed toward water and sediment quality assessment projects to determine the statistical confidence of these data, and some partners have not submitted data to the program's information clearinghouse. For these reasons, reporting system-wide environmental changes as a result of CBBEP or partner action is premature.

A partnership between the CBBEP and the City of Corpus Christi will help restore freshwater flow to the Nueces River Delta and revitalize a wetland that is crucial to the Gulf Coast. The Nueces Delta Preserve is a dynamic ecosystem of highly productive wetlands, open water, islands, prairie, and river and bay shorelines. The river provides vital riparian habitat, whereas brackish wetlands are home to shrimp, crabs, juvenile fish, and birds. The uplands contain an attractive diversity of native vegetation that host a variety of wildlife. Approximately 3,000 acres of wetlands-associated uplands have been acquired for the purpose of habitat protection as part of a long-term regional water and land management plan to meet human and environmental needs for fresh water (CBBEP, 2005b).

The Delta provides highly productive wetlands and critical habitat for numerous shorebirds, as well as recreationally and commercially important fish and shellfish species (e.g., shrimp, crabs, and juvenile finfish). Part of the new Nueces Delta Preserve will be purchased by the City of Corpus Christi for use as an overflow channel and pipeline corridor to deliver much-needed fresh water directly to the upper Nueces River Delta.

Conclusion

The CBBEP has taken actions to establish aggressive goals for the protection and restoration of the Coastal Bend Bays by obtaining consensus among a variety of different stakeholder groups. NCA monitoring data classify the Coastal Bend Bay's overall condition as poor. Because many of the CBBEP's own monitoring data are still being collected or evaluated, it is not known whether the comprehensive list of CBBEP indicators will show a pattern similar to the NCA data. Attaining the CBBEP's goals will require continued strong monitoring efforts, as well as comprehensive pollution and resource management. Projected population increases in the CBBEP area will require increasing cooperation among stakeholder groups in developing a strong regional water management plan that will balance the long-term environmental needs of the human inhabitants and living resources of the Coastal Bend Bays to maintain a sustainable freshwater system.

Outdoor enthusiasts getting ready to hit the waves in their catamarans on North Padre Island (CBBEP).