

# **PROBABLE CAUSES OF TRENDS IN SELECTED LIVING RESOURCES IN THE GALVESTON BAY SYSTEM**

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## **I. EXECUTIVE SUMMARY**

The Galveston Estuary became a participant in the National Estuary Program (NEP) in October 1988. The program is sponsored by the U.S. Environmental Protection Agency with the goal of maintaining estuaries in a healthy biological state while providing for other uses by developing a coordinated local, State and Federal management plan and program.

The diverse uses of the Galveston Estuary inevitably threaten the many species that depend on it. The most urbanized areas of Texas lie within the Galveston Estuary drainage (over 7,000,000 people; Ditton et al. 1989). Approximately half of the nation's chemical production and a third of its petroleum industry are located in the immediate vicinity of the Galveston Estuary. Fifty-one percent of the wastewater discharge permits issued in 1987 by the Texas Water Commission were in its watershed. Yet in 1989, the Galveston Estuary produced 24-38 percent (by weight) of the Texas coastwide commercial harvest of finfish, shrimp, crab, and oysters (Johns 1990) and almost 40 percent of the recreational harvest (Green et al. 1991).

This report is part of the effort to characterize the ecosystem of the Galveston Estuary. Its purpose is to investigate the probable causes of trends in the abundance of certain species, especially recent declines, as they relate to the overall health of the ecosystem. For some species, confining the discussion to a geographic scale as small as a single estuary may give a false impression of its population. But the primary question here is that of the health of the estuarine system, not the health of a particular species.

The species emphasized are those determined in an earlier study (Loeffler and Walton, 1992) to display chronic declines. The initial list of species to be studied was compiled by members of the Galveston Bay National Estuary Program Scientific and Technical Advisory Committee, with an emphasis on ecologically and commercially important organisms: finfish and shellfish, locally breeding birds, alligators, plankton, and open bay and marsh benthos. Oysters were studied elsewhere (Powell 1993). Statistically significant declining trends were most conspicuous for white shrimp, blue crab, and certain species of colonial waterbirds. These trends are discussed further in the present report.

## Summary of conclusions

A decrease in the population of white shrimp (*Penaeus setiferus*) from 1982 through 1990 was documented by Osborn et al. (1992), but newly available monitoring data showed a rebound in 1991. The 1991-93 El Niño event and associated high inflows brought fresh water and nutrients into the estuary that were probably mostly responsible. Warm winters and changes in fishery regulations possibly also contributed to the white shrimp recovery. White shrimp are frequently more abundant after heavy rains and flooding, suggesting that the regulation of rivers to completely eliminate flooding might not be the best policy for a productive estuary.

Separate trend analyses of 20-mm size groups in bag seine and trawl data for blue crab (*Callinectes sapidus*) showed that smallest crab increased in numbers, whereas the largest size classes decreased. Overfishing was the most probable cause of the decline in large crab, possibly leading to an increase in small crab by reducing cannibalism. The trends may also have been affected by poorly-understood ecological changes.

Of all birds in the Galveston Estuary, colonial waterbirds were the best documented and potentially the best indicators of the health of the estuary. Declining trends in those colonial waterbirds that feed at the marsh-bay interface (Slack et al. in prep.) suggested that some problem in bay margin habitats may have affected bird populations: the loss of tidal marsh acreage, fluctuations in prey fish, pollution, or disease. A problem in nesting habitat was not implicated, but predation, disturbance of rookeries, and the loss of islands (to subsidence and erosion) place limitations on nesting birds.

The probable causes for the general decline in northern pintails and green-winged teal were probably outside of the Galveston Estuary, specifically the loss of wetland habitat in their breeding grounds on the Great Plains. Non-migratory mottled ducks were affected by the loss of freshwater marsh habitat in Texas.

Wildlife and fishery biologists have long recognized the importance of interannual wet and drought cycles on the biota of Texas. El Niño-Southern Oscillation (ENSO) cycles, a global phenomenon centered on the tropical Pacific Ocean, affected the climate in Texas and consequently the fishery species of Galveston Bay. The mild winters and high inflows of fresh water and nutrients associated with the most recent El Niño event were correlated with high populations of some species in 1991, especially white shrimp, grass shrimp, and some fish that feed on plankton (mulletts and bay anchovy). The El Niño event of 1982-83 had a similar effect. The La Niña drought of 1988-89 correlated with low populations of some species, specifically blue crab and white shrimp, but with high populations of salinity-loving organisms such as brief squid.

Intensive shrimp trawling and the loss of wetlands certainly influenced living organisms, directly and by altering the distribution of nutrients within the estuary, though their effects were not obvious given the available data.

## Recommendations

In the short term white shrimp and blue crab are probably protected by recent changes in fishing regulations. Wading birds, however, might be a warning of problems at the bay margin, and should be closely monitored for possible bioaccumulation of contaminants and other sources of morbidity and mortality. Bulkheading and development on or adjacent to tidal or fresh marsh should be prohibited. Provisions should be adopted to protect existing marsh or to allow new marsh to develop in recently-inundated areas.

Better data are needed on fishing practices and the seafood harvest, especially by crabbers and subsistence fishermen. Devices to reduce bycatch from shrimp trawling should be investigated and tested. There is also a lack of long-term, high-resolution data that would make it possible to relate trends in living resources directly to water and sediment quality, nutrient regime, and hydrological phenomena in the estuary and Gulf of Mexico. The role of seasonal and interannual variations in climate should be thoroughly investigated.

Sufficient freshwater inflow to the estuary must be maintained to maintain productivity. Regulation must be designed to take climatic fluctuation into consideration. Excessive regulation of the inflow regime should be avoided. Cycles of drought and flooding are natural to the estuary and are possibly necessary for maximum long-term productivity.

As recommended by Green (1992), the GBNEP created a committee to design an integrated sampling program to be used to track short-lived organisms (phyto- and zooplankton) as indicators of ambient estuarine quality and longer-lived organisms (larger shellfish and fishes) as indicators of long-term trends in quality. Some species of birds should also be included in an integrated monitoring program as indicators of the quantity and quality of mudflat (American oystercatcher), beach (Wilson's plover, least terns), or marsh (clapper rail, marsh wren) habitats, or of the health of the estuary in general (seaside sparrow).

This committee has the goal of refining a definition of estuarine health for the Galveston Estuary and determining how data from the proposed sampling program would successfully measure this health. This requires that careful thought be given to the way the estuarine ecosystem works. The committee must also recognize where and how sampling could be done that would not only address the question of population abundances but also why they change and whether humans have any control over the changes. The description of nutrient flux and estuarine energetics should be specifically addressed. The value of the Galveston Estuary requires this monitoring effort to assure its wildlife communities are not lost.