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Contaminant Levels In Sediment And Biota In The Gulf Of Mexico Estuaries

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In 1991, the Environmental Monitoring and Assessment Program (EMAP) initiated a long-term monitoring program to assess the ecological status and long-term trends of the estuaries of the Louisianian Province. The Louisianian Province consists of the biogeographic region from Anclote Anchorage, FL, around the Gulf Coast to, and including, the Rio Grande, TX.

The area evaluated includes all tidally-influenced water bodies, or estuaries, greater than 2 km^2 in surface area. These include 27 large estuaries (Mobile Bay, AL; Mississippi Sound, MS; Lake Pontchartrain, LA; Galveston Bay, TX), large tidal rivers (Mississippi River), and 154 small estuaries/tidal rivers (Withlacoochie River, FL; Grand Bay, AL; Back Bay of Biloxi, MS; Amite River, LA; and Lavaca Bay, TX).

EMAP-E focuses on determining the status of response indicators to ascertain a measure of the ecological condition of the estuaries of the province. It is unique among monitoring programs in that it is nationwide in scope, focuses on ecological status and trends, and is based on unbiased sampling. These characteristics allow the data to be used to represent large biogeographic regions so that statements concerning the status of the estuarine resources as a whole can be made with a known level of confidence. EMAP-E is also active in other biogeographic regions of the country using

the same sampling design, indicator collection methods, and assessment approaches.

The samples are taken primarily in late summer (July and August) in the Louisianian Province. A total of 202 sites were selected to be sampled during a 7-week interval in 1991. Sampling included collecting habitat and water quality information (temperature, dissolved oxygen concentrations, salinity, clarity), deploying continuous monitoring apparatus for water quality (obtaining bottom dissolved oxygen concentration every 15 minutes for 24 hours), collecting sediments (benthic evaluation, sediment toxicity testing, organic content, grain size, and contaminant concentrations), fish trawling (characterization of fish communities, examination of pathology incidence, and tissue contaminant concentrations), and benthic dredging (to characterize large bivalve communities and marine debris).

Benthic evaluations (species-level abundance, composition, and biomass) were completed for 3-5 replicates at each site. While full distributions of the data were compiled for each indicator, as well as several species- or group-specific indicators (percentage of community that were amphipods), an overall index of benthic condition was developed using the following approach. A subset of the collected sites was determined to represent locations having poor environmental conditions (high sediment contamination and low dissolved oxygen concentrations), and a second set of sites was selected as reference sites having good environmental condition (little or no sediment contamination and high dissolved oxygen levels day and night).

The approach was to statistically analyze this subset to determine which benthic characteristics best differentiated between poor and good environmental quality. The result showed that the combination of benthic biodiversity and proportions of the benthic community represented by bivalves and tubicifid worms could be combined in an index score that correctly classified poor sites and good sites without any error, explaining about 90% of the variability observed in the data set. This analytical result, the Benthic Index, was then applied to all the benthic data collected from the 202 sites in the Louisianian Province. Once the scores were determined, their distribution was examined to assess the percentage of estuarine sediments in Gulf of Mexico estuaries characterized by poor benthic community structure. Approximately 30% of the sediments in the estuaries could be described as having this level of poor benthic community structure -- low biodiversity and, either, a low proportion of bivalves, or a high proportion of tubificid oligochaetes.

The frequency of external pathologies in finfish is another ecological response that can represent the condition of an estuary. The incidence of external pathologies was determined from an examination of all fish collected at the sites. Over 5,000 fish were examined. In the Louisianian Province, the background rate of occurrence of external pathologies (finrot, lesions, discolorations) was $0.7 \pm 0.3\%$. Most groupings of fish in Gulf of Mexico estuaries did not display pathology frequencies different from the background expectation (catfish 1%, demersal fish 1%). However, commercial and recreational fish displayed a combined pathology rate of 1.5% (Atlantic croaker, permit, seatrout), and pelagic fish showed a rate of 3.2% (seatrout, permit, menhaden).

The bottom waters of Gulf estuaries were examined to determine the extent of hypoxia during the sampling period by mooring a continuous monitoring device approximately 0.3m above the bottom. Using an algorithm determined in earlier studies, the minimum concentration, the average nighttime concentration, and the concentration at dawn were used to determine the sites that experienced hypoxia (ppm) greater than 20% of the time during the sampling period. In addition, instantaneous measures of dissolved oxygen were taken at each site. About 6% of the bottom waters of the estuaries of the Gulf of Mexico were continuously hypoxic throughout the sampling period, while an additional 6% were hypoxic in a cyclic manner, with the hypoxia occurring for more than 40% of the nighttime hours. Thus, the total proportion of the bottom waters displaying hypoxia in Gulf estuaries was 12%.