

Faunal Surveys

Status and Trends of Selected Living Resources in the Galveston Bay System

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Long term (seven to 13 years) data from the fisheries monitoring program of The Texas Parks and Wildlife Department (TPWD) in Galveston Bay are being analyzed to assess the overall status and trends of commercially and/or ecologically important species in the bay. The analyses concentrate on the data collected with three gear types (gill nets, bag seines, and otter trawls) to estimate the relative densities of groups representing recruitment, age at first reproduction, and the remainder of the population for selected species through time. This work is part of a larger project which will also include trends for other significant living resources in Galveston Bay.

Bag seine and gill net samples were taken at randomly selected sites along the shoreline in the bay, whereas otter trawl samples were collected at randomly selected sites in the open bay. Six to 16 bag seine samples were collected monthly since 1977; six to 45 gill net samples were collected each spring and fall since 1976; and 20 otter trawl samples were taken monthly since 1982.

The bag seine was used to sample mainly juveniles of fish and invertebrate species along the shore. Red drum (*Sciaenops ocellatus*) in the size range of 25 to 65 mm in total length were selected to represent the recruitment strength of the species. Choosing a small size interval was designed to minimize the probability of using data collected from the individuals of the same cohort caught over time. Only data collected in October, November, December and January were used since red drum in this size range first appeared in the bag seine samples in October each year and virtually all grew out of the size range by February of the following year.

The gill net was used to catch mainly subadults and adults of fish and invertebrate species. Inspection of size frequency distributions revealed that most red drum caught were in the size range of 375-700 mm. Based on the literature, two size classes, 350-499 and 500-700 mm, were selected to represent subadults and age at first reproduction, respectively. Only data from one of the two sampling seasons were used to minimize the probability of repeatedly using data from the same cohort as mentioned above. Data collected in the spring were used. Red drum spawn in the Gulf during summer and fall, therefore the spring sampling more appropriately represents the strength of the first time spawners for the year.

The normalized catch per unit effort (CPUE) is calculated for the selected size ranges and months (season) for each species/gear type combination, and then regressed against time (year and month) to detect trends.

Preliminary Characterization of Benthic Assemblages of Galveston Bay, Texas: Results from Sediment Profiling Imagery

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Baseline information on benthic assemblages and sediment types of upper and lower Galveston Bay, Texas was obtained in June and July 1990 as part of two, three-year studies being conducted by the Corps of Engineers to determine the rate of benthic community recovery on submerged dredged material disposal areas. The first study will monitor recovery on new work, stiff Pleistocene clay, pumped into two, 1,000-ft square (23 acre) experimental disposal areas. The second study will monitor recovery on existing, side-channel maintenance disposal areas. Data collected from both studies will be compared with conditions in adjacent bay bottom reference areas.

Data on the physical and biological characteristics of assemblages were obtained through a combination of sediment profiling imagery, sediment texture and organic analysis, and benthic infaunal sampling (LaSalle, Ray, Diaz, and Bass, 1991). Results of sediment profiling imagery and sediment sampling are described here. A sediment profiling camera obtains a vertical cross-sectional image of the sediment-water interface, from which a series of physical measurements may be obtained. Measurements obtained include depth of penetration, depth of the redox potential discontinuity (RPD), surface relief, presence and type of macroinvertebrate tubes and burrows, and stage of benthic succession.

For the new work study, a single experimental and two reference plots were chosen in both areas of the bay from among eight, 23-acre plots sampled as part of baseline characterizations (Fig. 1): four in the lower bay (designated A-D) and four in the upper bay (designated E-H). Upper bay plots were located between Redfish Bar and Morgan's Point; lower bay plots between Texas City Dike and Redfish Bar. Plots within each group were located 5,000 ft apart along a line parallel to and 6,500 ft east of the Houston Ship Channel. Images were obtained at eight fixed stations arranged in a radiating pattern from the center of each plot for a total of 64 images.

In the lower bay, the sediment was a mixture of silts (25.3-31.2%) and fine sands (49.7-56.4%) with an organic content of 1.7-4.3%. Average penetration among plots ranged from 4.1-8.2 cm, average RPD depth ranged from 0.5-0.8 cm, and surface relief was relatively even (<1 cm). Biologically, all plots appeared to

support early stage benthic assemblages as suggested by the presence of surface worm tubes, subsurface burrows, and feeding voids. Overall, the only major difference observed between plots in the lower bay was the lower penetration in Plot B (by 4 cm).

In the upper bay, the sediment was composed primarily of silts (52.3-60.1%) and clays (29.8-42.3%) with an organic content of 3.1-4.4%. Average penetration among plots ranged from 9.4-13.8 cm, average RPD depth ranged from 0.7-0.8 cm, and surface relief was relatively even (< 1 cm). Biological characteristics were similar to that described for lower bay plots, except for a lower number of surface tubes on all plots. The only major difference observed between plots in the upper bay was the lower penetration in Plot E (by 1-2 cm).

For the maintenance study, benthic assemblages were characterized along transects oriented perpendicular to the channel, extending from the channel edge, across existing maintenance disposal areas, and continuing onto undisturbed bay bottom (Fig. 1). Two transects were located in each portion of the bay, extending 20,000 ft to the east in the upper bay and 15,000 ft to the west in the lower bay. Sampling stations were located at distances of 500, 1,000, 2,500, 5,000, 10,000, 15,000, and 20,000 ft (upper bay transects only). Three images were obtained at each station (26 stations total) for a total of 78 images. The 2,500 ft station on each transect fell within the existing maintenance disposal areas in both portions of the bay (located between 2,000 and 3,000 ft from the channel).

In the lower bay, physical and biological characteristics were generally similar across stations on each transect. Sediments were primarily fine sands (48.7-94.6%) mixed with some silt (1.3-36.1%) with an organic content of 0.4-2.4%. Average penetration was highest nearest to the channel (7.5 cm, 500 ft) and lowest at the historically used disposal areas (no penetration, 2,500 ft) and at the farthest stations examined (4.8 cm, 15,000 ft). Average penetration among the remaining stations ranged from 4.3-6.0 cm. Average RPD depth ranged from 0.5-1.0 cm across all stations except the disposal areas, and the bottom was relatively uneven (range in relief of 0.5-1.6 cm). Biologically, all stations appeared to support early stage benthic assemblages as suggested by the presence of surface worm tubes, subsurface burrows, and feeding voids.

In the upper bay, there was a distinct change in the overall physical characteristics of stations near the channel (500, 1,000 and 2,500 ft) compared to those further out into the bay (5,000-20,000 ft). Sediments near the channel were primarily fine sands (36.0-83.0%) and silts (9.0-35.0%) with quantities of shell hash, and an organic content of 0.5-4.2%. Average penetration ranged from 3.3-7.5 cm, average RPD depth ranged from 1.1-1.8 cm, and the bottom was relatively uneven (physically disturbed, range in relief of 0.4-2.0 cm). Stations located on historically used disposal areas were not distinct from stations nearer the channel, except for being in shallower water. Sediments further out in the bay were primarily muddy/silts (42.1-69.7%) with greater organic content (1.9-5.0%), greater penetration (9.4-15.1 cm), but shallower RPD depth (0.3-0.5 cm). The bottom was relatively even (range in relief of 0.2-0.8 cm). Biologically, all stations appeared to support early stage benthic assemblages, similar to that observed in lower bay transects, except for a greater number of infaunal burrows.

In summary, baseline data from image analysis of experimental plots showed that biological and physical characteristics were similar within and among plots in each portion of the bay. Sediments in lower bay plots were dominated by fine sand, whereas upper bay plot sediments were dominated by silt. Both groups of plots appeared to support early stage benthic assemblages. Data obtained along transects in the lower bay were relatively uniform, sediments being composed primarily of fine sands with some silt. The only major difference being the relatively dense nature of the sediments at stations located on maintenance disposal areas. The disposal area stations are in shallower water, which may lead to greater sorting out of fine sediment materials. In contrast, upper bay transects showed a change from near-channel stations (500-2,500 ft), which were characterized by fine sands and silts, to stations further out into the bay, which were composed primarily of muddy-silts. Sediments at near-channel stations also appeared to be more disturbed. All stations in both portions of the bay appeared to support early stage benthic assemblages, the only difference being an apparent greater number of infaunal burrows in upper bay stations.

Literature Cited

LaSalle, M. W., G. Ray, R. J. Diaz, and R. J. Bass. 1991. Preliminary characterization of the benthic assemblages of Galveston Bay, Texas. Final Report to U. S. Army Engineer District, Galveston. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Preliminary Characterization of Benthic Assemblages of Galveston Bay, Texas: Results from Benthic Infaunal Sampling

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Baseline information on benthic assemblages and sediment types of upper and lower Galveston Bay, Texas was obtained in June and July, 1990 as part of two three-year studies being conducted by the Corps of Engineers to determine the rate of benthic community recovery on submerged dredged material disposal areas. The first study will monitor recovery on new work, stiff Pleistocene clay, pumped into two, 1,000-ft square (23 acre) experimental disposal areas. The second study will monitor recovery on existing, side-channel maintenance disposal areas. Data collected from both studies will be compared with conditions in adjacent bay bottom reference areas.

Data on the physical and biological characteristics of assemblages were obtained through a combination of sediment profiling imagery, sediment texture and organic analysis, and benthic infaunal sampling (LaSalle, Ray, Diaz, and Bass, 1991). Results of benthic infaunal sampling for the new work study are described here. Samples were collected with a Gray O'Hara box corer (0.06 m²) to a depth of 10 cm. A plexiglass liner was placed within the corer to facilitate removal of each sample.

For the new work study, a single experimental and two reference plots were chosen in both areas of the bay from among eight, 23-acre plots sampled as part of baseline characterizations: four in the lower (designated A-D) and four in the upper (designated E-H) bay (see Figure 1, page 145). Upper bay plots were located between Redfish Bar and Morgan's Point; lower bay plots between Texas City Dike and Redfish Bar. Plots within each group were located 5,000 ft apart along a line parallel to and 6,500 ft east of the Houston Ship Channel. Sampling was conducted in three selected plots within each area of the bay (A, B, and D in the lower bay; E, F, and G in the upper bay). Ten box core samples were taken from each plot at randomly chosen locations for a total of 60 samples.

A total of 84 species were encountered from both areas of the bay: 71 in the 3 lower bay plots and 26 in the 3 upper bay plots. There appears to be a gradient in the number of species from the lower to the upper bay areas, paralleling the gradient in salinity. Lower bay plots are characterized by high species richness (52 species) and high variability in species abundances among plots. Species making up these assemblages include euryhaline marine species (e.g., *Paraprionospio*

pinnata, *Magelona* sp.) and euryhaline opportunists (e.g., *Streblospio benedicti*, *Capitella capitata*). Upper bay plots were less variable in terms of abundance and were less species rich (16-20 species), being dominated by euryhaline opportunists and estuarine species (e.g., *Mulinia pontchartrainensis*, *Macoma mitchelli*). Overall, the assemblages from both areas were quite similar to those previously described from Galveston Bay.

Plots in both areas of the bay were dominated by the polychaete *Mediomastus* sp., composing from 34.3 to 60.8% of assemblages in lower bay plots and from 63.7 to 83.6% of assemblages in upper bay plots. Total organism density in lower bay plots ranged from 40.1 to 132.8 individuals per 600 cm², from 50.4 to 119.8 ind. per 600 cm² in upper bay plots.

For the maintenance study, benthic assemblages were characterized along transects oriented perpendicular to the channel, extending from the channel edge, across existing maintenance disposal areas, and continuing onto undisturbed bay bottom. Two transects were located in each portion of the bay, extending 20,000 ft to the east in the upper bay and 15,000 ft to the west in the lower bay. Sampling stations were located at distances of 500, 1,000, 2,500, 5,000, 10,000, 15,000, and 20,000 ft (upper bay transects only). Three box core samples were obtained at each station (26 stations total) for a total of 78 samples. The 2,500 ft station on each transect fell within the existing maintenance disposal areas in both portions of the bay (located between 2,000 and 3,000 ft from the channel).

Comparison of upper versus lower bay transects yielded the same trends as described for the plot samples: higher species richness in the lower bay, a gradient in species richness running along the bay axis, and a concomitant change in species composition. When the data were examined from the perspective of relative distance from the channel, different patterns were found in the two areas of the bay. In the lower bay, species richness and faunal abundances were slightly higher with increasing distance from the channel. Lowest species richness and abundances were associated with highly compacted sediments such as those of the dredged material placement sites. In the upper bay no such effect was visible. Species richness and abundances were highest within 1000 feet or less of the channel. Individual species abundances varied along the transects but no consistent patterns of change in species composition emerged. For instance, in the upper bay *Callianassa* spp. were most numerous near the channel and *Mediomastus* sp. were most numerous away from the channel, however overall species composition remained essentially constant.

Literature Cited

LaSalle, M. W., G. Ray, R. J. Diaz, and R. J. Bass. 1991. Preliminary characterization of the benthic assemblages of Galveston Bay, Texas. Final Report to U. S. Army Engineer District, Galveston. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.