EXECUTIVE SUMMARY

Galveston Bay has accreted substantial reef in the last 20 years. The location and mechanisms of reef accretion suggest that natural responses to changes in circulation and salinity by the oyster populations are primarily responsible rather than the direct production of new reef by man. These responses have been primarily induced, however, by both natural and man-made events. These occurrences include the construction of the Houston Ship Channel and the Texas City Dike, the removal, by mechanisms not well documented, of the original Redfish Bar, regional subsidence which has deepened the bay and facilitated shoreline retreat, and, in the smaller satellite bays, the construction of channels for barge and boat traffic. Local effects like leases, artificial reefs, and, in many areas, shell dredging have had less impact over the last 20 years, although, certainly, shell dredging significantly modified reef coverage in some areas prior to 1970.

Whether bay productivity has increased commensurate with the increased acreage cannot be assessed without recourse to a population dynamics model. As some reef has formed in present-day optimal locations, other reef, still extant, finds itself in areas of reduced quality. With the exception of the Clear Lake Embayment, the Mattie B./Tom Tom Reef area of the Hanna Reef tract and upper East Bay, conditions are not so poor as to result in loss of acreage. However, it is not at all clear how much productivity is required to balance the natural and anthropogenically-mediated taphonomic processes that continually destroy shell carbonate. Accordingly, the significant reef accretion documented by this survey should not be construed as clear evidence for increased productivity in Galveston Bay as a whole. Although certainly productivity has dramatically increased in certain areas of the bay, productivity may have decreased commensurably in other areas of the bay. A bay-scale population dynamics model coupled with direct measurements of productivity in selected locations would be needed to estimate the change in productivity caused by the relatively rapid changes in reef distribution as it responds to a changed environment.

The geological stability of reefs in a bay like Galveston Bay is a misinterpretation brought about by the observation of large masses of apparently stable carbonate formed by oysters in the bay. In reality, over decades to half-century time scales, oysters are capable of substantially realigning oyster reef tracts in response to a changing environment. Under these conditions, which exist in Galveston Bay today, the presence of oyster reefs should not be equated with productivity or with optimal living conditions for oysters. Such an equation is only defensible when the geological distribution of reefs is in balance with the bay's hydrodynamics, which is certainly not the case today in Galveston Bay.

Examination of the spatial structure of community and health-related variables of Galveston Bay oyster populations reveals that factors other than salinity play an important role in determining the status of individual populations. The factors, current flow and food supply being likely candidates, create patch sizes of 10 to 15 km in extent and produce directional trends that frequently do not run perpendicular to salinity isohalines. The results of a onetime spatially-intensive survey corroborate the integrated picture from an assessment of the 20-year trends in reef accretion and loss which suggested that selected areas of the bay have a much higher inherent productivity than others. Many of these areas are in the moderate to high salinity regions of the bay downestuary of the 15 ppt line. This inherently higher productivity occurs despite higher predator abundance and significantly higher prevalence and infection intensity of *Perkinsus marinus* at these sites.

Three sets of data, the reef survey, the health survey, and simulations by the TAMU/ODU oyster population dynamics model, suggest that the most productive regions of Galveston Bay under most conditions are the South Redfish Reef/Dickinson Embayment area, the reefs adjacent to the Houston Ship Channel southeast of Buoy 75, the Bull Hill area of the Hanna Reef Tract, and to some extent the Deer Islands/Confederate Reef area of West Bay. These four areas accreted the most reef in the Galveston Bay system over the last 20 years, they were observed to be the most productive areas under the conditions of mean monthly freshwater inflow and mean daily temperature in the model simulation, and they generally produced the healthiest oyster populations in the health assessment, as measured by oyster density, oyster biomass, size-frequency distribution, gonadal-somatic index, *Perkinsus marinus* infection intensity, and condition index. Both the health assessment and the simulation suggest that the South Redfish Reef and Houston Ship Channel area could be a primary location for brood stock in Galveston Bay.

Comparison of the field data and the model simulation also shows that the most important discrepancy between observation and expectation occurs in the Pelican Island Embayment and central West Bay. Whether due to restricted larval availability or some unidentified source of environmental degradation, this area is currently supporting much lower production than would be expected from known conditions or which were observed prior to 1930 by Galtsoff. Probably, the Texas City Dike is responsible for at least a portion of this discrepancy.

Finally it is interesting to note that the Redfish Bar area under pre-1900 conditions was not productive. The reef was too shallow and production was limited by current flow and a sharp salinity gradient. The productivity of the central part of Galveston Bay from the Dickinson Embayment across the Redfish Bar Reef Tract would appear to be the result of the dredging of the Houston Ship Channel and the gradual expansion of reefs parallel to the new isohaline structure of the bay. The data and model simulation demonstrate that local factors, probably related to food supply and current flow, can override the negative effects of increased mortality due to predation and disease and permit the production of healthy oyster populations in relatively moderate to high salinity areas. The region of highest inherent productivity in the bay, and also the region of greatest reef accretion, exists in the isohaline gradient running sub-parallel to the Houston Ship Channel. Although counter to standard dogma, the highest production is concentrated within the higher salinity portion of this salinity gradient downestuary of the 15 ppt line, which strongly suggests the importance of current flow and food availability as determinants of local variations in population health.