THE REQUIREMENT FOR FRESH WATER IN A GENERAL PLAN FOR MULTIPLE DEVELOPMENT OF THE MARINE BAYS

by

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In a recent study of marine resources in the Corpus Christi area it was estimated by Anderson (1960) that the marine bays were yielding about $370 an acre per year to multiple users with about half of the value in industrial usages and half in uses related to fishing, tourism, and sports activity. With about a million acres of bays in Texas, an extension of the estimate suggests a present value of 370 million dollars a year, a major resource. A summary of the dollar estimates is presented in Table 1.

The use of the marine and submerged lands is just beginning, and the potential values may be much greater in the near future. Compared to coastal regions of Florida and California, the Texas coast is relatively sparsely populated and its waters relatively little used.

Development of these marine resources is not proceeding smoothly, however, and as in most frontiers there are conflicts, exploitations, and competitions. To name just a few, there are conflicts between sports and commercial fishermen, oyster harvestors and shell miners, channel dredgers and those in sports fishing needing clear and undisturbed waters, bait fisherman and commercial shrimpers, developers of real estate marinas and those responsible for maintaining fish stocks, waste disposers and those needing nurseries in unpolluted waters, and many others. A statement of some of these conflicts is included in the recent publication on Texas Natural Resources of the Houston Chamber of Commerce (Odum, Muhlberg, and Kemp, 1959). Fortunately, in Texas, research is abreast of development and there is yet time for planning for the best development of a major frontier.

Table 1. Dollar per Acre per year estimates of the bays in the Corpus Christi Area from Anderson (1960)

	Annual Dollar Per Acre Values
Industrial	
Navigation	64
Oil and Gas	124
Cooling	10
Waste Disposal (One Case $0.30)	?
Shell	5
Sub Total	203
Use Based on Biological Food	
Tourist, Sports	130
Local Residents	21
Commercial Shrimp	13
Bait Shrimp	1.3
Fin Fish	0.34
Crabs and Oysters	1
Sub Total	167
Total	370

One of the developing conflicts concerns the increasing diversion of the freshwaters inland from rivers so that surges of fresh water will flood into the bays less and less frequently. The growing demand for freshwater has even led some to suggest the use of some marine bays as giant freshwater holding tanks a proposition in conflict with most of the present users of the bays. It is thus pertinent to a conference on freshwater to consider the future needs of freshwater for the development of the resources of the marine bays.

Bay Fertility

In south Texas there are bays which are already without inflows of freshwater. An examination of the conditions in these bays, their fertility, and value provides information concerning the importance of freshwater to the best development of the other bays.

In figure 1 is presented a map of summer productivity by the marine plants including algae and underwater grasses in the bays of Texas as measured by a new method. Chemical analysis of the water are made every three hours through a twenty-four hour period to determine the changes in dissolved oxygen content in the water. Since a pound of oxygen is manufactured for every pound of organic food matter manufactured by plants from sunlight, one may use the oxygen data to compute the rate of food manufacture by the plants. Similarly, from the rate oxygen disappears at night one may measure the rate of food consumption by the animals, plants, and microorganisms. In fertile bays there is much plant growth and subsequently consumption of the food products by the animals. The greater are the growths of food matter, the greater are the potentials of aquatic agriculture, tourist industries and users related to fish shrimp, and clear water. The broad patterns of productivity have now been determined in several bay systems with these methods used over a four year period (Odum and Hoskin, 1958; Park, Hood, and Odum, 1958).

The data in Figure 1 indicate the great fertility of the highly saline bays of south Texas with their lush grass flats serving as great nurseries of shrimp, crabs, and fin-

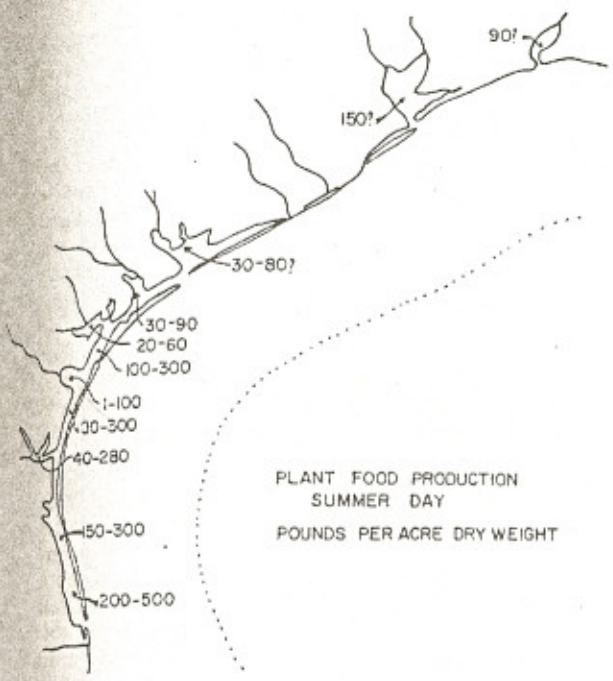

Figure 1. Daily yields of plant food production in the bays of Texas during summer 1960 as determined with the diurnal oxygen method. Where data are few a question mark is placed to indicate that generalizations are not yet possible.

fish. The absence of river runoffs permits the waters to clear allowing optimum light penetration for maximum growth of plant food. A stable salinity condition also allows the larger animals to grow to appreciable size for maintaining stocks. The stable system of plants, animals, and microorganisms by complementary action circulates and conserves necessary nutrients like phosphates, nitrates, and other trace elements. Thus it is apparent that fertility of bays with regular inflows of turbid freshwater are generally of lesser productivity. Judging by the situation in the Laguna Madre, shrimp, crabs, sports fishing, tourism, and many other related uses are best maintained without the freshwater providing there are no major pollutions.

The rapid growth of fish (137 lbs/acre/year) was documented by T. Hellier (1961) and the importance of the Laguna as a sports fishing area was recently documented in a summary of a creel census study (Simmons, 1961). The high yields of the Laguna have been reported for many years by the reports of the Texas Game and Fish Commission.

Others have also noted harmful effects of river flows on the marine waters. Hoese (1960) found the sharp fluctuations of salinity in Mesquite Bay detrimental to maintenance of bottom animals, an important component of fish food. Pomeroy (1960) in careful study of the phosphorus nutrient in a marine bay in Georgia also described the harmful action of the Altamaha River in diluting bay waters.

Brackish Waters Needed for Oysters

Although freshwater is not necessary to general productivity, a proper amount of freshwater is necessary to commercial oysters which do not succeed in either freshwater or waters of high salinity. To maintain bay salinity for oysters between 5 parts per thousand and 25 parts per thousand, some regular inflow of freshwater is needed. Live reefs and associated organisms are needed for the oyster industry, for tourists, and for the general sports fishing attraction. Thus some mechanism is needed to permit the conditions suitable for the oysters without wasting freshwater or diminishing fertility of whole bays. An idealized plan is suggested as follows:

The Zoned Sector Plan for Multiple Bay Development

In Figure 2 a typical marine bay is divided into 3 sectors by levees of spoil. Sector 1, a deep industrial sector, contains those uses potentially harmful to others such as navigation by ships, waste disposal, withdrawals for cooling systems, and maintenance dredging.

Sector 2, a nursery sector, is isolated from salinity shocks, wastes, poisons, and turbid materials to permit shallow beds of grass flats to grow in clear water for raising the young shrimp for offshore harvest and for aquatic leases for aquatic farming.

Sector 3 is a low salinity sector containing the turbid brackish water for oyster development. Reefs are to be

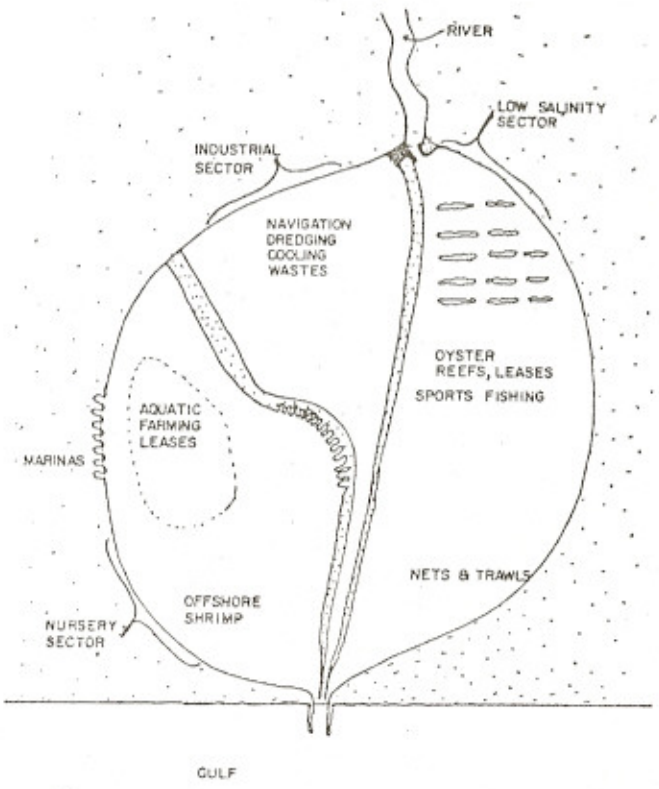

Figure 2. An idealized bay showing division into three zoned sectors for maximum development of multiple resources.

realigned in straight lines for management, leasing, and ease of approach by boats. This plan will also permit removal of shell by dredgers in inter-reef areas.

In such a development as idealized in Figure 2, very little fresh water is needed from upstream to maintain a stable salinity condition for oyster development in a small, low-salinity sector. In the event of floods, a system of gates will permit the discharge of excess water through the industrial sector instead of through the oyster sector, thus avoiding the periodic kills due to low salinity and helping to clean the industrial sector. Such a plan will need coordination with the plan for the river basin to insure availability of freshwater during drought.

How the multiple use plan can be put into effect, in part or in whole, has yet to be determined. Any such undertaking will require the broad backing of all interests in the state desiring multiple and equitable public progress. The costs of construction and maintenance may be obtained from sale of leases for marina development along the spoil levees. Whether the legislature can provide for a development directly or by creating some new agency remains to be seen, but the benefits may be great. Not only will separation of conflicting interests benefit these users, but the system of zoning and leases will stimulate a new era of private enterprise.

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