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A Precise Environment

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Aquarium enthusiasts know just how particular fish are about their surroundings. They know that fish-- especially saltwater fish--are downright finicky about their oxygen, food, pH balance, temperature, light, and water quality. For fish to reproduce in an aquarium, an aquarium owner must provide an environment exactly to their liking.

Fish and shellfish living along the Texas Gulf Coast demand almost as precise an environment. They must have fresh water from Texas rivers mixed with Gulf salt water at just the right time and in just the right quantity. They are picky about what kind of food the rivers bring to them, and they refuse to grow and reproduce when their environment does not meet their demands.

At least 97 percent of all fish and shellfish in the Gulf are dependent in some way on the coastal areas where streams and rivers mix with the Gulf's salt water. Some species such as the bay oyster spend their entire lives in these mixing areas, called estuaries, but most finfish and shellfish use the fertile areas as nursery grounds. Many species migrate into the estuaries to spawn, while others send their young into the estuaries for food and lower salinity or for protection against predators and parasites. Most fish and shellfish migrate back to the Gulf as adults.

Marshlands adjacent to each Texas bay provide significant quantities of organic material which form the base of the food chain in the estuaries. These areas produce as much as 15,000 dry weight pounds per acre per year of cord grass and other salt-tolerant vegetation. Only tropical rain forests, coral reefs, and some algal beds produce more abundantly per acre anywhere in the world.

FRESHWATER INFLOW

The productivity of estuaries and marshlands depends to a large extent on the quantity and timing of freshwater inflows from rivers and streams.

Fresh water comes into coastal systems from inland rivers and dilutes the seawater. Salinity of seawater averages 35 parts per thousand, but most immature fish and shellfish prefer salinities below 17.5.

Periodic flooding flushes marsh wetlands, transports food materials from the marshes into the estuaries, and removes or limits pollutants, parasites, bacteria, and viruses in the marshes.

Seasonal timing of floods is crucial. Winter flooding of marshes, for example, may not be as beneficial to the estuarine system as similar events in the spring because low winter temperatures do not support high biological activity. Because some fish species, such as the red drum, spawn in the fall, the young are particularly dependent on migration to the estuary for survival at that time. Others, such as spotted sea trout, may spawn throughout the summer.

Few generalizations can be made about the 1.5 million acres of Texas estuaries and the 1.1 million acres of adjacent marshland. The Texas coast is one of the most diverse estuarine regions in the world. The coastal environment ranges from water-rich East Texas forests to semi-arid brush country along the southwestern one-third of the coastline. Parts of the coast are among the most heavily populated in the nation while other parts of the Texas coast are seldom disturbed by man.

Six of Texas' seven major estuaries fit the textbook definition of an estuary: a semi-enclosed coastal body of water which has a free connection with the open sea and where seawater is measurably diluted with fresh water derived from land drainage. The remaining estuary, Laguna Madre, can also be referred to as a marine lagoon, since its connection with the sea is not "free" and since its water is often much saltier than seawater because of evaporation and lack of continuous freshwater inflow.

VALUABLE RESOURCE

Over 100 million pounds of fisheries products are harvested from the Texas Gulf Coast each year by sport and commercial fishermen. Texas harvests have been greater in value than that of any other Gulf state in recent years. Commercial and sports fishing activities in 1981, for example, had a total economic impact on the Texas economy of about $1.25 billion. This amount reflects the direct and indirect gross business, personal income, and tax revenue values to the state.

Experts warn, however, that the fertile estuaries along the Texas coast are extremely vulnerable because of development of water supplies for industrial, municipal and agricultural water users. River basin development, according to the Texas Department of Water Resources (TDWR), can affect an associated estuarine system in the following ways:

- reduction of freshwater inflow quantities.
- reduction of nutritive enrichments.
- reduction of sedimentary materials.

- elevation of salinity levels and toxic pollutants.
- alteration of the seasonal timing of freshwater inflows.

During the severe drought of the 1950s, the salinity in some Texas bays exceeded the average Gulf salinity by 40 percent due to low river flow and high evaporation. Reported commercial Gulf fish landings declined sharply during the same period.

Scientists say a similar drought now could cause far greater harm to the bays and estuaries because of the water development which has taken place since the 1950s. The flow in virtually every major river basin in Texas has been changed since that time. The number of major reservoirs, now over 180, has more than doubled in the past 30 years.

Water in river basins today is "managed" for use primarily by cities, industries and irrigators. Large dams hold flood water to be used when needed or to be released slowly when flood stages have passed with little concern for how changes in flow affect estuaries downstream.

The potential harm of upstream development to coastal environments went virtually unnoticed by state water planners and legislators during the 1960s--the most active decade for water development in Texas history.

Since 1971, however, Texas legislators have passed laws (1) acknowledging the importance of the estuaries, (2) issuing policy statements on the protection of these areas, and (3) authorizing comprehensive studies on estuarine requirements for fresh water.

The following paragraphs added to the Texas Water Code during the 1970s indicate the seriousness of the legislative directives in future protection for the estuaries.

It is the public policy of the State to provide for the conservation and development of the State's natural resources, including... the maintenance of a proper ecological environment of the bays and estuaries of Texas and the health of related living marine resources. Section 1.003.

In its consideration of an application for a permit to store, take, or divert water, the commission [Texas Water Commission] shall assess the effects, if any, of the issuance of such permit upon the bays and estuaries of Texas. Section 5.145.

The board [Texas Water Development Board] shall carry out comprehensive studies of the effects of freshwater inflows upon the bays and estuaries of Texas which studies shall include the development of methods of providing and maintaining the ecological environment thereof suitable to their living marine resources. Section 11.103.

This summer, the Texas Department of Water Resources completed the comprehensive studies mandated by the legislature. TDWR studied each estuary system and made estimates of the quantities of fresh water needed on a monthly and seasonal basis for

marsh inundation and nutrient transport, for proper salinity levels, and for support of various levels of fisheries harvests.

The study concluded that controlled introduction of fresh water into an estuary would be a significant contribution to its management if it could be done with an adequate volume of water at the proper time. TDWR assessed freshwater inflow needs of each estuary to demonstrate a wide range of production potential with different inflow patterns. Scientists evaluated three alternative levels of production:

- The Subsistence Alternative minimizes inflows needed by an estuary while still meeting salinity and marsh inundation and nutrient requirements.
- The Fisheries Harvest Maintenance Alternative requires inflows sufficient to support annual commercial fisheries harvests for the major seafood species at levels no less than their historical averages. Major coastal species harvested include spotted seatrout, red drum, black drum, white shrimp, brown shrimp, blue crabs, and bay oysters.
- The Fisheries Harvest Enhancement Alternative looks at how inflow patterns can enhance specific commercial fisheries harvests. The total freshwater inflow would not exceed historic averages, but the seasonal flow might be redistributed to increase the harvest of a specific commercial species.

Management of inflows into estuaries, TDWR says, will require computerized mathematical modeling techniques. It will also mean continued collection and compilation of both hydrological and biological data. Each river and its related estuary present different factors to be considered: ecological characteristics, upstream water rights, and economic trade-offs.

INFLOW ISSUES

Even though Texas law requires the maintenance of a healthful environment for fish and other marine life of the estuaries, and even though Texas water planners have recently analyzed freshwater requirements of the estuaries, the complex issues of freshwater inflows are as yet unresolved.

Tough questions for Texans to answer in the 1980s--and hopefully resolve before the next major drought in the state--include the following issues.

1. Surface water belongs to the state of Texas, and users must receive permission from the state to use the water. Which water users will have the right to limited water during drought years: municipal, industrial, agricultural, or estuaries?

2. If water from existing reservoirs is to be released for estuaries, who should pay for the storage: reservoir owners, water customers, fishermen, or all taxpayers?

3. Should the state continue to fund and coordinate data collection and monitoring freshwater inflows into estuaries along the Texas Gulf Coast?

4. At what productivity level should the state seek to maintain the estuaries and which species should be enhanced?

5. If future reservoir projects are required to release or pass through water for coastal areas, should state financial assistance help in the construction of these projects?

6. Should development be limited in those river basins where limited water may affect the productivity of the marine environment?

Now is the time for Texans to resolve these questions. Their importance and urgency to the state cannot be over emphasized. As many aquarium owners know, it is too late to change the water after the fish float on the surface.