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The Importance of Inflows

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At first glance, there might not appear to be a significant relationship between Texas river water and the general well-being of the fish, shrimp, crab and oyster populations that live up and down the Gulf Coast.

But a closer look reveals otherwise. Texas rivers, reservoirs and lakes all provide tremendous amounts of freshwater which eventually flow into coastal bays and estuaries.

This freshwater–called freshwater inflow–is essential to the delicate health of the bays, estuaries and wetlands of Texas, because it carries nutrients and food sources into these systems. Freshwater also reduces the salinity levels in the estuaries by mixing with saltwater from the Gulf. Low salinities are essential for the survival of many species.

Despite its importance, there are not yet any laws in Texas to guarantee that freshwater inflows will reach the state's bays and estuaries in sufficient amounts and at the proper times.

This issue was one of the most complex and politically sensitive issues facing Texas policymakers in the recently concluded Legislative Session. In May, the Legislature passed the "Texas Water Bill" (House Bill 2 and House Joint Resolution 6) which included provisions to reserve some future freshwater supplies for flows into bays and estuaries. The proposal has been signed by the Governor, will be voted upon by Texans in November elections and, if passed, will become law.

Until recently, data on the amount and timing of inflows and their impacts upon the state's estuarine ecosystems were nonexistent. But in 1975, the Texas Legislature mandated that the Texas Department of Water Resources (TDWR) produce comprehensive studies and reports on the effects of freshwater inflow upon the bays and estuaries of Texas. A series of technical reports followed, containing specific information

on the seven major estuaries in the state which stretch the length of the Texas Gulf Coast from Port Arthur to Brownsville. These estuary systems include the Nueces, Mission-Aransas, Guadalupe, Lavaca-Tres Palacios, Trinity-San Jacinto, Laguna Madre, and Sabine-Neches estuarine systems. An Executive Summary was published in 1982.

The reports helped fill an important void in the existing data base. By using computer modeling techniques, projections were made about the effects of inflow as it related to hydrology, circulation patterns, salinity, nutrient processes, basic food chain production and fisheries harvests.

In preparing the reports, TDWR researchers analyzed phytoplankton, vascular plants and bottom-dwelling benthic organisms, in addition to vertebrate and invertebrate fisheries species.

The studies produced estimates of the amount of freshwater inflow which would be needed in an estuary to meet certain objectives. Generally, there were three alternate long-term projections for each estuary: 1) subsistence, 2) maintenance of fisheries harvests, and 3) enhancement of selected commercial fisheries harvests.

All three options provide freshwater inflow estimates for a minimum monthly inflow which would sustain nutrient transport, habitat maintenance and salinity control in an estuary. The subsistence option includes these minimums and considers marsh inundation and salinity requirements of an estuary. The maintenance of the fisheries harvests option projects minimum monthly inflows, as well as inflows which would be sufficient to support average annual commercial fisheries harvests from 1962-76. (The maintenance option requires more freshwater inflow, in most cases, than does the subsistence option.) The third alternative, the fisheries harvests enhancement option, is designed to improve the harvest of a specific commercial fisheries harvests category which could vary from estuary to estuary. Total freshwater inflow under this alternative, however, could not exceed the average historic inflow during the period 1941-76.

The long-term inflow estimates take into account the salinity requirements for each species including the minimum and maximum salinities each species could tolerate, flooding requirements, the effects of inflow on nutrient loading and a host of other factors.

Limitations and Concerns About the TDWR Reports

As impressive as these documents seem to be, they do have their critics.

One criticism of the reports is that estimates of inflow needs are based in part on rough correlations, which may not fully explain the true cause and effect relationships. There is assumed to be a correlation of certain conditions to the productivity of certain species, but the correlations have yet to be proven with certainty.

Most of the projections in the reports are based on analysis of data on certain "key indicator species" which are ecologically characteristic and economically important to the Texas coast. Those indicator species included spotted seatrout, red drum, black drum, white shrimp, brown shrimp, blue crabs and bay oysters. Some conservationists have argued that the bay oyster should be used as the main key indicator species because data are available on oyster harvests since the 1800's. Also, because the oyster is relatively immobile, it cannot escape from and is therefore more vulnerable to changes in a bay or estuary than a finfish, for example, which can swim away from dangerous conditions. (Officials from the TDWR contend that the bay oyster is on the margin of its natural range in the Gulf and is a cold-water adapted New England species not representative of Gulf Coast species.)

Another criticism is that the reports do not derive estimates for some species which are insignificant as harvest species, but which still play important roles in the ecological relationships among the estuarine species. These include fish such as the sheepshead minnow and the menhaden, small fish species which are among the most numerous in Texas Gulf waters. Also, no attention was given to the effects of freshwater inflow on other commercially or recreationally important species other than fish, including waterfowl such as ducks and sea gulls, alligators and furbearers which also inhabit marshland and estuarine habitats.

Relationships of Freshwater Inflows To Fisheries Productivity

Bays and estuaries play a major role in determining the vitality of both inshore and offshore fisheries production. Fisheries, and goods and services associated with them, are major renewable natural and economic resources for Texas.

In 1979-80, commercial fishermen harvested more than 78 million pounds of shrimp, finfish, crab and oysters from Texas bays and estuaries. Nearly 1 million sport fishermen visit the state's bays and estuaries annually. In 1979-80, they caught an additional 9 million pounds of finfish (fishermen on charter boats reeled in 2.19 million pounds). Direct expenditures for sport fishing for 1979-80 were $2.65 million, while indirect expenditures (such items as motel rooms, gasoline and food) were estimated at $8.37 million. The value of the commercial finfish and shellfish catch from the Gulf of Mexico was estimated at $138.8 million in 1979-80, while indirect revenues to areas along the coast benefiting from the fishing industry were estimated at $438.5 million.

Nearly all of the coastal fisheries species in the Texas Gulf are estuarine-dependent, at one or more times of their life cycle, particularly in the juvenile stages. Some species such as oysters spend their entire lives in an estuarine system. Others, like shrimp, come into the estuaries during their juvenile stages. For many species, estuaries are essential nursery areas. Some species migrate to the shallow estuaries in their juvenile stages to escape predators and parasites associated with high Gulf salinities. Other species mature in low-salinity zones. Young fish and shellfish, for example, commonly utilize estuarine habitats that are less than 50 percent seawater, while optimum conditions for adult fish and shellfish are generally greater than 50 percent seawater.

In fact, there seems to be a general pattern among many species where eggs are hatched at sea and the larvae make their way inland into the low-salinity nursery habitats of the estuaries. After reaching maturity, they then return to the sea.

When large amounts of inflow result in the flooding of marshes and wetlands, essential nutrients including carbon, nitrogen and phosphorus are carried into the bays and estuaries, where they become a basic food source. Marshes and wetlands also serve as natural systems for cleaning and restoring water quality and shoreline stabilization. They also mitigate storm impacts on the mainland.

It is interesting to note that there are several variations in salinity and temperature requirements among competing species within a specific estuary. In the Lavaca-Tres Palacios estuary, for example, shellfish and all penaeid shrimp respond favorably to increased spring inflows and decreased winter and summer inflows. The blue crab thrives when inflows are increased from summer through late fall. Bay oysters would produce maximum numbers if inflows were decreased during the warm summer season, and increased in the cooler seasons of fall and winter. Finfish as a whole, and specifically spotted seatrout and red drum, fare best when spring inflows are abundant.

Methods of Providing Freshwater Inflow

The Executive Summary of the TDWR reports give some tentative recommendations on the amount of freshwater inflow needed under the three long-term management alternatives. In most cases, the maximum amounts of recommended inflow are not more than or are just slightly more than historic inflows.

But even though we have an idea of how much freshwater the bays and estuaries need, the means of supplying the inflow and paying for it are yet to be resolved.

Freshwater inflow comes from a variety of sources, including precipitation (rainfall), gaged and ungaged runoff from rivers, lakes and reservoirs, and return flows from upstream water users. Release of freshwater from reservoirs would be one means of supplementing inflows in the amounts estuarine systems need to flourish. Still, in many cases, there are competing interests for water use which may not want to easily relinquish their water rights.

Consider, for example, a hypothetical river that runs from Central Texas into the Gulf. On this river are a number of reservoirs, which are operated by local water districts and river authorities. Also, municipalities, industries and individual landowners may hold permits to withdraw water from the river. If all the users exercised their option simultaneously to remove the amount of water from the river which they were legally entitled to remove, the river could be pumped dry. The total amount of water allocated for diversion and use may actually exceed the amount available in the river. If a substantial amount of water is allocated to maintain the estuaries, the situation would become even more stressed, particularly during droughts.

Critical Issues Surrounding Release of Freshwater Inflows

The idea that supplemental amounts of freshwater inflows can be controlled by man, to some extent, raises a specter of philosophical and moral questions relating to how much interference man should exercise in dealing with the natural environment.

The flooding of marsh and wetland areas could be simulated, for example, by releasing water from reservoirs. If the state required releases for the number of inundations recommended in the TDWR reports and a number of natural inundations followed, would there be too much flooding which could actually be detrimental to the ecosystem?

The TDWR has specified three alternative management options for each estuary. Which agency or individual ought to decide which of the three management options–subsistence, maintenance, or enhancement of a selected species–ought to be chosen for a particular estuary?

Some critical questions will have to be addressed before freshwater from any source can be allocated to estuaries. These questions include such issues as:

1) Whose water is it? (individuals, water authorities, or all citizens of the state)

2) How will the use of state water be prioritized among competing user groups? (farmers, fishermen, industries, metropolitan areas)

3) How would the local sponsors of water projects provide for freshwater inflows to the state's bays and estuaries? How would they be compensated? Should they be compensated?

Finally, there is the argument between those groups who feel more research needs to be performed before these recommendations are implemented, and others who call for immediate implementation. Does more research need to be conducted before any action is taken, or is there presently enough research to exercise at least interim management options, pending additional findings? Some conservation and environmental groups argue that it is urgent that implementation of a program to guarantee freshwater inflows to bays and estuaries begin immediately. The appropriation of limited freshwater supplies continues daily. While the needs of estuaries are being further studied, they argue, all remaining available freshwater could be allocated.

Legislation recently passed by the Texas Legislature deals with some of these issues. House Bill 2 and House Joint Resolution 6 both allocate five percent of freshwater from the firm annual yield of future reservoirs built within 200 river miles of the Texas Gulf Coast to be set aside as inflow to estuaries. (That five percent figure would be substantially less than historic inflow levels.) The bill also prioritizes the needs of estuaries in relation to needs of other users, although domestic and municipal water users would still have superior rights. It would also require the TDWR and the Texas Department of Parks and Wildlife to establish and maintain a continuous data collection

and study program, and would assure that the freshwater inflow needs of bays and estuaries be considered at any hearing to issue or re-issue permits for state reservoirs. The legislation still must be approved by Texas voters in November to become law.

If legislation is passed which protects the realistic freshwater needs of estuaries, the state will have made a substantial step forward in protecting one of its most substantial economic and natural resources–the bays and estuaries of coastal Texas.