Habitat Restoration

Can Galveston Bay Fisheries Benefit from Marsh Creation?

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Introduction

The loss of estuarine wetlands is detrimental to many important fisheries because of the loss of essential nursery functions provided by these habitats (Boesch and Turner 1984, Minello and Zimmerman 1991). In Galveston Bay, 21% of the tidal marshes and 70% of the submerged aquatic vegetation has been lost since the 1950's (White et al. 1993). These wetland losses are continuing and are likely to accelerate with higher rates sea level rise. The resulting decline of high quality nursery area will almost certainly affect fisheries such as penaeid shrimps, blue crab, spotted seatrout, red drum, southern flounder and others. Among the few options available to offset effects of wetland loss on fisheries is creation of new habitats to replace those lost. One means of creating intertidal wetlands is through use of clean dredge material.

Our purpose was to examine the potential for biological gains and losses from marsh creation in various parts of Galveston Bay. In conducting the study, we compared animal abundance and biomass per unit area between salt marsh (*Spartina alterniflora*) and unvegetated open bay habitats. Because these habitat types are so physically different, it was necessary to employ and intercalibrate specific sampling techniques for each habitat. Accordingly, we used a drop trap sampler in the marsh and trawls in open water (compared in Zimmerman et al. 1984). Intercalibration was performed by measuring the catch efficiencies of the gear types relative to each other. Once the data were corrected for sampling efficiency, the marsh and open water measurements were directly comparable. As far as we are aware, this was the first time that densities of aquatic fauna have been compared between intertidal marsh and deeper subtidal waters throughout in an estuarine system.

Methods

Our approach was to measure densities and biomass of aquatic fauna (particularly fishery species) at open water sites and in nearby marshes, then compare the degree of faunal utilization between these habitats among the various regions of Galveston Bay. Differences were analyzed using analyses of variances (ANOVA) in a stratified design of areas designated as cells, zones and sides of the bay. Faunal densities and biomass were used as observations. We assumed that differences in utilization between marsh and open water were indicative of potential gain or loss in productivity from marsh creation. We also assumed that under favorable circumstances the marshes created at particular disposal sites would function similar to marshes existing in the same area. Field work was conducted in the fall of 1992 between mid-September and early October. The survey assumed no significant interaction between sites due to season. An earlier study in the bay indicated that differences in animal densities between marsh and open water do not vary significantly among locations with season (Zimmerman et al. 1990). The early fall was a good time for maximizing the number of species present in the system and for optimizing measurement of marsh utilization because tidal inundation was at a seasonal high for the year.

Results

The marsh fauna of Galveston Bay were characterized in the fall by white shrimp, brown shrimp, blue crab, grass shrimp, spotted seatrout, killifishes and gobies. In open water the fauna were characterized by mysids, bay anchovies and Atlantic croaker.

The lower parts of the bay and the eastern side had the highest abundance of marsh fishes and crustaceans, and the greatest differences in abundance between marsh and open water habitats (Figures 1 and 3). The western side of the bay had larger fish sizes (Figure 2) and the least difference in fish abundance (Figure 1) between marsh and open water. The lower bay marshes had greatest numbers of brown shrimp, white shrimp and spotted seatrout. The least numbers of marsh fishes and crustaceans occurred in the upper bay along barren shorelines near Seabrook, LaPorte and in the western part of Trinity Bay. The most abundant open water fishes, including bay anchovy and Atlantic croaker, were in the Houston Ship Channel and the Trinity delta areas. Mysids were more abundant in open water in both the upper and lower bay. Blue crabs were evenly distributed throughout the bay, but highly associated with marsh habitat .

Conclusions

In most instances, the abundance and biomass of crustaceans and fishes were significantly higher in salt marshes than in open water habitats (Figures 1,2, 3 and 4). This implies that a net gain may be achieved in secondary productivity through marsh creation. The lower and eastern parts of Galveston Bay appear to have the best chance for success in marsh creation based upon highest abundance and biomass of marsh fauna and largest differences between marsh and open water. These areas incorporate large marshes already existing in East Bay and Trinity Bay. Marshes created along barren shorelines in the upper western areas of the bay would achieve much less comparative biological gain. These are areas of apparent erosion and the risk of failure for establishing new marsh may be high. In addition, the western bay supports the highest abundances of open water fauna.

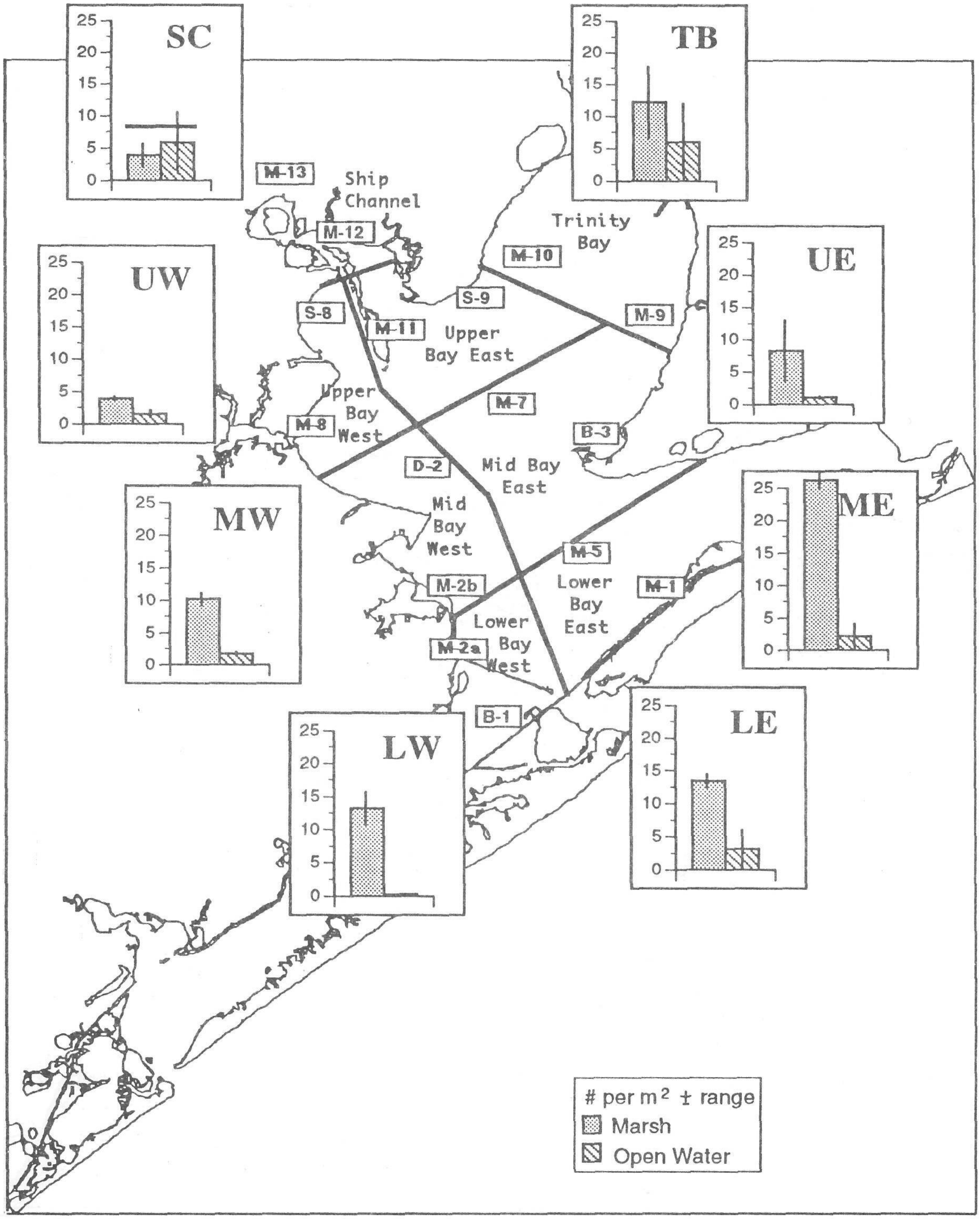

Figure 1. Mean cell densities of all fishes: Galveston Bay marsh and open water survey (Sept. 17 to Oct. 8, 1991).

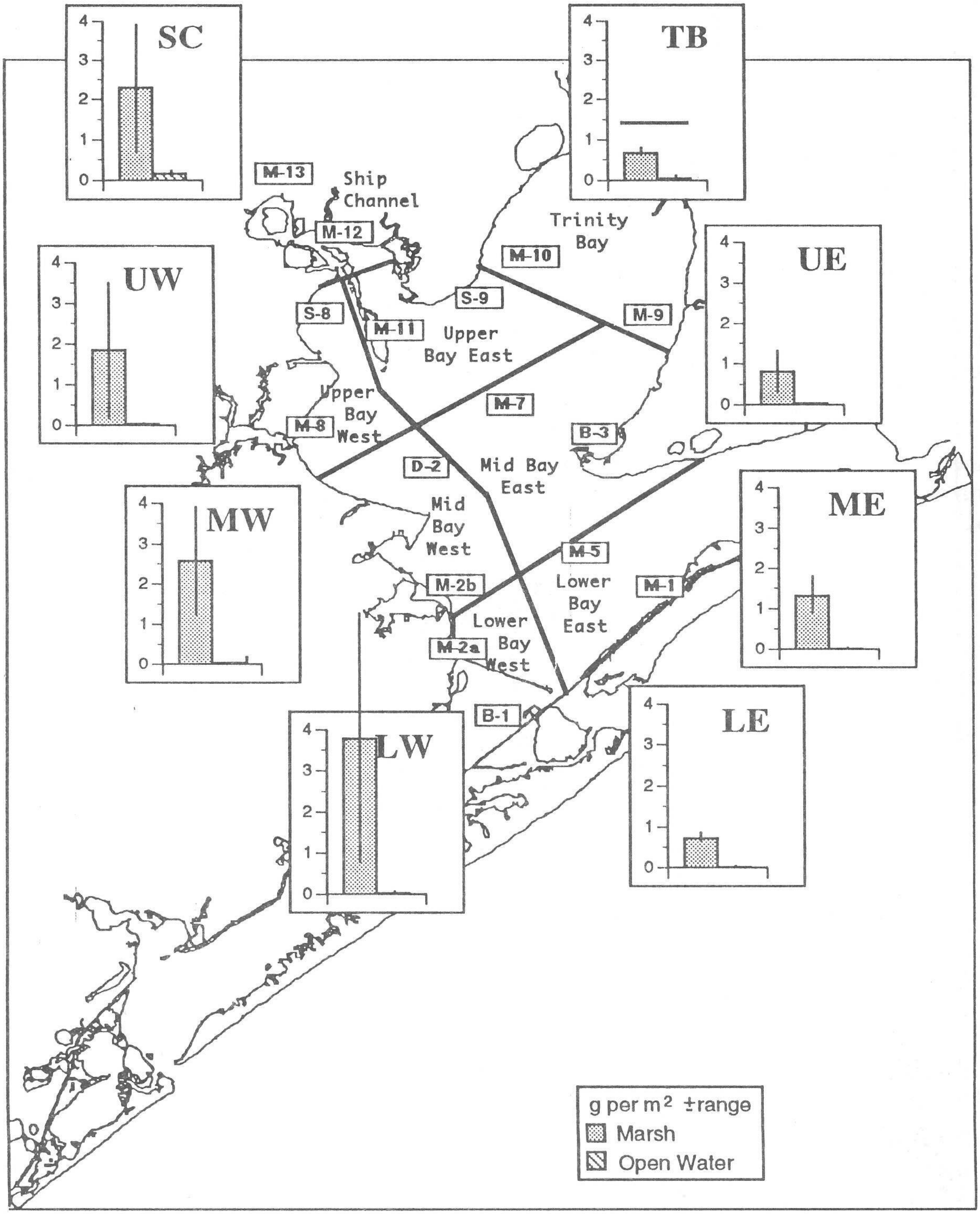

Figure 2. Mean cell biomass of all fishes: Galveston Bay marsh and open water survey (Sept. 17 to Oct. 8, 1991).

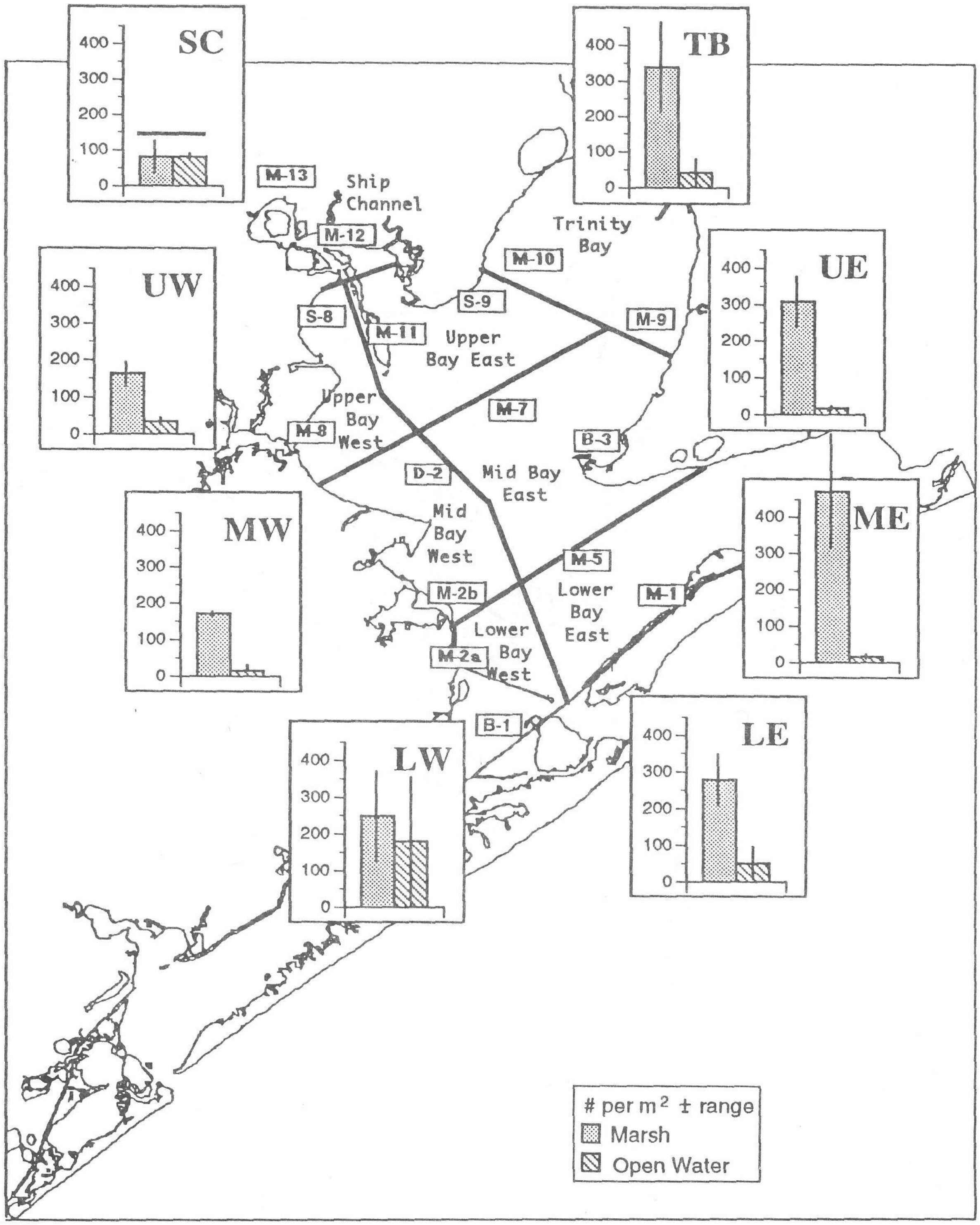

Figure 3. Mean cell densities of all crustaceans: Galveston Bay marsh and open water survey (Sept. 17 to Oct. 8, 1991).

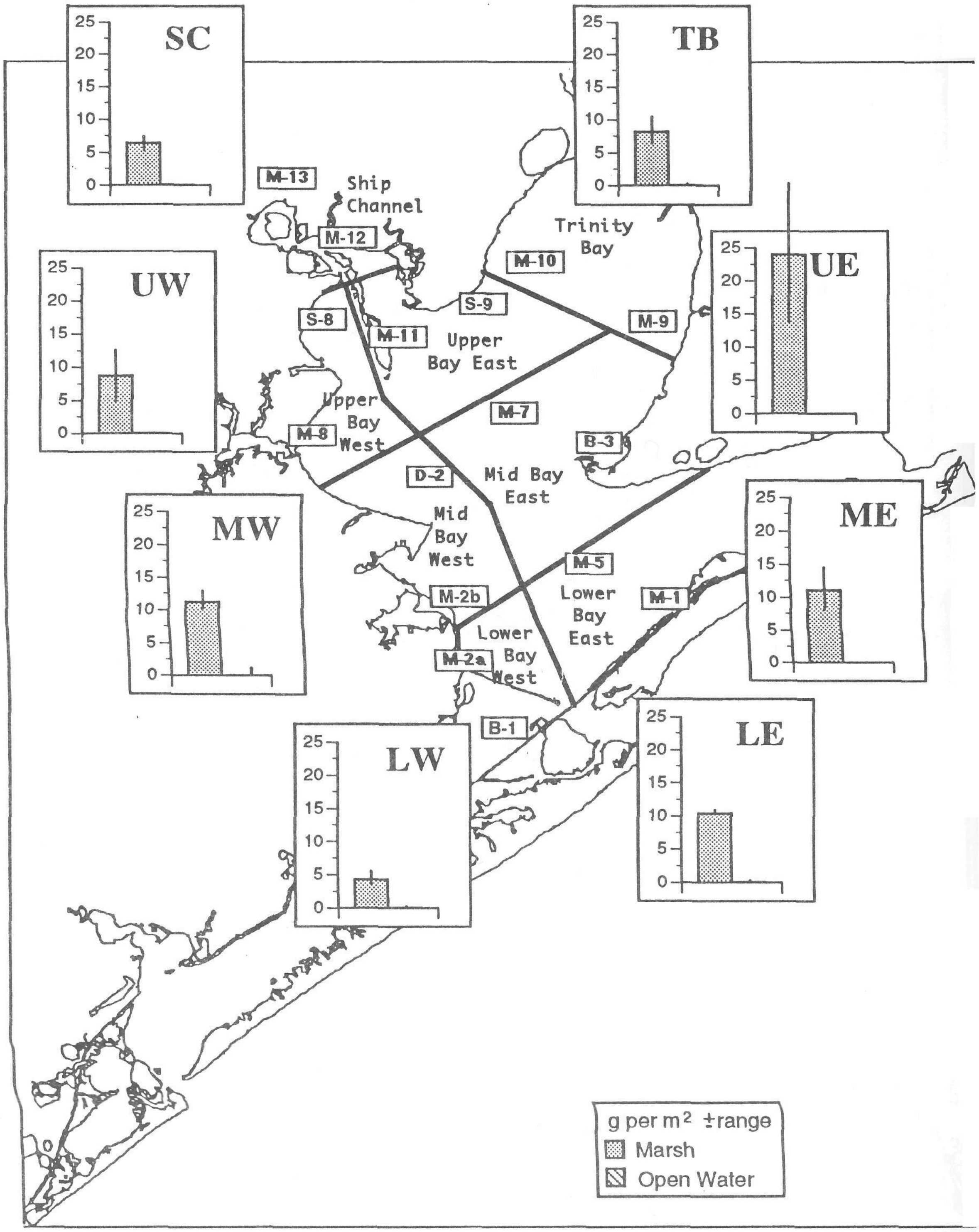

Figure 4. Mean cell biomass of all crustaceans: Galveston Bay marsh and open water survey (Sept. 17 to Oct. 8, 1991).

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Wetland Creation Efforts in Galveston Bay, Texas

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The shoreline of the Galveston Bay estuary is eroding at an average annual rate of four feet. The Galveston Bay National Estuary Program has identified shoreline erosion and the subsequent loss of wetland vegetation as two of the four priority problems in Galveston Bay. Loss of wetland habitats and coastal erosion will continue unless low-cost effective measures are developed and implemented for shoreline erosion control and habitat enhancement. Established stands of smooth cordgrass, *Spartina alterniflora* Lois, provide an effective means of shoreline erosion protection.

The Texas A&M University Marine Advisory Service and the USDA Soil Conservation Service initiated a project in 1989 with funding from the Galveston Bay National Estuary Program to study the impacts of vegetative shoreline erosion control measures in Galveston Bay.

Smooth cordgrass was transplanted at six sites in Galveston Bay (See Figure 1). Each site has different shoreline configurations, salinity regimes, and soil types. Transplant survival data was documented by site during the study. Baseline erosion rates and fisheries species abundance data were collected at the six sites during the study prior to wetland creation. Data collected during this study represent only preliminary findings. A monitoring program beyond the term of the grant may indicate other significant long-term impacts of wetland creation.

Coastal salt marshes are a very valuable resource. They serve as a nursery for over 90% of coastal marine organisms in the Gulf of Mexico. Under favorable conditions, they will produce more vegetation than almost any ecosystem on earth. The production will far exceed the production of any intensive agricultural crop. Tidal marshes are also important in the storage and assimilation of nutrients from the surrounding estuarine waters. They are also very important in trapping sediment and reducing turbidity in runoff water. Marshes are important in reducing flood control impacts by storing floodwater and releasing it slowly after peak flow. In many situations, these coastal wetlands also stabilize shorelines and afford protection to upland areas during storms by absorbing and dissipating wave energy.

Coastal wetlands in the Galveston Bay complex are rapidly disappearing. Channelization, salt water intrusion, pollution, shoreline erosion, and the possible impact of sea level rise are contributing factors to the loss of coastal wetland habitats

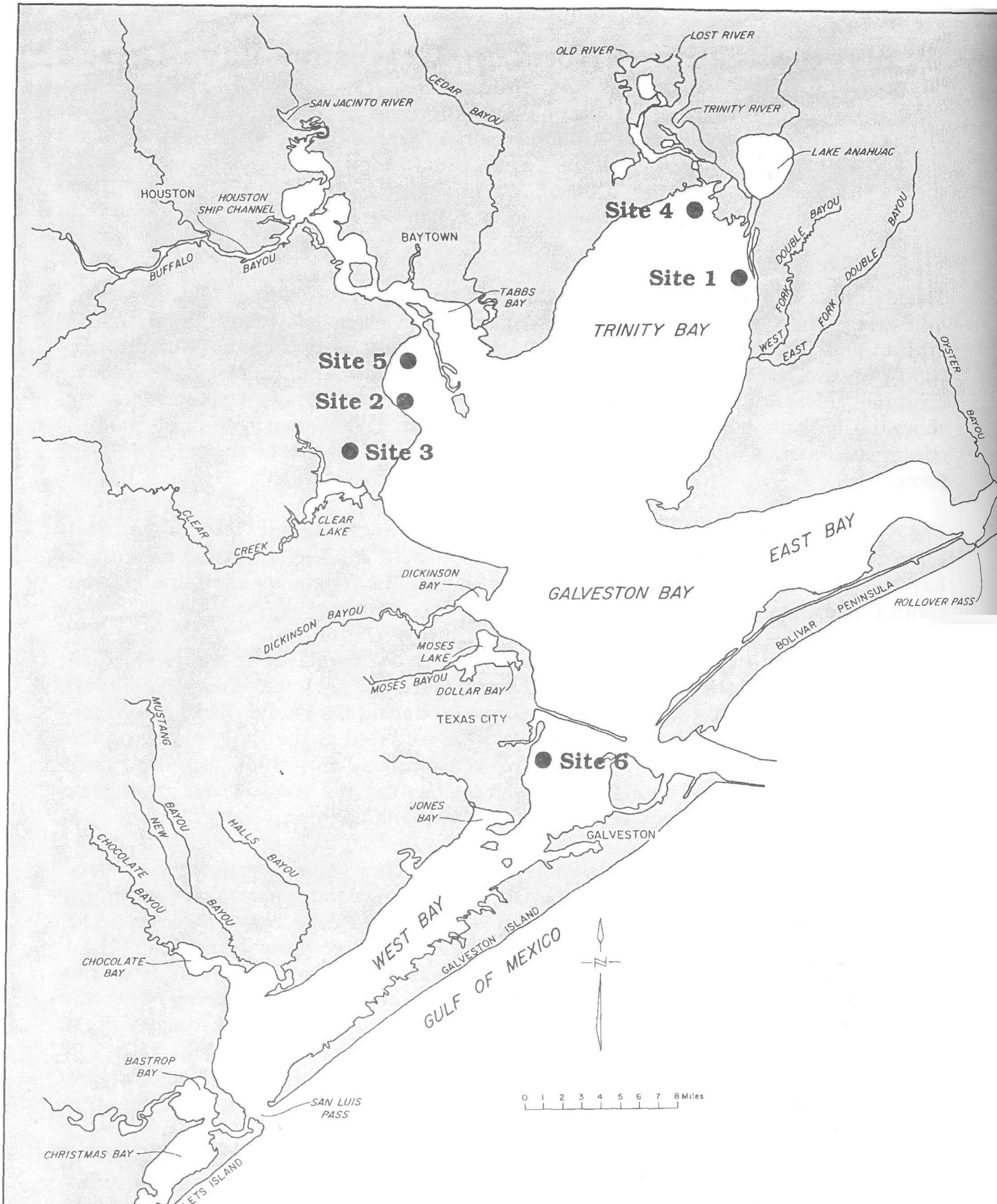

Figure 1. Wetland creation efforts in Galveston Bay

(White et al; 1985). Wetland surveys conducted in Galveston Bay between 1956 and 1979 indicate that approximately 25,000 acres or 16% of its coastal marshes have been lost (Paine and Morton, 1986).

Transplanting vegetation to re-create lost wildlife habitat and mitigate impacts of shoreline erosion has been used with success in Louisiana wetlands (Cutshall, 1985) and in Galveston Bay (Webb and Dodd, 1976).

Vegetative shoreline erosion control methods will not work in all cases along the Texas coast. Conditions where steep banks and/or deep water predominate are not conducive to vegetative treatment. However, where bay bottoms have a gradual slope, suitable soils, and proper salinity range, this vegetative method can be applied.

The objectives of this study are to:

1. Demonstrate to local landowners, organizations, and Federal agencies an alternative to traditional expensive shoreline erosion control measures through a vegetative transplant method using smooth cordgrass, which has been proven to effectively halt shoreline erosion;

2. Test vegetative shoreline erosion control measures under different shoreline and environmental conditions;

3. Document transplant survival at six sites in Galveston Bay; and

4. Document fisheries abundance and utilization by site.

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Beneficial Uses of Dredge Material in Galveston Bay

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Introduction

This paper briefly outlines a precedent-setting approach to one of the largest federal deep-draft navigation projects proposed in many recent years. It takes a demonstrated concept — beneficial uses of dredged material — to a different level than heretofore developed. The elements of this approach, taken individually, are not innovative; rather, it is simply in their combination.

Briefly described, there are seven distinct elements:

Interagency Cooperation — a commitment by the Federal and State resource agencies (and local project sponsor) to determine how dredged material can be beneficially utilized in Galveston Bay;

Purpose and Intent — ready agreement among the participants on a clear statement purpose to guide the group's efforts, coupled with a shared understanding of the intent underlying that purpose;

Scope — a willingness to consider beneficial uses of dredged material on a scale not previously contemplated, let alone implemented;

Public Involvement — implementation of a program to solicit beneficial use suggestions from various bay interests and user groups;

Evaluation Criteria — development of both a process and criteria by which to select beneficial uses and beneficial use sites that balances public desires, environmental concerns and engineering considerations;

Field Testing and Verification — development of a pre-construction program to field test and verify significant elements of the proposed beneficial uses plan and the development of on-going monitoring and management plans for the post-construction period; and

Local Sponsor Commitment — a willingness by the local sponsor to step forward and fund additional necessary pre-construction studies not provided for in the USACE budget and a commitment to bear the "extra" costs of a beneficial uses plan.

Background

Publication in 1987 of a Final Environmental Impact Statement (FEIS) regarding the proposed Houston Ship Channel (HSC) Widening and Deepening Project by the U.S. Army Corps of Engineers (USACE) failed to quell State and Federal resource agency concerns about a number of environmental issues. Protracted discussions over the next two years led to a significant agreement between those parties and with the concurrence of the Port of Houston Authority as local sponsor.

Congressional authorization would be deferred until 1994 while several major environmental issues were further examined.

The USACE would establish an Inter-agency Coordination Team (ICT) comprised of the Federal and State Resource Agencies to help develop the Scopes of Work and provide oversight of the studies deemed necessary for the re-evaluation of the project's impacts.

If authorized, the project would be constructed in two phases; a 45′ x 530′ first phase, and after review of actual first phase impacts, subsequent widening to 600′ and deepening to 50′, i.e., the full project as identified in the original EIS.

The HSC Project would be reviewed for consistency with the Galveston Bay National Estuary Program (GBNEP) to the extent that the Program's Comprehensive Conservation Management Plan (CCMP) had been developed at the time of issuance of the Supplemental Environmental Impact Statement (SEIS) for the HSC Project.

One of the prime concerns focused on the proposed dredge material disposal plan, which essentially called for confined upland disposal in the inland reaches of the channel and continuation of open bay unconfined disposal for the Galveston Bay reach. The willingness of the Port Authority to bear up to $37 million in additional costs for development of beneficial uses (of dredged material) further reinforced the ICT's ability to consider reducing or ameliorating adverse environmental impacts.

The Beneficial Uses Group (BUG)

The Beneficial Uses Group was created as a subcommittee of the ICT. The BUG's assigned task was to evaluate possible beneficial uses of dredged material and to incorporate them into a dredged material disposal plan for the HSC Project; the composition of the group is as follows:

- U.S. Army Corps of Engineers (USACE)
- U.S. Fish & Wildlife Service (USFWS),
- U.S. Environmental Protection Agency (EPA),
- National Marine Fisheries Service (NMFS)
- U.S. Soil Conservation Service (SCS),

- Texas Parks and Wildlife Department (TPWD),
- Texas General Land Office (GLO),
- Port of Houston Authority (PHA)
- Chair of the BUG

At the outset, an essential point was agreed upon: the participation in development of a beneficial use plan for dredged material by these participating agencies would not constitute an endorsement of the HSC project by those agencies individually or collectively. When developed, the BUG plan would be reviewed in the context of all the key environmental issues being addressed by the ICT.

Finally, the PHA, as local sponsor, is required by the Water Resources Development Act (WRDA) to provide and maintain disposal areas; in addition, the PHA has agreed to "pay for the difference in life-cycle cost between the recommended disposal plan and a locally preferred plan" (Department of the Army, 1990). Because of these responsibilities, the PHA engaged the services of experts in dredging and related fields to provide staff and assistance to the BUG.

Purpose

The formally adopted purpose of the BUG is stated as follows:

> "To develop a disposal plan that utilizes dredged material in an environmentally sound and economically acceptable manner that incorporates, to the extent possible, other public benefits into its design."

That statement of purpose arises from recognition of three basic principles by the BUG:

1. Dredged material is a potential valuable resource and should be considered and treated as such;

2. Development of an environmentally acceptable disposal plan is intrinsic to the eventual approval of this project, other environmental concerns not withstanding; and

3. Any disposal plan put forward by the BUG must have long-term environmental benefits for the Galveston Bay system.

Discussion

It is important to note that in this context, the BUG is an interagency group actually developing a "locally preferred" disposal plan, rather than reviewing a proposal in a regulatory setting. It is committed to the objective that the final plan will have a *net positive environmental effect* over the life of the project. This is especially significant in terms of scale — the plan addresses placement of up to 120 MCY of new work material and 190 MCY of maintenance material over the project life. Finally, the BUG actively solicited beneficial use suggestions from Bay interests and user groups — whose collective ideas have been given full consideration during the development of the recommended plan.

The presentation paper will go into more detail on the process as initially perceived and as it evolved. Particular emphasis will be given to the public involvement, evaluation criteria and field testing, and verification elements, including integration with other ICT studies currently underway as of this writing.

Conclusions

That this process is working (and evolving) cannot be questioned. However, the paper's conclusions will attempt to address the significant work effort that lies ahead as well as lessons learned and to be learned. However, it should be noted that some estuarine scientists are beginning to conclude that in estuaries where wetland loss rates are high and are not being replaced by natural marsh formation (such as in Galveston Bay), use of suitable dredge material to create marsh may be one of the few options available to try and offset those losses. That may well be the challenge in this project — how to address the continuing loss of bay wetlands within the context of acceptable trade-offs within the Galveston Bay system for the sake of that system.

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Potential Restoration for Submerged Aquatic Vegetation in Galveston Bay

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A decline of seagrass beds, or submerged aquatic vegetation (SAV), over the past few decades has recently been documented. Several studies have documented the losses from the mid-1950s to the late 1980s (Pulich and White, 1990; McFarlane, 1991; White and Paine, 1992). The Habitat Protection Task Force of the Galveston Bay National Estuary Program has as an objective to "Protect and restore submerged aquatic vegetation" (GBNEP, 1992). And a variety of groups are interested in enhancing/creating SAV habitat for a particular animal group of interest, such as, Ducks Unlimited for waterfowl and Gulf Coast Conservation Association for important recreational fisheries. This study explores the potential control factors, appropriate techniques/methodology, and cost effective opportunities for SAV restoration projects.

The causes of seagrass loss in Galveston Bay are still unknown. Historically, continuous beds flourished around the Trinity River Delta and along the west shoreline from Seabrook to San Leon (Renfro, 1959; Pullen, 1960). These beds consisted of widgeon grass (*Ruppia maritima*). The southern shoreline of West Bay had relatively long narrow beds of shoal grass (*Halodule wrightii*), with a mix of widgeon grass. A remnant of this habitat remains in the seagrass meadows of Christmas Bay, a secondary bay of west Galveston Bay. The distribution of these species is dependent on the environment, particularly salinity regimes. Shoal grass is limited to higher salinity waters, usually greater than 25 ppt. Widgeon grass can tolerate wide ranges of salinity and temperature. Declines in seagrass have been attributed to increased turbidity, subsidence, increased erosion through wave energy, pollution, nutrient fluctuations, human impacts, and bioturbations.

Light attenuation (i.e., light penetration) is presumably the major limiting factor to seagrasses in Galveston Bay. Increased turbidity and depth (via subsidence) are the principle factors in affecting light attenuation. A second important factor is low energy environments with limited erosional forces. Subsidence has removed natural wave barriers (berms) which created protected areas for seagrasses. Increased wave energy and erosional forces experienced in locales where seagrasses formerly existed have reduced the potential for re-establishment.

The specific requirements for these two species of seagrass differ primarily in their tolerance for salinity, which is reflected in their distribution. Both species establish beds primarily through vegetative propagation. However, widgeon grass is predominately dispersed by seed and often occurs sporadically in patches and ponds through seed germination. This aspect suggests that shoal grass is a better candidate species for restoration projects based on mechanisms of dispersal and establishment.

The success of a seagrass restoration project in Galveston Bay requires the control of environmental parameters that have contributed to their loss. Site selection for various SAV restoration projects should obviously include the species requirements of shallow depth (often exposed at extreme low tides), high salinity, low energy, and sand bottoms. Salinity is presumably the only factor that can not be controlled for the open bay margin of Galveston Bay. However, depth and energy and to some extent nutrients can be controlled or affected to allow the establishment of seagrasses. Depth/sediment may be managed through beneficial uses of dredged material from a variety of U.S. Army Corps of Engineers projects. Barriers can be constructed to reduce wave energy and turbidity. One such operation is the use of "Christmas tree fences" employed in Louisiana. Locating a project far from point source discharges, or proximal to sewage treatment effluents, as well as directly adding nutrients at planting can assist in the establishment of the bed. One other inconspicuous consideration is aesthetics; these projects would best serve the "public interest" in areas that will not later be developed (dredged, filled, or otherwise impacted) and have somewhat limited susceptibility from human impacts; yet, SAV projects should support living resources in nearby habitats of the bay (i.e., mud flats, oyster reefs, and salt marshes).

Methods of successful seagrass transplants have been demonstrated on the east coast (Fonseca, 1990), and south Texas (Cobb, 1987; Carangelo, 1988). These techniques coupled with wave energy reducing structures (berms or tree fences) could provide a successful restoration project in a variety of shallow bay margin areas of Galveston Bay. Estimated costs of seagrass transplanting range from 731 to 251 man-hours per acre depending on the method of transplant and assuming a 100 day-to-coverage factor (Fonseca et al., 1984; In press). Estimated costs of Christmas tree barrier construction with a great deal of volunteer effort ranged from $3.00 to $15.00 per linear foot (Diana Steller, Louisiana Department of Natural Resources, per. comm., 1992).

Financial support for restoration projects of SAV can come from a variety of sources. The Marine Fisheries Initiative Program (MARFIN) would benefit highly from such an activity; the Gulf of Mexico Fishery Council is increasing its emphasis on habitat related projects. Federal agencies have a variety of methods of acquiring funds for "demonstration" projects; this source, however, requires that agency to conduct the work. The Corps of Engineers is attempting to utilize dredged material in the most beneficial way. Many of the subsided areas could be enhanced with dredged material if it has the proper sediment qualities. Finally, as a cost reducing factor, volunteers who are devoted to the stewardship of Galveston Bay should be utilized to the fullest extent. Groups such as Galveston Bay Foundation, Galveston Bay Conservation and Preservation Association and others are strongly committed to increasing the health and productivity of the bay.

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Coal Combustion By-Products and Their Use in Oyster Reef Creation

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A recognized priority in the Galveston Bay system is the protection of important estuarine habitats. Oyster reefs comprise one of the most critical habitats in the bay system, and influence species diversity, shoreline stability, water quality, and sport and recreational fishing. Currently, there is a shortage of suitable substrate for the attachment of oyster spat in Galveston Bay. This problem is the result of a myriad of factors including subsidence, weather, removal of cultch during harvest, and historical hydraulic dredging practices.

The Texas Parks & Wildlife Department has historically made efforts to replace substrate by deploying natural shell in major oyster producing areas. However, shell can no longer be dredged from Texas coastal waters and supplies from nearby Louisiana are becoming extremely limited and costly. Due to the need for additional substrate and the lack of available natural shell, resource managers throughout the Gulf Coast have recognized the need for states to increase efforts to find affordable, alternative cultch materials (GSMFC, 1991).

A potential solution to this management problem may exist within industry. In May 1988 Houston Lighting & Power Company (HL&P), JTM Industries, and Texas A&M University at Galveston (TAMUG) initiated research to evaluate the potential use of coal combustion by-products (CCBP) as oyster reef substrate. Coal ash oyster reef programs have been investigated in the Chesapeake Bay area (Humphries, 1984) and in Delaware Bay (Price et al., 1987) and are currently being investigated in Mississippi (Herring, 1992). The primary objective of the HL&P program is to determine an environmentally sound and economically feasible mix of CCBP materials that can be used to enhance and construct oyster reefs along the Gulf Coast of the United States.

The two primary by-products involved in the study are fly ash and bottom ash, derived from the combustion of western coal at the W.A. Parish Generating Station in Thompson, Texas. The fly ash from W.A. Parish is Class C (per ASTM C618-89), with a grain size of less than 0.02 mm for 95-100% of the ash. Bottom ash grain size ranges from fine sand to coarse gravel. Bottom ash from the Limestone Generating Station near Jewett, Texas, was also evaluated as an alternative aggregate during these studies. Limestone bottom ash is derived from burning Texas lignite.

Mix Design & Strength Testing

To determine a CCBP mix design that would be both durable in the marine environment and suitable for oyster setting, nine various mixes were evaluated by HL&P and JTM. Four of the mixes met short-term strength requirements. Structures made of each mix design were taken to TAMUG for oyster spat setting tests, while additional test cylinders of the four mix designs were deployed in estuarine waters for long-term strength testing. TAMUG biologists determined that all mix designs were acceptable to oyster setting and growth, while long-term strength testing revealed average strengths for the mix designs to be 2800-3500 psi (Baker et al., 1991). There were no significant differences between spat sets on CCBP cultch materials and natural shell controls.

Environmental Suitability Testing

An EP Toxicity test was conducted on each of the four candidate mix designs to conservatively determine the leaching potential of the coal ash material. Initial results indicated that any of the four mix designs could be safely deployed in the estuarine environment. Toxicity Characteristic Leaching Procedure (TCLP) testing was also conducted on W.A. Parish fly ash and bottom ash. These tests also indicate that metals leaching would not be a factor in marine applications.

Bioaccumulation tests were conducted on oysters grown on the selected W.A. Parish mix design and control shell under three conditions — pre-spawn, post-spawn, and freshwater depuration. Results indicated that there was no significant difference between element concentrations in oysters grown on coal ash vs. control shell in 7 of 10 elements surveyed (Cr, Mn, Cu, Zn, As, Se, and Pb). There was a statistically significant increase in three element concentrations for coal ash grown oysters, Sn, Hg, and Ba. However, a statistical difference does not automatically infer a biological significance (Matis, 1992 unpublished report).

Bioaccumulation tests were also conducted on oysters grown on the W.A. Parish/Limestone mix design. Excessive rainfall runoff into the Galveston Bay system prohibited the extensive testing of oysters under various biological conditions. However, post-spawn condition oysters tested from Offatts Bayou indicated no significant differences for the 10 elements tested (Matis, 1992 unpublished report).

The general conclusion of bioaccumulation testing is that location, not substrate, is responsible for variations in metals uptake in oysters (Baker et al., 1991). A final series of bioaccumulation tests of oysters grown on CCBP substrate will be conducted in 1993.

In the fall of 1992, biomonitoring tests were conducted at Seacrest Laboratories in Houston, Texas, to further assess the potential toxicity of the CCBP materials. The first series of tests were conducted on *Mysidopsis bahia*. The materials proved to be non-toxic in these aquarium tests. Additional tests will be conducted in the spring of 1993 using oyster larvae (*Crassostrea virginica*).

Commercial Design & Fabrication

Intensive efforts were made to determine a cultch shape that would be cost effective, maximize oyster yields, and be compatible with sport and commercial harvest techniques. Several mass production techniques were examined and a pelletization process was selected as most desirable. Pelletization can mass produce an irregular shaped, rough textured sphere to meet stringent size criteria for oyster cultch. The rough texture enhances setting potential and the rounded shape increases the amount of interstitial spaces within the deployed reef. These spaces enhance nutrient flow through the reef and provide additional habitat for a diverse group of marine organisms.

Prototype Reef Development

Encouraging results from environmental suitability studies led to prototype reef development in the spring of 1990. JTM industries produced CCBP pellets to establish five small reefs, which were deployed in a wide range of habitat areas throughout Galveston Bay. Two years of intensive monitoring by TAMUG revealed that coal ash pellets provide an excellent substrate for oyster reef development.

Advanced Technology Project (ATP)

Prototype reef studies have been followed by a larger scale application of CCBP pellets. In the fall of 1991, TAMUG received an Advanced Technology Project (ATP) grant of $140,000 from the Texas Higher Education Coordinating Board. HL&P sponsored the project with a matching grant of approximately $50,000. The objectives of the ATP are to evaluate deployment and reef construction techniques utilizing coal ash pellets, assess natural marine community development on the pellets as well as any oyster head-starting success, and determine the extent of recreational fishing on the site.

In June of 1992, 1600 yds^3 of coal ash pellets and 400 yds^3 of natural shell were deployed on the northern tip of April Fool Reef by commercial oyster luggers. Approximately 27 yds^3 of CCBP pellets were exposed to oyster larvae in the TAMUG hatchery and transplanted on the test site. This experimental reef will be monitored for approximately two years.

Action Plan Demonstration Project

In the summer of 1992, an Action Plan Demonstration Project proposal to establish a five acre CCBP oyster reef in Galveston Bay was approved by the Galveston Bay National Estuary Program. The project is being funded by the U.S. Environmental Protection Agency, The Port of Houston Authority, and Houston Lighting & Power Company. The objective is to demonstrate the feasibility of mass producing, shipping, and deploying 12,100 yds^3 of coal ash pellets at a selected reef site in Galveston Bay. The reef will be monitored by TAMUG for two years to determine the extent of the site's marine community development.

Summary

The need for alternative cultch material is an ever increasing one. Mitigation efforts mandated by regulatory agencies to construct or enhance oyster reefs and increased enforcement actions will only increase the demand on a diminishing supply of natural shell and highlight the need for alternative materials.

Utilizing CCBP materials as oyster cultch is an outstanding opportunity to simultaneously benefit environmental, economic, and social interests along the Texas Coast. Recycling a by-product in an environmentally sound manner can fill the strategic needs for oyster cultch in a cost effective manner, while at the same time enhancing the marine ecosystem of Galveston Bay.

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