Chapter 4

Habitat Protection

Priority Problem

The Galveston Bay Estuary is composed of a variety of aquatic habitats ranging from open water areas to coastal wetlands. Maintaining varied and abundant high-quality habitat helps ensure the health and biological diversity of the entire estuarine system. Wetlands serve important hydrological, biological, and ecological functions in the bay ecosystem. Ensuring the protection of habitats in the Galveston Bay estuary has been designated as the most critical of all of the problems facing the bay.

Land cover change may be seen as an indicator of increases or decreases in water quality. Increases in developed land displacing wetland habitat, may result in land disturbance which increases erosion and sedimentation and by hydrologic alterations which increase runoff. Concomitant loss of the pollution mitigating properties of such wetland habitats impacts water quality as well. Landcover change is directly linked to habitat quantity and indirectly to habitat quality.

A trend of wetland decline has been identified within the estuary, threatening the sustainable productivity of the bay. This problem has been identified as the most critical of all problems currently facing the bay. Wetlands decline has been attributed to five major causes: 1) man-induced subsidence; 2) erosion; 3) direct conversion for agricultural, urban, industry, and transportation purposes; 4) dredge-and-fill activities; and 5) projects in which wetland areas are artificially isolated from the bay.

Management Goals and Objectives

Management goals are directed at reversing the decline of critical habitats and addressing high rates of erosion along bay shorelines. The stated goals of the Habitat Protection Action Plan are to:

- Expand areas and restore quality of wetland habitats,
- Halt the conversion of wetlands to other uses,
- Acquire existing wetlands and encourage conservation,
- Restore and create colonial nesting bird habitat, and
- Selectively moderate erosional impacts.

To achieve these goals the following specific objectives were adopted:

Objective 1	Create or restore 15,000 acres of vegetated wetlands within 10 years.
Action HP-1	Restore, create and protect wetlands.
Action HP-2	Promote beneficial uses of dredged material to restore and create wetlands.
Objective 2	Restore natural functions and values to 50% of degraded wetlands within 20 years.
Action HP-3	Inventory degraded wetlands and fund remedial measures.
Objective 3	Sustain no net loss of existing wetlands.
Action HP-4	Implement a coordinated, system-wide wetland regulatory strategy.
Objective 4	Place 50,000 acres of wetland habitat in public ownership within 20 years.
Action HP-5	Acquire and protect quality wetlands.
Objective 5	Develop economic incentives to encourage owners to protect wetlands from development.
Action HP-6	Develop economic and tax incentive programs to protect wetlands.
Objective 6	Improve and protect the habitat on 10 major colonial bird nesting sites within 5 years.
Action HP-7	Facilitate bird nesting on existing islands.
Objective 7	Create 2 additional bird nesting islands within 10 years.
Action HP-8	Build nesting islands using dredged materials.
Objective 8	Adopt a coordinated ecosystem approach to reduce erosional impacts to the bay.
Action HP-9	Reduce erosional impacts on wetlands and habitats.

Data Information Needs

The goal of Plan Objectives 1, 2, 3, 4, 6, 7, and 8 is to reverse the decline in the areal extent of wetlands, colonial nesting bird habitat, and other habitats of concern in the Bay. Information needed to assess these management objectives include:

- Identification of habitats of concern,
- Status and trends in areal extent and distribution of existing habitats of concern,
- Status and trends in areal extent and distribution of habitats created and restored by special projects, and
- Habitat change analysis information on a usable frequency.

The status of the areal extent and distribution of identified habitats of concern provides information needed to infer the ability of existing habitats to provide suitable habitat for bay biota, to moderate hydrological processes, to provide organic carbon to the estuarine food web, and to maintain water quality. Habitat data may also be used to evaluate the strength of the relationship between the areal extent of a habitat and the abundance of resident species. Trend information provides a means for evaluating whether progress is being made toward meeting Plan Objectives 1, 3, 5, 6, and 7.

Because it is not feasible to measure all environmental parameters, a set of primary indicator parameters were identified for the habitat component of the regional monitoring program. Primary habitats of concern in Galveston Bay have been identified by Task Force members (Table 4-1). The designation of indicator habitats does not mean that information on other habitats will not be collected, only that these have been selected as habitats of primary concern. These recommendations were made utilizing information from interviews with habitat experts from government agencies, academic institutions, and other local organizations.

The goal of Plan Objective 2 is to restore the quality of wetland habitats. Information needed to assess this management objective include:

- Identification of indicator parameters for habitat quality,
- Status and trends in the quality of existing habitats of concern, and
- Status and trends in the quality of degraded wetland habitats.

The status of habitat quality provides a means for assessing whether existing, restored, and created habitats are of adequate quality to support desired functions and values. These data may also be used to evaluate the strength of the relationship between habitat quality and the abundance of resident species. Trend data provides a means for evaluating whether progress is being made toward improving the quality of habitats throughout the estuary.

A primary purpose of Plan Objectives 1 through 8 is to ensure that there will be habitats of adequate quantity and quality to maintain and enhance Bay species. Many marine finfish and shellfish depend on these habitats during all or part of their life history. Continued loss of these wetland habitats may lead to the collapse of coastal ecosystems and their associated fisheries. Change (increases or decreases in areal extent, movement, consolidation or fragmentation, or qualitative change) in

TABLE 4-1. CANDIDATE INDICATORS AND MEASUREMENTS FOR HABITAT PROTECTION

Indicator Habitats	Measurement
Marsh	
•All marsh types	Areal extent and distribution % emergent vegetation % open water dominated by aquatic vegetation Marsh edge and interspersion Water duration Open water depth Salinity Aquatic organism access
•Brackish marsh	Change in relative sea level - subsidence/erosion
•Salt marsh	Percent *Spartina alterniflora*
Submerged vegetation	Areal extent and distribution
•Sea grasses	Biomass Vegetation spp. composition PAR Salinity
Oyster reefs	Areal extent and distribution
Colonial waterbird nesting habitat	Number of colonies and distribution # nesting pairs Abundance of predators (e.g., raccoons) Elevation above sea level Accessible feeding habitat Connectivity to mainland Indications of human disturbance

submerged and wetland habitat may be a sensitive integrator of overall water quality and potential for change in fisheries productivity. The task of identifying animal species that depend on wetlands for their existence was given to the Species Population Protection Task Force. Information on the status and trends in abundance and distribution of species whose existence depends on identified habitats of concern (see Chapter 5: Species Population Protection) is required to assess habitats are having the desired effect on animal populations they support. Habitat change data may be compared to species abundance trend data to evaluate the strength of the relationship between the areal extent and quality of a habitat to abundance of resident species.

Monitoring activities must provide information to evaluate whether progress toward these management objectives is being made. The habitat protection component of

the regional monitoring program must provide data to assist in:

- Determining whether severe alterations to important habitats are occurring,
- Identifying potential causes of alterations in habitats and the species they support,
- Evaluating alternative actions to mitigate identified adverse impacts to habitats and the species they support.

The following monitoring objectives have been used to design the regional monitoring program for Galveston Bay:

- Determine trends in the areal extent and distribution of selected habitats of concern,
- Determine the extent of habitat continuity and fragmentation,
- Determine trends in the abundance and distribution of species whose existence depends on wetland habitats,
- Provide quantitative estimates of habitat quality for prioritizing critical habitats and assessing success of plan actions.

Programmatic Monitoring

Administrative monitoring for habitat gains and losses will provide data necessary to directly or indirectly assess attainment of Habitat Objectives 1, 2, 4, 5, 6, and 8. Programmatic data information needs to address each of the objectives individually include:

- Acres of vegetated wetlands created or restored,
- Records of acres of wetlands transferred to public ownership,
- Data indicating level of impact of economic and tax incentive programs,
- Documentation of beneficial use of alternative materials.

Accounting for acres of vegetated wetlands will draw information from numerous sources including the environmental monitoring element for habitat. Various projects are being conducted in the bay area to create or restore vegetated wetlands. The Galveston Bay Program will monitor these efforts annually to compile records of wetland gains or losses. The COE permit records will be a source of information concerning wetland losses through the Section 404 permitting process and records on wetland mitigation efforts. Other key sources of information will be the NMFS, UFWS, TPWD, EPA, GLO and The Galveston Bay Foundation.

Acquisition of wetlands for public ownership and management may be accomplished through state, federal and private programs. All of these means will be pursued and records of conversion to public ownership will be maintained.

The Plan recommends implementation of a "Wetlands Exemption" among other tax and development disincentive programs. Once implemented, records of requests and approvals for such exemptions and general data on wetland conversions will provide information to assess this action.

Programs supporting the beneficial use of dredge materials for habitat creation or restoration will be monitored. Programs will include the use of thin layer deposition of dredge material on subsiding marshes and use of dredge material to create bird nesting islands. Records of such activities will be maintained and used to evaluate the effectiveness of Objectives 1, 3, and 8.

An integrated bay-wide erosion management program will be developed as part of Objective 9. Information on subsidence, a contributing factor in wetland habitat losses through inundation and erosion, will be collected and made available by the Harris-Galveston Coastal Subsidence District. A bay-wide system for ranking erosional areas will be developed by the GLO and SCS. Other activities that relate to this Objective are items from Objectives 2 and 3 concerning beneficial uses of dredge materials.

Environmental Monitoring

Environmental monitoring of habitat distribution and condition in and around the Galveston Bay estuary will provide data necessary to directly or indirectly assess the cumulative effects of almost all habitat objectives. This discussion is divided into two sections: Areal Extent, Distribution, and Classification discusses methods to monitor changes in the amount and distribution of habitats; and habitat function and value describes a method to be used to evaluate the relative condition of key indicator habitats based on their suitability for serving various ecological functions and values assigned to them.

Areal Extent, Distribution, and Classification

The methods used to classify Galveston Bay habitats and monitor their areal extent and distribution must be capable of differentiating various wetland types and quantifying their extent with an acceptable level of accuracy. To ensure comparability, the classification system used should be shown to be comparable with previously conducted evaluations. Because changes in habitats are pervasive and can be rapid the program must be capable of frequent and cost-effective classifications

Two existing monitoring programs were identified as potentially meeting the requirements of this program: the USFWS National Wetlands Inventory (NWI) and the NOAA Coast Watch Change Analysis Program (C-CAP). The NWI database on the extent and characterization of wetlands in the U.S. is based primarily on aerial photography. This method of assessment is time consuming, labor intensive and as a result expensive. C-CAP is a nationally standardized database on land cover and

habitat change in the coastal regions of the U.S. with a goal of better understanding the linkages between coastal and submerged aquatic habitats and abundance and health of living resources. (Dobson, et al., 1993) C-CAP utilizes standardized computerized approaches to classify and monitor coastal habitats from satellite thematic mapper (TM) multi-spectral imagery.

The Monitoring Work Group selected the C-CAP protocol as the one which best met the requirements of assessing plan objectives. The primary advantages of landcover mapping with satellite imagery using C-CAP protocol are: 1) it has standardized mapping classifications consistent with other major wetland classification systems, 2) extensive coverage can be obtained within a single satellite scene, 3) because it utilizes computerized classification schemes, classification and mapping can be accomplished over a relatively short period of time, in a cost effective way and 4) the classified landcover information is in a format readily integrated into GIS technology.

Major products available for Texas coastal areas are: 1) wetland landcover inventories for all Texas coastal wetlands, 2) change analyses information produced for each bay system at 3-5 year intervals, 3) input and integration of the landcover data and landcover change data with other natural resources data bases (e. g. coastal fisheries data, 404 permit data, hydrologic modeling, oil spill trajectory model, etc.) for the development of a comprehensive coastal GIS data base. (Personal correspondence, James Hinson, TPWD).

The TPWD program utilizes a supervised maximum-likelihood classifier to achieve land cover classifications. The land cover classification scheme used for Texas coastal zone habitat mapping by the TPWD includes land-cover types listed in Table 4-2 (Pulich, et al., 1992). A complete listing of landcover types and additional land-cover information is given in Appendix B (Klemas, et al., 1993). Numerous sources of ancillary data are also used to improve classification accuracy. For example, submerged aquatic vegetation cannot be classified from satellite imagery; aerial photography and other ancillary data is used to provide SAV classifications.

Hinson et al. (1994) conducted an evaluation of the accuracy of wetland and landcover classification using TM imagery. Ground-truthing techniques demonstrated that accuracy exceeding 85%, compared to the NWI classification, could be achieved for 10 major wetland landcover classes. It is recommended that ground-truthing be conducted as a Quality Assurance/ Quality Control measure to assure that this level of accuracy is maintained.

Habitat Function and Value

Functions, particularly when referring to wetland habitats, are the ecological benefits that a habitat provides. Wetland functions include fish and wildlife habitat, nursery habitat, and food web support among others. Habitat values are a measure of the human benefits provided by a habitat. Wetland values include flood

TABLE 4-2. LAND COVER CLASSIFICATION SCHEME USED FOR COASTAL ZONE HABITAT MAPPING AND ANALYSIS.*

LEVEL 0	LEVEL 1	LEVEL 2	ATTRIBUTES
WETLANDS	Marine		
	Estuarine	Aquatic Bed	Submerged Veg.
		Low Salt Marsh	S. alterniflora zone
		Brackish Marsh	Herbaceous
		Brackish Shrub	Woody zone
		Mud Flats	Tidal zone
		Open Water	0.5-30.0 ppt
	Palustrine	Fresh Marsh	Emergent Veg.
		Open Water	< 0.5 ppt
	Riverine	Emergent Veg.	Riparian
UPLANDS	Grasslands	Coastal Prairie	Native Pasture
	Woody Veg.	Shrub/scrub	Tallow, Willow, Cane, Brush land
		Forested	Oak, Hardwoods
	Agricultural	Cultivated	Croplands
	Developed	Industrial	Buildings
		Residential	Buildings
	Exposed Land	Beach, Sandflats	Natural Ground
		Roads, Levees	Disturbed

* From Pulich et al., 1992.

control, groundwater recharge, and recreational opportunities. A degraded habitat is defined as one which no longer performs one or more of its function or value roles. Using this definition we can then attempt to make measures of habitat quality in terms of ability to perform these roles. Quantifying wetland habitat quality allows managers to monitor trends in habitat quality that cannot be measured by extent and distribution. There is no widely accepted method for monitoring habitat quality in the Galveston Bay system.

A number of standardized techniques have been used for assessing habitat quality including Wetland Evaluation Technique (WET), Habitat Evaluation Procedure (HEP), and the Wetland Value Assessment Methodology (WVA). Each of these

methods has strengths and weaknesses. The method proposed by the Monitoring Work Group is the Wetland Value Assessment Methodology. This method was selected because it was designed to be rapid, easily applied, and utilizes existing or readily obtainable data for its assessments.

WVA (USFWS, 1991a) is a quantitative habitat-based assessment methodology which can be used to quantify changes in wetland quality and quantity. Developed as a ranking method by the USFWS Lafayette, LA office, WVA is a modification of the HEP also developed by the USFWS. WVA differs from the HEP in that HEP uses a species-oriented approach, whereas the WVA utilizes a community approach. WVA works under the premise that optimal conditions for a wetland can be characterized and that an index of wetland quality can be developed by evaluation of a wetland against that optimal condition. This is accomplished by development of suitability index graphs for each of the defined variables. A suitability index is a graphical representation of how the overall quality or suitability of a given wetland type is predicted to change as values of the given variable change (USFWS, 1991a).

This method uses seven variables for assessment of three marsh types and cypress-tupelo swamp. These marsh types are Fresh/intermediate, brackish marsh, and saline marsh. Suitability index graphs are available for the following variables:

- Percent of wetland covered by persistent emergent vegetation (≥ 10% canopy cover,
- Percent of open water area dominated (> 50% canopy cover) by aquatic vegetation,
- Marsh edge and interspersion,
- Water duration in relation to marsh surface,
- Open water depth in relation to marsh surface,
- Mean high salinity during the growing season,
- Aquatic organism access.

It must be cautioned that WVA was developed specifically for use in Louisiana coastal wetlands including fresh marsh and intermediate marsh, brackish marsh, and saline marsh. Although Galveston Bay wetland habitats may be similar to those found in Louisiana, field testing and possible revisions will be required before the WVA methodology can be widely applied to Galveston Bay wetlands. The USFWS will take the lead in evaluation and development of a suitable habitat quality assessment tool. Additional decisions on monitoring frequency and site selection procedures will also need to be developed.

Colonial Waterbird Habitat

Assessment of colonial water bird habitat is a controversial issue and there is a wide range of opinions on the value of conducting any such assessments. The Texas Colonial Waterbird Census (TCWC) monitors colonial waterbird nesting sites in the Galveston Bay estuary. This program does not include evaluation of

habitat extent or condition so information from the project as currently conducted cannot directly address the Habitat issue. However, the ultimate measure of habitat protection programs is measured in abundance and distribution of colonial bird species. The TCWC program provides nesting site utilization data which can be used to address Actions HP-7 and 8.

The Monitoring Work Group does not recommend conducting any type of habitat assessments requiring presence on the islands during nesting. The Work Group believes that disturbances from any such effort would cause greater harm to these colonies than any value that would be derived from such evaluations. Some evaluations of habitat that can be made from remote locations during bird counts may provide information on general habitat quality have been recommended. A list of candidate indicators and measures is given in Table 4-1. The Monitoring Work Group recomends that the Galveston Bay Program work with the USFWS to consider the value of conducting habitat evaluations for colonial bird nesting sites and to develop a methodology for assessments if deemed feasible and valuable.