Salt Marsh Restoration

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What is a salt marsh?

- Shallow areas flooded by ocean tides on a regular basis
- Found on margins of sounds and estuaries
- Plant communities adapted to highly stressful environment
- Areas lack trees and shrubs

Why are salt marshes valuable?

- Serve as nursery and spawning ground for 2/3 of commercial fish populations
- Highest production per acre of any ecosystem on earth
- Improve water quality
- Minimize shoreline erosion

How are they impacted?

- Dredging→excavation of channels raises sea level, drowning vegetation
- Filling→substrate smothered by sediment to support various construction efforts
- Dikes→interruption of flow, alters sedimentation and salt concentration patterns (increase pollution)

Process of Restoration

- Site selection is key!!
- proper assessment=success
- Most sites lack critical ingredient (tidal flows, sediment supply, blockage)
- Assess degree of alteration
- Restoration preferable to creation

Planning considerations

- Hydrology→determines plant zonation, tidal flux important for community
- Elevation→small changes affect zonation, important for species introduction
- Slope→1-3% maximizes intertidal area, and dissipates wave energy
- Tidal regime→ amplitude and frequency determine intertidal area

Continued..

- Drainage channels→improve tidal exchange and expand fish habitat
- Wave climate→determination of fetch important for plant establishment
- Soil characteristics→salinity, composition improve planting success
- Sediment source→intermediate amounts of sedimentation

Site preparation

- May only involve restoration of one major function (tidal flux, drainage, etc.)
- Grading maybe necessary to create optimal slope
- Implementation of drainage canals will allow proper flux and control salinity

Soil Preparation

- Sandy soils and normally low in nutrients and normally need enhanced tidal flooding
- Clay and silt are easier to manipulate
- Fertilization of site after planting is often helpful
- Installation of breakwaters in areas of appropriate fetch (<1mile)

Plant Propagation

- *Spartina alterniflora* should be harvested as close to maturity as possible (mid-Oct. in N.C.)
- Threshed and stored in estuarine water until spring
- Seeding carried out in early spring through summer

Table 6. Brackish and Salt Marsh Species Zonation

Plant Species	Salinity Range (ppt)[1]	Brackish or Salt Marsh	High or Low Marsh	Propagation Difficulty Level[2]	~ Soil pH[3]
Spartina alterniflora smooth cordgrass	0-35	Both	low	easy	7.3
Spartina patens saltmeadow cordgrass	0-35	Both	high	easy	7.0
Spartina cynosuroides big cordgrass	0-10	Brackish	high	easy	5.0-7.6
Juncus roemerianus black needlerush	0-35	Brackish	high	moderately difficult	6.6
Distichlis spicata saltgrass	0-50	Both	high	moderately difficult	6.6-7.6

[1] Environmental Concern (1993)
[2] Woodhouse (1979)
[3] Beal (1977)

Different Methods

- Seeding→ 100 per meter after tilling of seed bed (upper intertidal zone)
- Transplanting springs→viable over a wider range of conditions
- Greenhouse grown→ done in areas where live examples may not exist

Success

- Complete covering by seeding method possible in one growing season
- 2 growing seasons necessary with sprigs
- 3 growing seasons necessary with plugs (greenhouse variety)
- *Phragmites* die off due to salt water innundation

Do restored systems work?

- Constructed marshes quickly produce equal amounts of plant biomass
- Organic matter levels slower to elevate (20 years to equal natural systems)
- C:N ratios key to achieving success, decline with increase in infaunal activity and biomass decomposition

By the numbers…

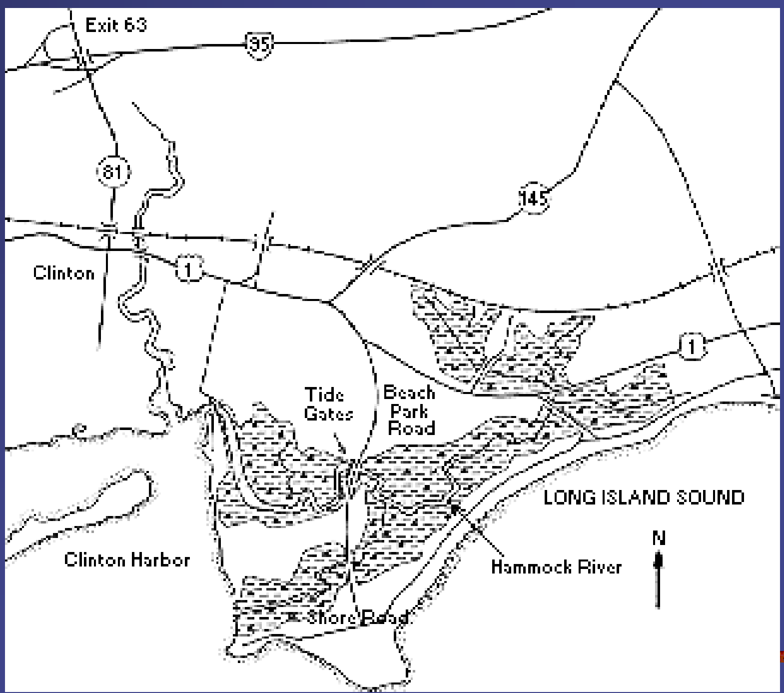
Attribute	**Created Marsh**				**Natural Marsh**	
		New	5yr			
Standing Biomass(g/m2)		150	1000			500
Belowground (g/m2)		50	2400			2000
Infauna Density(#/m2)		17500	20000			50000
Fishes(#/m)		0	2.1			2.33
Organic Matter(%)		NA	0.6			45
soil C:N ratio		25	23			18
Ammonia N (kmol/ha)		NA	1.76			3.17
N fixation(g/m2/yr)		NA	12			6
Denitrification(g/m2/yr)		NA	0.1			1

United States

■ EAST COAST:	% or Acres of SALT MARSHES LOST
■ Long Island Sound	30% Conn.;
■ North Carolina	not determined
■ GULF OF MEXICO:	
■ Galveston Bay	30,000 acres of marsh
■ Tampa Bay	44% of Bay's salt marsh habitat

Case Study – Long Island Sound

- Conn. EPA - Hammock River, Clinton Restoration



Continued

- Tidal marsh drained early part of this century for salt marsh haying and mosquito control
- During the summer, tide gates closed to drain surface water from the marsh, eliminating the breeding habitat for the salt marsh mosquito.
- Without daily tidal flow marshes sediments accumulated in ditches, trapping rainwater, an ideal freshwater mosquito habitat.
- Existing high marsh plant communities replaced by Phragmites

Restoration

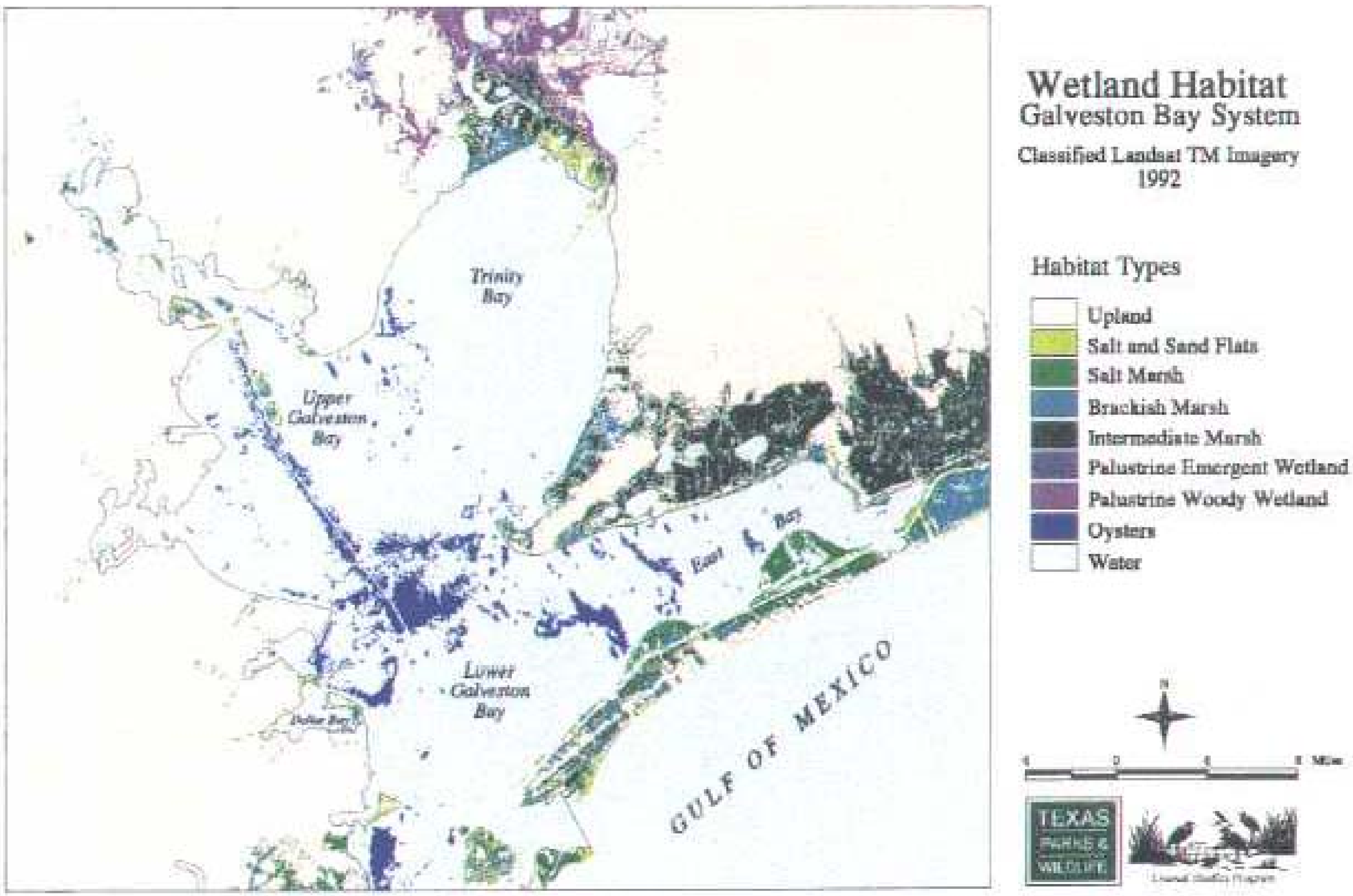
In Spring 1985, a tide gate was opened.

By Fall 1985, height of Phragmites reduced by 30 centimeters (1 ft.)

Continued

- By the fifth/sixth year, Phragmites stopped growing
- Salt marsh grasses were colonizing exposed peat
- Phragmites easily suppressed or removed by restoration of tidal flow, intolerant of salinity levels 18ppt.

Figure 5


Trinity Bay
Upper Galveston Bay
Lower Galveston Bay
East Bay
GULF OF MEXICO
Wetland Habitat
Galveston Bay System
Classified Landsat TM Imagery
1992
Habitat Types
Upland
Salt and Sand Flats
Salt Marsh
Brackish Marsh
Intermediate Marsh
Palustrine Emergent Wetland
Palustrine Woody Wetland
Oysters
Water
TEXAS PARKS & WILDLIFE

Case Study – Galveston Bay, TX

- Galveston Bay Foundation – Pierce Marsh Restoration
  - 1999 project used innovative berming to restore 62 acres if inter-tidal and sub-tidal wetland in Basford Lake, once entirely salt marsh has been lost to subsidence.
    - Subsidence is the ground sinking due to loss of groundwater or oil or gas extraction; result of human pressures.
    - Erosion is usually associated w/subsidence.
  - Berms or levees were created using mud from the Lake bottom, then planted w/ *Spartina alterniflora* to create salt marsh habitat

Galveston Bay - construction

- Constructed 153 terraces using equipment with a backhoe to achieve a shallow slope of 3:1, providing a suitable planting substrate for *Spartina alterniflora*.

Galveston Bay- seedling source

- The source for most seedlings is the Foundations nursery, a partnership with the local electric utility company

Galveston Bay- terracing/rock groin

- An open end checkerboard pattern of terraces used to maximize marsh/water interface, minimize fetch distances and maximize the ingress and egress of marine fishery species.

Case study – Long Beach, NC

- North Carolina Coastal Federation – Private Property Owner
  - Grade site
  - Geotextile fabric
  - Granite riprap sill at waters edge (in this case they wanted to add 20 ft. of *Spartina*)
  - Plant seedlings obtained from private nursery
  - Combination of stone structure and vegetated marsh fringe effectively reduces effects of shoreline erosion

Case Study – Schlickter, MD

- Breakwater located 60 to 75 feet from shore, notice higher and wider than sill
- Fill graded out to breakwater to prepare for planting
  - Note curve between breakwaters to keep shore from eroding
- Plant *Spartina* obtained from nursery

Conclusion

- Connecticut EPA
  - 20 years, 1500 acres of salt marsh planted

Restoration Rules of Thumb

- Re-establishment of regular tidal flushing with saltwater (over 18 ppt) initiates the replacement of Phragmites by salt marsh plants and this conversion normally occurs over a five to ten year period.
- Re-establishment of salt marsh plants proceeds spontaneously if a nearby salt marsh is present to supply a seed source. In most cases, expensive planting or transplanting programs are not necessary.

Continued

- Restoration of tidal flows to their pre-disturbance volumes is not always desirable, especially in the case of subsided wetlands.
- Restoration will reduce or eliminate mosquito breeding in subsided marshes
- Restoration re-establishes scenic vistas

Sources

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- www.savebay.com
- www.bea.nmfs.gov
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