NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM

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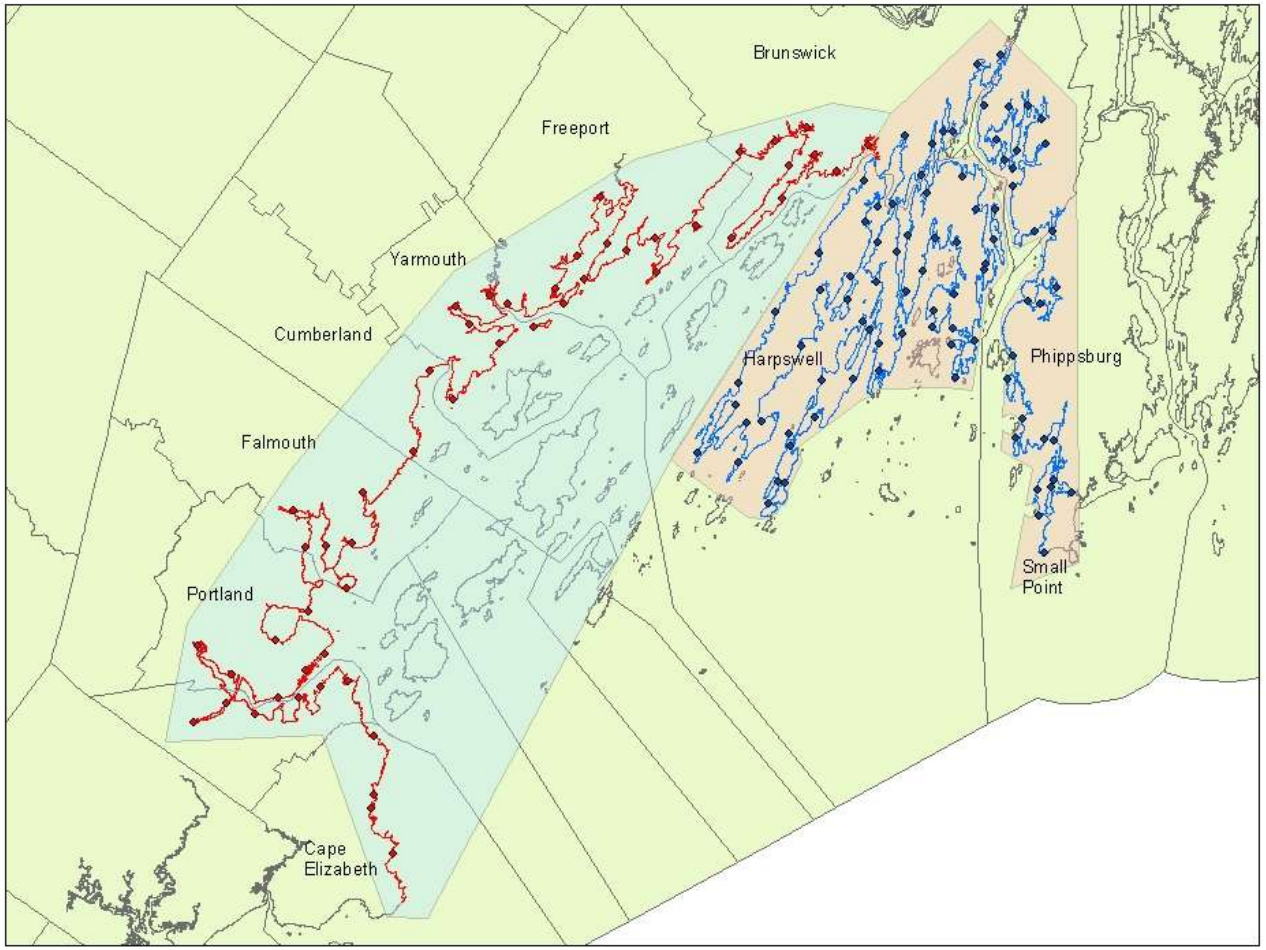
WELLS NATIONAL ESTUARINE RESEARCH RESERVE

RESTORING RESILIENCE TO CASCO BAY'S SHORES

National Estuarine Research Reserve System


Brunswick
Freeport
Yarmouth
Cumberland
Harpswell
Phippsburg
Falmouth
Small Point
Portland
Cape Elizabeth

Why Restore Coastal Habitats?

- Resilience
  - the ability to recover from disturbance
- Healthy coastal habitats have the greatest resilience
- Restoring salt marshes will improve coastal resilience

Climate Change

- Both Chronic and Acute Disturbance
  - Coastal Storms: increased frequency and intensity
  - Rainfall: extreme precipitation events
  - Temperature:
  - Relative Sea Level: 2 – 3 mm per year

Why Restore Salt Marshes?

- Physical Resistance to Storm Surge
- Filtration of Freshwater Runoff
- Filtration of Sediments from Fresh or Marine
- Maintains Elevation at Mean Sea Level
- Unique Habitat for Many Plants and Animals
- Source of Energy for Coastal Food Webs
  - Nekton Trophic Relay

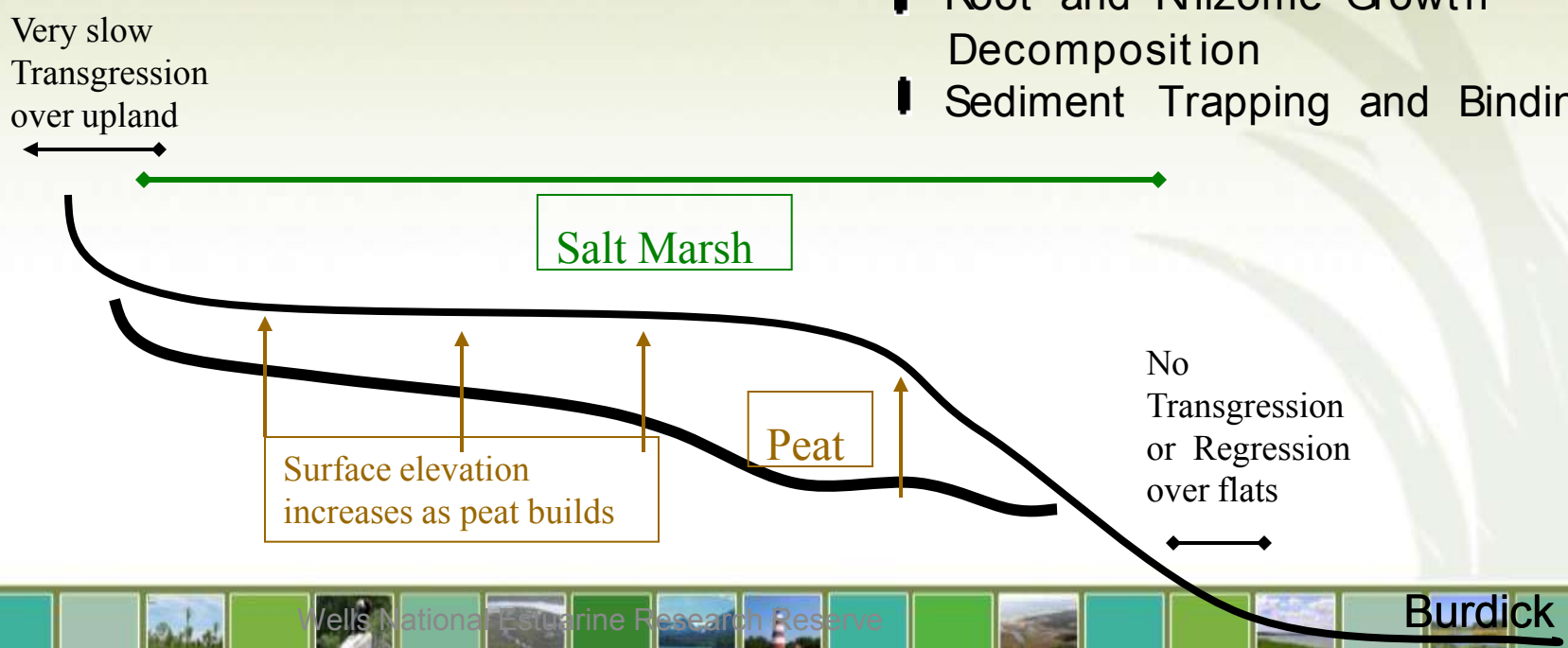
Healthy Marshes Track Sea Level

Conceptual model of marsh sediment interactions
Marsh persistence during periods of sea level rise

Conditions for elevation changes

Physical
- Sea Level Rise (0-5 mm/yr)
- Wave and Ice Exposure
- Sediment Supply
- Compaction

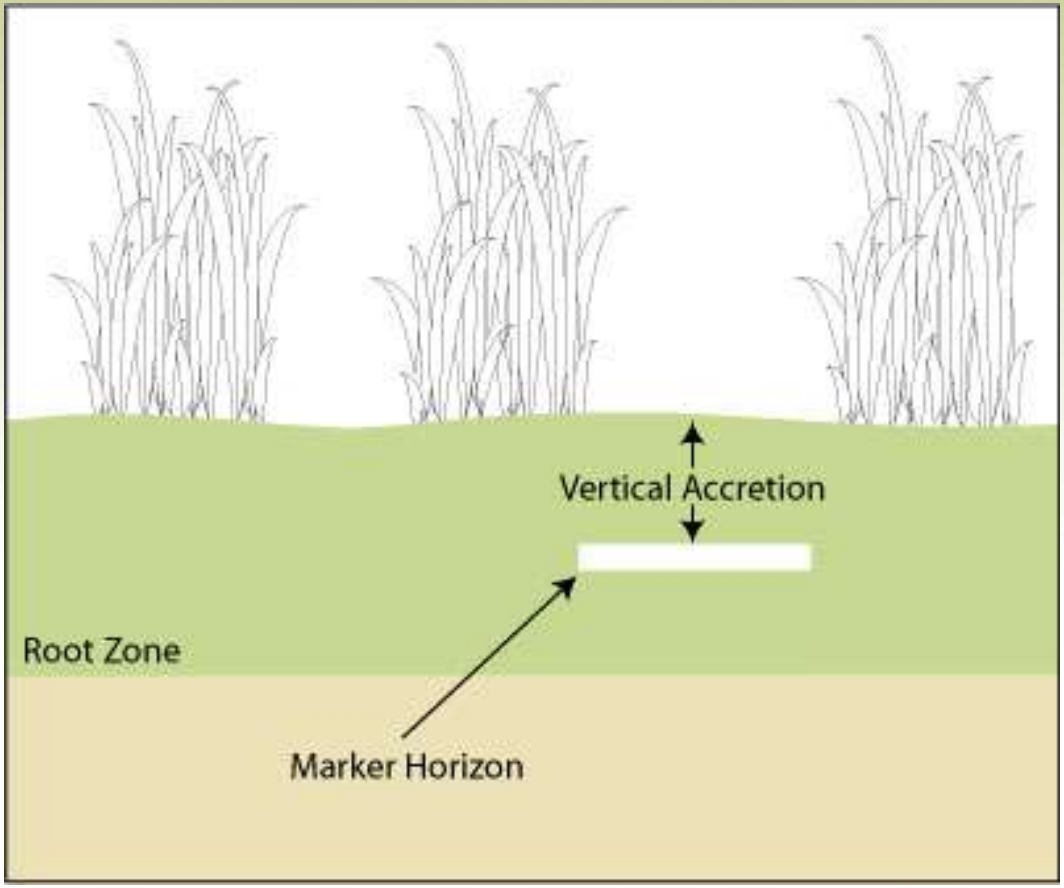
Biological
- Root and Rhizome Growth
- Decomposition
- Sediment Trapping and Binding



Burdick 2004

Marker Horizon

Donald R. Cahoon, Ph.D and James Lynch



Marsh Response to Chronic Disturbance - Erosion

More Erosion


Nutrients

Homes - Buffer Loss - Nutrients - Docks: an increasingly popular combination

Phragmites Rules ?

If we help it get started …….

Phrag Loves Lawns

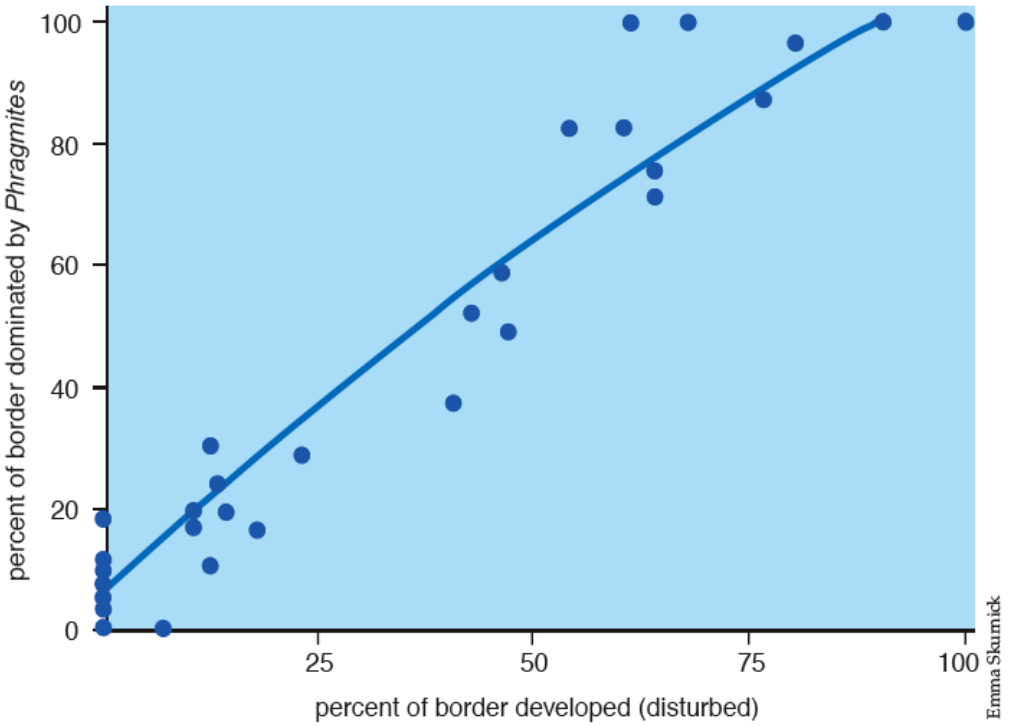
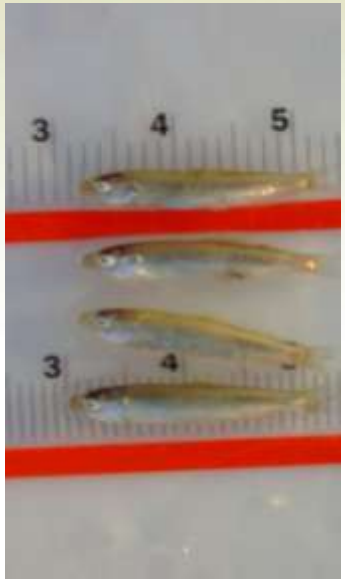


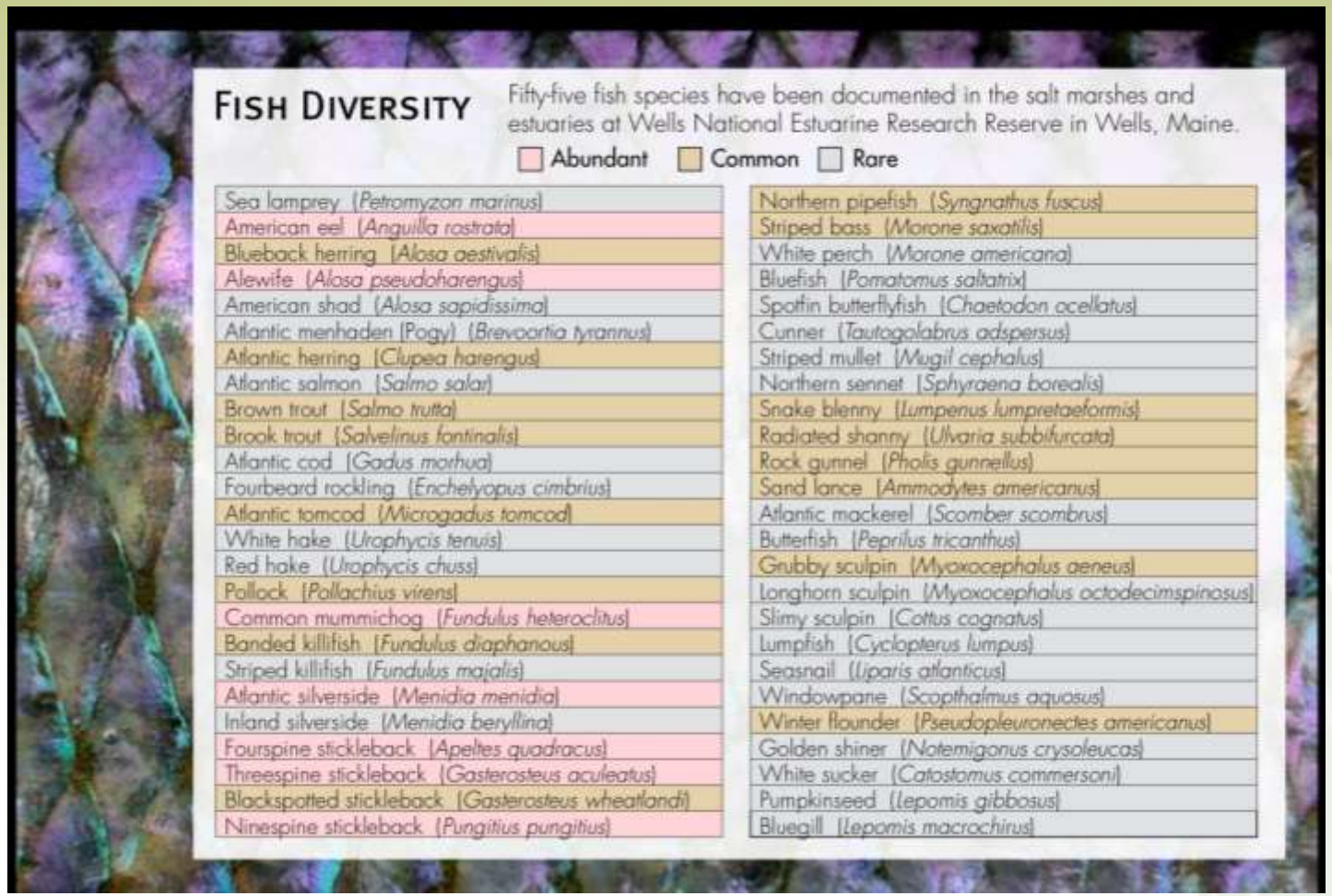
Figure 4. *Phragmites*, a reed, dominates some New England salt marshes. For thousands of years, *Phragmites* made up a small portion of the plants living along the terrestrial edge of New England salt marshes. When developers removed the woody vegetation along the terrestrial edges of marshes, more nitrogen-rich freshwater was allowed in. As a result, the soil's salinity dropped and nitrogen increased. Then, *Phragmites* started growing toward the saltwater. As shown here, a strong correlation exists between the percentage of a shoreline that is developed *(horizontal axis)* and the percentage of the marsh that gets dominated by *Phragmites (vertical axis)*. Today, this reed dominates many salt marshes from Maine to the Chesapeake Bay.

Finding Fishes on the Marsh

Residents, Transients, Migrants



Wells NERR Fishes – 50 Species
GOM Estuaries – 55 Species

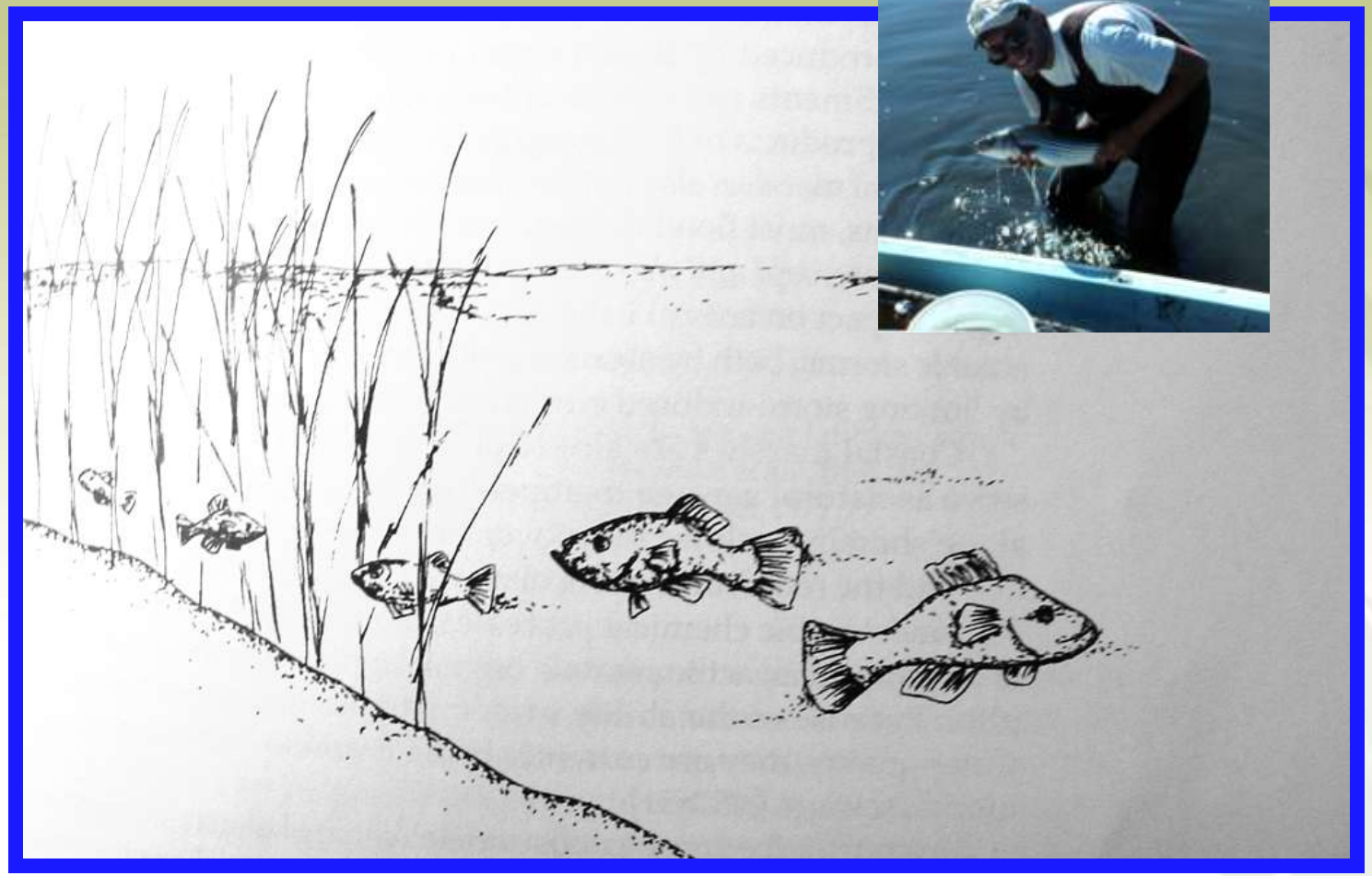


Nekton Trophic Relay

- Small fish stay in shallow water and eat smaller things
- Bigger fish stay in deep water and eat larger things, such as juvenile fish.
- The biggest fish live in deeper water and eat even larger things, such as adult fish.

Large Predators as Energy Exporters

NEKTON TROPHIC RELAY MODEL (Kneib)



Nekton Trophic Relay – Kneib 1997

1

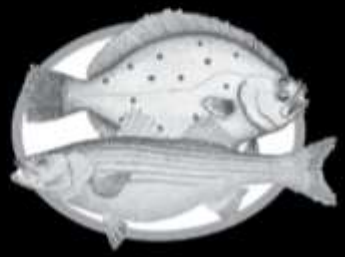
On the marsh surface, dead plant matter is colonized by bacteria, fungi, and protozoans, making a rich food called detritus.

2

Small invertebrates living in the marsh consume detritus and other invertebrates. These may include crabs, amphipods, shrimp, and worms.

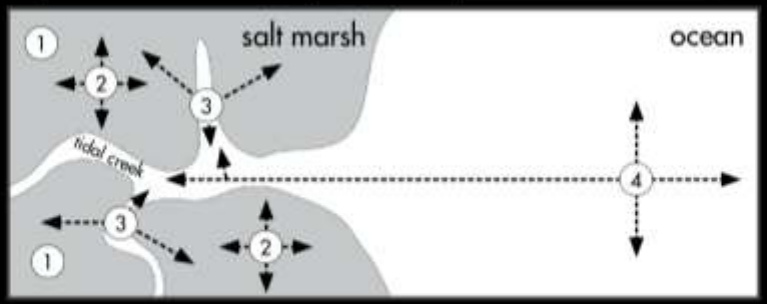
3

At high tide, mummichogs, silversides, and other small fish swim from the creeks onto the flooded marsh to feed on detritus and invertebrates.



4

Fished species such as striped bass and winter flounder eat small fish and invertebrates in the marsh and then leave the marsh, bringing nutrients to offshore food webs.



8

Ways to Restore and Maintain Salt Marsh Habitat

- Restore/Maintain Natural Tidal Hydrology
- Restore/Maintain Natural Shorelands
- Restore/Maintain Natural Sediment Sources
- Provide for Habitat Migration

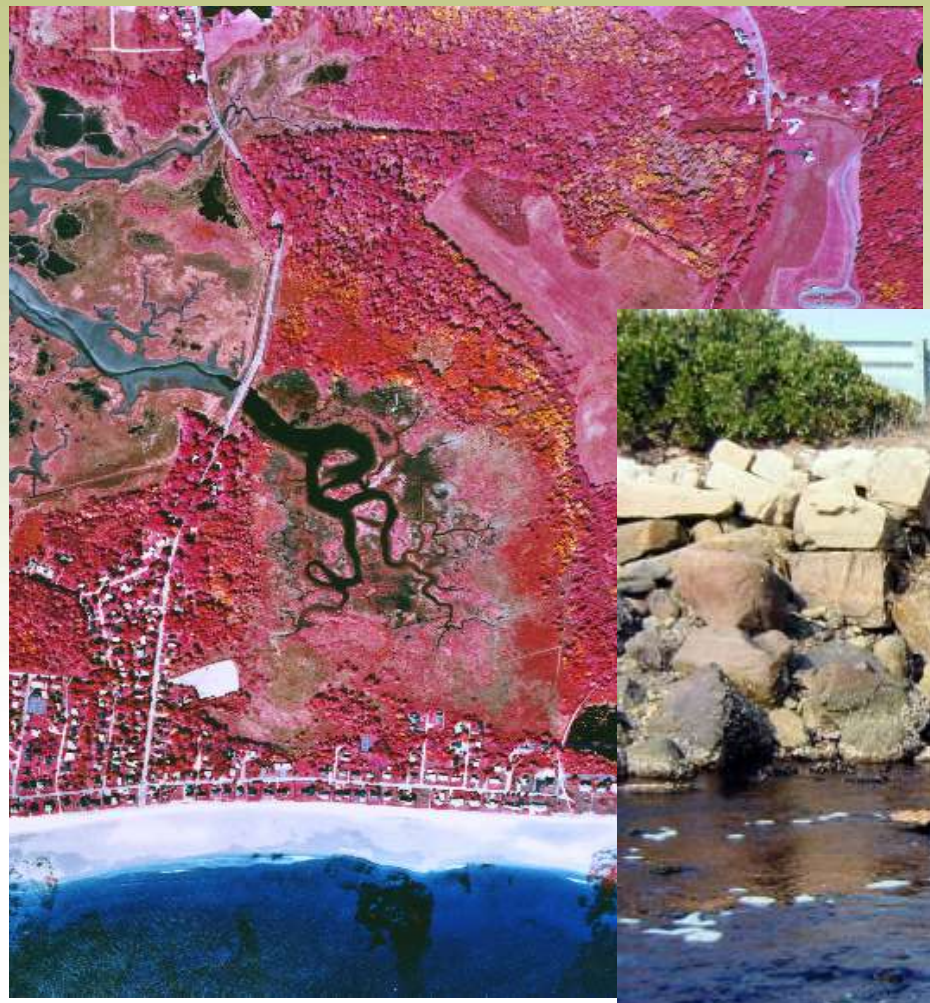
Restoration Goal

- Produce self-sustaining ecosystem that closely resembles natural system in structure, function and values

Restoring Marshes in the Gulf of Maine

- Hydrology – seems to be on the right track
- Small scale alterations – not clear
- Improvements in adjacent land use – need to be implemented

Tidal Restriction

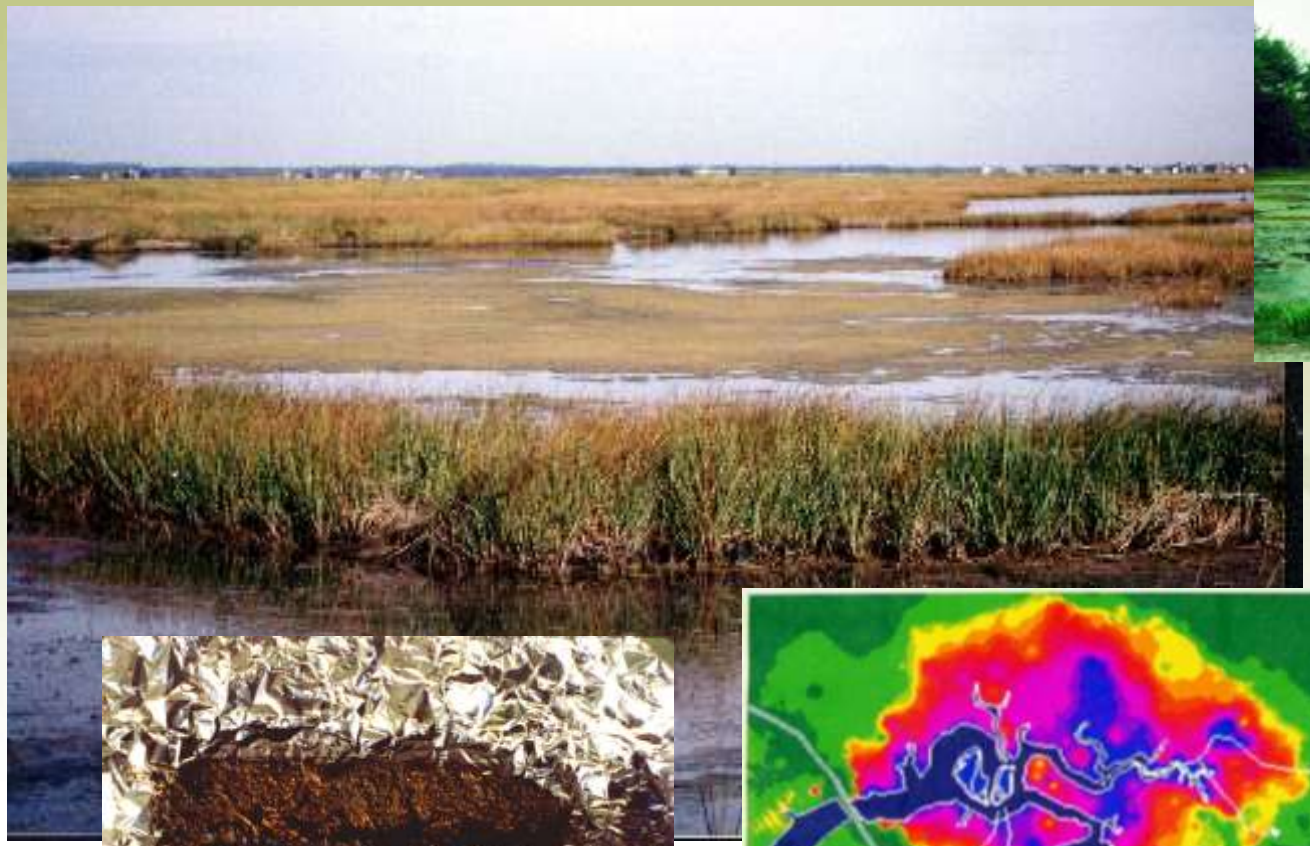


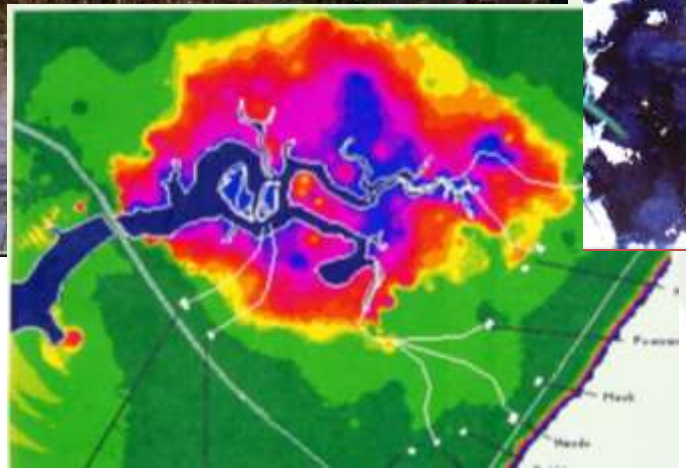
When Tides are Lost

Marshes are transformed

Thousands of Acres of Lost Salt Marsh Production

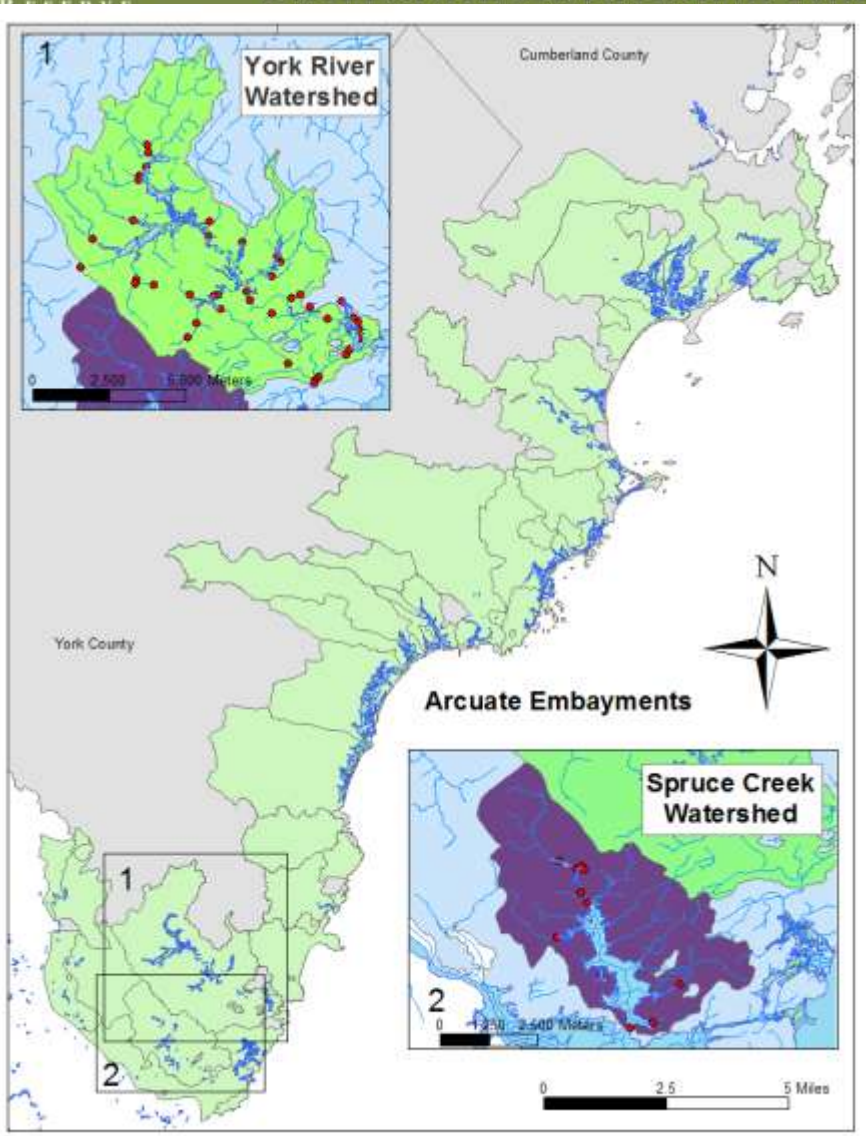
SUBSIDENCE





Spruce Creek Pre-Restoration

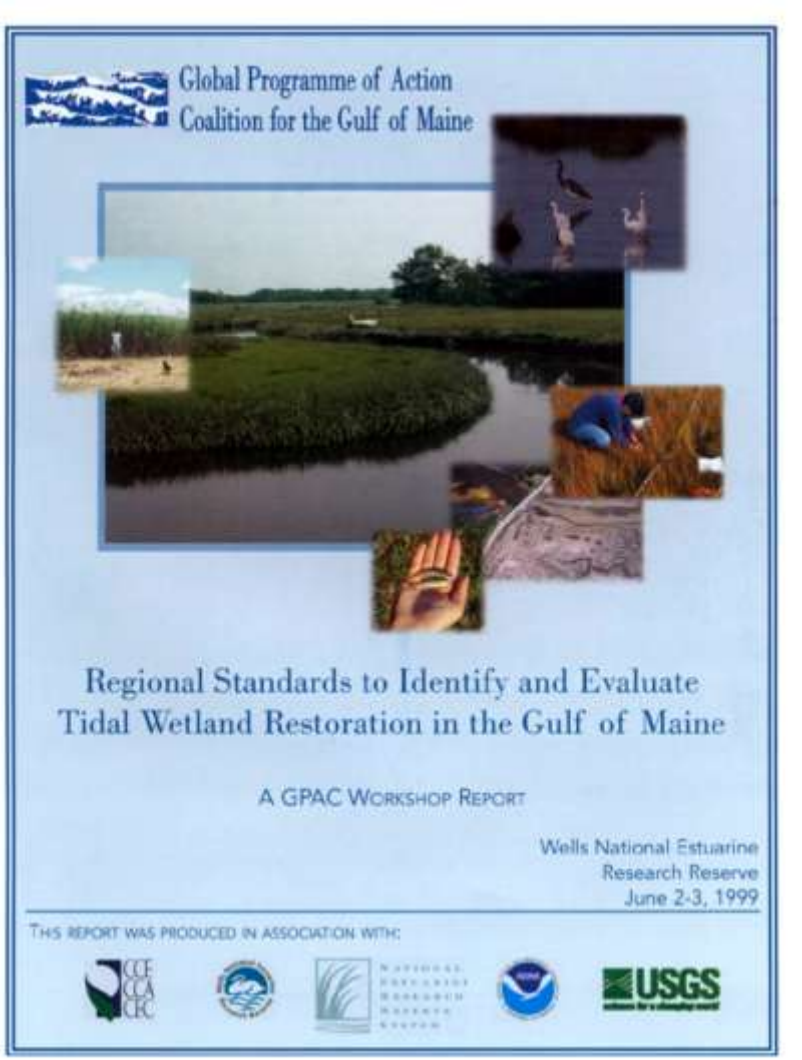
Spruce Creek Post Restoration (Year 4)



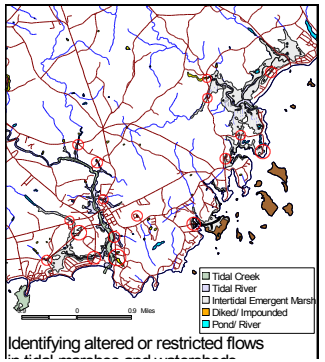
Nearly 30% of York County tidal marsh area is compromised by tidal restriction

How is the Patient Doing?

- Recovering Salt Marshes need Check-Ups
- Recovery requires improvement in ecological state over time - to expected level
- Recovery is measured by comparison to appropriate “healthy” examples called reference systems
- Recovery cannot be assumed – it must be evaluated
- Recovery often requires additional intervention


Global Programme of Action
Coalition for the Gulf of Maine
Regional Standards to Identify and Evaluate
Tidal Wetland Restoration in the Gulf of Maine
A GPAC Workshop Report
Wells National Estuarine
Research Reserve
June 2-3, 1999
This report was produced in association with:
USGS

GPAC Core Variables



Base Map

Location, Key Features, Wetland Types, Stations

Soils/Sediments

Porewater Salinity

Nekton

Composition, Density, Species Richness, Length, Biomass

Hydrology

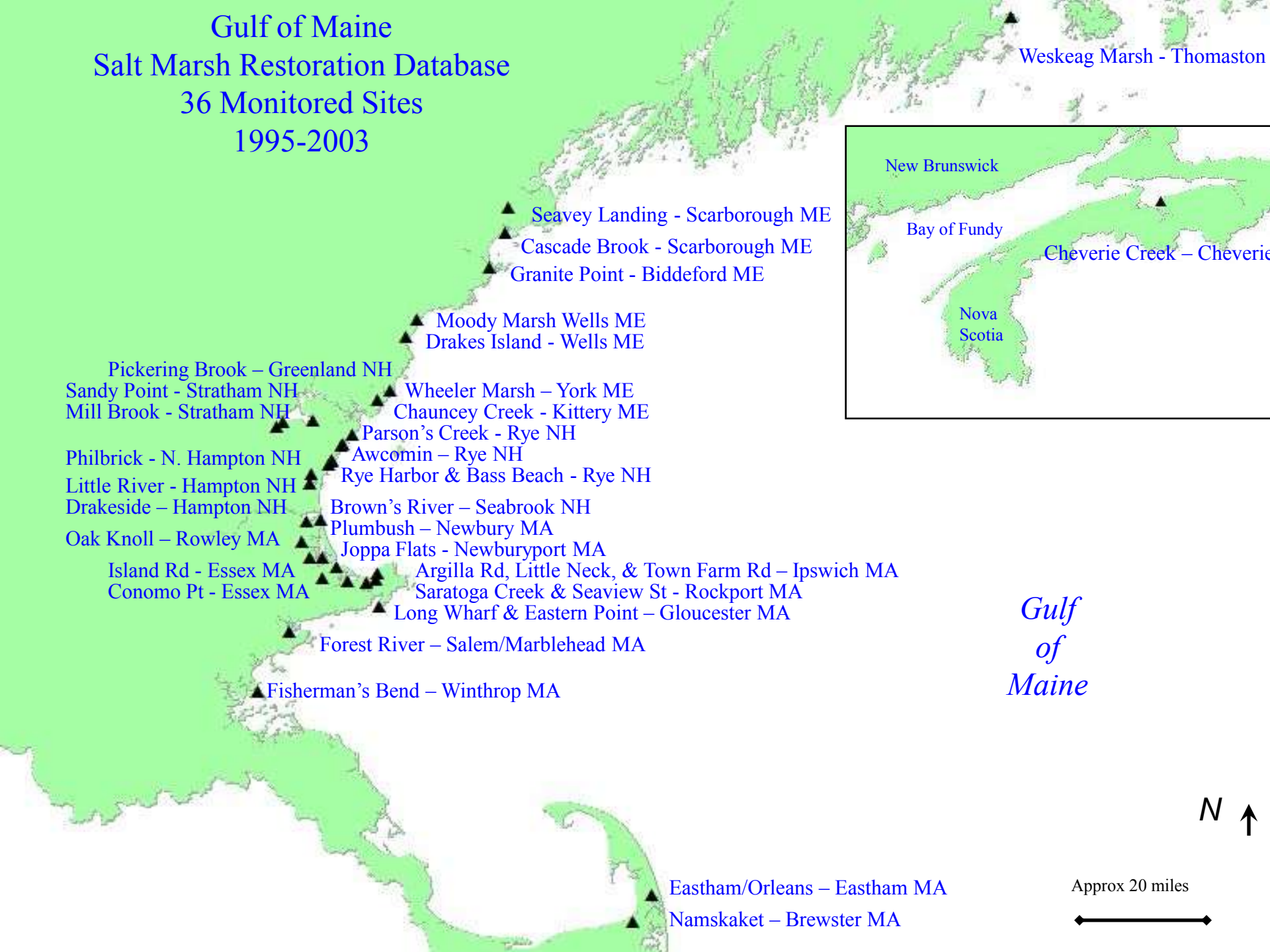
Tidal Signal, Marsh Surface Elevation

Vegetation

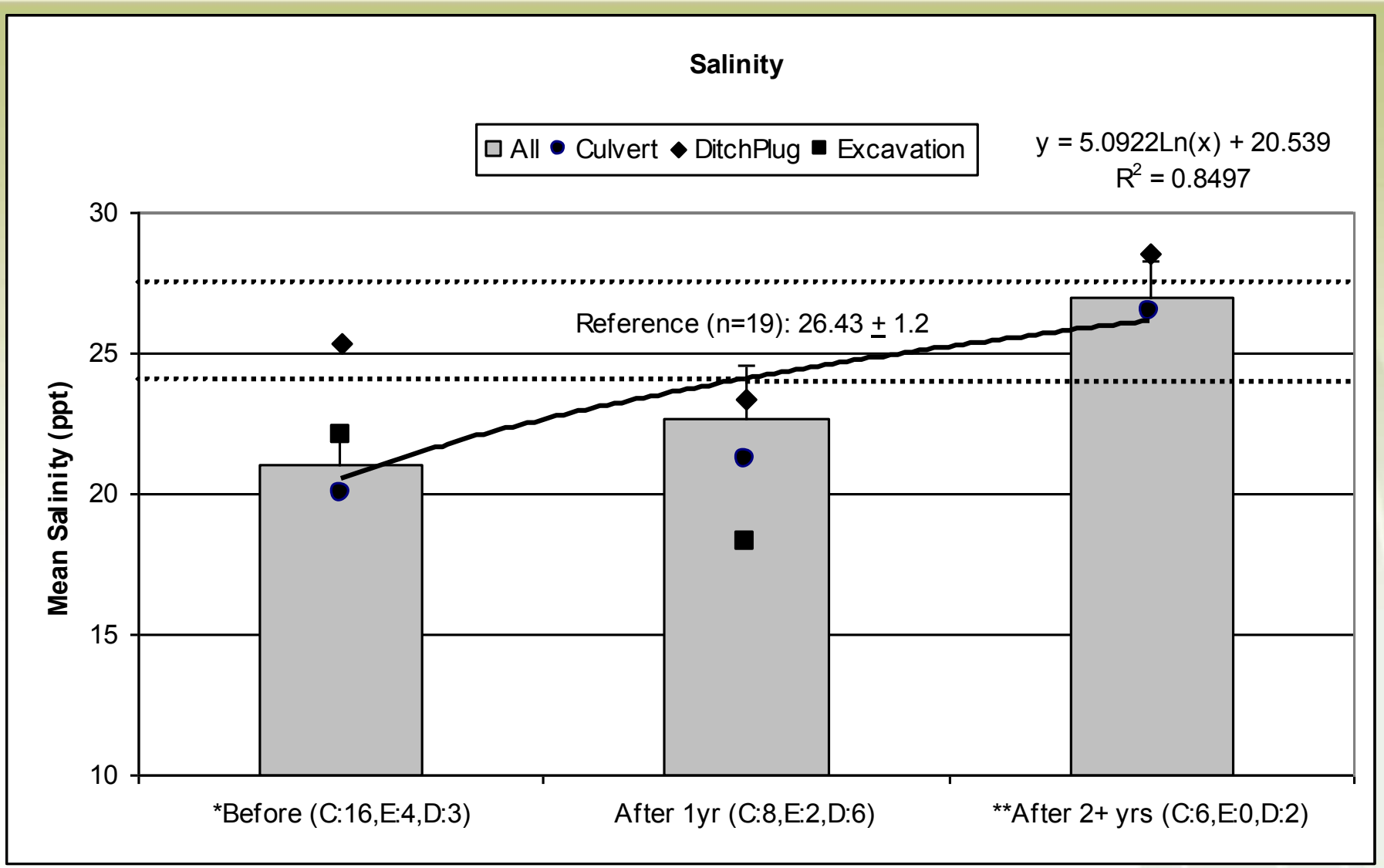
Composition, Abundance, Height, Density, Photos

Birds

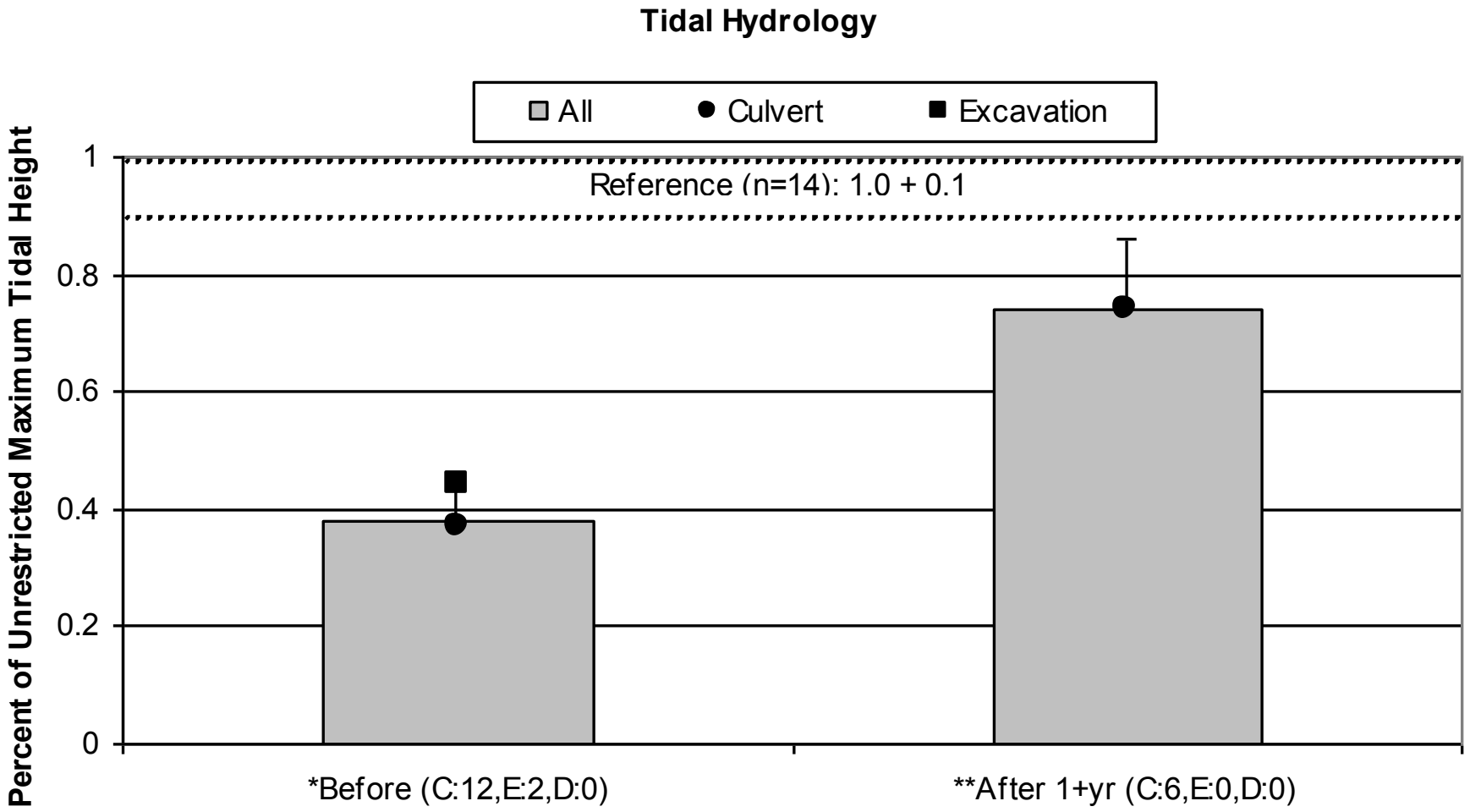
Density, Species Richness, Feeding and Breeding Behavior


Gulf of Maine
Salt Marsh Restoration Database
36 Monitored Sites
1995-2003
Weskeag Marsh - Thomaston
New Brunswick
Bay of Fundy
Cheverie Creek – Cheverie
Nova Scotia
Seavey Landing - Scarborough ME
Cascade Brook - Scarborough ME
Granite Point - Biddeford ME
Moody Marsh Wells ME
Drakes Island - Wells ME
Pickering Brook – Greenland NH
Sandy Point - Stratham NH
Mill Brook - Stratham NH
Wheeler Marsh – York ME
Chauncey Creek - Kittery ME
Parson's Creek - Rye NH
Awcomin – Rye NH
Philbrick - N. Hampton NH
Rye Harbor & Bass Beach - Rye NH
Little River - Hampton NH
Drakeside – Hampton NH
Brown's River – Seabrook NH
Plumbush – Newbury MA
Oak Knoll – Rowley MA
Joppa Flats - Newburyport MA
Island Rd - Essex MA
Argilla Rd, Little Neck, & Town Farm Rd – Ipswich MA
Conomo Pt - Essex MA
Saratoga Creek & Seaview St - Rockport MA
Long Wharf & Eastern Point – Gloucester MA
Forest River – Salem/Marblehead MA
Fisherman's Bend – Winthrop MA
Gulf of Maine
Eastham/Orleans – Eastham MA
Namskaket – Brewster MA
N
Approx 20 miles

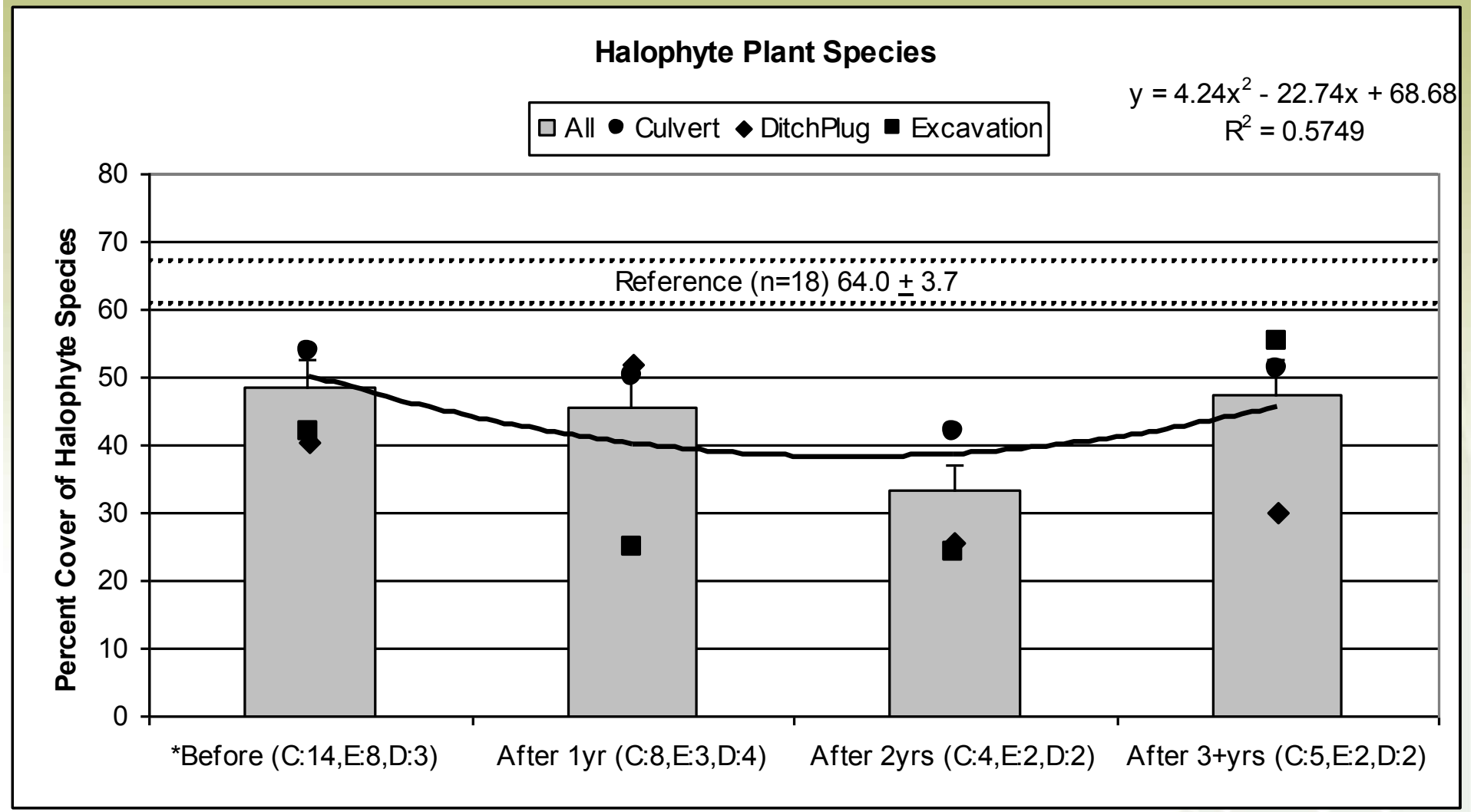
Functional Results: Soil Salinity



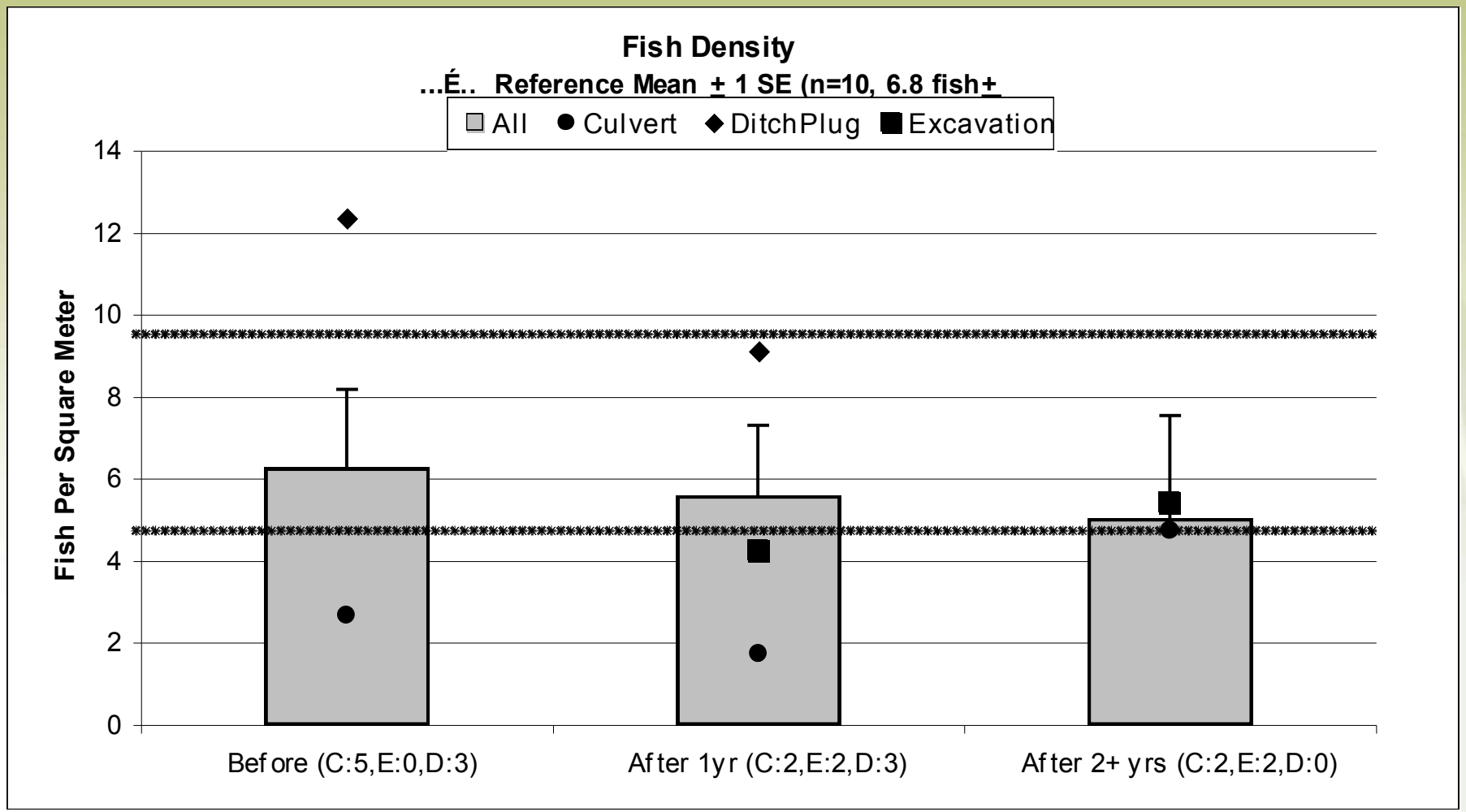
Functional Results: Tidal Hydrology



Functional Results: Vegetation (Halophyte)



Functional Results: Fish



Assessment Conclusions

I.	Sites selected for restoration activities are degraded relative to reference marshes for many ecological indicators.	
II.	Regional restoration practices are successful at restoring functions of degraded marshes.	physical
III.	Recovery of biologic functions is inconclusive, although communities trended toward reference states.	plant
IV.	Response of biologic functions may be more variable and physical responses, continue monitoring.	take longer than
V.	Differences in regional use of the protocol detract from assessment capabilities.	regional
VI.	Progress toward increased regional acceptance would be protocol refinements.	facilitated by

Drakes Island Marsh

- 125 acre wetland partially restored in 1991
- Additional restoration action in 2005
  - Self Regulating Tide Gate (SRT)
- Manage tide gate for “natural” hydrology
  - Use % time under water as a measureable indicator
  - Requires accurate elevation surveys
  - Requires water level/elevation monitoring

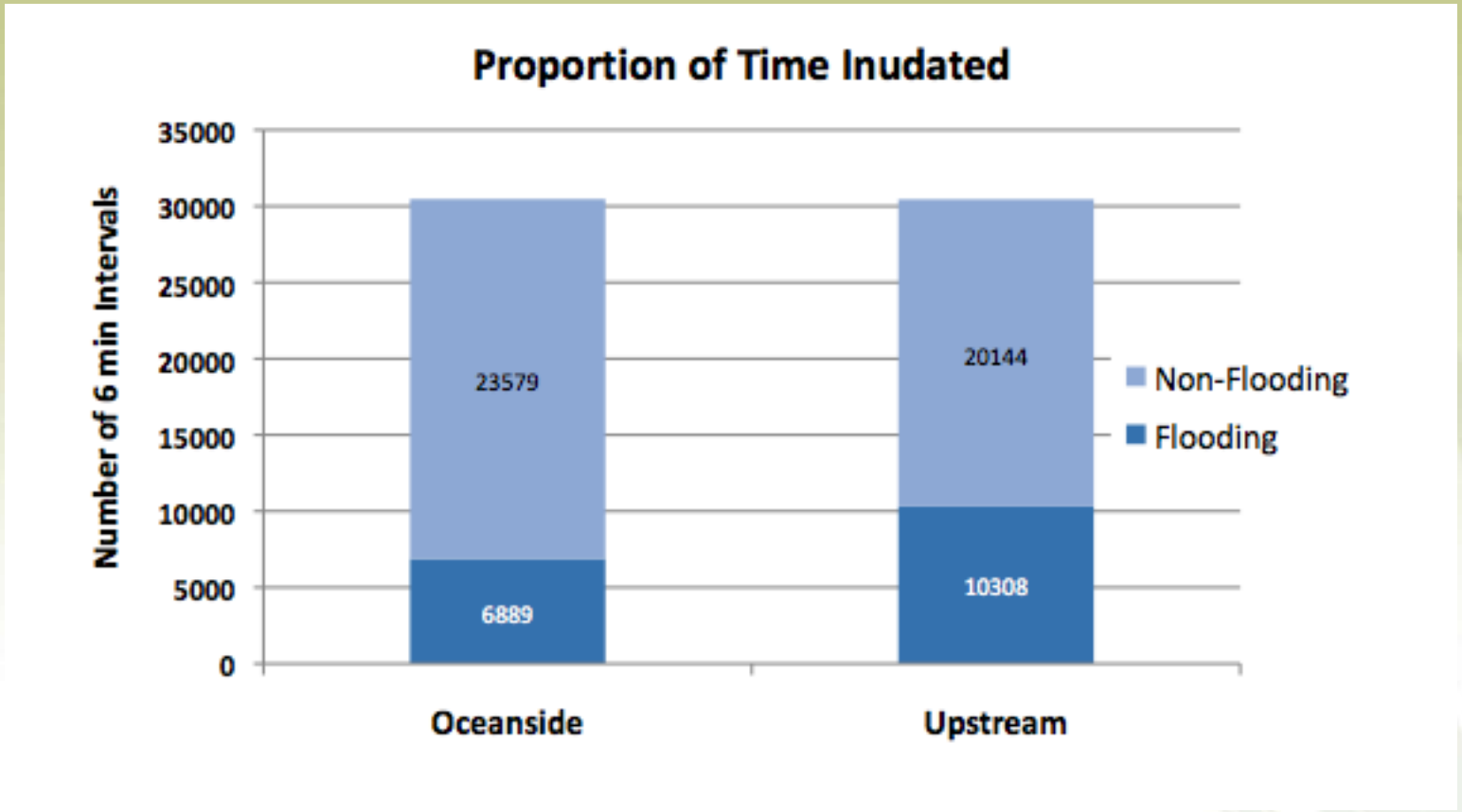
National Estuarine Research Reserve System

Self-Regulating Tide Gate (SRT)

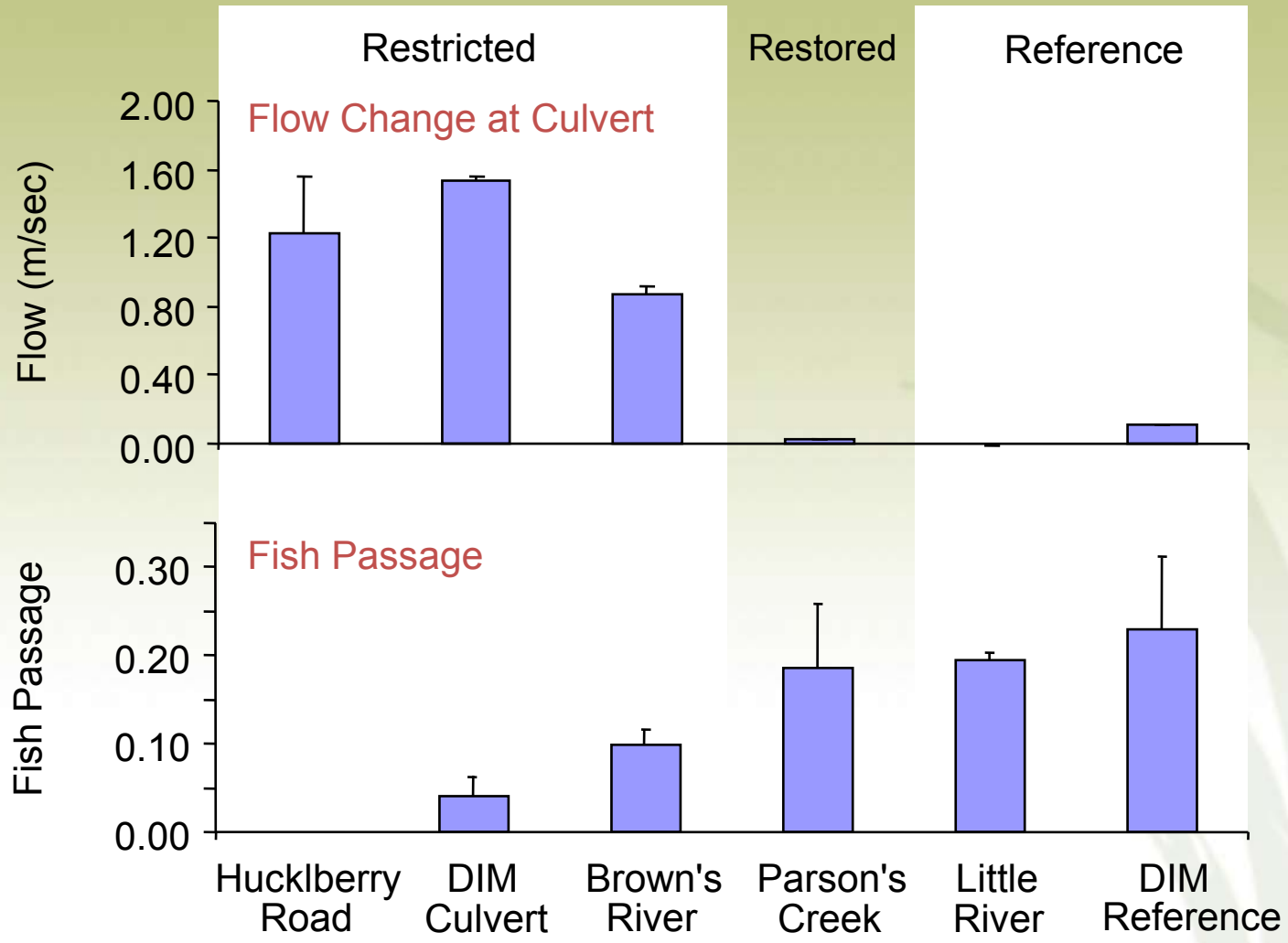
National Estuarine Research Reserve System


Legend
1:2,719
Transect D
Transect C
Transect B
Transect A
low
High

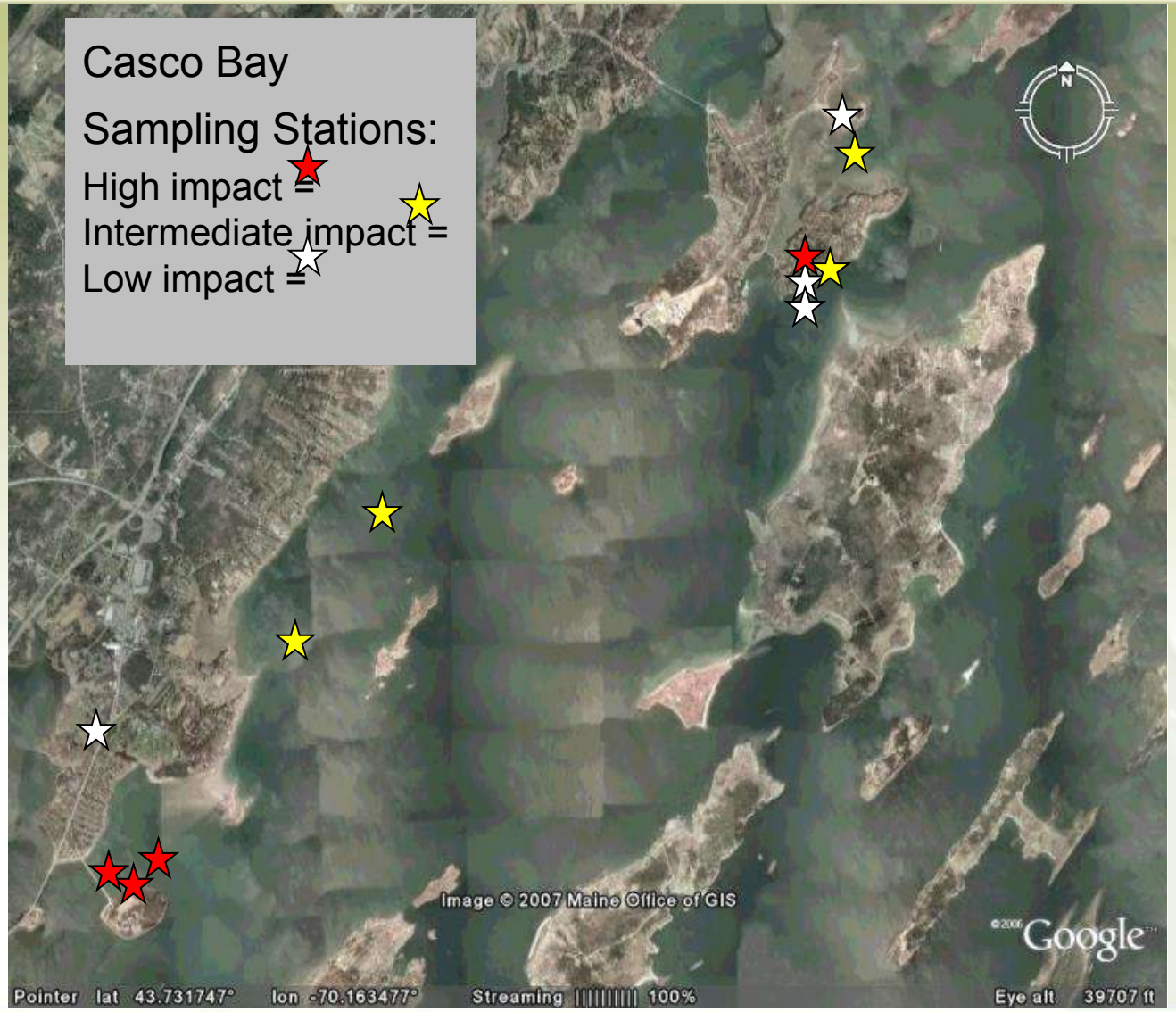

Legend
1:3,257
0
50
100 Meters
long
Upper Transverse B
Upper Transverse A
Central Transverse B
Central Transverse A


Proportion of Time Inudated
Number of 6 min Intervals
35000
30000
25000
20000
15000
10000
5000
0
23579
6889
20144
10308
Non-Flooding
Flooding
Oceanside
Upstream

Change in Flow at the Culvert and Rate of Fish Passage



Nekton Indicators of Casco Bay Fringing Marsh Health 2002 & 2004



CASCO BAY FRINGING MARSH NEKTON

Crustaceans

- Green Crab
- Jonah Crab
- Sand Shrimp
- Hermit Crab

Marsh Resident Fish

- Mummichog
- Atlantic Silverside
- Three Spine Stickleback
- Four Spine Stickleback

Juvenile Marine Fishes

- Winter and Smooth Flounder
- Hake

Migratory Species

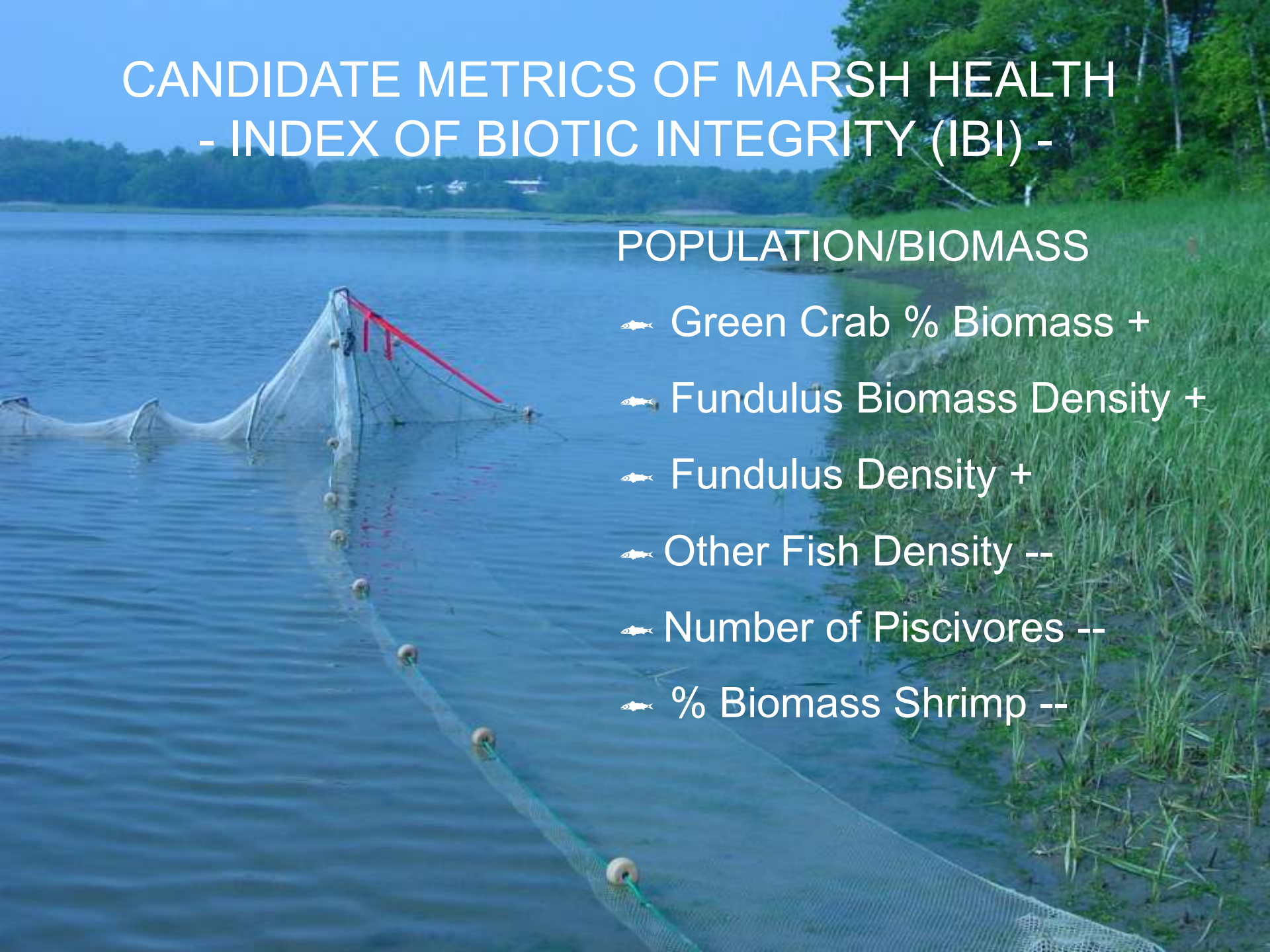
- Rainbow Smelt
- Tom Cod
- American Eel
- Alewife

Marine Transient Fishes

- Atlantic Herring
- Striped Bass
- Mullet

Other Candidates

- Sand Lance
- Pollock
- Bluefish
- Cod?



CANDIDATE METRICS OF MARSH HEALTH - INDEX OF BIOTIC INTEGRITY (IBI) -

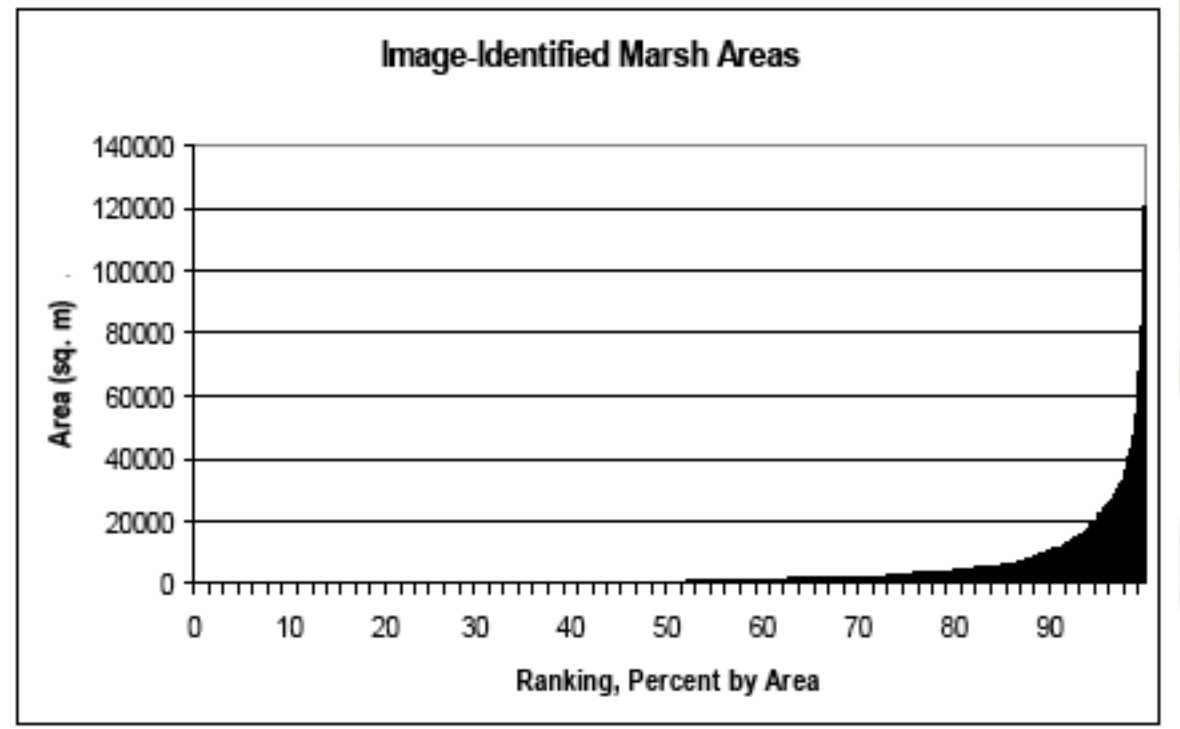
POPULATION/BIOMASS

- Green Crab % Biomass +
- Fundulus Biomass Density +
- Fundulus Density +
- Other Fish Density --
- Number of Piscivores --
- % Biomass Shrimp --


Project Report: Mapping and Restoration Inventory of Fringing Marsh Habitat in the Casco Bay Estuary
Casco Bay Estuary Partnership
wellsreserve
Funded through grants from the Casco Bay Estuary Partnership and the U.S. Environmental Protection Agency

Casco Bay Fringing Marshes

- 1,160 mainland marsh units identified
- 101 acres total area
- Benefits to 93 miles of coastline



Projecting Marsh Migration

Marsh Footprints Change with Sea Level

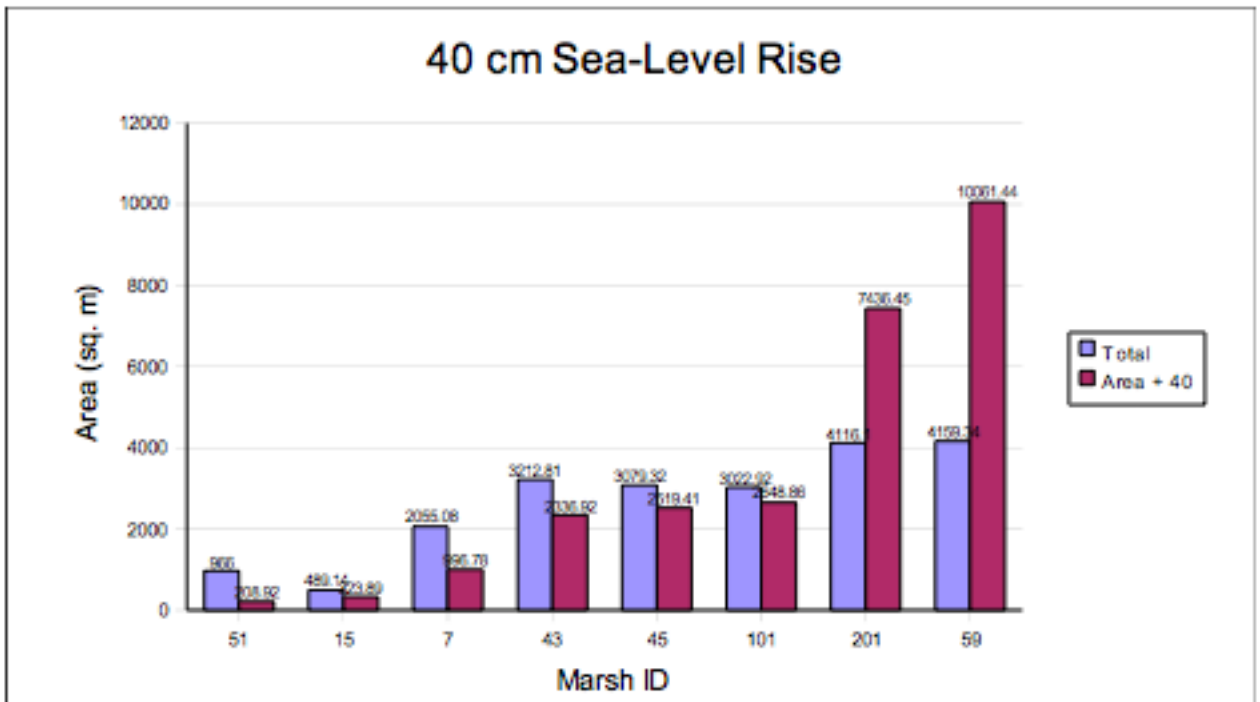
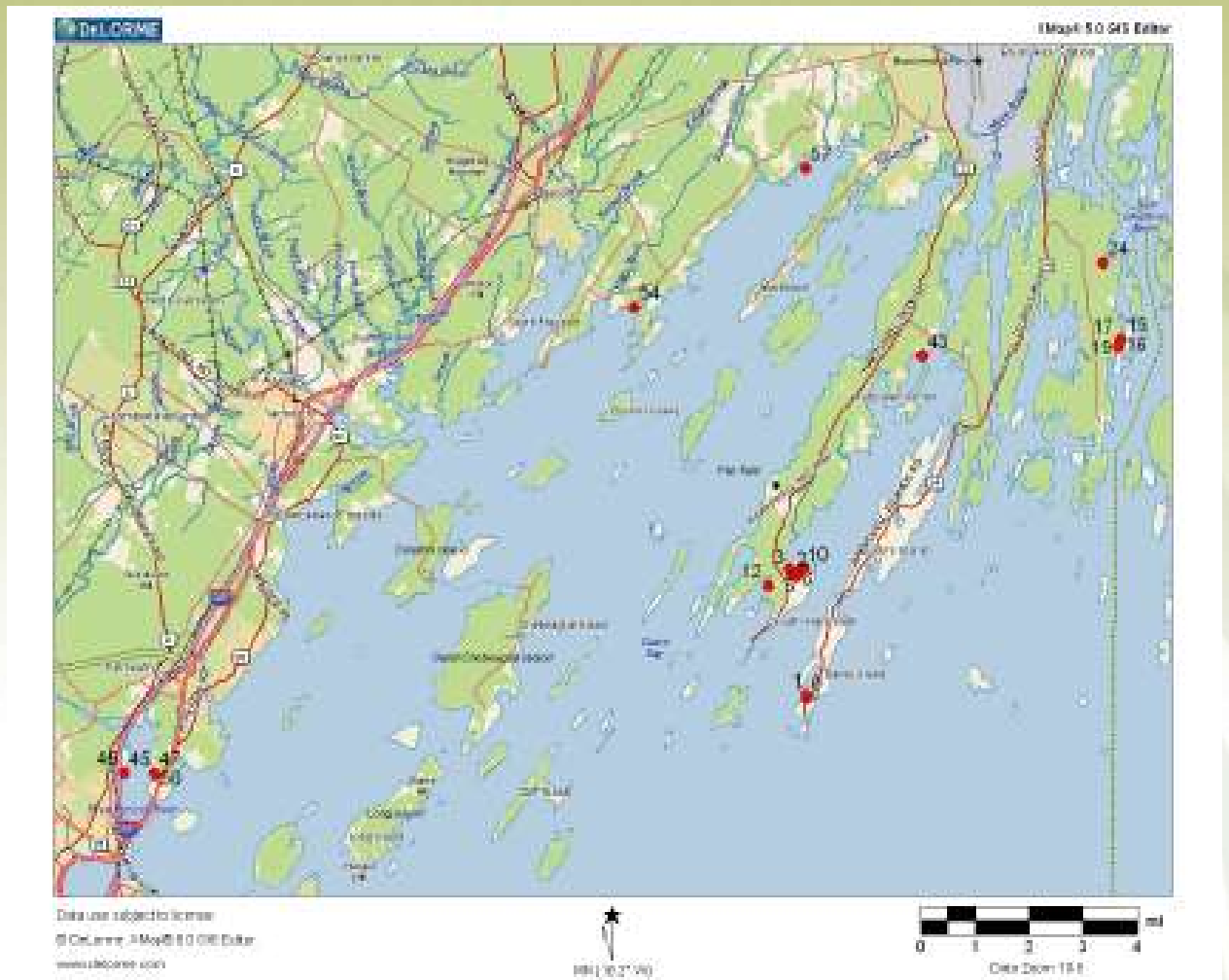


Figure 14: Total existing marsh area and estimated marsh area for 40 cm sea-level rise (both in square meters).

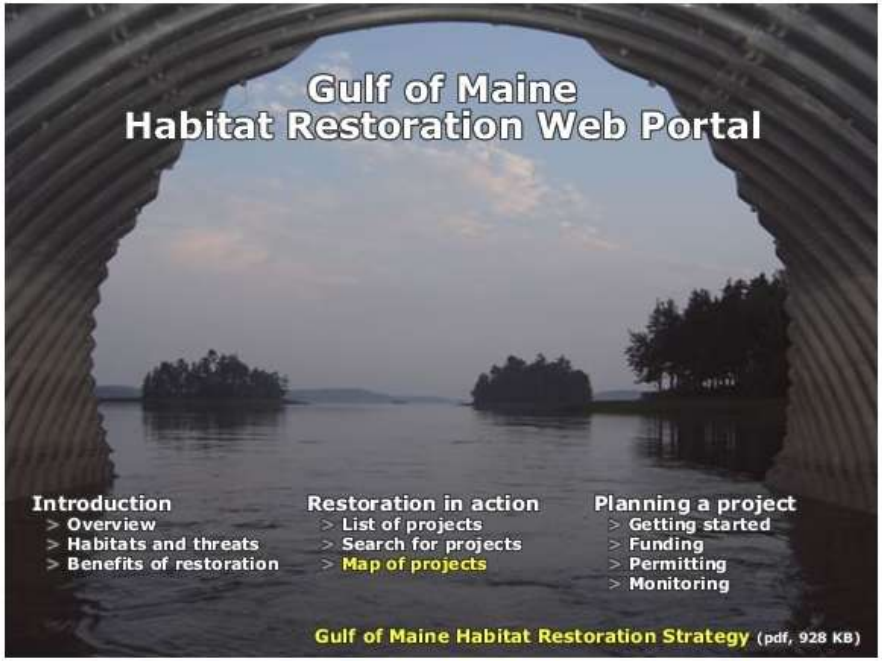
Casco Bay Fringing Marshes

- Average Impact Score – 73%
- Restoration priorities:
  - Improve shoreland buffers
  - Reduce physical damage
    - Docks, boats, foot traffic
  - Control Phragmites

Priority Sites for Restoration



- GOMC home
- Habitat restoration home
- Introduction
  - Overview
  - Habitats and threats
  - Tidal restrictions atlas
  - Benefits of restoration
- Restoration in action
  - Project inventory
  - Search projects
  - Map of projects
- Project planning
  - Getting started
  - Funding
  - Permitting
  - Monitoring
- Information resources
  - Restoration research
  - Species gallery
  - Volunteer opportunities
  - References
  - Contacts



GOMC-NOAA Habitat Restoration Grants Program

In partnership with the NOAA National Marine Fisheries Service Community-based Restoration Program, the Gulf of Maine Council provides grants to support a strategic approach to marine, coastal, and riverine habitat restoration within Maine, Massachusetts, and New Hampshire. Non-government organizations, community associations, cooperatives, civic groups, municipalities, schools, and tribal and state governments are eligible to compete for funding made available through the GOMC-NOAA Habitat Restoration Grants Program.

Overview of the Gulf of Maine Council-NOAA Habitat Restoration Grants Program.

Projects funded by GOMC-NOAA Habitat Restoration Grants Program

Summary of grants 2002-2006: Word (87 KB) or PDF (97 KB)

By jurisdiction	By habitat	By project type
Maine	Salt marsh	Culvert
Massachusetts	Eelgrass	Tide gate
New Hampshire	River	Dam
Nova Scotia	Oyster reef	Fish ladder

All projects