A simple protocol for collecting baseline data on marsh migration

LONG ISLAND SOUND STUDY
A PARTNERSHIP TO RESTORE AND PROTECT THE SOUND

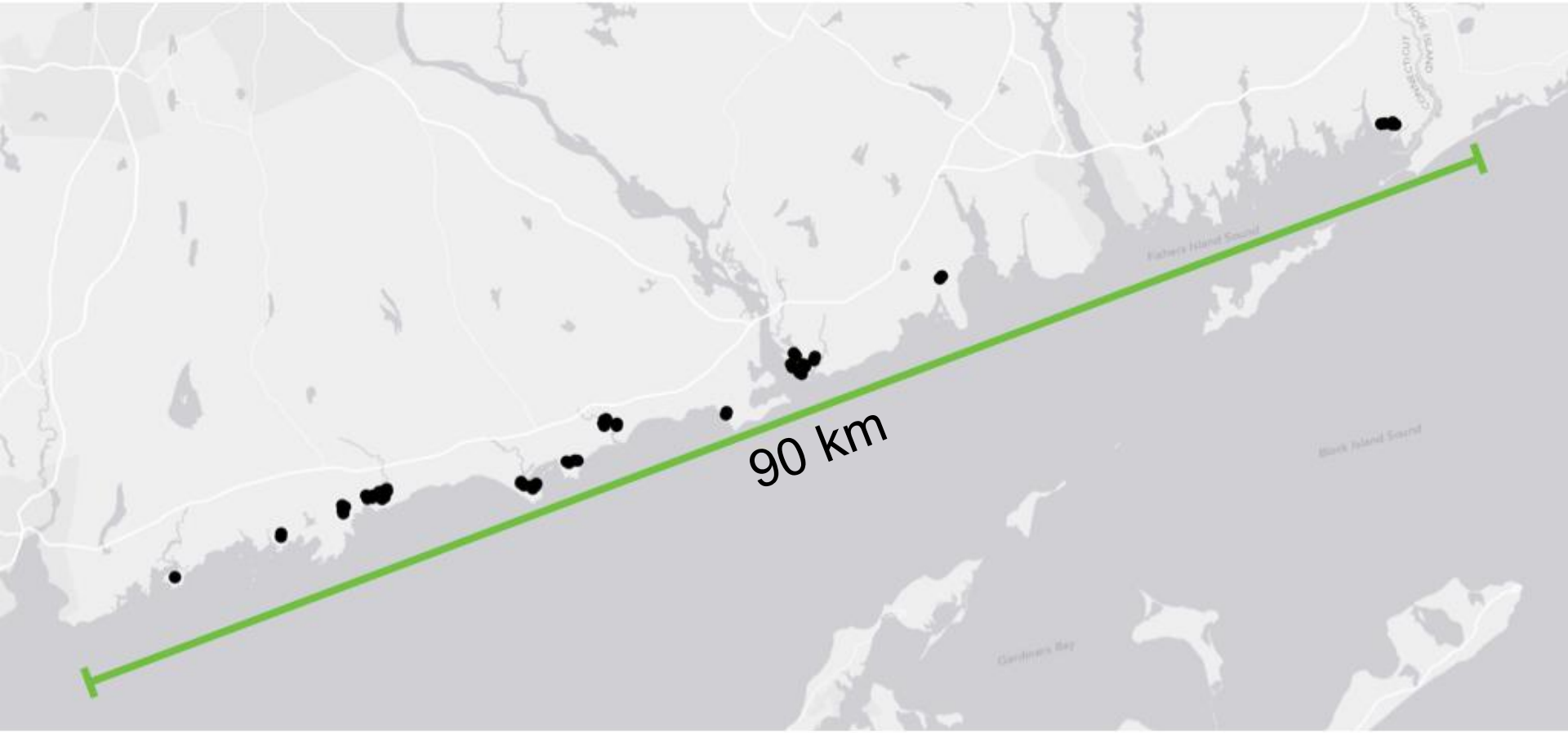
Ecology and Evolutionary Biology
University of Connecticut

Sentinels of climate change:

Coastal indicators of wildlife and ecosystem change in LIS

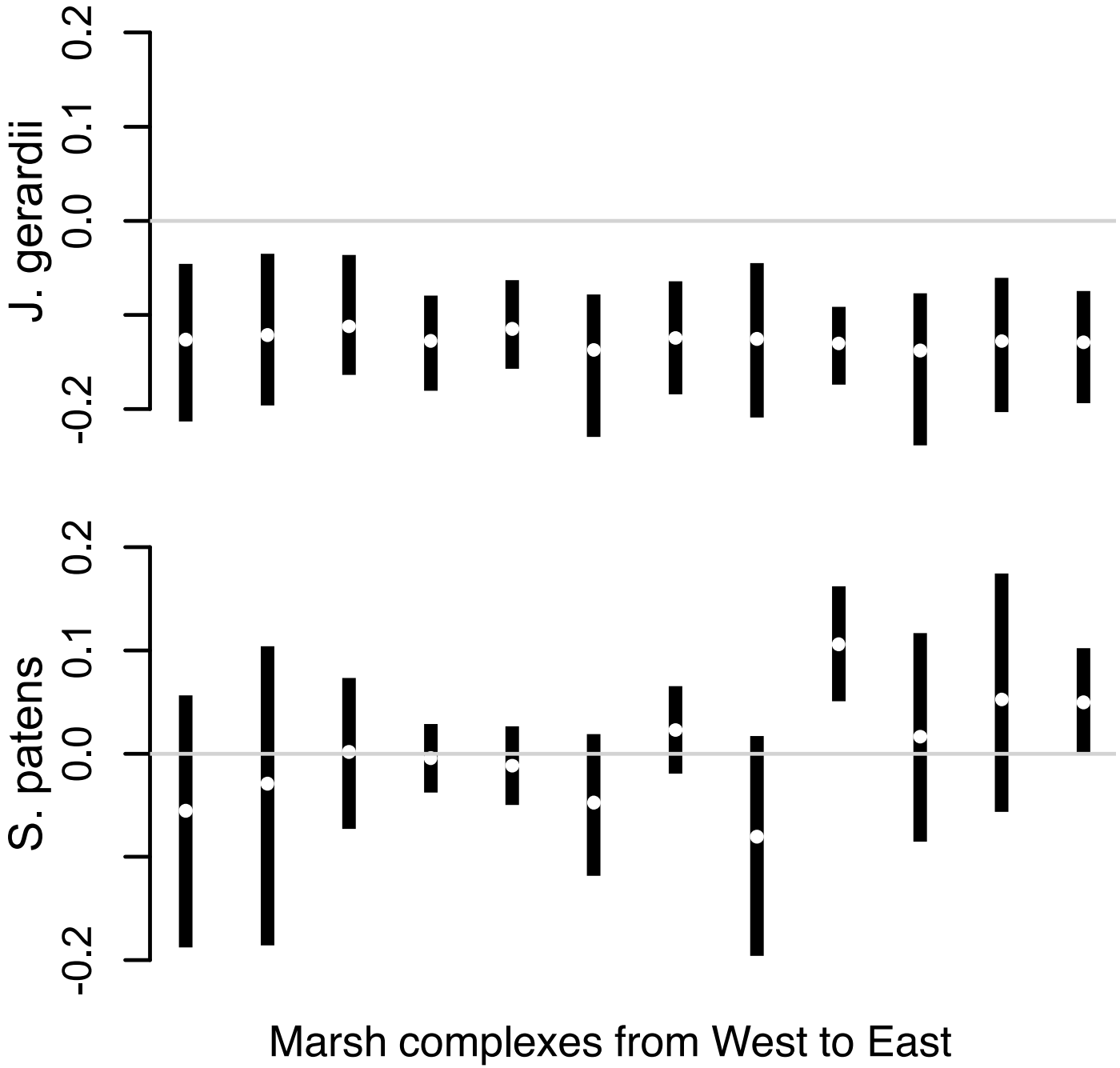
Chris Elphick, Chris Field, Min Huang

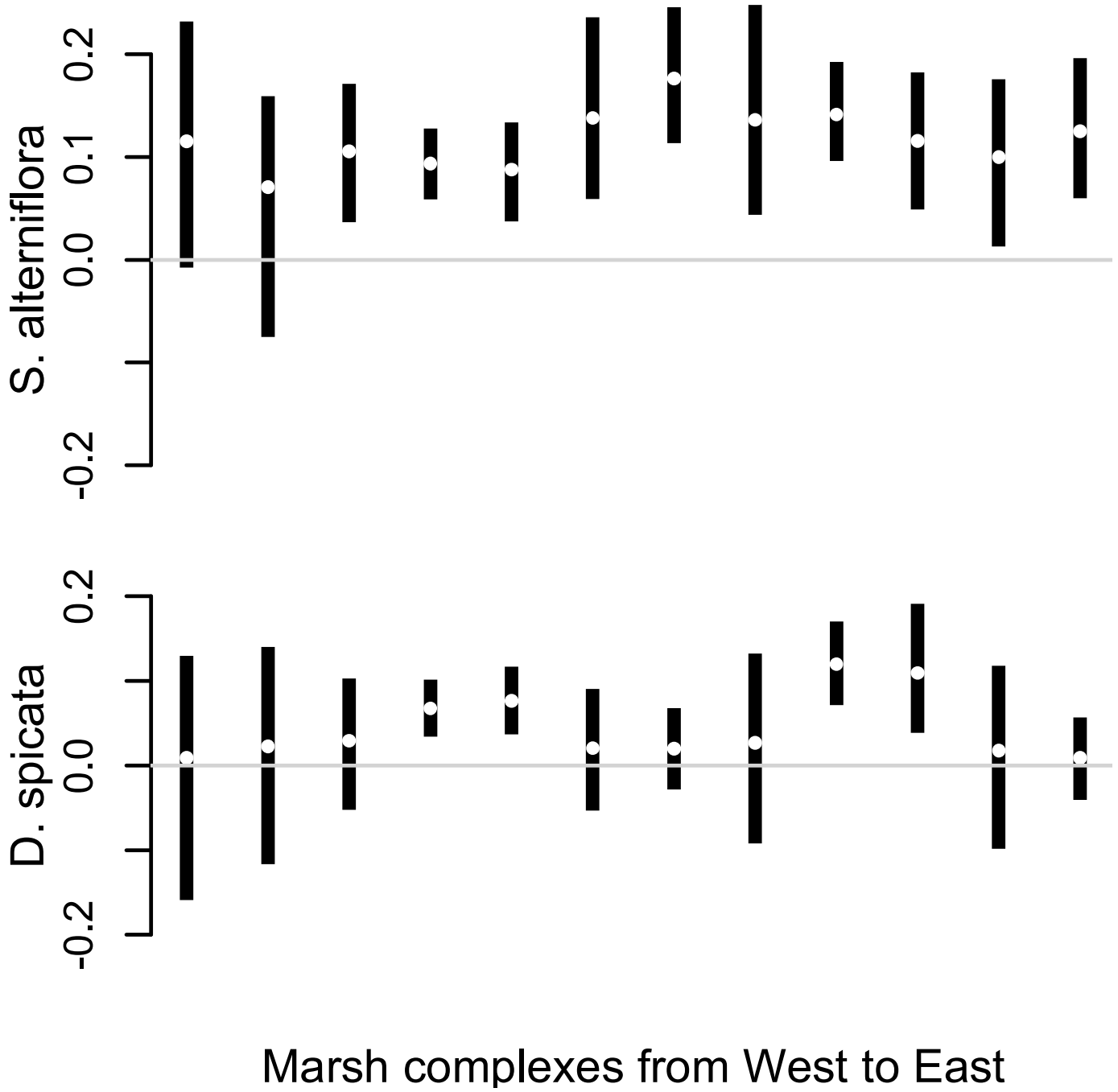
55 (1 ha) plots across 12 marsh complexes



surveyed in 2002-2004, resurveyed in 2013

55 (1 ha) plots across 12 marsh complexes


J. gerardii
0.2
0.1
0.0
-0.2
S. patens
0.2
0.1
0.0
-0.2
Marsh complexes from West to East


S. alterniflora
0.2
0.1
0.0
-0.2
D. spicata
0.2
0.0
-0.2
Marsh complexes from West to East

Monitoring Indicators of Climate Change along Long Island Sound: A Simple Protocol for Collecting Baseline Data on Marsh Migration

Wetland Science and Practice, September 2014

Monitoring Indicators of Climate Change along Long Island Sound: A Simple Protocol for Collecting Baseline Data on Marsh Migration

Wetland Science and Practice, September 2014

Five standardized protocols available by request
(and online in a few days)

- Edge point count SOP
- Identifying and georeferencing the marsh edge SOP
- Saltmarsh vegetation resurvey SOP
- Saltmarsh vegetation transect SOP
- Tree mortality SOP

Recent tree mortality and crown dieback

Seedling occurrence

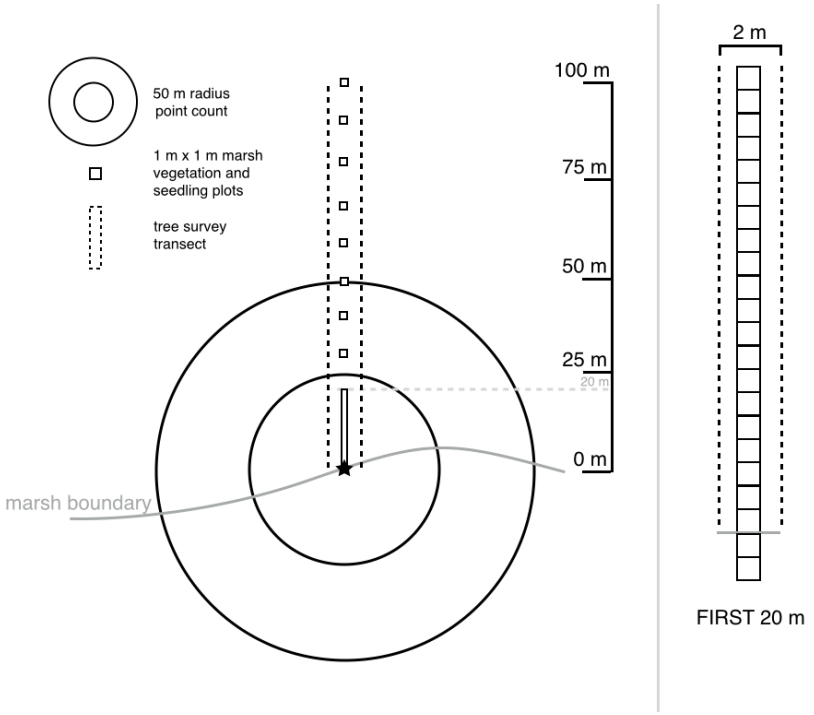
Position and plant composition of marsh-to-forest boundary

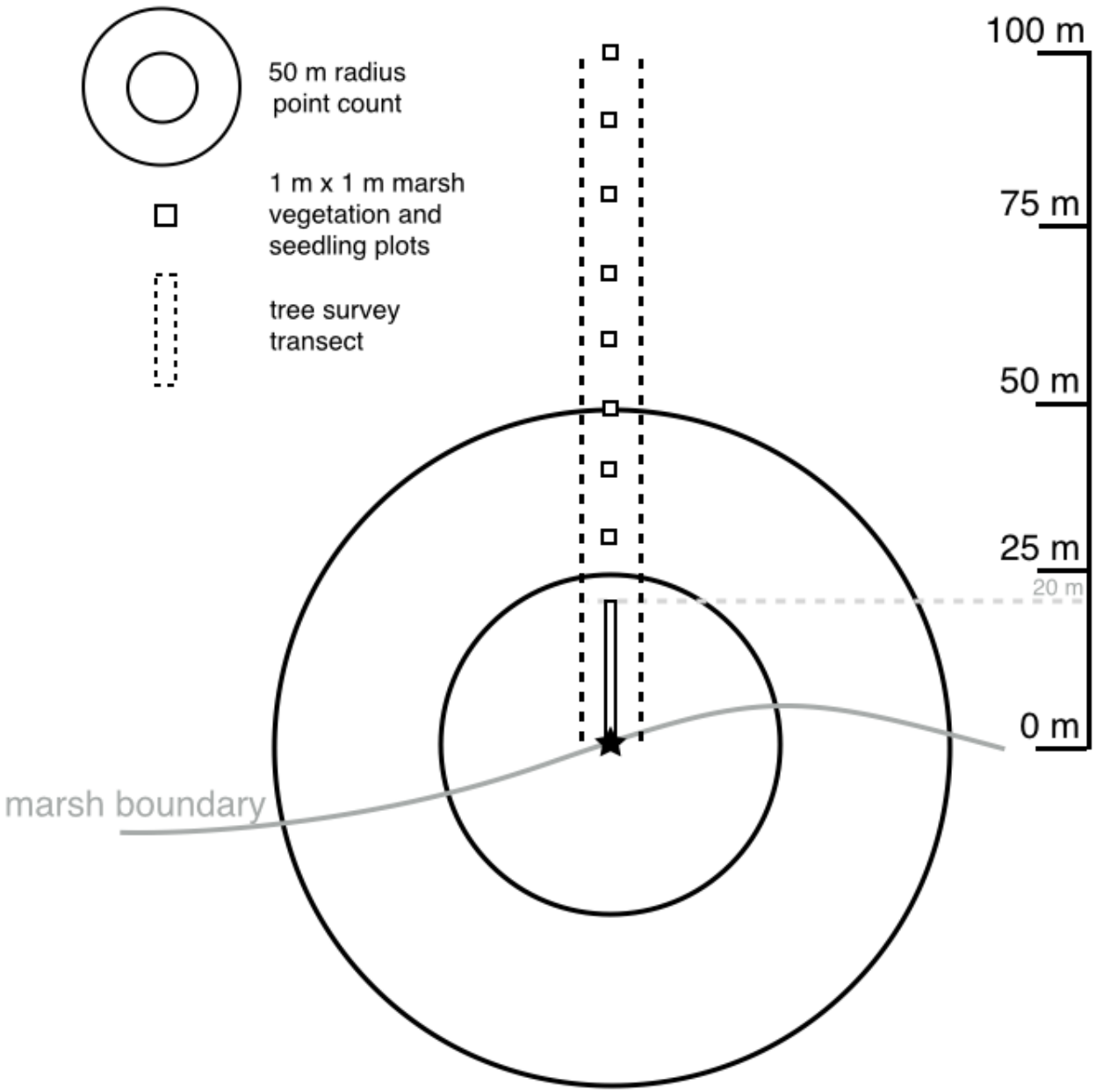
Marsh plant occurrence in the upland

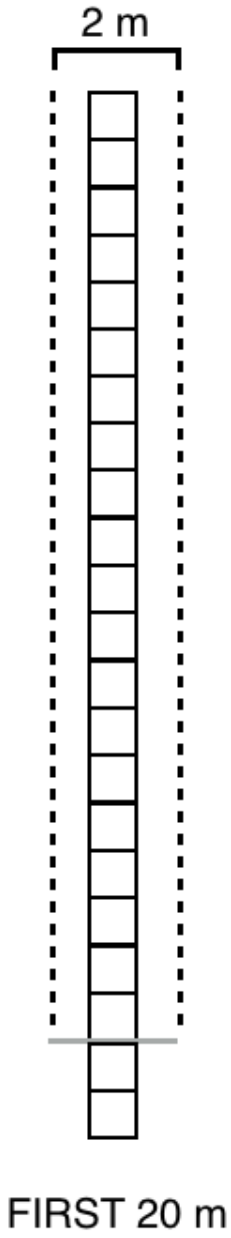
Bird community composition

*Historical aerial photographs

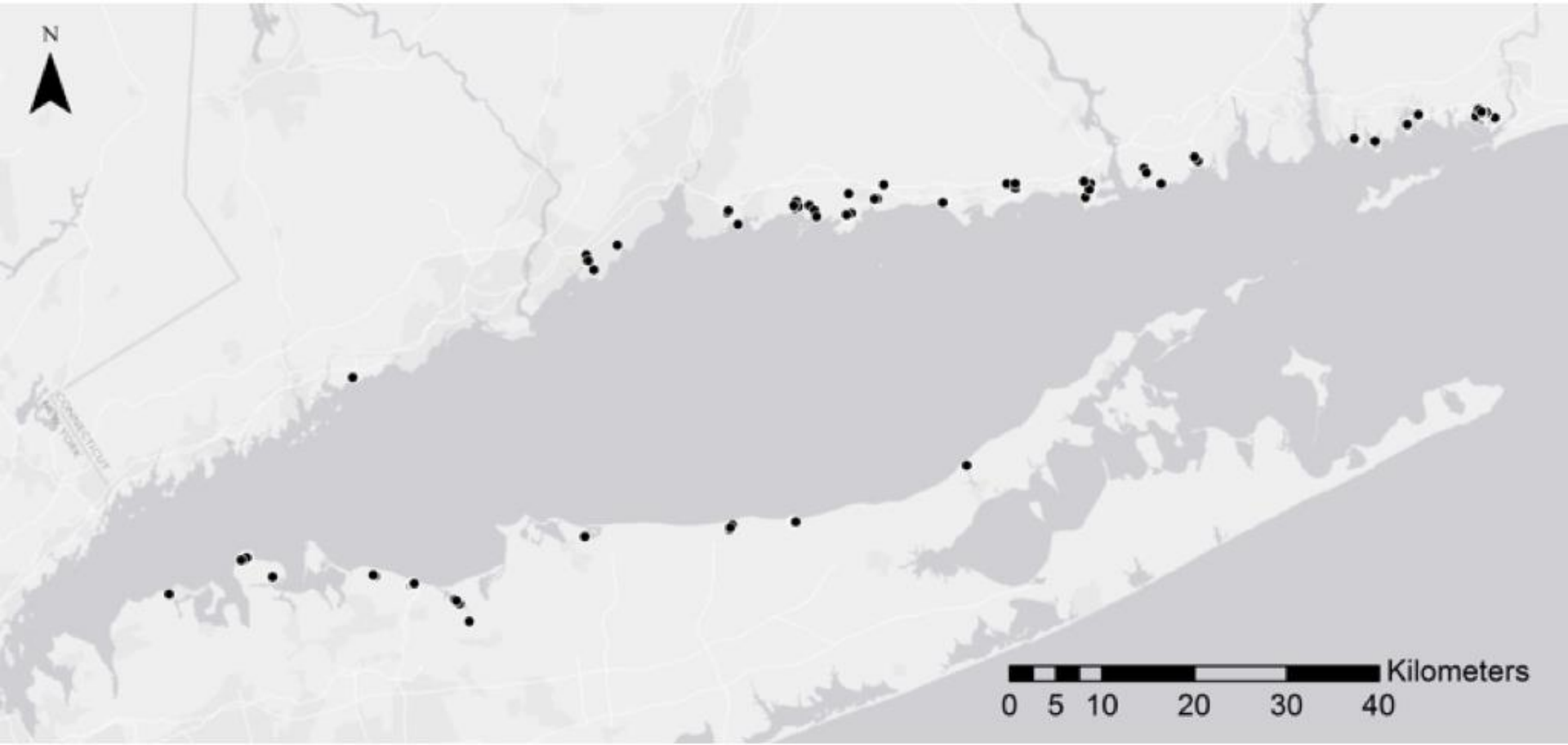
*Tree growth rates




50 m radius
point count
1 m x 1 m marsh
vegetation and
seedling plots
tree survey
transect
100 m
75 m
50 m
25 m
20 m
0 m
marsh boundary

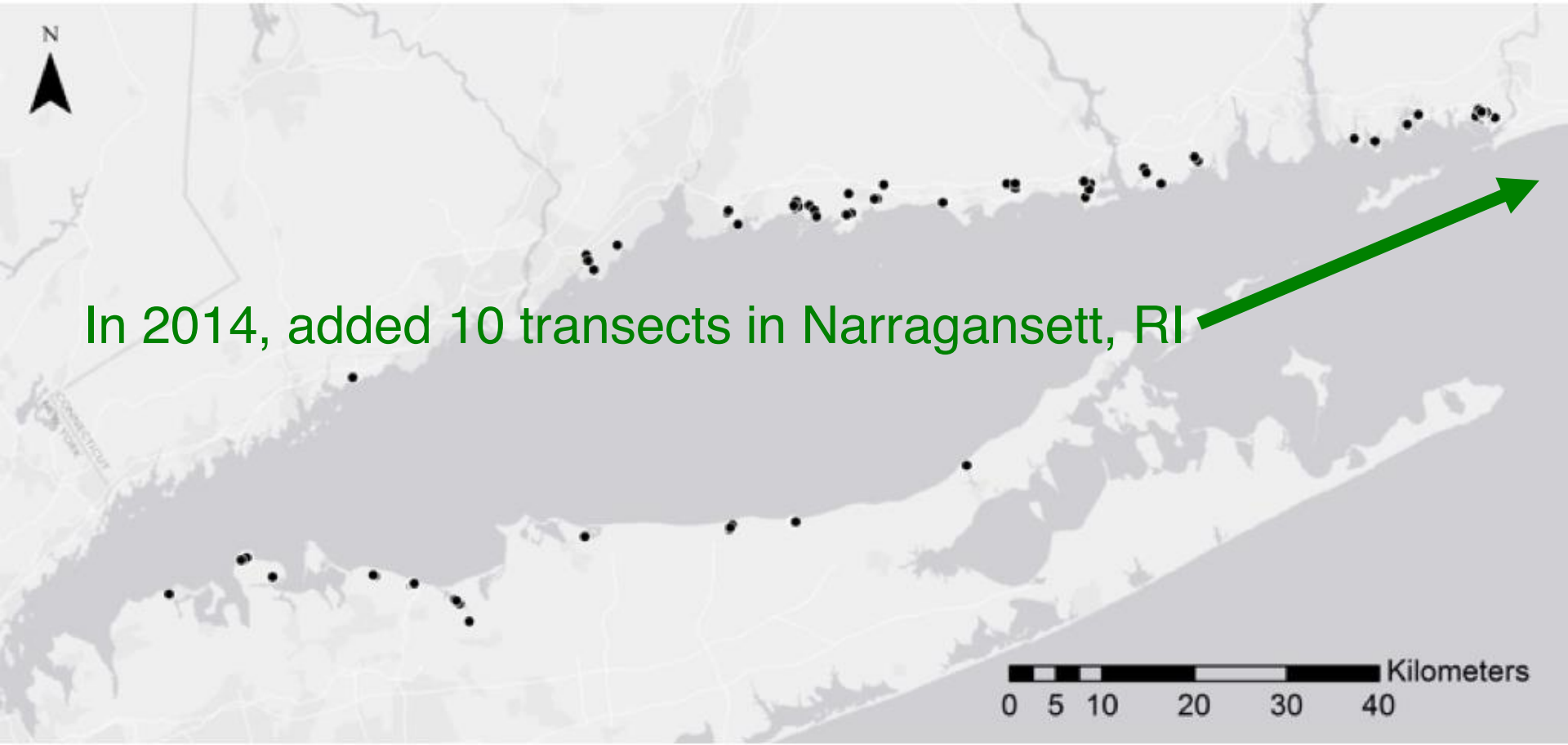

2 m
FIRST 20 m

182 long-term transects across Long Island Sound…



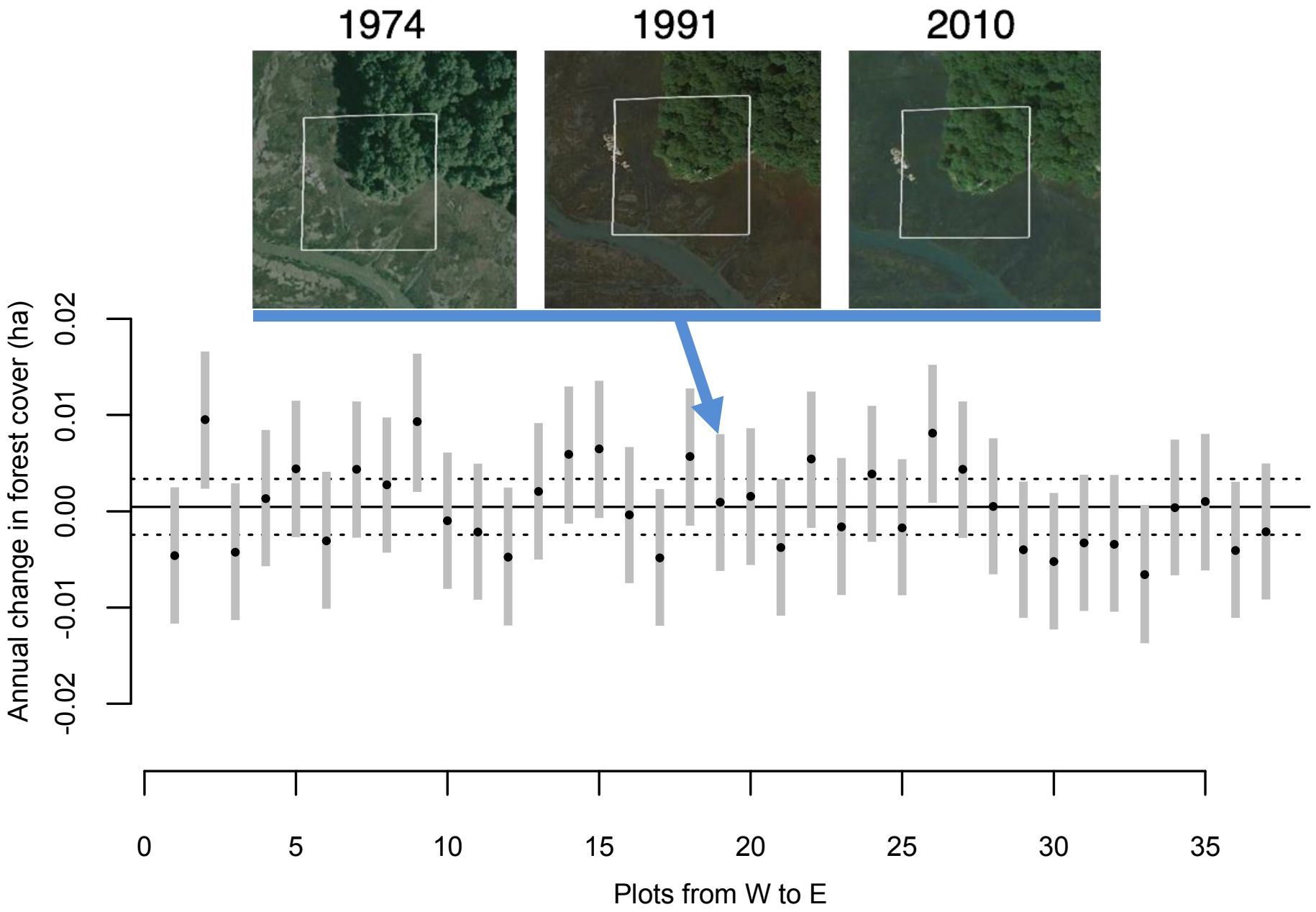
…randomly located in areas most likely to be experiencing transgression. Established in 2013.

182 long-term transects across Long Island Sound…

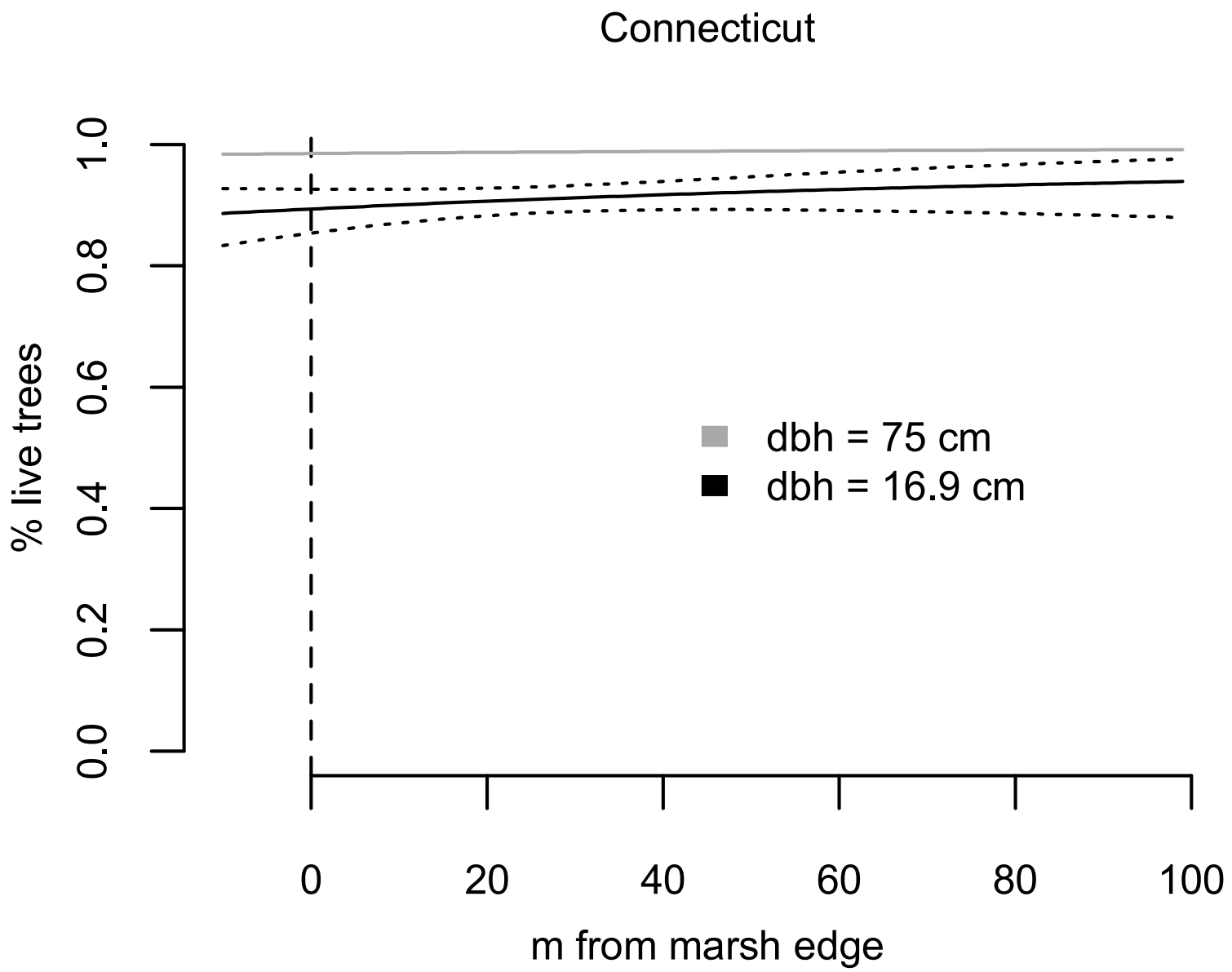


…randomly located in areas most likely to be experiencing transgression. Established in 2013.

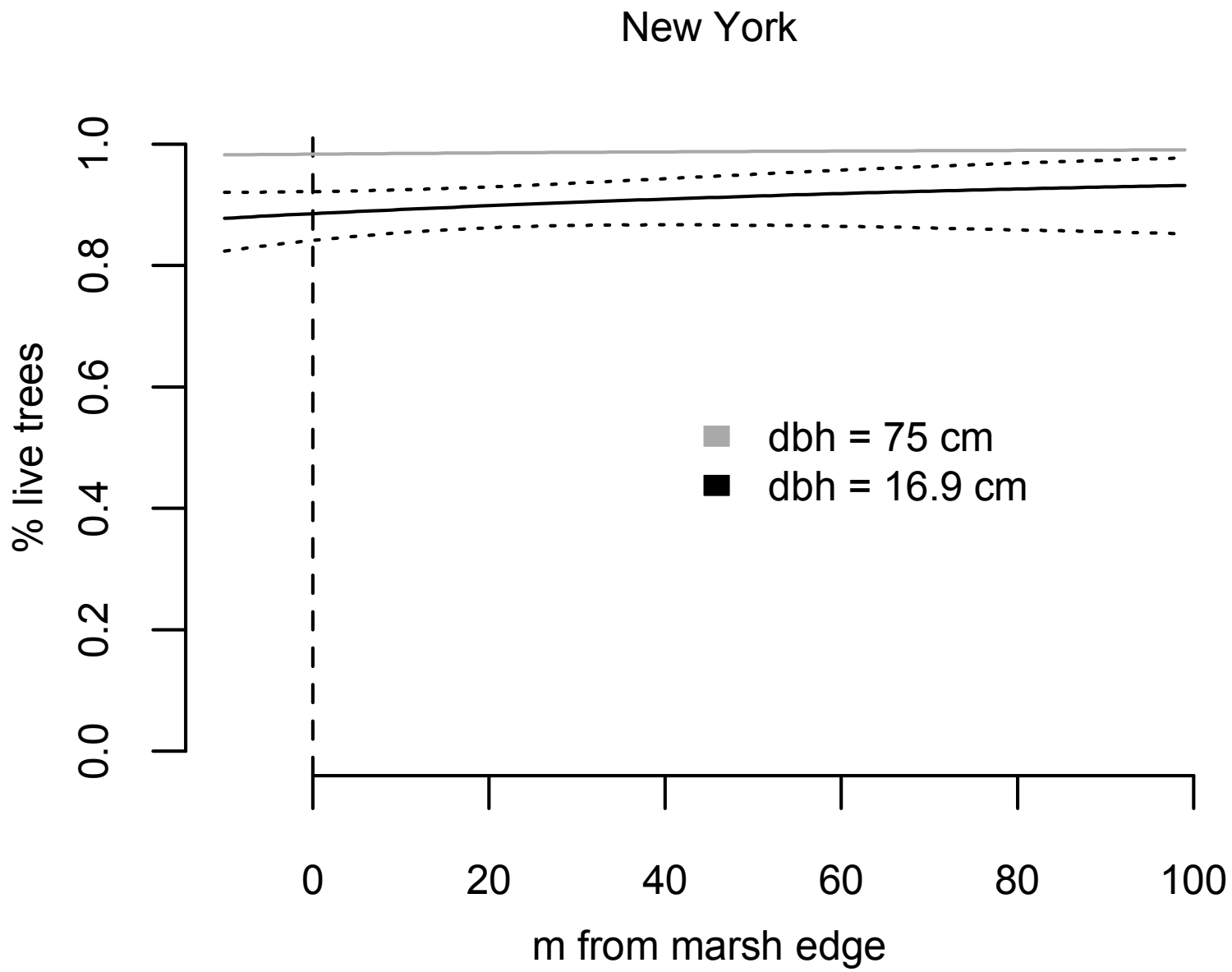
Change from aerial photos over 3 time steps



Recent tree mortality along baseline transects



Recent tree mortality along baseline transects



What we've learned so far…

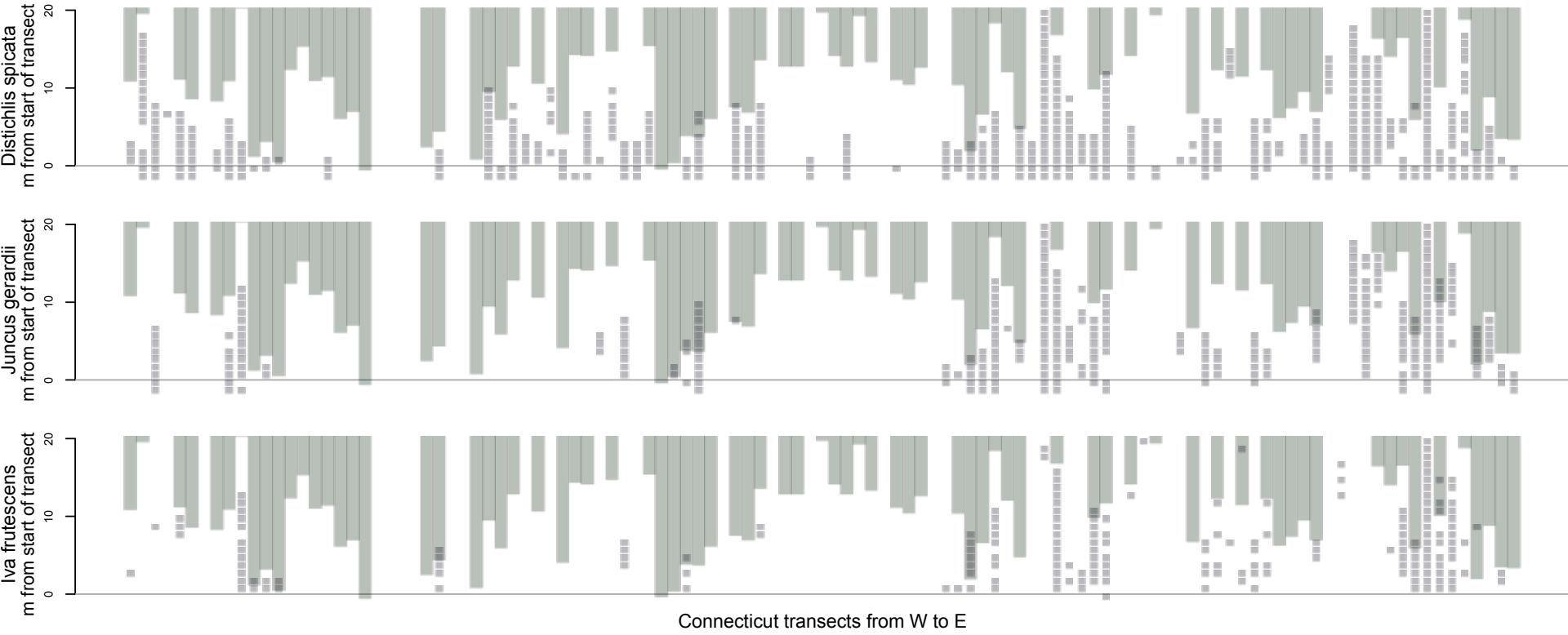
No evidence yet that marsh vegetation is moving into forested areas in LIS.

Multiple lines of evidence at multiple scales suggest that LIS coastal forest is resilient to SLR.

Biotic factors (esp. trees) might play a larger role than we thought in determining when and where transgression happens.

Questions?

christopher.field@uconn.edu
or
chris.elphick@uconn.edu


Distichlis spicata
m from start of transect
0
10
20
Juncus gerardii
m from start of transect
0
10
20
Iva frutescens
m from start of transect
0
10
20
Connecticut transects from W to E


Salt marsh skating
Palmer River circa 1967

US Fish and Wildlife Service Salt Marsh Integrity Assessments: An exploratory summary of 2012 and 2013 data

Susan C. Adamowicz,
Toni Mikula, Jordan Kramer,
Hilary Neckles, Glenn Guntenspergen, Janith Taylor

8/16/2013

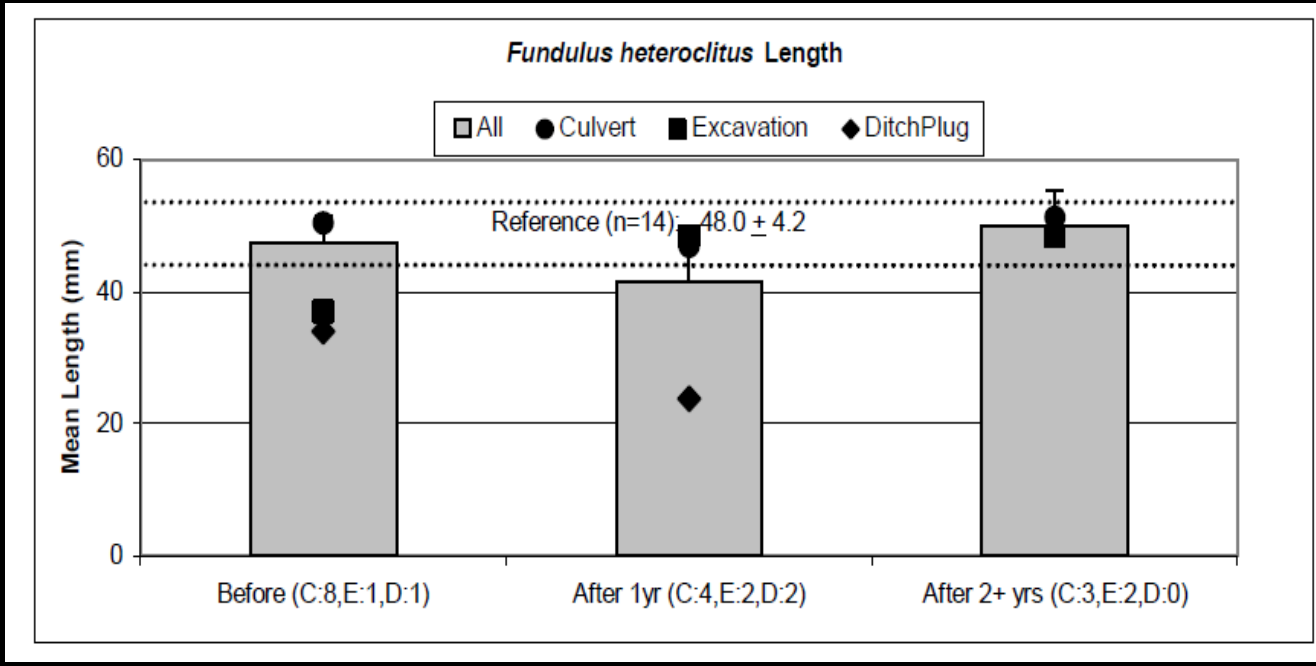
Background

- USFWS Region 5 National Wildlife Refuges
- Refuge purposes…..
  - Threatened & Endangered Species
  - Migratory Birds
  - Wilderness
  - Shorebirds & Wading Birds
  - Encourage Natural Diversity
  - Conservation of Wetlands

Background cont.

- Prior to 2008, US FWS had series of unrelated research projects but ***no common baseline assessment***

Fundulus heteroclitus Length (mm)



Before After 1 yr After 2+ yr

Konisky et al. 2004

Background cont.

- Desire for more informed management decision making at local and regional level

Scott Kahan

Regional Director

Wendi Weber

Regional Refuge Chief

Chief, Division of Natural Resources

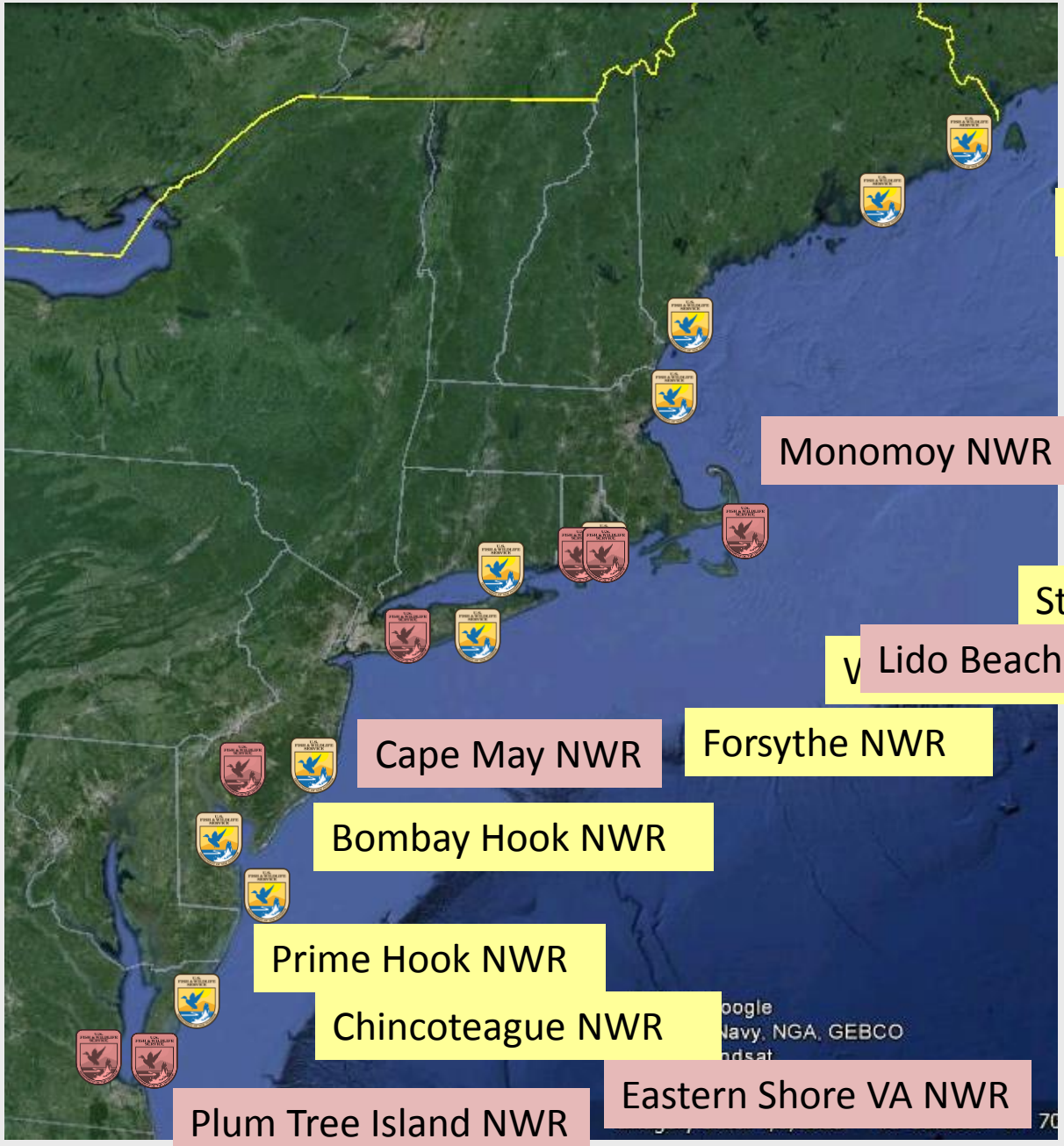
Refuge Manager

Jan Taylor

Refuge Biologist

Salt Marsh Integrity Assessments

- Purpose of SMI:
  - Baseline data for
    - Assessing state conditions
    - Decision tool for optimizing selection of management efforts at a single site and/or among sites
  - Assessing effects of management efforts
- Today: just exploring initial data summaries


2013 Locations
Moosehorn NWR
Maine Coastal Island NWR
Rachel Carson NWR
Parker River NWR
Monomoy NWR
John Chafee NWR
Ninigret NWR
Stewart B. McKinney NWR
Lido Beach NWR
Forsythe NWR
Cape May NWR
Bombay Hook NWR
Prime Hook NWR
Chincoteague NWR
Eastern Shore VA NWR
Plum Tree Island NWR

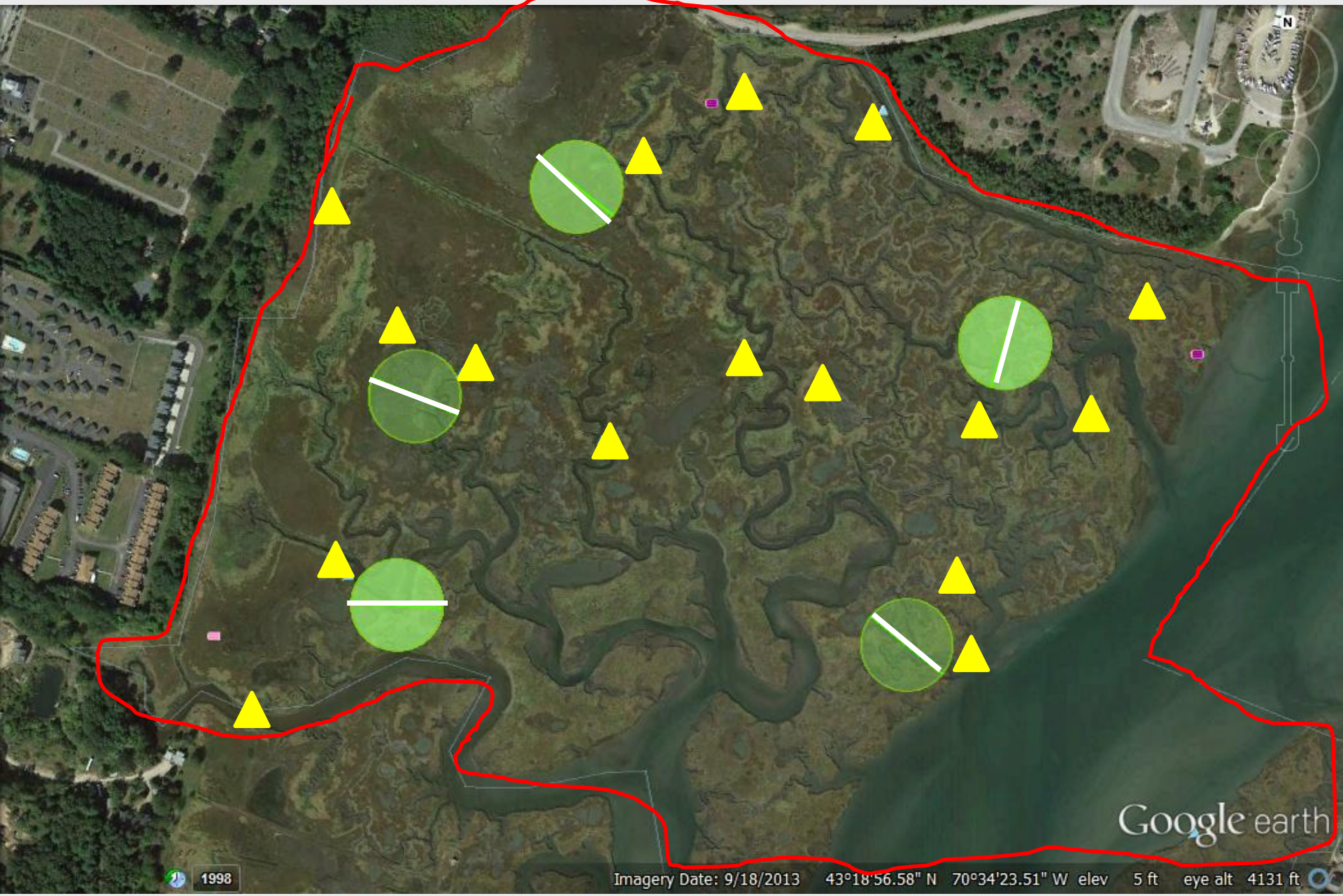
Methods

- SMI Units: portions of a salt marsh system that are likely to be management units and are marked by "obvious" boundaries (roads, creeks, ditches, upland border etc.)

Webhannet Marsh, Wells, ME

Methods

- SMI/SHARP bird survey plots (50m radius) are basis for location of other metrics
  - Vegetation Transects across bird plot down elevation gradient.
  - Nekton (fish & crustacean): 20 sample sites per unit


N
1998
Imagery Date: 9/18/2013 43°18'56.58" N 70°34'23.51" W elev 5 ft eye alt 4131 ft
Google earth

2012 By The Numbers

- 11 National Wildlife Refuges from Maine to Virginia

  A **minimum** of:
  - 34 salt marsh units
  - 680 nekton stations
  - 102 bird stations
  - 102 vegetation transects

2013 By The Numbers

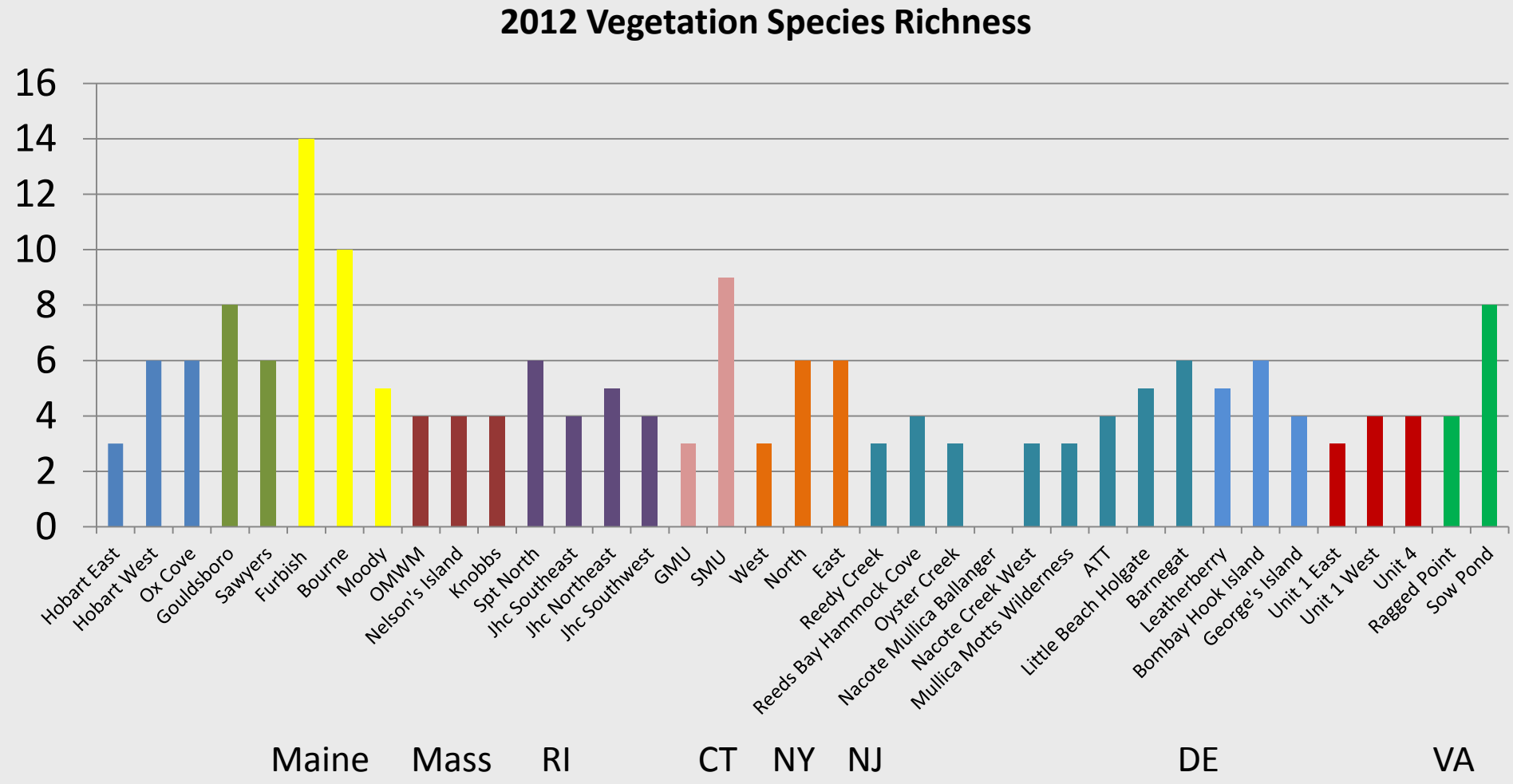
- 8 National Wildlife Refuges from Maine to Delaware

  A **minimum** of:
  - 26 salt marsh units
  - 502 nekton stations
  - 126 bird stations
  - 126 vegetation transects

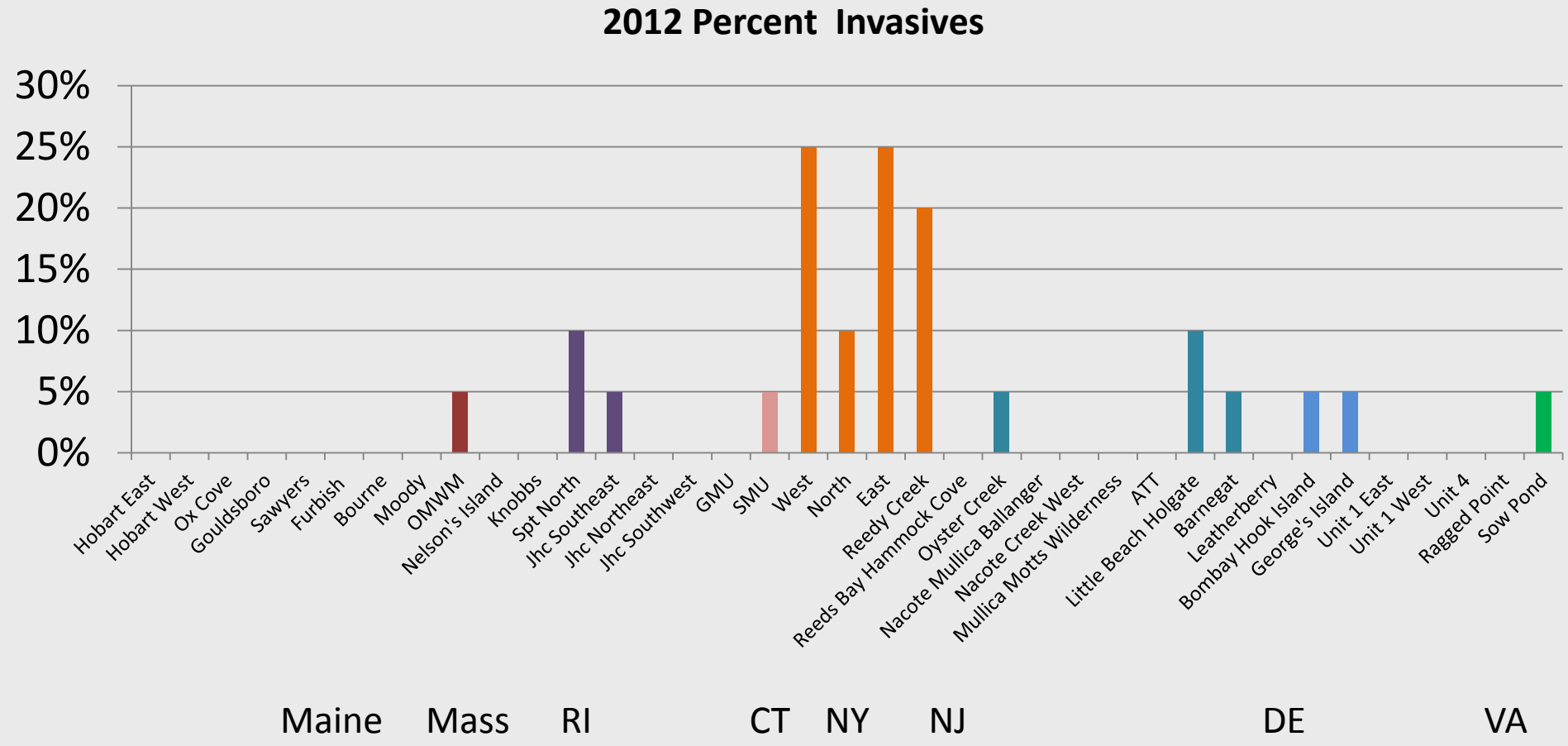
Vegetation: Point Intercept

- 10 Points along a 100m transect
- At least 3 transects per SMI unit
- Spp composition
- Abundance

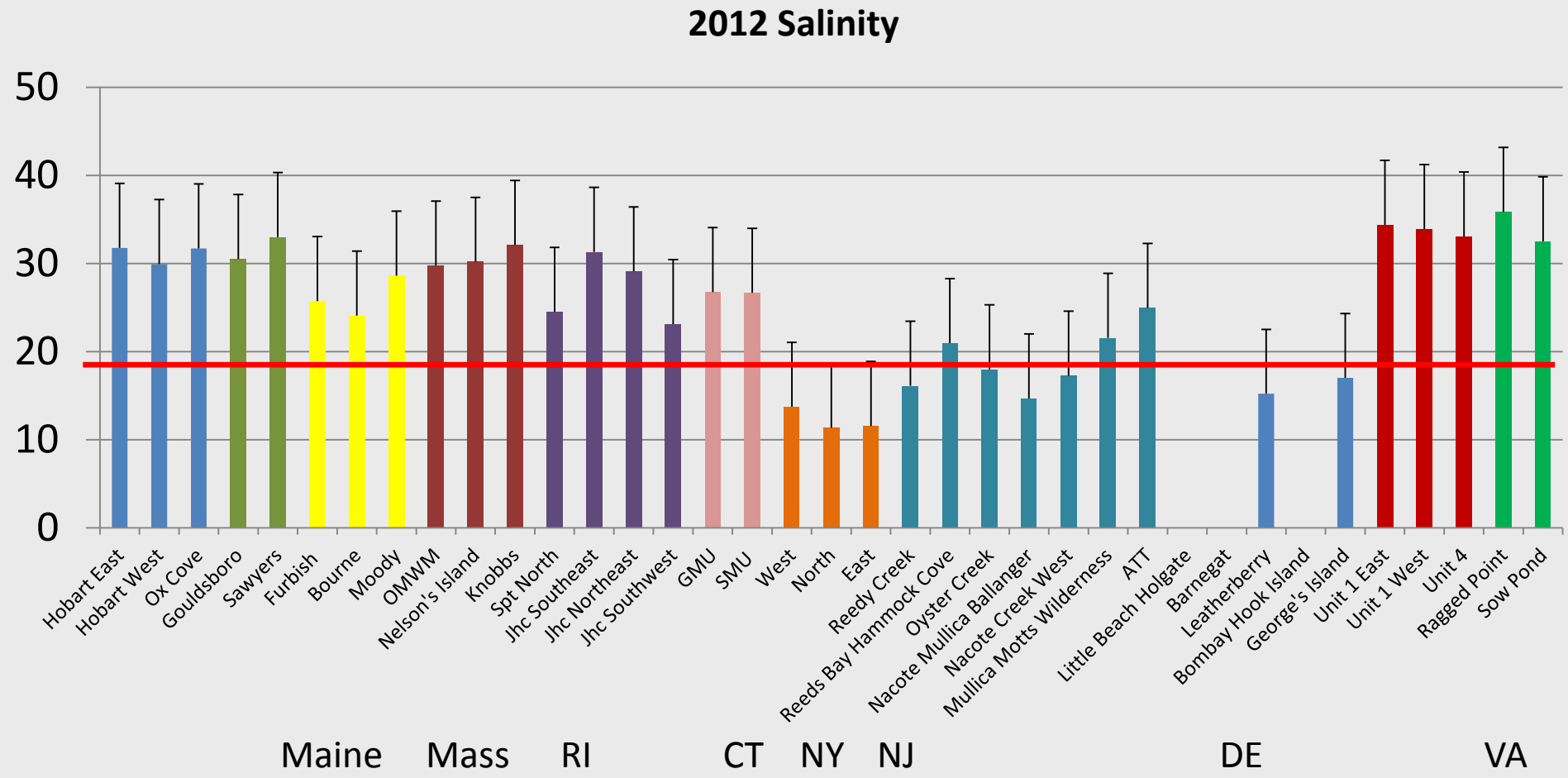
Vegetation Results



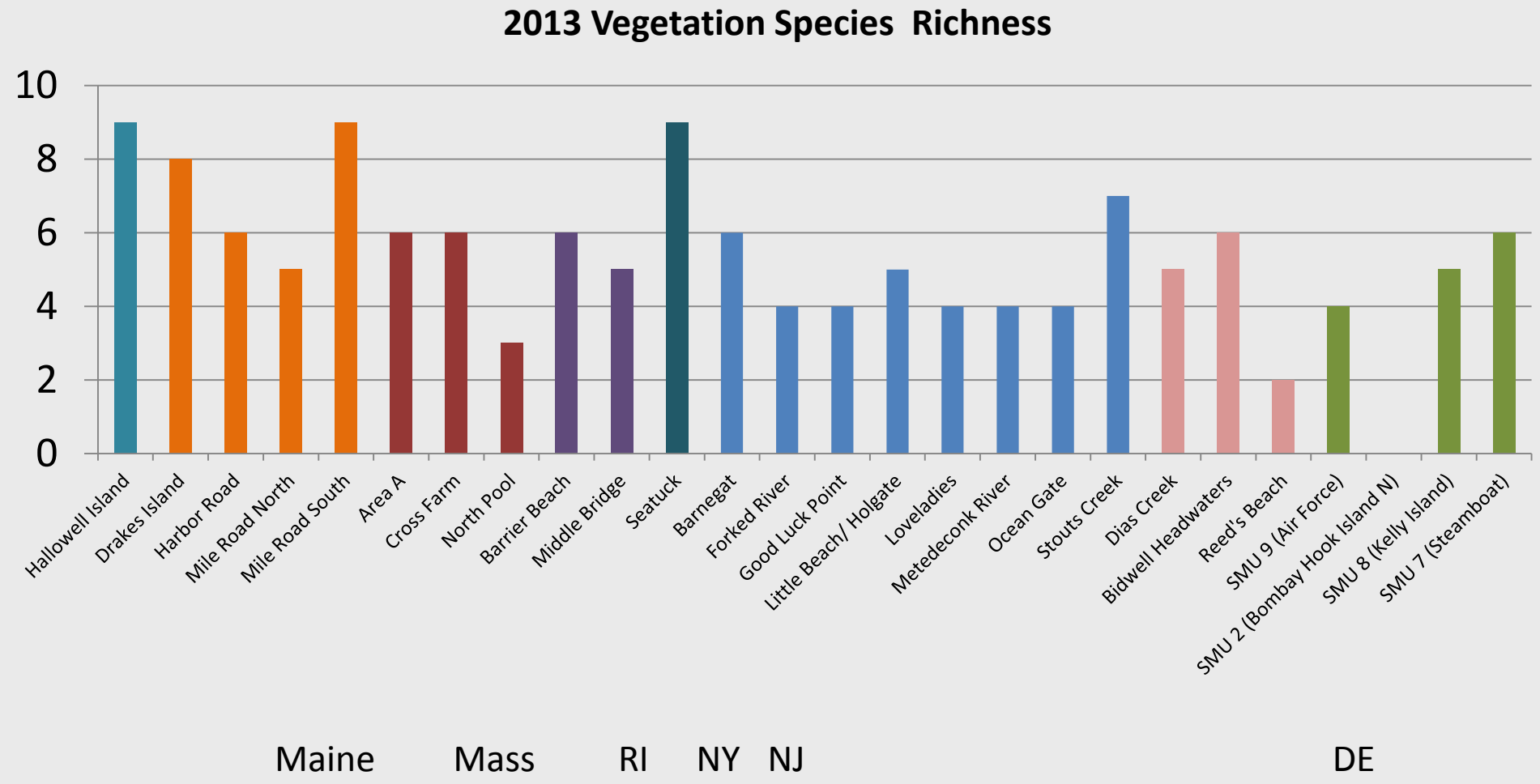
Vegetation Results



Surface Water Salinity

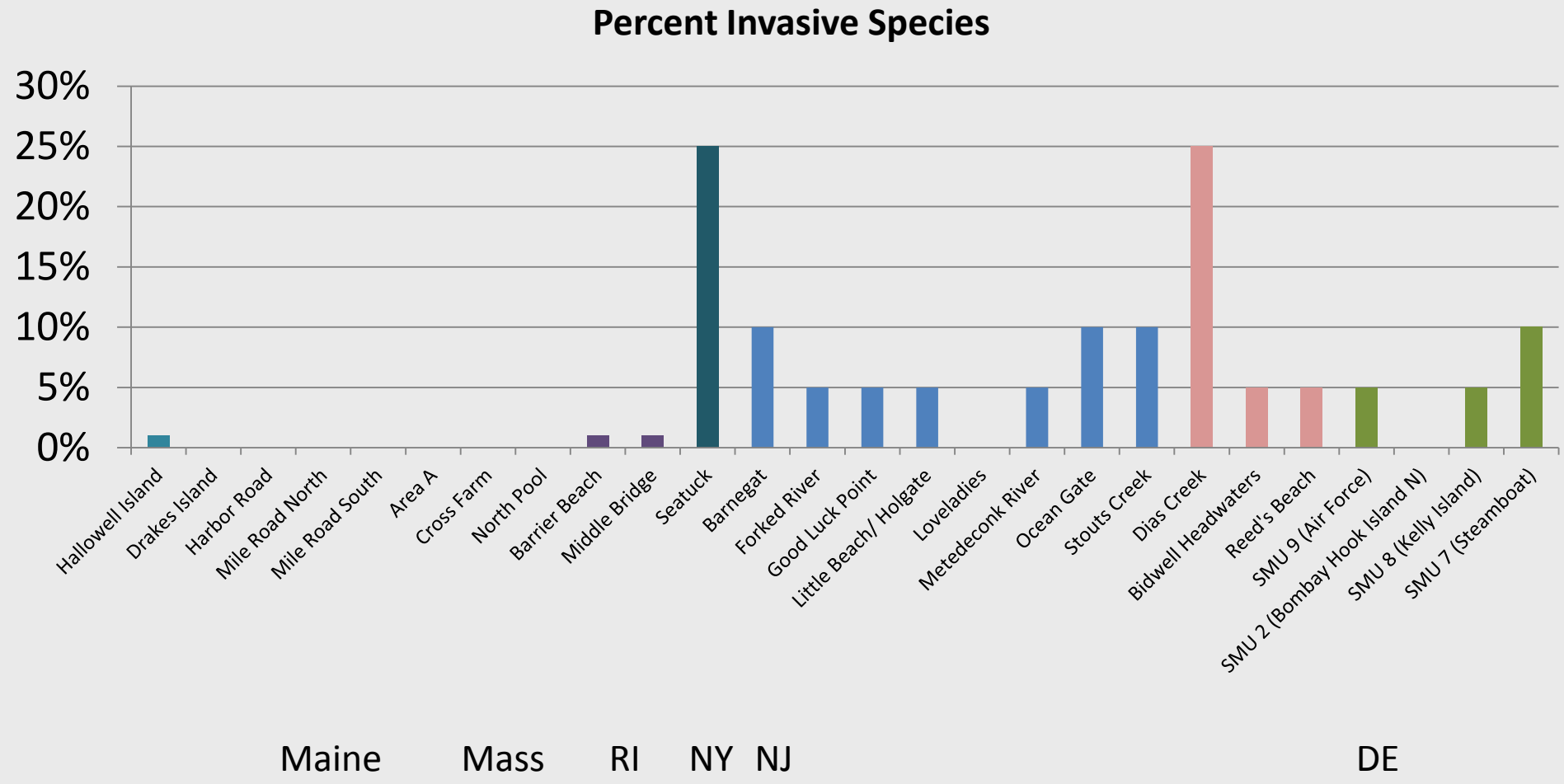


2013 Vegetation



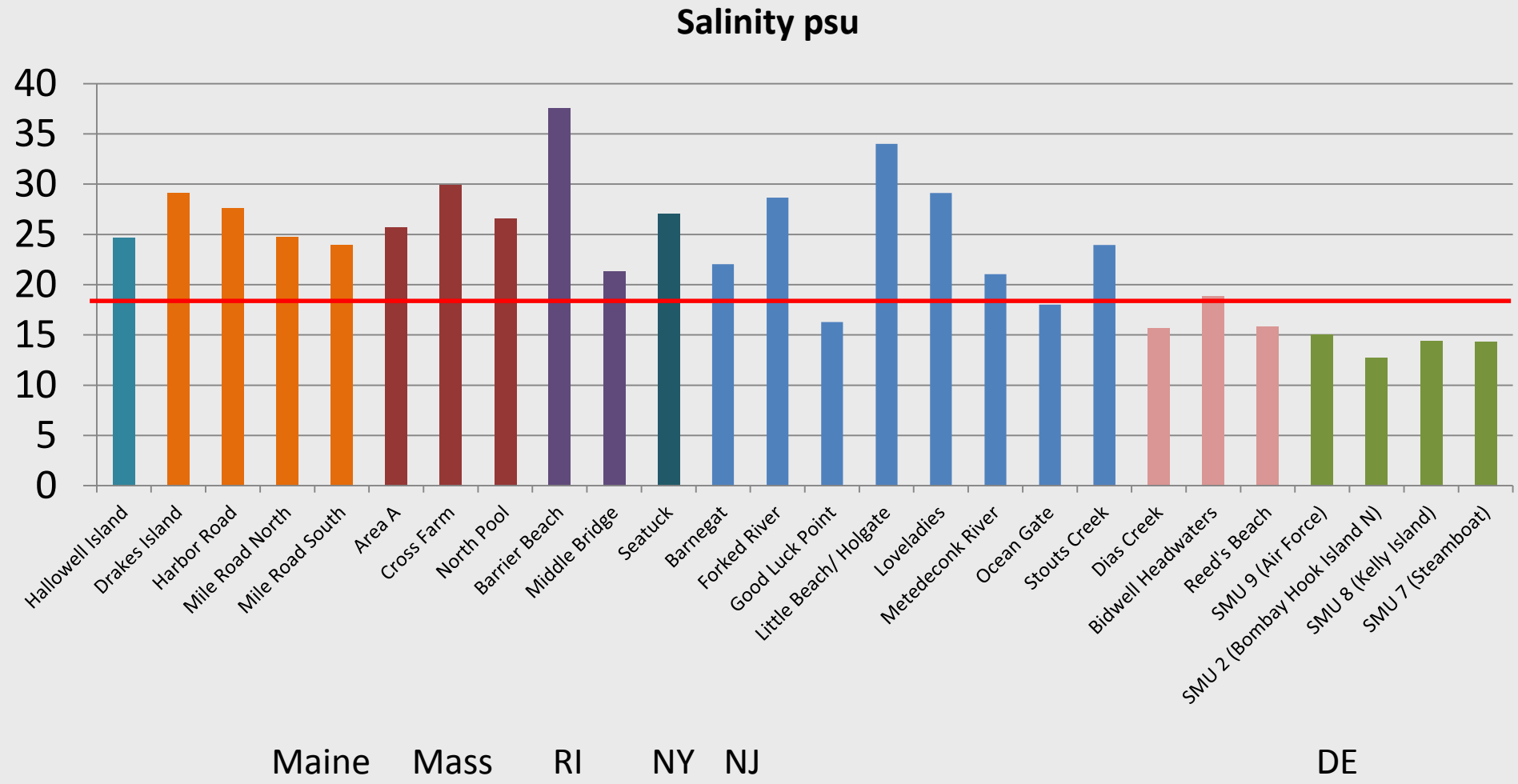
Maine Mass RI NY NJ DE

2013 Vegetation Cont.

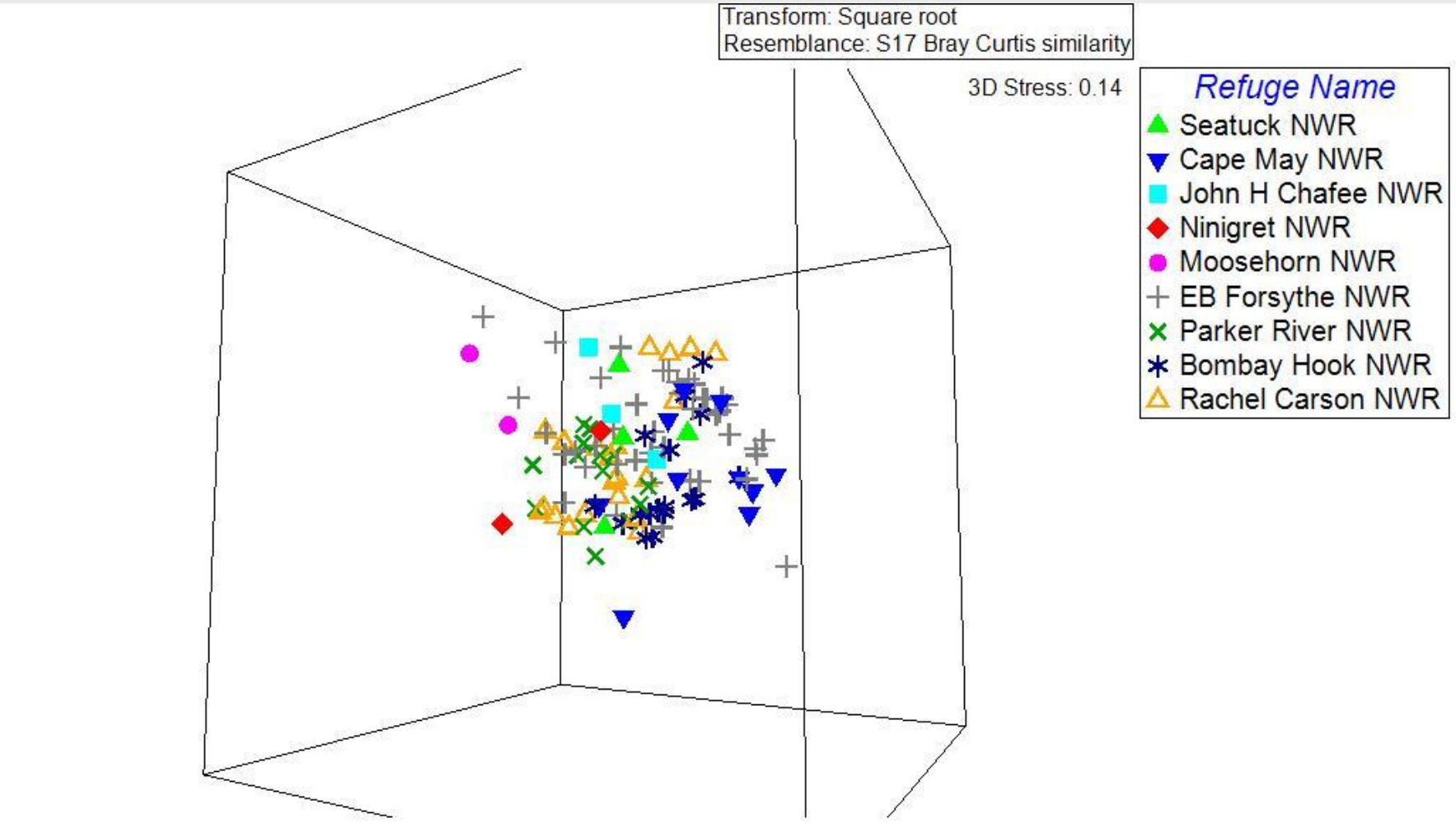


Maine Mass RI NY NJ DE

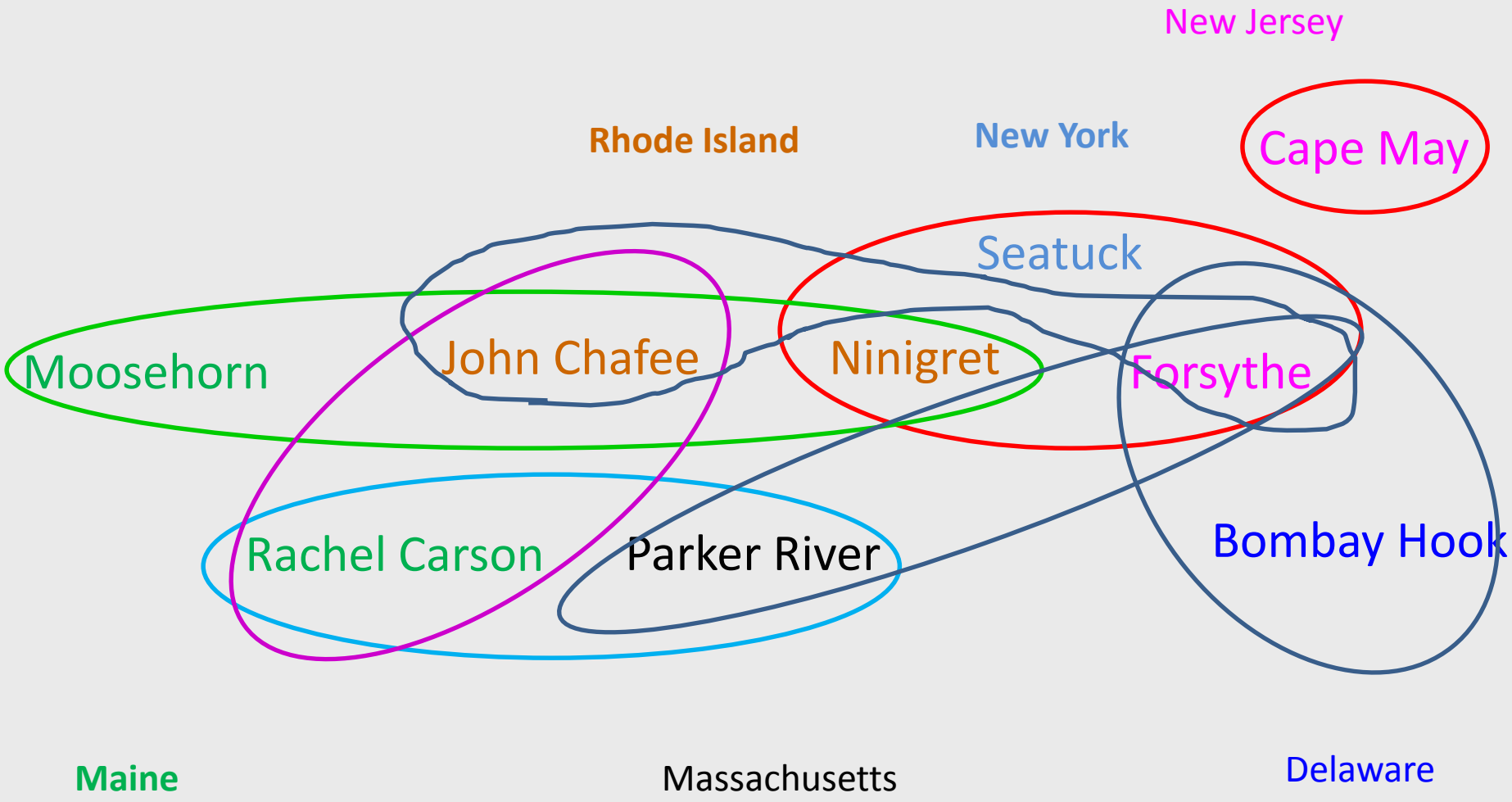
2013 Salinity



Vegetation: 2013 MDS Plot

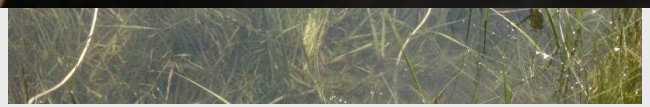


Vegetation: 2013 Anosim Results

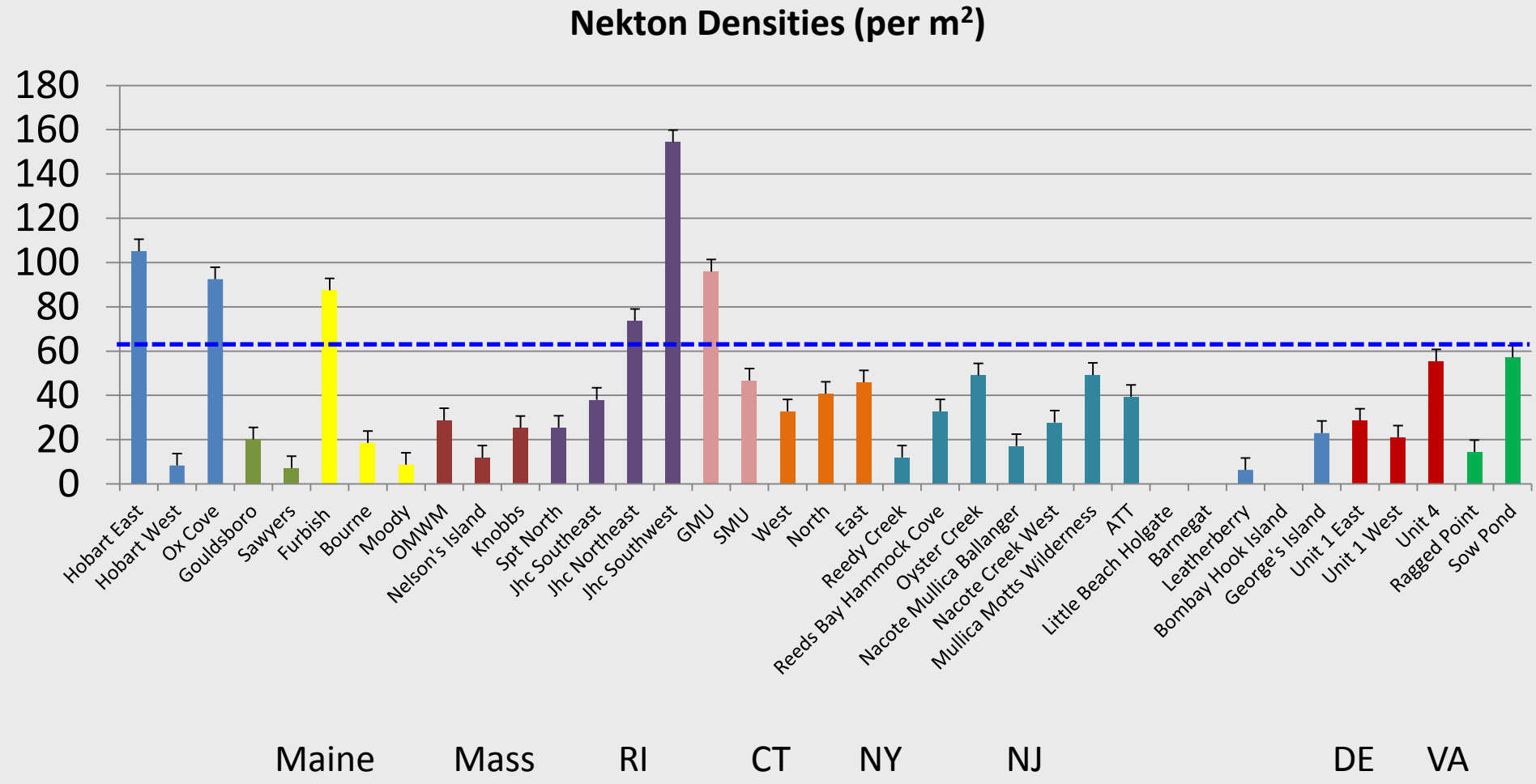


Nekton Sampling

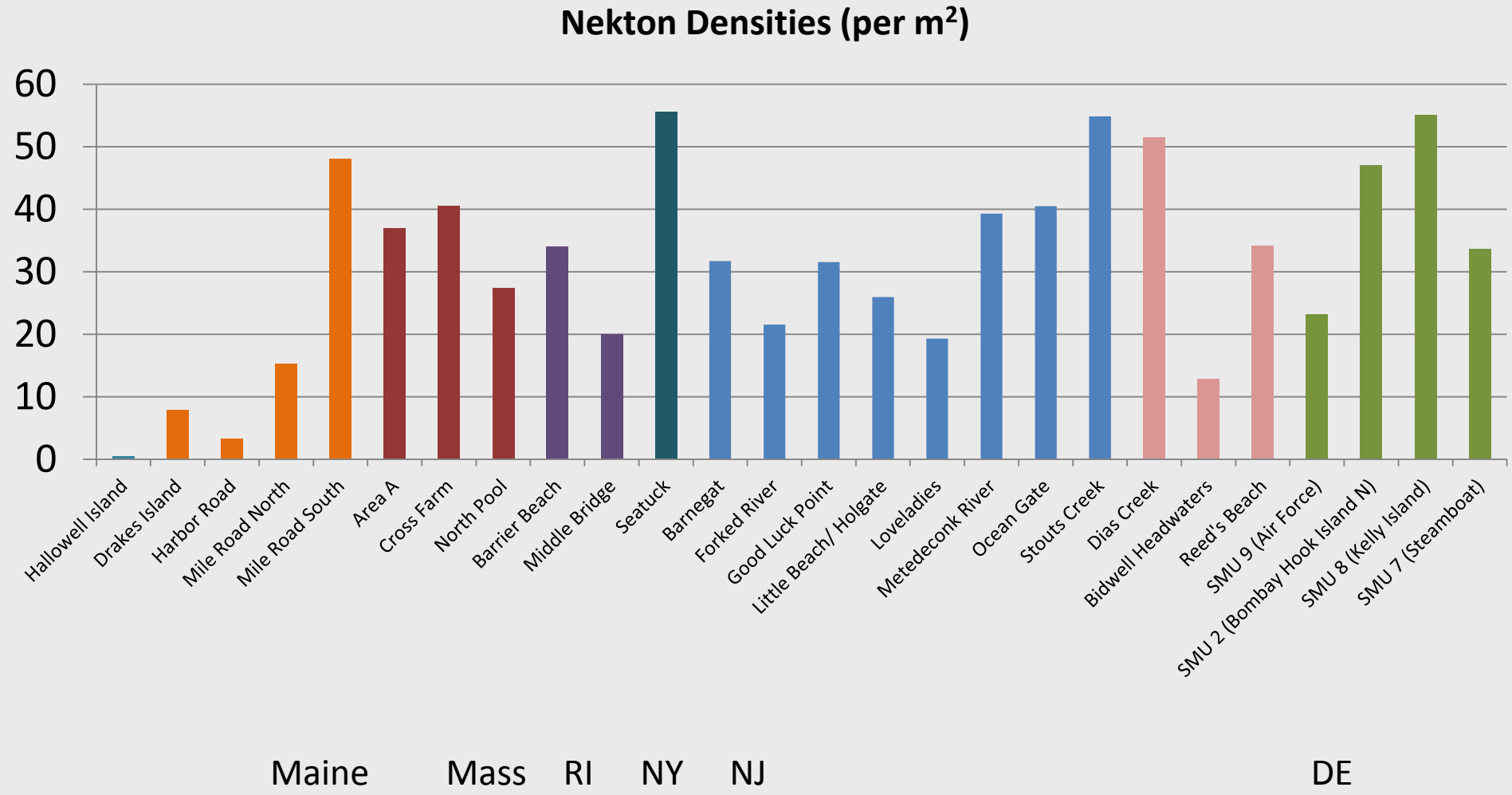
20 **Nekton** samples per SMI Unit
Any combination of Ditch Net or Throw Trap



Nekton: 2012 Results



Nekton: 2013 Results



Nekton: 2013 Anosim Results

Rhode Island

New York

New Jersey

Alosa pseudoharengus

Moosehorn

Seatuck

John Chafee

Ninigret

Forsythe

Cape May

Parker River

Rachel Carson

Fundulus heteroclitus

Bombay Hook

Maine

Massachusetts

Delaware

Summary

- Rapid assessment of vegetation allows broad brush comparison of salt marsh units within and among refuges
  - Individual refuges mostly have <10spp; but cumulatively there 25 spp were sampled
  - Anosim analysis revealed some unexpected relationships that deserve further exploration

Summary Cont.

- Nekton
  - Maximum densities might have been influenced by dry conditions (concentrating) in 2012
  - What's going on with difference between Chafee and Ninigret? (One is riverine estuary, one a coastal pond!) But is the difference that large?

Next Steps

- This exploratory step will be helpful to our efforts to develop decision tools for managers
  - Identify items for further exploration
  - Identify potential outliers and relationships
- Continue to work toward developing the SDM decision tool
- Hurricane Sandy funding will allow us to complete our baseline data gathering by 2017.

Acknowledgements

Field Crews from 13 National Wildlife Refuges in 2008, 2009, 2012, 2013

Project Developers: USFWS, USGS, Univ DE

U.S. FISH & WILDLIFE SERVICE

NATIONAL WILDLIFE REFUGE SYSTEM

USGS

Saltmarsh Habitat & Avian Research Program

MAINE

UCONN

UNIVERSITY OF DELAWARE

1865 THE UNIVERSITY OF MAINE

Audubon

National Estuarine Research Reserve System
System-Wide Monitoring Program (SWMP)

Paul E. Stacey
Great Bay National Estuarine Research Reserve
New Hampshire Fish & Game Department
3 December 2014

NBCC – Marsh Migration Modeling and Policy Workshop

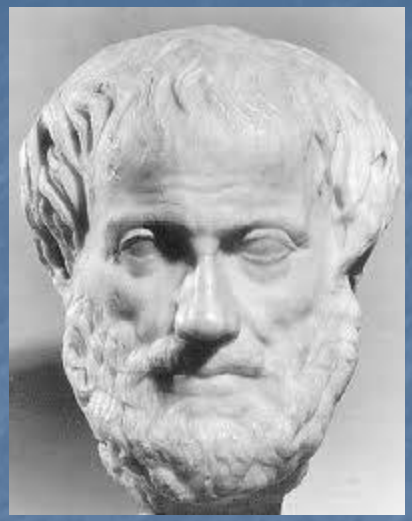
GREAT BAY NATIONAL ESTUARINE RESEARCH RESERVE

FISH GAME

Design with Nature

Estuarine Management is like a box of chocolates. You never know what you're going to get…

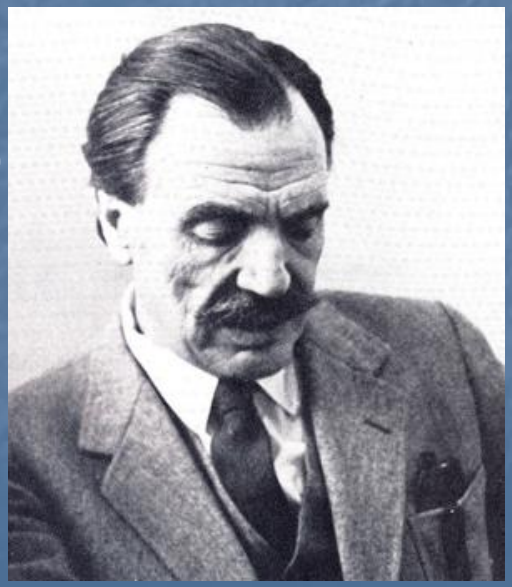
Anything New Here?



Aristotle 384-322 BC

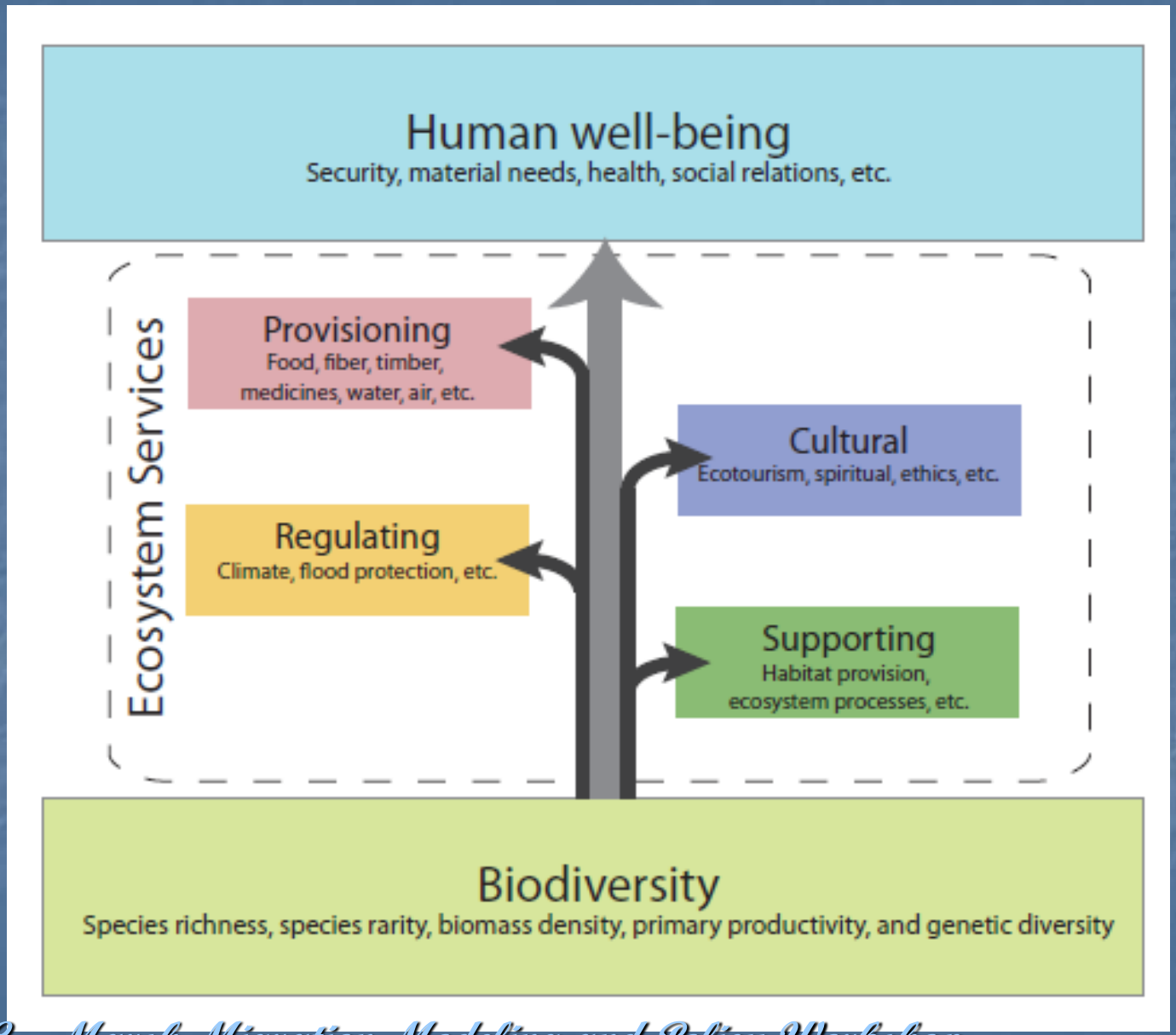
"Nature does nothing uselessly"

McHarg 1920 - 2001 AD



To become the stewards of the biosphere, we must design with Nature

Ecosystem Services Framework



Ewing, B., et al. 2010. Global Footprint Network.

Ecosystem Services

"**Ecosystem Services** are the direct or indirect contributions from ecosystems that help *support*, *sustain*, and *enrich* human life" (Yoskowitz, et al. 2010).

Cultural Services

Provisioning Services

Regulating Services

Supportive Services

Perceived Value to Humans

Plantier Santos, 2010

Shared Resources

Trade-offs Collectively Impact:

- Society
- Economy
- Environment

NERRS Reserves

Research Reserve System

Northeast

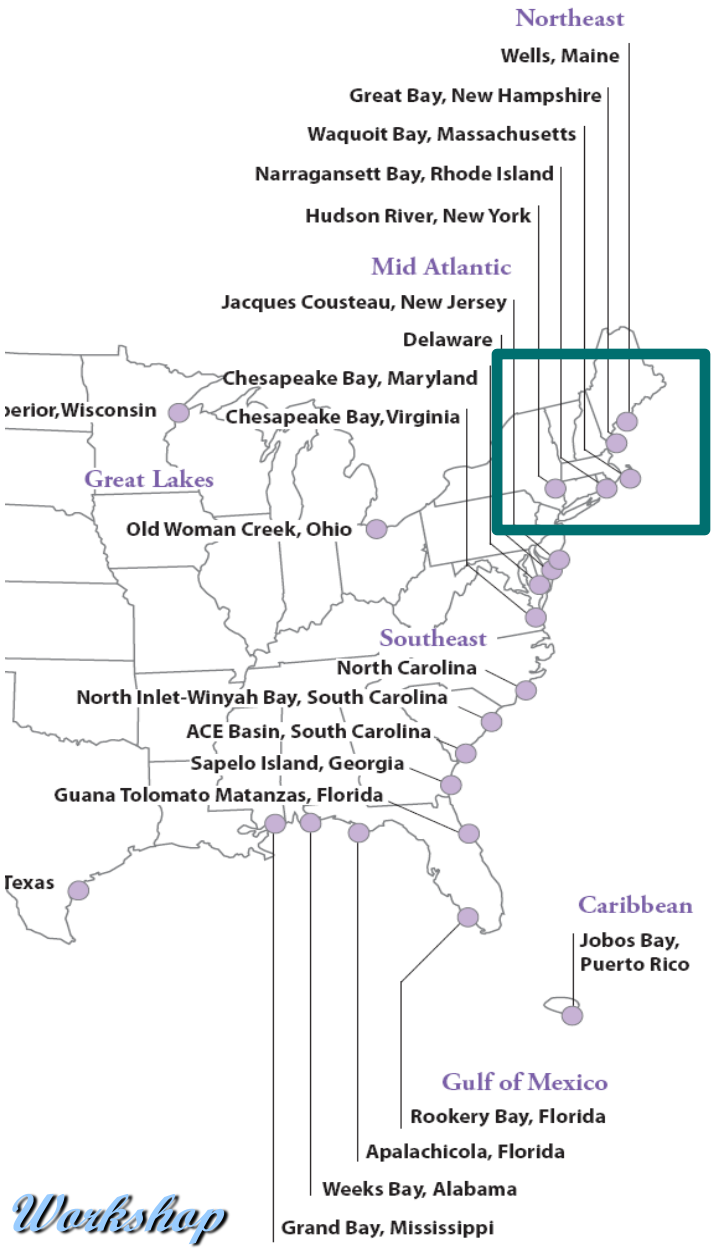
Wells, Maine

Great Bay, New Hampshire

Waquoit Bay, Massachusetts

Narragansett Bay, Rhode Island

Hudson River, New York



National Estuarine Research Reserve System

SYSTEM-WIDE MONITORING PROGRAM PLAN

WHAT IS "SWMP"?

To better meet its public trust responsibilities, the NERRS has established a System-Wide Monitoring Program (SWMP) with a primary mission to:

Develop quantitative measurements of short-term variability and long-term changes in the water quality, biological systems, and land-use / land -cover characteristics of estuaries and estuarine ecosystems for the purposes of informing effective coastal zone management.

NERRS has identified three fundamental questions that information provided by SWMP should address:

- How do environmental conditions vary through space and time within the network of NERRS sites?
- How does ecosystem function vary through space and time within critical NERRS habitats?
- To what extent are changes in estuarine ecosystems represented by the NERRS attributable to natural variability versus anthropogenic activity?

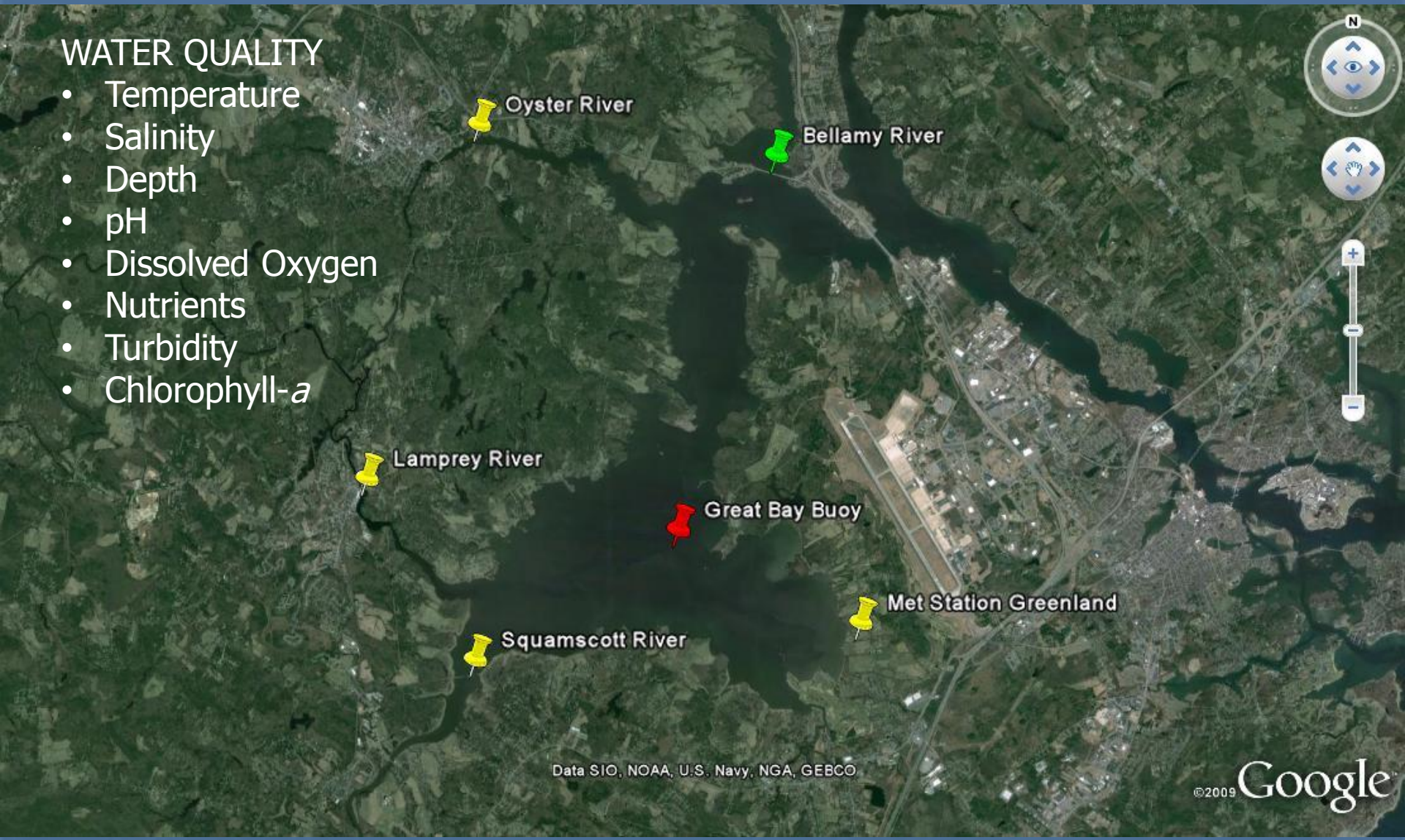
Monitoring at GBNERR

- Monitoring Goal:
  - To comprehensively monitor the chemical, physical and biological attributes of Great Bay and its watershed to:
    1) effectively track trends of key indicators;
    2) support research efforts to better understand the Great Bay ecosystem's structure and function; and
    3) to inform managers of necessary actions to protect and restore Great Bay and the natural resources and ecosystem services it provides.

Research and Monitoring Outcome Priorities

- Watershed Model
- Hydrodynamic Model
- Water Quality Model
- Habitat Models
- Ecosystem Response Indicators

SWMP Core Components – Water Chemistry



SWMP Core Compo…try

WATER QUALITY
- Temperature
- Salinity
- Depth
- pH
- Dissolved Oxygen
- Nutrients
- Turbidity
- Chlorophyll-*a*

Oyster Riv…

Lamprey River

Squamsco…

Data SI…

Monitoring Programs and Needs in the Piscataqua Region Estuaries

Monitoring Partnerships:
- University of New Hampshire
- Piscataqua Region Estuaries Partnership
- Great Bay National Estuarine Research Reserve
- NH Dept. of Environmental Services
- NH Fish and Game Department
- Seabrook Station

Multiple Benefits of Monitoring:
- Trend detection
- Adaptive management
- Research
- Regulatory compliance
- Restoration planning

Legend

PREP Watershed
Town Boundaries

Sampling Stations
- Datasondes
- Estuary Water Quality
- River Water Quality
- Mussel Tissue for Toxic Pollution
- Oyster & Clam Populations
- Diadromous Fish Returns
- Beach Water Quality Monitoring

Funding Status
- Fully Funded
- Under Funded
- Not Funded

Eelgrass Habitat Monitoring:
Eelgrass is a submerged aquatic plant that provides essential habitat for fish, shellfish, waterfowl, and other animals. The boundaries of eelgrass habitat in the Piscataqua Region Estuaries are mapped each year.

Impervious Surface Monitoring:
Parking lots, roadways, and building roofs prevent rain water from infiltrating into the ground, increase pollutant loads and runoff during storms. Impervious surfaces in towns of the Piscataqua Region watershed are calculated using satellite imagery every five years.

Rochester
Berwick
Somersworth
South Berwick
Rollinsford
Dover
Madbury
York
Eliot
Nottingham
Durham
Lee
Kittery
Newington
Portsmouth
New Castle
Greenland
Stratham
Rye
North Hampton
Hampton
Hampton Falls
Seabrook
Amesbury
Salisbury
Atlantic Ocean
Great Bay
Little Bay
Portsmouth Harbor
Hampton-Seabrook Harbor

0 0.5 1 2 3 Miles

PISCATAQUA REGION Estuaries Partnership

NROC – Marsh Migration Mode…

Google

SWMP Core Components – Biomonitoring

NERRS SWMP Vegetation Monitoring Protocol

Long-term Monitoring of Estuarine Vegetation Communities

National Estuarine Research Reserve System
Technical Report

Vegetation Monitoring Workgroup
Chair, Dr. Kenneth Moore, Research Coordinator
Chesapeake Bay National Estuarine Research Reserve System in Virginia
Gloucester Point, VA 23062

9/6/2013

SWMP – Saltmarsh Vegetation Bioindicator

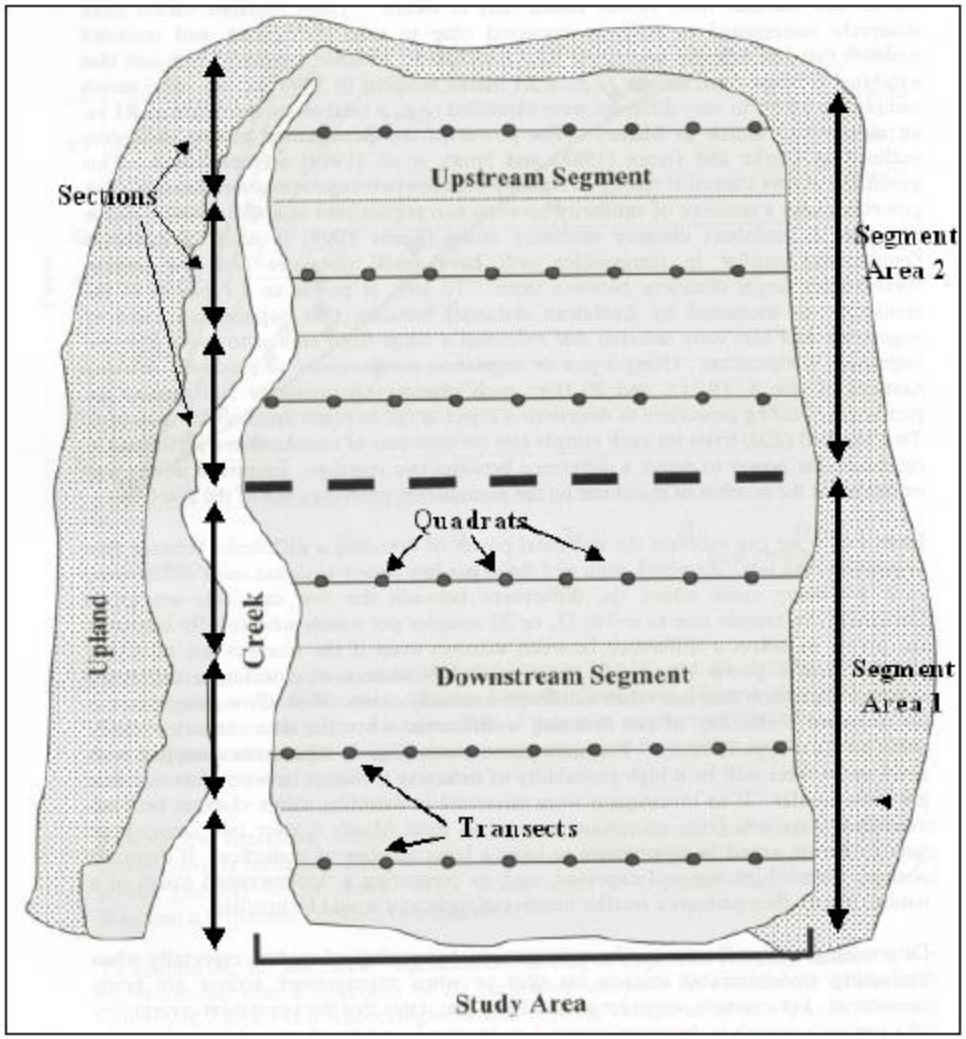
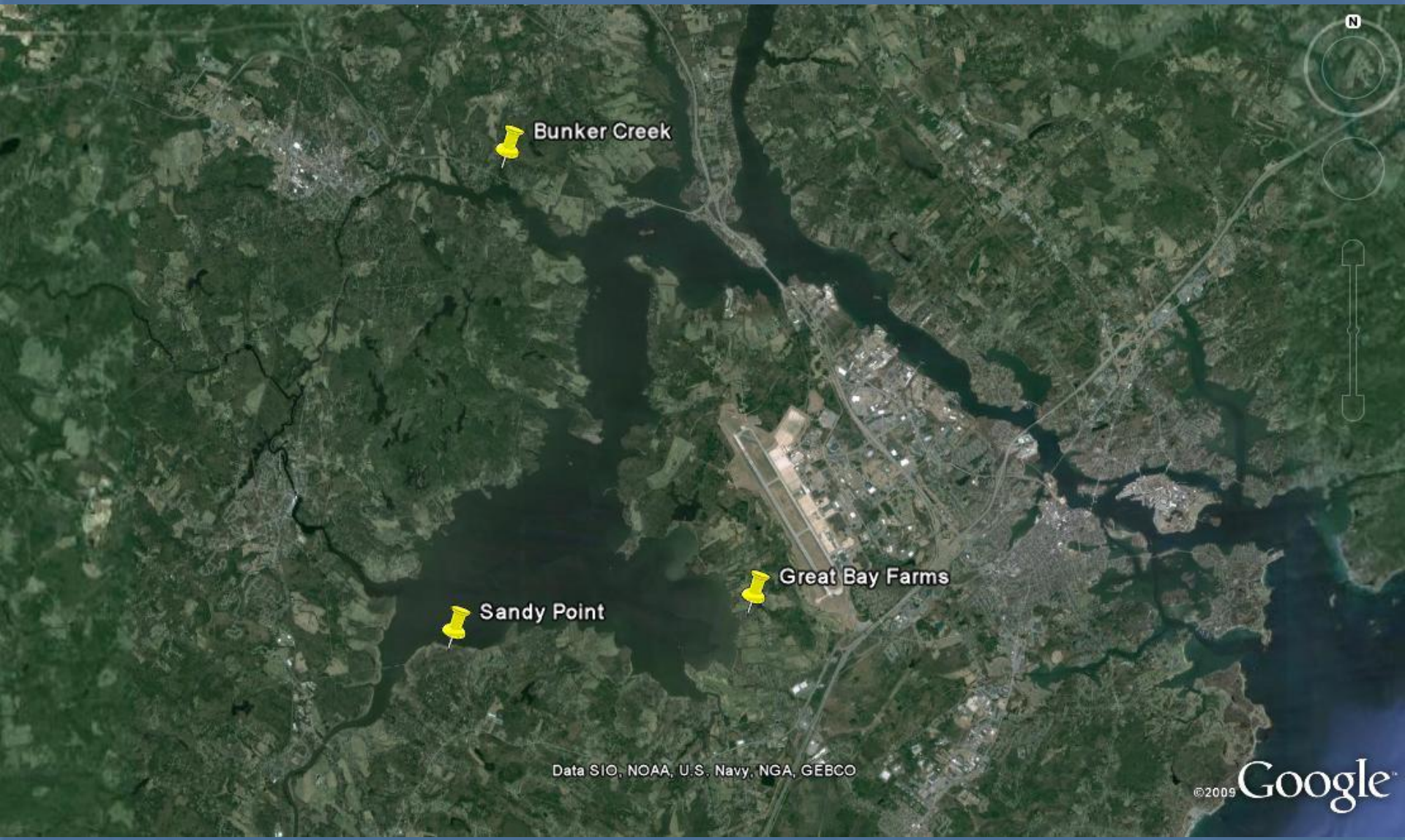
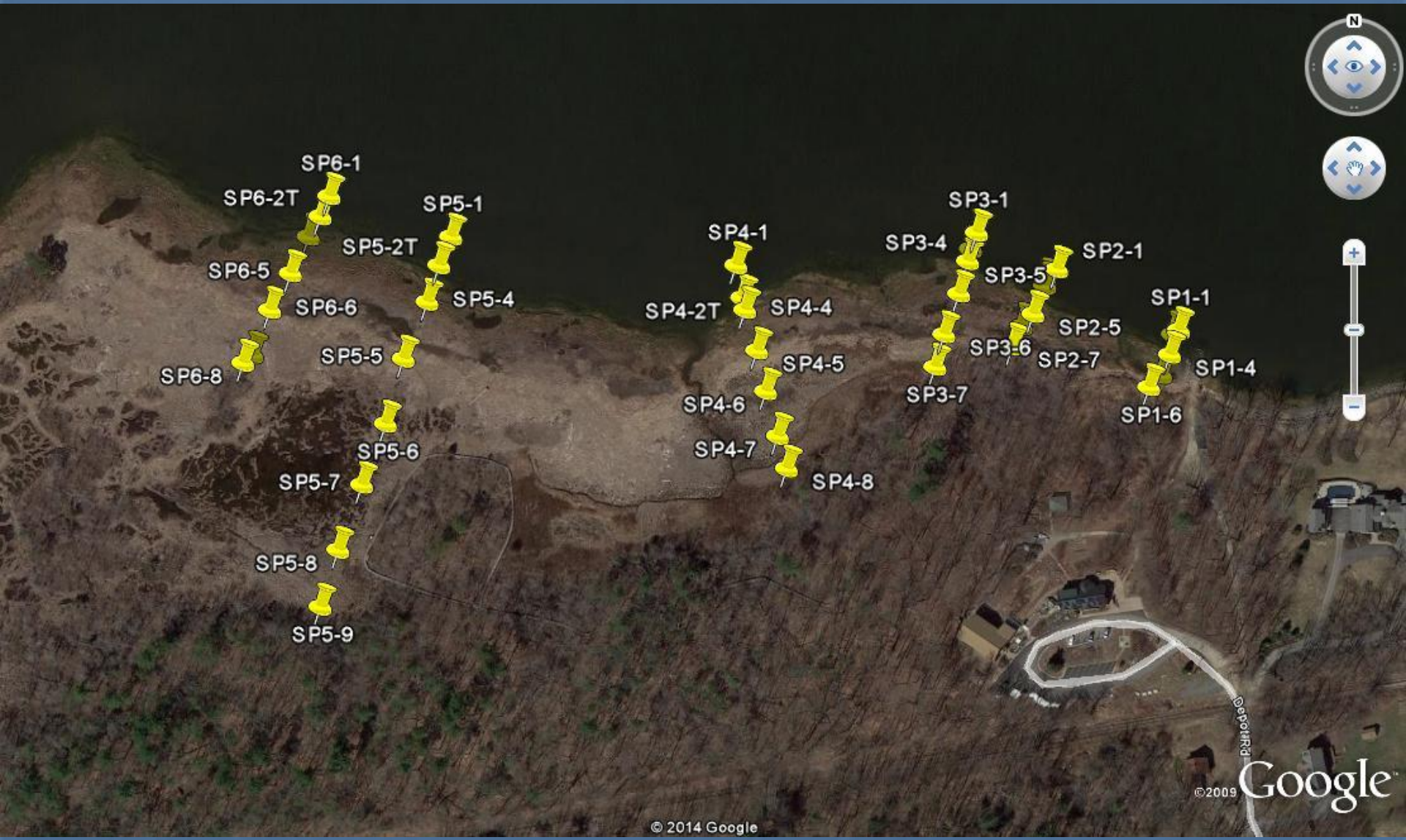


Figure 1. Emergent Marsh Sampling Design (from Roman et al. 2001).

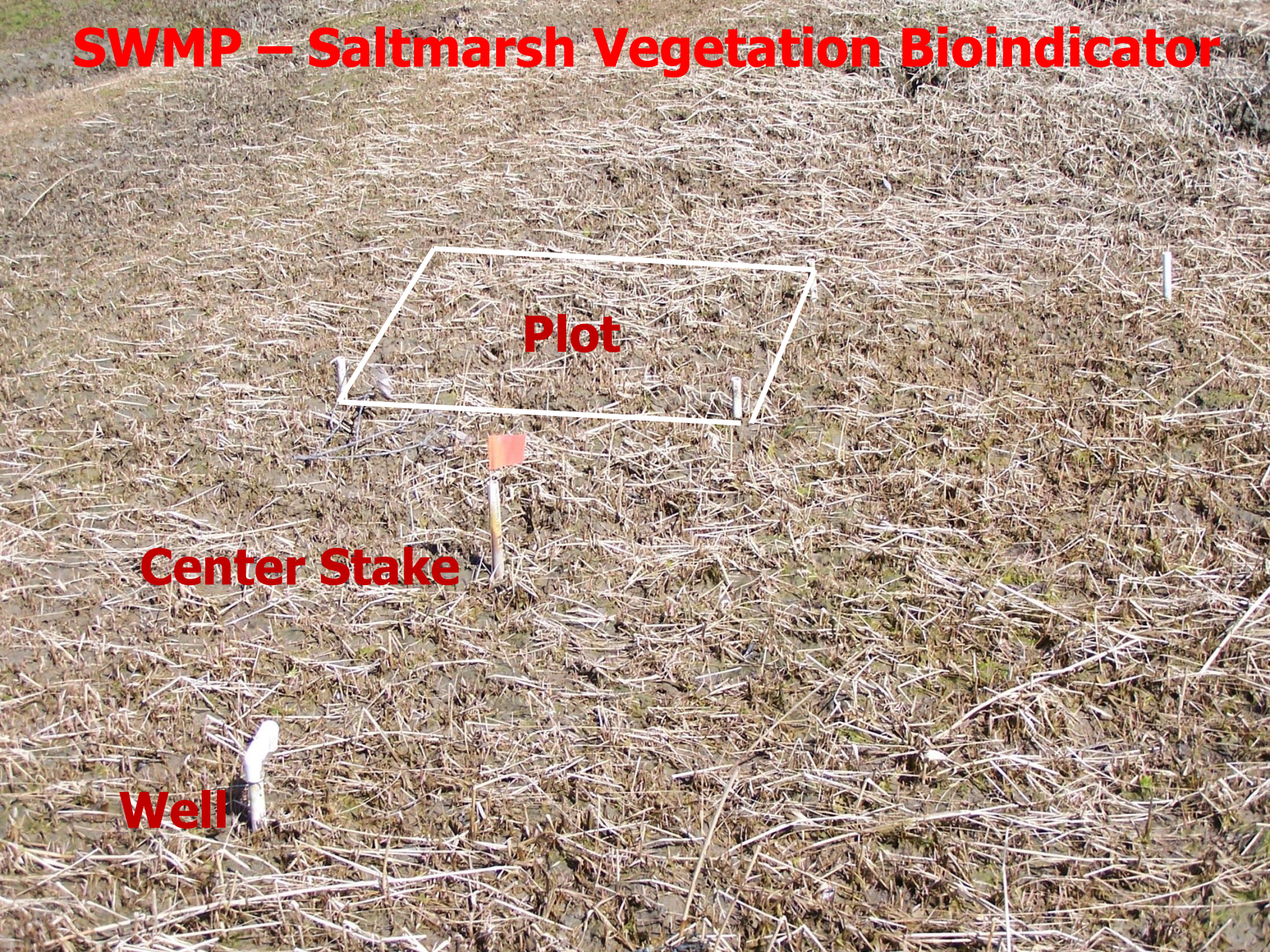
SWMP – Saltmarsh Vegetation Bioindicator



SWMP – Saltmarsh Vegetation Bioindicator



SWMP – Saltmarsh Vegetation Bioindicator



SWMP – Saltmarsh Vegetation Bioindicator

Field Data Sheet

Locational

Date:	Starting Time:	Field Team:
Site: Bunker Creek	Transect: 1	Plot: BC 1-1
Habitat: Low	Latitude (D M): 43 08.090	Longitude (D M): 70 53.228
Distance from Water (m): 9.3	Distance to Next Plot (m): 30	Weather:

Water Measurements

Parameter (cm to 0.5)	Last	Today	Parameter (cm to 0.5)	Last	Today
Well Top to Soil	15		Well Top to GW Depth	14	
Well Top to Standing Water	14		Salinity (PPT)	25	

Vegetation Metrics

Non Vegetation (%):	Last	Today	Non Vegetation (%):	Last	Today
Bare Mud	50		Wrack		
Dead			Water		

Canopy Height/Stem Count:	Last				Today			
	Percent	Stems	Canopy	Quad	Percent	Stems	Canopy	Quad
Distichlis spicata								

SWMP – Surface Elevation - SET

SWMP – Bioindicator Development

NROC – Marsh Migration Modeling and Policy Workshop

SWMP – Vertical Control

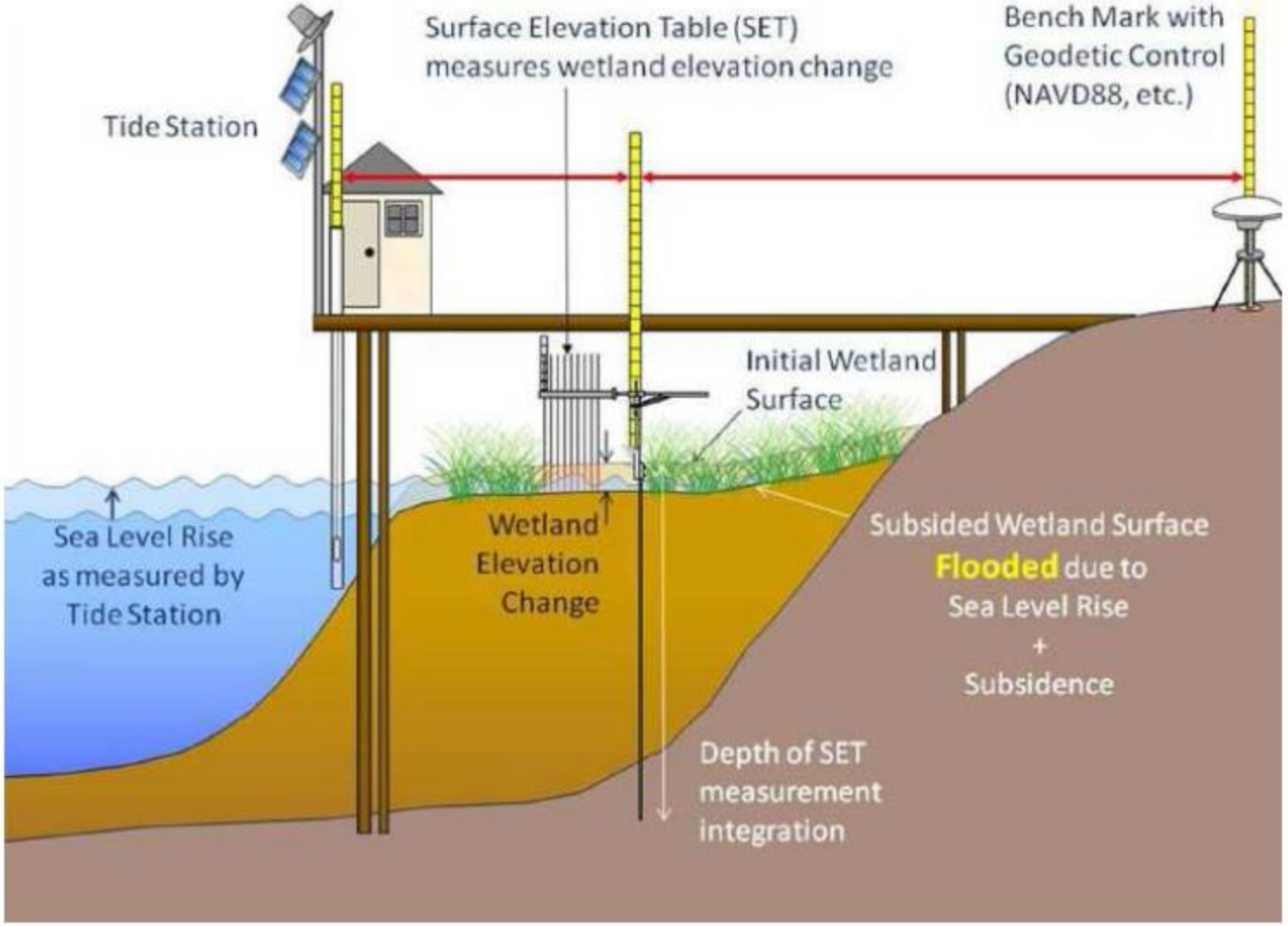


Figure 1. Core elements schematic of vertical control infrastructure necessary to measure sea level relative to land and wetland elevation change relationships.

Drivers of Ecosystem Change

- Climate Change
- Development
- Food and Fiber Production
- Resource Extraction and Relocation (Water, Minerals, Energy)
- Ecosystem Instability (Invasives, Extinctions, Pestilence, Range and Regime Shifts)

Great Bay NERR
Priority Issues and Research Needs

- Understanding and Adapting to Climate Change
- Restoring and Preserving Habitat and Ecosystem Functions
- Protecting and Restoring Water Quality

NERRS CORE INDICATORS – CLIMATE CHANGE APPLICATION

STRESSOR	PHYSICAL	CHEMICAL	BIOLOGICAL
Temperature	Air Water	Dissolved Oxygen Nutrients	Chla/Productivity Peri/Phyto-plankton Salt Marsh Veg. SAV/Macroalgae Nekton
Weather • Precipitation • Extreme Events - Flood - Wind	Hydrology/ Hydrodynamics Salinity Temperature Erosion/ Sedimentation	Salinity Nutrients	Chla/Productivity Peri/Phyto-plankton Salt Marsh Veg. SAV/Macroalgae Nekton
Sea Level Rise	Level Sensors SETs Salinity Erosion/ Sedimentation	Salinity	Upland Veg. Salt Marsh Veg. SAV/Macroalgae Nekton
Carbon Dioxide		pH Dissolved Oxygen	Chla/Productivity

NERRS Synthesis: Measure of Marsh Sustainability Against SLR

- Vegetation Distribution (How low?)
- Marsh Elevation Change (SET data/SLR)
- Sediment Accretion Rate
- Turbidity
- Tidal Range (Low Range more susceptible)
- Sea Level Rise

Integrated Sentinel Monitoring Network for Climate Change in the Northeastern U.S. Coastal Ecosystems

Presented by:
Members of the
Integrated Sentinel
Monitoring Network

Integrated Sentinel Monitoring Network Vision and Goals

Vision

Our vision is to create and sustain an adaptive sentinel monitoring and data management program that informs researchers, managers and the public about ecosystem status and vulnerabilities and supports an integrated, ecosystem-based management framework for adaptive responses to climate change and related ecosystem pressures.

Paul E. Stacey
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Great Bay National Estuarine
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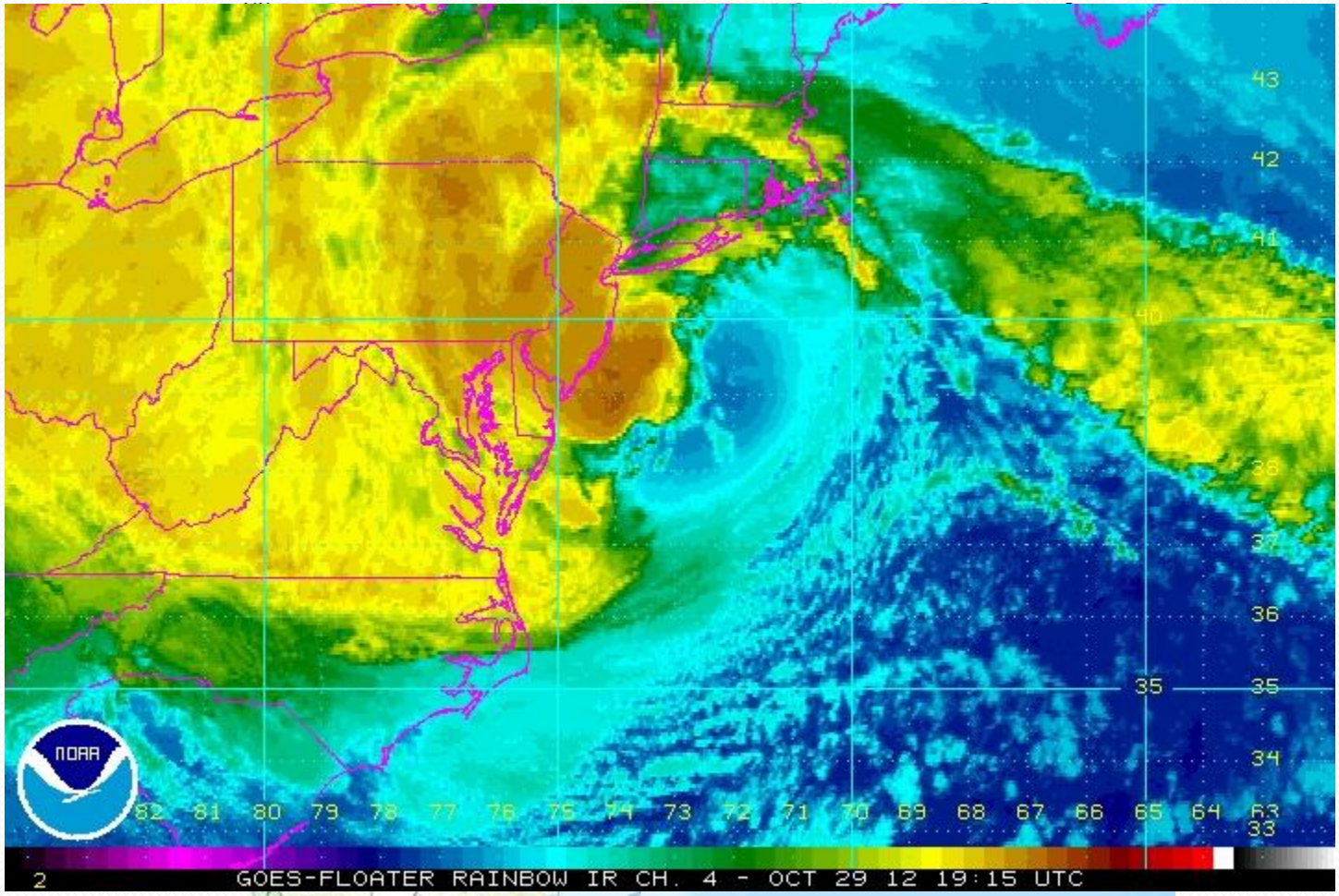
NROC – Marsh Migration Modeling and Policy Workshop

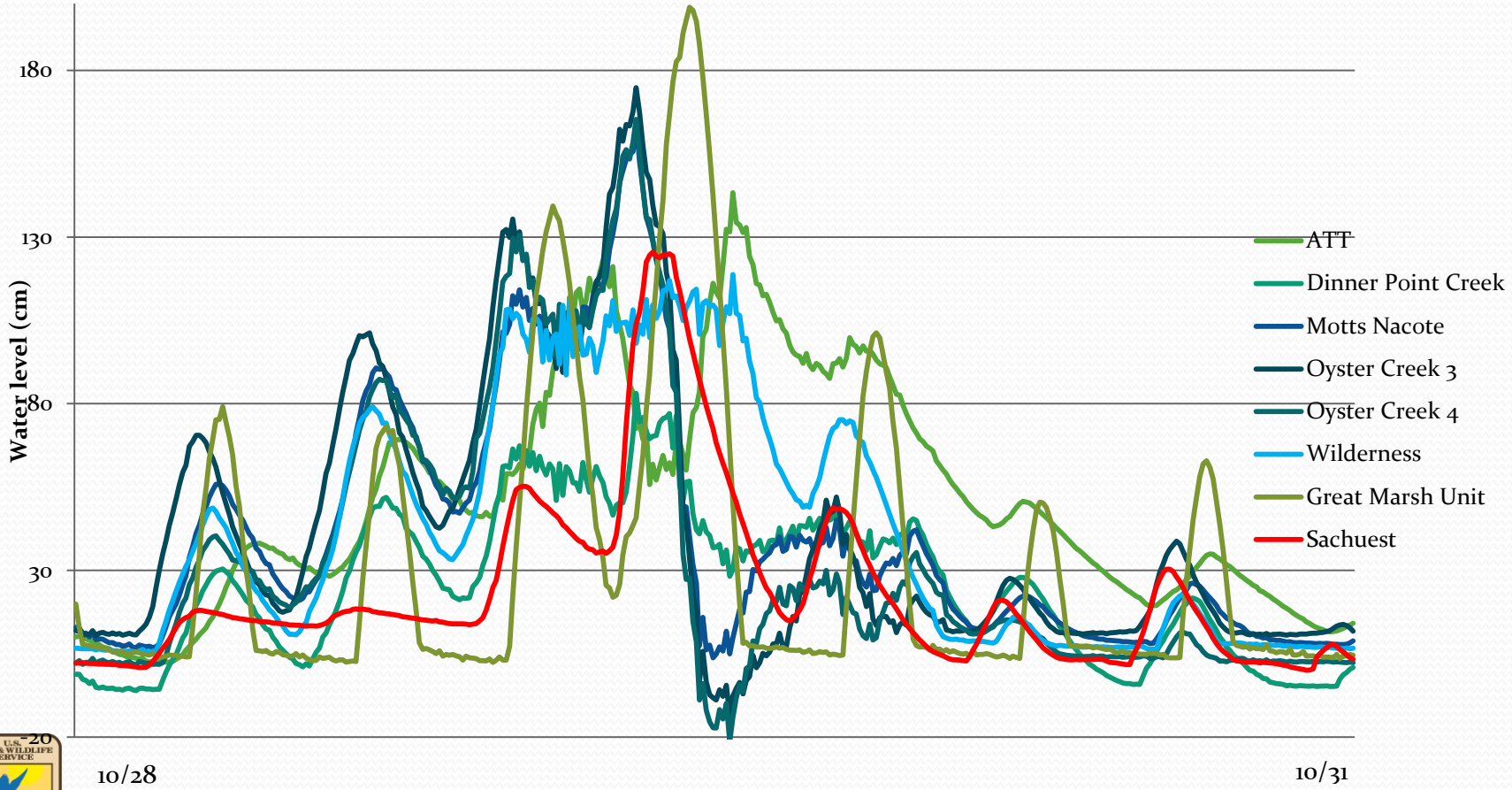
Hurricane Sandy Resiliency Projects: US Fish and Wildlife Service

Susan C. Adamowicz, USFWS
Rachel Carson National Wildlife Refuge
Susan_adamowicz@fws.gov

Hurricane Sandy 2012



Storm Surge Recorded at Different National Wildlife Refuges: NJ to RI



Storm's Aftermath

How to increase marsh resilience?

Recovery & Resiliency

- Following the storm, Congress provided 475M for immediate clean-up and restoration
- Over $300M was provided toward projects to increase the resilience of coastal systems and to protect coastal communities
  - FWS was granted $102M for 31 resilience projects
  - And $65M for debris removal, rebuilding

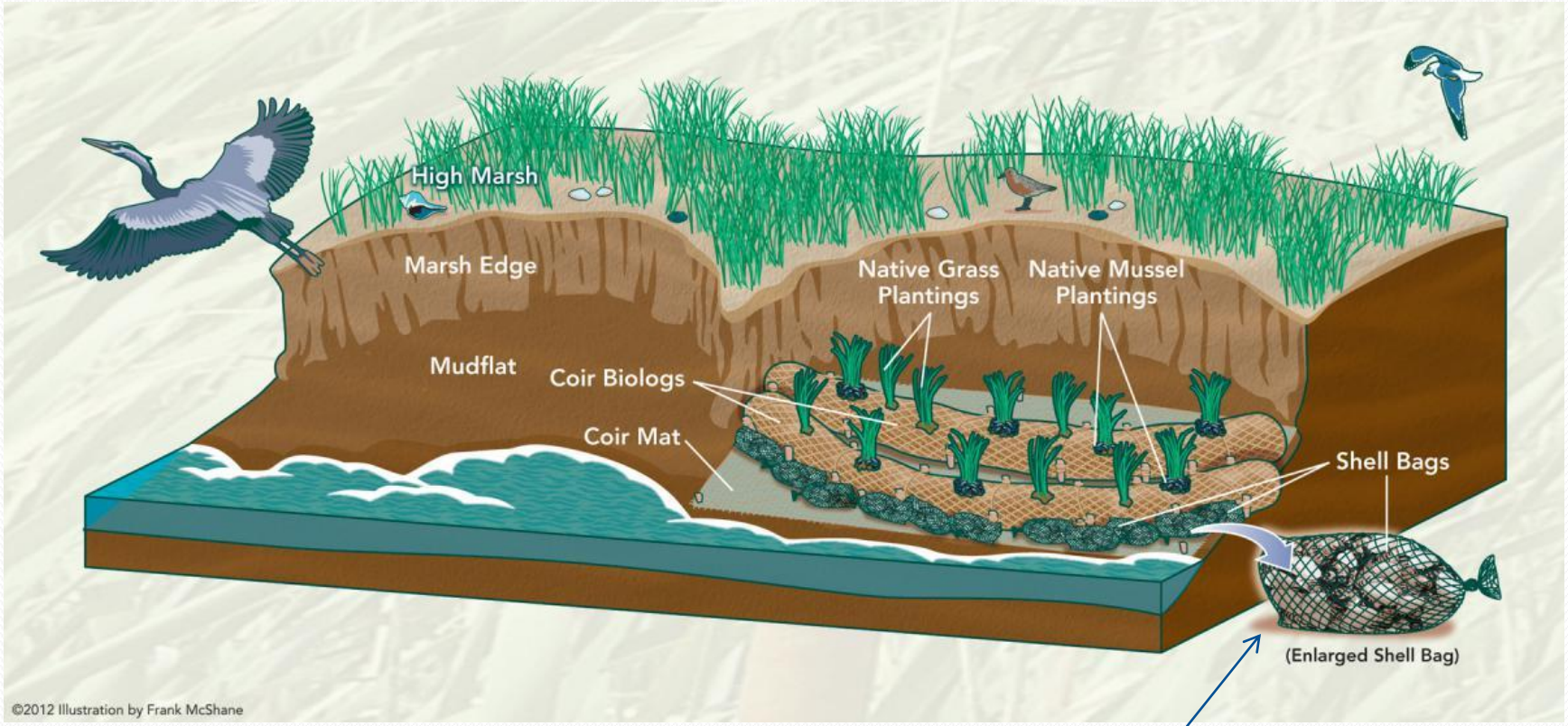
Resiliency Techniques

- Dam Removal
- Breachway Closure
- Living Shoreline
- Thin Layer Deposition
- Runnels
- Invasive Species Control
- Innovative/ Other
  - Ditch remediation
  - Innovative Phrag Control
  - Telephone Pole and Cable Removal

Breachway Closure

- Prime Hook NWR (freshwater waterfowl impoundment built on salt marsh was breached by storm surge → loss of vegetation (Phrag), elevation , incr risk to community
  - Close breachway
  - Restore salt marsh in designated locations
  - Re-jigger previously jiggered tidal channels to permit better tidal flooding AND drainage

Oyster Reef/ Living Shoreline



Shell bag, oyster castles

Living Shoreline

Coir Log

Stone Barrier

Thin Layer Deposition

RI, LI, NJ, DE

Silt slurry, DE

Runnels

Improperly impounded water, Narrow River

Innovative: Ditch Remediation

Ditch with salt hay

New S. alterniflora growth

April 2011,
Aug 2011,
Aug 2012

Innovative: Phrag Control

Innovative:
Pole and Cable Removal

Resiliency Project Contacts

- Matt Whitbeck: Chesapeake Bay
- Susan Guiteras: DE
- Nick Ernst: RI
- Boze Hancock, RI
- Paul Castelli: NJ
- Kevin Holcomb: VA
- Georgia Basso: Monitoring & Regional Considerations

Test of time….

For Continuing Information on FWS Projects go to:
http://www.fws.gov/hurricane/sandy/

For a list of Partner Projects go to:
http://www.nfwf.org/hurricanesandy/Documents/2014-grants-list-v2.pdf

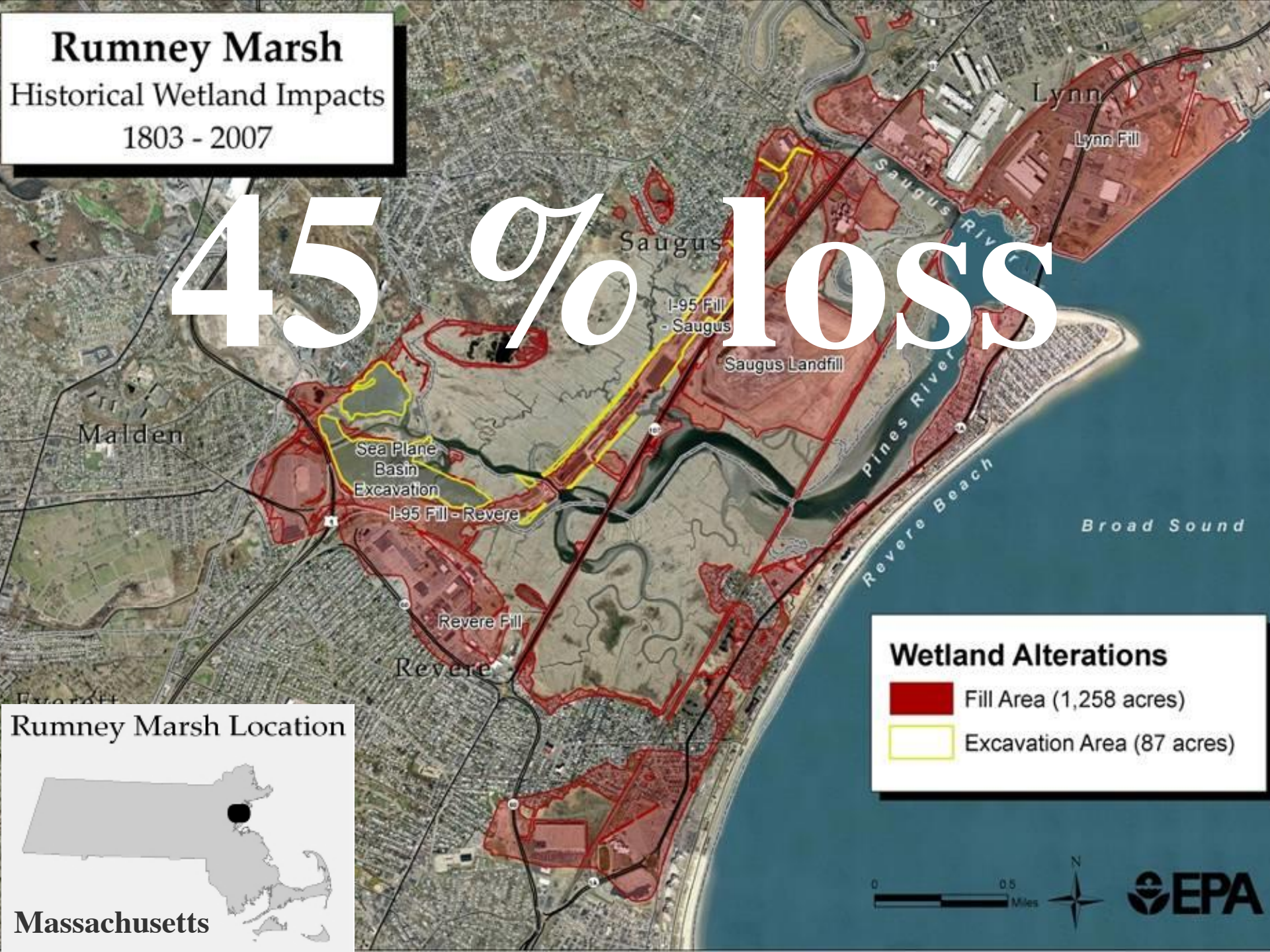
Restoration of Tidally Restricted Salt Marshes at Rumney Marsh, Revere, Massachusetts: Balancing Flood Protection with Marsh Restoration by use of Self-Regulating Tide Gates

Edward Reiner - EPA New England

NROC Marsh Migration Workshop
December, 3, 2014
Greenland, NH

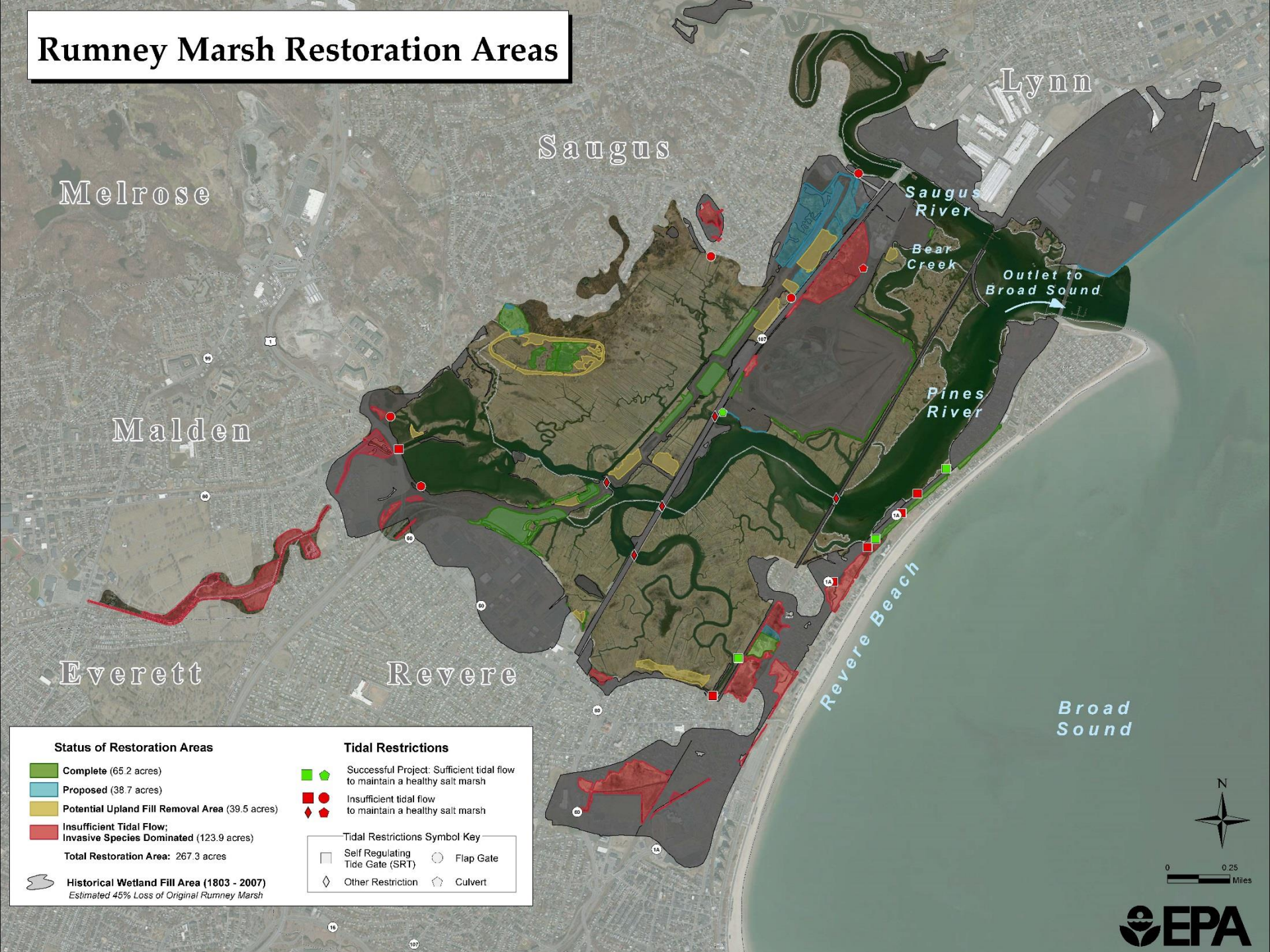
Disclaimer

This presentation represents the views of the author and does not necessarily reflect the position of the U.S. Environmental Protection Agency. No official endorsement by EPA is intended or inferred.


Rumney Marsh
Historical Wetland Impacts
1803 - 2007
45 % loss
Lynn
Lynn Fill
Saugus River
Saugus
I-95 Fill - Saugus
Saugus Landfill
Pines River
Malden
Sea Plane Basin Excavation
I-95 Fill - Revere
Revere Beach
Broad Sound
Revere Fill
Revere
Wetland Alterations
Fill Area (1,258 acres)
Excavation Area (87 acres)
Rumney Marsh Location
Massachusetts
0
0.5
Miles
N
EPA


Tidal Restrictions
Successful Project: Sufficient tidal flow to maintain a healthy salt marsh
Insufficient tidal flow to maintain a healthy salt marsh
Tidal Restrictions Symbol Key
Self Regulating Tide Gate (SRT)
Flap Gate
Other Restriction
Culvert
Saugus
Saugus River
Bear Creek
Outlet to Broad Sound
Pines River
Revere Beach
Broad Sound
Revere
1
60
107
1A
N
0
0.1
Miles
EPA

Rumney Marsh Restoration Areas



Status of Restoration Areas

- **Complete** (65.2 acres)
- **Proposed** (38.7 acres)
- **Potential Upland Fill Removal Area** (39.5 acres)
- **Insufficient Tidal Flow; Invasive Species Dominated** (123.9 acres)
- **Total Restoration Area:** 267.3 acres
- **Historical Wetland Fill Area (1803 - 2007)**
  Estimated 45% Loss of Original Rumney Marsh

Tidal Restrictions

- Successful Project: Sufficient tidal flow to maintain a healthy salt marsh
- Insufficient tidal flow to maintain a healthy salt marsh

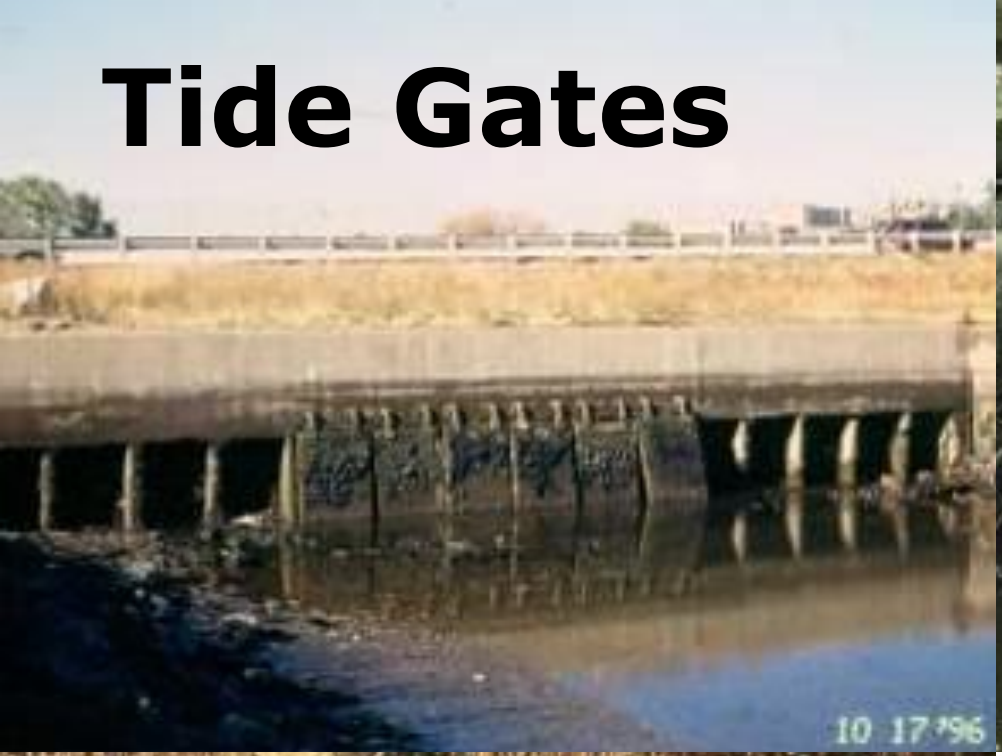
Tidal Restrictions Symbol Key

- Self Regulating Tide Gate (SRT)
- Flap Gate
- Other Restriction
- Culvert

EPA

I-95 Abandoned Embankment

Tide Gates

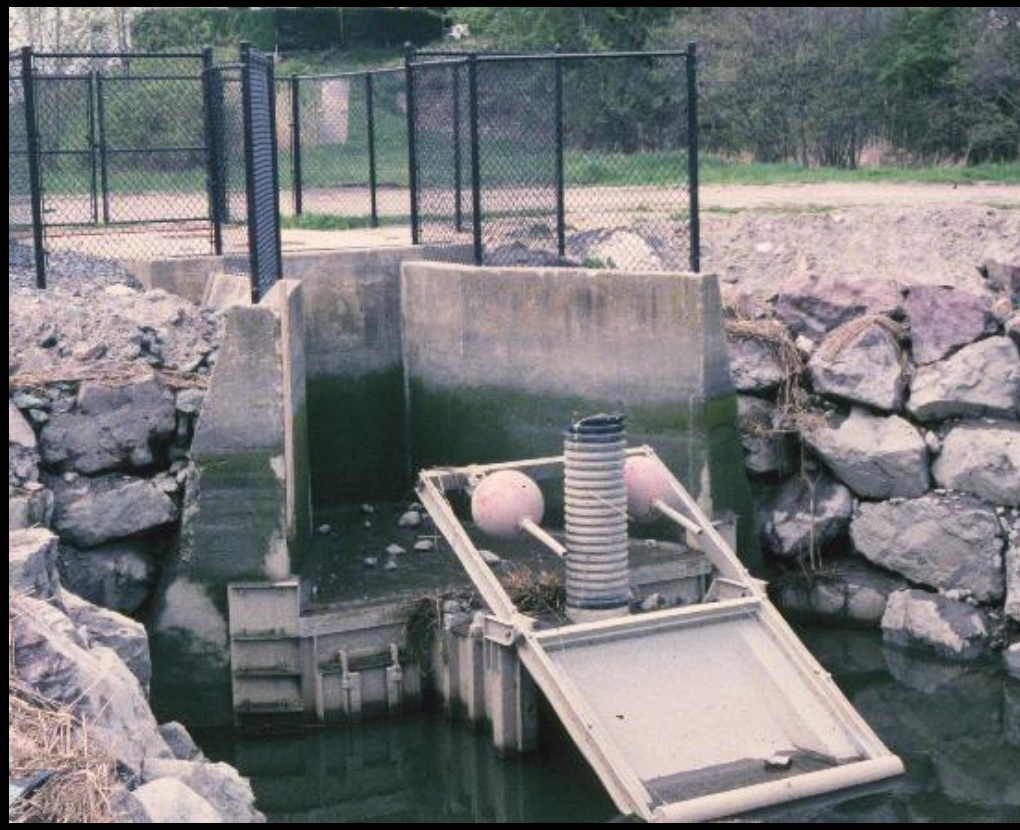


Salt Marshes Need Salt Water

Phragmites

Standard Flap Gates Kill Salt Marshes Unless They Leak *a lot*

Self-Regulating Tidegates Provide Adjustable Tidal Flow



Restoration of Tidal Flows

- ✓ Central County Ditch - 1997
- ✓ Route 1A - 2000
- ✓ Town Line Brook – 2001
- ✓ Oak Island Marsh – 2003

Rumney Marsh has 11 SRT's in Revere

- x Ballard Street, Saugus – 2015 ?

Dense Stands of *Phragmites* Cause

Fire and Flood Problems

Trash Racks Require Cleaning

Failure to operate Tide Gate properly

Culvert Problems

Riprap Blocking Culvert Inlet

Culvert Outlet Blocked

Sediment Problems

SRT 3 Inlet

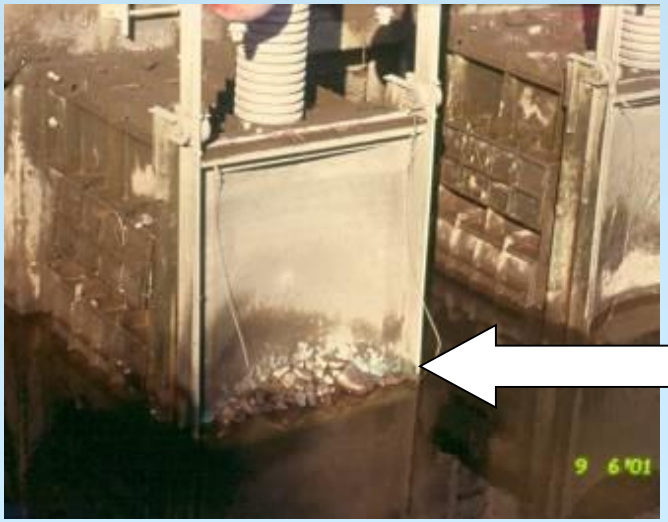
SRT 6 Outlet

Sediment Removal and Pipe Repairs are Needed

Vandalism

Rocks Block Pipe

Aluminum Grates and Parts Stolen



Rocks Thrown at SRT

Insufficient Culverts

Restored Creek

Route 1A Culverts 3, 5 & 6 Need Replacement

Culverts

24” Round Culvert
(inadequate flow)

New 48” Twin Box Culvert
(adequate flow)

Oak Island Combo Gate 2011

Erosion

Erosion is everywhere

Marsh Erosion

Erosion is evident in many New England Marshes

Low Marsh die off