NROC Council Meeting
Portsmouth, NH
May 21, 2015

Meeting Materials

This was the Spring NROC meeting, during which the EC and partners provided updates; the Sentinel Monitoring and Marsh Migration projects were highlighted; and a demo of EPA's RAINE tool was given. NROC was joined by representatives from CSO and the Army Corps for sessions on the NACCS model and issues surrounding offshore sand management.

Attached are the following materials and presentations from the meeting:

- Integrated Sentinel Monitoring Network for Change in Northeastern US Ocean and Coastal Ecosystems *(Brian Thompson, CT)*
- Make Ways for Marshes *(Peter Taylor, Waterview Consulting)*
- Resilience and Adaptation in New England (RAINE) (*Ivy Mlsna, EPA)*
- NACCS Model (*Mary Cialone, ERDC)*
- Responding to Waves of Change (*Howard Marlowe, Warwick Group Consulting*)

Integrated Sentinel Monitoring Network for Change in Northeastern U.S. Ocean and Coastal Ecosystems

Presented by:
Members of the Integrated Sentinel Monitoring Network

Northeast Regional Ocean Council, Portsmouth, NH

May 21, 2015

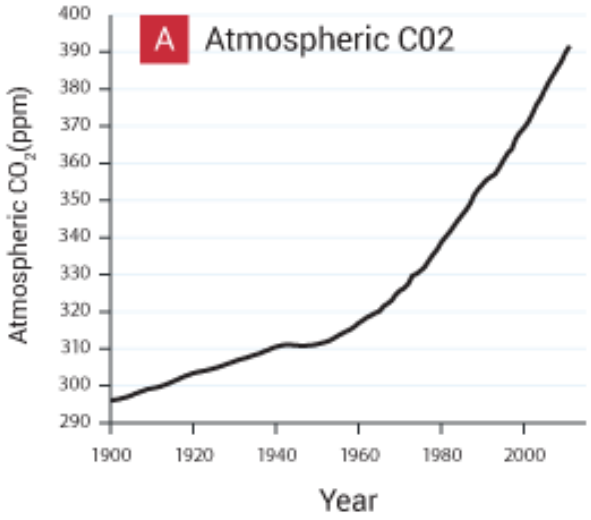
We love the coasts …. Too much

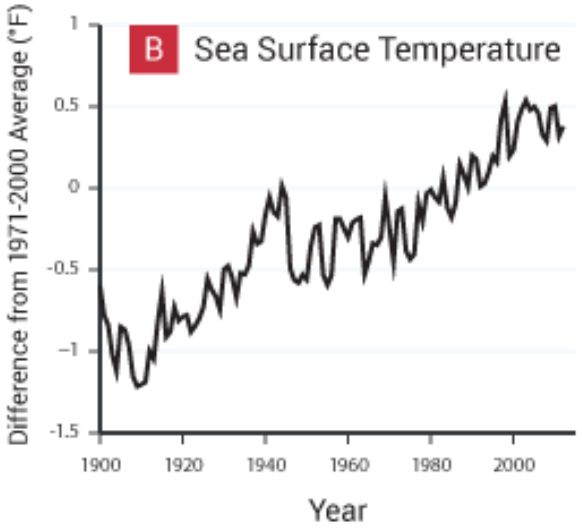
Image source: http://www.icleiusa.org/climate_and_energy/Climate_Adaptation_Guidance/groton-connecticut-coastal-climate-adaptation-workshop-meeting-notes-and-presentations

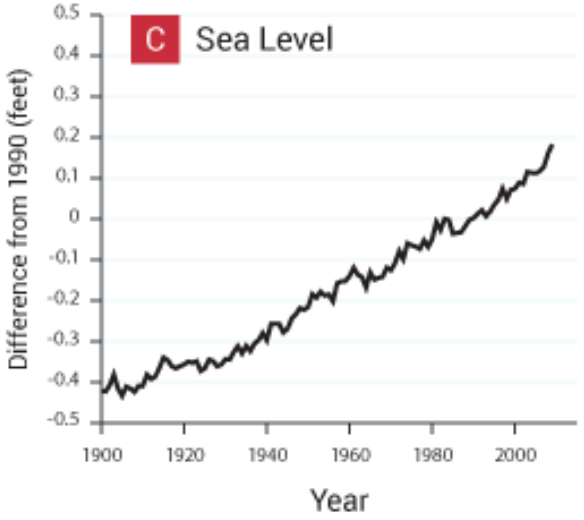
We have used the coasts to live, do business, discharge sewage, extract resources, and alter habitat

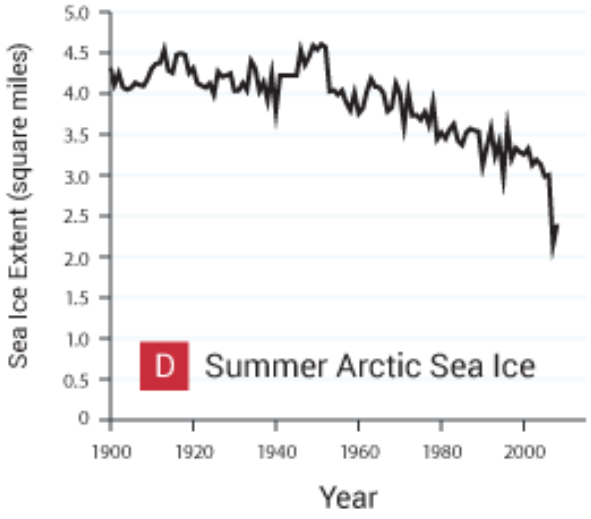
Source: Vital Signs, Maine
New culvert in Brunswick, ME providing more flushing to salt marsh

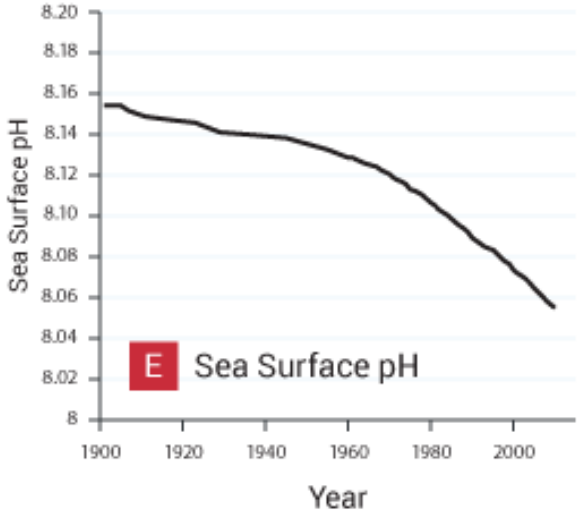
Ocean Impacts of Increased Atmospheric Carbon Dioxide









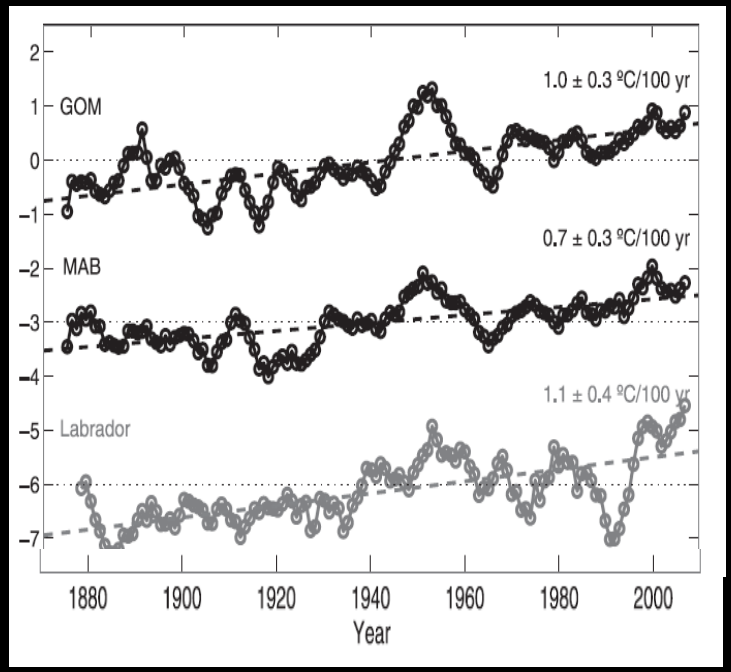


As a result, our coastal waters are vulnerable to climate and ecosystem change threats

The mean sea surface temperature has been increasing in the past 100 years and more quickly in the past 10 years

What does this mean for ecosystem health? Can we monitor and quantify these changes to the ecosystem?

1880-2005 1 DEG C per 100 yr



YEAR

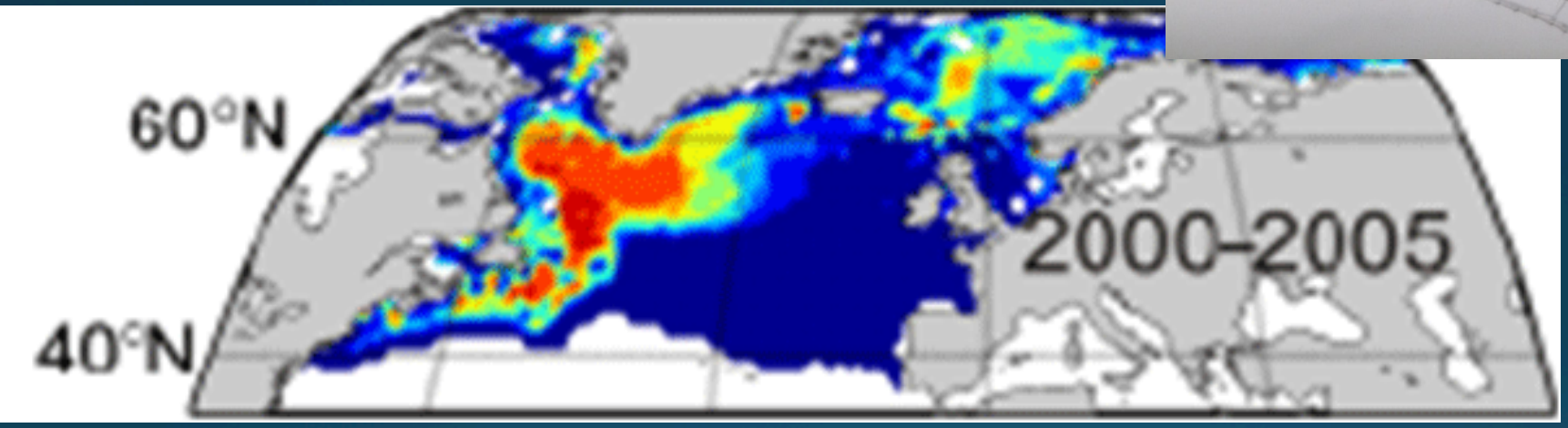
Shearman and Lentz 2010

Water temps

Stratification

Primary productivity

Will warming in NW Atlantic drive *Calanus finmarchicus* and krill northward?



(Reygondeau and Beaugrand 2011)

The decline of these energy-rich prey may lead to declines in herring, sandlance, groundfish, tuna, seabirds, northern right whales and other species that rely, either directly or indirectly, on *C. finmarchicus* as a primary food source.

Ecosystem responses to climate change is making news

The Boston Globe

"Time to Pay Heed to the Tadpole's Tale" September, 2014

"Gulf of Maine ocean temperatures above normal" March, 2012

Portland Press Herald

"Changing ecosystem concerns fishermen" March, 2013

NBC NIGHTLY NEWS

"Troubled waters: puffins and climate change in the Gulf of Maine" August, 2013

THE HUFFINGTON POST

"Climate Change Impacts Ripple Through Fishing Industry While Ocean Science Lags Behind " May, 2013

But wait, there's more!
And some of these "Sentinels" are not reported on NPR or Fox News

American lobster range moving northward!

Rare species disappearing in Cobscook Bay!

More reported vibriosis!

Zooplankton in Long Island Sound getting smaller!

Eutrophication and green crabs causing eelgrass declines in many embayments, such as Waquoit Bay or Casco Bay!

Declines in seabird colonies!

More gelatinous plankton!

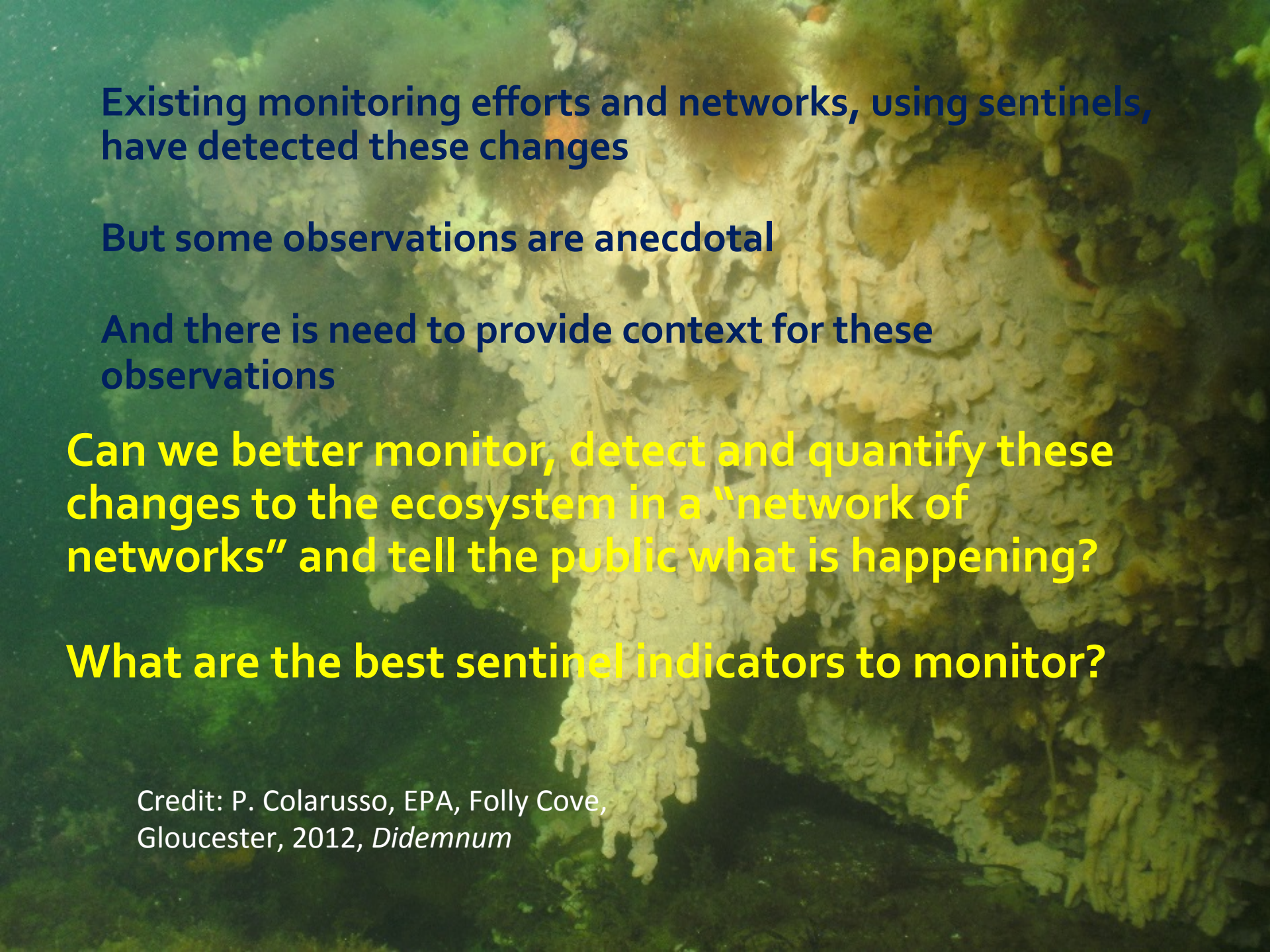
Rising sea levels affecting coastal wetlands!

Coccolithophores calcification rates declining!

Increases in black sea bass and longfin squid north of Cape Cod!

Earlier onset of stratification and lowered productivity in the Gulf of Maine!

Loss of forage fish!



Existing monitoring efforts and networks, using sentinels, have detected these changes

But some observations are anecdotal

And there is need to provide context for these observations

Can we better monitor, detect and quantify these changes to the ecosystem in a "network of networks" and tell the public what is happening?

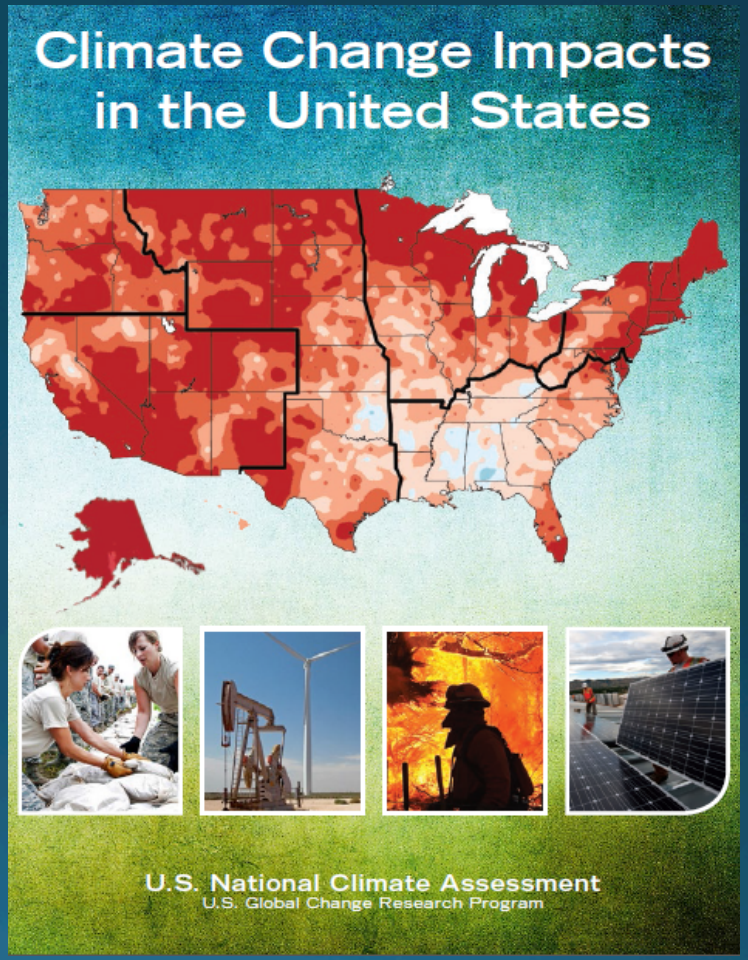
What are the best sentinel indicators to monitor?

Credit: P. Colarusso, EPA, Folly Cove, Gloucester, 2012, *Didemnum*

The US Government has mandated that we should understand climate change impacts on the ecosystem

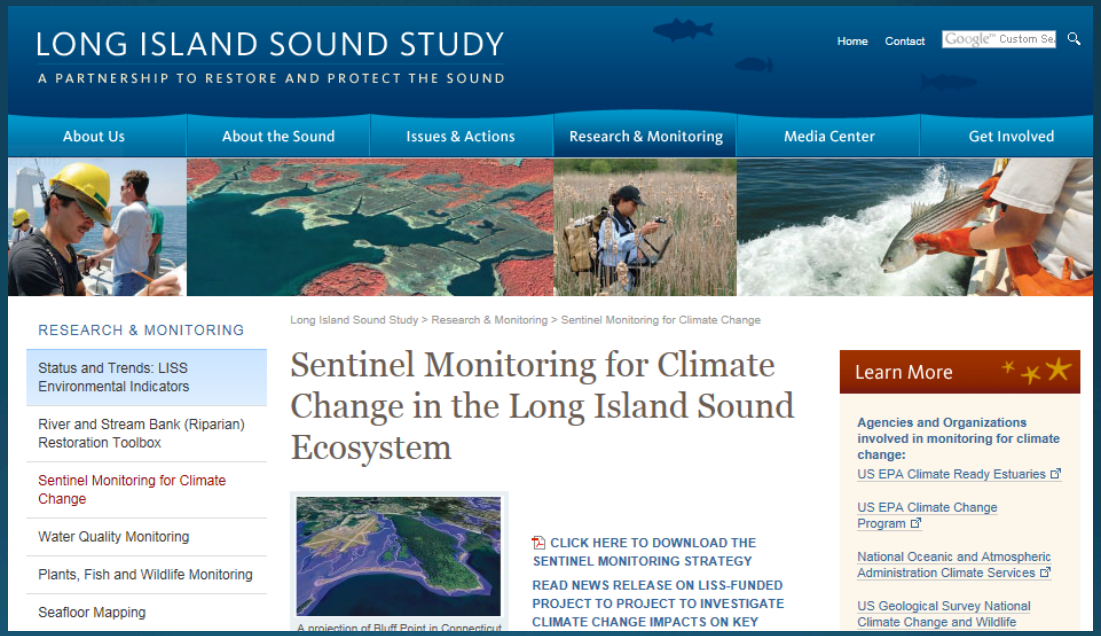
- Third National Climate Assessment released in May 2014 as part of the mandate of the U.S. Global Change Research Program (USGCRP) to "assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change."

- June 25, 2013 – "The President's Climate Action Plan" is released with section on preparing for climate change, including:
  - Using Sound Science to Manage Climate Impacts
    - Developing Actionable Climate Science
    - Assessing Climate Change Impacts in the U.S.
    - Launching a Climate Data Initiative



Our regional scientific community organizations have consistently identified as a priority: ***Sentinel monitoring of ecosystem health to better understand regional climate change impacts***

- New England-Canadian Maritime Collaboration and Planning Initiative
- NERACOOS and NROC Ocean and Coastal Ecosystem Health Committees
- Gulf of Maine Ecosystem Indicator Partnership
- Long Island Sound Study



"The Sentinel Monitoring for Climate Change in Long Island Sound Program is a multidisciplinary scientific approach to provide early warning of climate change impacts to Long Island Sound ecosystems, species and processes to facilitate appropriate and timely management decisions and adaptation responses."

Goals of the Integrated Sentinel Monitoring Network

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.

Goal

The overall goal of the ISMN is to improve our ability to detect and understand the causes of long-term change in the composition, structure, and function of Northeastern U.S. and Canadian maritime coastal ecosystems. The ISMN integrates existing marine and estuarine monitoring, observing, and data management efforts (both traditional scientific and community-based) from across the region and represents an agreement between a wide range of federal and state government agencies.

We are writing a Science and Implementation Plan

The plan is the foundation to secure funding

Implementing the plan will fill monitoring and data gaps for the ISMN and create a "network of networks"

Integrated Sentinel Monitoring Network for Change in Northeastern U.S. Ocean and Coastal Ecosystems

Draft Science and Implementation Plan – April 22, 2015

A project of the Joint NROC and NERACOOS
Ocean and Coastal Ecosystem Health Committee

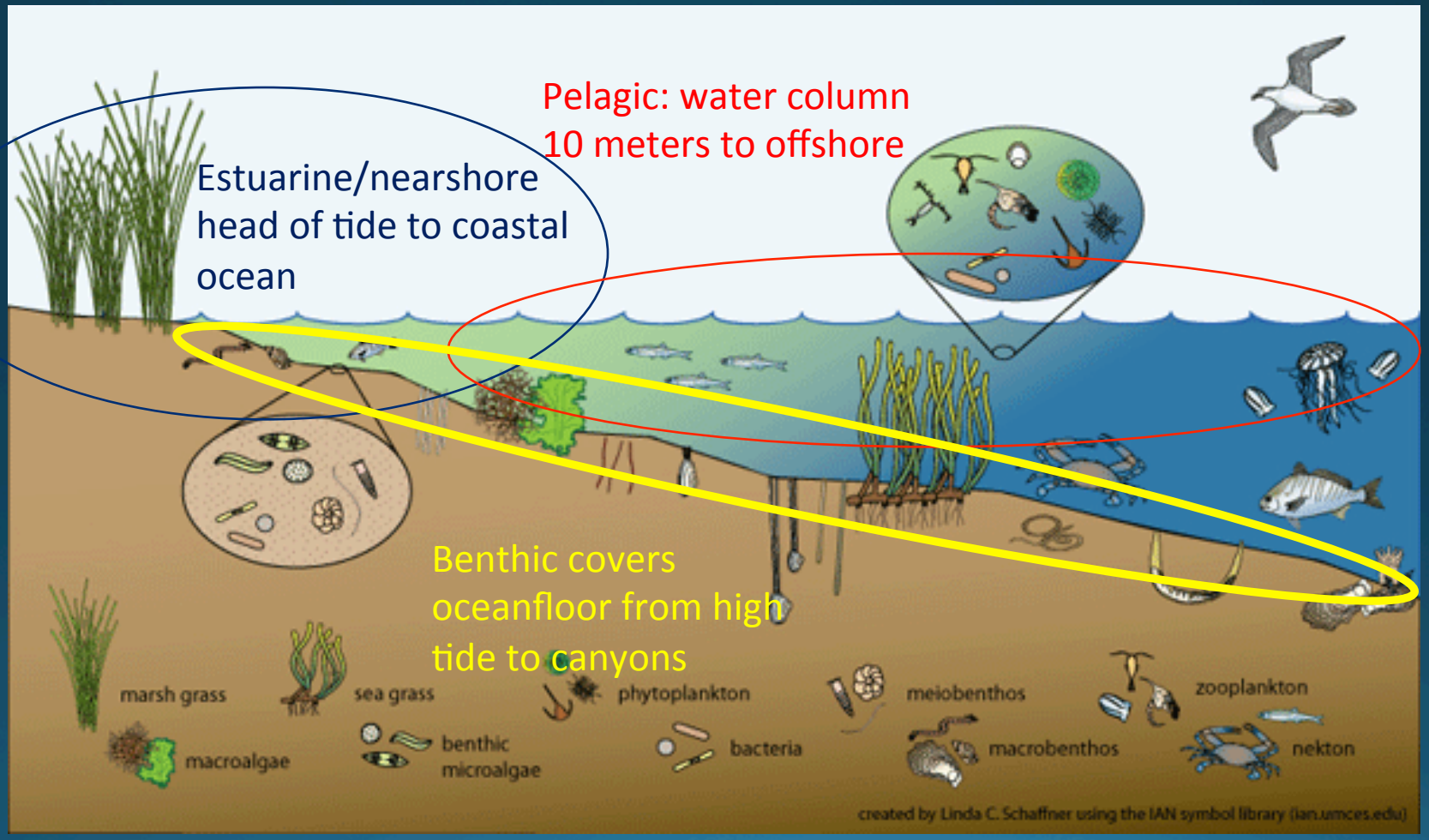





ABSTRACT

The Northeastern U.S. Region spans a range of ocean and coastal environments from Long Island Sound to the Canadian border in eastern Gulf of Maine and includes ecologically and economically rich ecosystems. Climate change, living resource harvesting and increasing human populations are altering the structure and function of these ecosystems. Ecosystem changes are not only threatening

We formed workgroups focusing on pelagic, benthic and estuarine/nearshore habitats



We have over 30 partner organizations and over 50 scientists/planners involved

Bigelow Laboratory for Ocean Sciences

Casco Bay Estuary Partnership

Connecticut Department of Energy and Environmental Protection

Fisheries and Ocean Canada

Great Bay National Estuarine Research Reserve

Gulf of Maine Council Ecosystem Indicator Partnership

Gulf of Maine Research Institute

Maine Department of Marine Resources

Maine Geological Survey

Massachusetts Bays Program

Massachusetts Department of Marine Fisheries

Massachusetts Office of Coastal Zone Management

Massachusetts Water Resources Authority

Massachusetts Institute of Technology Sea Grant

National Oceanic and Atmospheric Administration, National Marine Fisheries Service

NERACOOS

New England Interstate Water Pollution Control Commission

New Haven University

Northeastern University

Provincetown Center for Coastal Studies

Rhode Island Department of Environmental Management

Stellwagen Bank National Marine Sanctuary

The Nature Conservancy

Suffolk University

U.S. Army Corps of Engineers

U.S. Environmental Protection Agency

U.S. Geological Survey

University of Connecticut

University of Maine

University of Massachusetts Boston

University of New Hampshire

University of Rhode Island

Wells National Estuarine Research Reserve

Woods Hole Oceanographic Institution

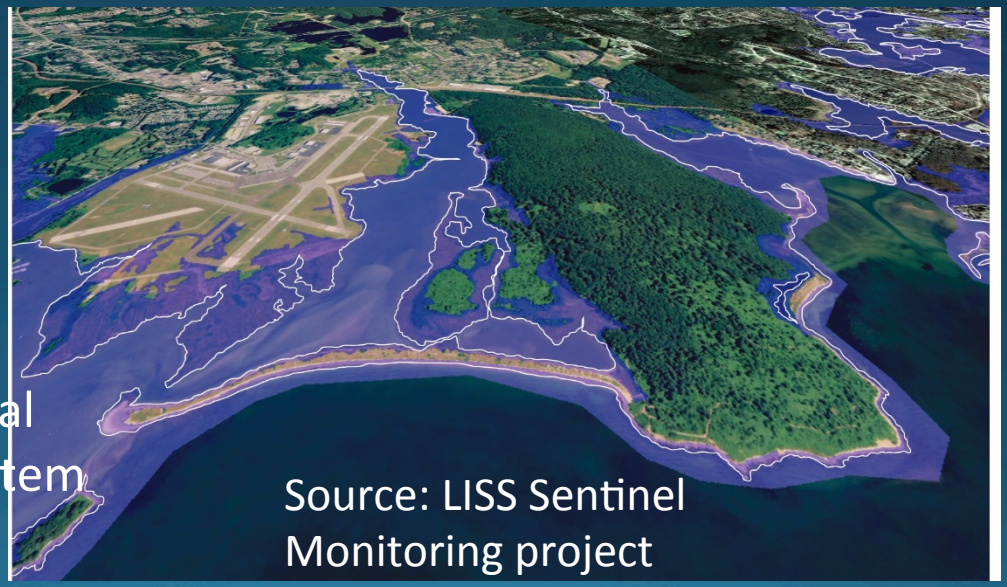
Consensus definition which distinguished between the ideas of **Sentinel** and **Indicator**

- We are defining a ***Sentinel*** as a habitat, (abiotic) condition or process, or a species, population or community; it's change in state or condition indicates some aspect of ecosystem change (good or bad).

- An ***Indicator*** is something you can physically measure that tells you something about the direction of change in the state or condition of the Sentinel.

Indicators are based on conceptual models that link drivers to ecosystem responses

Example: If salt marshes are considered a Sentinel, then the change in state of the salt marsh as measured by aerial extent (the indicator) tells you the salt marsh is changing due to some stressor (sea level rise) and indicates there may be important changes in your ecosystem, like potential loss of commercial fish nursery habitat.



Source: LISS Sentinel Monitoring project

We have identified potential gaps of monitoring:

Spatial location of salt marsh elevation monitoring

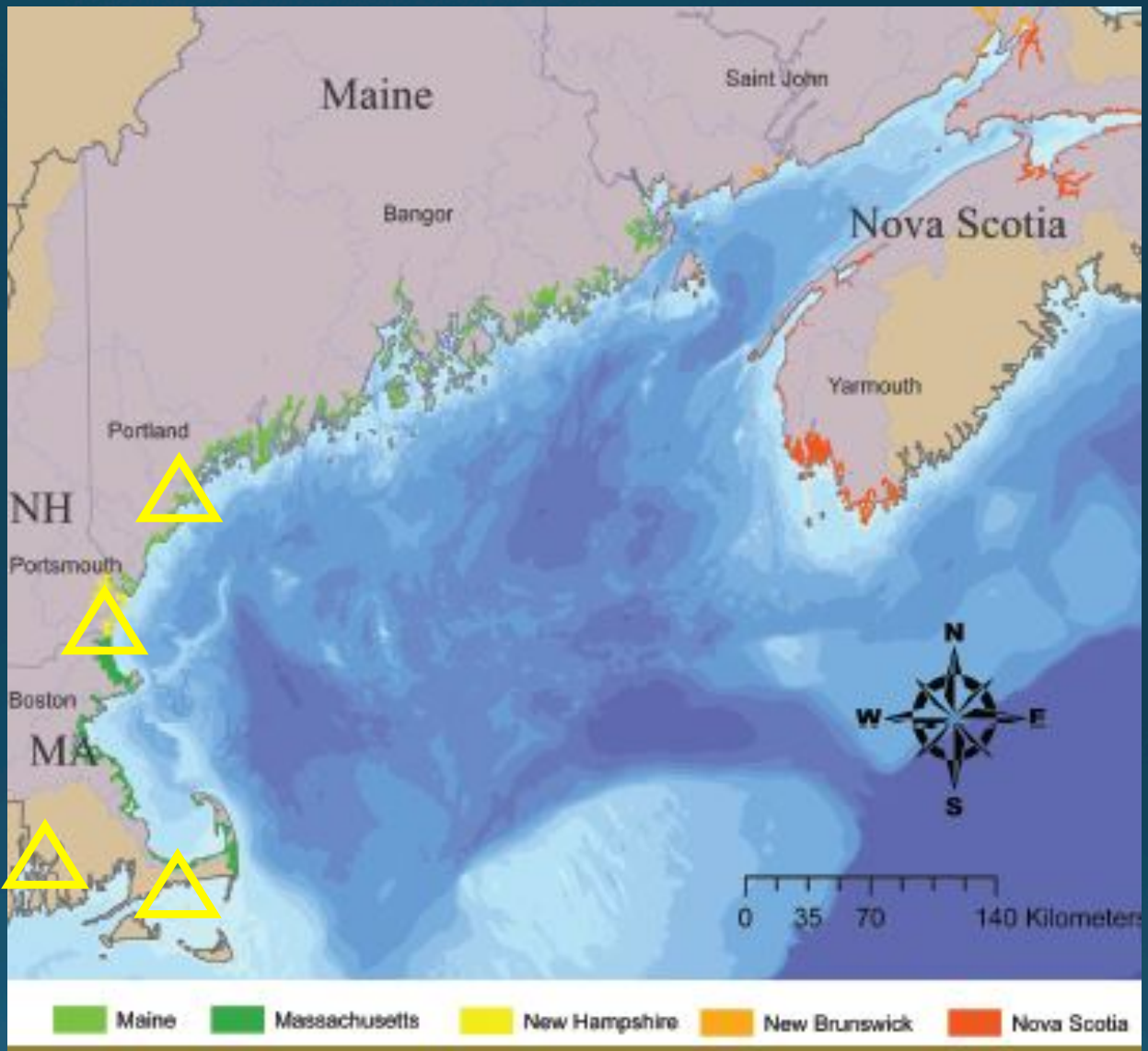
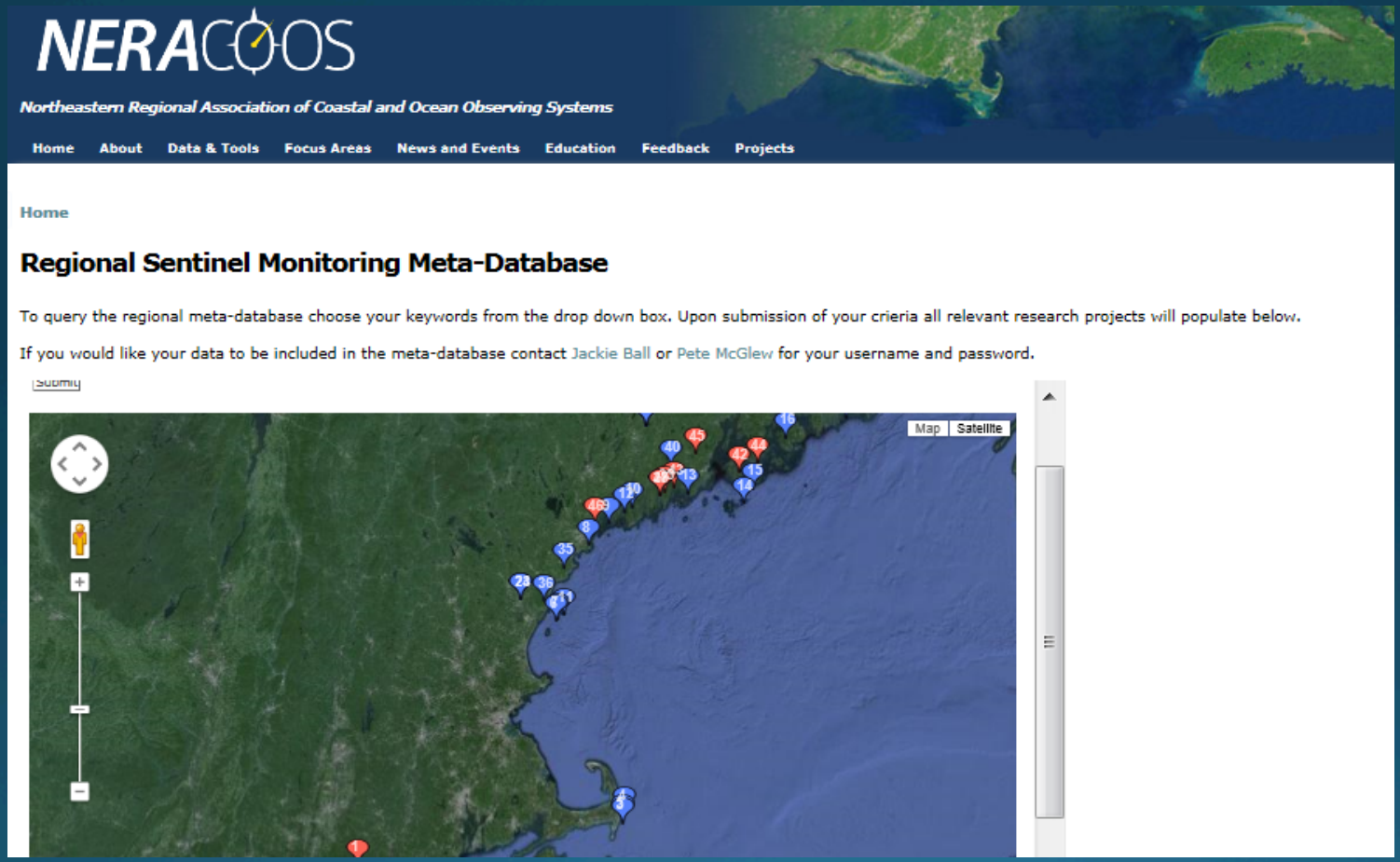


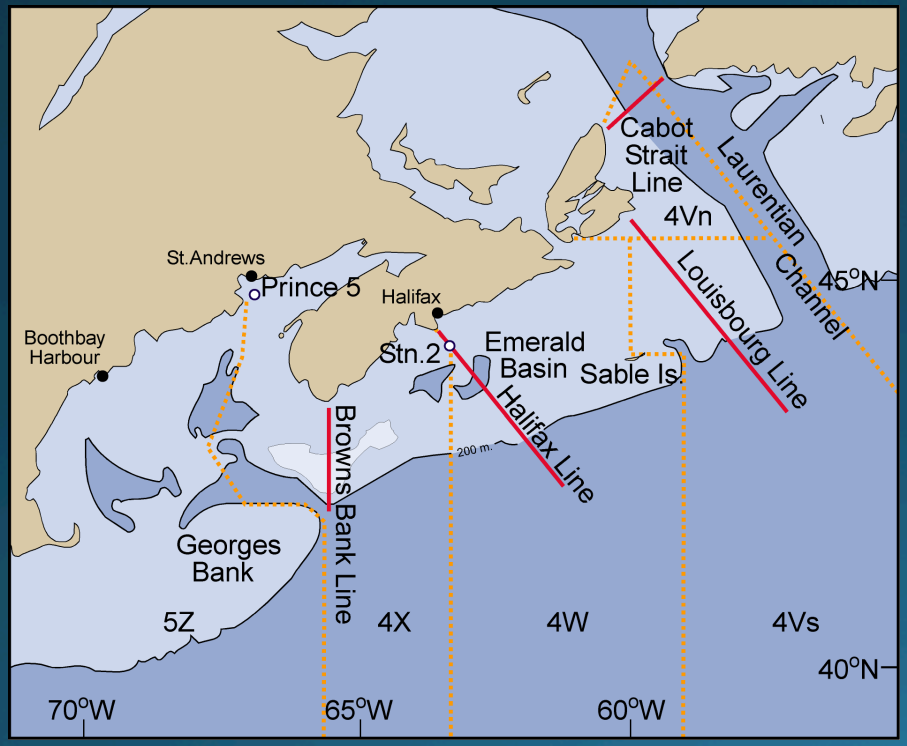
Figure 1: Salt marsh extent in the Gulf of Maine
Increased accuracy of methods is just one factor that influences the estimates of total salt marsh area. While it is desirable to use the most recent aerial photography, the current areas for two of the states and one province are based on aerial photos taken prior to 2000. Moreover, the extent of marsh in a region is always in flux due to natural and human influences.
Source: see table above.

Database of projects will be utilized to continue to identify gaps and add sentinel networks to our network



Example of a long term monitoring program that would be part of the network:

Atlantic Zonal Monitoring Program (Maritime Region): 1998-Present

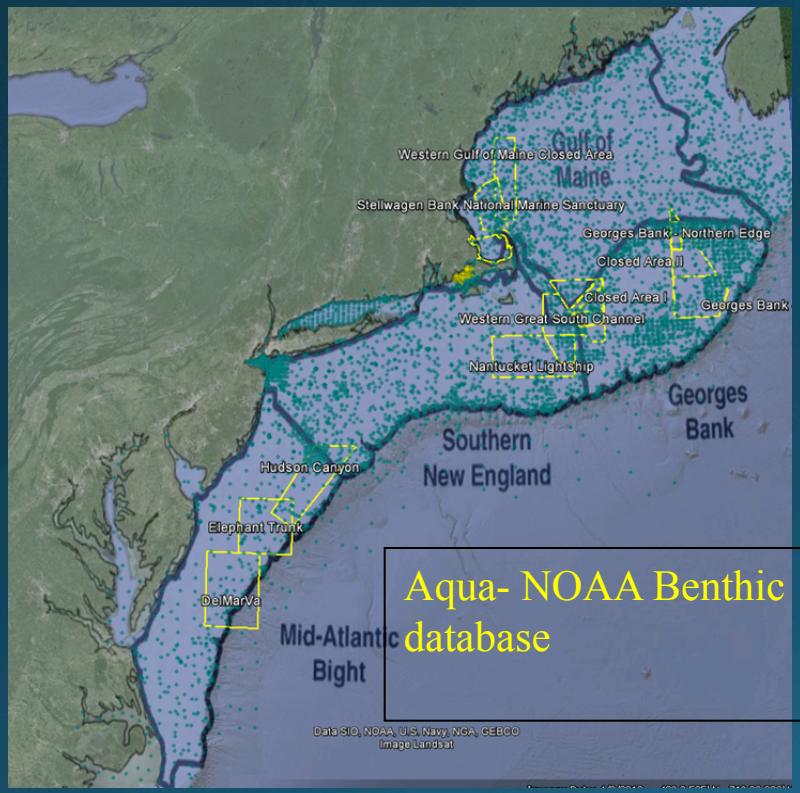


Standard protocol
-CTD
-Bottle samples (6 depths)
-Net tow (vertical, 3/4m ring 202 mm mesh net)

Hydrographic variables temperature, salinity, dissolved oxygen, fluorescence, chlorophyll *a* and nutrients

Plankton variables
Phytoplankton cell counts
Zooplankton biomass, species composition and abundance

Benthic workgroup has identified multiple datasets and has identified sentinel sites



Aqua- NOAA Benthic database

High resolution grids conducted in NEBO sentinel sites by HabCam 2007-2010.

A database subcommittee evaluating data structure

- Interoperability
- Quality control
- Distributed data system, accessibility to all
- Analyzing , interpreting, synthesizing data to tell stories and inform management
- Standardization
- Coordinate with Northeast Coastal and Ocean Data Partnership

Next steps

- Draft Science and Implementation Plan being completed this month, with workgroup review over the next few weeks
- Final draft will go out for broader review in June, 2015
- Plan describes options for establishment of a coordination center to facilitate data compilation, analyses, synthesis and modeling and prediction capabilities and communicate how the ecosystem is changing
- For more information about the project, visit our website at http://www.neracoos.org/sentinelmonitoring

Image source: Jeremy Miller, NERRS

Presentation to the Northeast Regional Ocean Council
May 21, 2015

Peter Taylor
Waterview Consulting
peter@waterviewconsulting.com

Guidance on Using Models of Tidal Wetland Migration to Support Community Resilience to Sea Level Rise

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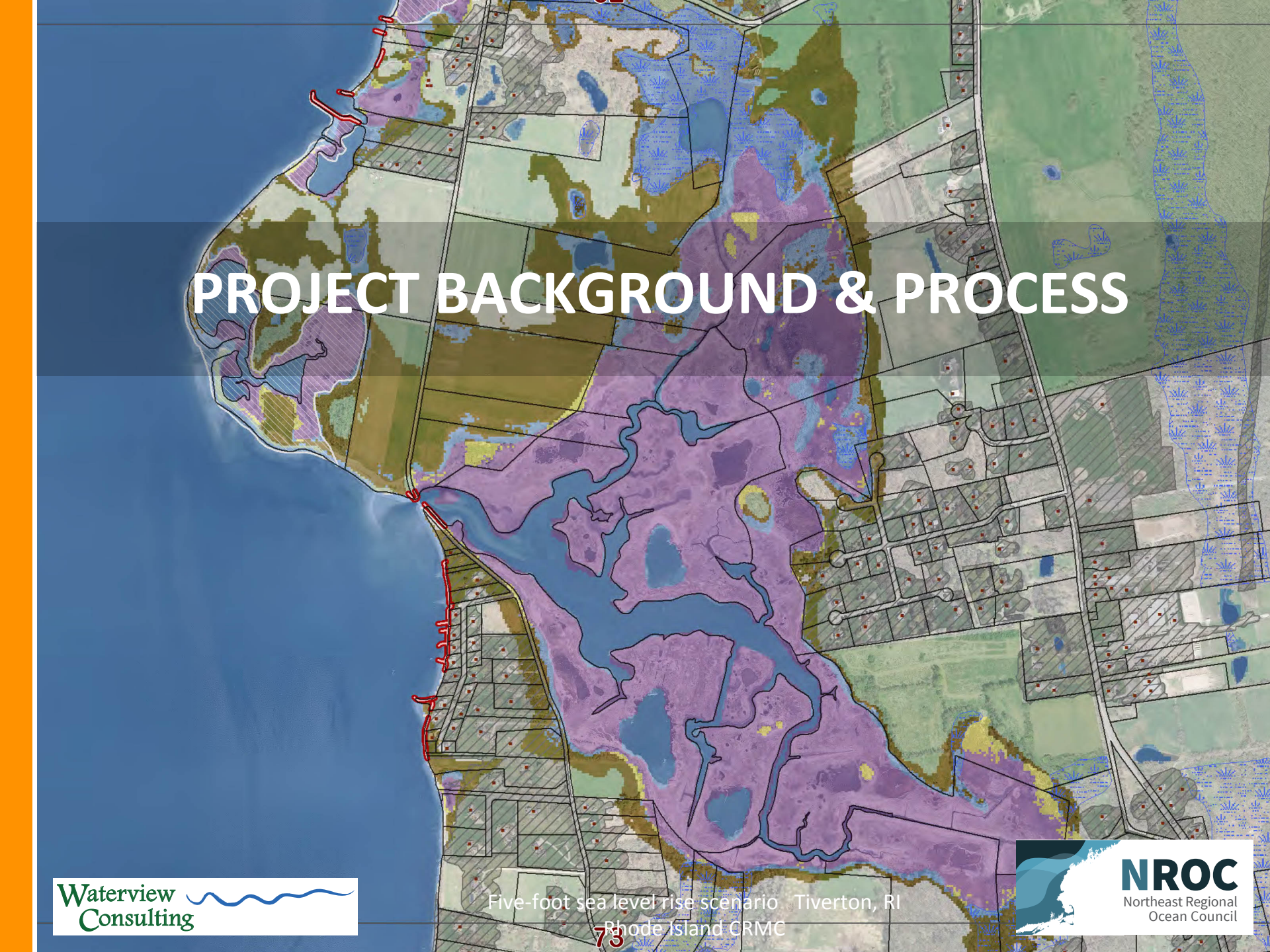
PROJECT BACKGROUND & PROCESS



Five-foot sea level rise scenario Tiverton, RI
Rhode Island CRMC

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542-22

THE REPORT

1. Introduction
2. Getting Started With Marsh Migration Modeling
   Guide To Selected Models And Model-Based Tools
3. Obtaining And Working With Data
4. Handling Uncertainty
5. Communicating Results
6. Conclusion
   Recommendations
7. Additional Resources

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Marsh advancement by 2080 Bridgeport, CT
TNC and state and municipal partners

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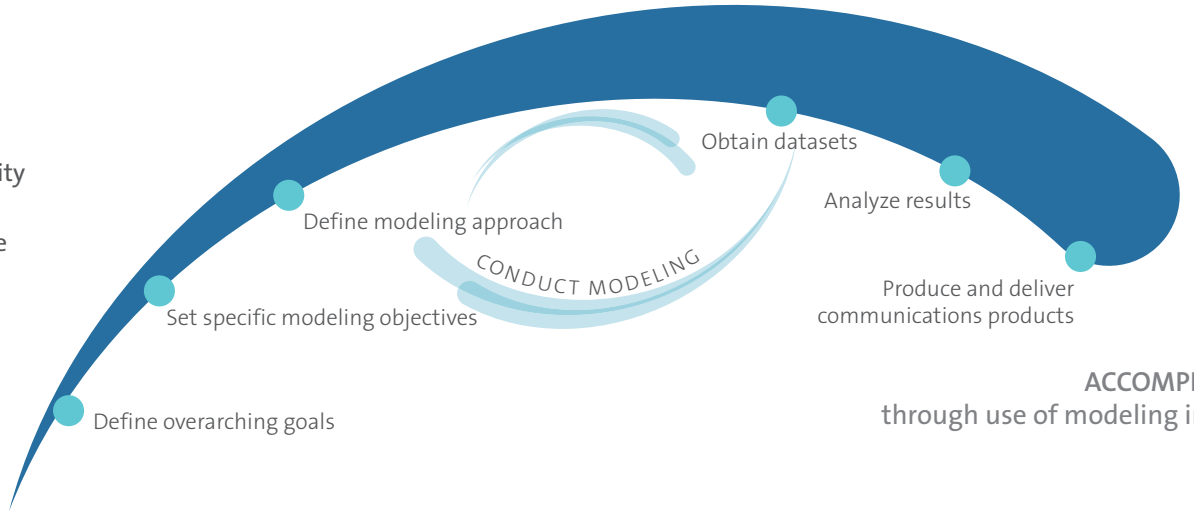
GETTING STARTED WITH MARSH MIGRATION MODELING

Marsh migration modeling is a rapidly evolving area of scientific investigation that is also being actively applied to management and policy decision-making. While the process of using marsh migration models as decision support tools depends on the specific goals and objectives, this section provides an overview and framework that can be applied in any management context.

THE MODELING PROCESS

The decision-support value of modeling can be maximized by clearly defining the management questions, choosing and applying appropriate models with high-quality data, and producing outputs that clearly and accurately communicate the results, confidence levels, and assumptions in a useful form to managers and stakeholders.



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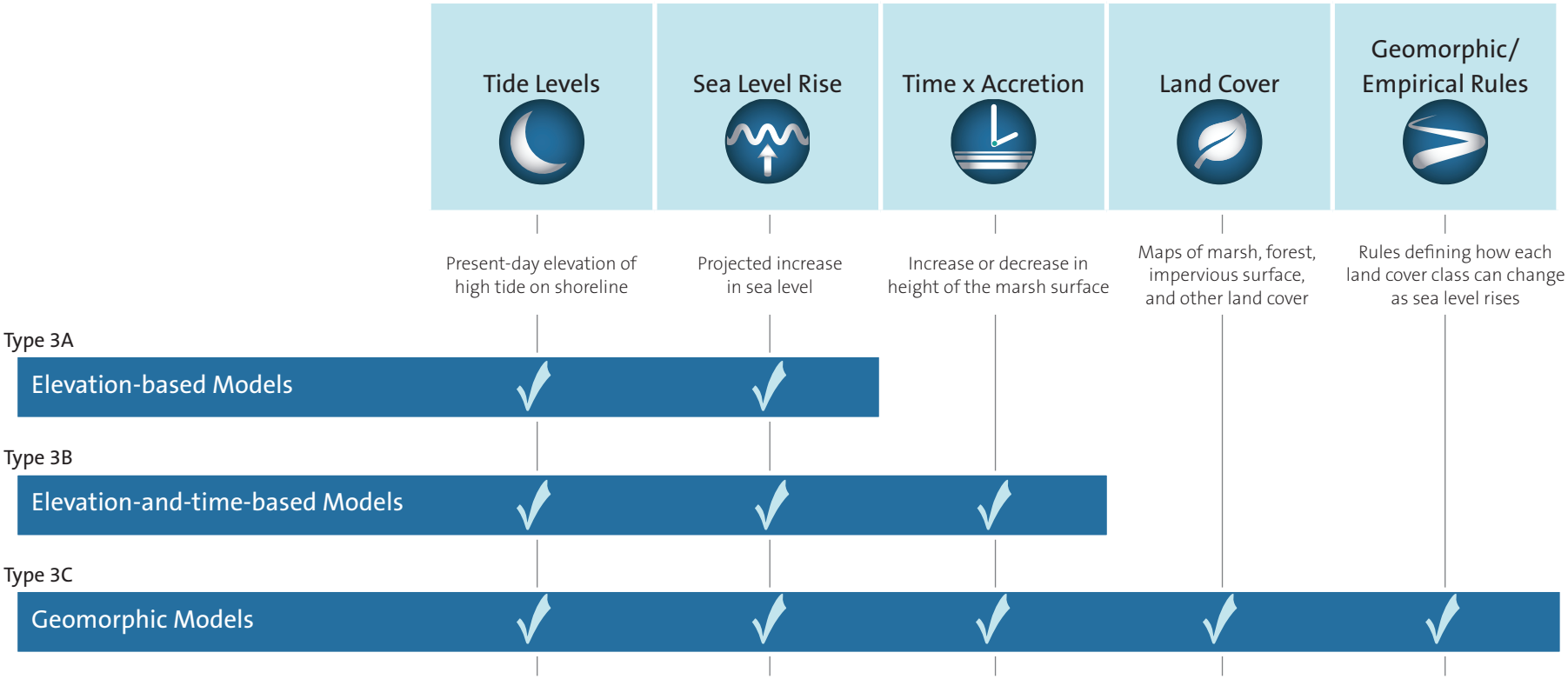
Category 3: Rules-based Models

Rules-based models consist of simple algorithms that in essence create a decision-tree of major habitat changes without trying to capture all of the processes behind those changes. They are a relatively economical way to produce useful results, especially given the many uncertain parameters associated with marsh migration. For this reason, they are the most commonly used models for management decision-making, and they are the focus of the remainder of this report. Rules-based models can be divided into three types based on the number of variables they include.



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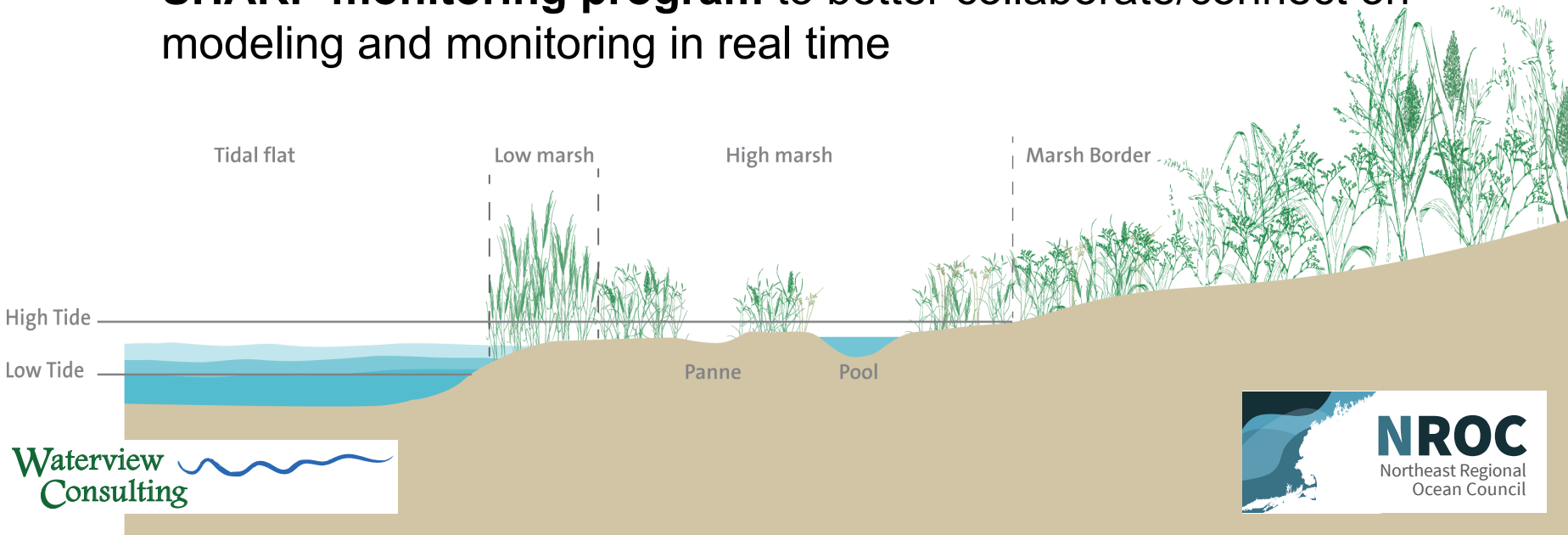
NEEDS

A. **Post-modeling field surveys** to monitor transgression zones
B. Development of **methods for validating models** to see if real-world data confirms or can inform future marsh migration modeling and post-modeling policy
C. Develop **region-specific conceptual model** of marsh migration
D. Additional examples of **proof-of-concept restoration/ preservation methods** for assisted marsh migration
E. Connect modeling **SLAMM and other modeling efforts to the SHARP monitoring program** to better collaborate/connect on modeling and monitoring in real time



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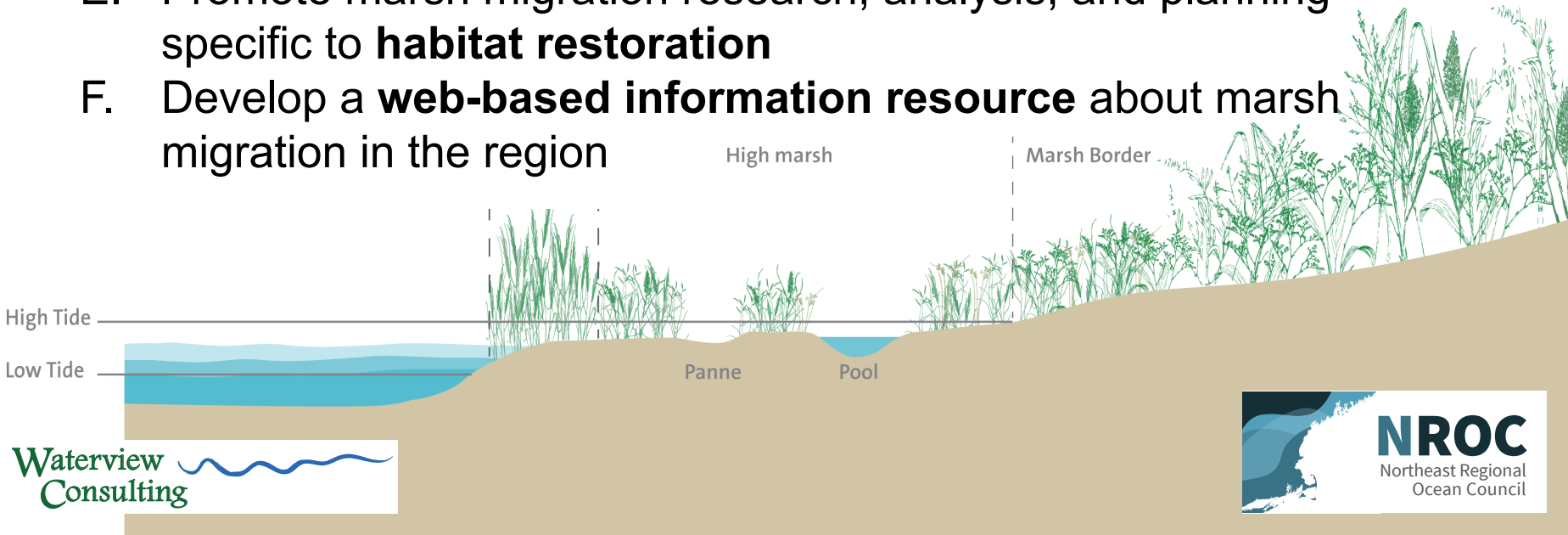
RECOMMENDATIONS

A. **Facilitate ongoing interaction** among people engaged in marsh migration-related efforts in the Northeast
B. Launch a **regional data initiative** in support of marsh migration management
C. Develop a **toolkit of policy, management, and regulatory approaches** to facilitate marsh migration
D. Provide data products and processes for planning and management for use at the **municipal level**
E. Promote marsh migration research, analysis, and planning specific to **habitat restoration**
F. Develop a **web-based information resource** about marsh migration in the region



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