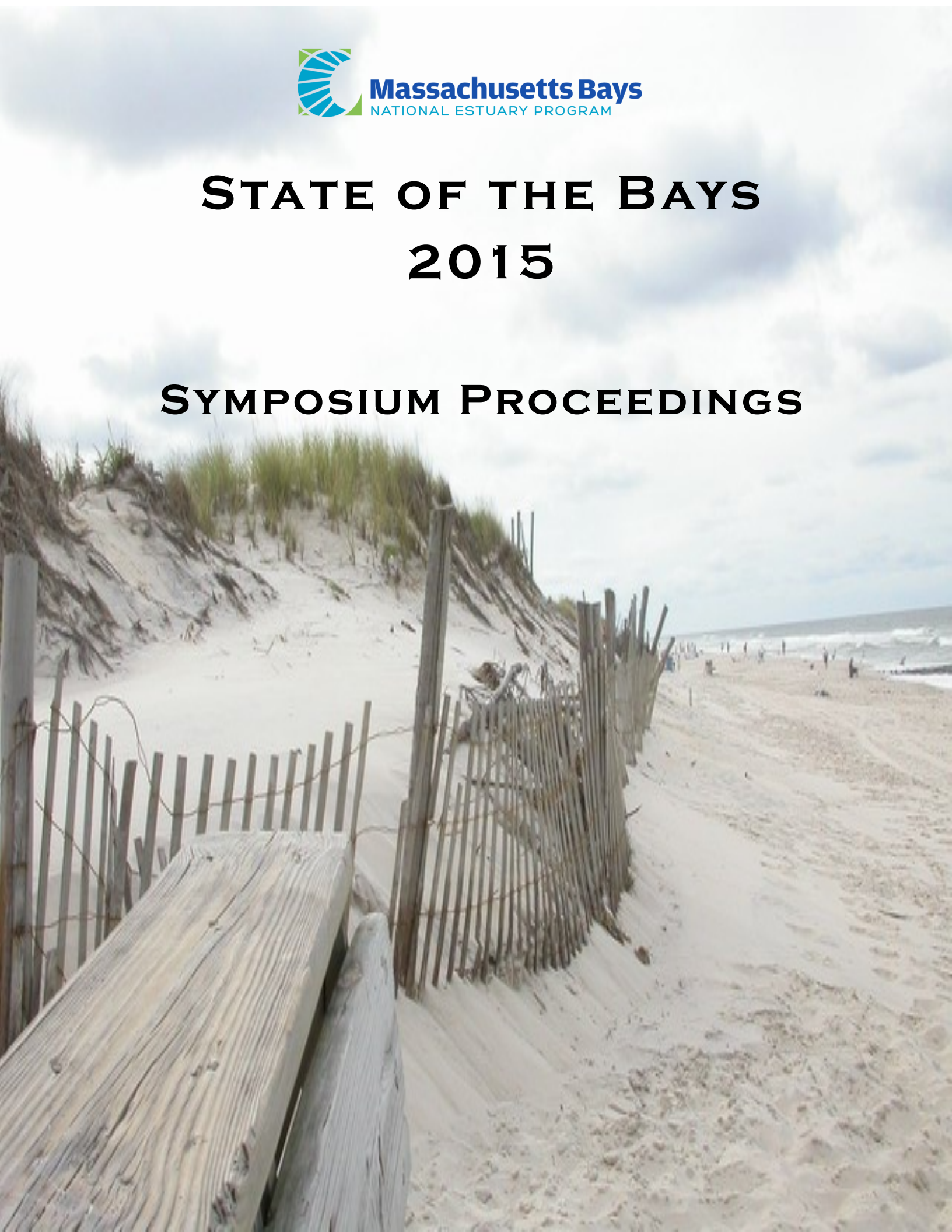
Massachusetts Bays
NATIONAL ESTUARY PROGRAM

State of the Bays 2015

Symposium Proceedings



"The time must come when this coast will be a place of resort for those New-Englanders who really wish to visit the seaside. At present it is wholly unknown to the fashionable world, and probably it will never be agreeable to them. If it is merely a ten-pin alley, or a circular railway, or an ocean of mint-julep, that the visitor is in search of,--if he thinks more of the wine than the brine, as I suspect some do at Newport,--I trust that for a long time he will be disappointed here."

Cape Cod, Henry David Thoreau

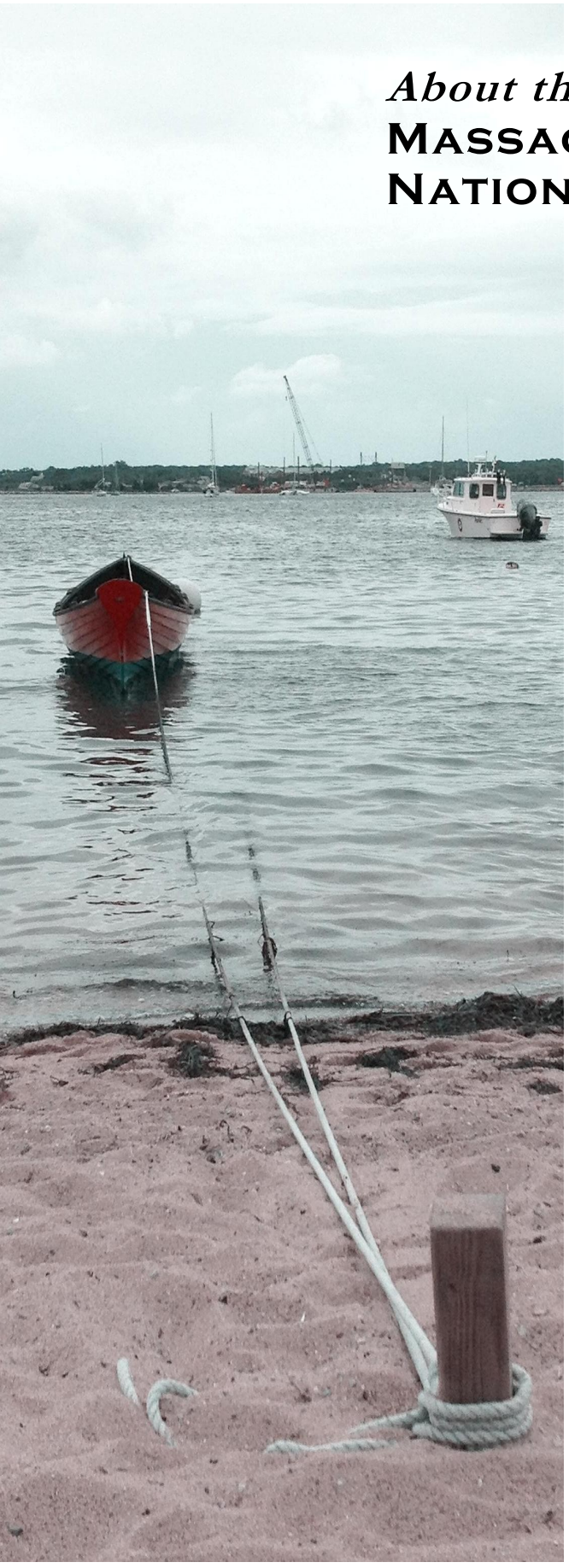


Photo: CZM

About the Massachusetts Bays National Estuary Program

MassBays is an EPA-funded program hosted by the Massachusetts Executive Office of Energy and Environmental Affairs, dedicated to protecting, restoring, and enhancing the coastal resources of Massachusetts Bay and Cape Cod Bay. We facilitate partnerships to prompt local, state, and federal action and stewardship, by convening stakeholders on the local and regional level, providing a scientific basis for management decisions, and working with decisionmakers to identify problems and solutions.

MASSBAYS NATIONAL ESTUARY PROGRAM
251 Causeway Street, Suite 800
Boston, Massachusetts 02114

617-626-1204
Www.massbays.org

This is a publication of the Massachusetts Bays National Estuary Program (MassBays) with funding under grant No. CE96197001 from the U.S. Environmental Protection Agency (EPA). The views expressed here are those of the authors and do not necessarily reflect those of EPA or its sub-agencies.

Contents

About this Document	1
Introduction	3
Setting the Stage	4
Human Uses, Weather and Climate	12
Water Quality	24
Habitats	34
Wildlife	46
Looking Forward	56
Speakers' Biographies	60

About this Document

The 2015 State of the Bays Symposium Proceedings represents the effort of many organizations and individuals working and volunteering in Massachusetts Bay and Cape Cod Bay. On April 15, 2015, 100 people gathered to hear from 19 panelists, 5 expert panel moderators, and 4 plenary speakers about our understanding of the ecosystem and human impacts on that system. MassBays' goals for the 2015 State of the Bays Symposium were to:

- Assess trends and conditions in the ecosystems and communities of Massachusetts Bay and Cape Cod Bay.
- Convene MassBays' broader network of partners and stakeholders to facilitate connections and enhance networking across the bays.
- Present a Draft Comprehensive Conservation and Management Plan for the MassBays National Estuary Program—a 5- to 7-year strategic plan for restoring and protecting local estuarine ecosystems.

More than half of the attendees who provided formal evaluation (27/44 respondents) think MassBays should hold a Symposium more frequently, and almost everyone reported that they had generated new ideas and new potential for collaboration over the course of the day. We offer this State of the Bays Report as a way to share these resources with a broader audience. Here you will find statistics about priority topics within the U.S. Environmental Protection Agency (EPA)'s National Estuary Program, including invasive species, piping plovers, and capacity for salt marsh migration in response to sea level rise. Drawings made in real time to record the proceedings are also included, as well as on-the-spot observations from participants during individual and group brainstorming. The Symposium consisted of three parts; the Proceedings are organized in the same manner. The three sections are:

1. *Setting the Stage - Keynote speakers provided context to how* MassBays is part of the national effort to restore and protect estuaries. The MassBays' planning area encompasses Massachusetts Bay and Cape Cod Bay, both of which are part of the Gulf of Maine ecosystem; the organization itself is part of a national effort to protect and restore estuaries.
2. *What we know: Human Use, Weather and Climate; Water Quality; Habitat; and Wildlife*— Presenters provided insights into the following questions: What has changed over space and time in the past 5 to 10 years? Who cares–or should care–and why? Each topic concluded with a moderated question and answer session.
3. *Looking Forward:* - Can we do a better job of using existing information to make useful and informative statements about the State of the Bays? Can we fill in gaps by connecting monitoring efforts and research programs? MassBays' Comprehensive Conservation and Management Plan will support new frameworks for data collection and sharing.

Section Two of the document is organized according to the four topics addressed by expert panelists: Human Use, Weather and Climate; Water Quality; Habitat; and Wildlife. Graphic representations of the presentations and the interconnections within the topic areas introduce each section. Each 3-minute presentation is summarized with an abstract and representative slides highlighting trends and conditions, findings, the bottom line, and implications for management and future actions. These pages also include resources for more in-depth information. Short biographies of the keynote speakers and panelists appear at the very end of the document.

MassBays invites you to use these Proceedings to learn a little more about the characteristics, functions, and health of local ecosystem, generate questions that will help set the agenda for the next State of the Bays Symposium, and add your own voice to those asking for increased protections and restoration at the local level. If you'd like to learn more, visit the MassBays website (www.massbays.org) or contact Pam DiBona (pamela.dibona@state.ma.us).

Note: Our generous speakers have provided abstracts and slides from their presentations, and reviewed each summary to make sure the information here is as accurate as possible. If a reader finds a mistake, we hope you will share the correction with us.

CZM

Introduction

About the MassBays National Estuary Program

Presenter: Samantha Woods, Chair, MassBays Management Committee
North and South Rivers Watershed Association

Vision

We envision a network of healthy and resilient estuaries, sustainable ecosystems that support the life and communities dependent upon them.

Mission

MassBays is dedicated to protecting, restoring and enhancing the estuarine ecosystems of Massachusetts and Cape Cod Bays. We facilitate partnerships to prompt local, state, and federal action and stewardship by convening stakeholders on the local and regional level, providing scientific basis for management decisions, and working with decisionmakers to identify problems and solutions.

The MassBays National Estuary Program (MassBays) is one of 28 National Estuary Programs (NEPs) established under Section 320 of the Clean Water Act to address problems facing valuable coastal resources in estuarine areas. Stretching from Salisbury to Provincetown, the planning area encompasses Massachusetts and Cape Cod Bays, including 50 cities and towns that are home to more than 1.7 million people. To better address the region's ecological and geomorphological diversity, MassBays' planning area is divided into five regions, each with its own regional coordinator. Regional coordinators respond to local needs, convene stakeholders and decision-makers, provide technical and hands-on assistance, and conduct education and outreach to engage volunteers and inform citizens. MassBays is overseen by a Management Committee that uses a consensus-building approach and a collaborative decision making process to ensure that MassBays' work is tailored to regional environmental conditions and priorities based on stakeholder input.

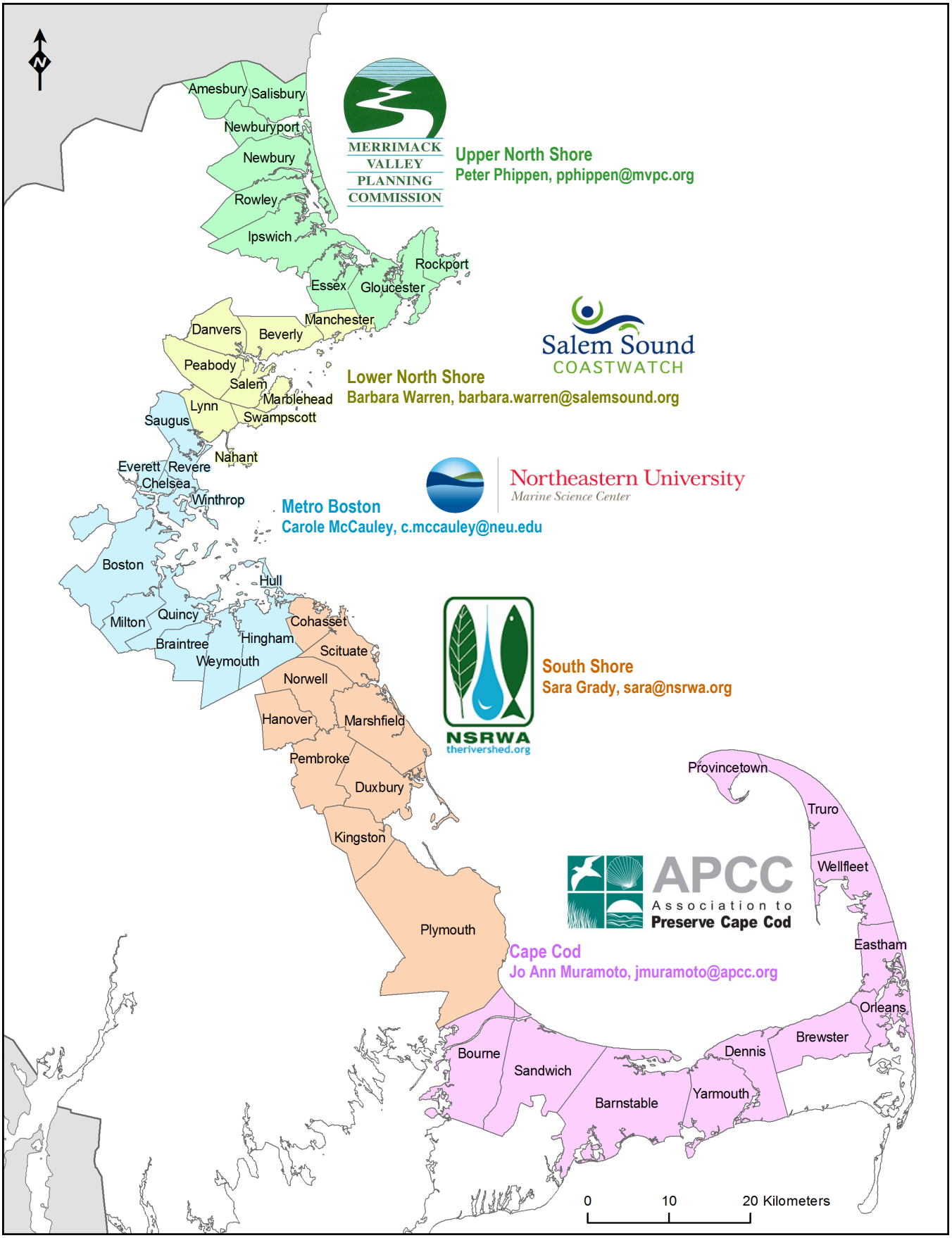
MassBays is a network of partners

Management Committee members include:

Environmental non-governmental organizations
Researchers/Academic institutions
Local decisionmakers
Federal agencies
State agencies
Regional planning agencies
Businesses

Symposium attendees include:

Scientists who work in and around the Bays
Town planners and engineers
Educators
Citizen volunteers
Resource managers


Amesbury
Salisbury
Newburyport
Newbury
Rowley
Ipswich
Rockport
Essex
Gloucester
Manchester
Danvers
Beverly
Peabody
Salem
Marblehead
Lynn
Swampscott
Saugus
Nahant
Everett
Revere
Chelsea
Winthrop
Boston
Hull
Milton
Quincy
Cohasset
Hingham
Braintree
Weymouth
Scituate
Norwell
Hanover
Marshfield
Pembroke
Duxbury
Kingston
Plymouth
Provincetown
Truro
Wellfleet
Eastham
Orleans
Brewster
Dennis
Yarmouth
Barnstable
Sandwich
Bourne
MERRIMACK VALLEY PLANNING COMMISSION
Upper North Shore
Peter Phippen, pphippen@mvpc.org
Salem Sound COASTWATCH
Lower North Shore
Barbara Warren, barbara.warren@salemsound.org
Northeastern University
Marine Science Center
Metro Boston
Carole McCauley, c.mccauley@neu.edu
NSRWA
therivershed.org
South Shore
Sara Grady, sara@nsrwa.org
APCC
Association to Preserve Cape Cod
Cape Cod
Jo Ann Muramoto, jmuramoto@apcc.org
0
10
20 Kilometers

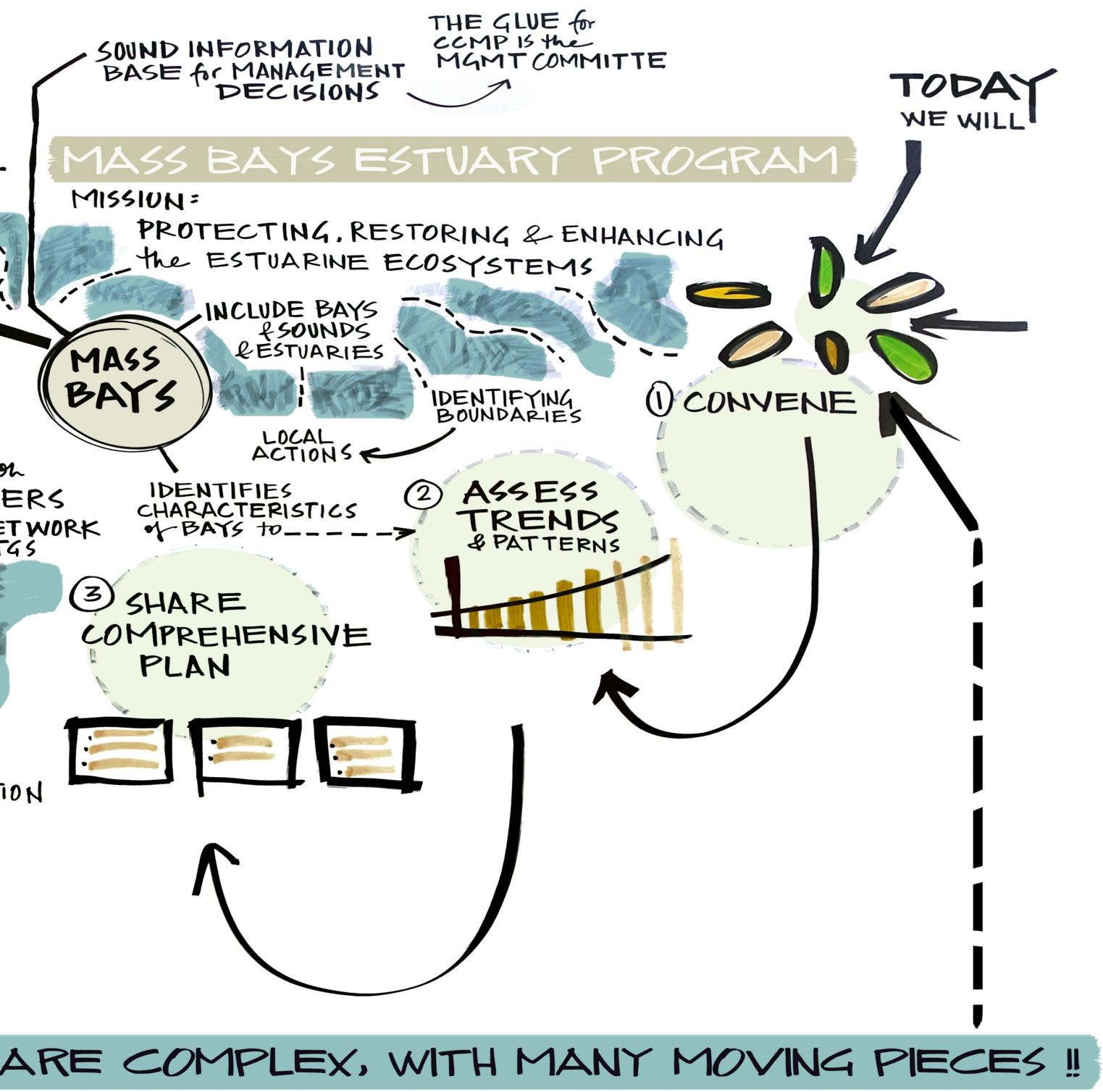
Setting

Massachusetts Bays
NATIONAL ESTUARY PROGRAM

2015 State of the Bays Symposium
15 April 2015 • Boston, MA

dpict. Images by Kelvy Bird | www.dpict.info

the Stage

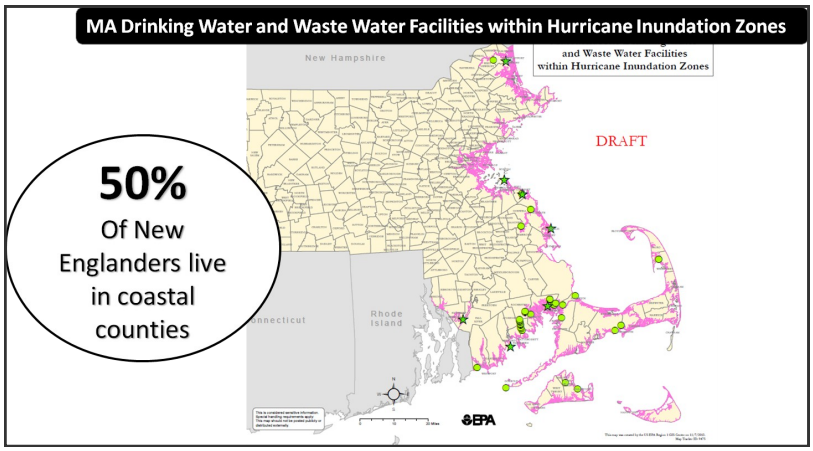

SOUND INFORMATION BASE for MANAGEMENT DECISIONS
THE GLUE for CCMP is the MGMT COMMITTE
TODAY WE WILL
MASS BAYS ESTUARY PROGRAM
MISSION:
PROTECTING, RESTORING & ENHANCING the ESTUARINE ECOSYSTEMS
MASS BAYS
INCLUDE BAYS & SOUNDS & ESTUARIES
IDENTIFYING BOUNDARIES
LOCAL ACTIONS
IDENTIFIES CHARACTERISTICS of BAYS to
① CONVENE
② ASSESS TRENDS & PATTERNS
③ SHARE COMPREHENSIVE PLAN
ARE COMPLEX, WITH MANY MOVING PIECES !!

MassBays in Context

MassBays is part of the national effort to restore and protect estuaries. The MassBays planning area encompasses Massachusetts Bay and Cape Cod Bay, which are part of the larger Gulf of Maine ecosystem.

EPA's Local Connection

Presenter: Deborah Szaro
U.S. Environmental Protection Agency Region 1

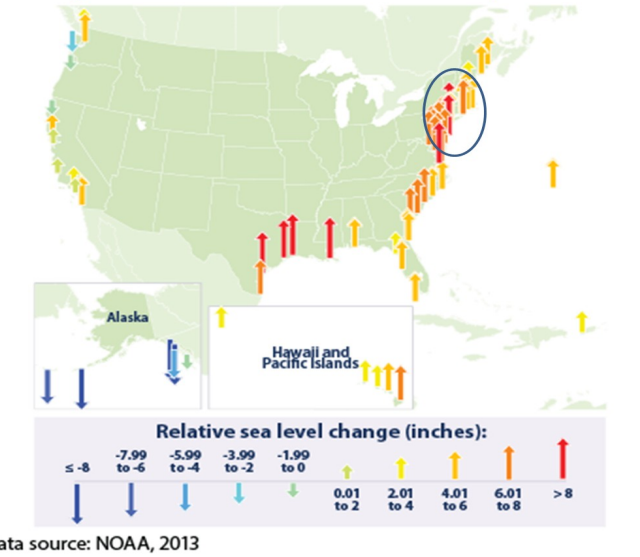


In New England...

- Three of the top five most densely populated coastal counties in the U.S.
- 14.4 million residents, just over 50% of them living in coastline counties.
- Water resources are the top priority for EPA.

Sea Level Rise statistics

- Global sea levels are projected to rise 1 to 4 ft (0.3 to 1.2 m) by 2100.
- Sea level rise in the Northeast is expected to exceed global average due to local land subsidence and weakening of the Gulf Stream (as suggested by some models).
- Sea level rise of 2 ft (0.6 m), without any changes in storms, would more than triple the frequency of dangerous coastal flooding throughout most of the Northeast.



Data source: NOAA, 2013

EPA Priorities

- Revitalizing communities
- Addressing climate change
- Addressing water quality: nutrients
- Addressing water quality: stormwater

EPA Priorities in Action

Addressing nutrient loadings in coastal communities (Cape Cod):

- 71 embayment systems need nutrient (N) TMDLs for up to 87% reductions.
- N sources are 78% septic wastewater; 9% fertilizers, 8% impervious surfaces, and 5% wastewater treatment facilities.
- 2015: Cape Cod Commission is updating the region's §208 Wastewater Management Plan for Nutrients to guide communities in remediation of impaired waters.

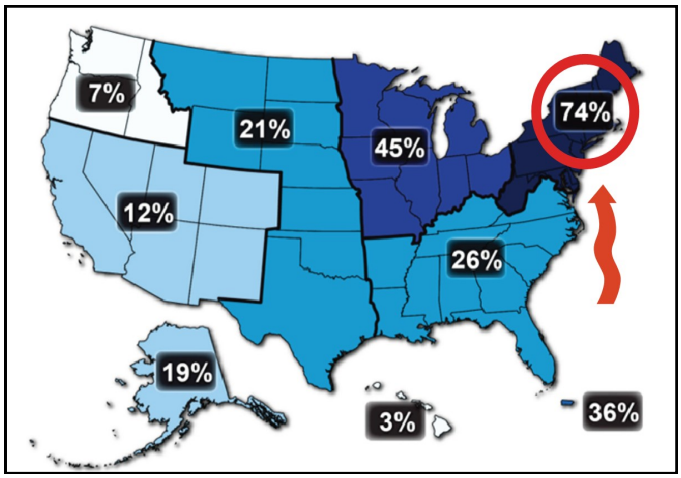
Massachusetts Stormwater Runoff and Municipal Separate Storm Sewer System (MS4) permit

2014 draft MS4 permit released including requirements to establish:

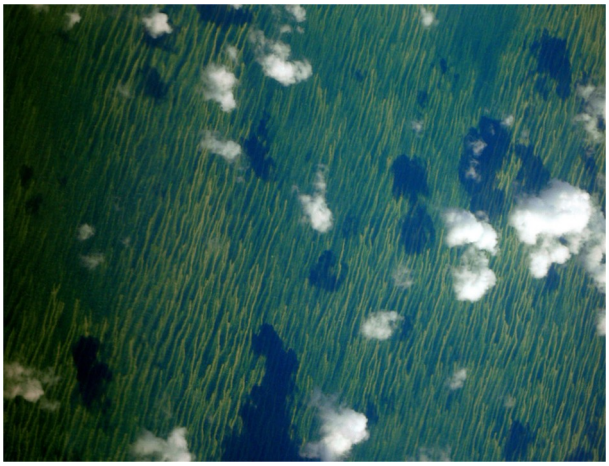
- TMDLs for pathogens and nutrients.
- A Stormwater Management Plan to control pollutants, protect water quality, and satisfy appropriate requirements of the Clean Water Act.

Tools to assist municipalities (especially those with high percent impervious cover) include:

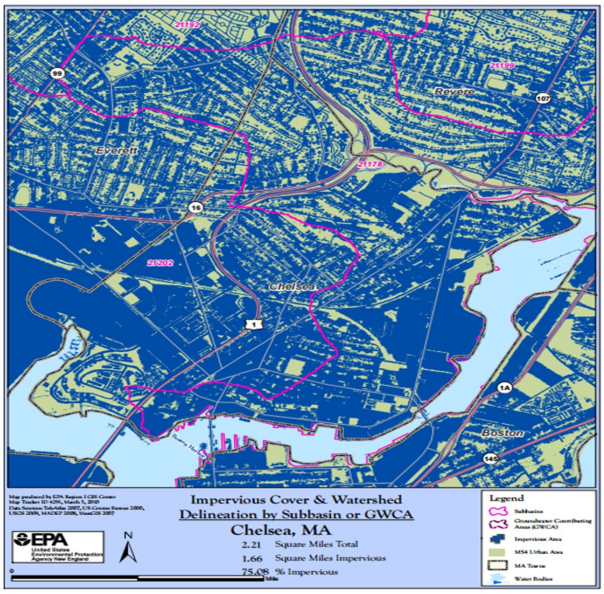
- Stormwater BMP Performance Analysis.
- Stormwater Management Optimization (Opti-Tool).
- Nutrient Accounting and Tracking.



Increase in extreme precipitation: 1958-2010



Aerial view of algal bloom



Chelsea's land area is 75% impervious

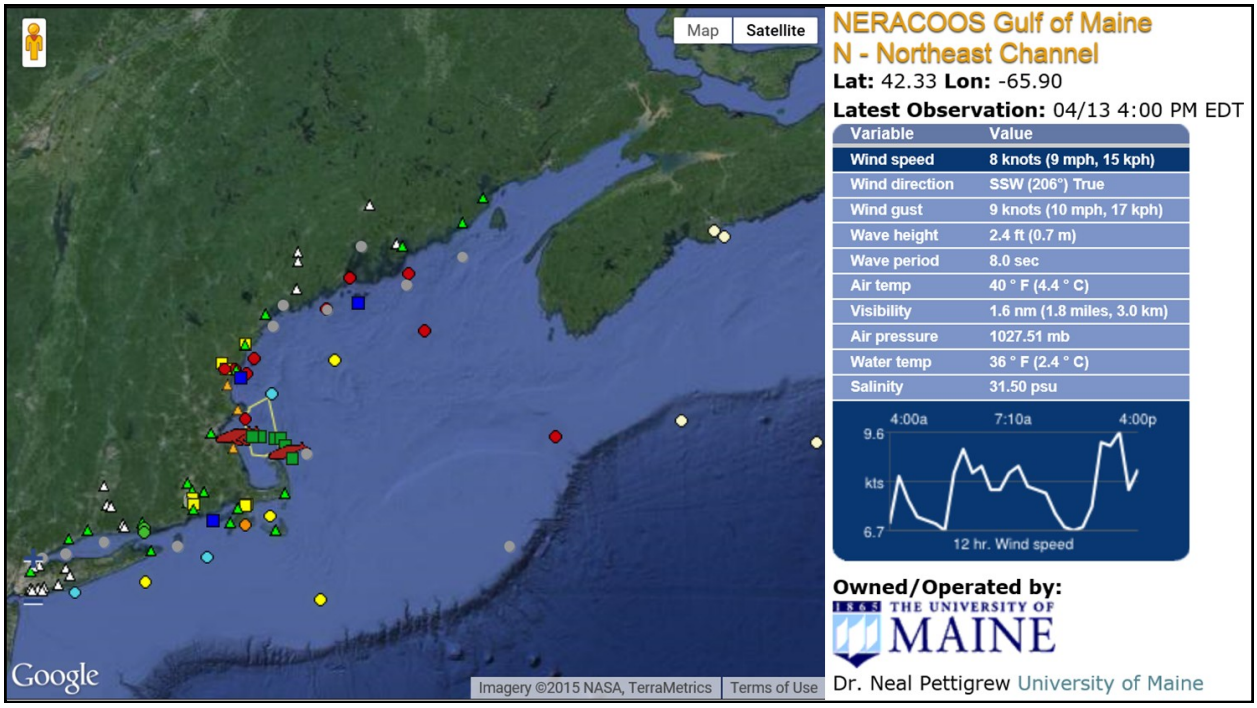
RESOURCES:

U.S. Environmental Protection Agency www.epa.gov/
Environmental Protection Agency Region 1 www2.epa.gov/aboutepa/epa-region-1-new-england

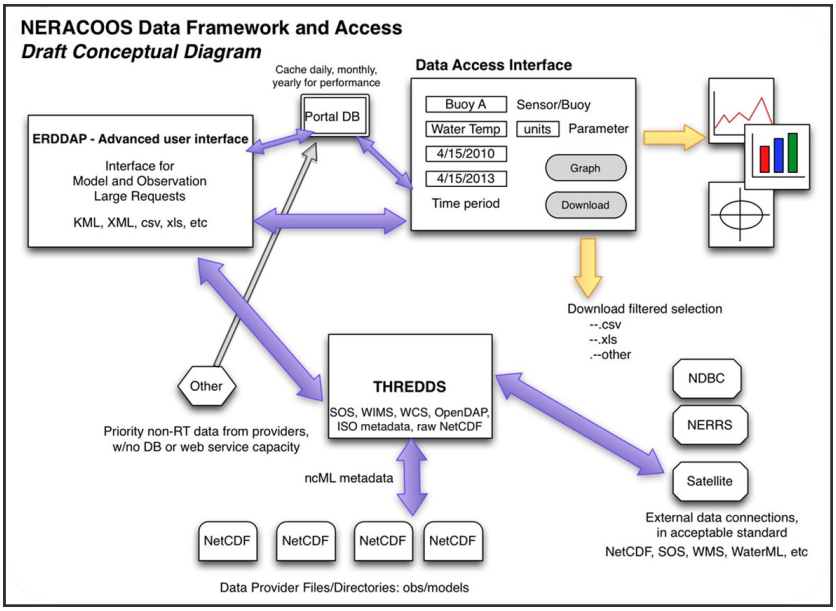
Gateway to the Gulf of Maine

Presenter: Ru Morrison
Northeast Regional Association of Coastal and Ocean Observing Systems

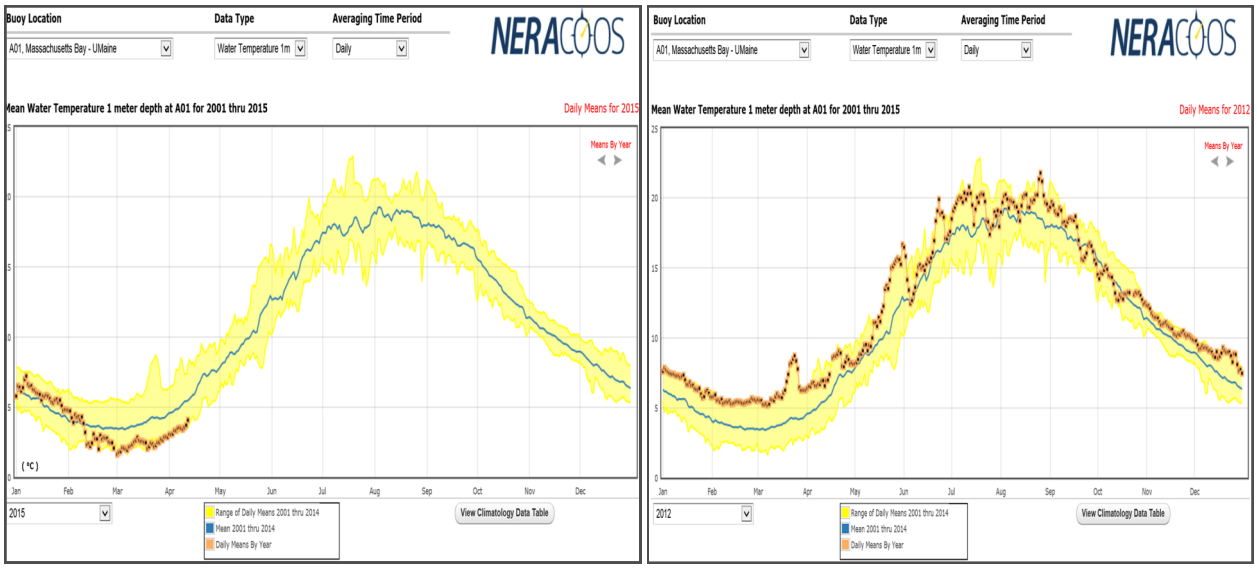
Massachusetts and Cape Cod Bays are part of the larger Gulf of Maine ecosystem. MassBays, partnering with institutions across the region, supports data sharing among partners in the Gulf of Maine, helping to produce a picture of ecosystem trends and conditions in the Gulf and enable managers and scientists to enhance and protect estuarine and marine resource. The Northeast Regional Association of Coastal and Observing Systems (NERACOOS) plays a leadership role in this effort bringing resources and expertise to produce, integrate, and communicate high-quality information to increase safety, economic and environmental resilience, and sustainable use of the coastal ocean. NERACOOS' work is stakeholder-driven, science-based, and policy-neutral. Examples of NERACOOS products are depicted here.



Screen capture: Real-time Data Portal

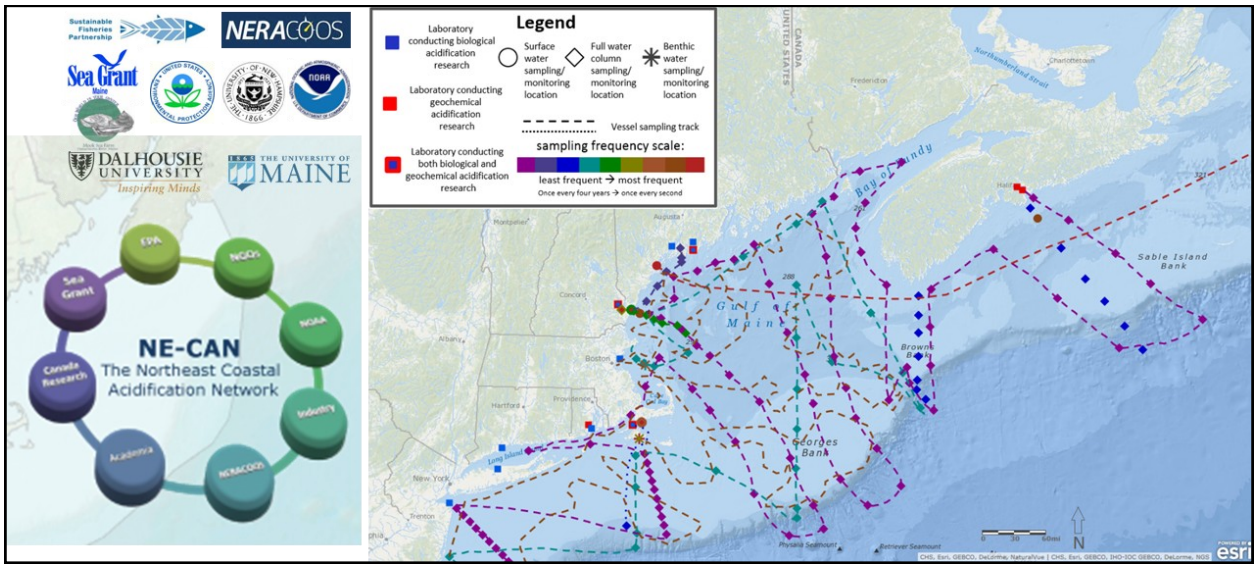


NERACOOS Data Management Framework

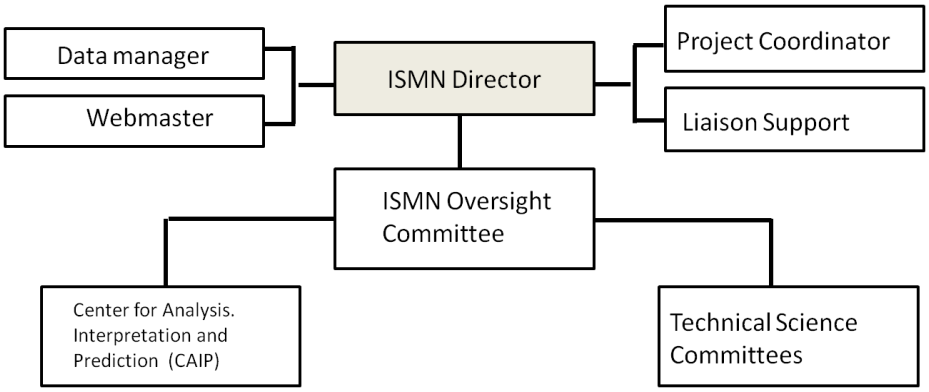


Ocean and Weather Climate Display

Northeast Coastal Acidification Network



INTEGRATED SENTINEL MONITORING NETWORK FOR ECOSYSTEM CHANGE IN NORTHEASTERN OCEAN AND COASTAL WATERS (PROPOSED STRUCTURE)



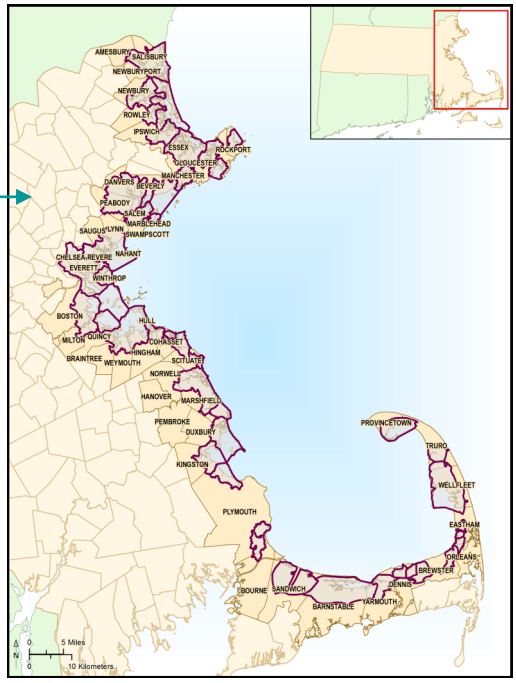
RESOURCES: NERACOOS www.neracoos.org/

Introduction to the Bays

Presenter: Bruce Carlisle
Massachusetts Office of Coastal Zone Management

THE SETTING: THE BAY AND THE BAYS

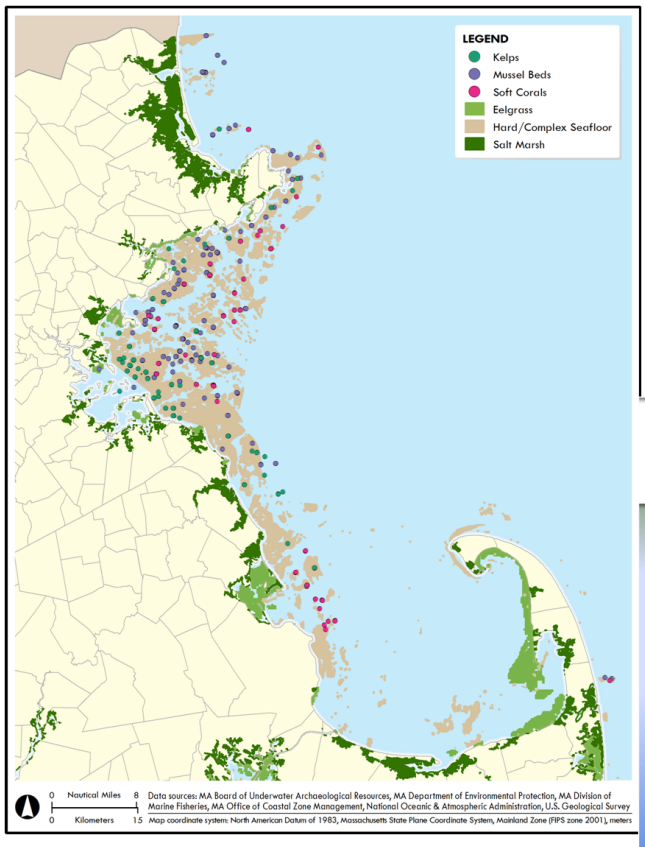
- Two bays—Massachusetts Bay and Cape Cod Bay
- Five regions—Upper North Shore, Lower North Shore, Metro Boston, South Shore, and Cape Cod
- 47 embayments delineated in 2013
- 50 coastal communities
- >1,000 miles of coastline



OCEANOGRAPHIC CHARACTERISTICS

- Mass Bay is connected to the Gulf of Maine system via the Maine Coastal Current.
- River inputs, particularly during spring runoff, have influence on flow.
- Semidiurnal tidal range is up to 13.4 ft (4.1 m).
- Maximum depth is 292 ft (90 m) in Stellwagen Basin, and average depth is 97.7 ft (29.8 m).

SEAFLOOR CHARACTERISTICS



Source: 2015 Massachusetts Ocean Management Plan (CZM)

ESTUARINE LIFE AND HABITAT

- **Phytoplankton = 302 sp**
- **Algae = 431 sp**
- **Invertebrates = 1721 sp**
- **Crabs & Shrimp = 16 sp**
- **Fish = 467 sp**
- **Birds = 176 sp**
- **Mammals = 29 sp**

Source: Census of Marine Life, Gulf of Maine Register

Important Habitat Areas:

- **Upwelling and fronts**
- **Biogenic habitats: eelgrass, kelp, corals, shellfish/invert reefs**
- **Abiotic structure: hard and complex seafloor**
- **Salt marsh**
- **Mudflats**

Source: various – MA Ocean Plan Baseline Assessment

Economy and Population

Massachusetts GDP:

- **2000 = $350.2 M**
- **2013 = $420.8 M**

Mass Bays coastal counties GDP:

- **2000 = $276.8 M**
- **2013 = $333.9 M**

Source: National Ocean Economics Program (2009 dollars)

Massachusetts:

- **2000 = 6.36 M**
- **2013 = 6.71 M**

Mass Bays coastal counties:

- **2000 = 4.22 M**
- **2013 = 4.49 M**

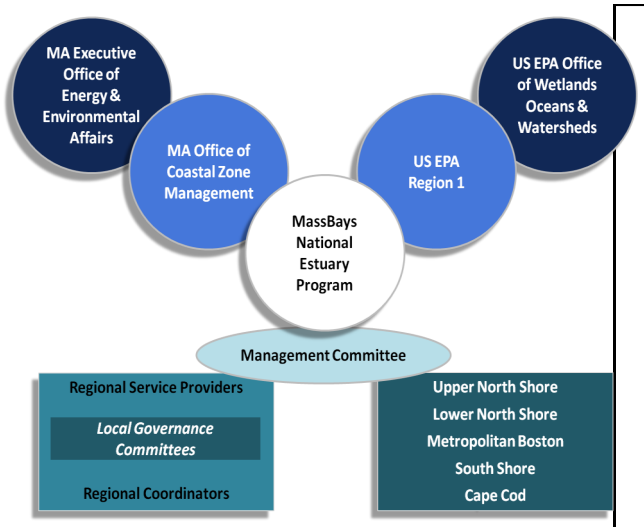
Source: U.S. Census Bureau

Uses and Activities

Fishing
Recreational
Maritime transportation
Energy
Infrastructure
Ocean disposal
Shoreline protection
Offshore sand/ beach nourishment
Research and education
Archaeological and cultural heritage
Military training and defense

About the MassBays National Estuary Program

- Launched in 1988 as part of a settlement for a Clean Water Act lawsuit on Boston Harbor.
- Accepted into the National Estuary Program (NEP) in 1990.
- One of two NEPs hosted by the MA Office of Coastal Zone Management (CZM).
- In early years, MassBays funded significant research and studies to assess condition and pollution problems in the Bays.
- First Comprehensive Conservation and Management Plan (CCMP) was developed in 1996.
- CCMP serves as the blueprint for coordinated action among government and partners to restore and protect the diverse natural resources of the Bays.



MassBays' Role

Strong track record in supporting and disseminating information on the conditions and trends in Mass and Cape Cod Bays:

- Scientific studies; Research and Planning Grant program
- State of Bay reports and symposia
- Coastal condition assessments with EPA, DEP, DMF, UMass

With its partners, MassBays plays an important role in coastal management:

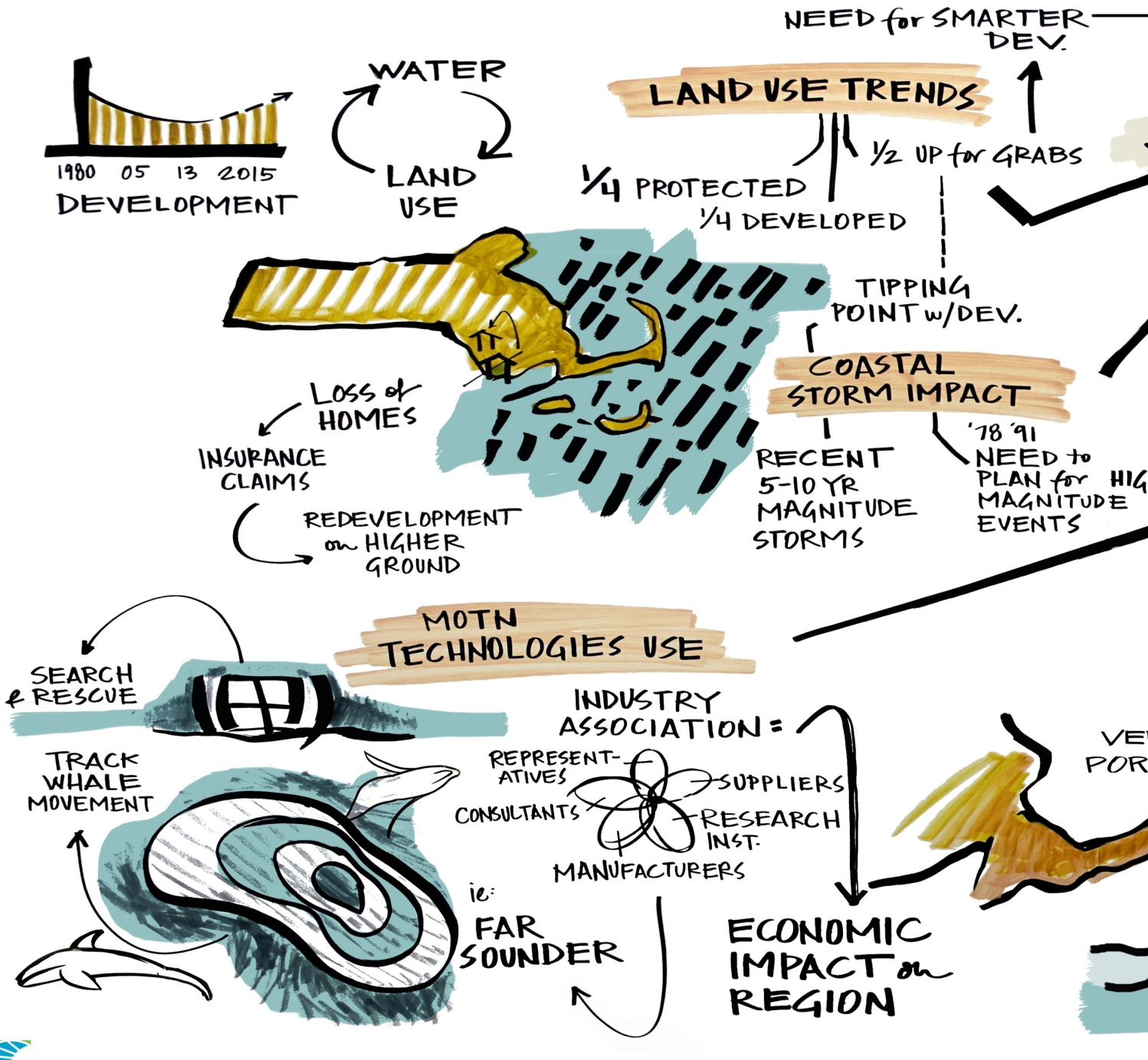
- Strong connection to local communities.
- Commitment to science and information sharing.

CCMP revision underway to identify goals and strategic actions for 5 to 8 years and ways to measure progress.

Massachusetts Office of Coastal Zone Management

RESOURCES: MA Office of Coastal Zone Management
www.mass.gov/eea/agencies/czm/

Human Uses,

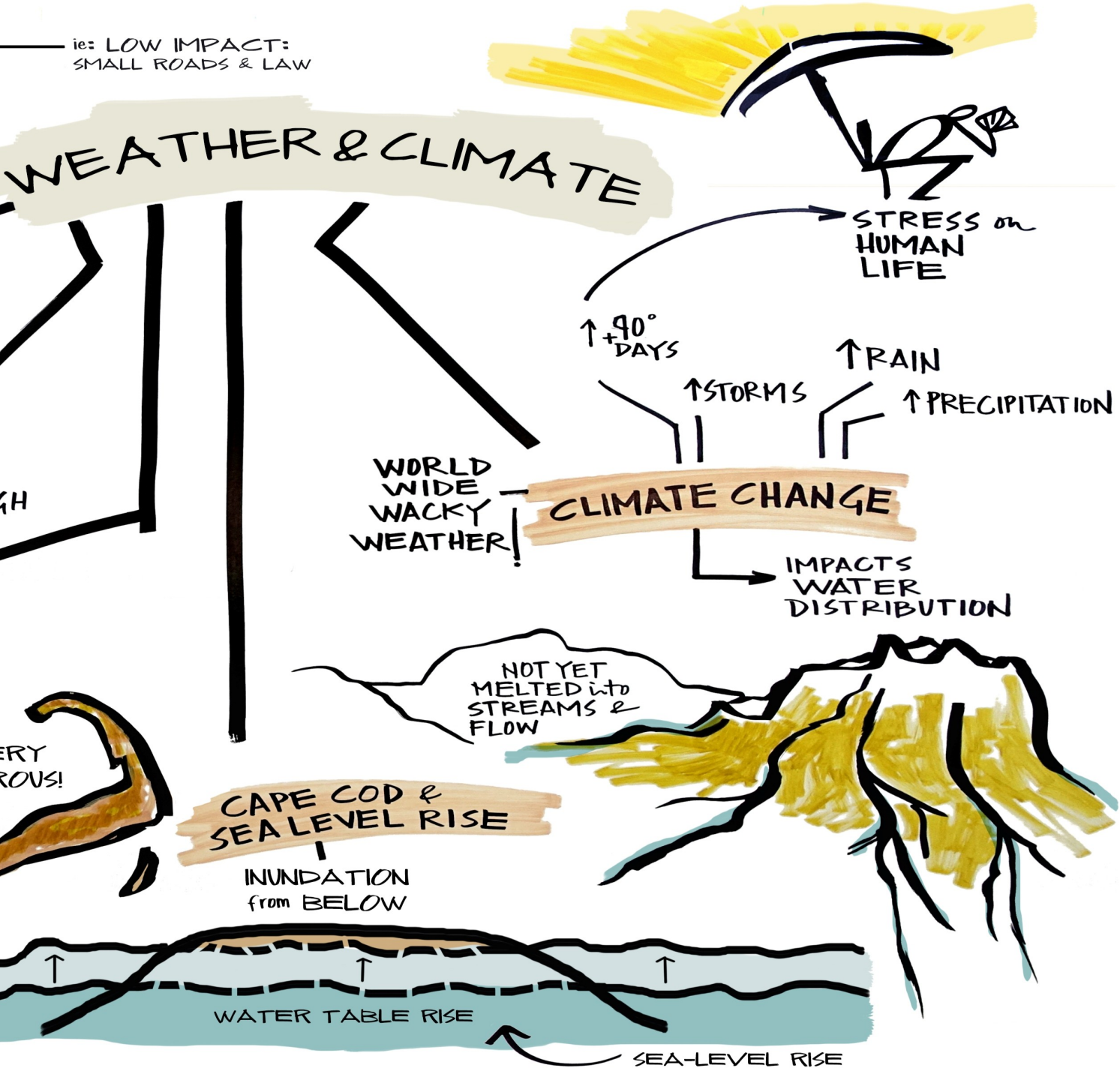


Massachusetts Bays
NATIONAL ESTUARY PROGRAM

2015 State of the Bays Symposium
15 April 2015 • Boston, MA

dpict. Images by Kelvy Bird | www.dpict.info

Weather and Climate



Land Use Trends and Community Resilience

Presenter: Heidi Ricci
MassAudubon

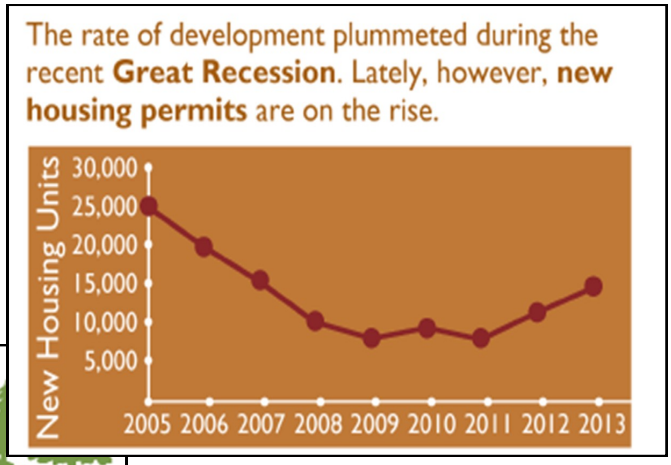
OVERVIEW

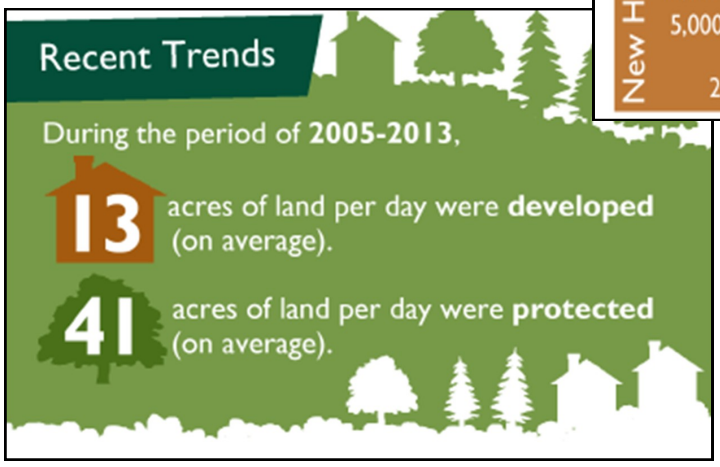
Over the past 40 years, the Massachusetts landscape has been transformed by new residential and commercial development. This is particularly evident in the eastern and southeastern parts of the state, affecting both coastal communities and the watersheds draining to Massachusetts and Cape Cod Bays. Released in June 2014, *Losing Ground: Planning for Resilience* found that from 2005-2013, 13 acres (5.26 ha)/day of natural lands were developed and nearly 50,000 acres (20,234 ha) of forest were lost. The land development rate is down from 20 acres/day between 1999-2005, and 40 acres (16 ha) /day in 1985-1999 period. However the current period of analysis includes the years of the recession when development slowed dramatically. Currently, more than 2.8 million acres (1.13 million ha) of undeveloped land, or 53% of the land in the state, are not protected, including over 1.5 million acres (0.67 million ha) (30% of the state) identified as being of high conservation value in *BioMap2*. In light of climate change environmental and economic impacts, it is increasingly important for proper planning when it comes to development and to incorporate Low Impact Development techniques.

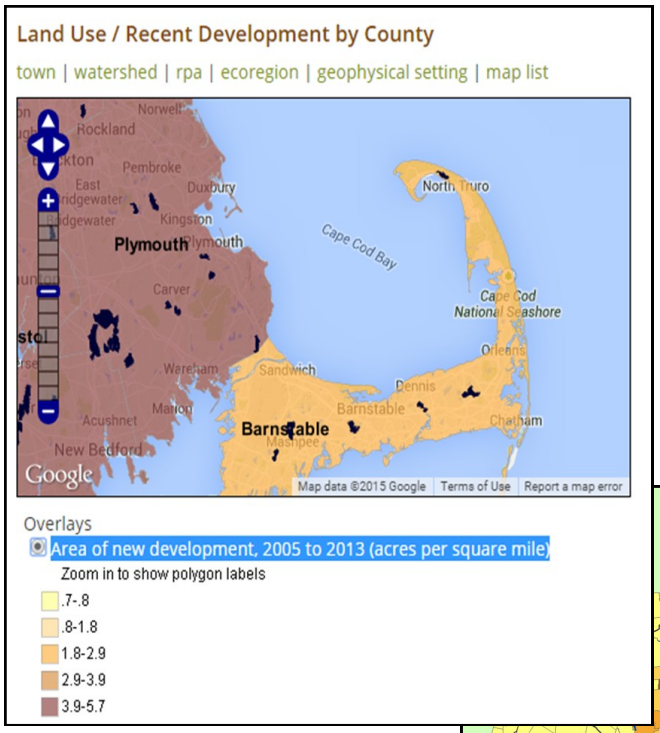
TRENDS AND CONDITIONS

DATA SOURCES

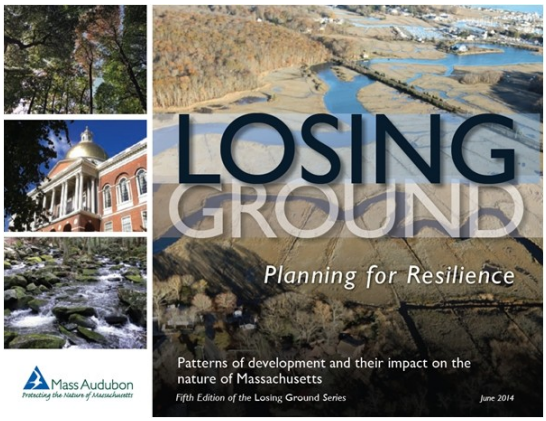
- *Losing Ground: Planning for Resilience (2014)*
- Data: 2005-2013
- Land use change/recent development and conservation

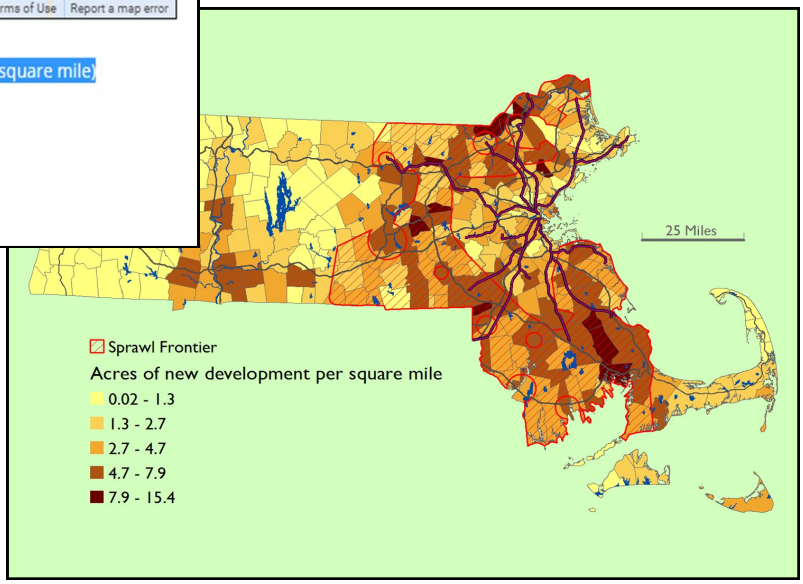






Screenshot: data and interactive maps available at www.massaudubon.org





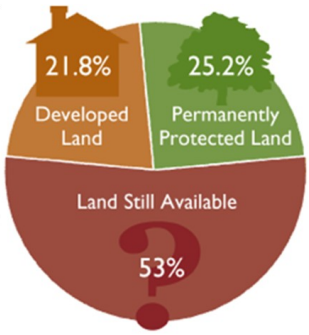
Development rates are highest around the I-495 belt, the "sprawl frontier," including MassBays' South Shore region.

BOTTOM LINE AND IMPLICATIONS

GIVEN INTENSE DEVELOPMENT PRESSURES IN EASTERN MA, PROTECTION OF REMAINING COASTAL AND INLAND BUFFERS AND IMPROVEMENT IN NEW DEVELOPMENT DESIGN NEED TO BECOME A PRIORITY.

APPROPRIATE PLANNING WILL:

- Protect highly resilient lands.
- Promote Low Impact Development.
- Align local plans and zoning.
- Look beyond parcel and municipal boundaries.
- Direct development away from vulnerable areas.



RESOURCES:

Losing Ground: Planning for Resilience (5th Ed.) www.massaudubon.org/our-conservation-work/education-community-outreach/sustainable-planning-development/losing-ground-report

Mass Audubon www.massaudubon.org/

BioMap 2 http://maps.massgis.state.ma.us/dfg/biomap2.htm

Mass Audubon
Protecting the Nature of Massachusetts

MOTN Technologies in Use in Massachusetts Bays

Presenter: Harlan Doliner
Marine Ocean Technology Network

OVERVIEW

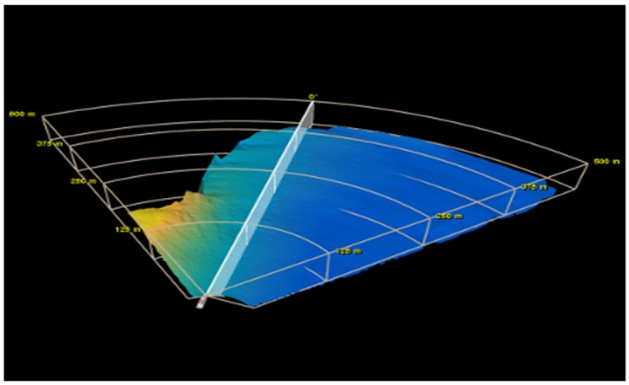
Technologies developed by or attributable to companies and institutions that are members of MOTN, the nonprofit Marine & Oceanographic Technology Network (www.MOTN.org), have played a significant role in the gathering of biological, oceanographic, and infrastructure data in Massachusetts Bay. Oceanographic technology has made great strides over the last few decades, enabling progress in data collection and analyses that enhances scientific information about ocean ecosystems. Representative examples and their potential future uses are provided.

TRENDS IN TECHNOLOGY

MOTN fosters cooperation between, and opportunities for, its member companies. Member companies include industry suppliers, consultants, representatives, research institutes and manufacturers—all working together to increase business opportunities both within and outside of the organization.

MOTN Technologies Active in Massachusetts Bay

Local companies, nonprofits, and institutions have developed technology that has enabled huge advancements in the study of coastal and ocean resources.



FarSounder

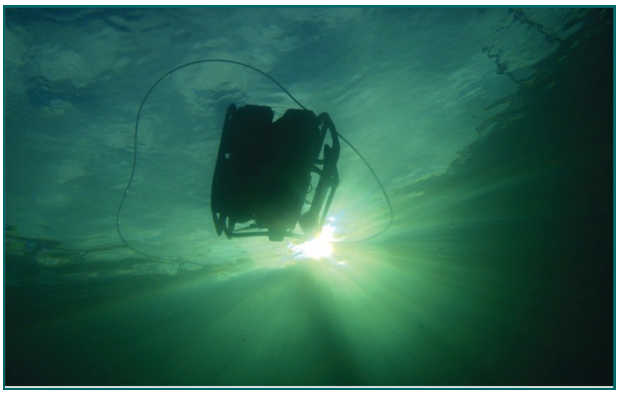
Developed 3-D technology to facilitate sea-floor mapping.

Woods Hole Oceanographic Institution

Developed technology to tag and tract marine mammals, allowing us to follow these creatures' journeys around the world.

TELEDYNE SEABOTIX

Manufactures underwater MiniROVs that perform a multitude of tasks including maritime security, search and recovery, hull and pipeline inspection, hazardous environment intervention, aquaculture, sensor deployment, and oceanographic research.

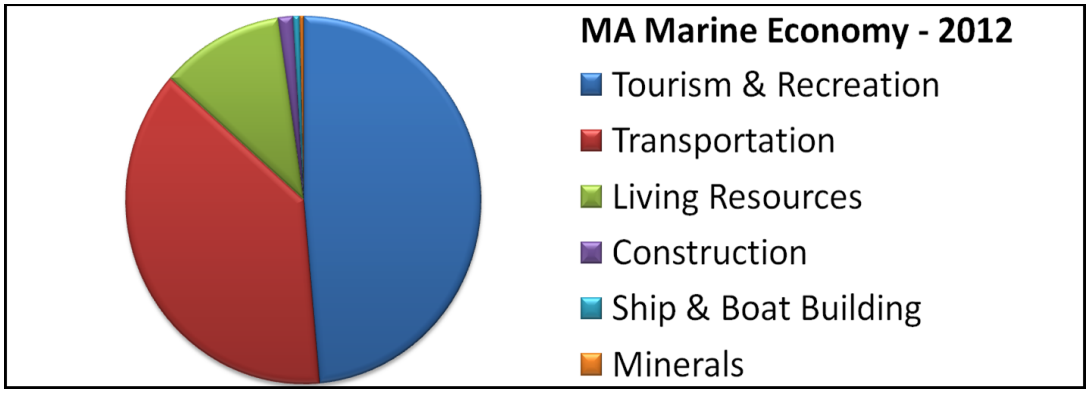


MCLANE RESEARCH LABORATORIES

Manufactures time-series oceanographic profilers, samplers, and flotation.

MOTN's network of marine technology businesses serves as a resource for researchers seeking instrumentation, technicians and others seeking employment, and anyone interested in the latest news and events related to ocean and coastal technology.

MASS BAYS MARINE ECONOMY



Source: National Ocean Economics Program

RESOURCES:

The Marine & Oceanographic Technology Network
www.motn.org/

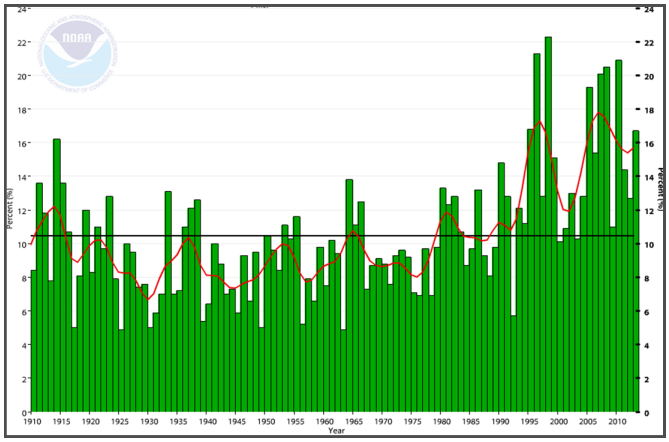
Trends in Northeast Weather and Climate

Presenter: Ellen Mecray
National Oceanographic and Atmospheric Administration

OVERVIEW

The Gulf of Maine Council's Climate Network convenes scientists and planners to raise awareness about climate impacts and inspire effective action in local communities. This collaborative approach engages participants across borders to address shared concerns such as sea level rise, ocean acidification, and extreme weather events. The network compiles regional climate data, training adaptation, and climate adaptation guidance to help community leaders find the resources they need.

TRENDS AND CONDITIONS

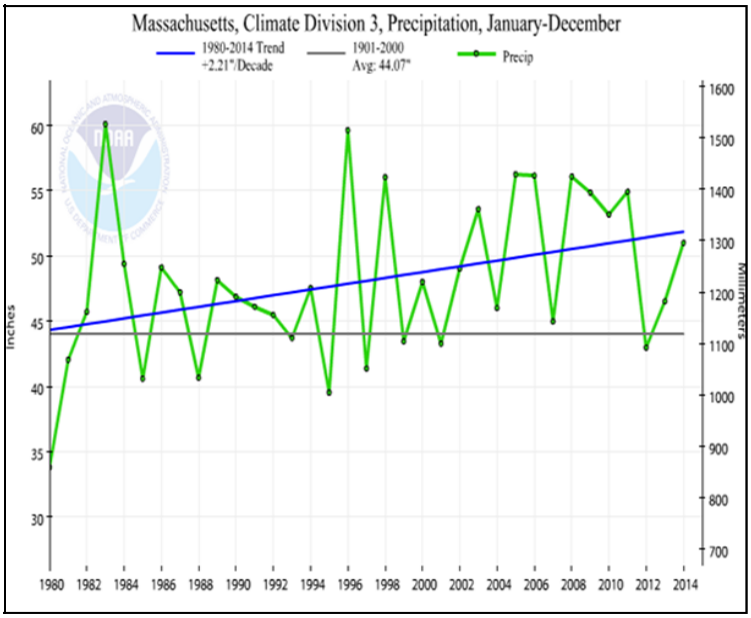


(Above) Frequency (%) of 1-day heavy precipitation events, 1910-2013 [NOAA]

Observations in the Northeast

- Increased intensity of heavy rain events
- Increased precipitation frequency
- Increasing number of days >90°F (32°C)
- Greater impacts from coastal storms
- Increased storm surge and flooding especially during high tides
- Sea level increase in northeast greater than the global average
- Salt water intrusion (Cape Cod especially vulnerable)

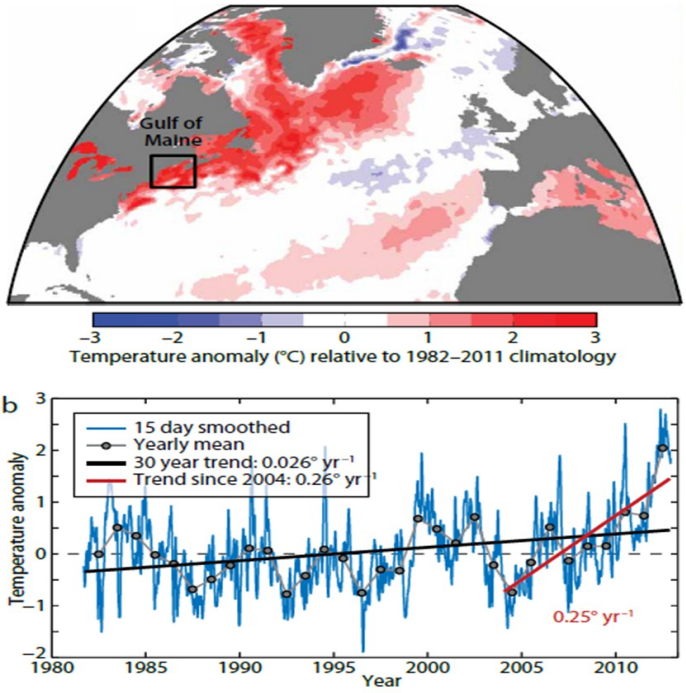
(Right) Increase in intensity of heavy rain events, 1940-2014 [NOAA]
http://www.ncdc.noaa.gov/cag/



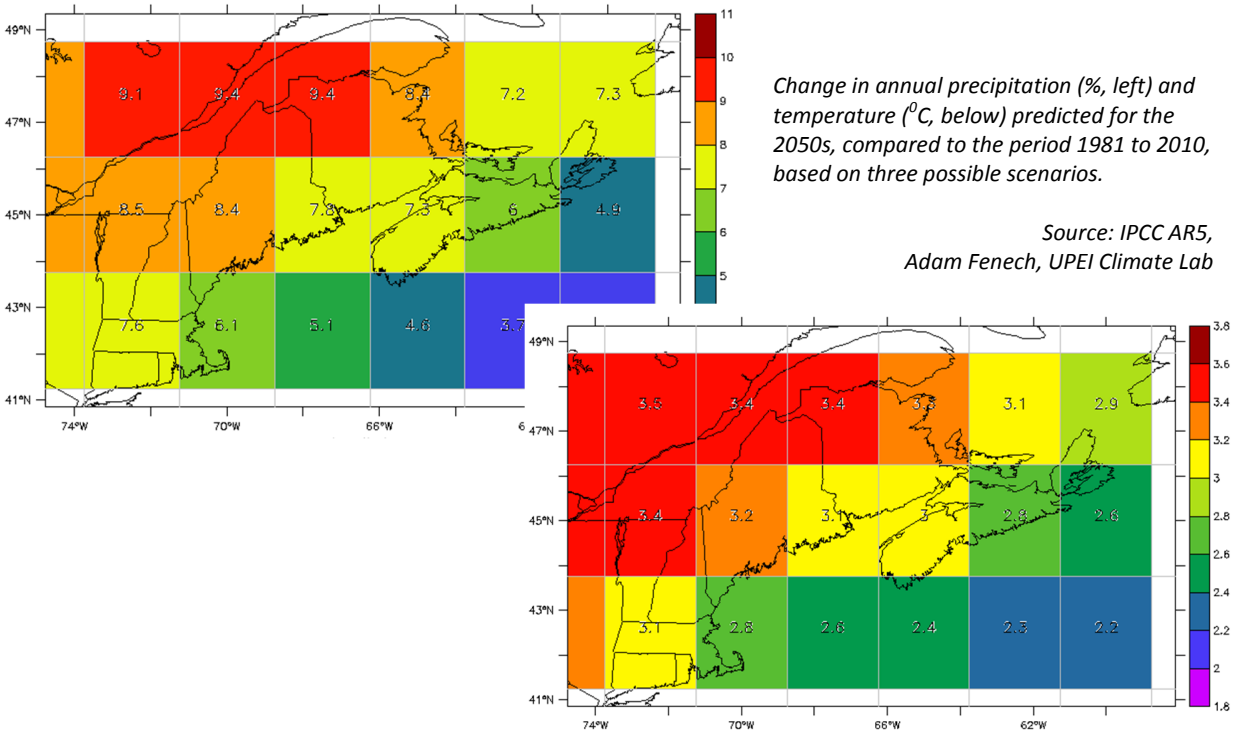
GULF OF MAINE OCEAN TEMPERATURE TRENDS

- During Summer 2012 , Gulf of Maine (GOM) was warmer than 99% of the global ocean.
- Between 1982 and 2002, GOM water temperature increased 0.5^{0}C (black line). The trend since 2004 is more dramatic, increasing by 1^{0}C every 4 yrs (red line).

Source: Mills et al., 2003



BOTTOM LINE AND IMPLICATIONS



Change in annual precipitation (%, left) and temperature (^{0}C, below) predicted for the 2050s, compared to the period 1981 to 2010, based on three possible scenarios.

Source: IPCC AR5, Adam Fenech, UPEI Climate Lab

RESOURCES:

State Climatologists stateclimate.org/
Regional Climate Centers www.ncdc.noaa.gov/customer-support/partnerships/regional-climate-centers
Quarterly Climate Summaries/Outlooks www.drought.gov/drought/content/resources/reports
Climate Information Dashboard www.gulfofmaine.org/dashboard/

Gulf of Maine Council on the Marine Environment
Celebrating 25 years of action for a healthy environment

Coastal Storm Impacts

Presenter: Julia Knisel
MA Office Of Coastal Zone Management

Photo: CZM

TRENDS AND CONDITIONS

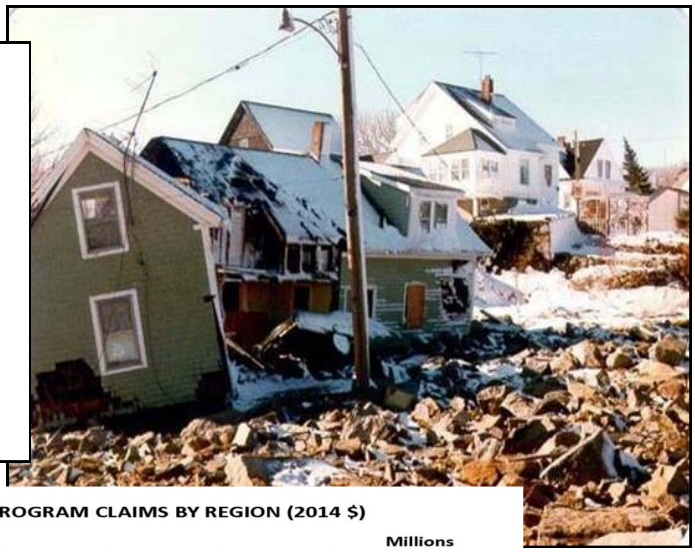
Data Sources

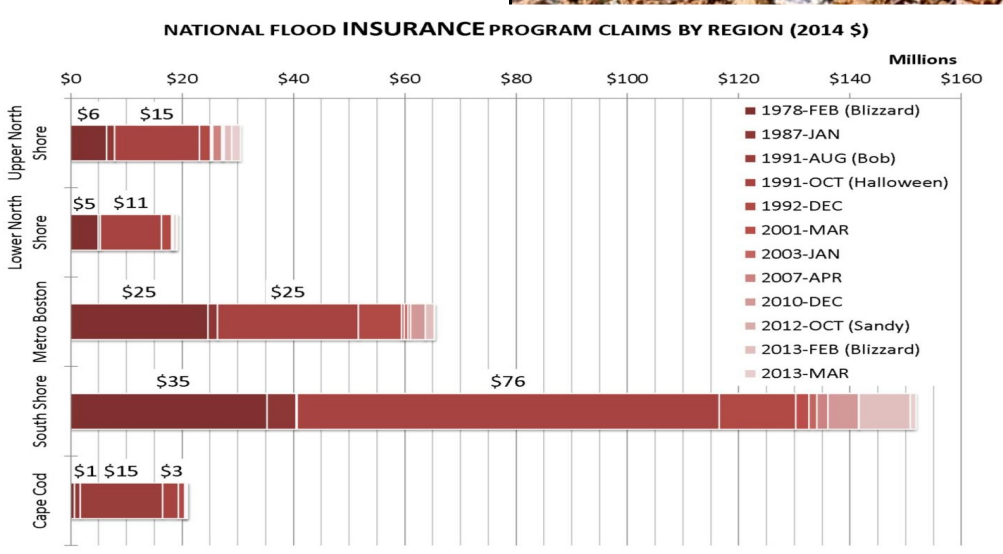
National Flood Insurance Program Claims

- 1978 to present
- Region-wide
- Do not include uninsured damage

MA Coastal Storm Damage Assessment Team Reports

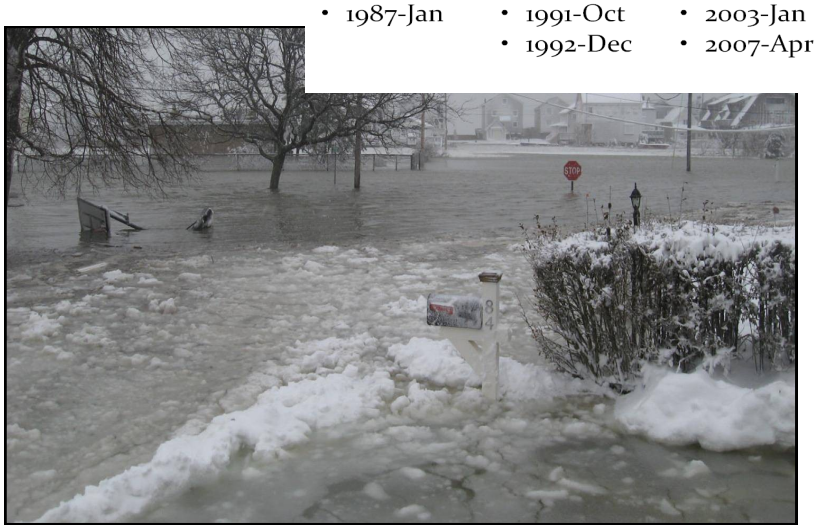
- 2010 to present
- Hot spots
- "Windshield" surveys





National Flood Insurance Program Claims (1978-present)
millions 2014 $

$82	$172	$10	$26	?
• 1978-Feb • 1987-Jan	• 1991-Aug • 1991-Oct • 1992-Dec	• 2001-Mar • 2003-Jan • 2007-Apr	• 2010-Dec • 2012-Oct • 2013-Feb • 2013-Mar	



Coastal Storm Impacts

- Property losses
- Public safety threats
- Natural resource losses

BOTTOM LINE AND IMPLICATIONS

Take-Home Messages

- South Shore has experienced most severe coastal storm impacts.
- Costs of 1978 and 1991 events far exceed recent (and more frequent) events.
- Need to plan and prepare for bigger events (like the 1978 and 1991 storms).

Resources:
Massachusetts StormSmart Coasts www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/

Massachusetts Office of Coastal Zone Management

CASE STUDY

Evaluating the Effects of Sea Level Rise on Massachusetts Aquifers: A Cape Cod Pilot Study

Presenter: Jo Ann Muramoto
Association to Preserve Cape Cod
MassBays Regional Coordinator (Cape Cod)

ABOUT THE STUDY

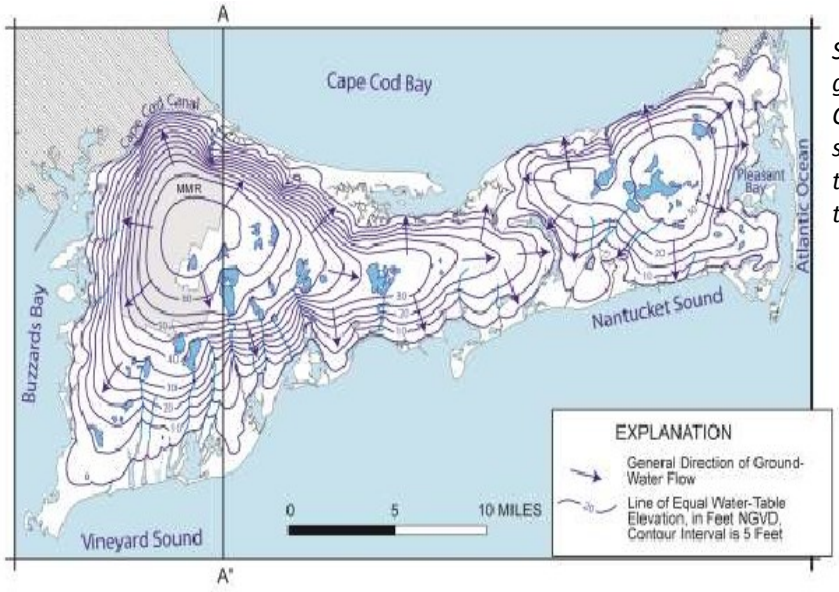
The USGS conducted hydrological studies of the Lower Cape groundwater system and found it became more saline with over-pumping (for drinking water) due to saltwater intrusion. These same modeling studies indicated that rising sea level could impact coastal aquifers by changing the elevation of the water table and depth to groundwater, changing stream baseflows, and changing position of the freshwater/saltwater interface.

Our question: How would such changes affect water resources, water quality, stream flow, habitat, wastewater, stormwater, and infrastructure in the mid-Cape?

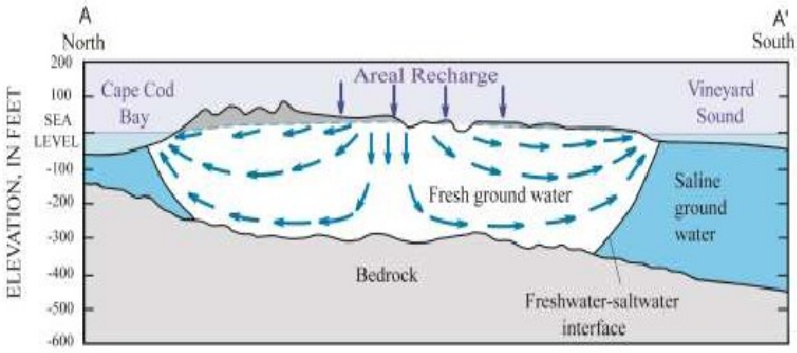
GOALS

- Model effects of sea level rise (2 ft/0.6 m, 4 ft/0.8 m, 6 ft/1.8 m) on groundwater interface. Model should be transferable.
- Evaluate impacts on water, wetlands, septic systems/wastewater management, stormwater management, and infrastructure.
- Develop adaptation measures.
- Provide outreach.

THE STUDY AREA



Sagamore Bridge and Monomoy groundwater flow lenses of Cape Cod, MA. Contour lines indicate the subsurface elevation of the water table, which is mounded higher in the Upper and Mid-Cape.



Cross-section of the groundwater lens: fresh water sits on top of saline groundwater which is in contact with sea water. As sea level rises the lighter freshwater lens would be lifted up, thus raising the water table, and potentially impacting infrastructure such as septic systems.

NEXT STEPS

The response of the groundwater system needs to be modeled using site-specific data to show response of the groundwater system to rising sea levels. Once the modeling study is complete (Summer 2015), work on adaptation measures will begin.

PROJECT PARTNERS & FUNDERS

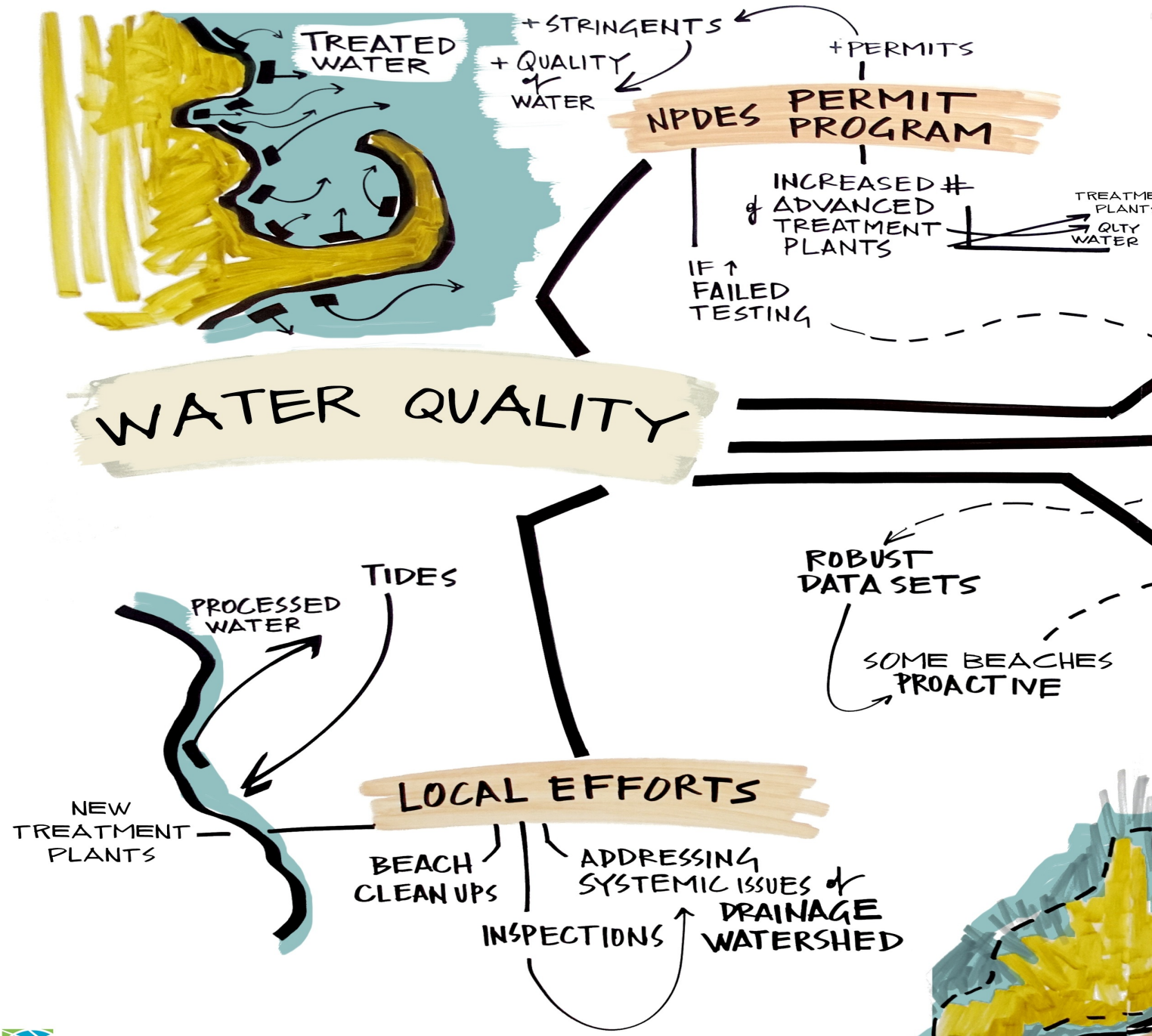
U.S. Geological Survey
Cape Cod Commission
The Nature Conservancy
Massachusetts Environmental Trust
MassBays National Estuary Program
Cape Cod Five Cents Savings Bank
Barnstable County Coastal Resources Committee

RESOURCES:

APCC Effects of Sea Level Rise on Coastal Aquifers www.apcc.org/sealevelrise/index.html
Video: Sea Level Rise: Changing Cape Cod Groundwater www.apcc.org/videos/index.html

APCC Association to Preserve Cape Cod

WATER

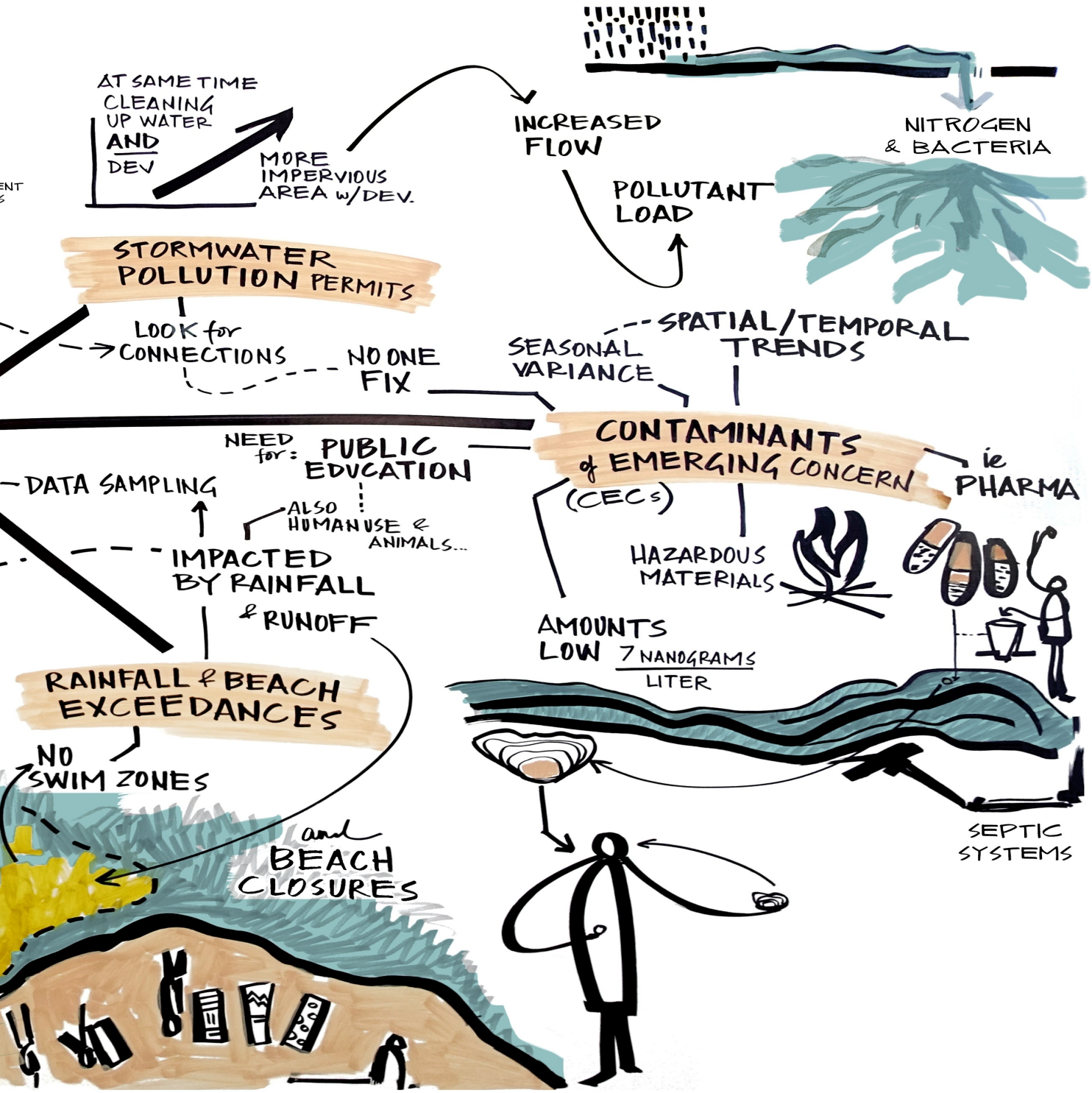


Massachusetts Bays
NATIONAL ESTUARY PROGRAM

2015 State of the Bays Symposium
15 April 2015 • Boston, MA

dpict. Images by Kelvy Bird | www.dpict.info

QUALITY


AT SAME TIME CLEANING UP WATER AND DEV
MORE IMPERVIOUS AREA w/DEV.
INCREASED FLOW
NITROGEN & BACTERIA
POLLUTANT LOAD
STORMWATER POLLUTION PERMITS
LOOK for CONNECTIONS
NO ONE FIX
SEASONAL VARIANCE
SPATIAL/TEMPORAL TRENDS
CONTAMINANTS of EMERGING CONCERN (CECs)
ie PHARMA
NEED for: PUBLIC EDUCATION
DATA SAMPLING
ALSO HUMAN USE & ANIMALS...
IMPACTED BY RAINFALL & RUNOFF
HAZARDOUS MATERIALS
AMOUNTS LOW 7 NANOGRAMS / LITER
RAINFALL & BEACH EXCEEDANCES
NO SWIM ZONES
and BEACH CLOSURES
SEPTIC SYSTEMS

National Pollution Discharge Elimination System Permit Program

Presenter: Betsy Davis
U.S. Environmental Protection Agency

OVERVIEW

In Massachusetts NPDES permits are issued jointly by the U.S. Environmental Protection Agency (EPA) and the MA Department of Environmental Protection (DEP). As of 2014, 15 Publicly Owned Treatment Works (POTWs) discharge directly into the MassBays planning area. Over the years all treatment plants along the MassBays coast except one have upgraded their treatment level or relocated their outfall location to improve the quality of effluent discharged into Massachusetts Bay. POTW permits have stringent effluent limits in an effort to control the discharge of toxics and nutrients into the Bays from point sources. Additionally, since 2010 requirements have been put in place for POTW owners and operators to improve maintenance and operation in order to address flow entering the POTW from inflow and infiltration.

TRENDS AND CONDITIONS

Data Sources

- MassGIS Impervious Area Cover—2005
- MassDEP 2012 305(b) integrated waters list
- National Stormwater Quality Database

Advanced treatment POTWs:

- Cohasset Wastewater Treatment Plant: membrane filtration
- Scituate Wastewater Treatment Plant: filters
- Charles River plants: filtration, multiport chemical addition

BOTTOM LINE AND IMPLICATIONS

NPDES permits: Nutrient Monitoring and Reporting

- Some NPDES permit have been re-issued.
- May include ammonia nitrogen limits.
- Includes monitoring and reporting for nutrients (nitrogen).

Co-Permittee Requirements

- Operation and maintenance of the sewer system
- Notification of unauthorized dischargers

Resources:
NPDES Stormwater Permit Program www.epa.gov/region1/npdes/stormwater/index.html

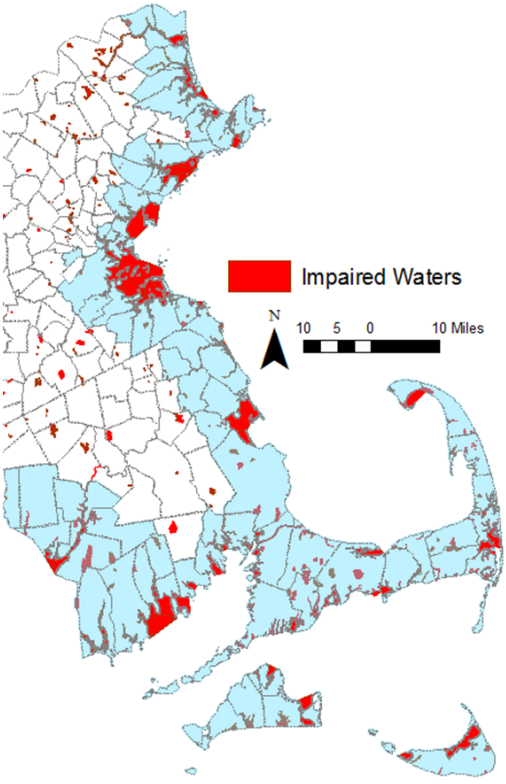
Trends in Stormwater Pollution and MS4 Permits

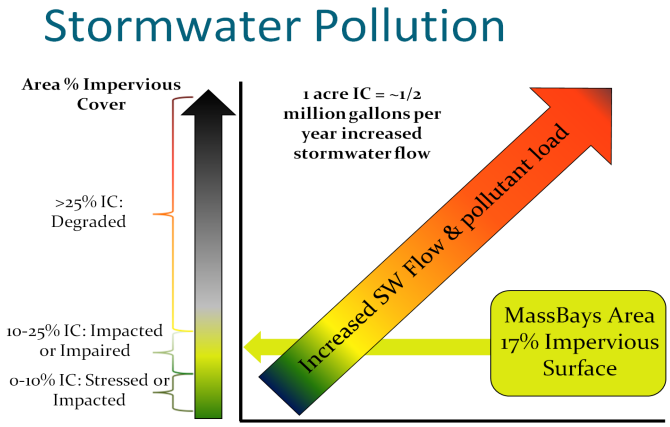
Presenter: Newton Tedder
U.S. Environmental Protection Agency

OVERVIEW

Pollutant loads and discharges from industrial facilities and POTWs to Massachusetts embayments have been declining for decades due to treatment upgrades and tighter NPDES permit limits. This has lead to an overall improvement in water quality in coastal waterbodies since the passing of the Clean Water Act. However, during this same time, stormwater flow from increased development and expanded impervious cover along the coast has increased pollutant loads delivered to those same embayments. Today, stormwater is the number one cause of impairments to coastal waters. Increased stormwater flow due to impervious cover in coastal areas delivers large loads of nitrogen, phosphorus, solids, bacteria, metals, and oil and grease to coastal waters, in many cases causing or contributing to water quality impairments and beach closures. The most recent Municipal Separate Storm Sewer System (MS4) permit begins to target reductions in stormwater pollutants prior to discharge. The permit represents a step forward in stormwater pollution control so we can begin to reverse water quality deterioration in the Commonwealth's coastal waters.

TRENDS AND CONDITIONS





BOTTOM LINE AND IMPLICATIONS

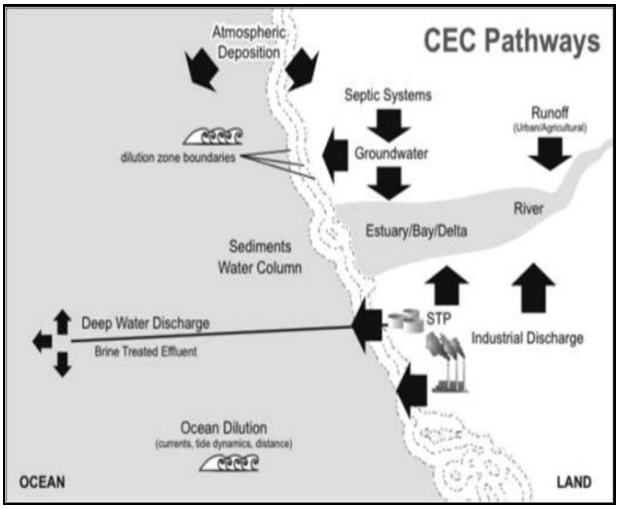
- Stormwater runoff is causing waterbody impairments due to nitrogen and bacteria inputs.
- Current nitrogen load from impervious cover within the MassBays area is over 100,000 lb (45,359 kg)/yr.
- Current yearly stormwater flow from impervious cover is equivalent to an 8 MGD (30.2 MLD) treatment plant.

Contaminants of Emerging Concern

Presenter: Amy Costa
Center for Coastal Studies

OVERVIEW

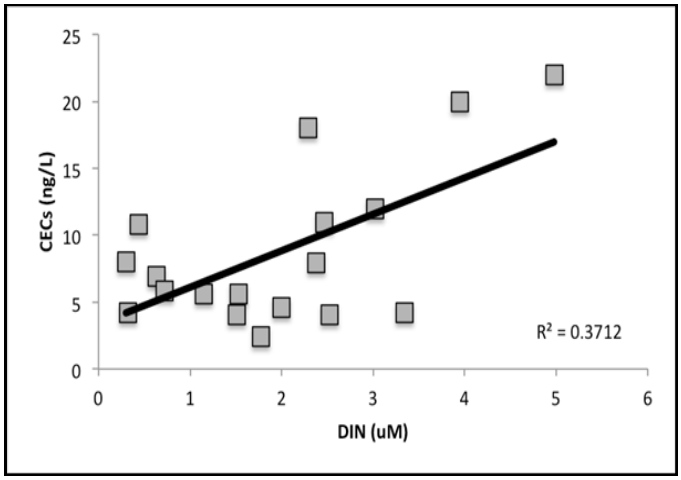
Contaminants of emerging concern (CECs) encompass thousands of chemical compound types. By definition, these are anthropogenic compounds that are released into the environment and may pose a risk, but at present are largely unregulated. Although these chemicals have been introduced into the environment for decades, it is not until recently that technology to detect them became available. Research by the Center for Coastal Studies (CCS) focused on the water soluble CECs (pharmaceuticals and personal care products) with the goal of characterizing types, distribution and possible sources into coastal waters.



This work was the first to document the presence of CECs in Massachusetts' coastal waters. Data were evaluated for spatio-temporal trends and analyzed in the context of land use and water quality data specific to each watershed. Additional work by the CCS has addressed potential environmental impacts by investigating the bioavailability of these contaminants in the marine environment. This work has built the foundation for future monitoring of CECs, and the results indicate that monitoring for CECs should be a critical part of water quality research on Cape Cod. Regulation and mitigation steps can then be identified for future implementation and protection of our coastal resources.

Data Sources

- USGS (2002) - documented the presence of low levels of CECs in a network of 139 targeted streams across the U.S.
- Cape Cod Toxic Substances Hydrology Research Site - MA Military Reservation
- Silent Spring Institute - ponds (2006), public wells (2010), private wells (2011)



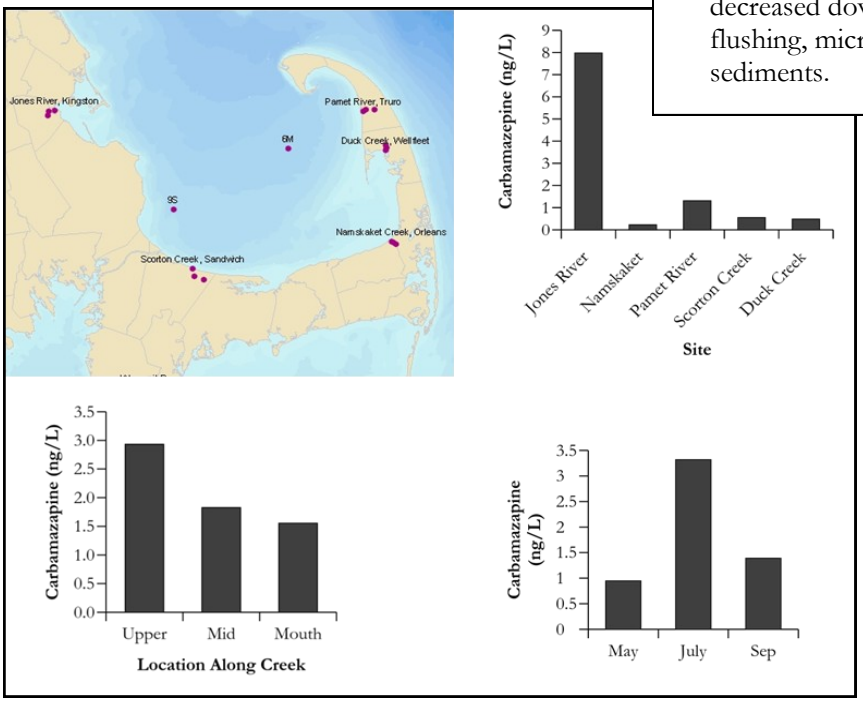
CEC occurrence and concentration are closely associated with wastewater and human use.

TRENDS AND CONDITIONS

- 2010: CECs in Massachusetts waters were detected in low concentrations (ng/L,)
- 2012: Study on relationship of spatial and temporal trends was conducted (funded by MassBays) (figure below).
- 2014: Building on the 2012 study, a study on bioaccumulation and passive samplers was conducted (funded by Massachusetts Environmental Trust).

TEMPORAL AND SPATIAL VARIATIONS OF CARBAMAZEPINE (2012)

- Highest concentrations were detected in July
- Of the 5 inshore areas sampled, highest concentrations were detected in Jones River. The Jones River Watershed is the largest watershed and most developed of those sampled.
- Along each creek sampled (upper, mid-way, and near river mouth), carbamazepine concentrations were highest in the upper section and decreased downstream probably due to tidal flushing, microbial degradation or sorption to sediments.



Temporal and spatial variation of carbamazepine, an anticonvulsant drug used to treat brain and nerve disorders, among sampling stations in Massachusetts waters (CCS, 2012)

BOTTOM LINE AND IMPLICATIONS

- CECs are present in our coastal waters.
- Concentrations are linked to the degree of human use.
- Evidence exists for bioaccumulation of some (but not all) CECs.
- CECs are closely associated with wastewater as indicated by dissolved inorganic nitrogen levels (DIN).
- Need to establish baseline data.
- Future studies are needed to address occurrence, fate, transport, toxicity and persistence.
- More work on environmental impacts is needed.
- Largely unregulated but beginning to receive attention.

RESOURCES:

Bioaccumulation of Contaminants of Emerging Concern http://coastalstudies.org/programs/cape-cod-bay-monitoring-program/bioaccumulation-of-contaminants-of-cec/

Cape Cod Monitoring Program http://coastalstudies.org/programs/cape-cod-bay-monitoring-program/bioaccumulation-of-contaminants-of-cec/

Trends in Beach Water Conditions

Presenter: Michael Celona
MA Department of Public Health

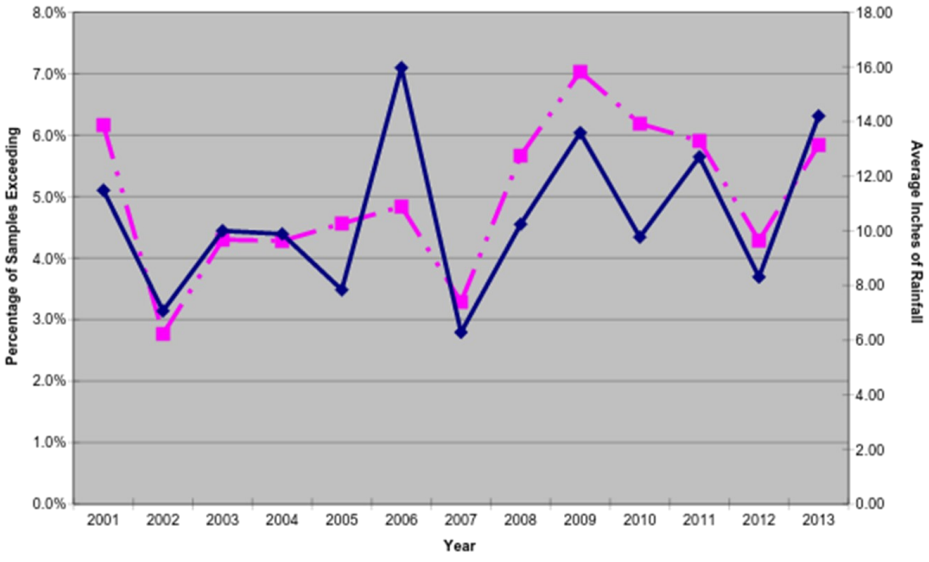
OVERVIEW

In 2000, the Massachusetts legislature passed An Act Relative to Minimum Standards for Public Bathing Waters, often referred to as the Massachusetts Beaches Act. The Act directed the Massachusetts Department of Public Health (MDPH) to develop marine and freshwater bathing water standards protective of public health, require regular bacteria testing at all public and semi-public beaches, and notify the public when bathing standards are violated. The Act also mandated that MDPH publish an annual report analyzing statewide bacteria testing results. Approximately 7,500 marine beach samples are collected annually. Results have shown that marine beach exceedances are strongly correlated with both seasonal rainfall amounts and recent rainfall.

TRENDS AND CONDITIONS

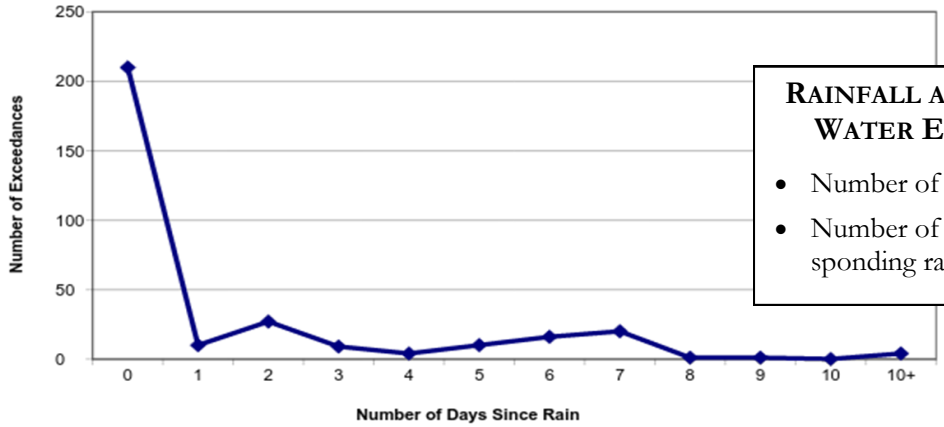
DATA SOURCE

- MDPH Annual bacteria testing reports from coastal beach sampling, 2001 to 2013



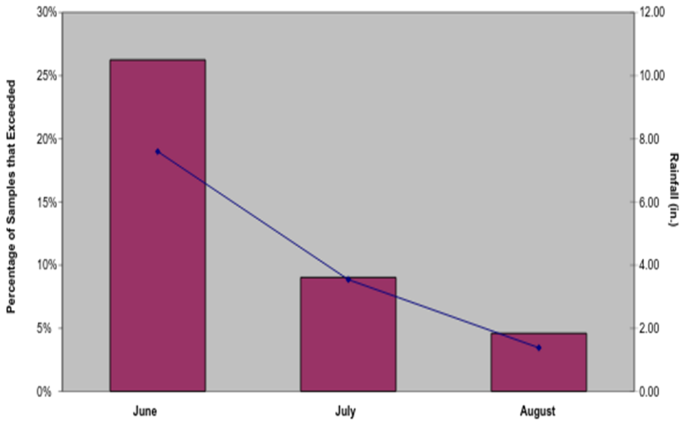
Percent of samples exceeding state bathing beach standards (pink dashed line) and average annual rainfall (inches, blue line) at coastal beaches, 2001 to 2013.

Photo: CZM



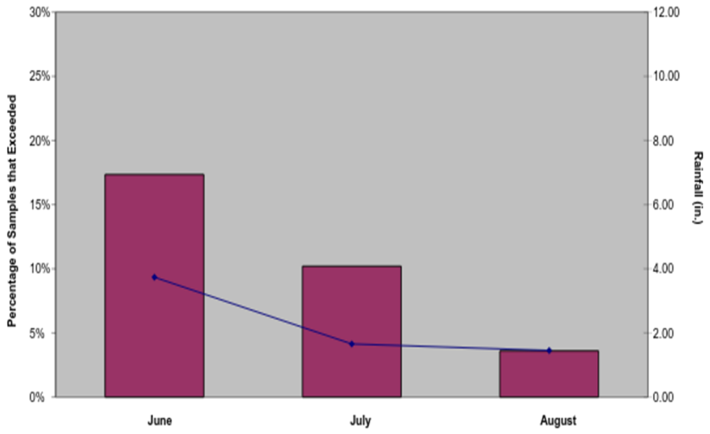
RAINFALL AND MARINE BEACH WATER EXCEEDANCE: 2013

- Number of exceedances: 475
- Number of exceedances with corresponding rainfall events: 312 (66%).



Percent of samples exceeding state standards (blue line) and inches of rainfall (red bar) in 2013. (Left) Boston-area beaches (Boston, Braintree, Quincy, Lynn, Revere, and Winthrop); (Below) Chatham-area beaches (Brewster, Chatham, Dennis, Eastham, Orleans, and Harwich).

Photo: CZM



BOTTOM LINE AND IMPLICATIONS

- Marine beach exceedances are strongly correlated with both seasonal rainfall amounts and recent rainfall.
- Stormwater and runoff are significant factors in marine beach exceedances.

RESOURCES:

MA DPH Annual Beach Testing Reports www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/beaches-algae/

Marine and Freshwater Beach Testing in MA: 2014 Season http://www.mass.gov/eohhs/docs/dph/environmental/exposure/beach-reports/beach-annual-report14.pdf

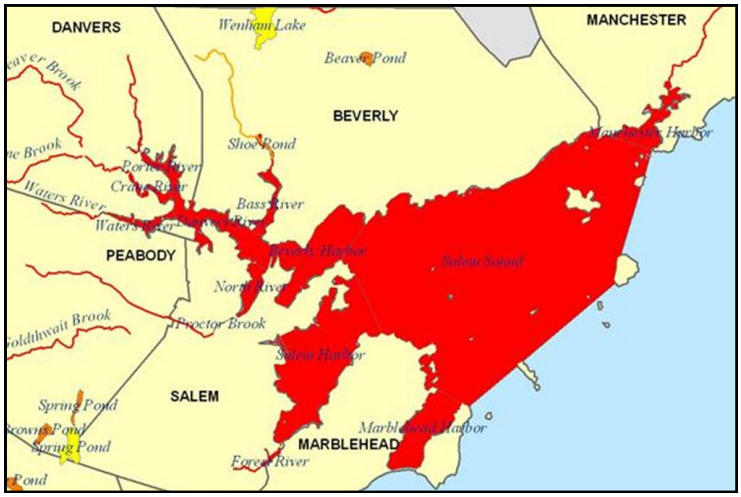
CASE STUDY

Stormwater Success Stories and Lessons Learned: The North Shore

Presenter: Barbara Warren
Salem Sound Coastwatch
MassBays Regional Coordinator (Lower North Shore)

BACKGROUND

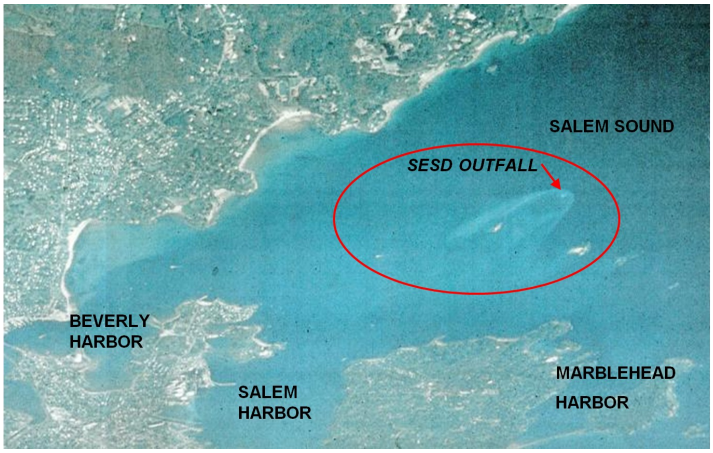
Rain can cause temporary elevated bacterial counts at discharge sites and within near-shore coastal waters. Runoff from impervious surfaces flushes contaminants through storm drains, bringing pollution onto coastal habitats. Therefore, testing under dry conditions gives a better picture of ongoing contamination problems.



Red areas indicate no-shellfishing areas based on contamination by pathogens.

The Big Picture

- 303(d) List: Category 5 impairment for Pathogens on the North Shore.
- North Coastal TMDL for Pathogens was established in 2012.
- 1965: 156 pipes discharging into Salem Sound - 55% estimated to be raw sewage.
- South Essex Sewerage Discharge - secondary treatment in 1998, 20 MGD (75 MLD)
- Sewer pipes from Manchester - secondary treatment in 1971, upgraded 1997-1998.



South Essex wastewater effluent visible on incoming tide.

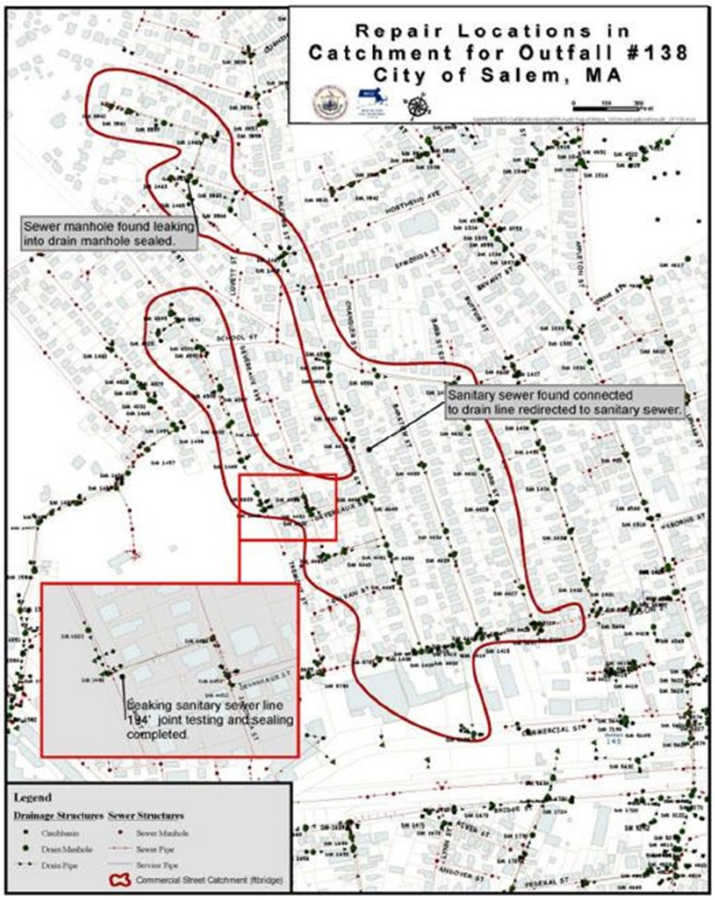
CLEAN BEACHES AND STREAMS PROJECT 1999 to 2014

- Volunteers monitored stormwater flows into Salem Sound from outfall pipes and streams.
- Every summer, 20 to 25 sites sampled biweekly.

Over the years, illicit connections have been found and fixed -- but one at a time is not good enough!

SYSTEMATIC INVESTIGATION

EPA Administrative Order mandated that the City of Salem undertake illicit discharge detection and elimination efforts and illicit discharge removal at four MS4 drain outfalls that had been monitored by Salem Sound Coastwatch.



(Right) Repairs in the North River Watershed, Mason Street, Salem (New England Engineering Corp.)

RESULTS

Manhole inspections, building inspections, dye testing, water sampling, visual pipeline inspection, and exploratory excavations led to:

- Sewer pipe installation to redirect sanitary sewer connections from drains.
- Replacement of sewer manholes.
- Repair of damaged drain pipes.
- Internal sealing and waterproofing of sewer/drain manholes and pipes.
- Joint testing and sealing of collector sewers.

BOTTOM LINE AND IMPLICATIONS

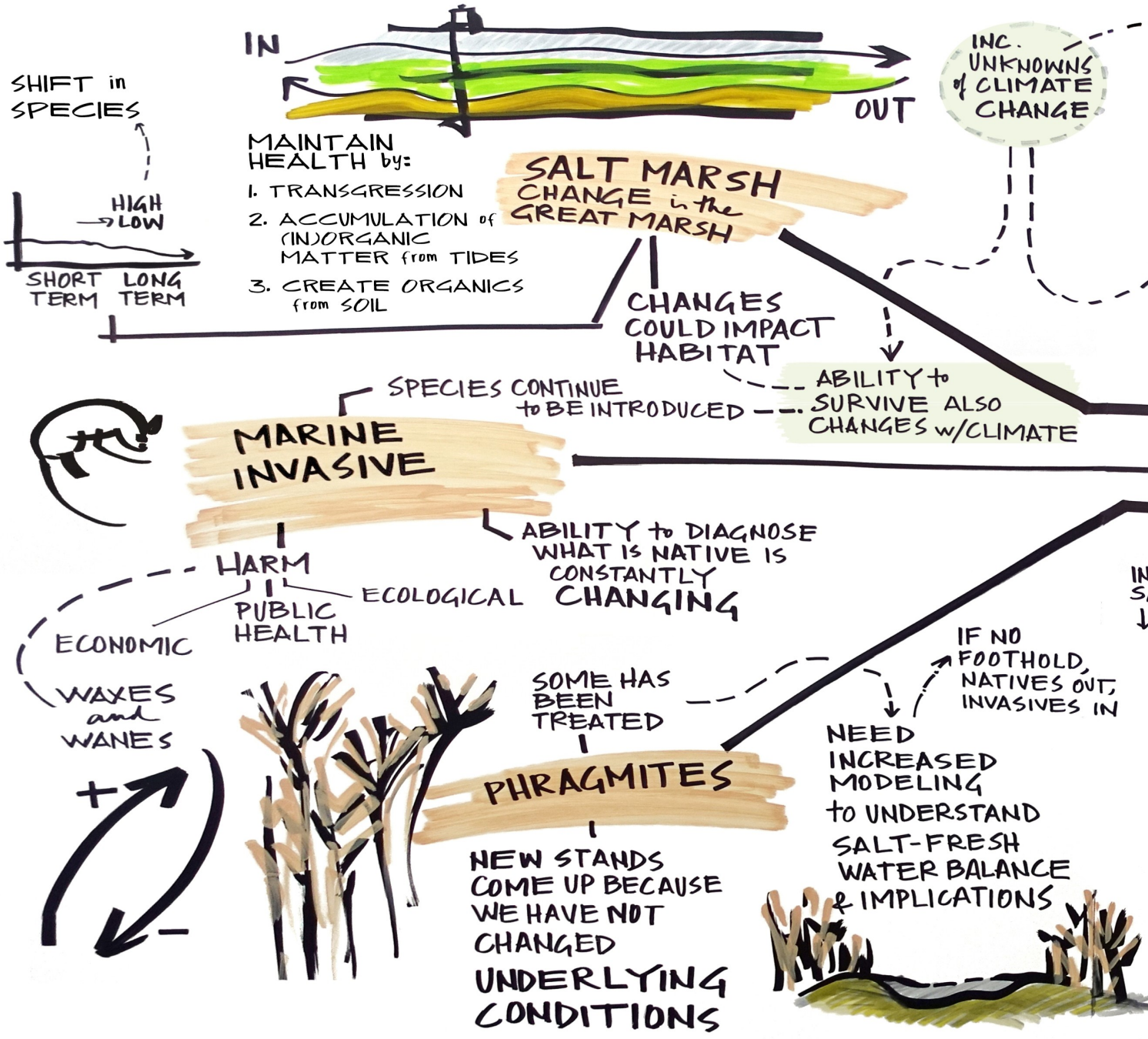
- Improvements have been made, but stormwater outfalls are still contributing bacteria to Salem Sound.
- Ongoing monitoring should be conducted.
- Systematic inspections of outfall drainage watersheds are critical for success, whether sewered or not.

RESOURCES:

Clean Beaches and Streams www.salemsound.org/waterTesting.html
SESD www.marblehead.org/index.aspx?NID=1099

Salem Sound COASTWATCH

Habitats



Massachusetts Bays
NATIONAL ESTUARY PROGRAM

2015 State of the Bays Symposium
15 April 2015 • Boston, MA

dpict. Images by Kelvy Bird | www.dpict.info

PROJECTS to COME WILL BE MORE COMPLEX
WETLAND & STREAM RESTORATION
REMOVE DAMS
TIDAL WETLAND IMPROVEMENT
WATERWAY INTEGRATION
ADDRESSED LOW HANGING FRUIT of PROJECTS
SOCIAL & ECONOMIC BENEFITS
KEEPING KEY INFRASTRUCTURE IN PLACE
HABITATS
NCREASED SALINITY
↓PHRAGMITES
... and NEED MORE ROBUST MAPPING
SURFACE the EXPERTS!
TREND of LOSS
MINING & MAPPING DATA
EELGRASS
MAPPING SEAGRASS BEDS IS NOT EASY

Eelgrass Habitat: Status and Trends

Presenter: Andy Lipsky
SeaPlan

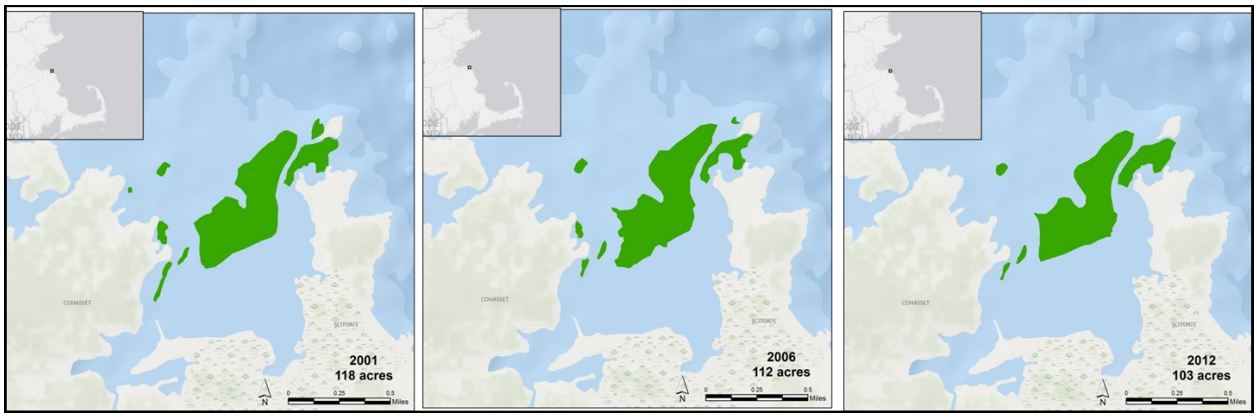
OVERVIEW

Eelgrass habitats are critical components of shallow coastal ecosystems throughout the Northeast region. Eelgrass provides food and shelter for a great variety of commercially and recreationally important fish and shellfish and their prey and beds can help stabilize shorelines and sediments. However, eelgrass is vulnerable to poor water quality, disease, shading effects from docks and piers, physical disturbance from moorings and boats and bioturbators, and the impacts of rising water temperature. To answer the question: *"What are recent trends in eelgrass abundance and conditions in Massachusetts Bays?*" a qualitative and quantitative methodology was employed. Quantitative analysis involved obtaining, evaluating, and analyzing the best available published spatial datasets, unpublished spatial data and analysis, and recent data from a global seagrass monitoring program. Subsequent discussions about trends in eelgrass abundance and condition with regional eelgrass/marine scientists were also used to gather knowledge and ground interpretation of the data. Despite the lack of sufficient spatial data coverage (both spatial and temporal) and resolution over the last ten years, results from this analysis indicate that eelgrass continues to decline in the Massachusetts Bays region.

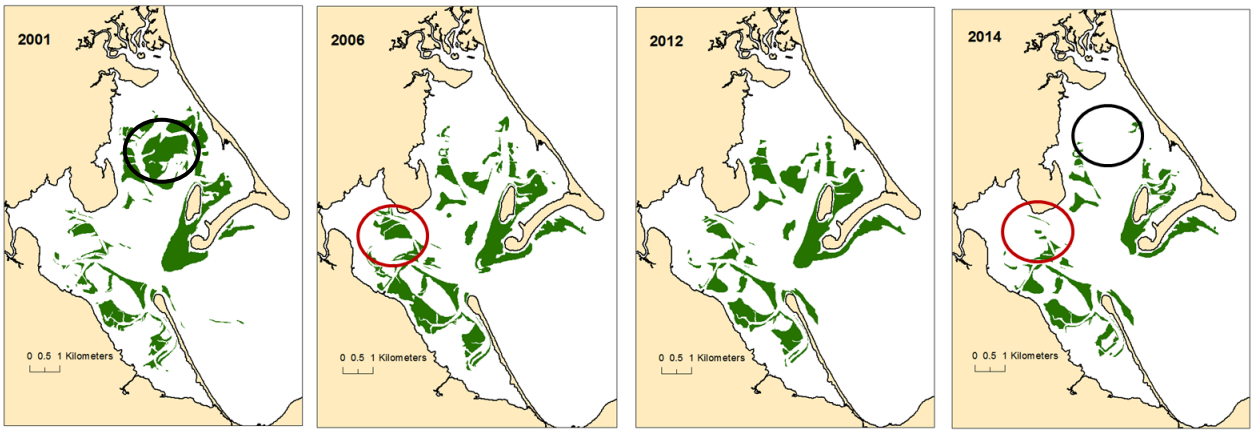
TRENDS AND CONDITIONS

DATA SOURCES

- Spatial datasets: Northeast Regional Ocean Data Portal; MassDEP eelgrass mapping web tool.
- Spatial data analysis: MA Division of Marine Fisheries (*MarineFisheries*)
- Monitoring data: percent eelgrass cover at three stations in Massachusetts Bay and Cape Cod Bay from SeagrassNet



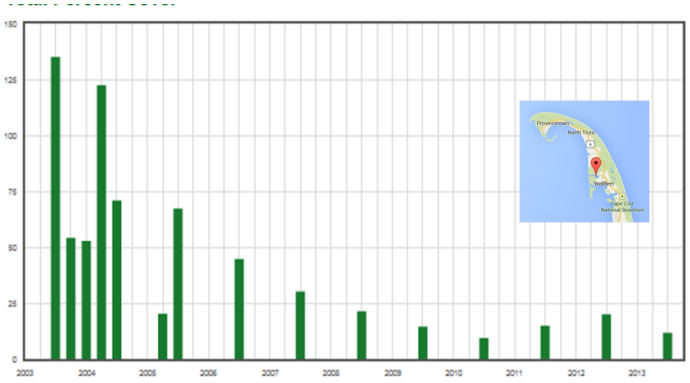
Trends in eelgrass conditions in Cohasset Harbor, 2001 to 2012. (MassDEP Eelgrass Mapping Project)



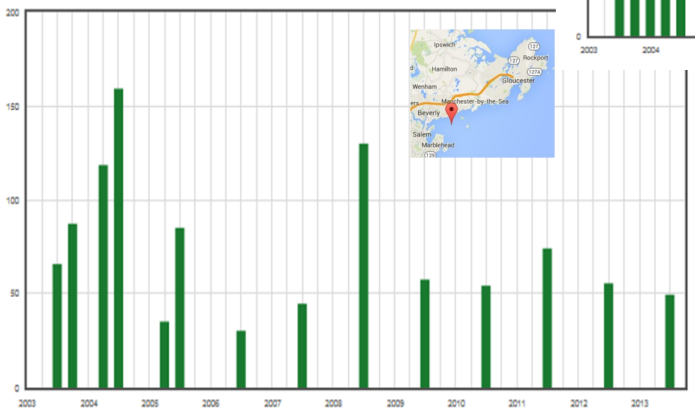
Trends in eelgrass conditions: Notable losses in center of Duxbury Bay (black circle); prominent bed in Kingston Bay (red circle) greatly reduced. (MassDEP [pre-2014 maps]; MarineFisheries *[2014 map])*

DRIVERS OF REDUCTIONS IN EELGRASS

- Bioturbation (green crabs, birds)
- Physical disturbance (moorings, dredging)
- Pollution sources
- Disease
- Synergistic effects of these



SeagrassNet station: total percent cover eelgrass in Duck Harbor, Cape Cod Bay, 2003 to 2013. (USGS)



*SeagrassNet station: total percent cover eelgrass in Salem Sound, 2003 to 2013. (*MarineFisheries*)*

BOTTOM LINE AND IMPLICATIONS

- Available data show declines over multiple timeframes.
- Current state of mapping and monitoring is inadequate to quantify trends in entire MassBays region, but regional experts concur on downward trends in condition and abundance over the last decade.
- We can leverage new and traditional technologies for more frequent and comprehensive monitoring.
- We should continue to implement monitoring and conservation measures where local understanding of stressors/response exist.

RESOURCES:

SeaPlan www.seaplan.org/
SeagrassNet www.seagrassnet.org/
Northeast Ocean Data Portal www.northeastoceandata.org/eelgrass/
DEP Eelgrass Viewer www.mass.gov/eea/agencies/massdep/water/watersheds/eelgrass-mapping-project.html

SEAPLAN
VIBRANT ECONOMIES • HEALTHY OCEANS

Progress in Coastal Wetland and Stream Restoration

Presenter: Hunt Durey
MA Division of Ecological Restoration

OVERVIEW

Over the past several decades, substantial progress has been made restoring degraded coastal wetlands and streams across the MassBays region. Many public and private partners have collaborated with MA Division of Ecological Restoration (DER) to develop the knowledge, expertise, and resources needed to complete restoration projects and build capacity for future efforts.

PROGRESS IN THE BAYS

Coastal Wetlands and Stream Restoration in the MassBays Planning Area

Data Sources

- DER data
- MassBays-region specific

Dam Removal Projects

Completed: 15 removals, 25 river miles restored.

In development: 11 removals, 133 river miles to be restored.

Tidal Wetland Restoration Projects

Completed: 53 wetlands, more than 1100 acres (445 ha) restored.

In development: 13 wetlands, approximately 1400 acres (566 ha) to be restored.

Wapping Road Dam, Jones River, Kingston, removed 2011

Off Billington Street Dam, Town Brook, Plymouth, removed 2014.

Newman Road Tidal Restoration, Newbury, restored 2010.

FUTURE DIRECTIONS: CHALLENGES AND OPPORTUNITIES

- Needs greatly outweigh capacity.
- Past apex of tidal resource restoration; most "low hanging fruit" are restored.
- Challenges presented by uncertainties and shifting priorities due to climate change and human response.
- No shortage of high-value dam and culvert projects that would restore habitat continuity.
- Opportunities with other types of restoration, e.g., nutrients/water quality, seagrass, shellfish, retired cranberry bogs, tidal wetland migration zones.

RESOURCES:
MA Division of Ecological Restoration www.mass.gov/eea/agencies/dfg/der/

COMMONWEALTH OF MASSACHUSETTS
Division of Ecological Restoration

Salt Marsh Change in Great Marsh

Presenter: Anne Giblin
Plum Island Ecosystems LTER and Marine Biological Laboratory

OVERVIEW

The rate of sea level rise (SLR) is expected to accelerate over the next century due to the warming of ocean waters and the melting of ice on land. Marshes have the ability to keep up with sea-level rise by three mechanisms: 1) transgression (migration) onto upland, 2) accreting organic and inorganic sediments from tidal waters, and, 3) the accumulation of some portion of the carbon produced below-ground from roots and rhizomes leading to net carbon accretion. Currently transgression is limited in many areas by coastal development, meaning that marshes must keep up with sea level by accretion or drown. Studies in the Great Marsh and other areas are currently underway to determine if marshes in New England are keeping up with current rates of SLR and if they have the potential to maintain elevation as SLR rates increase. Initial results suggest that while low-marsh areas dominated by *Spartina alterniflora* are gaining elevation at rates higher than current rates of SLR, areas in the high marsh dominated by *Spartina patens* are just keeping up or falling behind. In addition, the source of sediments allowing for marsh accretion appears to be the marsh itself, i.e. there are areas of net marsh erosion which are supplying the sediment for the remaining marsh to maintain itself. Over time this would mean that there may be an increase in open water, and a transition to more low-marsh habitat and less high-marsh habitat. This matches similar trends seen elsewhere in New England. The implications of this shift in overall geomorphology are not completely known. Newer high-resolution topography from aircraft-borne LiDAR provides an excellent baseline to monitor future changes.

TRENDS AND CONDITIONS

Data Sources

Existing:

- Plum Island Ecosystems Long-Term Ecological Research (LTER) (NOAA)
- 2011 Statewide Coastal LiDAR remote sensing data (NOAA)
- MassGIS (wetland classification is not detailed)

Pending:

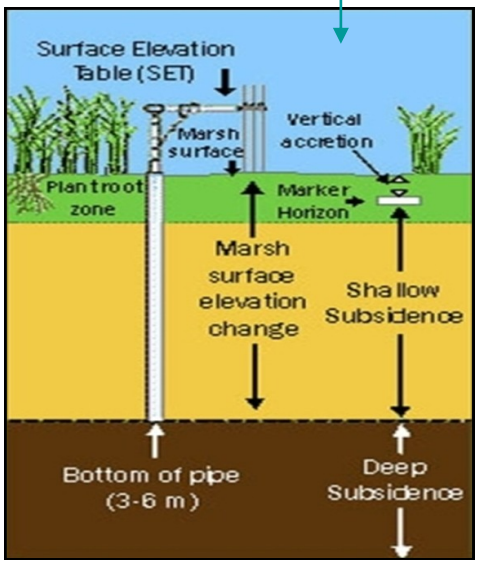
- Massachusetts salt marsh migration modeling (CZM)
- Surface Elevation Table (SET) data for the Eastern seaboard (NOAA)

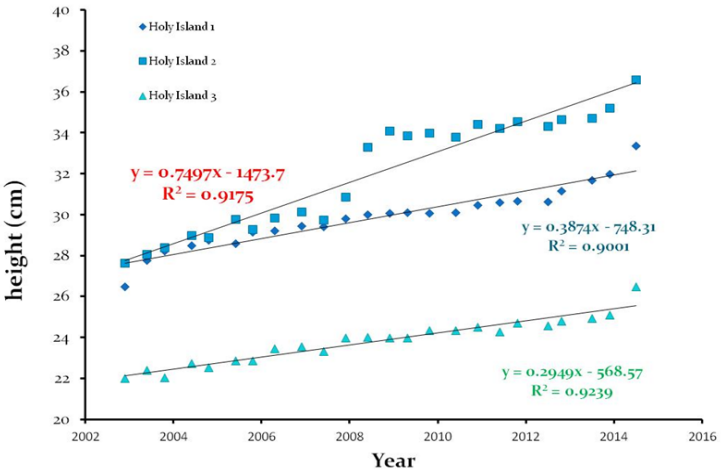
How do marshes keep up with sea level rise?

- Migrate backwards onto higher ground (transgression).
- Accumulate organic and inorganic material from the incoming tide (accretion).
- Produce organic matter in the soils; some fraction of this does not decompose.

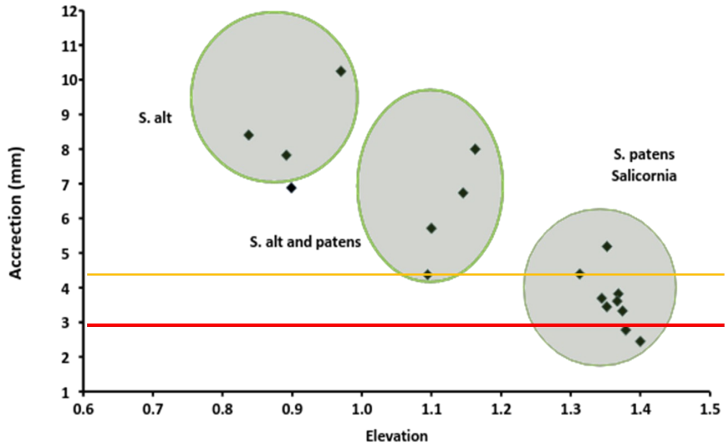
MEASURING SEDIMENT ACCUMULATION

A sediment elevation table (SET) is anchored deep in the marsh, below the layer that compacts.

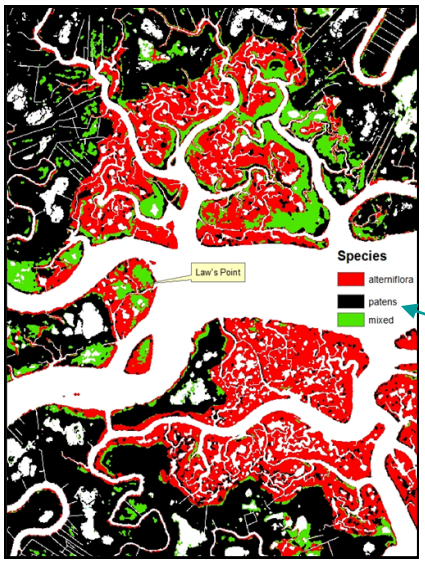




(Above) SET data from Holy Island, in Ipswich MA, 2012 to 2014. (PIE LTER)



(Above) Amount of accretion differs among salt marsh vegetation types.



TOOLS FOR MAPPING LONG-TERM CHANGE

- LiDAR can be used to get marsh elevation over large areas.
- Hyperspectral imaging, combined with ground-truth data can show where plant communities are and where they are changing.
- Older aerial photos are not useful for distinguishing vegetation types, but do reveal changes in major features, like ponds and creeks.

BOTTOM LINE AND IMPLICATIONS

- Tools to measure plant communities and elevation at high resolution are available; data outputs can be used to identify vulnerable marsh areas and address future change.
- Different species use the marsh differently. Changes in marsh configuration will probably alter species distributions but the overall impact on secondary production is unknown.

RESOURCES:

PIE LTER http://pie-lter.ecosystems.mbl.edu/
Statewide Coastal LiDAR, 2011 https://catalog.data.gov/dataset/massachusetts-2011-lidar-coverage-usace-national-coastal-mapping-program

MBL Biological Discovery in Woods Hole
Founded in 1888 as the Marine Biological Laboratory

LTER

Marine Invasive Species: Status and Trends

Presenter: Adrienne Pappal
MA Office of Coastal Zone Management

OVERVIEW

Marine habitats in the MassBays region are home to an ever-growing suite of marine invasive species, defined as non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health (ISAC 2006). With limited control and management strategies available, successful marine invaders can have wide ranging and detrimental impacts on coastal ecosystems, including competitive displacement of native species, aesthetic impacts, and gear fouling. That said, there are few empirical data available in our region, particularly regarding economics to assess impacts. Since 2000, the triennial Rapid Assessment Survey (RAS) has monitored marine species along the Northeast coast, specifically focusing on floating docks and ports—the "hot spots" for marine introductions via vessel traffic, aquaculture, and other vectors. The survey attracts participation by top taxonomists from around the world, and greatly increases our knowledge of marine species in the region. Results indicate that non-native marine species continue to be introduced to the MassBays region. Twelve new non-native marine species have been detected in the MassBays region since 2007, bringing the total number to 32. Given recent advances in the science of determining species origins and the limited area surveyed, this number is likely an underestimate.

TRENDS AND CONDITIONS

Data Sources

- Rapid Assessment Survey 2010, 2013
- Rhode Island to Southern Maine
- Timed search (1hr) of all species at floating docks (and rocky shores in 2010)

Marine Invasive Species Impacts

- Shading
- Competition with/predation on native species
- Shifts in community composition
- Reduction in commercial species
- Fishing/boat gear fouling
- Introduction of disease, harmful aquatic organisms, and/or pathogens

Impacts may not be immediately evident; they may be intermittent (e.g. green crab).

New Species, 2010 and 2013	Taxonomic Group
Calpomenia peregrina	Phaeophyta
Pyropia yezeonsis	Rhodophyta
Heterosiphonia japonica[1]	Rhodophyta
Lomentaria orcadensis	Rhodophyta
Lomentaria clavellosa	Rhodophyta
Bugula simplex[2]	Bryozoa
Conopeum seurati	Bryozoa
Tricellaria inopinata	Bryozoa
Clytia linearis[3]	Hydrozoa
Melita palmata[3]	Amphipoda
Ianiropsis serricaudis[4]	Isopoda
Palaemon elegans	European shrimp

Photo: L. Green

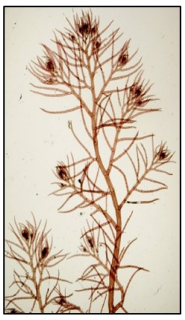


Photo: I. Bárbara

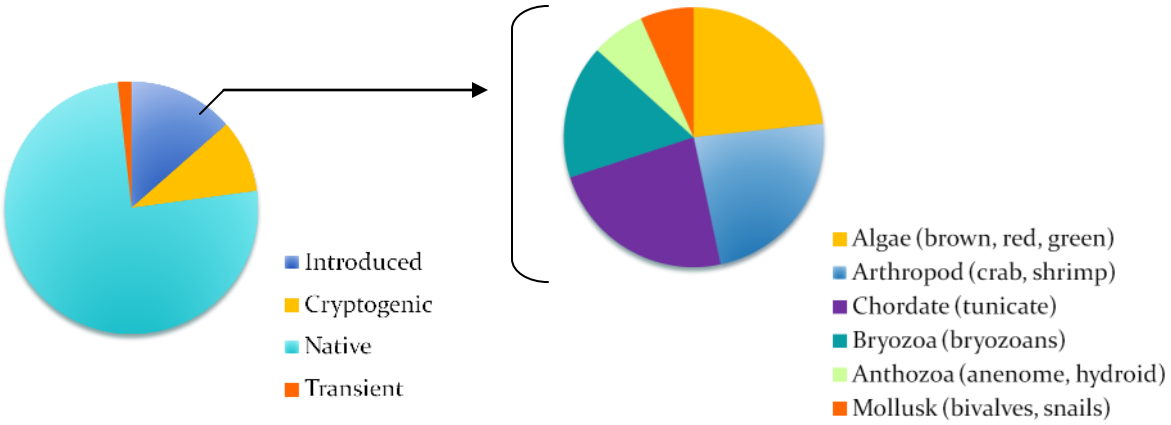
Photo: A. Gittenberger

Photo: A. Gittenberger

Photo: H. Hillewaert

Photo: A. Pappal

[1]Result from outside RAS; [2]Previously classified as cryptogenic; [3]Establishment unknown; [4]Previously identified to genus level only



BOTTOM LINE AND IMPLICATIONS

- Species continued to be introduced and established in the MassBays region and elsewhere.
- Impacts are increasing.
- Climate change interactions are unknown.
- More information is needed.

Resources: MA CZM Aquatic Invasive Species Program ww.mass.gov/eea/agencies/czm/program-areas/aquatic-invasive-species/
Report on the 2013 Rapid Assessment Survey of Marine Species at New England Bays and Harbors www.mass.gov/eea/docs/czm/invasives/ras-2013-final.pdf
Non-Native Seaweeds in MA www.mass.gov/eea/docs/czm/invasives/non-native-seaweed-fact-sheet.pdf
State of the Gulf of Maine Report - Marine Invasive Species www.gulfofmaine.org/state-of-the-gulf/docs/marine-invasive-species.pdf

Massachusetts Office of Coastal Zone Management

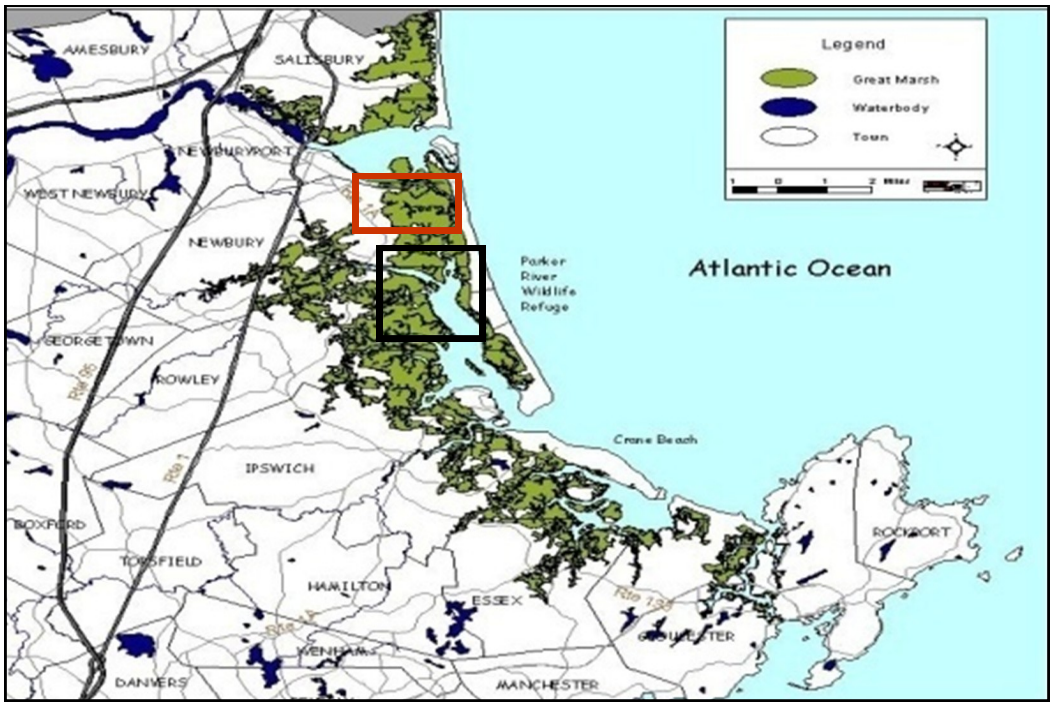
CASE STUDY

Management of *Phragmites* in the Great Marsh

Presenter: Peter Phippen
Merrimack Valley Planning Commission
MassBays Regional Coordinator (Upper North Shore)

OVERVIEW

The Great Marsh Revitalization Task Force has been managing invasive *Phragmites australis* in the northern portion of the Great Marsh for nearly a decade. These efforts have been funded by grants from the U.S. Fish and Wildlife North American Wetlands Conservation Act, the MA Department of Conservation and Recreation Partnership, and Areas of Critical Environmental Concern program, and directed by the MassBays Upper North Shore Regional Coordinator. The focus of these control efforts has been in the open, high-marsh platform in Newbury, Newburyport, and Salisbury, where invasion by *Phragmites* has been considerable. Chemical treatments, burning, and/or mowing have reduced the number of stands dramatically. In most cases, native vegetation has replaced *Phragmites* almost immediately in the growing season following treatment. Although considerable strides have been made to restore native vegetation to the open marsh, the fundamental conditions allowing *Phragmites* to proliferate still exist. A recent Hurricane Sandy Resiliency grant award from the National Fish and Wildlife Foundation for efforts on the Great Marsh will allow continuation of management efforts as well as hydrodynamic modeling to determine the underlying causes of *Phragmites* proliferation and generate strategic recommendations to address those factors.



Treatment (chemicals, burning, and mowing) has been conducted in hundreds of acres of open, high-marsh platform in the Upper Newbury Marsh (black box, 2007) and Southeast Salisbury Marsh (red box, 2014).

RESULTS

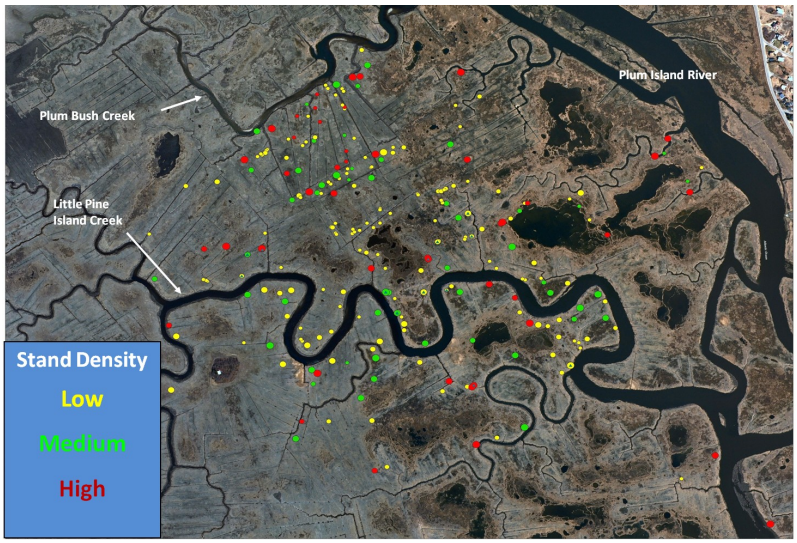
Newbury Marsh:

- From 300 down to 75 stands in the Plumbush Creek to Pine Island Creek open marsh.
- 75% are low density stands.
- Former *Phragmites* habitat has been replaced by robust native vegetation.

  However, new stands emerge every year

Salisbury Marsh:

- Reduction in size of stands.
- Re-vegetation with native plant communities observed.



Phragmites locations in Newbury, 2011 (above) and 2013 (below).

BOTTOM LINE AND IMPLICATIONS

- Some sections of the open marsh require two and even three treatments.
- Reduction in *Phragmites* and replacement by native vegetation has been observed in most areas.
- However, new stands are appearing in low salinity area. How long can treatment be applied?
- Hydrodynamic model to be developed to identify salinity influx and concentration patterns in the Great Marsh using U.S. Fish and Wildlife Foundation grant funds, 2015-2017.
- Results of model may help in the identification of solutions to allow more salt water flow in the Great Marsh and/or allow trapped freshwater to flow out of the marshes.
- Without intervention or management it is predicted that the marsh will be overwhelmed by *Phragmites* and a substantial amount of native habitat will be lost.

RESOURCES:

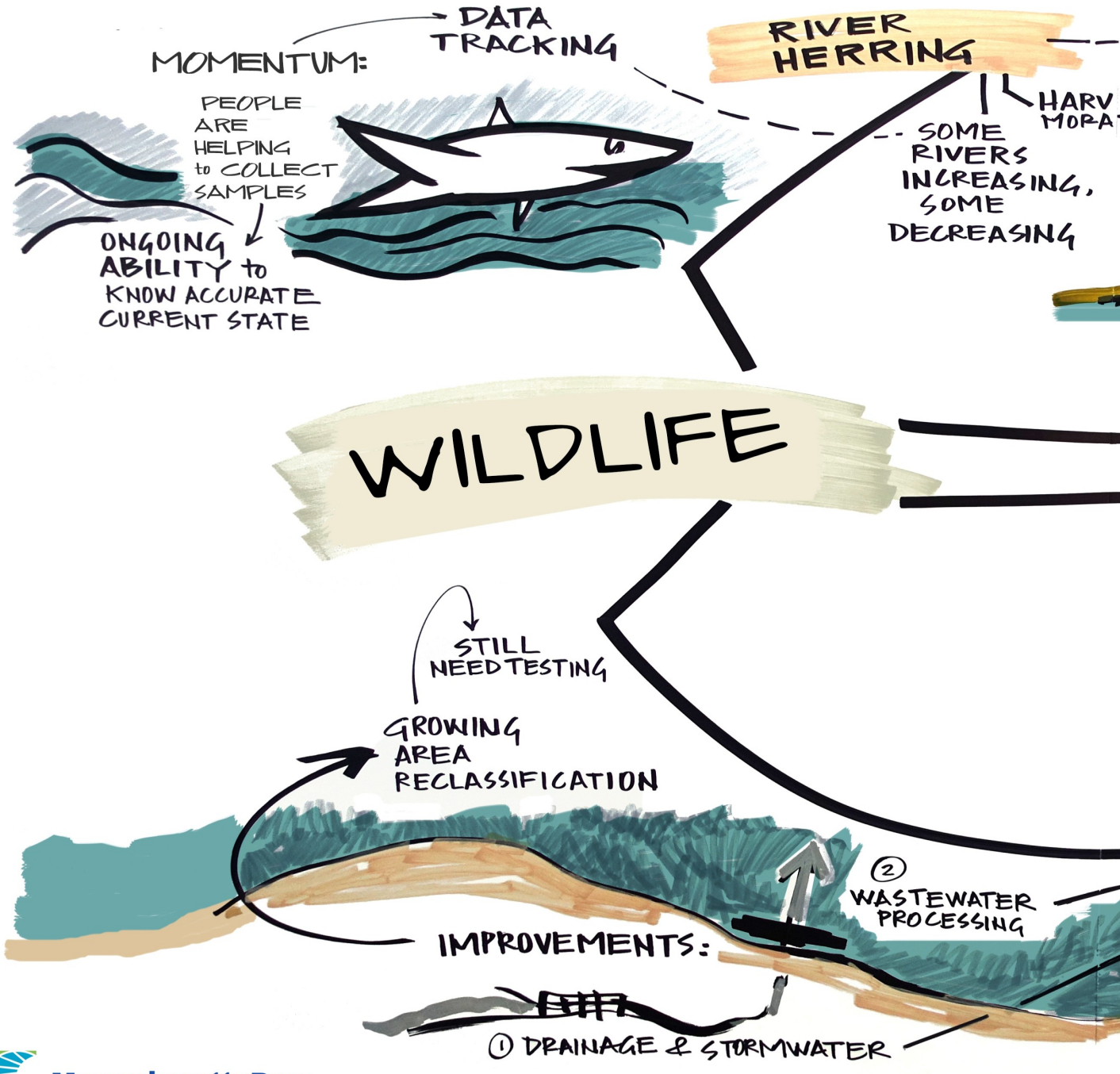
Great Marsh Activities mvpc.org/wp-content/uploads/Great-Marsh-Activity-Update_June2015.pdf

Great Marsh Coalition http://mvpc.org/programs/environment/eight-towns-the-bay/great-marsh-coalition/

EIGHT TOWNS AND THE GREAT MARSH

MERRIMACK VALLEY PLANNING COMMISSION

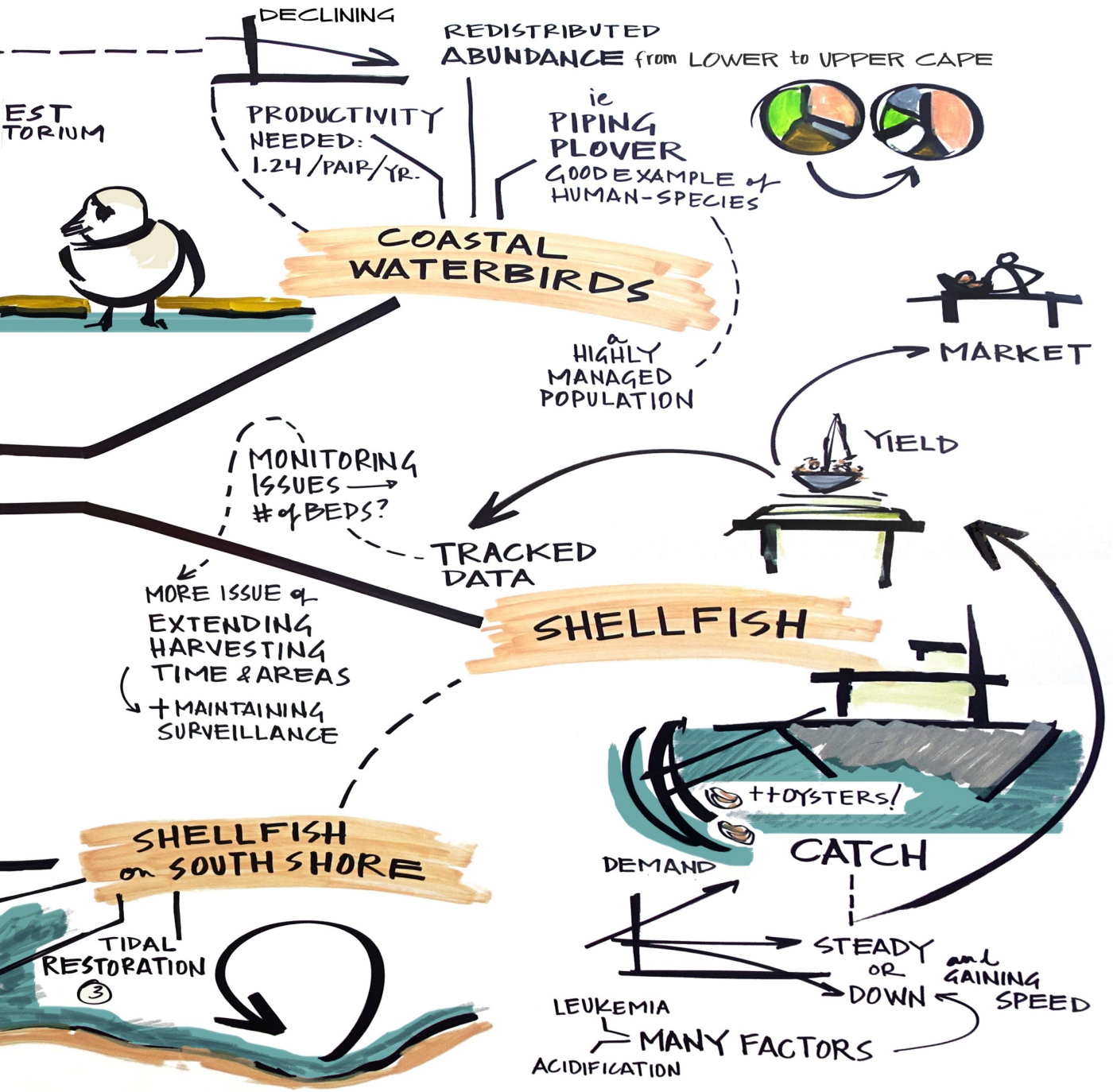
Wildlife



Massachusetts Bays
NATIONAL ESTUARY PROGRAM

2015 State of the Bays Symposium
15 April 2015 • Boston, MA

dpict. Images by Kelvy Bird | www.dpict.info


DECLINING
REDISTRIBUTED
ABUNDANCE from LOWER to UPPER CAPE
EST
TORIUM
PRODUCTIVITY
NEEDED:
1.24/PAIR/YR.
ie
PIPING
PLOVER
GOOD EXAMPLE of
HUMAN-SPECIES
COASTAL
WATERBIRDS
a
HIGHLY
MANAGED
POPULATION
MARKET
YIELD
MONITORING
ISSUES →
# of BEDS?
TRACKED
DATA
MORE ISSUE of
EXTENDING
HARVESTING
TIME & AREAS
+MAINTAINING
SURVEILLANCE
SHELLFISH
++OYSTERS!
SHELLFISH
on SOUTH SHORE
DEMAND
CATCH
TIDAL
RESTORATION
3
STEADY
OR
DOWN
and
GAINING
SPEED
LEUKEMIA
ACIDIFICATION
MANY FACTORS

Trends in Massachusetts Shellfish Landings

Presenter: Jeff Kennedy
MA Division of Marine Fisheries

OVERVIEW

Fisheries managers have long relied on fishermen's landings data as a proxy for direct population measures. This is particularly true with shellfisheries managers, as population surveys are labor-intensive, expensive, and of short-lived utility. In Massachusetts, "home rule" of shellfish harvesting has created a patchwork of local community rules and regulations asserting unequal fishing pressure and impacting species population densities between neighboring communities and among adjacent coastal regions. Though landings have been tracked for 150 years in various ways, data with accuracy and resolution sufficient to allow shellfish growing area-by-growing area comparison has only become available in the last decade. In Massachusetts, catch reports have been required of commercial fishermen for many years, yet the ability to track and analyze this data only began in 2005 with the implementation and adoption by *MarineFisheries* of the Atlantic Coastal Cooperative Statistics Program (ACCSP)'s Standard Atlantic Fisheries Information System (SAFIS) data warehouse. Utilizing this SAFIS data, a brief overview of Massachusetts bivalve shellfish landings by region is provided here with an emphasis on recent trends in an emerging fishery.

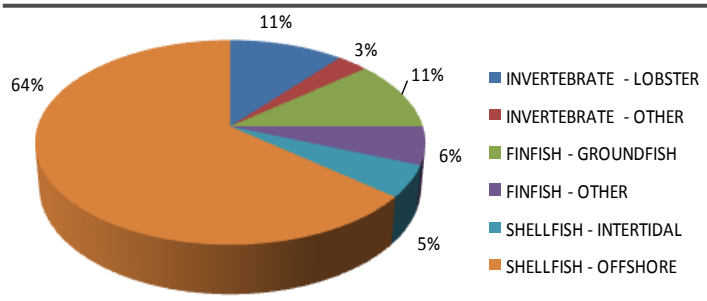
TRENDS AND CONDITIONS

DATA SOURCES

- MassBays: Landings by Species
- Massachusetts-wide: Inshore value and landings, landings rank
- Massachusetts-wide : Oyster landings v. value v. aquaculture permits

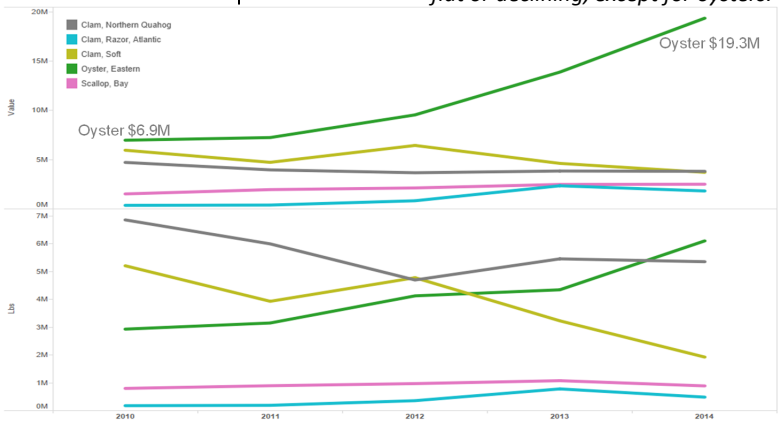
CZM

Photo: MarineFisheries



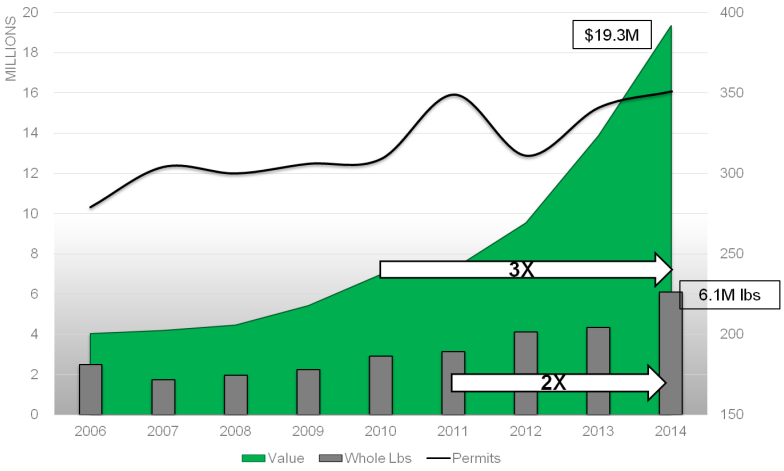
(Left) Value of Massachusetts landed species by fishery sector (%, 2013).
Source: MA dealer-reported landings MIS and Fisheries Statistics Program

(Below) Inshore Value and Landings, 2010 to 2014. Recent inshore/intertidal shellfish landings are either flat or declining, except for oysters.



OYSTER STATS

- Oyster landings value has tripled from 2010 to 2014 primarily due to increases in aquaculture and aquaculture efficiency.
- Oyster production (pounds) have doubled from 2011 to 2014.
- Private commercial aquaculture propagation permits have grown from ~300 (2006) to ~350 (2014).
- In 2012, oysters made up 87% of all aquaculture production.
- 2014 produced more than 32 million individual oysters, up from about 25 million in 2010.



(Right) 2006 to 2014 Oyster Landings v. Value v. Aquaculture Permits

BOTTOM LINE AND IMPLICATIONS

- Inter-annual variations in landings can be dramatic.
- Many intertidal species production values are static or declining (e.g. soft-shell clams). Exceptions: razor clams which have increased on the North Shores; and oysters statewide.
- Intertidal harvest makes up 5% of state landings by value.
- Most oyster landings are aquaculture products.
- Offshore shellfish landings are level or climbing; increases due to increased harvest opportunity.
- Sea scallops constitute 60% of state landings by value, primarily from offshore federal waters.

RESOURCES: MA Division of Marine Fisheries www.mass.gov/eea/agencies/dfg/dmf/programs-and-projects/shellfisheries-management.html
Shellfish Suitability Areas www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/shlfshsuit.html
MA Designated Shellfish Growing Areas www.mass.gov/eea/agencies/dfg/dmf/programs-and-projects/designated-shellfish-growing-areas.html

MarineFisheries
Commonwealth of Massachusetts

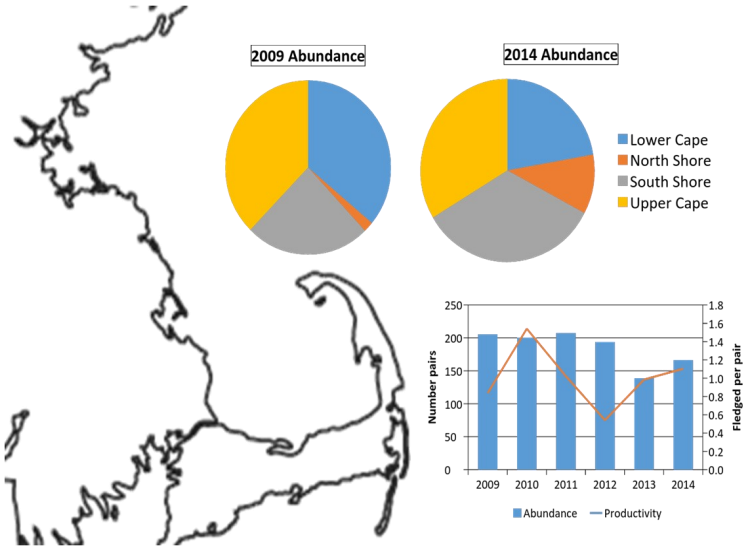
State of Coastal Waterbirds

Presenter: Katharine Parsons
Mass Audubon

OVERVIEW

The MassBays planning region provides significant habitat to coastal bird populations, including nesting shorebirds. The Piping Plover (*Charadrius melodus*) nests on beaches throughout the North Shore, South Shore, and Cape Cod regions. An extensive network of cooperators has provided annual census and productivity data to *MarineFisheries* and Wildlife's Natural Heritage and Endangered Species Program since the population was listed under state and federal endangered species laws in 1986. Since 2009, plover abundance in Massachusetts Bay and Cape Cod Bay has declined by 19% (a loss of 40 pairs). Most losses have been from Lower Cape beaches. Plover abundance has increased in the North Shore (4-fold increase) and South Shore (12%). Productivity measured as number of young fledged per pair has been variable over the period 2009-2014; a June storm in 2012 led to the lowest state-wide fledging rate recorded since 1986. Productivity at Cape Cod sites has been consistently below sustainable rates since 2011 while North Shore productivity has been consistently above sustainable rates. In summery, Piping Plover abundance in MassBays is declining. Losses from beaches with the lowest recreational use are significant and correlate with low productivity. Plover nesting is increasing in suburban and urban regions of MassBays; reproductive success in the metro Boston area is the highest in the state. Intensive management and community support will be necessary to sustain the Piping Plover population in MassBays.

TRENDS AND CONDITIONS



Piping Plover Abundance and Productivity, 2009 to 2014

DATA SOURCES

MA Department of Fish and Wildlife's Natural Heritage and Endangered Species Program: annual piping plover census data/reports (2009-2014)

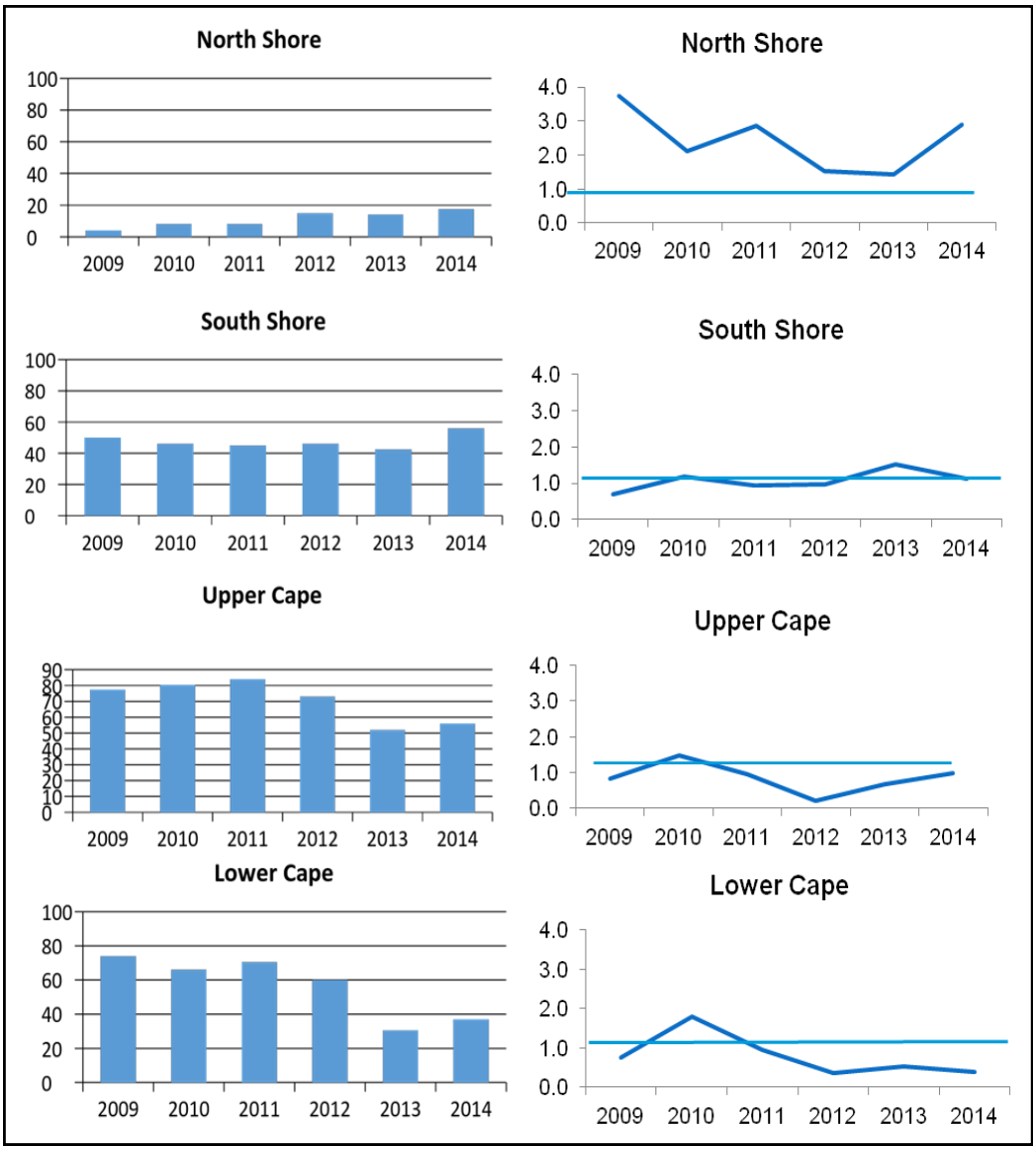
*Piping plover (*Charadrius melodus)
Photo: T. Pomper

PIPING PLOVER
ABUNDANCE, 2009 TO 2014

Number of breeding pairs/year

PIPING PLOVER
PRODUCTIVITY, 2009 TO 2014

Number of chicks fledged/pair/year; horizontal line represents population-sustaining productivity.



BOTTOM LINE AND IMPLICATIONS

- Plovers are decreasing on lower Cape.
- Plovers are increasing on urban/suburban beaches.
- "Wild" beaches providing less suitable habitat—why?
- Greater management and community support is needed to sustain populations.

RESOURCES: Coastal Waterbird Conservation www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/rare-birds/coastal-waterbird-conservation.html
Piping Plover, Atlantic Coast Population www.fws.gov/Northeast/pipingplover/

Mass Audubon
Protecting the Nature of Massachusetts

State of River Herring

Presenter: Abigail Franklin Archer
Cape Cod Cooperative Extension

OVERVIEW

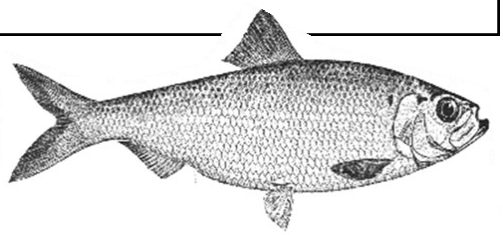
River herring (*Alosa pseudoharengus* & *Alosa aestivalis*) are culturally important in the MassBays region as a sign and symbol of spring and are an especially welcome presence after the dramatic winter of 2014-2015. River herring populations exhibited a decline in the mid 2000s which prompted MarineFisheries to establish the first ever moratorium on river harvest in 2005 (Nelson et al. 2011) Have the local populations recovered since then? Answering that question requires fishery independent data from before , during, and after the decline. Because river herring were so numerous, few formal sampling and run count estimations existed prior to the 2000s. The longest running dataset in Massachusetts was initiated in the 1980s, from Monument River (Bournedale). Data show a fluctuating but increasing trend in total alewife run size through 2000. The population dropped precipitously through 2002 and continued to decline through 2006. A gradual increase has been noted since 2007. From 2010 to 2014, data from eight rivers across four of the MassBays regions indicate steady or increasing populations in five of the rivers. At three of these rivers counting efforts began recently. In response to the decline in populations and the need for data to understand it, volunteer count programs were created to collect data using statistically valid methods. From 2010 to 2015 the number of programs increased from 12 to 19, and the number of volunteers has more than doubled from 211 to 461. Since 2010 state, regional, and federal agencies have initiated monitoring, assessment, management, and research activities. A challenge going forward is maintaining funding and effort for current activities.

TRENDS AND CONDITIONS

Data Sources

2010-2014/5; - MassBays region:

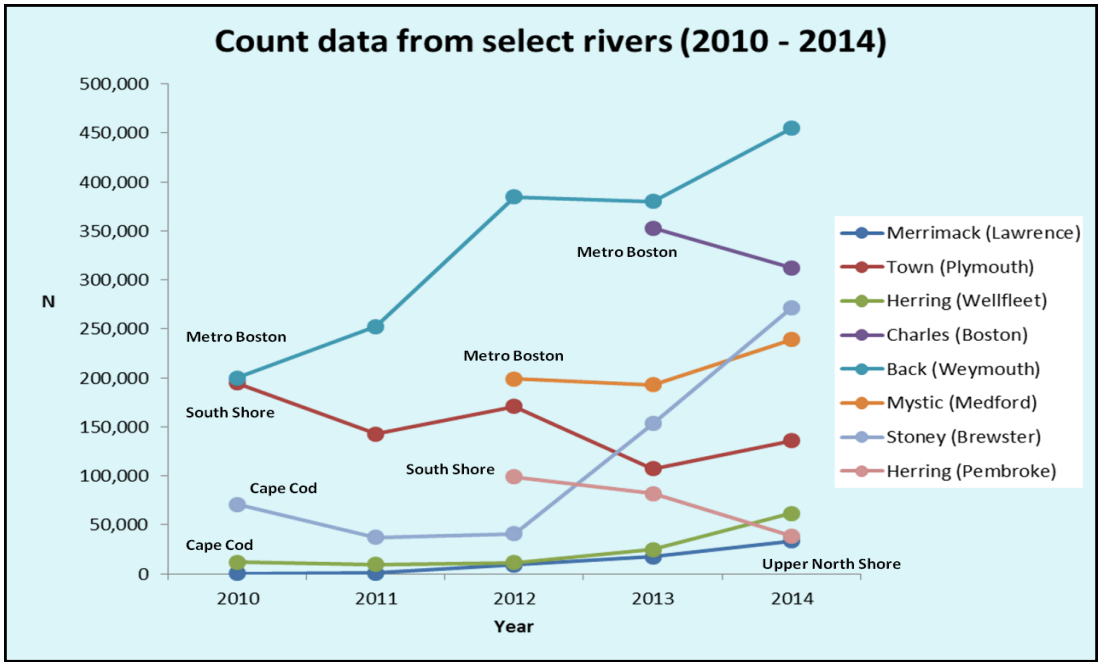
- Atlantic States Fisheries Marine Commission
- Association to Preserve Cape Cod
- Bass River Rod and Gun Club
- Merrimack Valley Planning Commission
- Jones River Watershed Association
- Town of Plymouth
- *MarineFisheries*
- North and South Rivers Watershed Association
- MA Division of Ecological Restoration
- Gloucester Herring Warden
- Mystic River Watershed Association



River Herring (Alosa pseudoharengus)

NUMBER OF VOLUNTEER GROUPS (AND VOLUNTEERS) IN MASSBAYS REGIONS, 2010-2014

Year	Cape Cod	South Shore	Metro Boston	Lower North	Upper North	Total
2010	2 (37)	5 (61)	1 (1)	0	4 (112)	12 (211)
2011	3 (46)	4 (45)	1 (1)	0	4 (125)	12 (217)
2012	4 (45)	7 (198)	2 (86)	0	4 (90)	17 (419)
2013	4 (41)	8 (117)	2 (88)	0	4 (137)	18 (383)
2014	6 (112)	7 (145)	2 (99)	0	4 (105)	19 (461)



Source: *MarineFisheries*

BOTTOM LINE AND IMPLICATIONS

- Data are inadequate to determine whether populations have recovered or not.
- Citizens of MassBays are engaged in this issue as volunteers.
- State and federal agencies are working with partners to do needed work to monitor and sample the population, monitor river herring captured as bycatch, and restore access to habitat.
- Direct resources to high impact restoration opportunities
- Challenge: to keep the momentum
    - ◊ Retain volunteers
    - ◊ Maintain funding for *MarineFisheries* in-river and dockside sampling efforts
    - ◊ Maintain *MarineFisheries* assistance to towns on fish passage infrastructure maintenance
    - ◊ Maintain MA DER assistance to towns that want to pursue stream restoration habitat continuity projects

RESOURCES:

2012 River Herring Benchmark Stock Assessment www.asmfc.org/uploads/file/riverHerringBenchmarkStockAssessmentVolumeIR_May2012.pdf
Cape Cod Cooperative Extension Marine Program www.capecodextension.org/Marine-Programs/
River Herring Network http://riverherringnetwork.com/

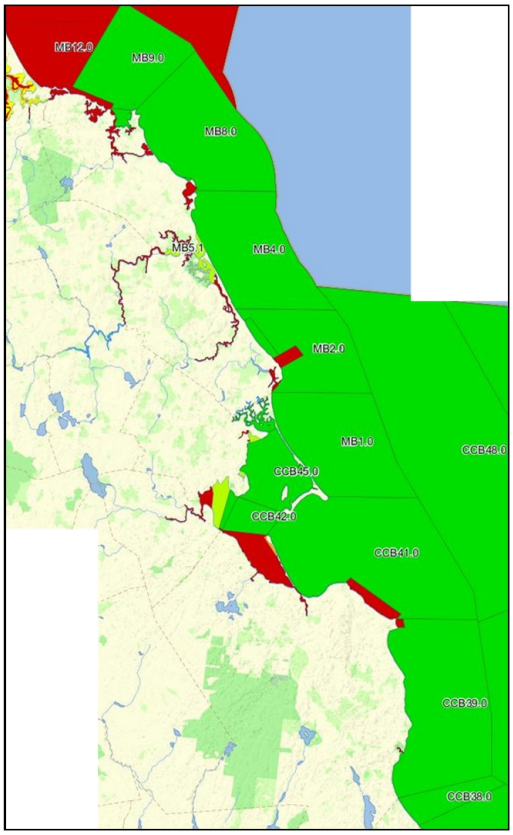
CASE STUDY

Shellfish Bed Openings on the South Shore

Presenter: Sara Grady
North and South Rivers Watershed Association
MassBays Regional Coordinator (South Shore)

OVERVIEW

The South Shore region of Massachusetts (Cohasset to Plymouth) has almost 115,000 acres of designated shellfish growing area, of which just over 12,000 acres are estuarine. Estuarine shellfish growing areas are more likely to be closed for harvesting due to water quality degradation from watershed-based impacts like stormwater and wastewater. The communities of the South Shore have received over $3 million in state and federal funding since 2002 to address these impacts, of which $2.94 million was targeted towards stormwater. Since 2007, 590 acres of shellfish have been reclassified as open, not including small border adjustments or the added benefit of increases in the duration of open periods. Despite these successes and marked water quality improvements due to the intense stormwater remediation efforts of these communities, there has been a lag between improved water quality and the ability to reclassify the shellfish beds. There are also concerns about diminishing returns and a threshold for water quality improvements once the major resources of pollution have been remediated.



BACKGROUND

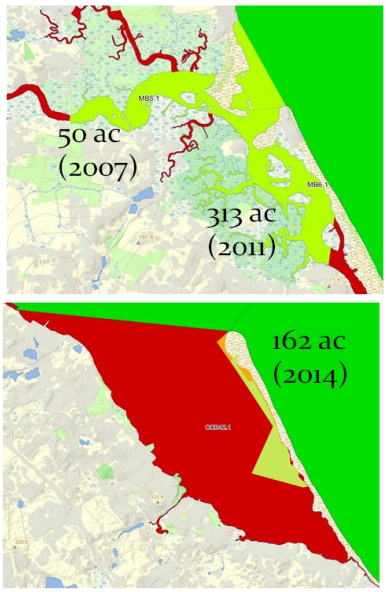
114,905 acres of designated shellfish growing area on South Shore (from Cohasset to Plymouth; left): 102,695 nearshore; 12,246 estuarine (green plus red areas, left)

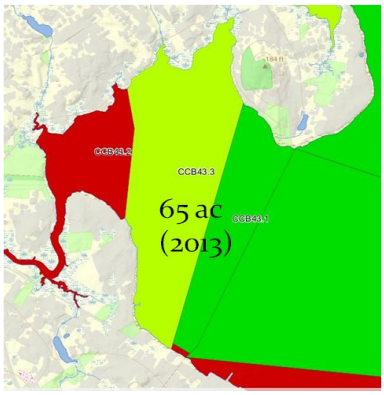
Area closed to shellfishing (red, left) are primarily estuarine because of reduced tidal flushing and/or stormwater and waste-water impacts.

WATER QUALITY IMPROVEMENTS

- **Restoration:** $43,500 to improve tidal flushing to designated shellfish habitat.
- **Wastewater:** Established as a No Discharge Area (NDA) in 2006—$142,000 for pumpout improvements.
- **Sewering:** millions to Marshfield, Scituate, Duxbury, Plymouth and Kingston.
- **Stormwater:** $2.94M for stormwater improvement projects on the South Shore.

RESULTS OF WATER QUALITY IMPROVEMENT EFFORTS





Shellfish growing areas reopened to harvest during the period 2007 to 2014 are indicated in light green.

SHELLFISH GROWING AREA RE-CLASSIFICATIONS, 2007 TO 2014

- Spatial gain of open shellfish beds: 590 acres (238.76 ha)
- Temporal gains: conditional beds open for longer season

BOTTOM LINE AND IMPLICATIONS

- There is community and regional interest in reclassification.
- Reclassification requires *MarineFisheries* resources for monitoring and testing.

NEXT STEPS

- Identify if water quality threshold (point of diminishing returns) exists.
- Consider new approaches to bacterial remediation (shellfish for water quality and habitat restoration).
- Additional shoreline surveys and bacterial source tracking to identify sources.

Photo: M. Thomas

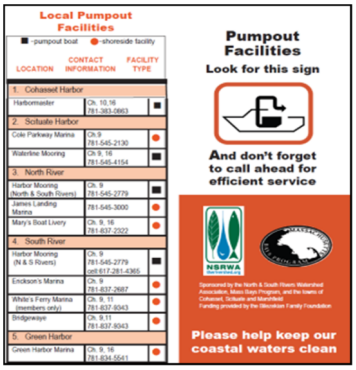


Photo: S. Grady

RESOURCES:

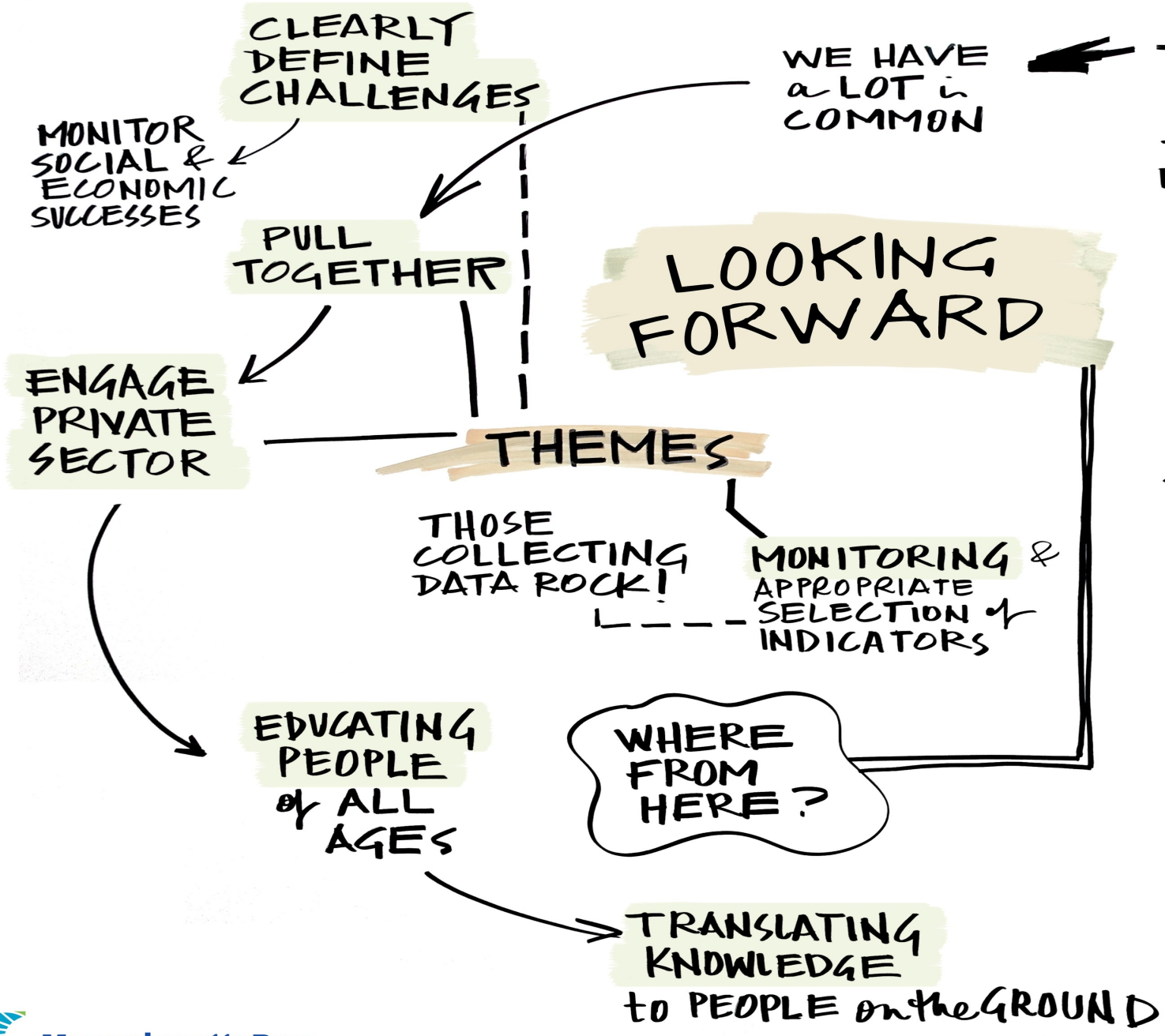
North and South Rivers Watershed Association www.nsrwa.org/environment/restoring-fish-streams/shellfish-restoration/

Shellfish Suitability Areas www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/shlfshsuit.html

Designated Shellfish Growing Areas (*MarineFisheries*) www.mass.gov/eea/agencies/dfg/dmf/programs-and-projects/designated-shellfish-growing-areas.html

NSRWA

Looking

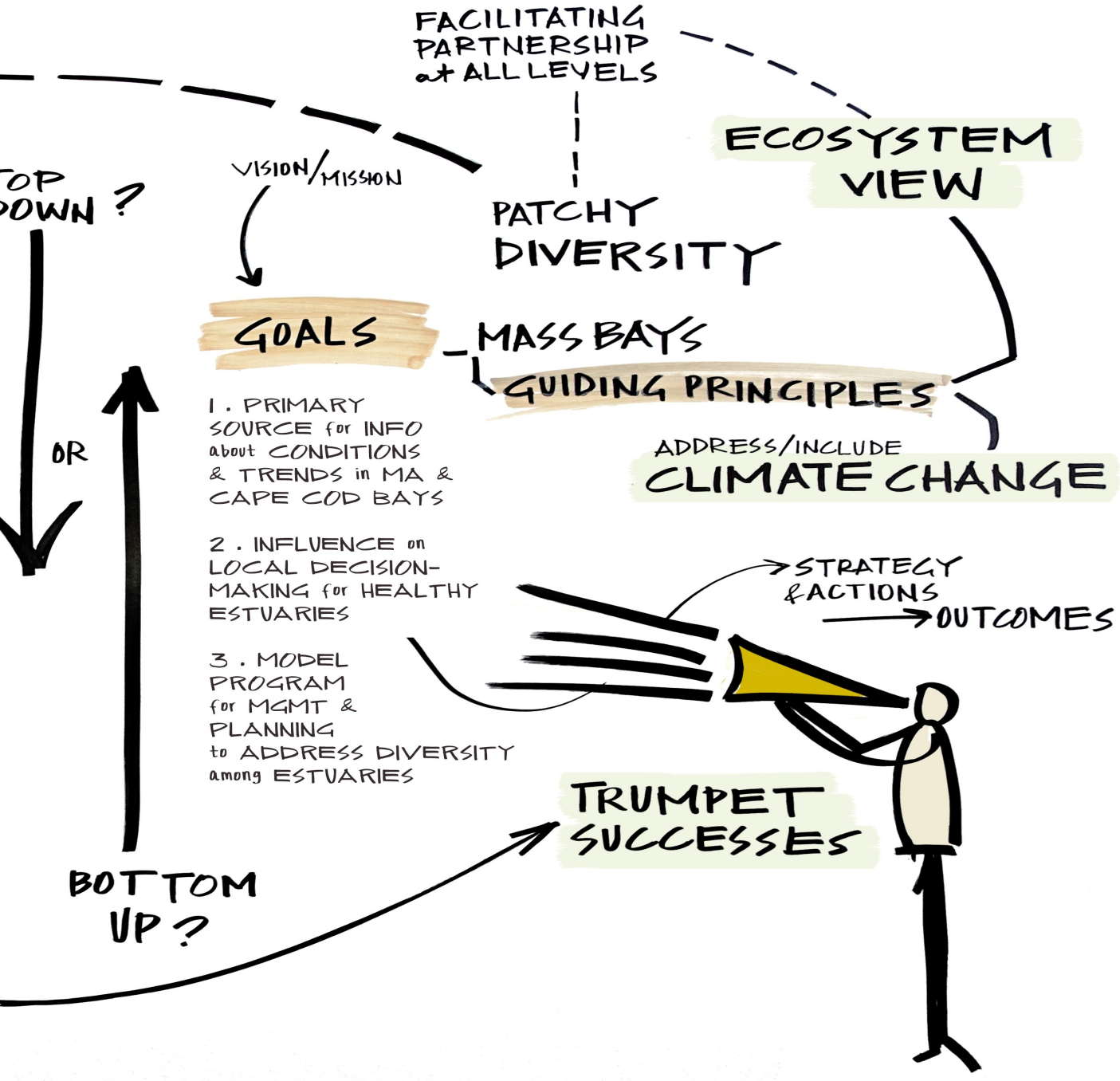


Massachusetts Bays
NATIONAL ESTUARY PROGRAM

2015 State of the Bays Symposium
15 April 2015 • Boston, MA

dpict. Images by Kelvy Bird | www.dpict.info

Forward


FACILITATING PARTNERSHIP at ALL LEVELS
ECOSYSTEM VIEW
VISION/MISSION
PATCHY DIVERSITY
GOALS
MASS BAYS
GUIDING PRINCIPLES
ADDRESS/INCLUDE CLIMATE CHANGE
1. PRIMARY SOURCE for INFO about CONDITIONS & TRENDS in MA & CAPE COD BAYS
2. INFLUENCE on LOCAL DECISION-MAKING for HEALTHY ESTUARIES
3. MODEL PROGRAM for MGMT & PLANNING to ADDRESS DIVERSITY among ESTUARIES
STRATEGY & ACTIONS
OUTCOMES
TRUMPET SUCCESSES
BOTTOM UP?
OR

Looking Forward

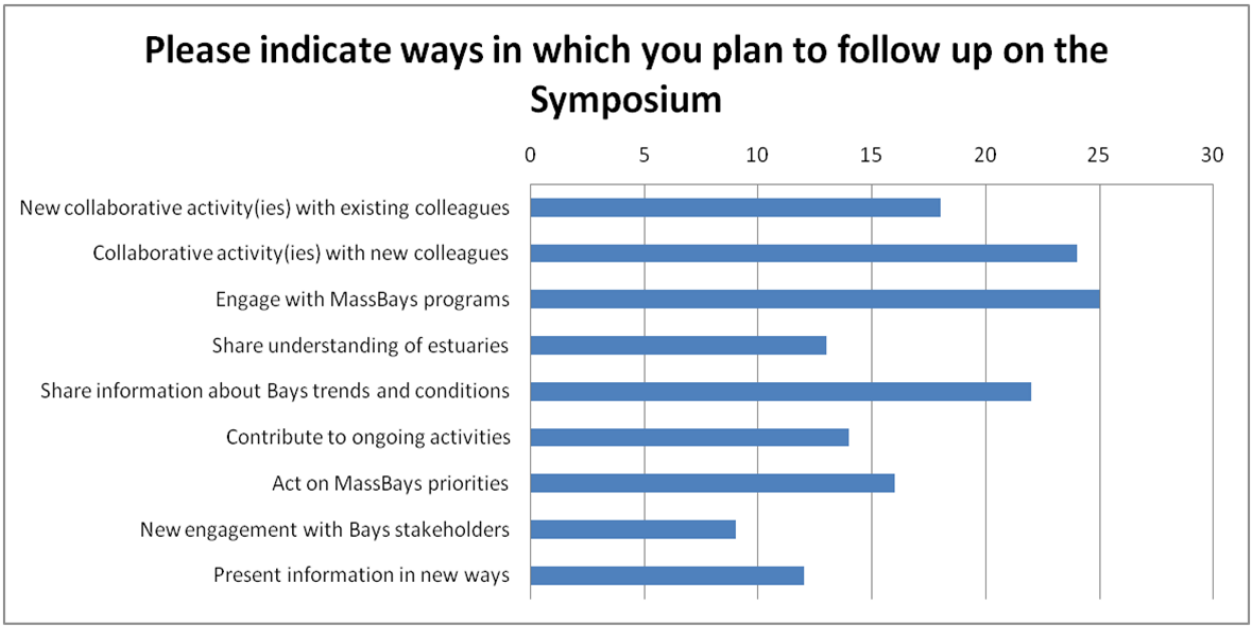
Can we do a better job of using existing information to make useful and informative statements about the State of the Bays? Can we fill in gaps by connecting monitoring efforts to each other, and to research programs? Through our Comprehensive Conservation and Management Plan, MassBays will support new frameworks for data collection and sharing across the Gulf of Maine region.

Making Connections

Presenter: Pam DiBona, MassBays

STATE OF THE BAYS SYMPOSIUM: BOTTOM LINE AND IMPLICATIONS

- MassBays is part of the National Estuary Program, is situated in the Gulf of Maine, and contains multiple points of diversity in its complex planning area.
- Many are working in and collecting data around the Bays. Environmental status is hard to pin down; trends are not always easy to tease out.
- MassBays has a role in generating information, informing management, and taking action—and will continue to do so.



Of the 44 attendees who provided evaluations (written and online), all indicated that they would follow up in at least one way.

ATTENDEES INDENTIFIED TOPICS AND THEMES FOR FUTURE WORK AND THE NEXT SYMPOSIUM

WHAT DID WE MISS?

Socioeconomic

- More social science research and methods to influence behavior
- Impacts on fishing and industry—people
- Economic benefits of regulations
- Cost benefit analysis—need to show how resources can be used most effectively

Data and Monitoring

- Need for comprehensive monitoring program
- Mechanisms for data compatibility
- Data sharing and availability—where do all the data go?
- Data quality—accurate/good enough to predict future trends?

Habitat

- Why are spatial distributions changing?
- Importance of habitat connectivity

Problems to Solutions

- Need to focus on solutions
- Current outlook/message is negative—what can we do about it?

Messaging and Politics

- Education before legislation
- How to convey message in a convincing manner
- Unified message
- Private sector on board
- No unfunded mandates

WHAT RESONATES?

Lots of Unknowns

- How can we stop the spread of invasives?
- What can we do about CEC?
- Climate change impacts?
- Multiple stressors

Restoration

- Prioritization based on ecological need
- Mine historic data to avoid shifting baseline
- Importance of stormwater management

Public Awareness of Programs, Plans and Trends:

- MassBays National Estuary Program
- Share comprehensive plans
- Increase visibility e.g. King Tide evidence of sea level change

Photo: CZM

Speakers'

Samantha Woods is the Executive Director of the North and South Rivers Watershed Association located on the South Shore of Massachusetts Bay, and the current Chair of the MassBays Management Committee. She has over 20 years of experience working to improve the health of our coastal resources and throughout her career has worked with MassBays and other National Estuary Programs throughout the country.

U.S. EPA New England is lucky to have **Deborah Szaro** as Deputy Regional Administrator. Prior to her position in New England, Deb directed the Division of Environmental Science Assessment at the EPA Lab in Edison, NJ. There, she was responsible for directing and managing a diverse staff of scientists, engineers and technicians engaged in ambient and source monitoring for all environmental media, the generation of data used in enforcement actions, development and implementation of data quality assurance polices and protocols, and the operation of the regional analytical testing laboratory.

J. Ruairidh (Ru) Morrison is the Executive Director of NERACOOS, the Northeastern Regional Association of Coastal Ocean Observing Systems, one of the eleven regions of the U.S. Integrated Ocean Observing Systems (IOOS®). He received his Ph.D. from the University of Wales, Bangor in 1999 and since then has worked at the Bermuda Biological Station for Research, the Woods Hole Oceanographic Institution, and the University of New Hampshire where he retains an affiliate faculty position. His research background is in optical oceanography, ocean color remote sensing, and observing systems. He is Chair of the IOOS Association, a councilor on the bi-national Gulf of Maine Council on the Marine Environment, co-chair of the 2012 IOOS Summit, chair of the steering committee for the Northeast Coastal Acidification Network (NECAN), member of the board of the Marine and Oceanographic Technology Network (MOTN) and member of working groups for the International Council for Exploration of the Sea and Group on Earth Observations.

Bruce K. Carlisle is the Director of the Massachusetts Office of Coastal Zone Management (CZM), providing oversight of policy, planning, and technical approaches for CZM program areas including ocean planning, offshore renewable energy, shoreline and floodplain management, climate change adaptation and coastal resilience planning, habitat protection and restoration, port and harbor planning, water quality, seafloor and tidal habitat mapping, and GIS/data management. Bruce also supervises CZM's regulatory review of coastal and ocean projects. He formerly served as both Acting and Assistant Director for CZM, as well as the manager for the Commonwealth's Wetlands Restoration Program, where he led collaborative efforts to restore former and degraded wetlands. He holds a Masters in Environmental Policy from Tufts University.

Pam DiBona brings more than 20 years' experience in the public, nonprofit, and private sectors to her position as Executive Director of MassBays National Estuary Program. She has expertise in organizational development and strategic planning expertise along with a solid understanding of ocean and coastal science, gained through positions at the New England Aquarium, Massachusetts Department of Conservation and Recreation, the Environmental League of Massachusetts, and the Charles River Watershed Association. Pam earned a B.A. in Biochemistry from Connecticut College, and an M.S. in Environmental Microbiology and a Graduate Certificate in Critical and Creative Thinking, both from UMass Boston.

Jon Kachmar is The Nature Conservancy's Massachusetts Coastal Program Director, with responsibilities for statewide coastal conservation and restoration work as well as regional efforts from Cape Cod to Long Island Sound. He has an undergraduate degree in Marine Affairs from the University of Rhode Island, and a master's degree in Public Policy and Management from the University of Southern Maine focusing on coastal zone management. Jon is an avid sailor, fly fisherman, and backcountry skier.

Biographies

E. Heidi Ricci is a Senior Policy Analyst at Mass Audubon, with over 25 years of experience in environmental policy and land use management. She directs the Shaping the Future of Your Community program, which received an Environmental Merit Award from the U.S. EPA New England Region in 2013. The program focuses on helping municipalities adopt and apply sustainable development techniques to support landscape resiliency for the benefit of both people and nature in the face of climate change. Heidi is First Vice President of the Massachusetts Association of Conservation Commissions (MACC) and a founding Board member of the Massachusetts Rivers Alliance. She holds a B.S. degree in Biology from Tufts University and an M.S. degree in Resource Management and Administration from Antioch University New England.

Harlan Doliner is an environmental and maritime attorney practicing with the Boston office of the law firm of Verrill Dana LLP, and an adjunct professor for the Law Schools at Boston College and Roger Williams University. Harlan chairs the firm's Maritime Group, and advises on maritime technology and security issues; corporate and real estate transaction risk evaluation and support; hazardous waste site reuse; complex facility siting; management and regulatory compliance; and land use permitting, especially wetlands and related fisheries and wildlife issues. A member of MassBays' Management Committee, Harlan is also president of the Marine & Oceanographic Technology Network, a board member of the Environmental Business Council of New England, and was founding chair of the Environmental Law Section of the Boston Bar Association. He received his law degree from Boston College and his M.A. and B.A. from Johns Hopkins.

Ellen Mecray is the NOAA Regional Climate Services Director for the Eastern Region, based in Taunton, Massachusetts. She is also the U.S. co-lead for the Gulf of Maine Council's Climate Network and co-lead for the New England Federal Partners Climate committee. In her NOAA role, Ellen brings climate information to regional, state, and local geographies and specific sectors of importance to the eastern region. Prior to joining NOAA, Ellen was an oceanographer with the US Geological Survey's Coastal and Marine Geology program. She holds a Bachelor's degree in geology from Colgate University and a Master's in geological oceanography from the University of Rhode Island.

Julia Knisel is Coastal Shoreline and Floodplain Manager for the Massachusetts Office of Coastal Zone Management, leading development and implementation of policies and strategies to promote sound adaptation and reduce vulnerability along the coast. Julia coordinates with state and federal agencies, local cities and towns, regional planning agencies, and NGOs to build partnerships and collaborative approaches to improve management of coastal erosion and flooding. She oversees the Massachusetts StormSmart Coasts program to help communities prepare for and protect themselves from coastal storms and flooding, both now and under higher sea levels.

As MassBays' Regional Coordinator for Cape Cod, **Jo Ann Muramoto** helps towns and organizations to protect and restore coastal resources by providing technical assistance, grant-writing, project management, coordination, monitoring and outreach. Her work experience includes research in marine chemistry, environmental consulting, and wetlands regulation as a conservation administrator in the Town of Falmouth. Jo Ann has a B.S. in biology from Caltech and a Ph.D. in geological sciences from Cornell University.

Sam Cleaves (moderator) is a Senior Regional Planner at the Metropolitan Area Planning Commission (MAPC) where he has worked since 2000. He is a municipal and regional planning director with extensive experience working for and with municipal governments, businesses and state agencies developing, implementing and coordinating land use and environmental planning projects within eastern Massachusetts. Prior to joining MAPC, Sam was Planning Director for the City of Gloucester, coordinated the Metro Boston and Salem Sound subregions for MassBays Program in the 1990s and early 2000's. He lives in Gloucester and currently serves on the Gloucester Clean Energy Commission.

WATER QUALITY PANEL

Betsy Davis has been working at EPA for 24 years and 20 of those years have been in the drinking water and wastewater programs. Her primary focus is writing NPDES permit for dischargers in Massachusetts and as the Drinking Water Coordinator for New Hampshire. Her background is in Civil Engineering.

Newton Tedder is an environmental scientist over 10 years experience in hydrology and hydrogeology in the public and private sector. He has been at EPA Region 1 for 4 years and currently serves as the lead permit writer for the New Hampshire and Massachusetts Municipal Separate Storm Sewer permits. He holds a M.S. in Geology from Boston College.

Amy Costa is the Director of the Cape Cod Bay Monitoring Program at the Center for Coastal Studies. As a research scientist, Amy focuses on the quality and overall health of marine and coastal ecosystems through the integration of chemical, physical and biological studies.

Michael Celona is Chief of the Water Toxics Unit in the MA Department of Public Health's Environmental Toxicology Program where he coordinates water-related activities involving bathing beaches, freshwater algae blooms, drinking water, and freshwater fish advisories. He sits on the New England Interstate Water Pollution Control Commission and the MA Board of Registration of Operators of Drinking Water Supply Facilities. He has a B.A. in Environmental Science from Wheaton College and an M.A. in Urban and Environmental Policy from Tufts University.

Barbara Warren is the MassBays Lower North Shore Regional Coordinator and the Executive Director of Salem Sound Coastwatch, where she has been working for the past 12 years. She has a Masters in Education from Lesley University and a Masters of Science in Environmental Studies from Antioch New England. Barbara has received both an EPA New England Environmental Merit Award and the Salem State University Friend of the Earth Award.

Wendy Leo (moderator) is Senior Program Manager for NPDES Compliance at the Massachusetts Water Resources Authority, which she joined following graduate school and a Knauss Sea Grant Fellowship. Her work includes data management as well as reporting on wastewater and receiving water quality. Wendy has been involved in the Massachusetts Bays Program in different capacities since its inception.

HABITAT PANEL

Andy Lipsky is a skilled facilitator, marine and watershed scientist, and a leader in managing large conservation and development projects, Andy directs SeaPlan's science and policy work. In his 20 year career, he has worked at the NGO, state, tribal, and federal levels, including two years at the White House helping to develop and implement President Obama's National Ocean Policy.

Hunt Durey is Deputy Director of the Division of Ecological Restoration within the MA Department of Fish and Game. From 2000 to 2009, he served as the Restoration Planner and then Manager of the MA Wetlands Restoration Program. Prior to that, Hunt served as Conservation Agent for the town of Boxford, MA and worked for a private environmental consulting firm as a project manager and wetland scientist.

Anne Giblin is a Senior Scientist at The Ecosystems Center of the Marine Biological Laboratory. Her interests are in element cycling in sediments, especially nitrogen. She has worked on issues of coastal eutrophication and salt marsh loss in the New England region and for 20 years studied benthic processes in Mass Bay and Boston Harbor as part of the outfall relocation monitoring program. She earned her doctorate in Ecology from Boston University.

Adrienne Pappal joined the MA Office of Coastal Zone Management in 2007 as the Aquatic Invasive Species Program Coordinator. Since then she has expanded marine invasive species information, monitoring, and outreach resources by coordinating the regional Marine Invader Monitoring and Information Collaborative (MIMIC), co-coordinating the 2010 and 2013 Rapid Assessment Surveys, and authoring a review of marine invasive species for the Gulf of Maine Council. She currently manages the Coastal Habitat and Water Quality program at CZM.

Peter Phippen is an environmental scientist with 35 years experience fresh and saltwater resource management. He holds a M.S. in hydrogeology from Boston University, and an M.A.L.D. in environmental landscape design from the Conway School. He is the Coastal Coordinator of the Eight Towns and the Bay Committee, the northern shore MassBays coordinator and the Merrimack Valley Planning Commission, and is focused on helping the North Shore municipalities address coastal pollution and restoration problems.

Juliet Simpson (moderator) is a coastal aquatic ecologist with the MIT Sea Grant College Program. Her primary interests are in the effects of climate change on salt marshes and eelgrass meadows, the ecology and physiology of fresh- and saltwater plants and algae, water quality regulation, and the transport and fate of terrestrially-derived pollutants to the coastal ocean. She earned her doctorate in Ecology from University of California at Santa Barbara.

WILDLIFE PANEL

Jeff Kennedy has over 30 years experience in the shellfish program at the Massachusetts Division of Marine Fisheries. In his current position as Shellfish Regional Supervisor and Purification Plant Manager he oversees shellfish management and sanitary classification of shellfish growing areas from Hull to Salisbury including managing depuration plant operations along with the associated contaminated softshell clam fishery.

Katharine Parsons holds a doctorate in Ecology from Rutgers University. She has 30 years of experience in coastal waterbird research, management and policy in the northeast. Since 2011, she has directed Mass Audubon's Coastal Waterbird Program which works with coastal communities throughout Massachusetts to protect rare birds and their habitats.

Abigail Franklin Archer is a Marine Resource Specialist with the Cape Cod Cooperative Extension Marine Program & Woods Hole Sea Grant. She received her Master's degree in Wildlife and Fisheries Conservation from the University of Massachusetts, Amherst with thesis work focusing on evaluation of river herring passage through nature-like and technical fishways. Abigail serves as coordinator for the River Herring Network, a professional society for river herring wardens on Cape Cod and Southeastern MA, and is the current president of the Estuaries Section of the American Fisheries Society.

Sara P. Grady is the South Shore Regional Coordinator for the Massachusetts Bays National Estuary Program and Watershed Ecologist at the North and South Rivers Watershed Association in Norwell, MA. She received her Bachelor of Science in Aquatic Biology from Brown University in 2001 and her Ph.D. in Biology from the Boston University Marine Program in Woods Hole in 2006. Her specialties include coastal and estuarine ecology, invertebrate zoology, and ecological restoration.

Kathryn Ford (moderator) is a native of Massachusetts. She received her doctorate in oceanography at the University of Rhode Island and joined the Division of Marine Fisheries in 2005. She currently manages the Fisheries Habitat Program which conducts environmental review, habitat research, and ocean planning to avoid impacts from construction on marine fisheries resources. The program has active research programs focused on eelgrass, marshes, and artificial reefs. Kathryn serves on several committees including the Mass Bays Management Committee, the Science Advisory Council for Mass Ocean Planning, and the New England Fishery Management Council Habitat PDT. Kathryn holds a doctorate in Oceanography from the University of Rhode Island. She Kathryn lives in New Bedford with her husband,