9th Annual State of the Harbor Forum

presented by the

Nantucket Land & Water Council

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Nantucket Land & Water Council's 9th Annual

STATE OF THE HARBOR FORUM

Presenting Nantucket's First Eelgrass Management Plan

Thank You to Our WATER FUND Founders!

Contributions to the NLWC's Water Fund are directed specifically to our extensive water quality research, programs, and initiatives.

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Harry Wilcox

Water Fund FOUNDERS Circle

Support our 2025 Water Fund Challenge Grant!

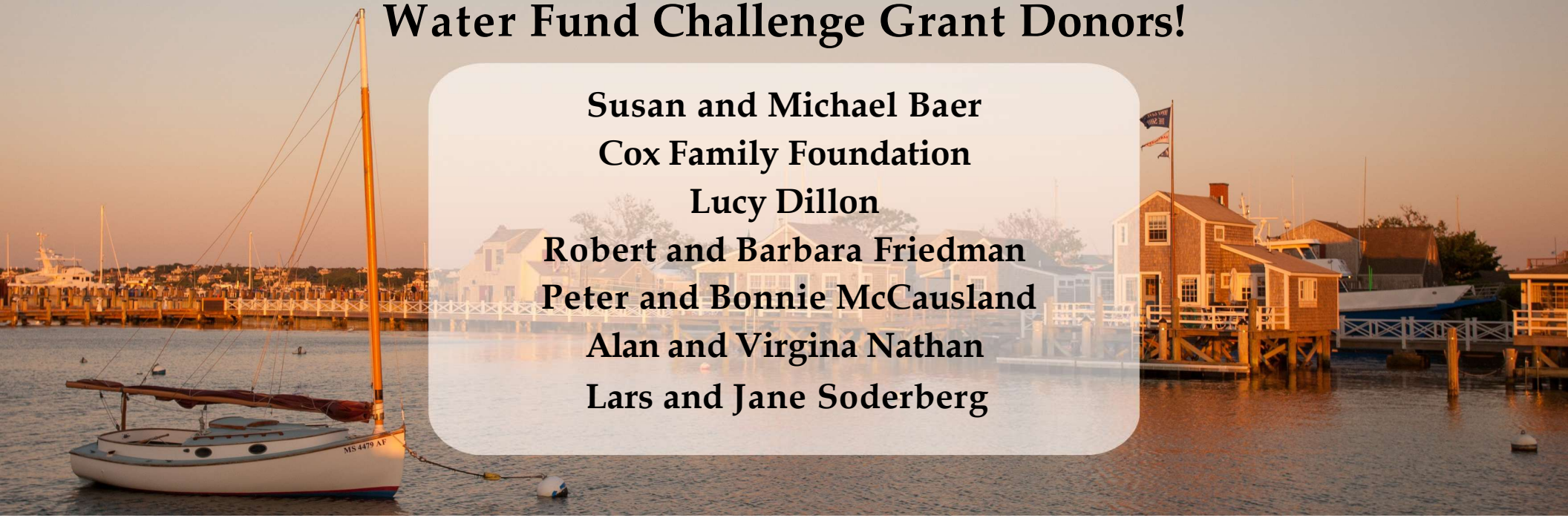
In 2025, some dedicated members of the NLWC board have, once again, come together to offer a generous **Water Fund Challenge Grant** to the organization.

Any gift to our Water Fund will be matched on a 1:1 Basis up to $75,000.

Thank You to our 2025

Water Fund Challenge Grant Donors!

Susan and Michael Baer
Cox Family Foundation
Lucy Dillon
Robert and Barbara Friedman
Peter and Bonnie McCausland
Alan and Virgina Nathan
Lars and Jane Soderberg



Our Harbor, Our Responsibility:
Presenting Nantucket's Eelgrass Management Plan

Tara Riley
Shellfish and Aquatic Resources Manager,
Town of Nantucket

Dr. Alyssa Novak
Research Assistant Professor,
Boston University

Kimberly Starbuck
Senior Research Associate,
Urban Harbors Institute

Jeffrey Carlson
Director of Natural Resources Department,
Town of Nantucket

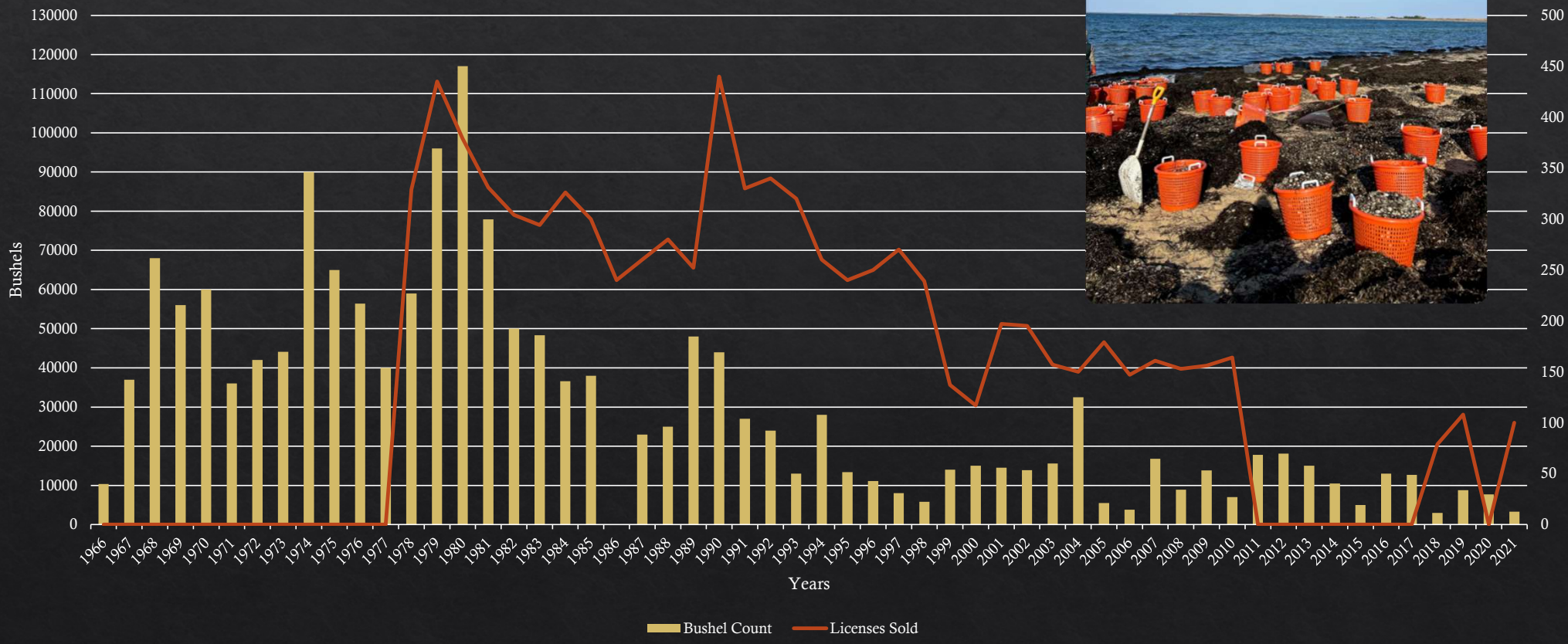
Nantucket Island's First Eelgrass Management Plan 2025

Tara Riley
Shellfish and Aquatic Resource Manager
Town of Nantucket Natural Resources Dept.

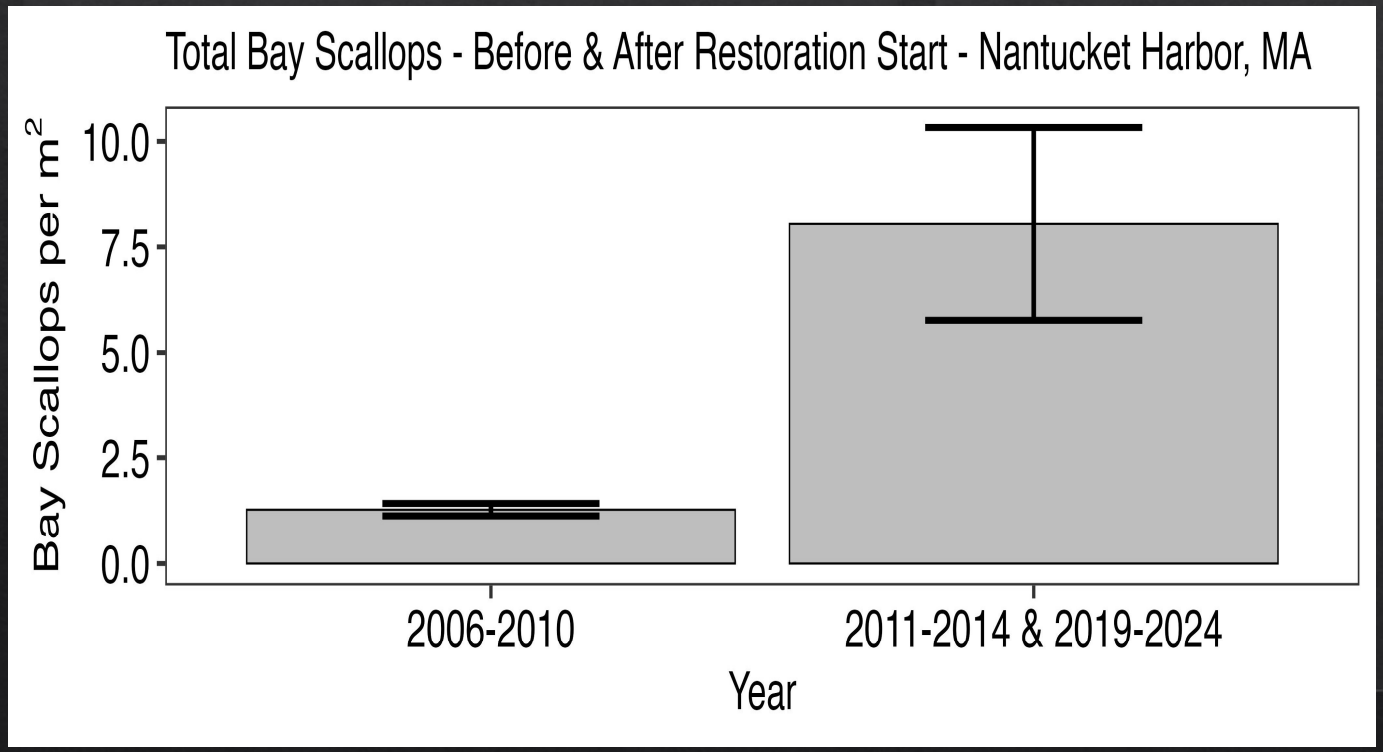
Eelgrass and Ecosystem Services

- Underwater marine flowering seagrass species
- Plant structure provides a three-dimensional habitat for feeding, refuge, and nursery for many different species
- Eelgrass roots and rhizomes stabilize sediment, reducing erosion and dissipate wave energy
- Sequesters carbon/produces oxygen/ buffers against acidification
- Key to the survival and sustainability of bay scallop populations and restoration programs

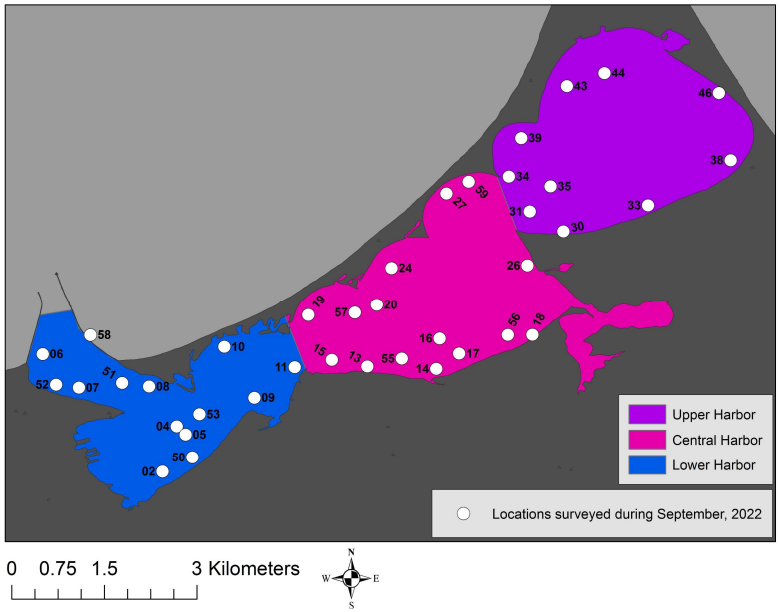
Bay Scallop Bushel Counts

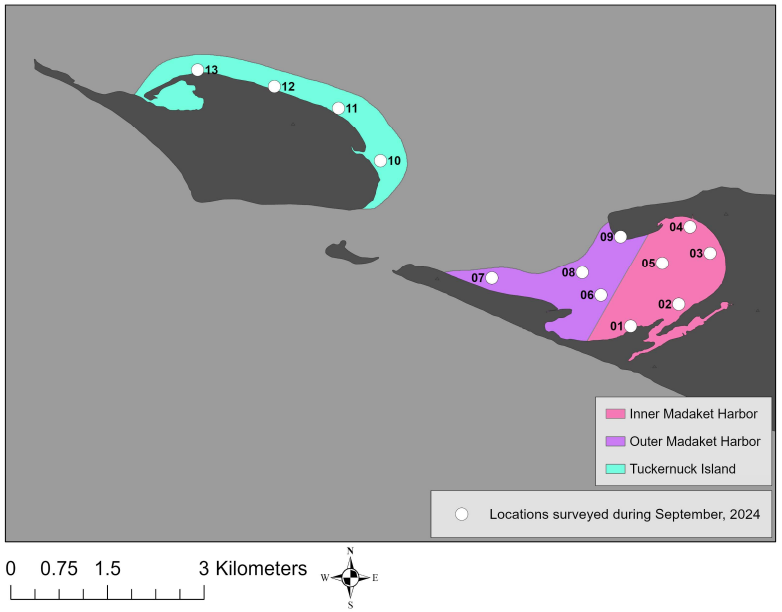


Total Bay Scallop Average Pre and Post Restoration Years



Nantucket and Madaket Harbor Eelgrass Survey Sites

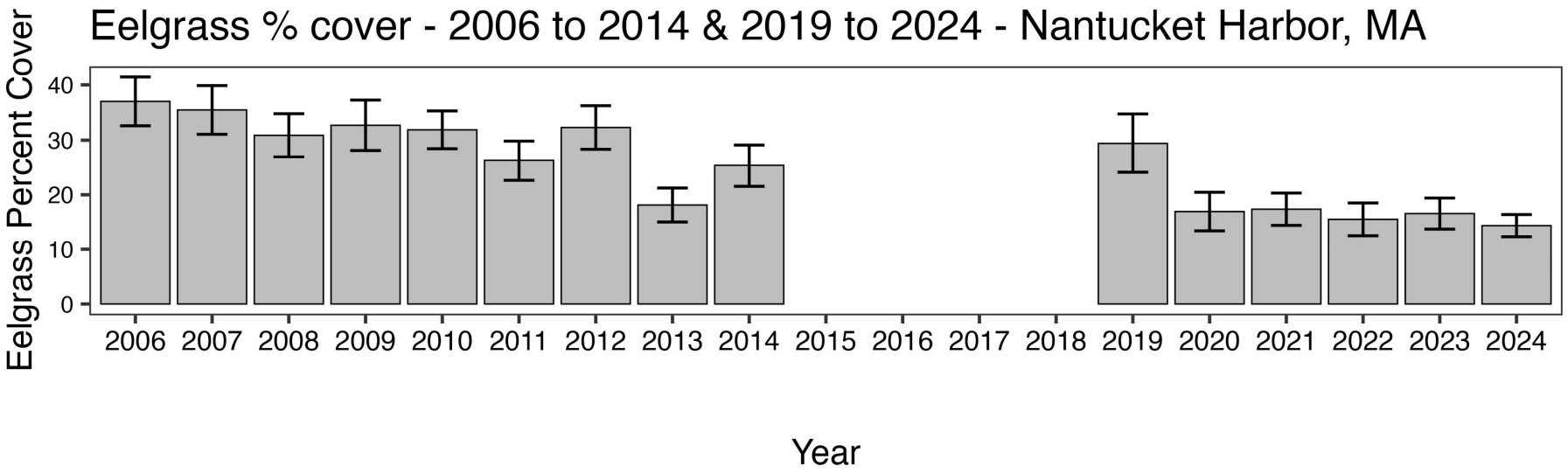




Annual Habitat and Physical Parameter Data Collected

- Total % Coverage (eelgrass, macroalgae)
- Separate % for eelgrass, branching, filamentous, codium, sheet algae, and boring sponge
- Blade Length and Fouling Scale
- % Bare
- Sediment Characteristics
- Underwater photos of each site
- **Physical Parameters**: cloud cover, wind, sea state, beaufort scale, water depth, temperature, dissolved oxygen, % saturation, and salinity

% Eelgrass Cover Nantucket Harbor



Madaket Harbor Baseline Survey (Total Eelgrass Coverage)

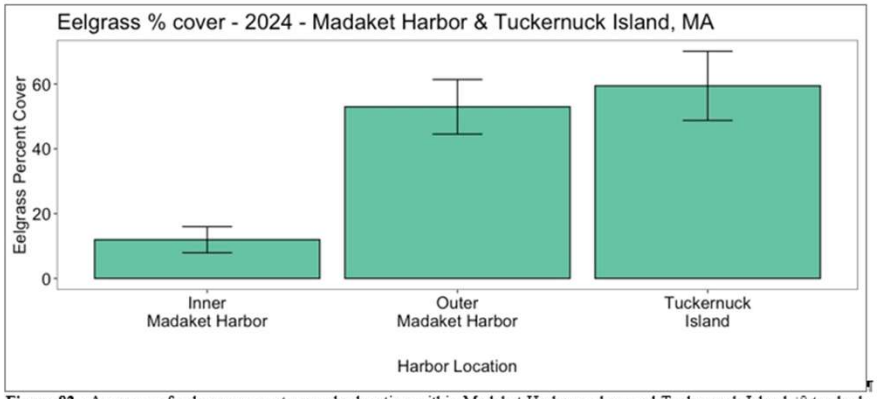
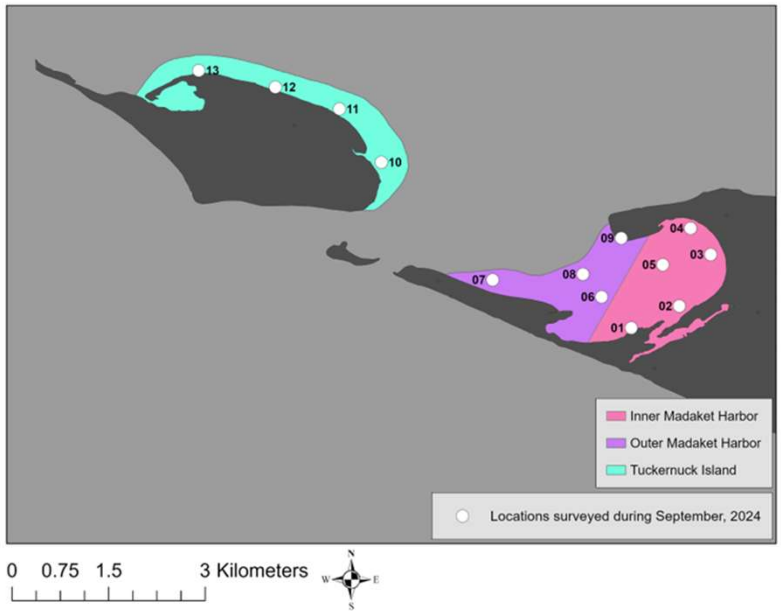


Figure 82. Averages of eelgrass percent cover by location within Madaket Harbor and around Tuckernuck Island ± standard error of the mean (SE) during September 2024.

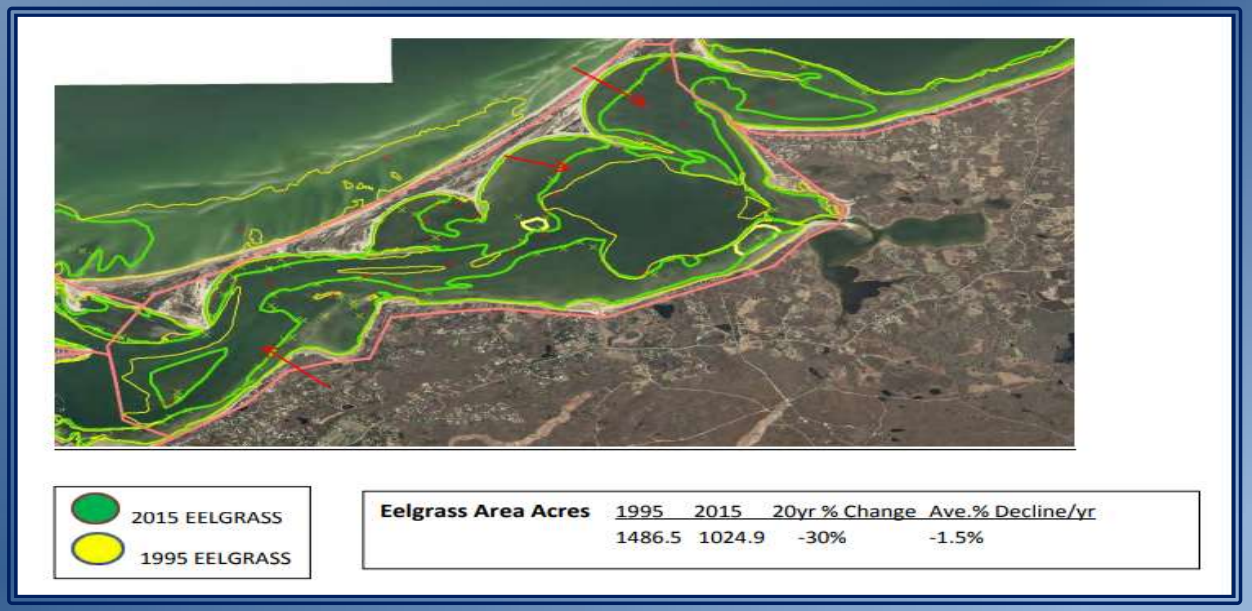


Eelgrass Restoration Updates for Nantucket Harbor

Alyssa Novak, PhD
Boston University, Earth and Environment, Boston, MA

Status of Eelgrass Meadows

- Nantucket Harbor 30% loss
- Madaket Harbor 24% loss
- Tuckernuck and Muskeget 1% increase



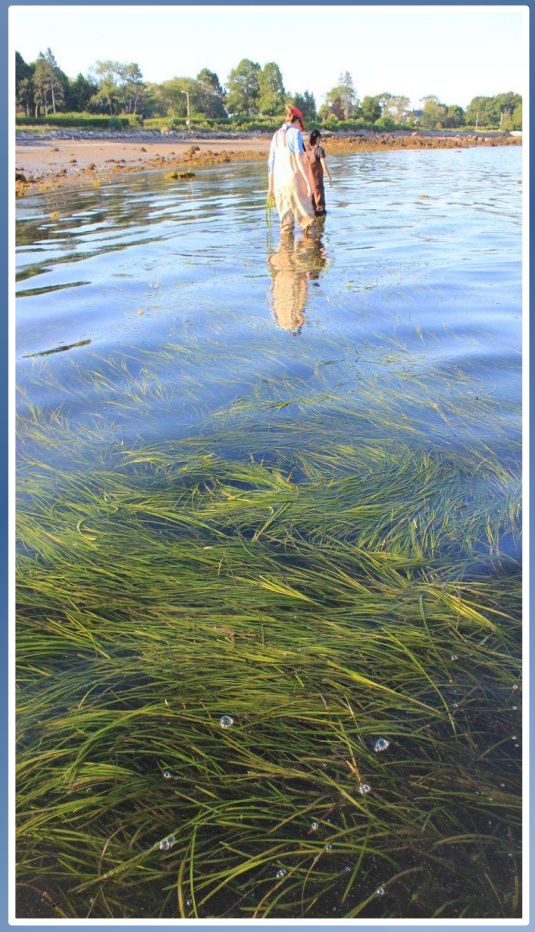
Eelgrass Restoration Background

- Why Restore?
  - Increase ecosystem services
  - Facilitates natural recovery
  - Raises public awareness

- Challenges
  - Expensive
  - Variable success rates

- Methods
  - Seeds
  - Vegetative shoots

- Steps
  - Identify/Remove stressors
  - Proper site selection
  - Identify a donor population
  - Transplant/Spread risks



Restoration Sites

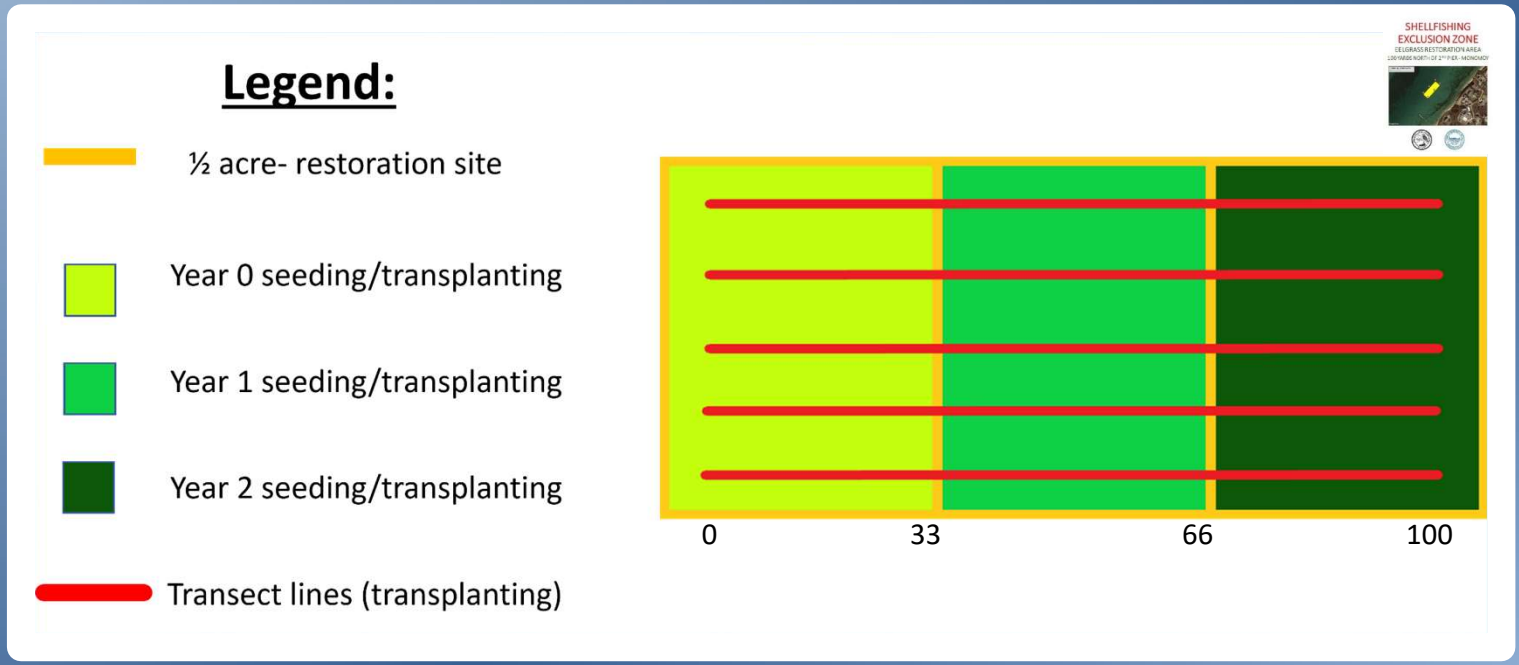
Monomoy

2012 2017

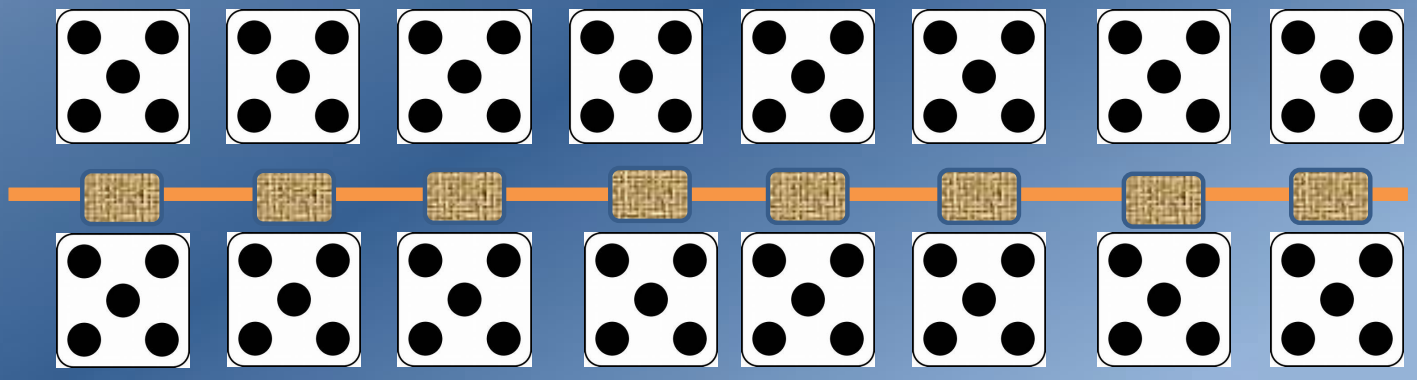
5th Bend

2012 2022

Transplant Design

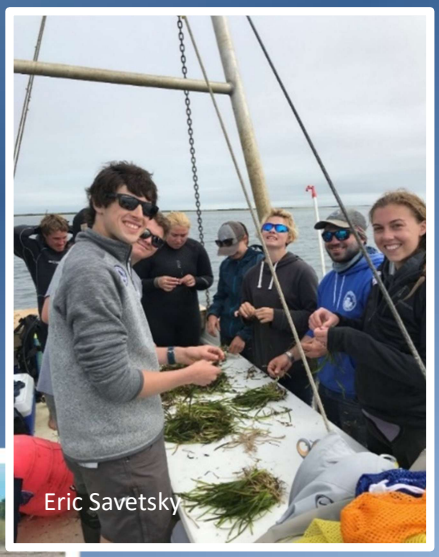


Transplant Design



Community Engagement

- Student/Volunteer
  - Promotes place-/project-based learning
  - Meet and work with scientists
  - Understand management behind science
  - Increase self-esteem
  - Show options for college/career paths
  - Connect with peers with similar interests
  - Connect with nature and the community



- Project benefits
  - Facilitates project activation
  - Motivated- enthusiastic members
  - New capabilities and innovation
  - Cost-sharing support
  - Community recognition

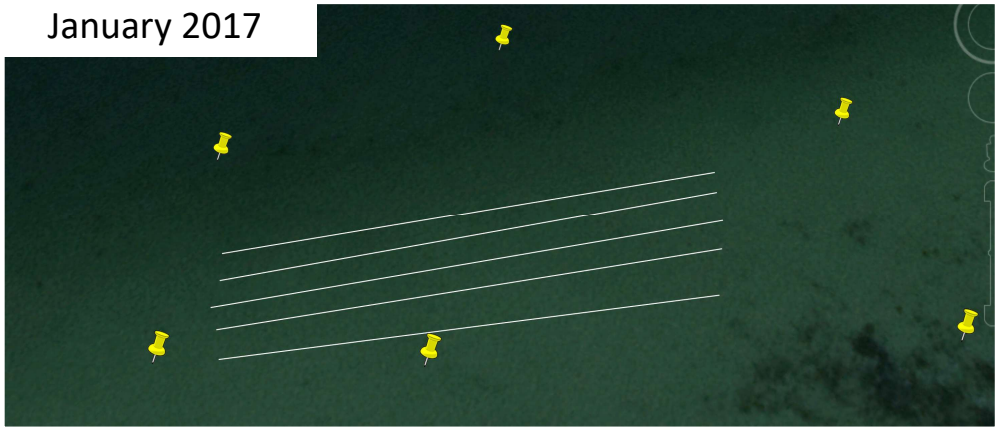
Assessing Success

Remote
- Assess expansion with drone

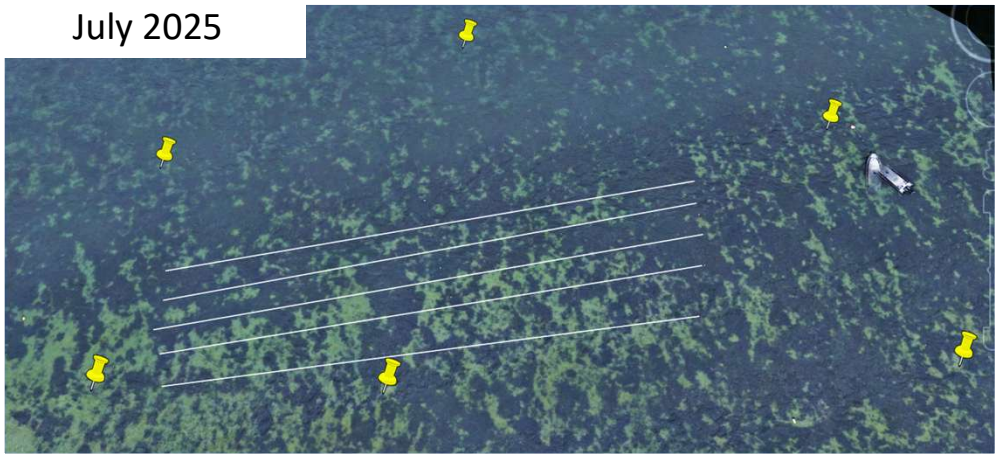
In situ
- Calculate survival of planting units
- Plant Parameters
  - % cover, canopy height, shoot density, reproductive, areal extent

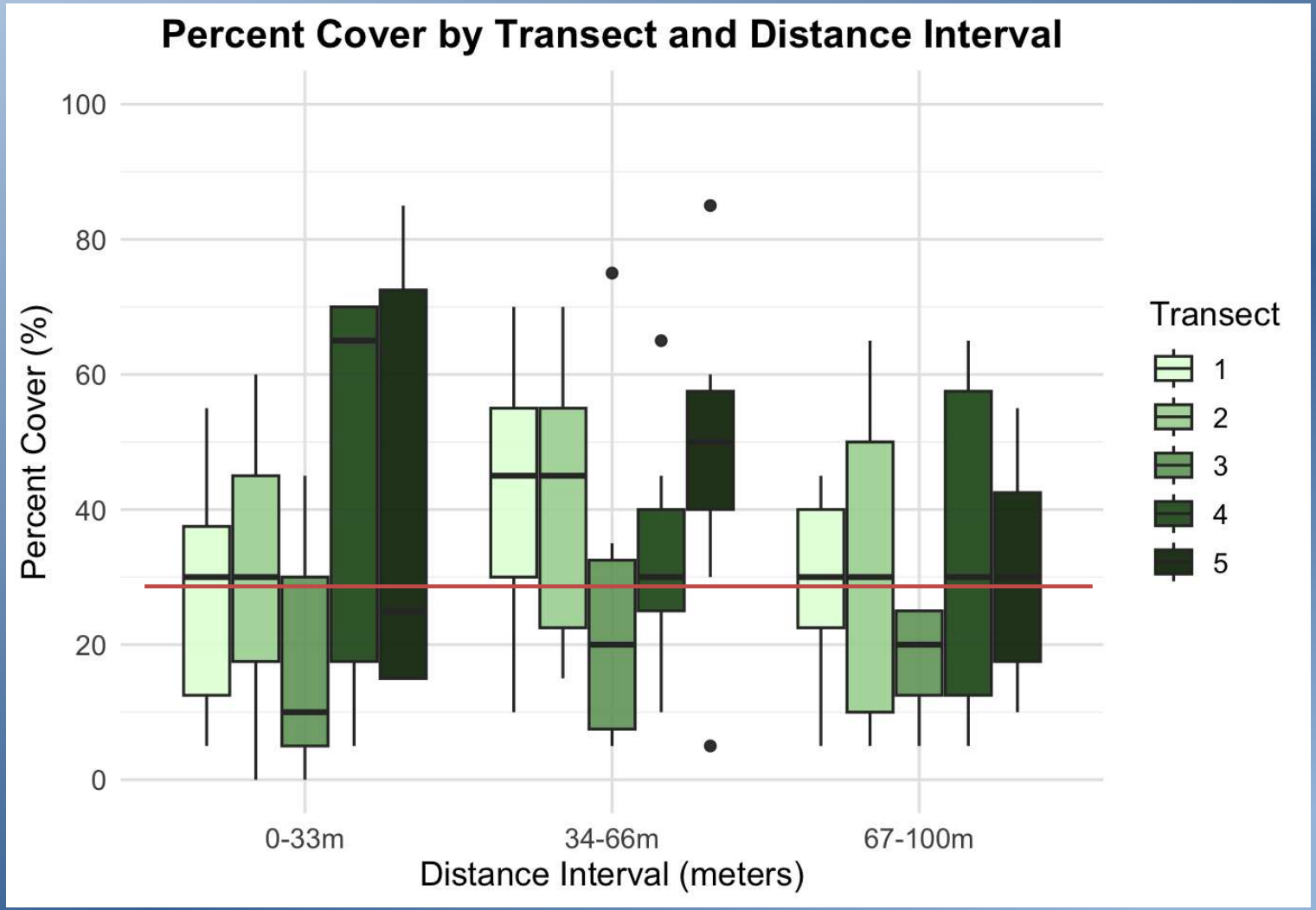
Monomoy

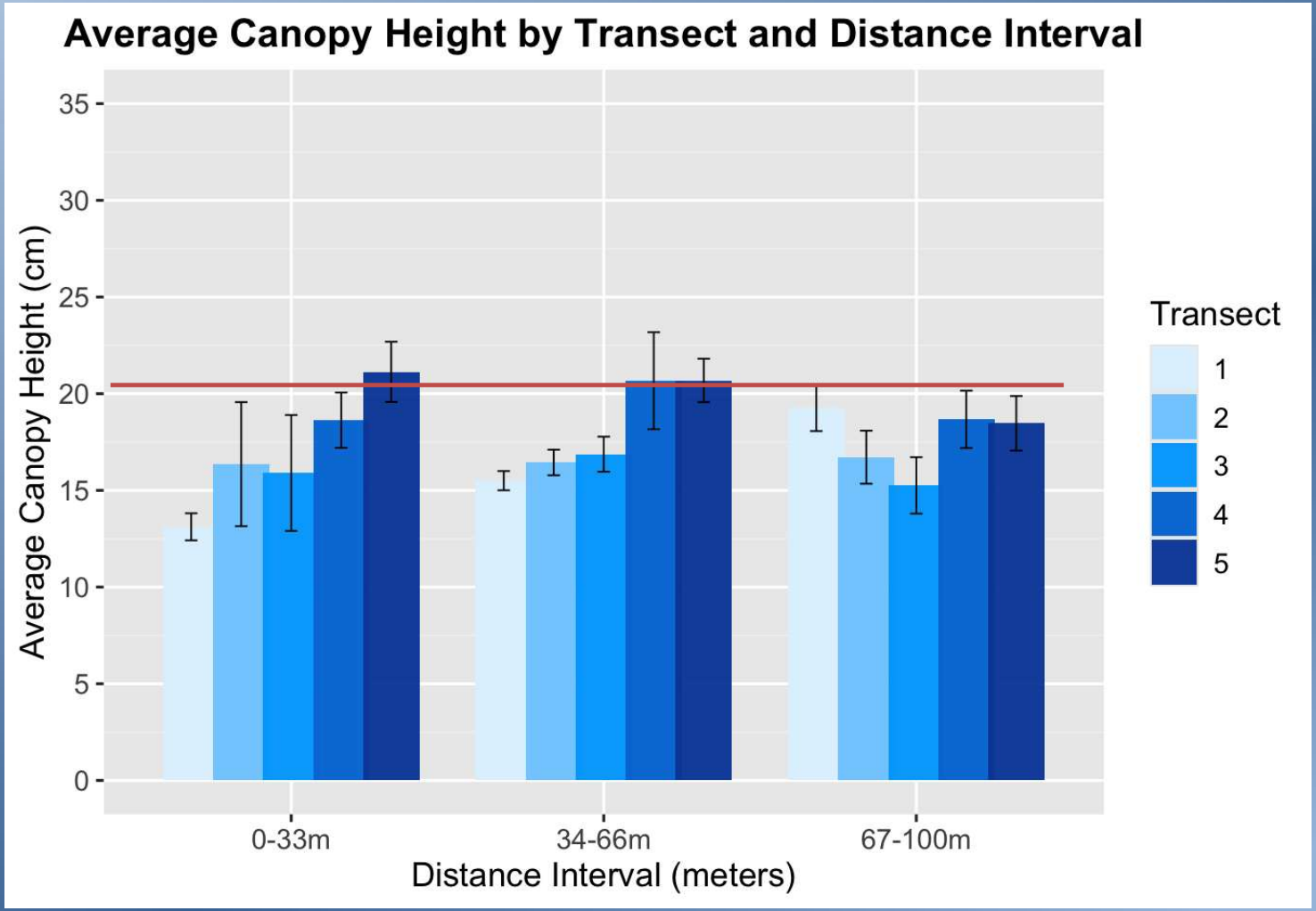
January 2017

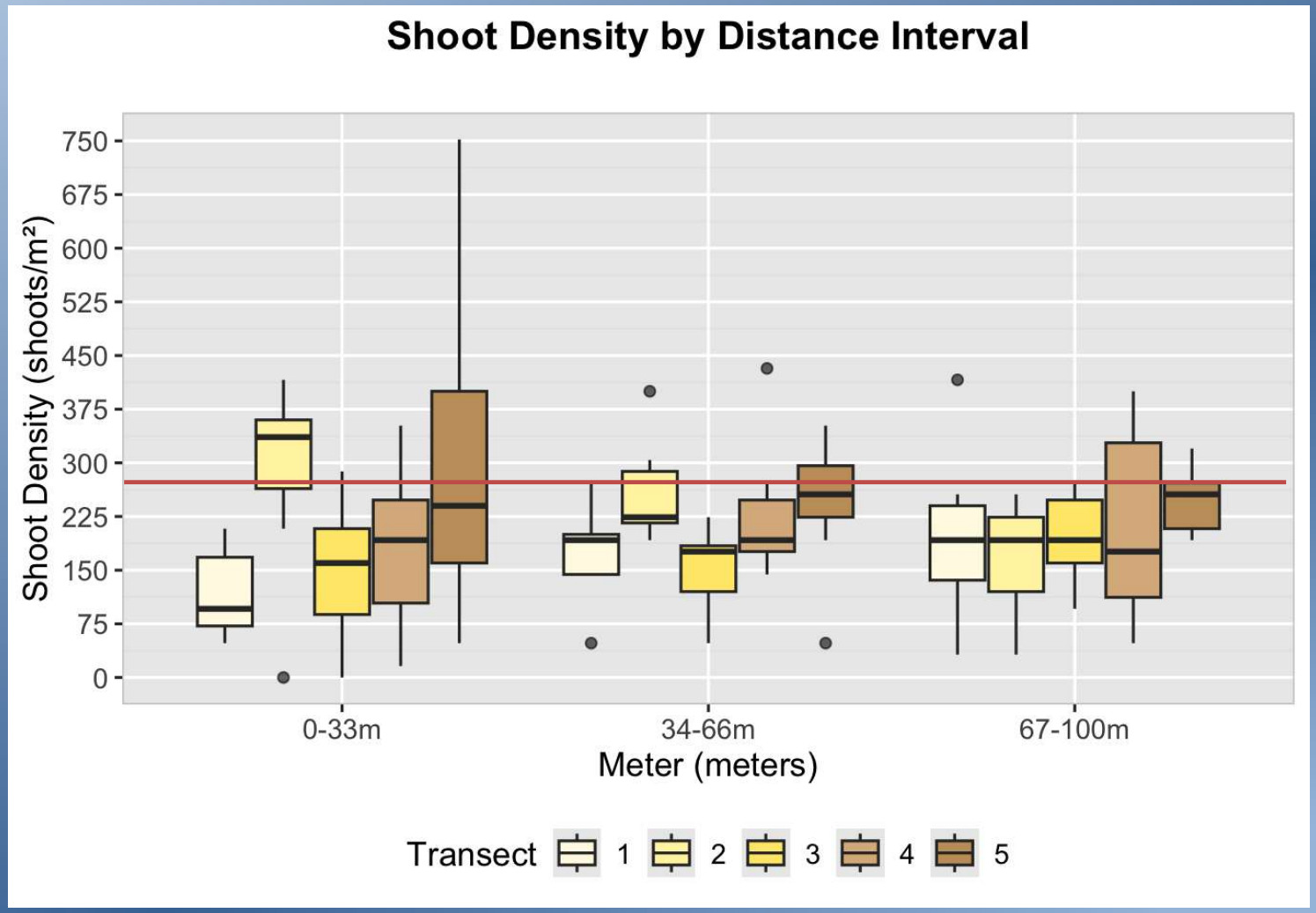


July 2025




Percent Cover by Transect and Distance Interval
Percent Cover (%)
100
80
60
40
20
0
0-33m
34-66m
67-100m
Distance Interval (meters)
Transect
1
2
3
4
5


Average Canopy Height by Transect and Distance Interval
Average Canopy Height (cm)
35
30
25
20
15
10
5
0
0-33m
34-66m
67-100m
Distance Interval (meters)
Transect
1
2
3
4
5


Shoot Density by Distance Interval
Shoot Density (shoots/m²)
750
675
600
525
450
375
300
225
150
75
0
0-33m
34-66m
67-100m
Meter (meters)
Transect
1
2
3
4
5

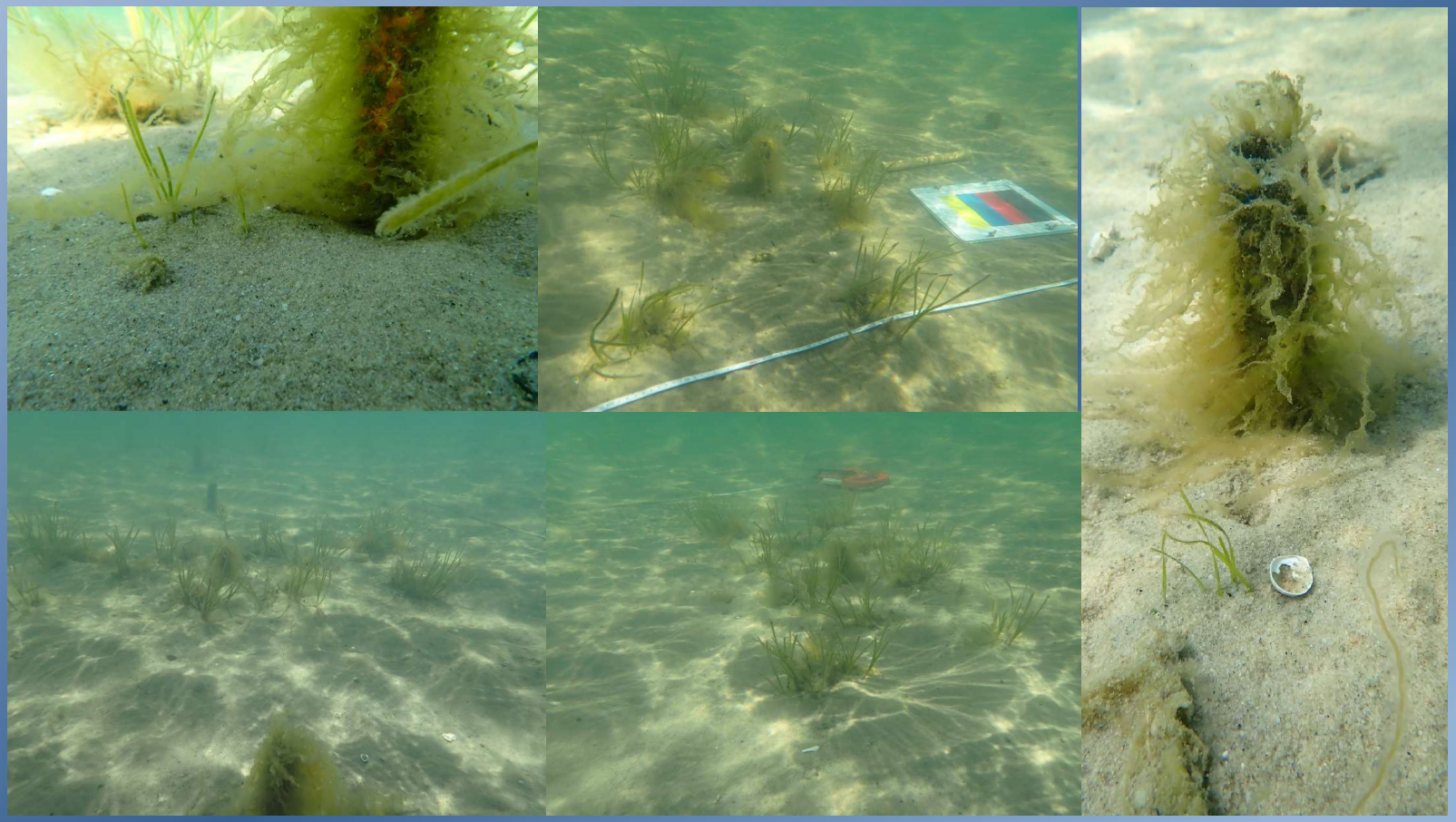
Monomoy

Georgia Fanthorpe

Challenges

Eric Savetsky

5th Bend



Stressors

Marine Pollution Bulletin 197 (2023) 115689

Contents lists available at ScienceDirect

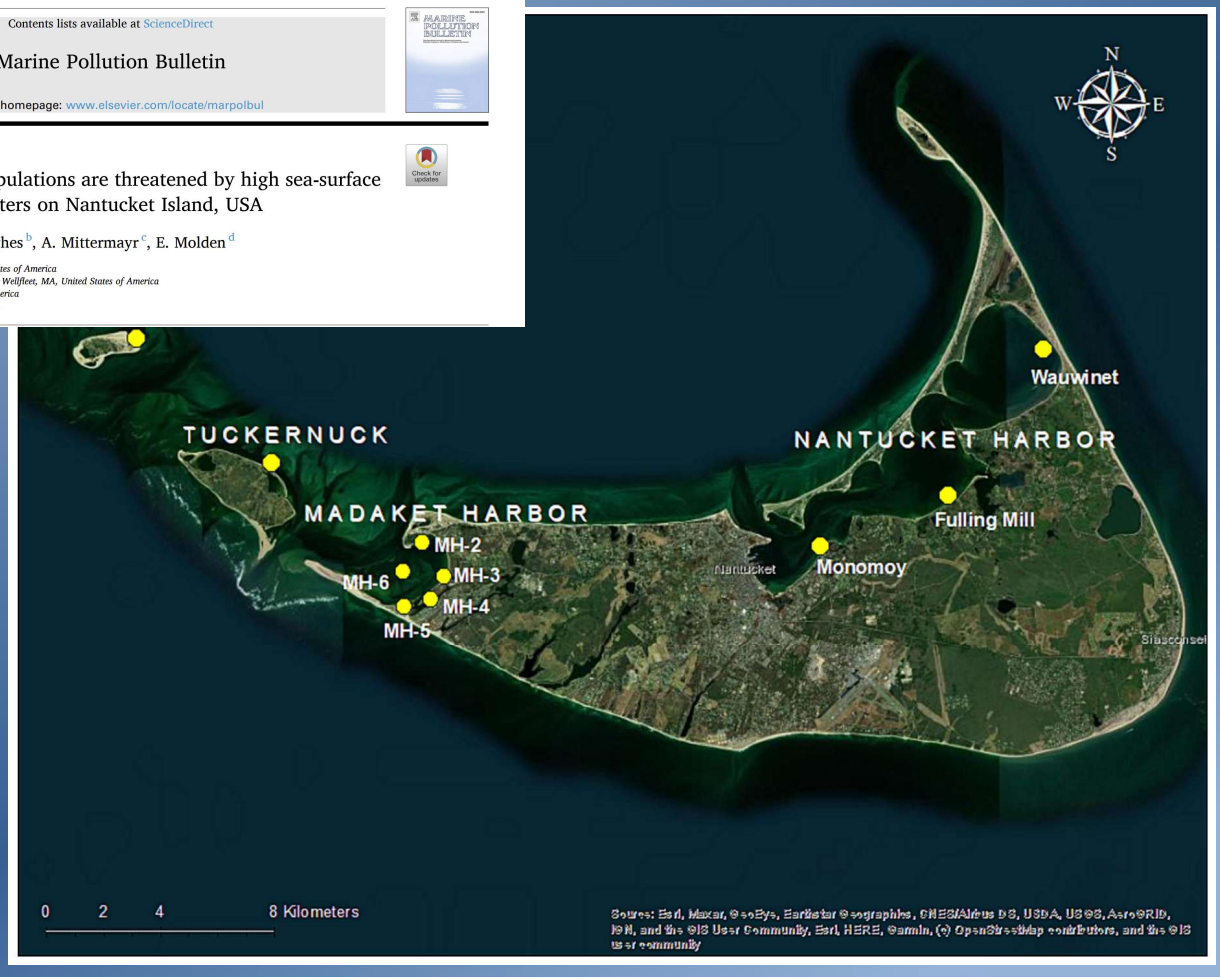
Marine Pollution Bulletin

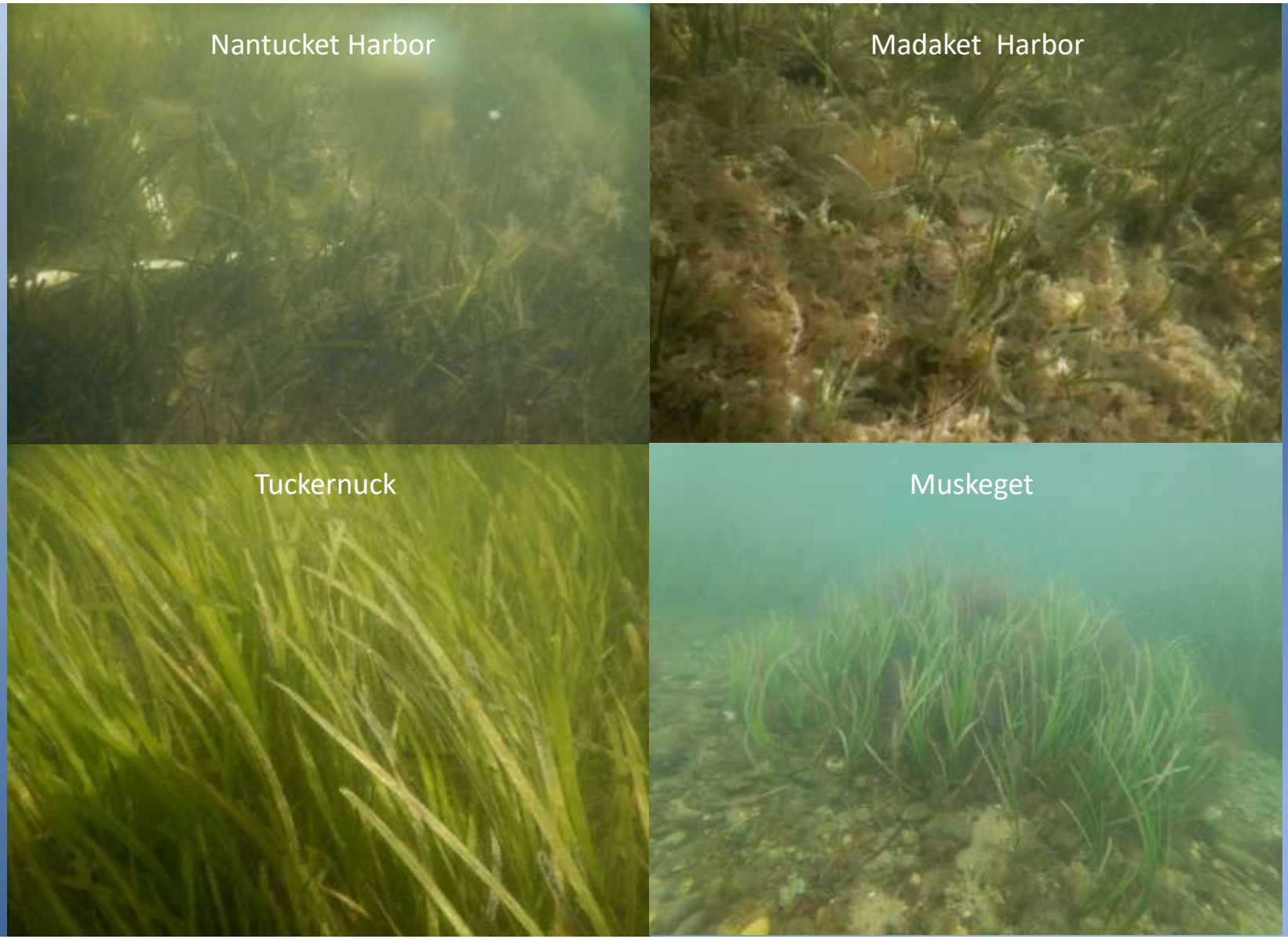
journal homepage: www.elsevier.com/locate/marpolbul

Eelgrass (*Zostera marina* L.) populations are threatened by high sea-surface temperatures and impaired waters on Nantucket Island, USA

A.B. Novak [a,*], H.K. Plaisted [b], Z.J. Hughes [b], A. Mittermayr [c], E. Molden [d]

[a] Boston University, Earth and Environment, Boston, MA, United States of America
[b] US National Park Service, Northeast Coastal and Barrier Network, Wellfleet, MA, United States of America
[c] Center for Coastal Studies, Provincetown, MA, United States of America
[d] Nantucket Land Council, Nantucket, MA, United States of America




Nantucket Harbor
Madaket Harbor
Tuckernuck
Muskeget

Temperature

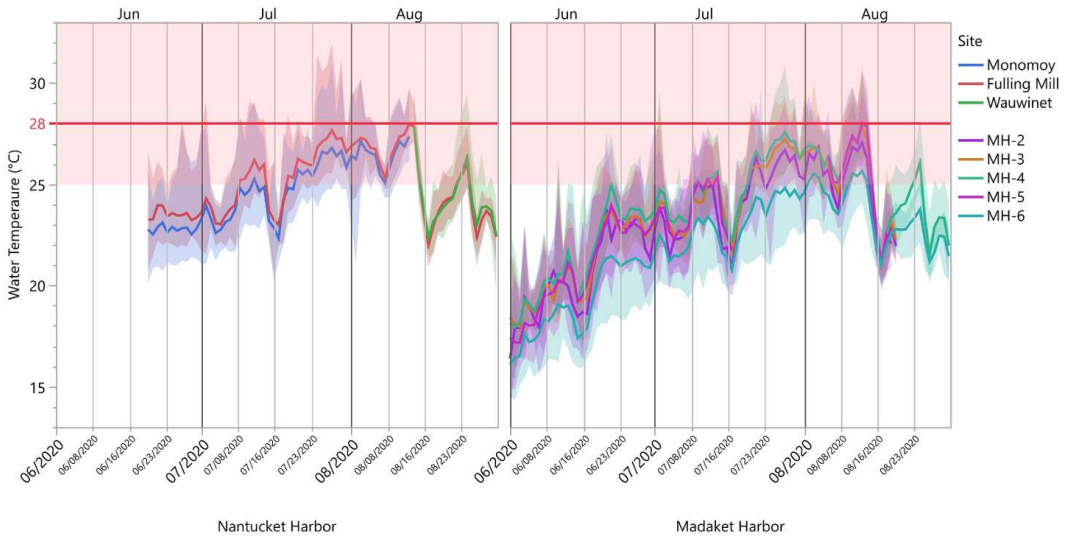


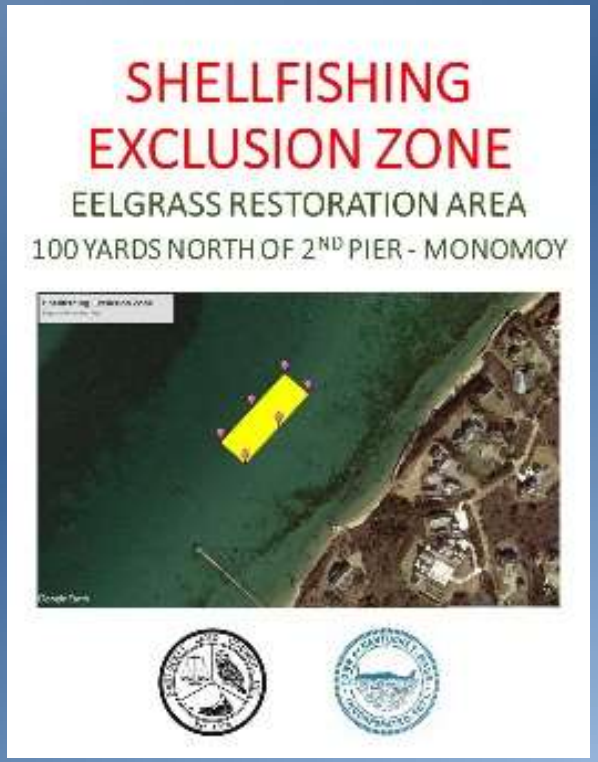
Fig. 7. Hourly mean water temperature (±range) at the canopy height during peak growing season. Pink shaded areas denote temperatures above the stress threshold for *Z. marina* (Greve et al., 2003; Reusch et al., 2005) and the red line denotes temperatures where large-scale declines in this species have been observed (Shields et al., 2019). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Novak et al. 2023

Eelgrass is thermally stressed

Ensuring Success

- Fertilizer Guidelines/Regulations
- Septic System Guidelines
- Closure of restoration areas
- Conservation moorings
- Outreach and Education



Adapting to Climate Change

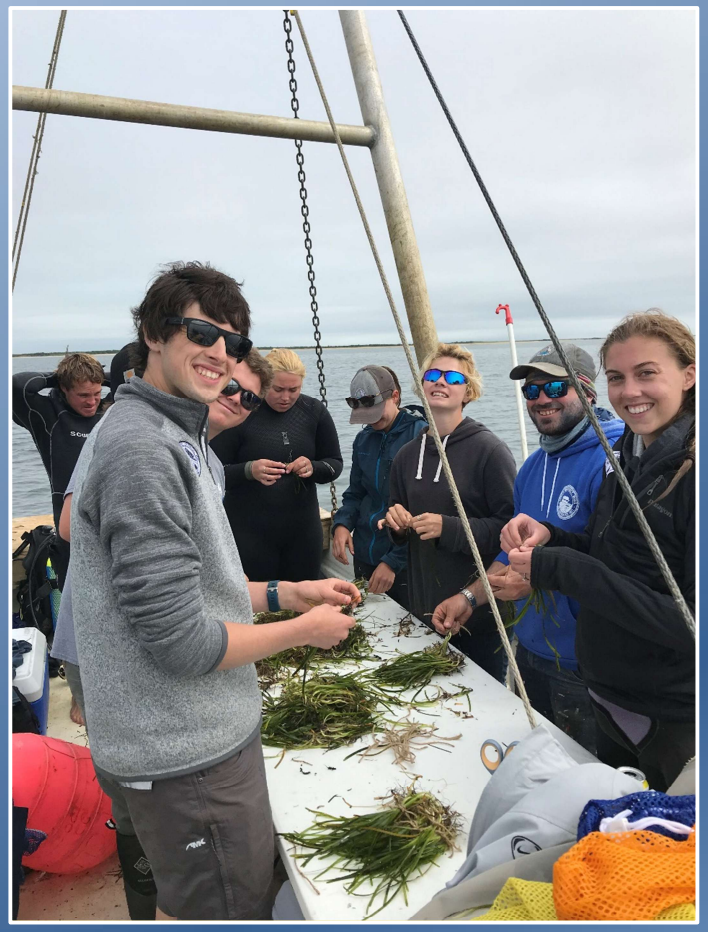
Building Eelgrass Resilience in Parks from ME to NC

Reduce climate vulnerability of eelgrass meadows across multiple parks through the application of assisted gene flow approaches

Summary

- Eelgrass is an important natural resource that provides many ecosystem services on Nantucket
- 34% of all eelgrass habitat has been lost in Nantucket
- Two ½ acre eelgrass restorations occurring in Nantucket to facilitate recovery
- Many areas of system still challenged by light-limitation & warming waters
- More actions being taken to build a resilient population

Acknowledgements



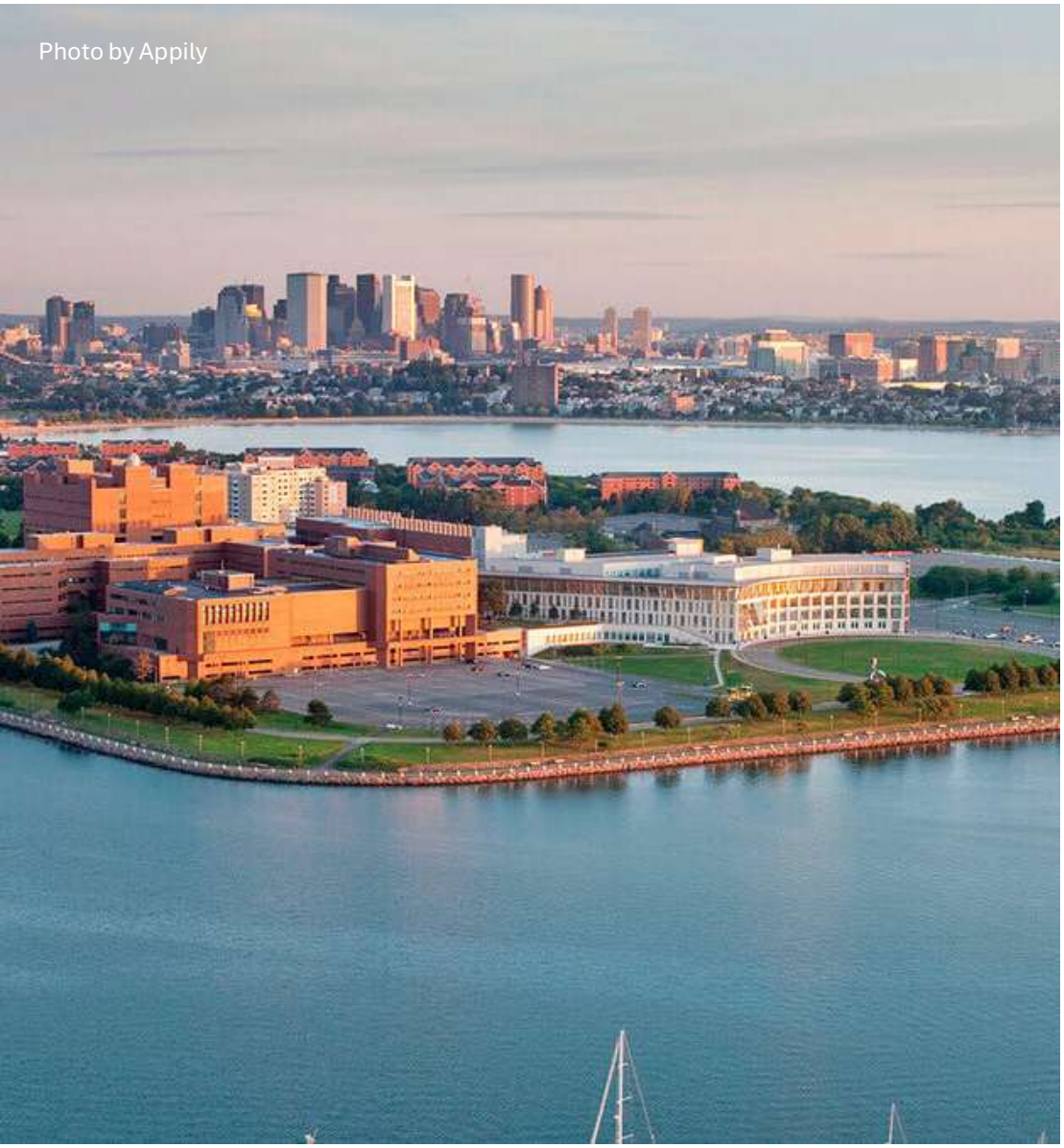
Nantucket Land and Water Council
MA In Lieu Fee Program
Town of Nantucket –
Natural Resources Department
Harbormaster
Great Harbor Yacht Club Foundation
Agua Fund
NPS- Holly Plaisted
Anderson's Stillwater Moorings
The Sunken Ship
Roastd
Many
Volunteers

Nantucket Eelgrass Management Plan

Kim Starbuck, Urban Harbors Institute, UMass Boston

Tara Riley, Town of Nantucket

Funding: Great Harbor Yacht Club Foundation



Urban Harbors Institute (UHI), UMass Boston

- Founded in 1989
- Applied research institute in the School for the Environment
- Provide research, technical assistance, and advisory services
- Experience on Nantucket
  - 2009 Nantucket and Madaket Harbors Action Plan, 2025 Plan Update
  - Nantucket Shellfish Management Plan
  - Nantucket Eelgrass Management Plan

The Eelgrass Management Plan Team

Steering committee:

- Town of Nantucket (Tara Riley, Emma Morgan, Griffin Harkins, Jeff Carlson)
- Nantucket Land & Water Council (Emily Molden, RJ Turcotte)
- UMass Boston Nantucket Field Station (Yvonne Vaillancourt)

Advisors: Dr. Robert Orth (VIMS), Dr. Bradley Peterson (Stonybrook University), Dr. Stephen Heck (Stonybrook University), Dr. Stephen Tettlebach (GHYCF advisor), Dr. Alyssa Novak (Boston University), Dr. Bill DuPaul (VIMS)

Map created by the Urban Harbors Institute, UMass Boston
May 2025

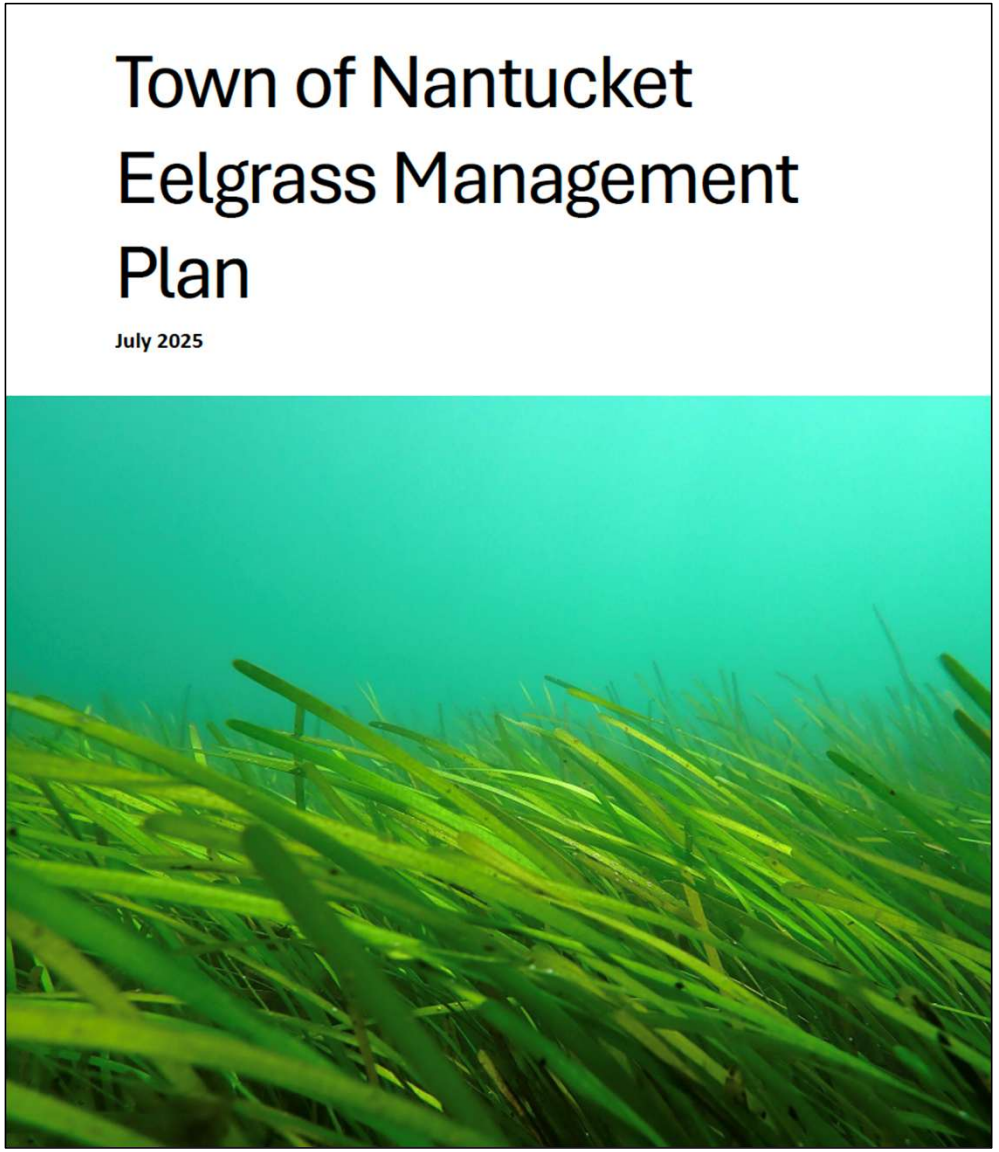
N

0 0.75 1.5 3 Miles


Nantucket Harbor
Madaket Harbor
Tuckernuck
Muskeget
Photo by: Novak

Plan Organization

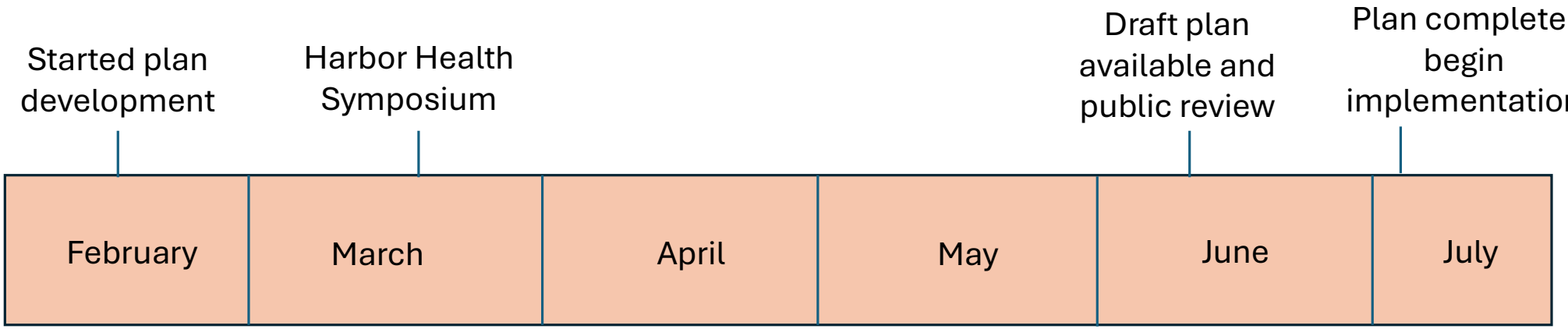
1. Plan purpose and process
2. Background information on eelgrass
3. Historic and existing conditions
4. Background information on stressors, research, restoration, education, regulatory context
5. Comprehensive plan with goals, objectives, and recommendations / action items



1. Plan Purpose

- Gather historic and baseline conditions
- Document stressors
- Identify recommendations and action items
  - Protection
  - Restoration
  - Research and monitoring
  - Mitigation
  - Laws and regulations
  - Outreach and education
  - Collaboration and implementation

Plan Process



Steering committee meeting every other week
Conducted research
Reviewed other eelgrass management plans
Received valuable input from advisors

Harbor Health Symposium

Late March, 2025

Over 30 experts and stakeholders discussing eelgrass on Nantucket

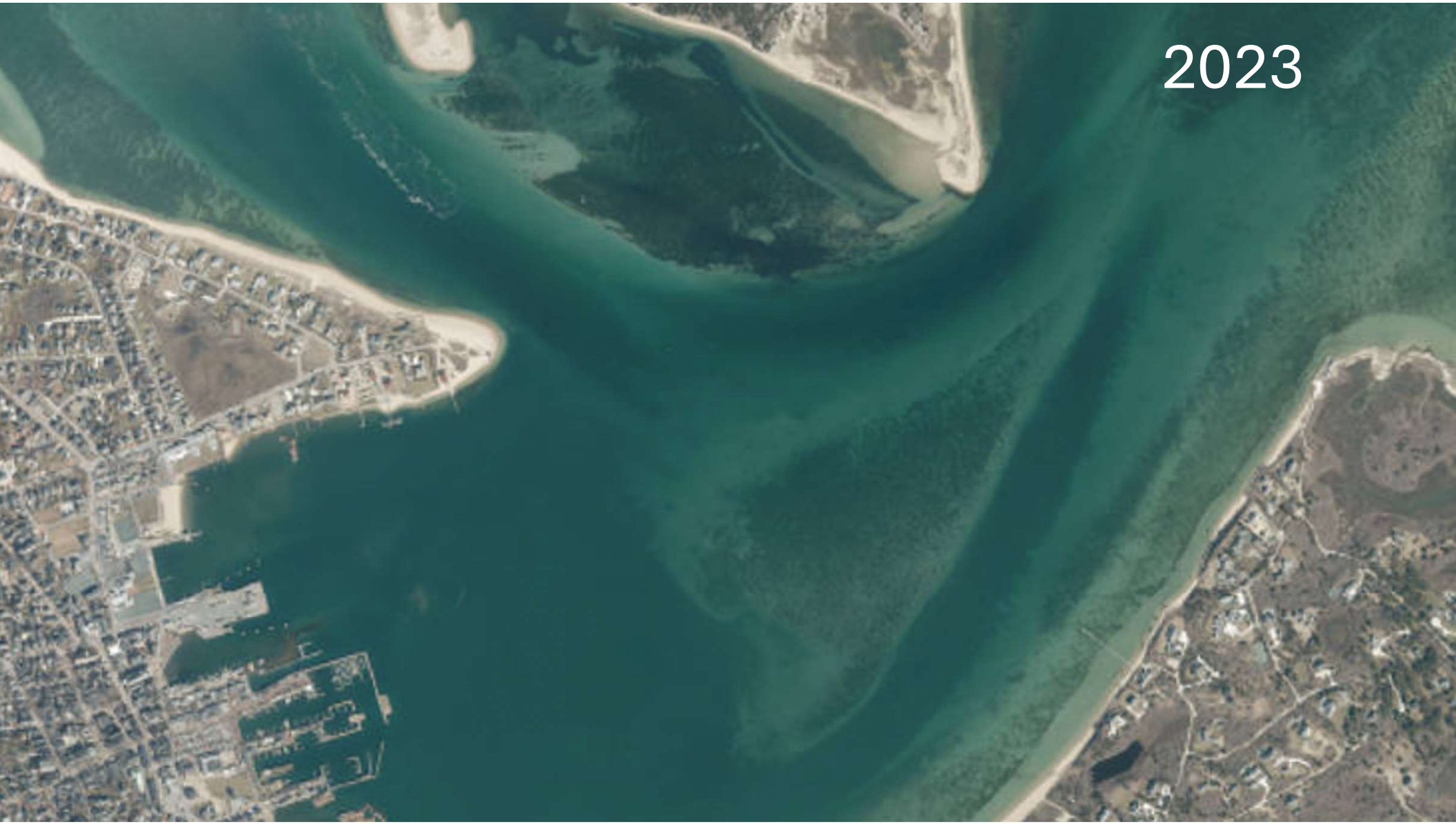
Roundtables:

- Water quality
- Stressors
- Protection and monitoring
- Research and restoration
- Education and outreach

2. Background on Eelgrass in Nantucket Waters

- Type of marine, flowering seagrass
- Plays important role in shaping Nantucket's coastal ecosystems
  - Stabilizing sediment
  - Removing carbon dioxide
  - Feeding ground, food source, nursery
- Eelgrass has declined approximately 62% in Nantucket waters between 2006 and 2014

3. Historic and Existing Conditions


2023

More Recent Conditions

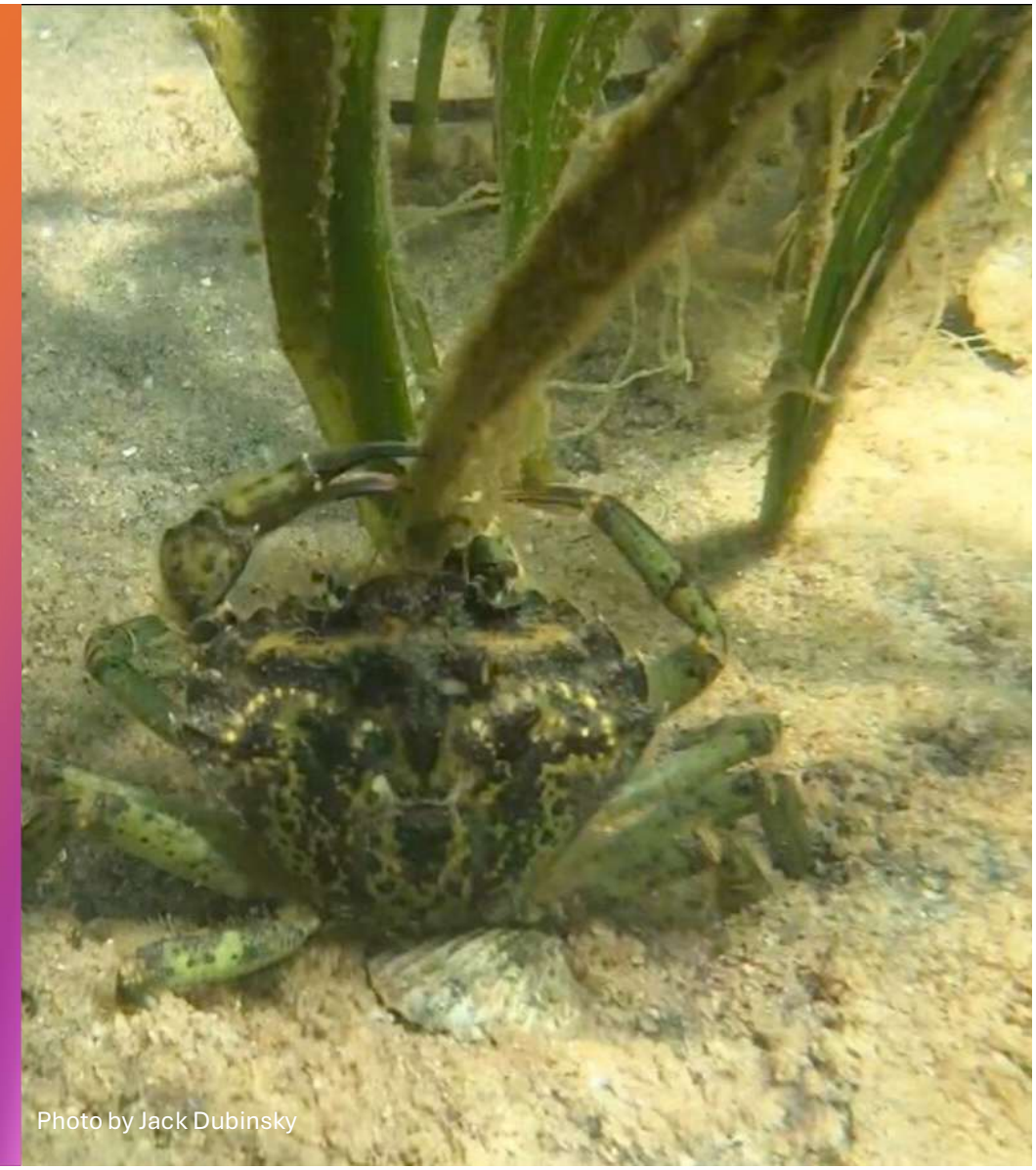


Photo by Jack Dubinsky

4. More Background Information

- Stressors (physical, chemical, environmental, contaminants)
- Research (mapping extent, assessing health, mooring impacts)
- Restoration (Nantucket projects, examples of other projects, restoration methods)
- Education (education happening on Nantucket)
- Regulatory context (state, federal, and municipal laws and regulations)

Plan Categories

PROTECTION

RESEARCH AND MONITORING

EDUCATION AND OUTREACH

RESTORATION

FIRST STEPS: PROTECTING WHAT WE HAVE

Goal 1: <u>Protect</u> existing stable and growing eelgrass beds located in Nantucket waters.

- *Objective 1: Identify and protect stable eelgrass beds to prevent their loss.*

Recommendation 1: The Town should select and define indicators that aid in identifying which eelgrass beds are considered "stable" (*e.g.*, amount of time without eelgrass loss), which are growing, and which are declining and/or degraded. Sites identified as "stable" or "growing" should be prioritized for protection.

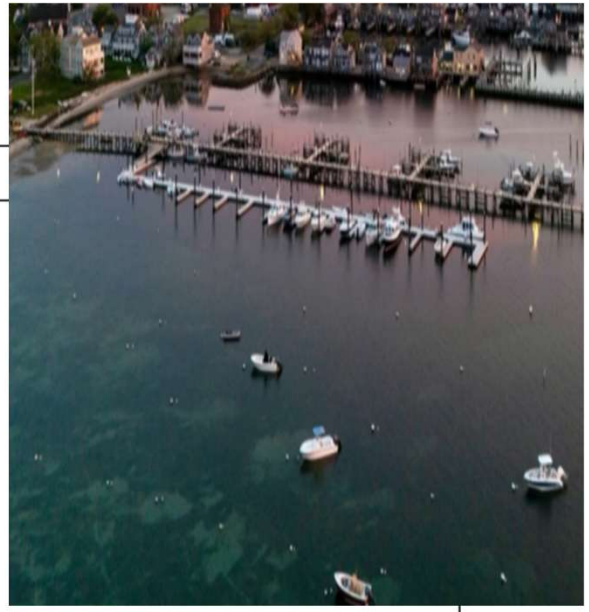
Goal 1: Ensure laws and regulations support eelgrass health.

- *Objective 1: Update laws, regulations, and management policies to promote eelgrass protection and restoration*

- **Recommendation 1:** Implement targeted research initiatives to understand the short- and long-term factors driving localized changes in eelgrass beds.

Table xx: Eelgrass Stressors

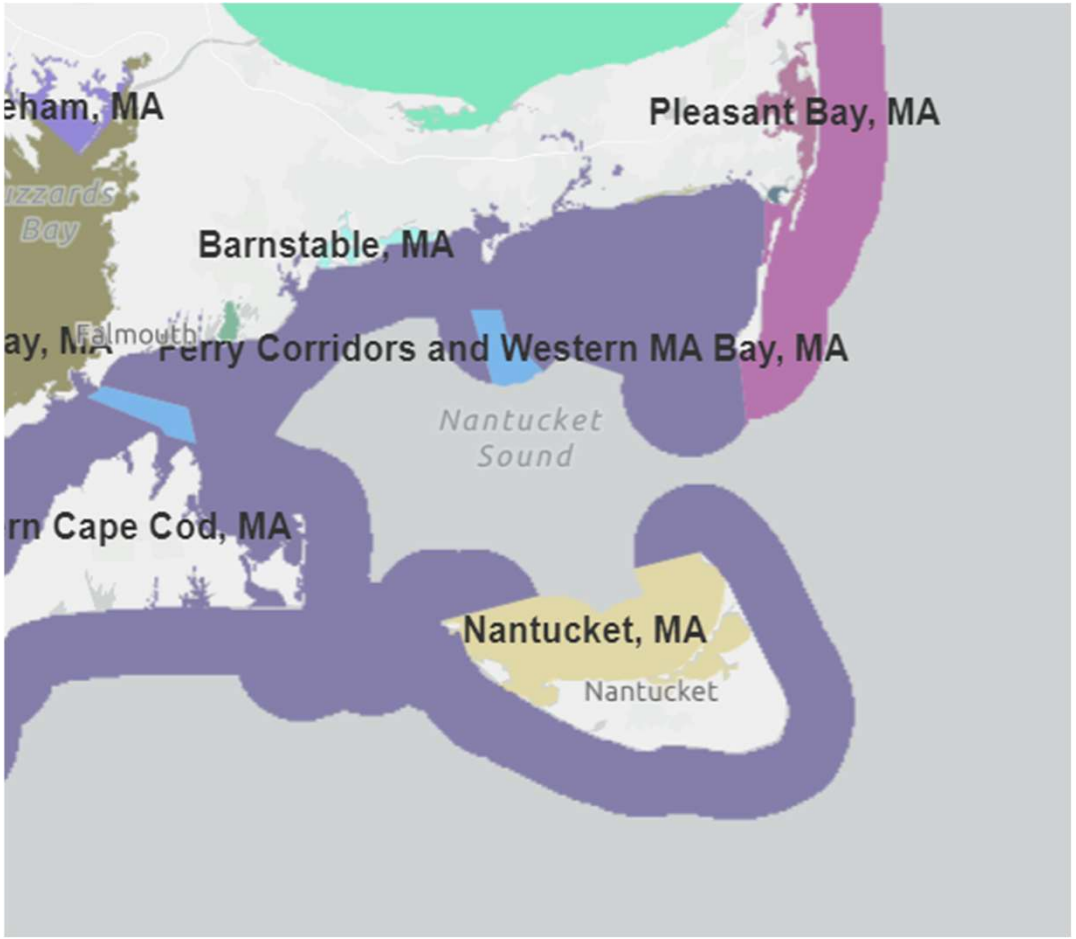
Note that an * indicates that this stressor is addressed in the recommendations



Physical Stressors from Harbor Activity		**Other Physical Stressors**		
Boating and Ferry Transportation Vessels (type and speed)* Vessel engine type Number of engines Vessel holding tank* Trip frequency Acoustics Shading from boats, docks, pier structures Anchoring (chain scour)*	***Harbor Projects*** In-water construction* • Pile driving • Breakwaters Shoreline armoring Dredging for navigation Barges (anchored and moored)	Sedimentation and turbidity • Boating activity* • Shading* • Nutrients* Macroalgae competition • Shading • Nutrients* • Oxygen Depletion Predation Disease* Invasive species Marine snails Foliar organisms Benthic diatoms Storms*		
Moorings Location and type* Improperly sited moorings* Number of moorings Chain scour*	***Fishing and Shellfishing*** Scallop dredging* Dredge design, weight, tow time, number of dredges deployed Clam raking*			
Chemical Stressors			**Environmental Stressors**	**Contaminants of Emerging Concern**
Nutrient inputs • Nonpoint/ point sources* • Non-controllable sources • Nitrates • Sulfides • Oxygen depletion Harmful Algal Bloom toxins	Stormwater* Groundwater Ocean acidification Fuel spill Grey water* Cleaning products Surfactants*		Sea level rise Thermal stress* Increased severity and frequency of storms*	Microplastics Tire dust* Sunscreen* Per- and polyfluoroalkyl substances (PFAS)* Pesticides and herbicides*

Big Picture Recommendation Example

- **Recommendation 9:** Encourage the U.S. Environmental Protection Agency to designate all of Nantucket Sound as a No Discharge Area



Specific Local Recommendation Examples for Recreational and Commercial Fisheries

Recommendation 11: Prohibit clam raking in eelgrass meadows and ensure this rule is enforced.

Recommendation 12: Review on-island vendors of fishing gear to ensure they are selling the proper equipment. Implement mandatory inspections of commercial fishing gear, such as conducting pre-commercial fishing season gear checks. Additionally, enforce both commercial and recreational shellfish regulations, *e.g.*, CH 260 of the Town's regulations.

Recommendation 13: Identify areas in Nantucket and Madaket harbors for implementation of rotational closures of shellfish beds for sensitive eelgrass habitats (closed to dredging and push-raking). Monitor these sites to assess the effectiveness of closures

Boating and Harbor Activity Recommendation Examples

Recommendation 15: Conduct studies on the effects of boat wakes and speed on eelgrass beds at the entrance of Nantucket Harbor to help guide the speed and no wake location discussion.

Recommendation 16: Update and conduct additional surveys on eelgrass beds near mooring fields to assess impacts of traditional moorings compared to conservation moorings, measuring the relationship between scar size, chain length, chain weight, boat size, and location within the harbor. Seek funding to test a meaningful number of conservation moorings in an area involving eelgrass to compare impacts

Nutrient/Chemical Recommendation Examples

Objective 2: Ensure that conditions in Nantucket waters can support existing eelgrass and enhance the success of restoration efforts.

Recommendation 2: Conduct testing for herbicide and pesticide related chemicals in groundwater wells in the Nantucket and Madaket Harbor watershed, as well as soils from properties or adjacent to properties with herbicide and pesticide use.

Nutrient/Chemical Recommendation Examples

Recommendation 3: Take measures to reduce the impacts of landscaping activities on water quality. Example actions include:

- Review the types of herbicides and pesticides sold on-island and those used by applicators to ensure the least harmful methods.
- Develop material to incorporate into the fertilizer program
- Continue to promote native lawns and landscapes.
- Prohibit the application of pesticides used to control insects during outdoor events such as weddings and similar gatherings.
- Continue education about and implementation of the Town's Fertilizer Regulations and Best Management Practices for Fertilizer Use[151].

Research and Monitoring Recommendation Examples

Goal 1: Advance understanding of eelgrass through research and monitoring.

- *Objective 1: Develop a better understanding of historic eelgrass conditions.*
- *Objective 2: Conduct monitoring to better understand eelgrass conditions in the harbors and around Tuckernuck Island.*

Education and Outreach Recommendation Examples

- **Recommendation 1:** Develop and implement a coordinated outreach/education plan to increase awareness of eelgrass and support for research, protection, and restoration effort
- **Recommendation 19:** Using existing data, create a public-facing map that shows the locations of eelgrass beds in Nantucket harbors and areas for safe anchoring. Share this map with boaters for educational purposes.

Education and Outreach Recommendation Examples

- **Recommendation 20:** Pursue a regulation to ban anchoring in eelgrass. The Town of Tisbury's ban on anchoring in Lake Tashmoo may serve as an example
- **Recommendation 2:** Identify ways to incentivize/recognize actions that support healthy eelgrass. For example, the Town could create an eelgrass steward certification or recognition program for people who meet standards related to boating, fishing, and other best practices. The Town could also work with schools and scouting groups to develop a badge/certificate that youth could earn by meeting certain criteria.

Restoration Recommendation Examples

Goal 1: Restore lost and declining eelgrass beds

Objective 1: Select sites for potential seeding and/or transplanting work

Objective 2: Establish transplant methods and success criteria for all restoration efforts

Objective 3: Identify donor beds for restoration work involving transplantation

EMP Final Plan Available

(Town of Nantucket Natural Resources Department Website and Social Media)

Eelgrass Management Plan

READ THE EELGRASS MANAGEMENT PLAN FOR NANTUCKET

Click HERE

Nantucket Eelgrass Management Plan - Comments

Please leave your comment HERE on the Nantucket Eelgrass Management Plan. **The deadline for comments is Sunday, June 22nd at 5 PM.**

The Town of Nantucket is partnering with the Urban Harbors Institute at UMass Boston and a team of advisors to develop an Eelgrass Management Plan for Nantucket Harbor, Madaket Harbor, and Tuckernuck.

Eelgrass is a critical component of our coastal ecosystem, supporting marine biodiversity, improving water quality, and helping to stabilize the shoreline. This planning effort aims to support the long-term health and sustainability of eelgrass habitats in our local waters.

Eelgrass (*Zostera marina L.*) is a subtidal seagrass found on both the east and west coasts of North America. Over the last 40 years, eelgrass has declined worldwide as a result of increased turbidity, algal blooms, physical disturbances, disease, and a host of other stressors. Specifically, in Massachusetts, the eelgrass population has declined approximately 50% in the last 30 years. Historic levels were also much more plentiful until a "wasting disease" caused a 90% die-off of meadows in the 1930s. The decline has also been observed

OUTREACH OPPORTUNITIES

Harbor Shellfish Advisory Board Meeting – 131 Pleasant St. and Via Zoom (link coming 6/13)
June 17th 5 pm

A Presentation of Nantucket's Eelgrass Management Plan - Nantucket Land & Water Council's 9th Annual State of the Harbor Forum - Great Harbor Yacht Club
Tuesday, July 15th 4:30 PM - 6:30 PM - Reception to follow

SUPPORTING DOCUMENTS

- Nantucket Harbor Benthic Survey 2020
- Nantucket Harbor Benthic Survey 2021
- Nantucket Harbor Benthic Survey 2022
- Nantucket Harbor Benthic Survey 2023
- Nantucket Madaket And Tuckernuck Benthic Surveys 2024

Public Engagement Session Coming Soon!

Town of Nantucket Natural Resources Department

Nantucket Land & Water Council Est. 1974

Great Harbor Yacht Club Foundation

UMass Boston Nantucket Field Station

UMass Boston Urban Harbors Institute

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Thank You!

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Nantucket & Madaket Harbors Action Plan Update

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9th Annual State of the Harbor Forum

presented by the

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