

Development of an Intertidal Biodiversity Monitoring Framework to Support Coastal Adaptation in the Boston Harbor Islands National and State Park

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Monitoring and Research Symposium

April 8, 2025

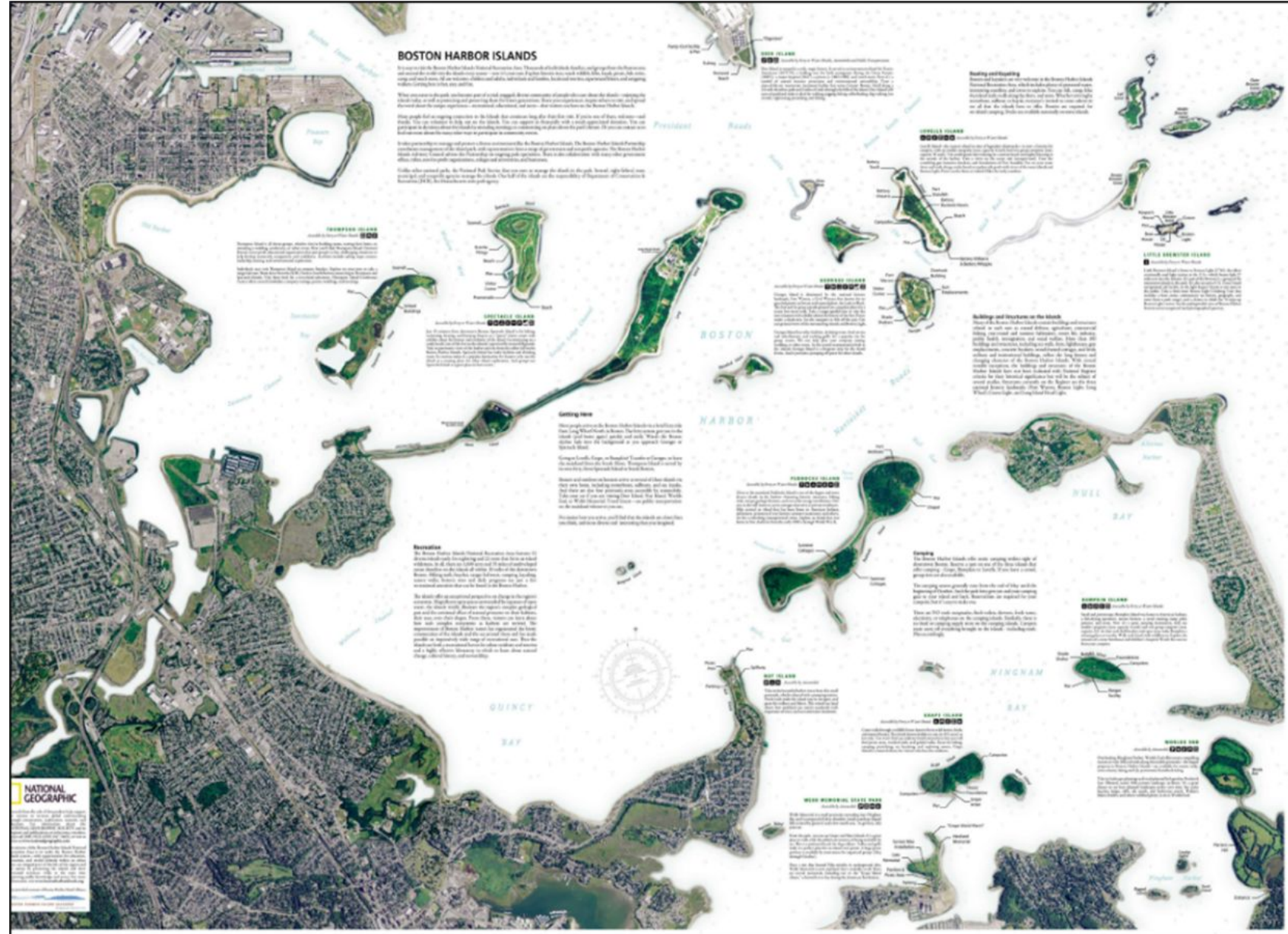
Marc Albert

Science and Stewardship Partnerships

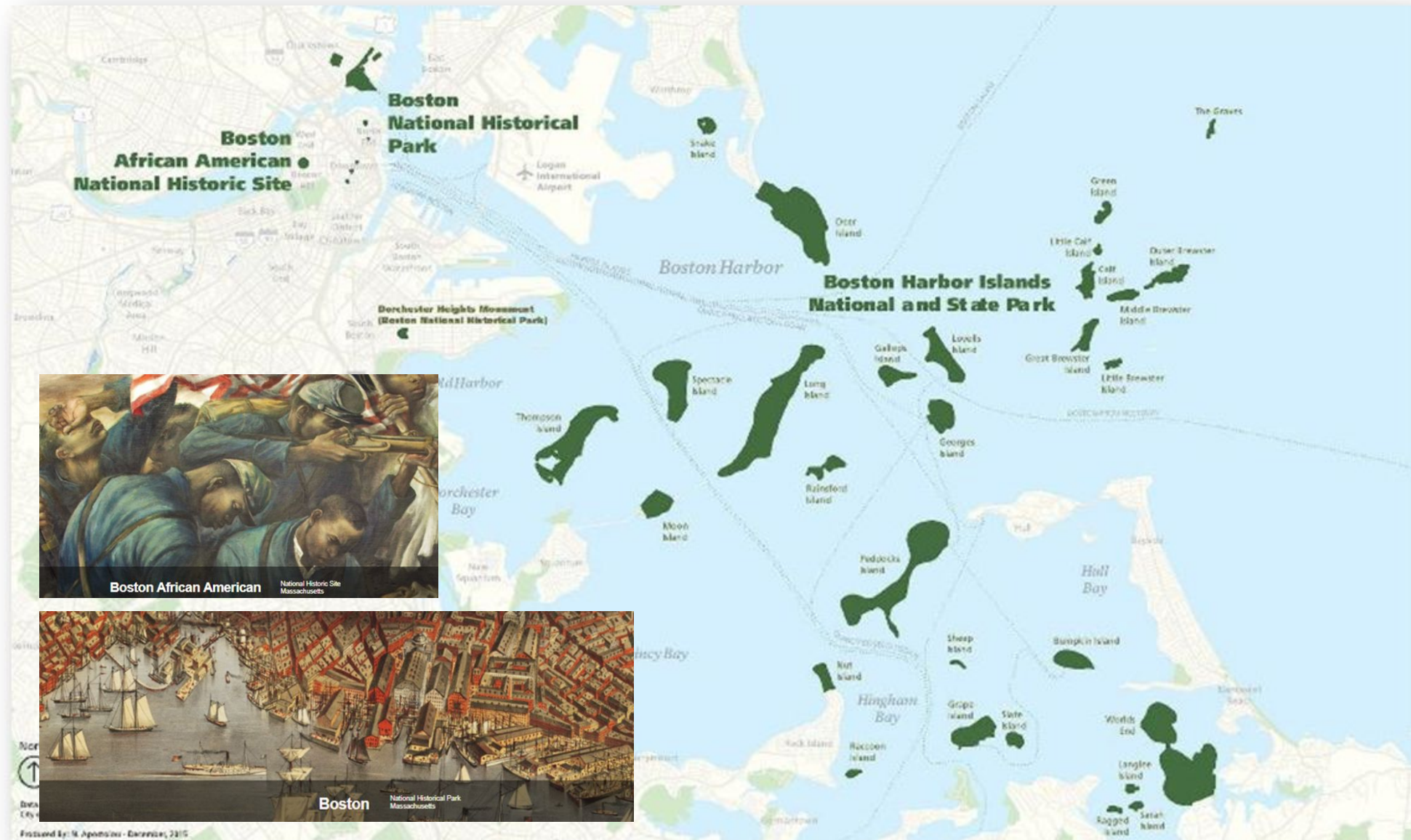
National Parks of Boston



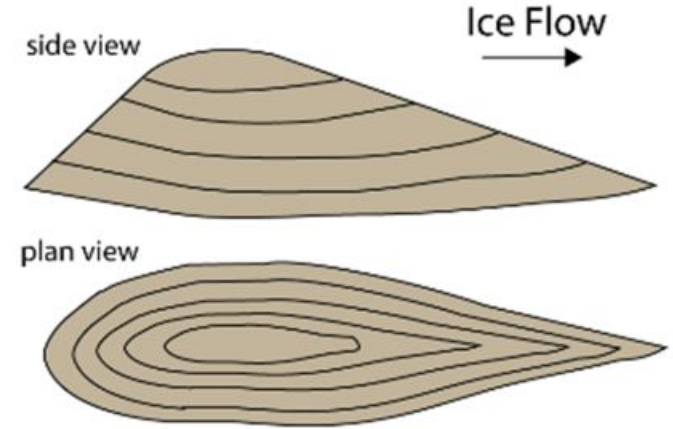
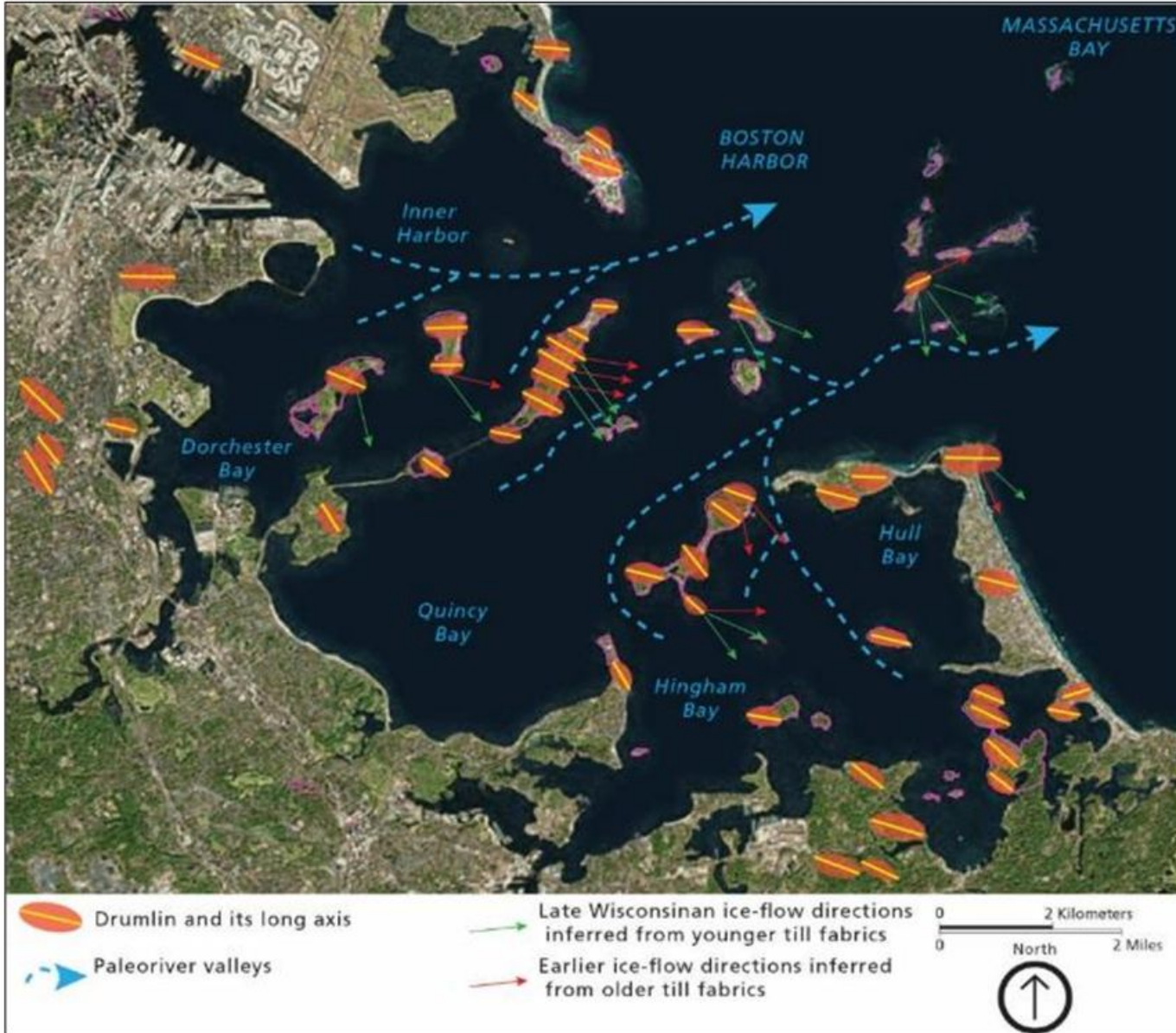
Boston Harbor Islands – A Dynamic Urban Archipelago



National Parks of Boston



The Only Partially – Drowned Drumlin Field In North America



Boston Harbor Sediments – Substrates - Habitats



Salt Marsh



Mixed Coarse Intertidal



Permanent Rocky Intertidal

Smaller

Sediment Particle Size

Larger

Clay --- Silt ---- Sand --- Gravel ---- Cobble --- Boulders

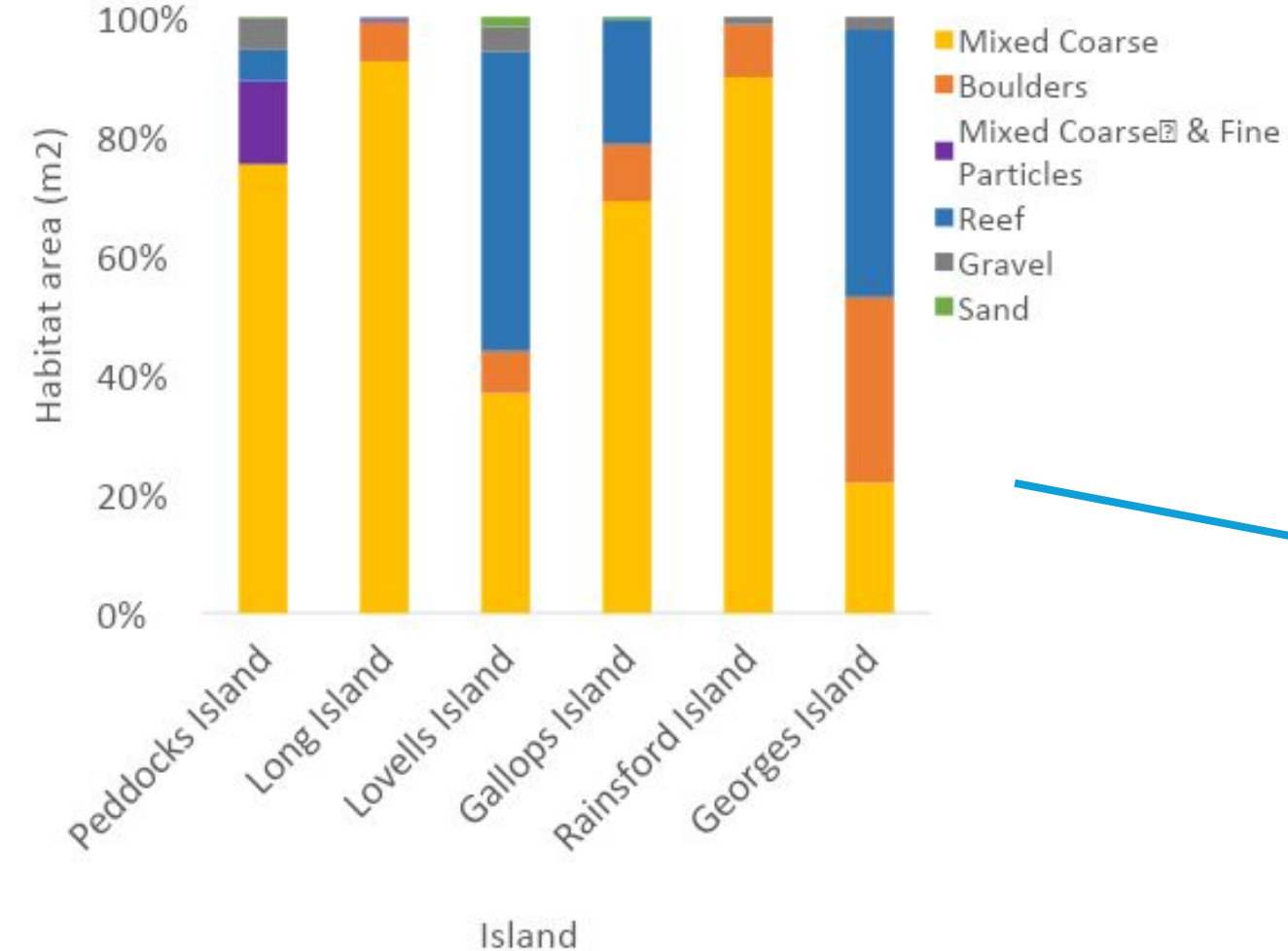
Mixed coarse substrate

"consisting of rocks, boulders, cobbles, gravel, shell, and sand (no one substratum type > 75% surface cover, < 50% cover by rocks or boulders)."

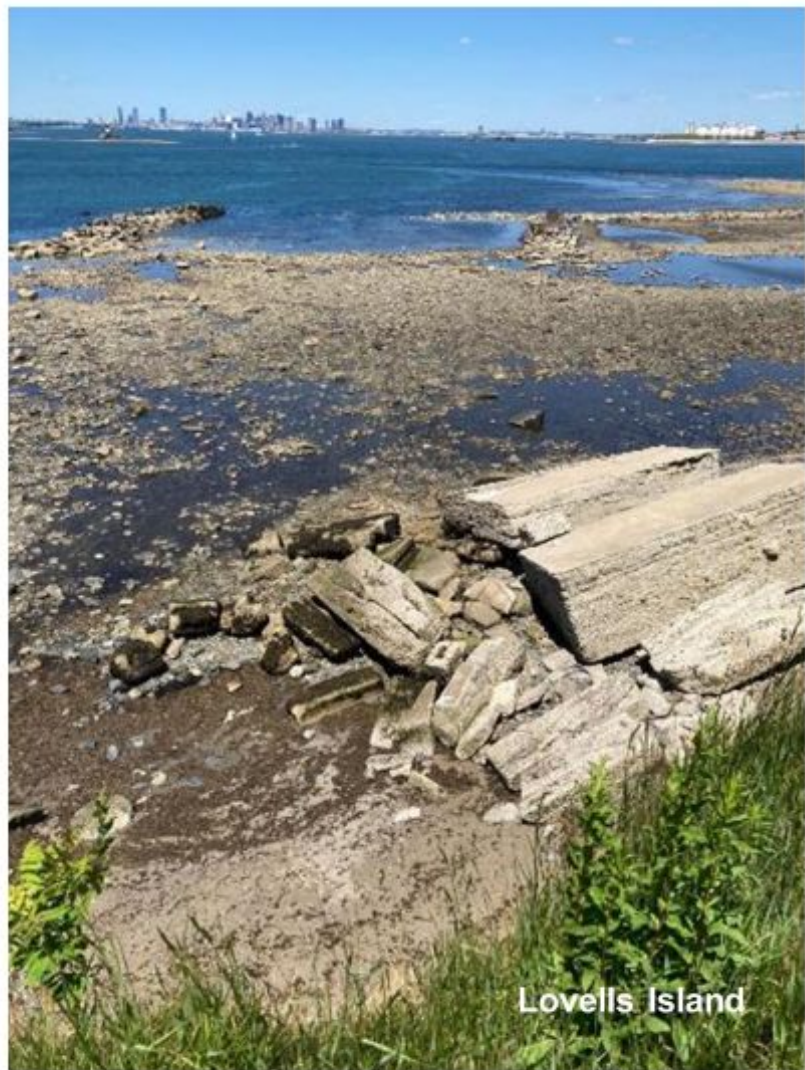
-Bell et al. 2003



Mixed coarse substrate habitats



Changing Coastal Ecosystems and Landscapes



Threatened Cultural Heritage



Save Places ▾

Explore Places ▾

Our Work ▾

Support ▾

Donate Renew



CITY of **BOSTON** | Mayor Michelle Wu



HOME ▸ DEPARTMENTS ▸ ARCHAEOLOGY ▸ BOSTON HARBOR ISLANDS ARCHAEOLOGICAL CLIMATE ACTION PLAN

BOSTON HARBOR ISLANDS ARCHAEOLOGICAL CLIMATE ACTION PLAN

11 MOST ENDANGERED HISTORIC PLACES

Our Beloved Kin: Remapping a New History of King Philip's War

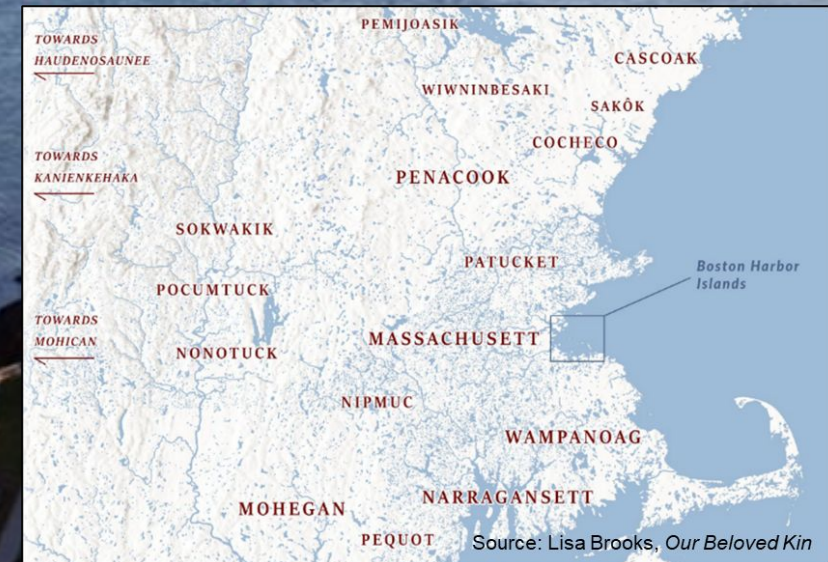
A Digital Awikhigan



This website is a digital companion to the book © Our Beloved Kin: A New History of King Philip's War, available in print and e-book versions from Yale University Press. Continue to the [Start Guide](#) to learn how to navigate this site, whether you are already reading *Our Beloved Kin* or you want to learn more about networks of relations in Native space during the seventeenth century.

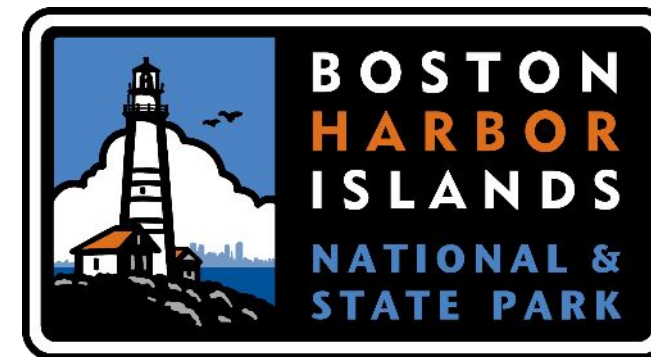
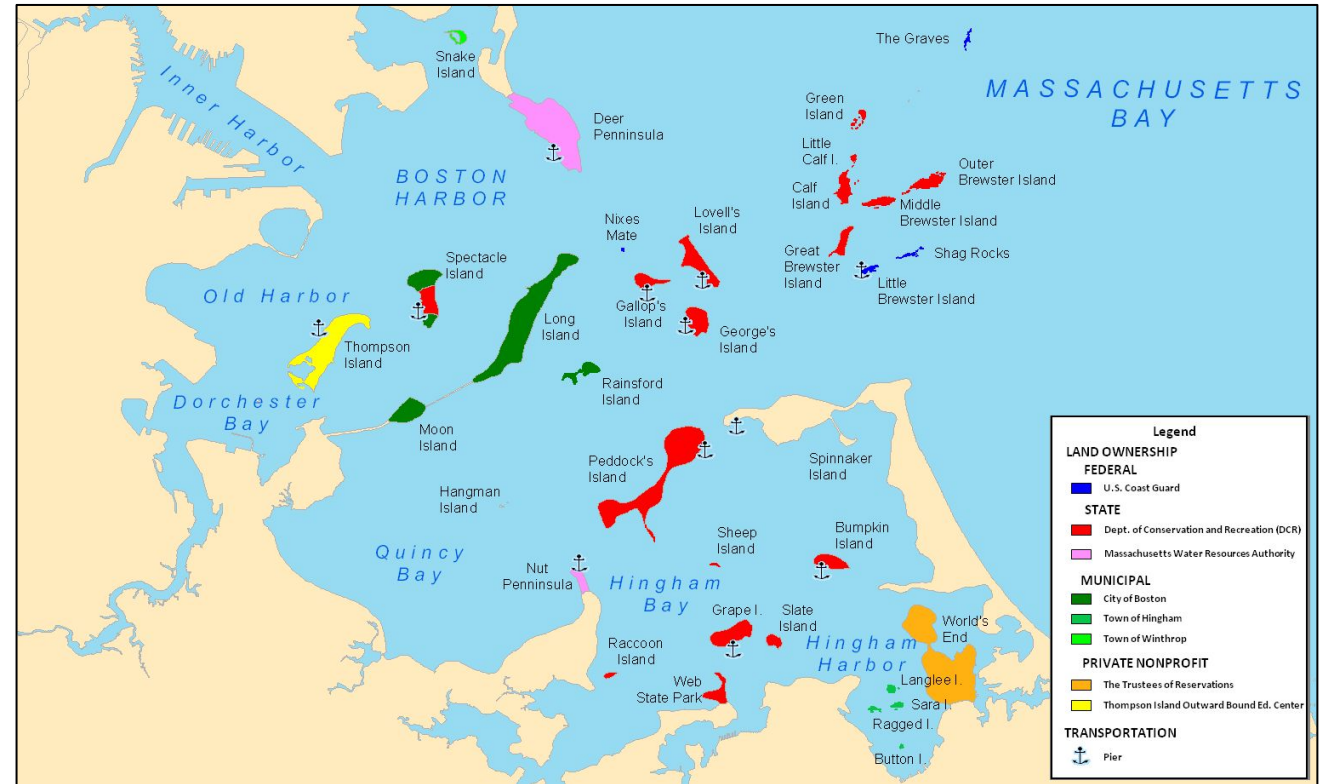
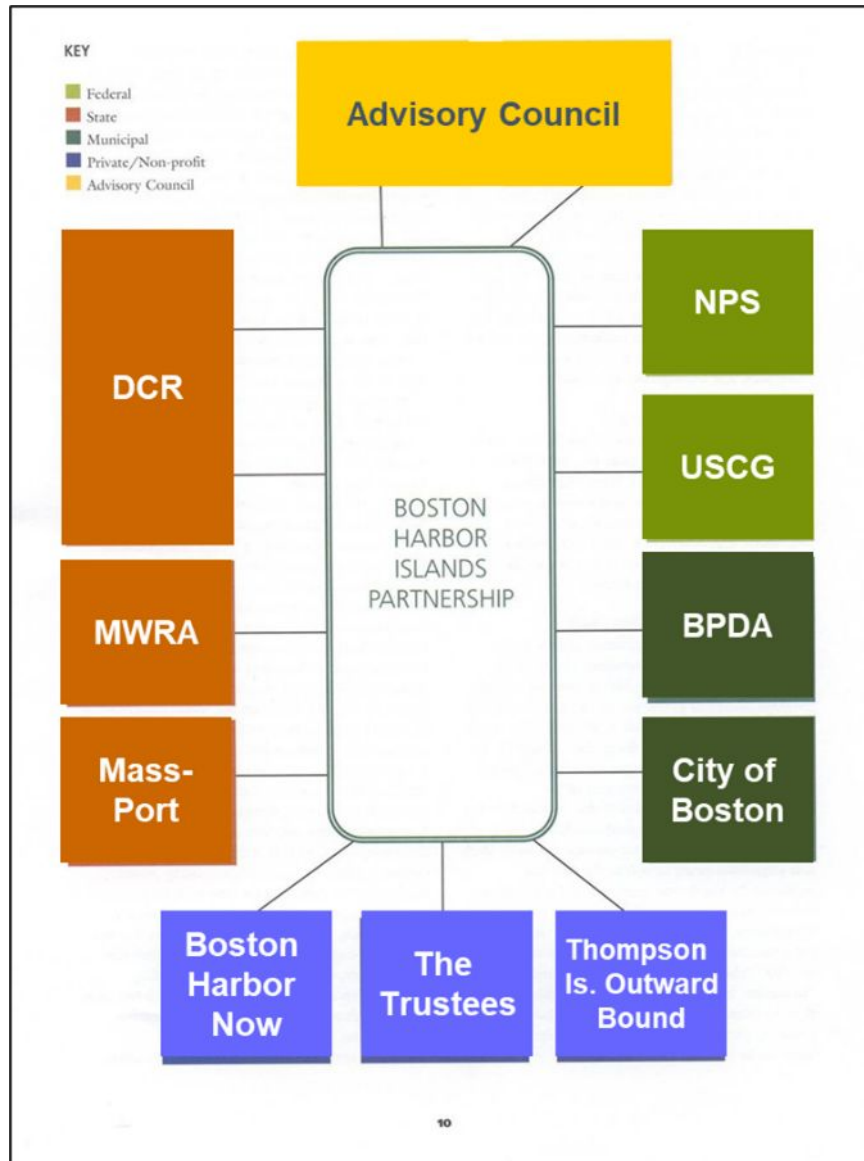
Words, Images, History: Site Concept

Awikhigan is an Abenaki word which originally referred to birchbark maps and scrolls, but came to encompass letters, petitions, maps, books and works of art. In our time, this word



Source: Lisa Brooks, *Our Beloved Kin*

Boston Harbor Islands – Management in Partnership



The Science – Informed Management Challenge

We have a responsibility to consider the effects of any manipulations on biodiversity

And

The islands have an unusually high % of 'mixed coarse' substrates

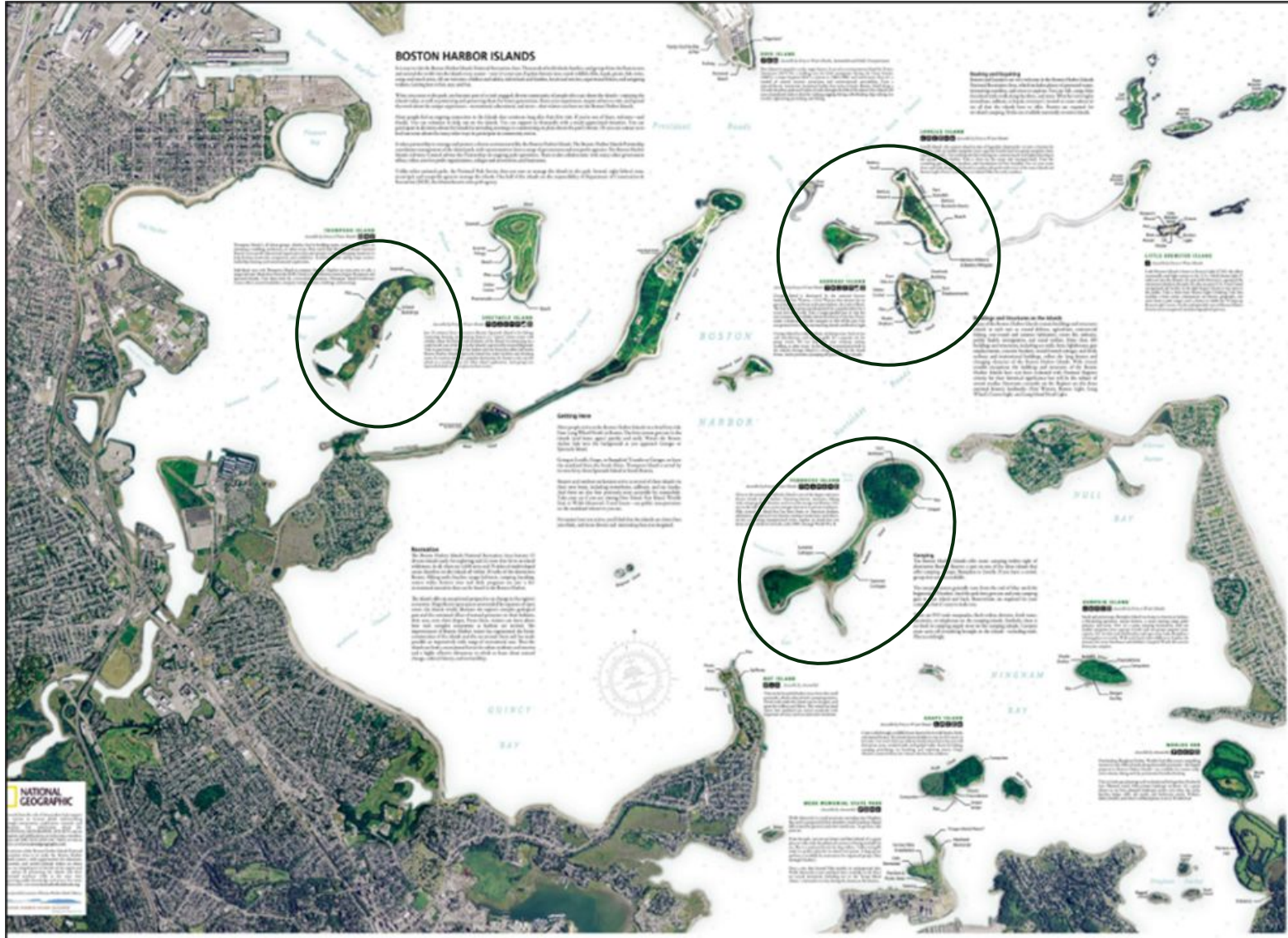
But

The methods for biodiversity surveys in permanent rocky intertidal may not be best for assessing mixed coarse intertidal biodiversity

Therefore

This project was developed to determine if we can efficiently & reliably inventory biodiversity in mixed coarse intertidal habitats.

Study Purpose: Develop an Effective Method for Assessing Intertidal Biodiversity in Mixed Coarse Intertidal Habitats of the Boston Harbor Islands



Focal Islands:

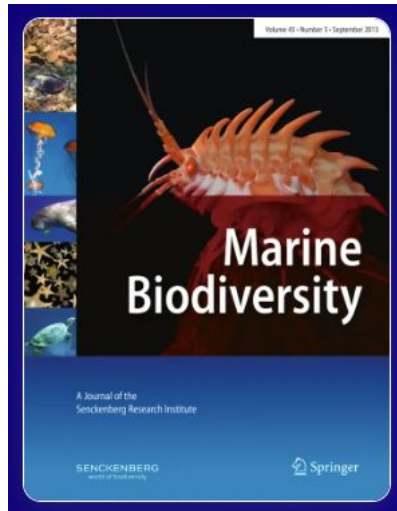
- Georges
- Gallops
- Lovells
- Peddocks
- Thompson/Stone

Project Overview

1. **Synthesis and analysis** of historical marine biodiversity data from Boston Harbor
2. **Testing of existing protocols** for macro invertebrate and macroalgal biodiversity monitoring
3. **Development of a hybrid protocol** for monitoring on mixed coarse substrate
4. **Evaluation of new protocol to establish baseline data** for areas of interest across five Boston Harbor islands



Inventory and Synthesis of Historical Data



Marine Biodiversity (2024) 54:78
<https://doi.org/10.1007/s12526-024-01462-4>

SENCKENBERG

ORIGINAL PAPER



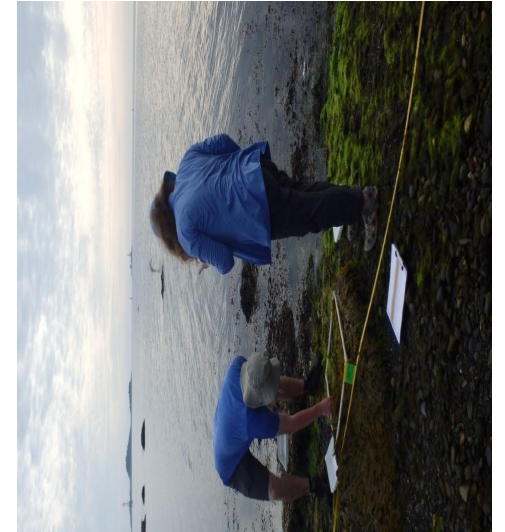
Historical insights, current challenges: tracking marine biodiversity in an urban harbor ecosystem in the face of climate change

Alysha B. Putnam¹ · Sarah C. Endyke² · Ally R. Jones³ · Lucy A. D. Lockwood⁴ · Justin Taylor¹ · Marc Albert⁵ · Michelle D. Staudinger^{1,3,6}

- Developed an inventory of marine species found in Boston Harbor
- Species taxonomy and introduced species
- Biodiversity analysis - average taxonomic distinctness
- Open Access paper published in October 2024
<https://doi.org/10.1007/s12526-024-01462-4>

Comparison of Quadrat Sampling Protocols on Mixed Coarse Substrate

- ❑ NPS Northeast Temperate Network (NETN)
Long Term Rocky Intertidal Monitoring
Long, J. D., and B. R. Mitchell. 2015 revision. Natural Resource Report NPS/NETN/NRR—2015/922. National Park Service, Fort Collins, CO.
- ❑ Northeastern Coastal Stations Alliance (NECSA) Rocky Intertidal Protocol
7/2018 revision
- ❑ Stone Living Lab (SLL) Intertidal Protocol Dr. Jarrett Byrnes, UMass Boston, SLL
- Evaluated all three protocols simultaneously at mixed coarse substrate sites to understand protocol strengths and limitations
- Informed development of new protocol for mixed coarse substrate
- Hybrid could leverage strengths of each approach



Comparison of Quadrat Sampling Protocols on Mixed Coarse Substrate

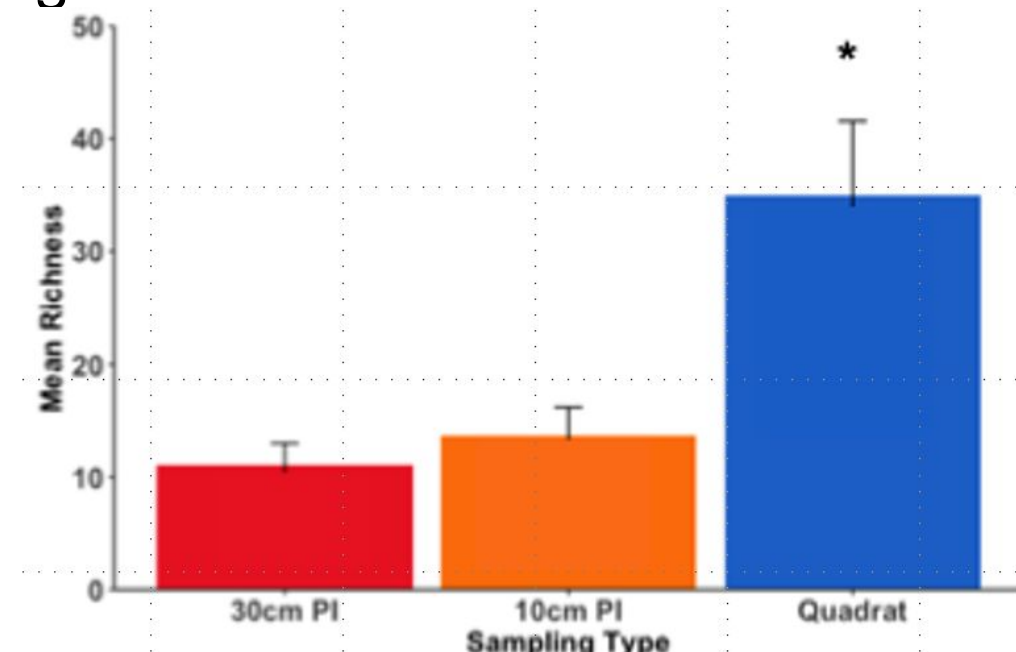
- ❑ Each protocol tested was similar in:
 - ❑ dividing intertidal area into zones (high, mid, and low)
 - ❑ use of transects and quadrats to survey species across these zones.
- ❑ Protocols differed in:
 - ❑ grid layout / transect length (30-48m)
 - ❑ quadrat placement - random vs. fixed location
 - ❑ number of quadrats (16 - 25) and size (0.25 – 0.375 m²)
 - ❑ use of biological zones (Ascophyllum, barnacle, Fucus, mussel, red algae)
 - ❑ use of point intercept for species identification at fixed intervals (10cm - 30cm) along transects



Comparison of Quadrat Sampling Protocols on Mixed Coarse Substrate

Based on analysis of 2022 multi-protocol quadrat sampling at three sites:

- Incorporate elements of tested protocols that maximize species detection
- Wider transect area (45m vs 30m) for spatial coverage
- Stratified sampling incorporating five biological zones (Ascophyllum, barnacle, Fucus, mussel, red algae)
- Randomized quadrat placement with additions for zonal coverage
- Omit point-intercept sampling



Additional Monitoring Protocols Tested

Crab band transects
and baited traps



Results: match crab sampling
technique to specie(s) of interest

Photoquadrats

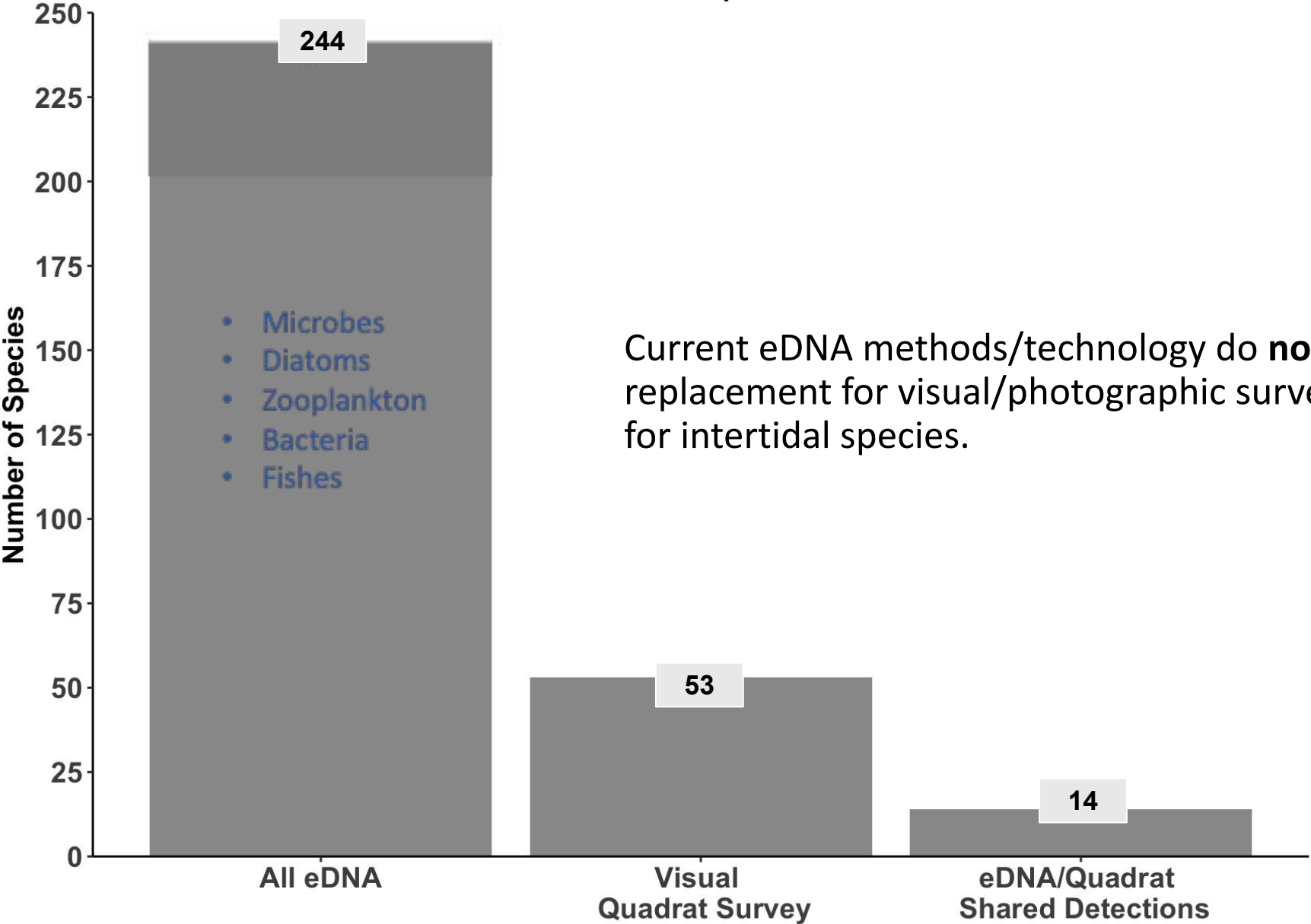


Results: forthcoming at CERF et al.,
Fall 2025

eDNA



Georges Island 2022
eDNA Comparison



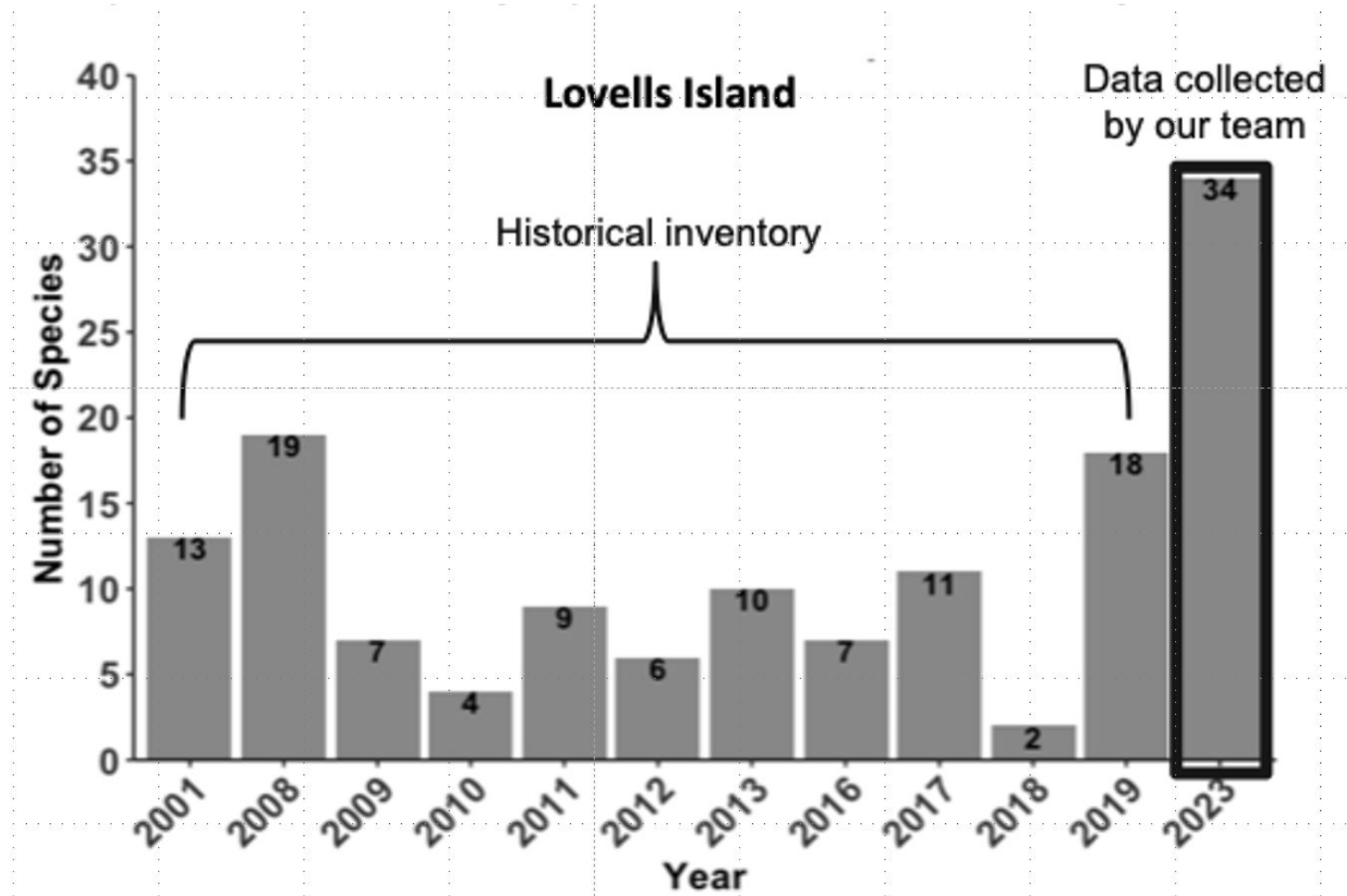
Current eDNA methods/technology do **not** provide a replacement for visual/photographic survey methods for intertidal species.

Hybrid Visual Survey Protocol

- Site sampling area:
48 m wide by distance from estimated MHW to estimated MLW or 100 m, whichever shorter.
- Sampling area divided into grid of nine regions (15 m by 1/3 vertical sampling distance)
- Coverage over five biological zones (if present) (Ascophyllum, barnacle, Fucus, mussel, red algae)
- 36 quadrats (0.5 m^2) placed by randomization within zones and regions; five per biological zone, four quadrats per region



Protocol Highly Effective at Species Detection



An Intertidal Biodiversity Monitoring Framework to Support Coastal Adaptation in the Boston Harbor Islands National and State Park

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USGS Contractor



USGS-NPS
Natural Resources
Preservation Program



UMASS
AMHERST

