How does the bay respond to changes in the watershed?

A benthic habitat perspective

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NBEP Science Advisory Committee

NARRAGANSETT BAY ESTUARY PROGRAM

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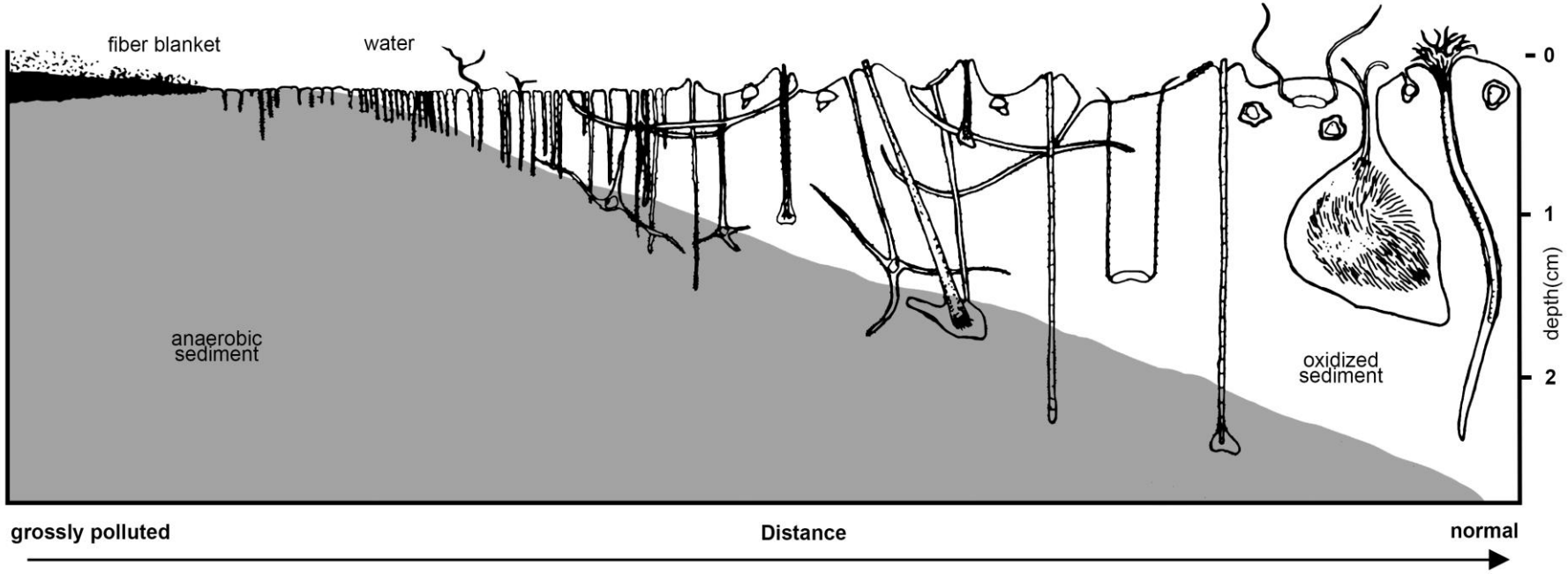
What is benthic habitat and why do we care?

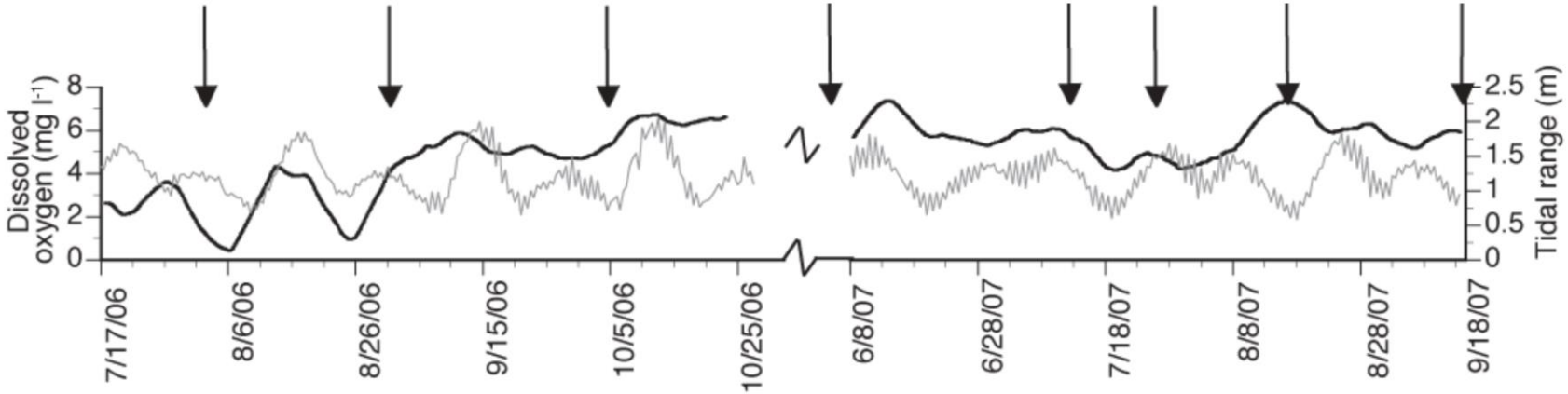
- It’s everywhere
- The animals living in and on the seafloor don’t move long distances
- The sediment and things living in it reflect recent bottom water quality conditions
- Benthic fauna are the filters and vacuum cleaners of the seafloor - feeding fish and crabs; oxygenating the sediment; returning nutrients to primary producers

Organism-sediment relationships over time



Adapted from Rhoads & Germano 1986

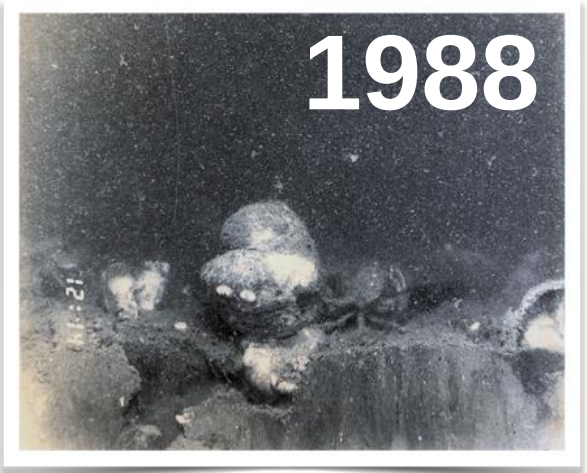
So, when should we check on benthic habitats?



What is benthic monitoring?

Physical samples

Images



Video

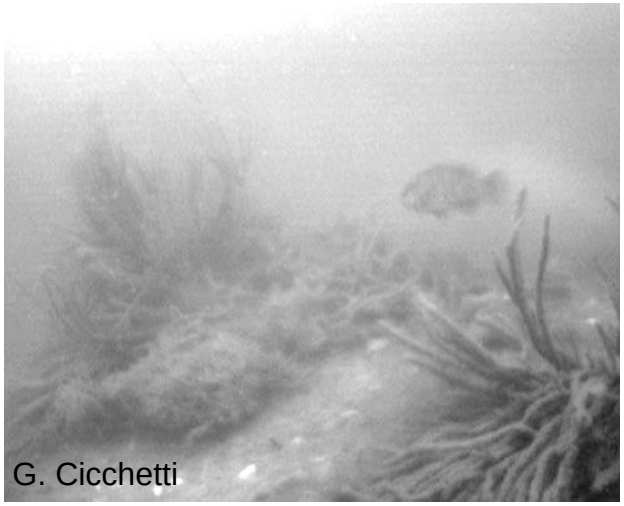


Table 1. Recent efforts to monitor benthic habitat and/or community composition in Narragansett Bay.

Benthic monitoring strategy	Organizing group	Spatial extent	Temporal extent	Future sampling
Benthic macrofauna community composition and abundance	Marine Ecosystems Research Laboratory, URI-GSO	4 stations in Upper Bay	4 stations 2000, 2001, 2002, 2004; 1 station 2005–2010	None planned
Trends report	EPA	Upper Bay	Trends analysis of data 1950s–2015	None planned
National Coastal Condition Report	EPA	Bay-wide (some stations permanent, others changing)	Summer 2005/6, 2010, 2015	2020
Benthic video sled	Narragansett Bay Commission	3 transects in Providence River Estuary	2–6 times per year, 2014–present	Attempted monthly
Sediment profile imagery	URI	Bay-wide	1988, 2008	None planned

Sediment profile imagery (SPI)

Frame is lowered to seafloor using boat's A-frame

Waterproof housing with camera

Wedge-shaped prism that enters the sediment and window against which picture is taken

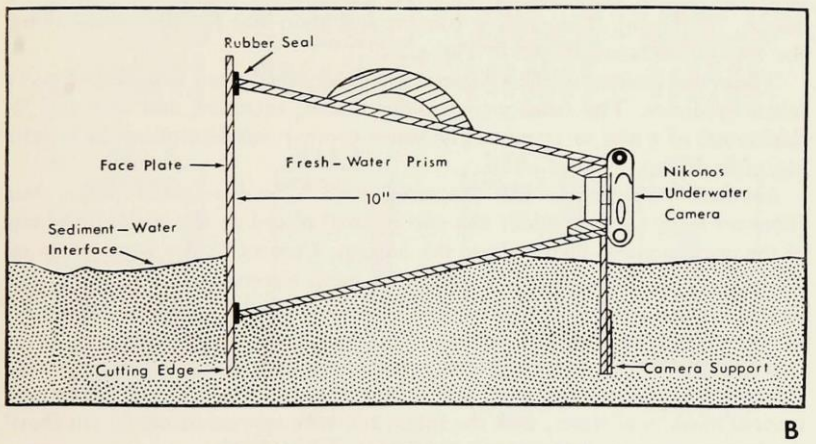
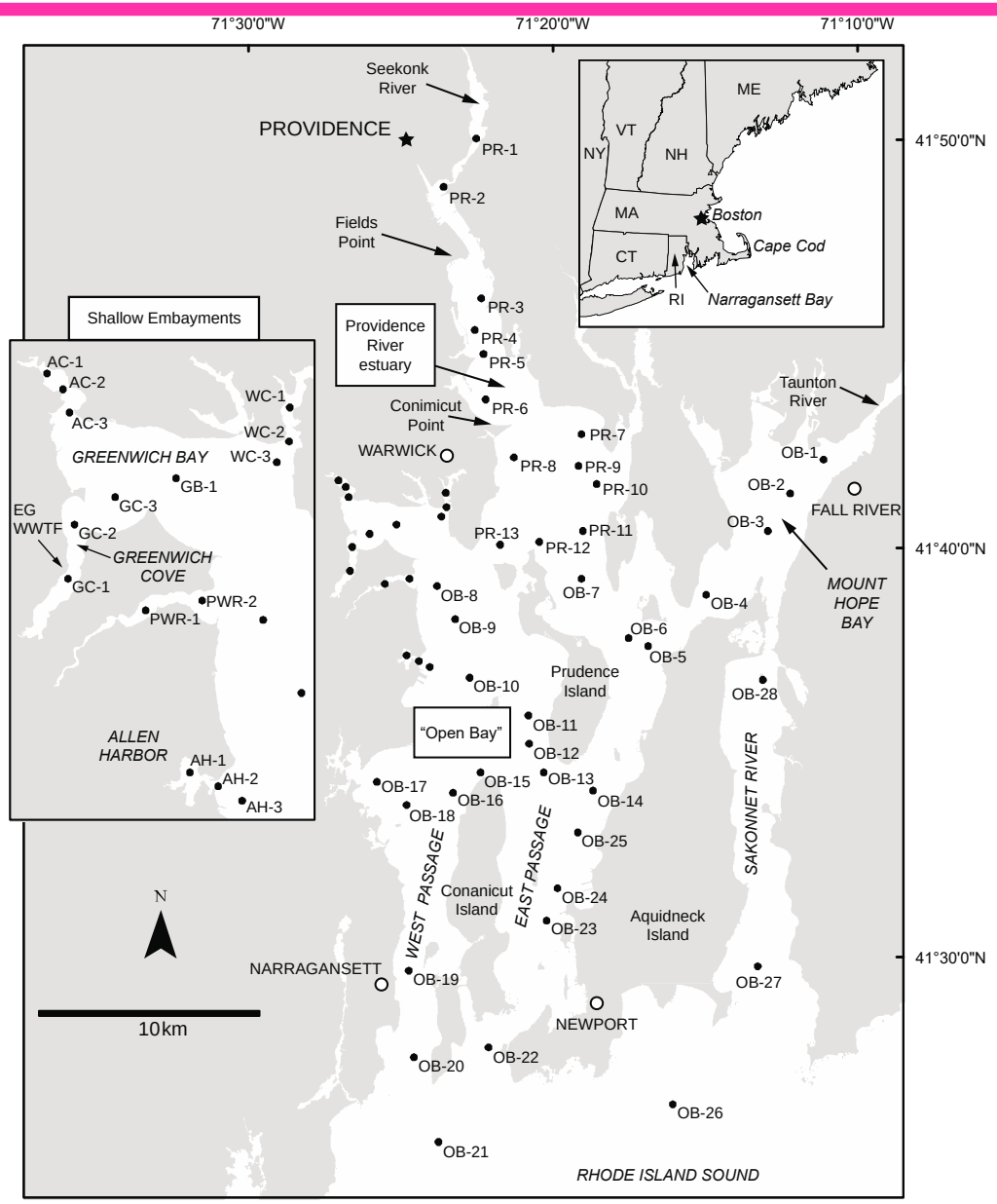


Figure 3. Sediment-water interface camera. (A) Lateral view showing the plexiglas pyramid attached to a Nikonos underwater camera, the apical part of the fresh-water prism, painted black to decrease backscatter of light, and Nikonos flash unit used to illuminate the sediment-water interface profile. (B) Cross-section showing the camera placed in position (by a diver) to photograph the sediment surface in profile.

1988 2008 2018

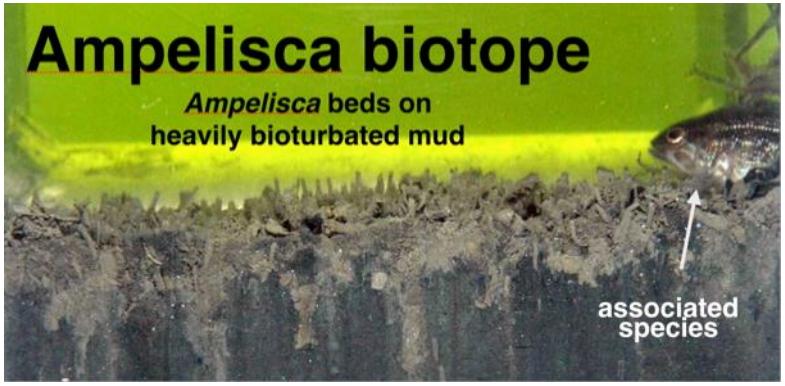


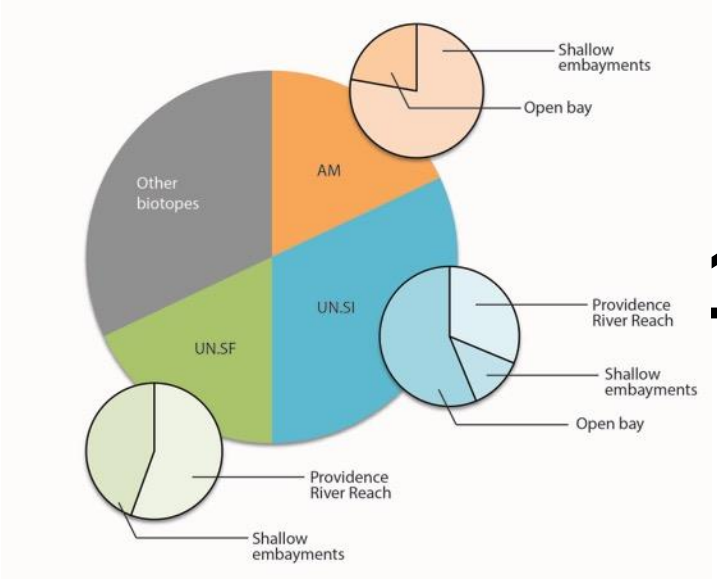
BIG CHANGES

BAY-WIDE biotopes dominated by *Ampelisca* increased >5x

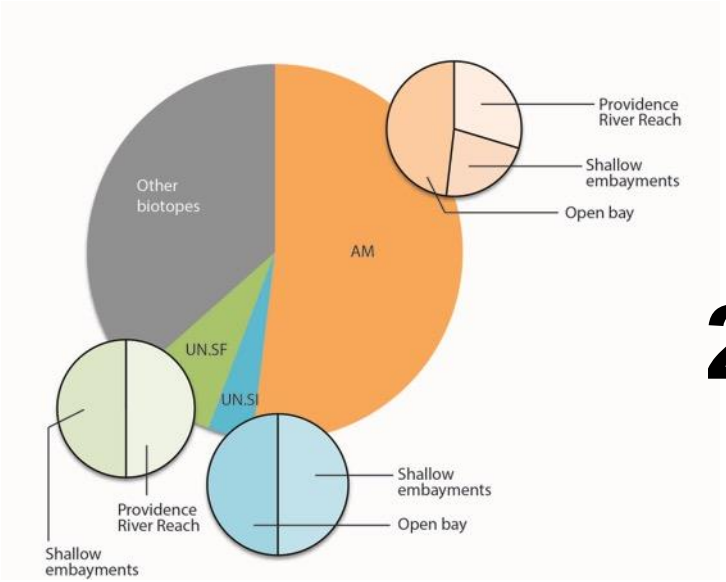
PROVIDENCE RIVER went from 0 to 78% stations with *Ampelisca*

POOR QUALITY HABITATS declined from 24% to 5%





1988



2008

***Ampelisca* biotopes appear to track critical boundaries in organic enrichment between high and low quality habitats**

Station

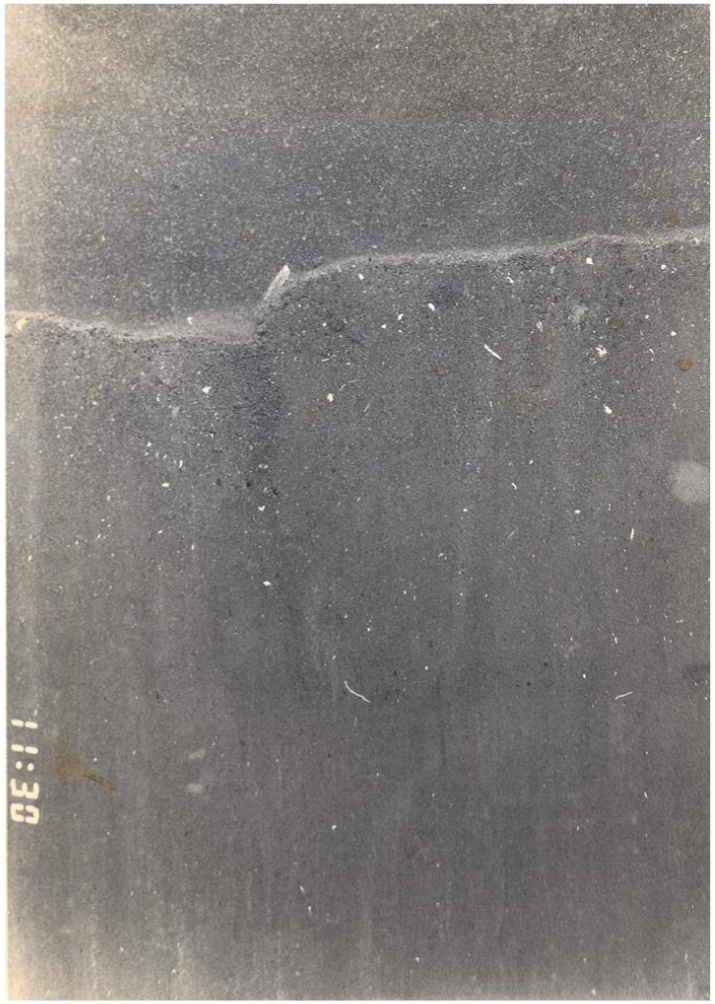
1988

PR-3

2008

Station

1988



PR-10

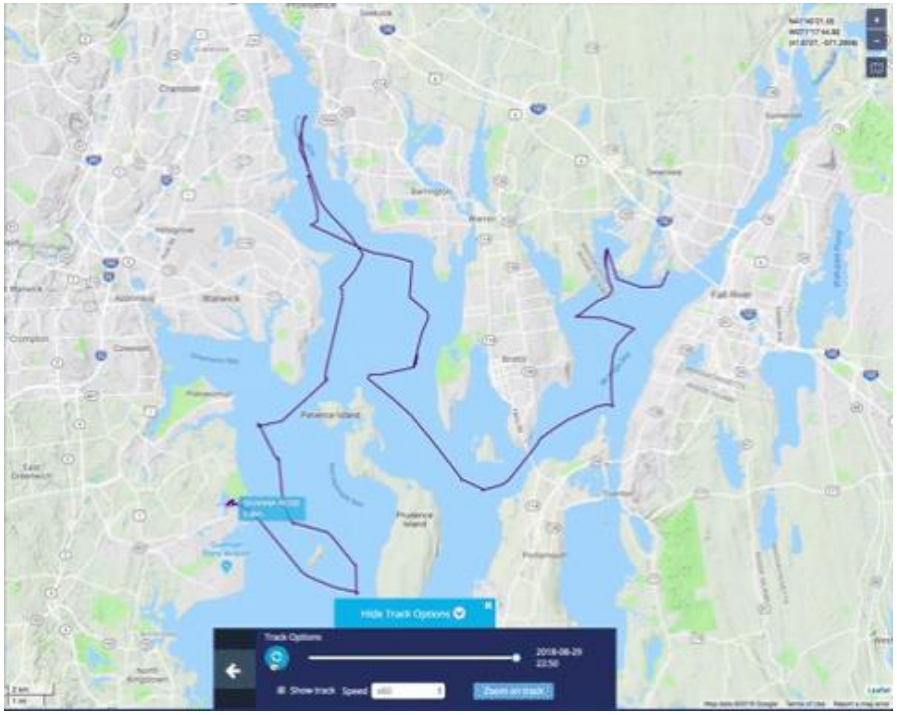
2008

Re-run the 1988 & 2008 surveys in 2018

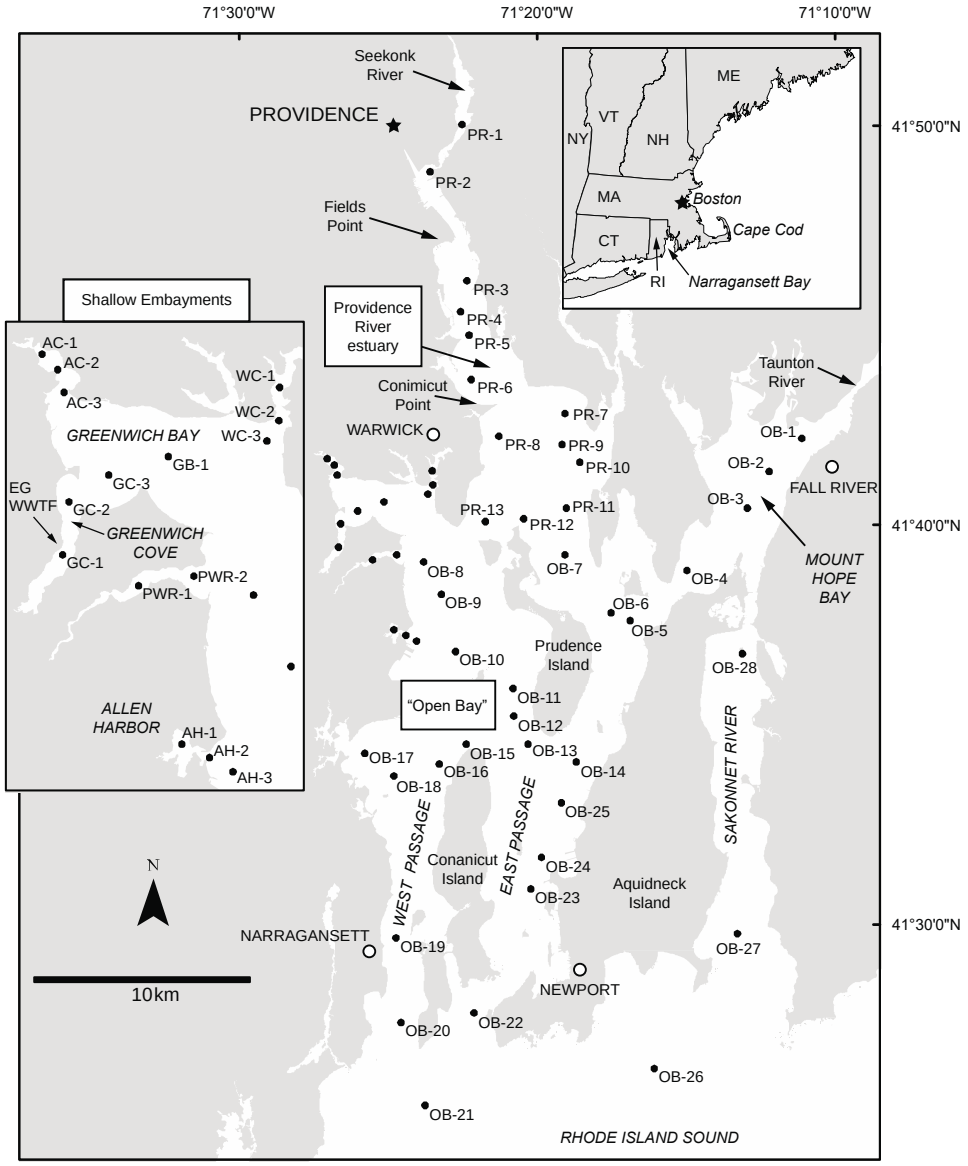
Same tools

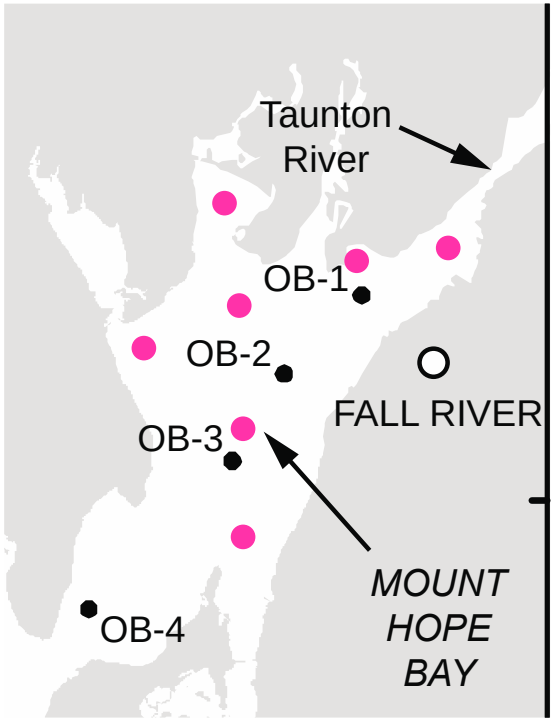
Same time of year

Same sites



1988 2008 2018





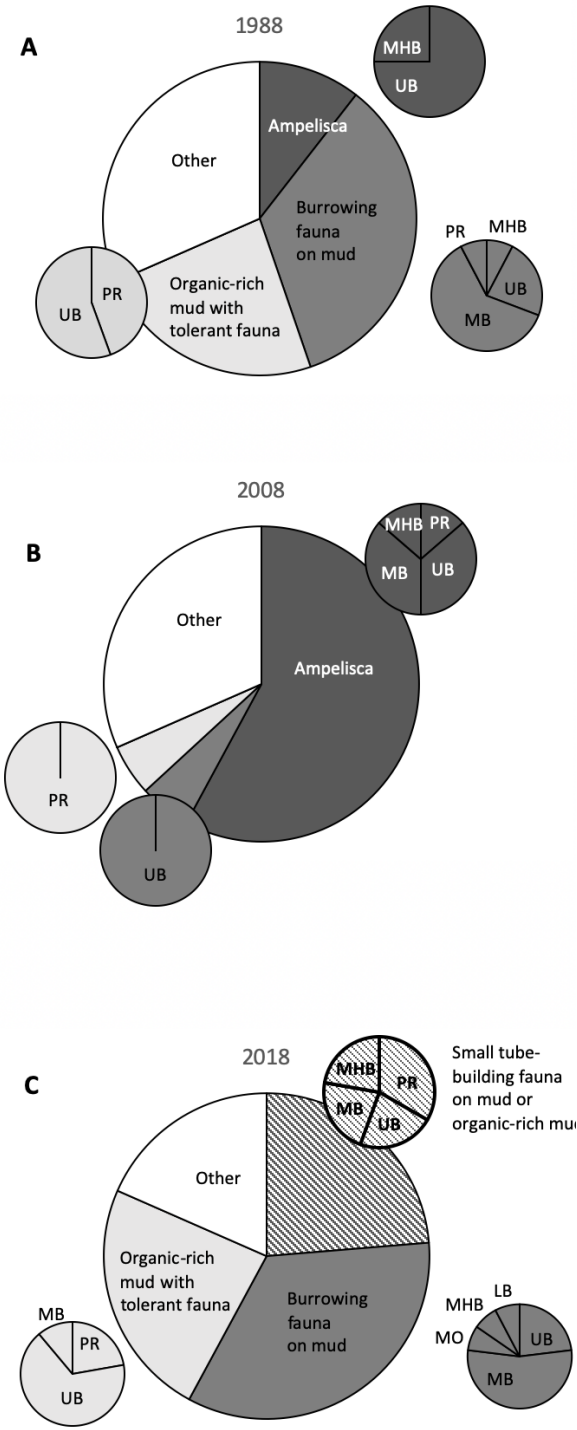
BIG CHANGES
AGAIN

<u>No Ampelisca biotopes</u> in 2018

Upper Providence River/Seekonk River, Greenwich Bay, and Allen Harbor benthic habitat quality stayed poor or declined

New biotope in 2018: Small tube-building fauna on mud or organic-rich mud

Same biotope diversity; rebound of biotope evenness



What happened to Ampelisca?

8 – Small tube-building fauna (new biotope)

8 – Burrowing fauna on mud (dominant biotope in 1988)

4 – Organic mud with tolerant fauna (Greenwich Bay & Allen Harbor)

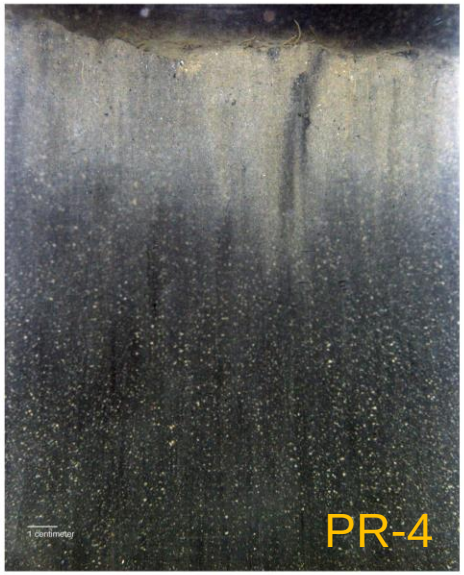
1 – Burrowing and tube-building fauna on sandy mud (Allen Harbor)

2008

2018

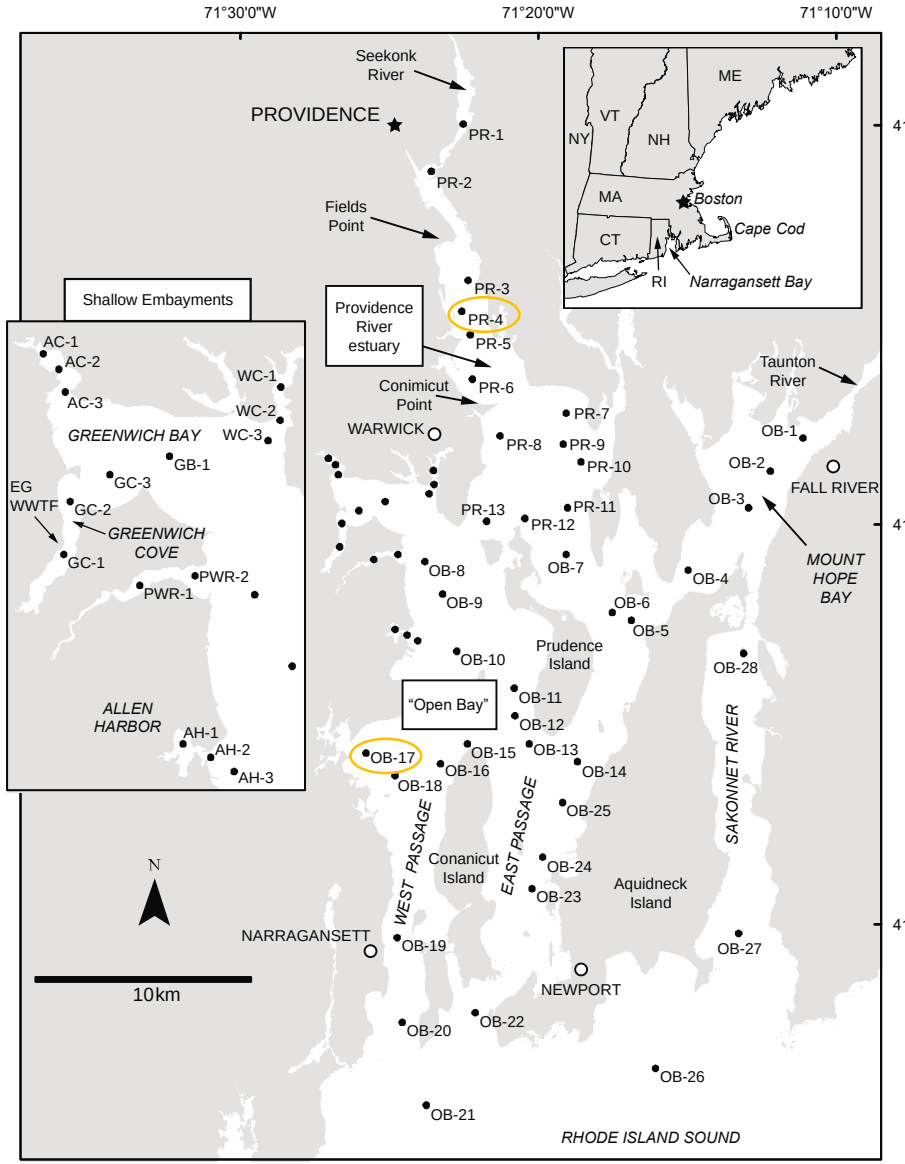
A

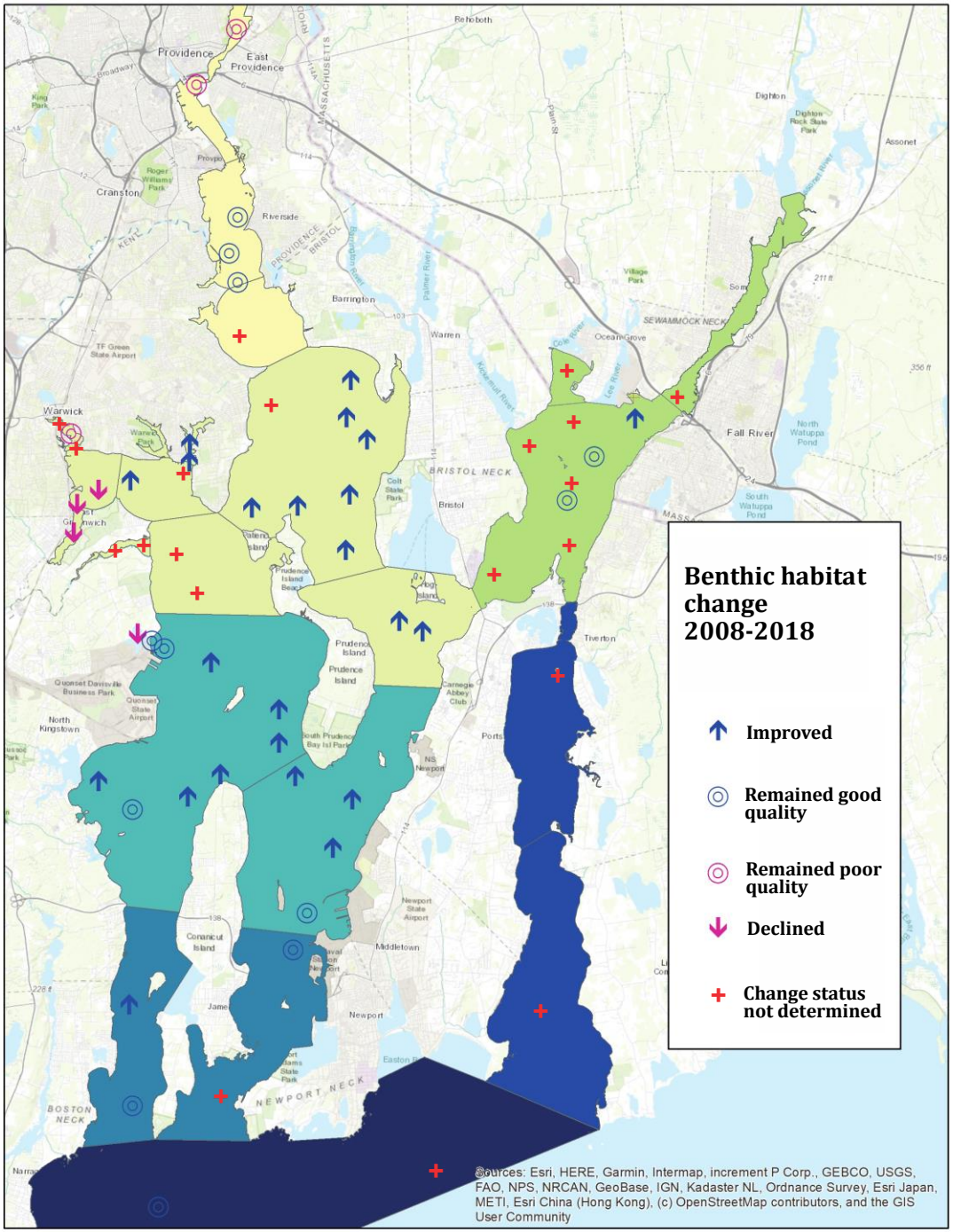
B

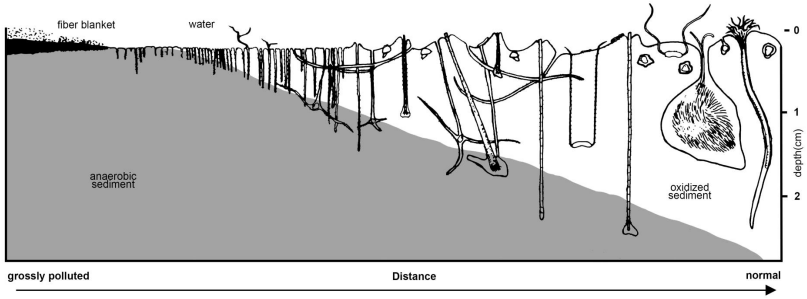


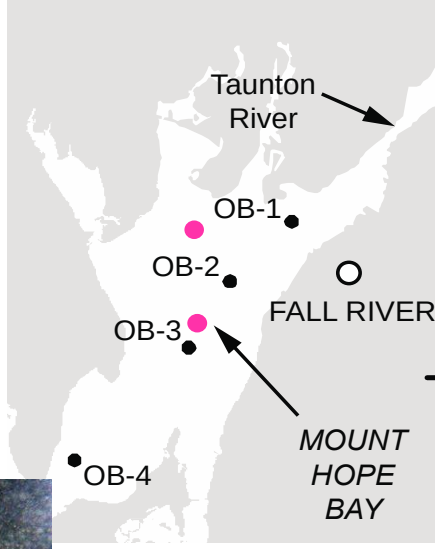
C

D




Benthic habitat change 2008-2018
Improved
Remained good quality
Remained poor quality
Declined
Change status not determined
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Providence
East Providence
Cranston
Warwick
Barrington
Warren
Bristol
Fall River
Tiverton
Newport
Middletown
North Kingstown
Conanicut Island
Prudence Island
BRISTOL NECK
NEWPORT NECK
BOSTON NECK
SEWAMMOCK NECK

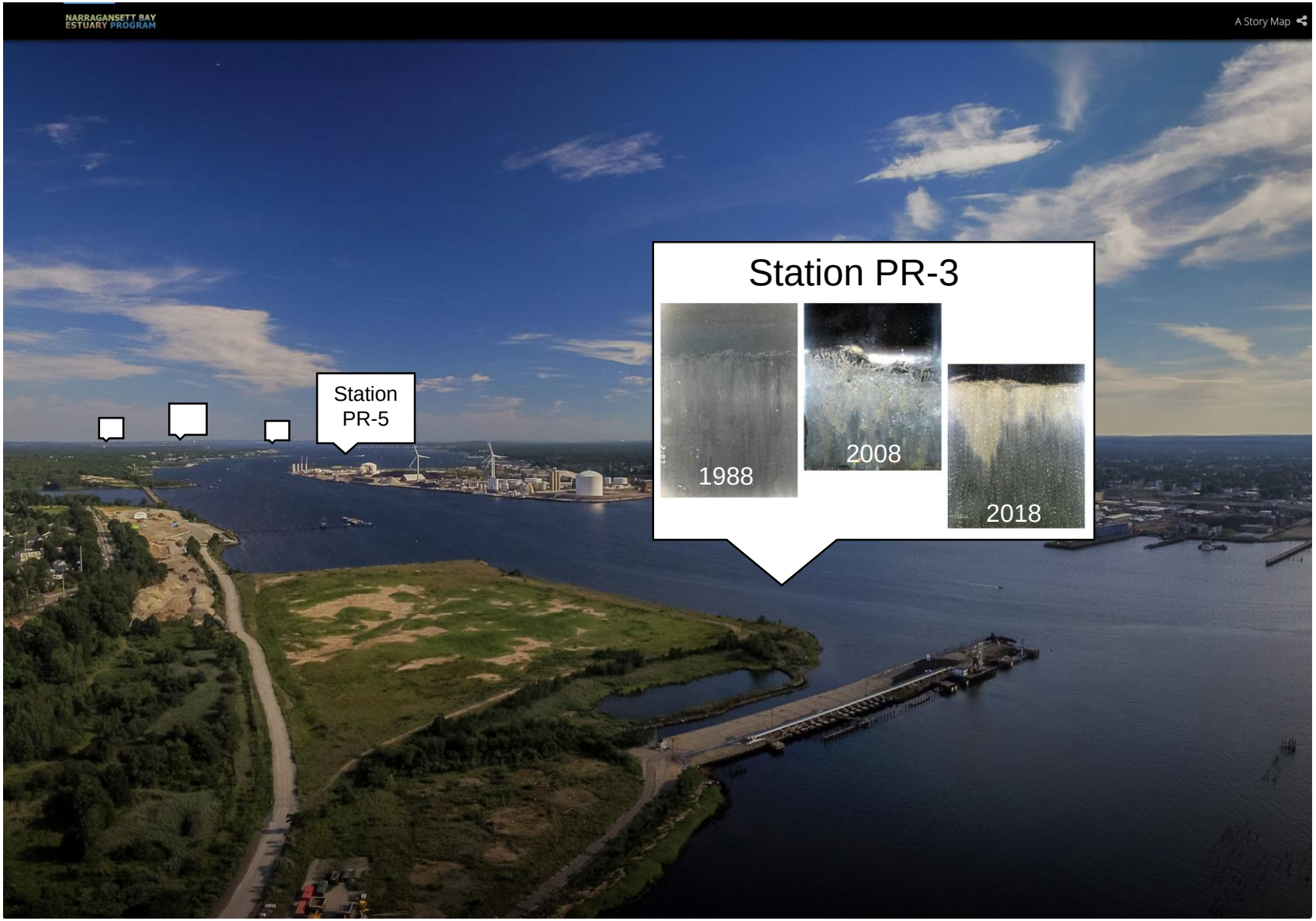




RI DEM BART

MA DEP buoy

Recommendation for updating the Benthic Communities indicator for NBEP



Recommendation for updating the Benthic Communities indicator for NBEP

Storymap with the following features:

- Briefly describes the importance of benthic communities to the Narragansett Bay ecosystem, including to fish and shellfish communities
- Underwater video sled clips showing healthy benthic habitats with fish, shellfish; degraded benthic habitats with evidence of low oxygen
- Brief description of imagery techniques
- Interactive maps with clickable images to show benthic habitat quality change over time

SAC recommendations?

What's next – synthesis project

- Led by The Nature Conservancy, with partners/collaborators at URI, EPA, RIDEM, NBC
- Focus on Providence River/Upper Bay
  - Synthesize records of previous studies and surveys to describe historical benthic conditions
  - Collect benthic community data to establish current status to compare with historical conditions; recommend a multi-tool approach
    - SPI
    - Underwater drop video
    - Underwater video sled
    - Diver cores / sediment grabs
  - Relate benthic community data to changes in nutrient inputs and other ecosystem stressors over time using the Biological Condition Gradient (BCG) model