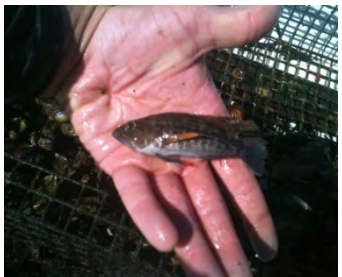
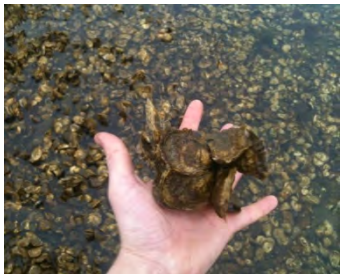
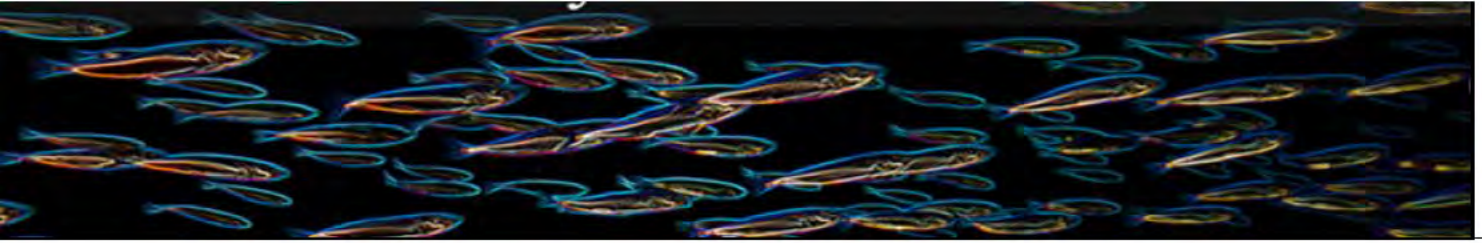
Artificial Reef Site Selection Modeling

Kevin Ruddock

GIS Analyst, The Nature Conservancy

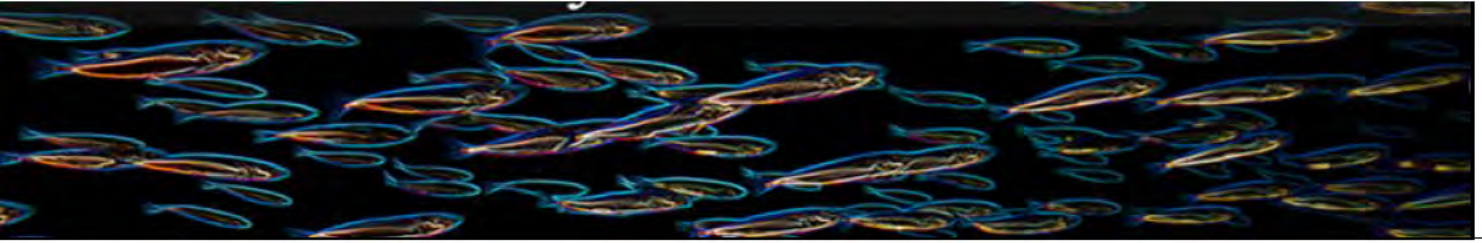





Near-shore estuarine/marine reef habitats

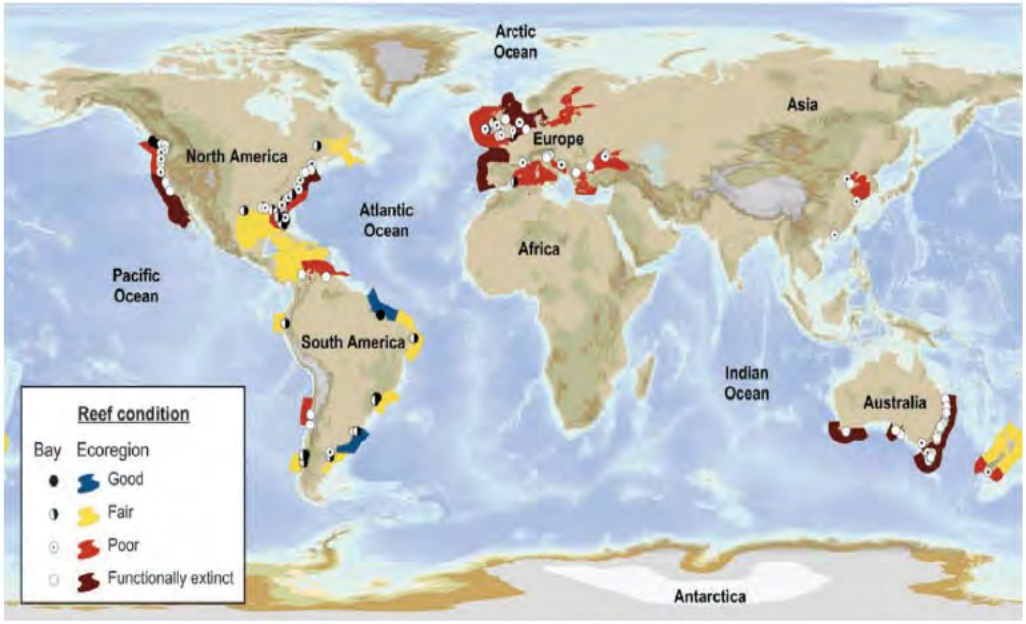
- Topographically complex structures provide refuge and increase productivity
- Juvenile demersal fish are dependent upon these structures (tautog, cunner, scup, winter flounder, and black sea bass)
- Substrate for benthic fauna



Loss and fragmentation

- Cumulative impacts from:
- Sedimentation
- Destructive fishing practices
- Storm-wave erosion
- Climate change

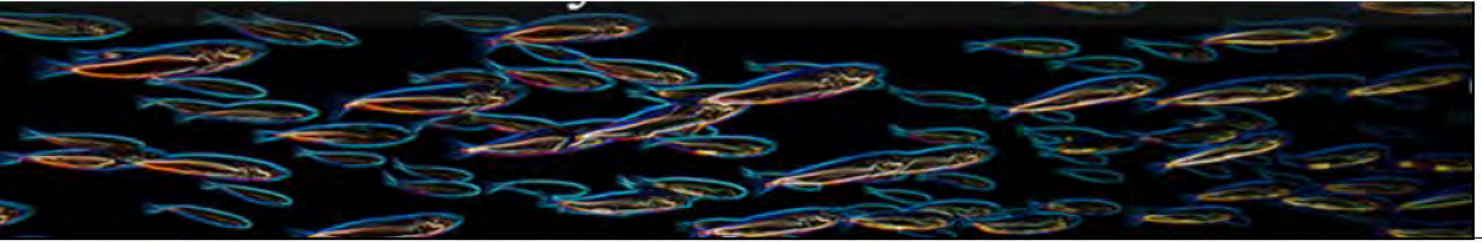
- Documented shift in Narragansett Bay from demersal to pelagic species



Source: TNC, Beck et al. (2009)



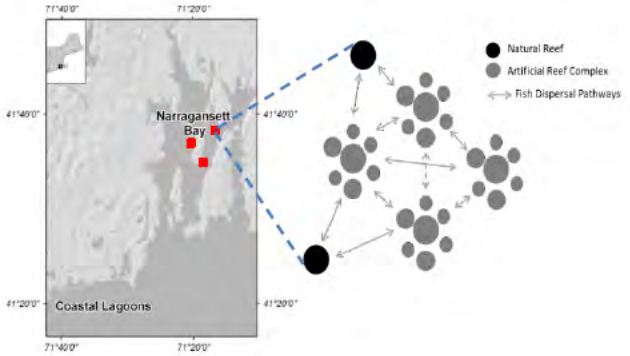




TNC-DEM Collaborative Artificial Reef Research Project (CARRP)

Goals

- Improve our understanding of the functional value of artificial reefs, do they…
  - Increase productivity of demersals?
  - Increase growth rate and survival of juveniles?
  - Attract existing fish stock resulting in increased mortality through exploitation?
- Improve our understanding of the value of artificial reefs as a fisheries enhancement and conservation tool
- Develop partnerships among scientists, resource managers and the fishing community



D. Steven Brown(1)
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Coastal Ecologist, The Nature Conservancy
Principal Biologist, Rhode Island Department of Environmental Management, Marine Fisheries



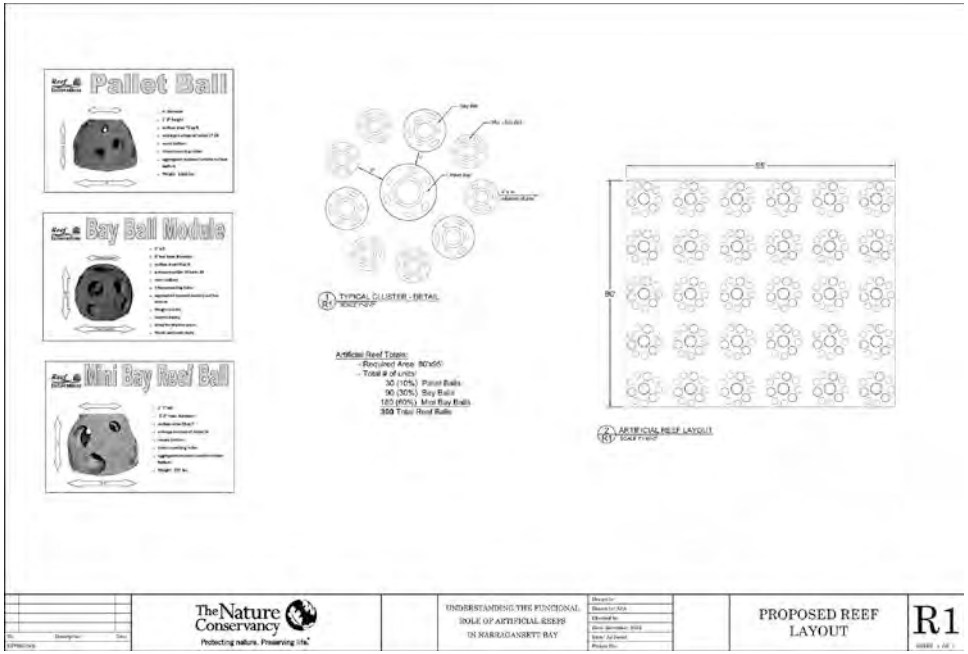


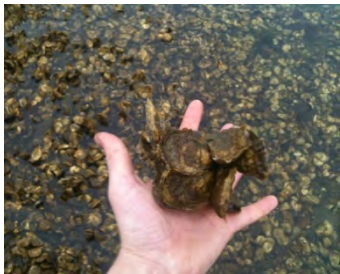
Reef Design and Site Selection

Site Selection Criteria

- Physical
  - Will the depth and sediment type be suitable?
- Biological
  - Need to avoid existing habitats
- Social
  - Need to avoid conflicts with existing uses

Exclusion mapping followed by stakeholder review and ground-truthing

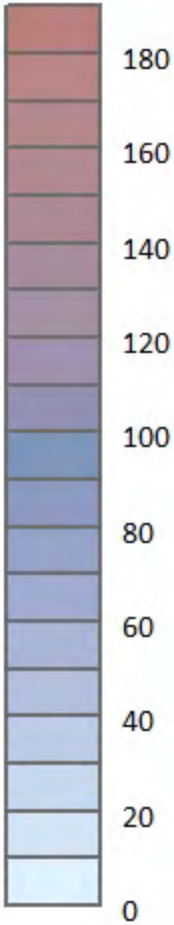


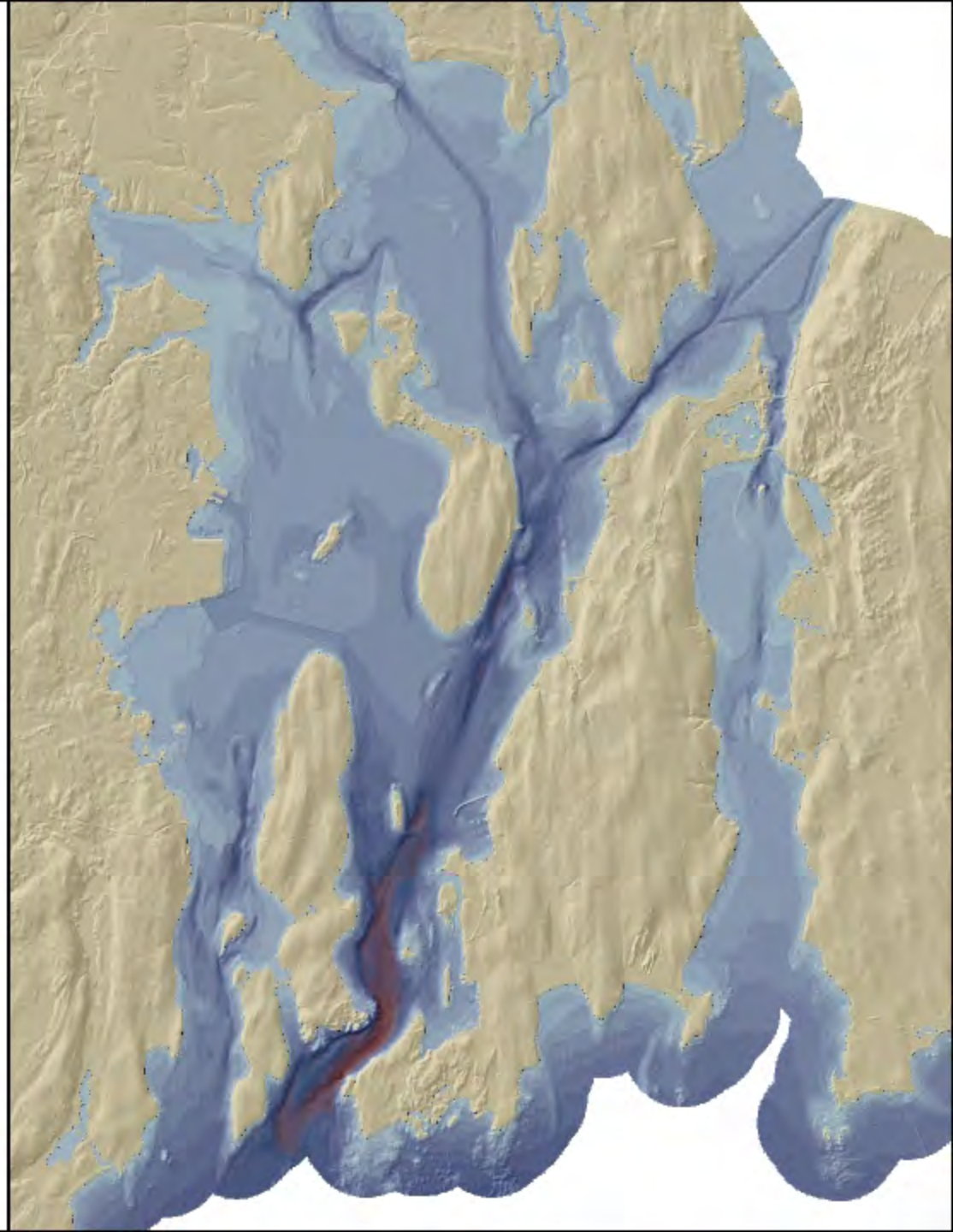


Narragansett Bay

Artifical Reef
Site Selection Model

Bathymetry
(feet, relative to Mean Tide)

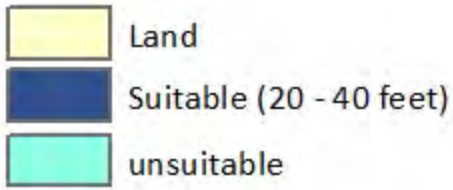




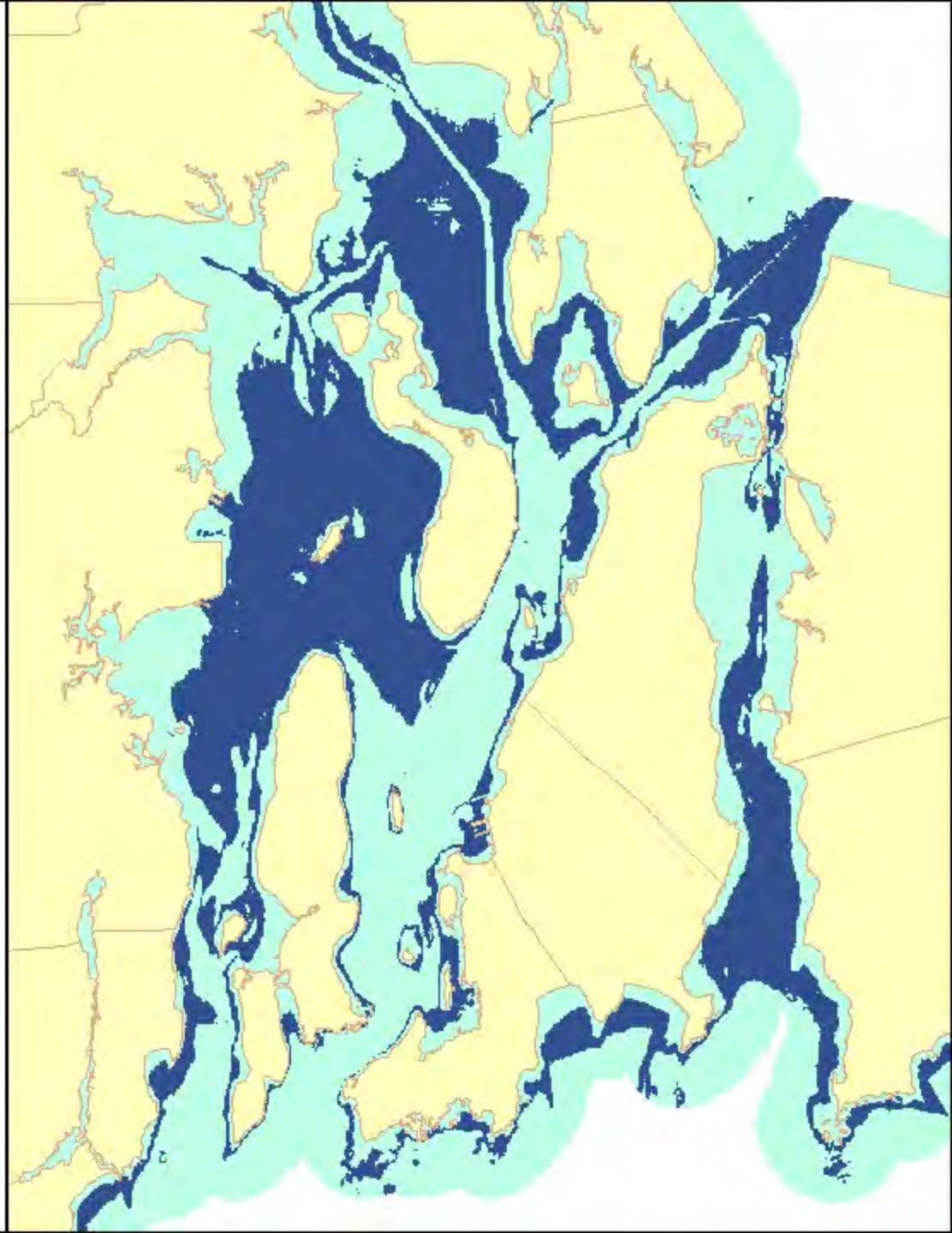
Narragansett Bay

Artifical Reef
Site Selection Model

Bathymetry Classes



Topobathy
Damon, URI EDC



Narragansett Bay

Artifical Reef
Site Selection Model

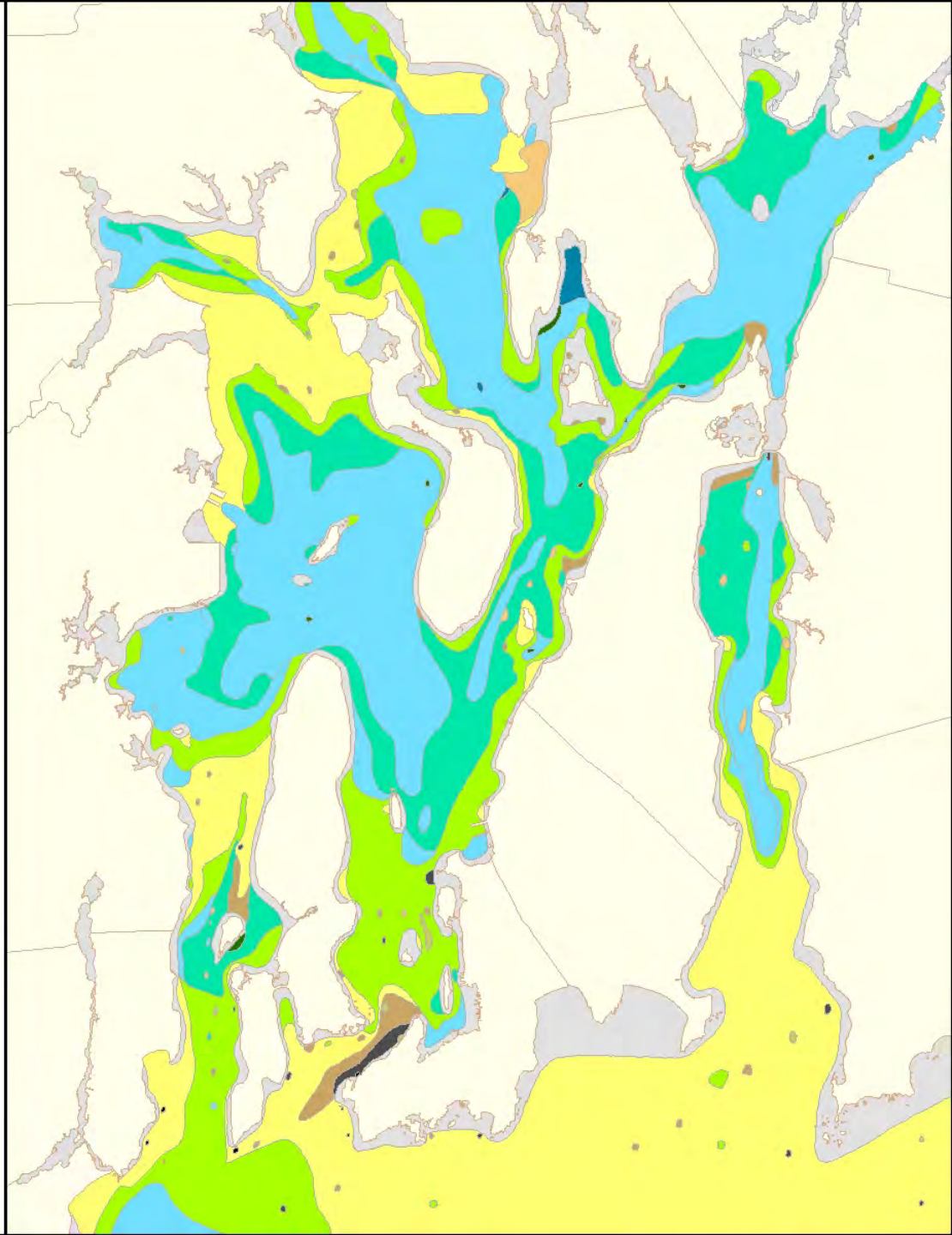
Sediment

Suitable

- Sandy Gravel
- Gravel-Sand-Silt
- Gravelly Sand
- Sand
- Gravel-Silt-Clay
- Sand-Silt-Clay
- Silty Sand

Not Suitable

- Rock
- Gravel
- Clay-Silt
- Sandy Silt
- Silt
- uncoded
- Not Sampled



RIDEM Narragansett Bay Estuary Program
McMaster, 1960

Narragansett Bay

Artifical Reef
Site Selection Model

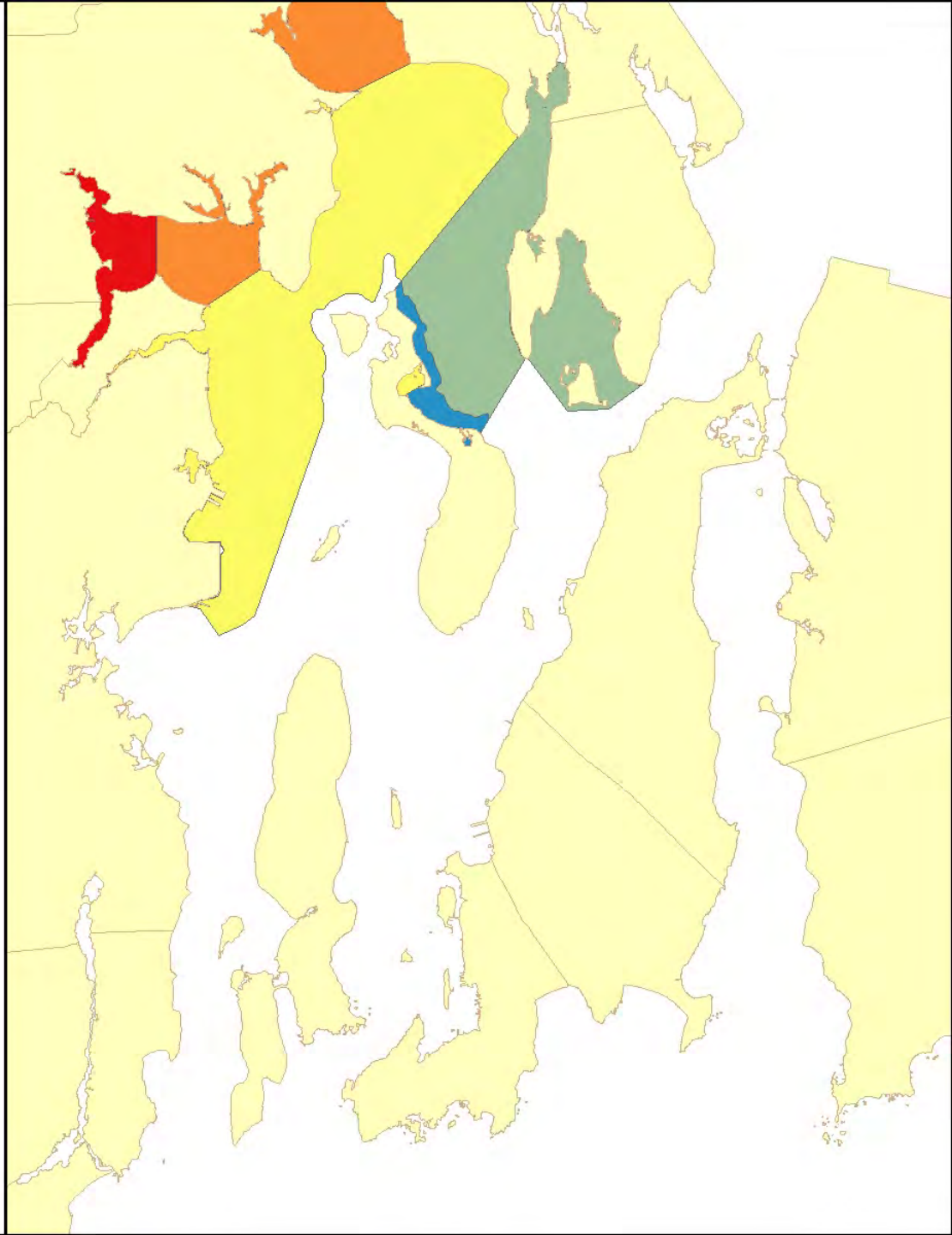
Dissolved Oxygen: Anoxia Potential

Suitable

- Moderate
- Slight

Not Suitable

- Extreme
- Severe



RI CRMC
Deacutis, 2003

Narragansett Bay

Artifical Reef
Site Selection Model

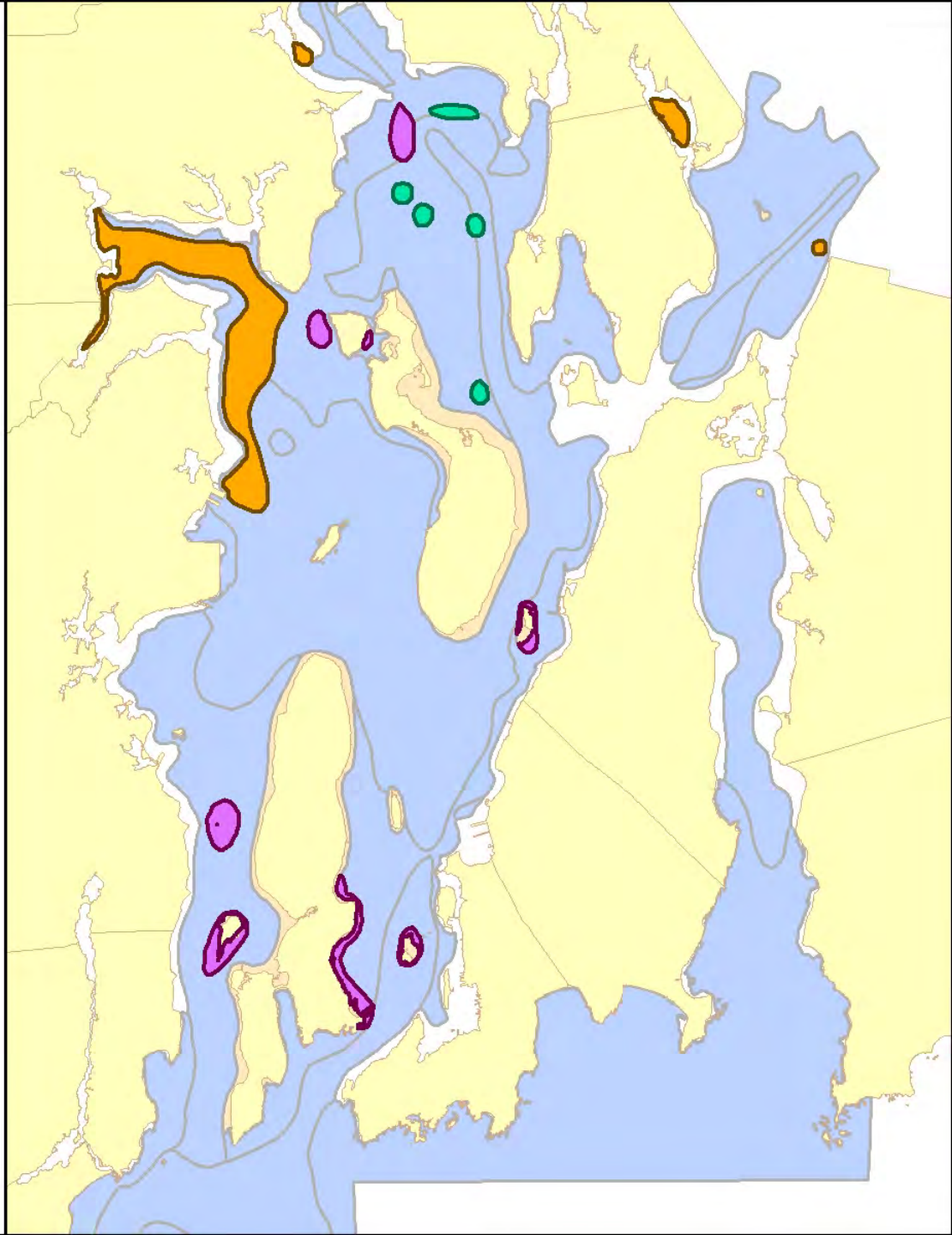
Faunal Beds

Suitable

- EOW
- LOWER BAY COMPLEX
- LOWER PROV RIVER CHANNEL
- MIDBAY DEEP
- MT HOPE BAY SILT CLAY
- RI SOUND SAND
- RI SOUND SANDY SILT
- RI SOUND SILTY SAND
- SEEKONK UNDREDGED BOTTOM
- UPPER BAY COMPLEX
- UPPER BAY SOFT SEDIMENTS
- UPPER PROV RIVER CHANNEL

Not Suitable

- AMPELISCA BEDS
- CREPIDULA BEDS
- MUSSEL BEDS

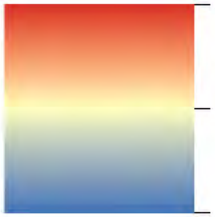


Benthic Domains
Narragansett Bay Estuary Program, 1992

Narragansett Bay

Artifical Reef
Site Selection Model

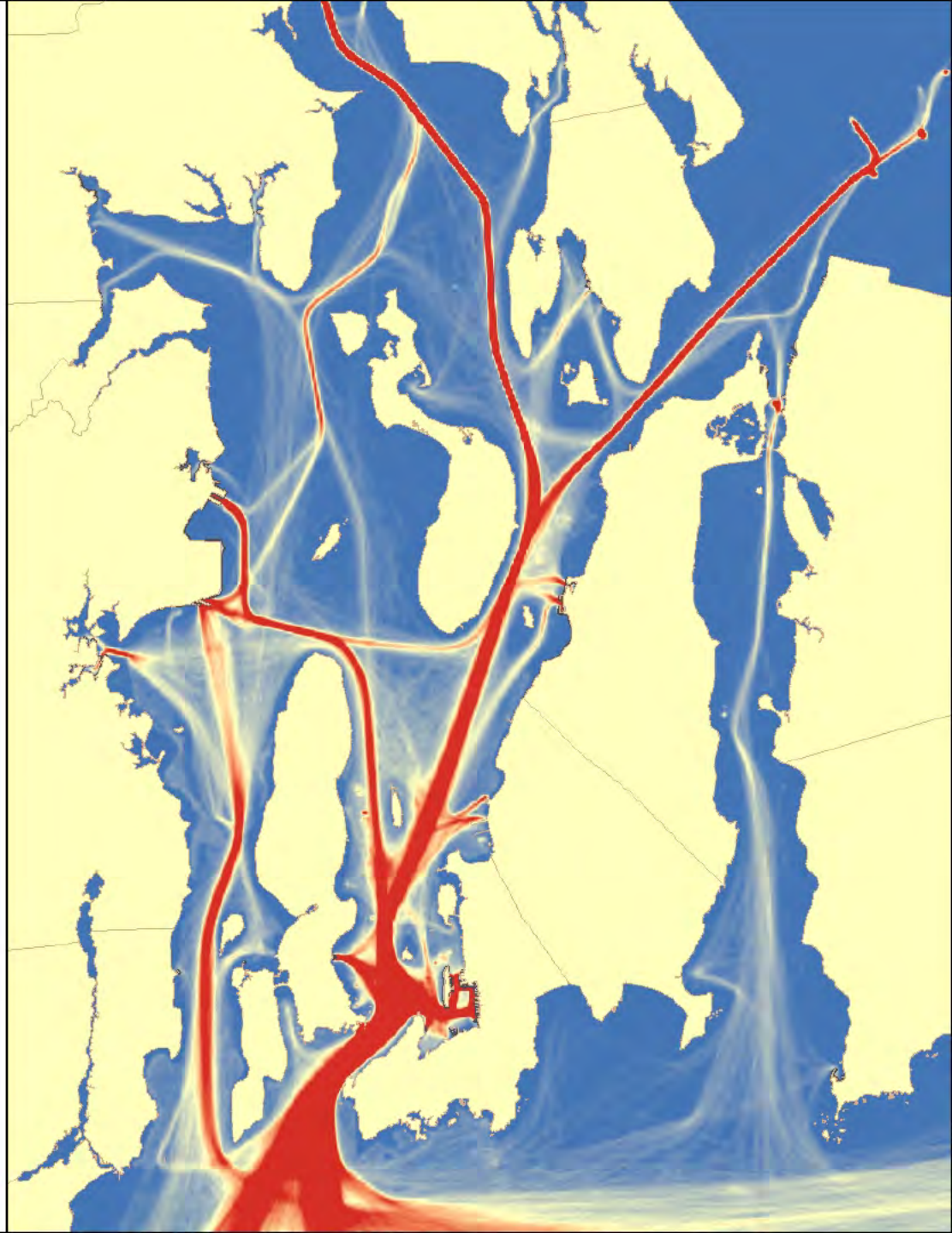
Ship Track Density



High Density

Low Density

NOAA Automatic Identification Systems (AIS), 2011

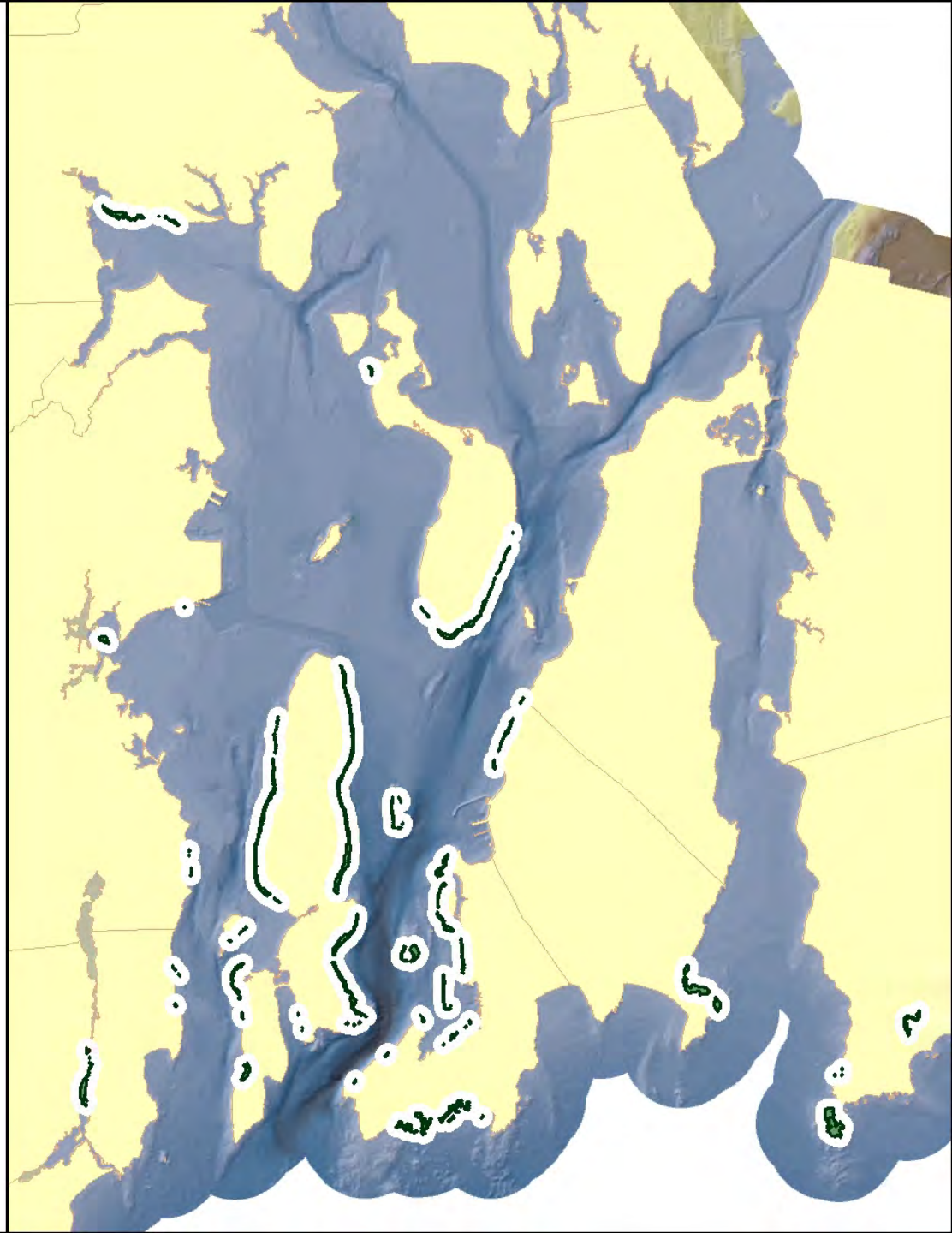


Narragansett Bay

Artifical Reef
Site Selection Model

Eelgrass and Widgeon Grass

Eelgrass and Widgeon grass



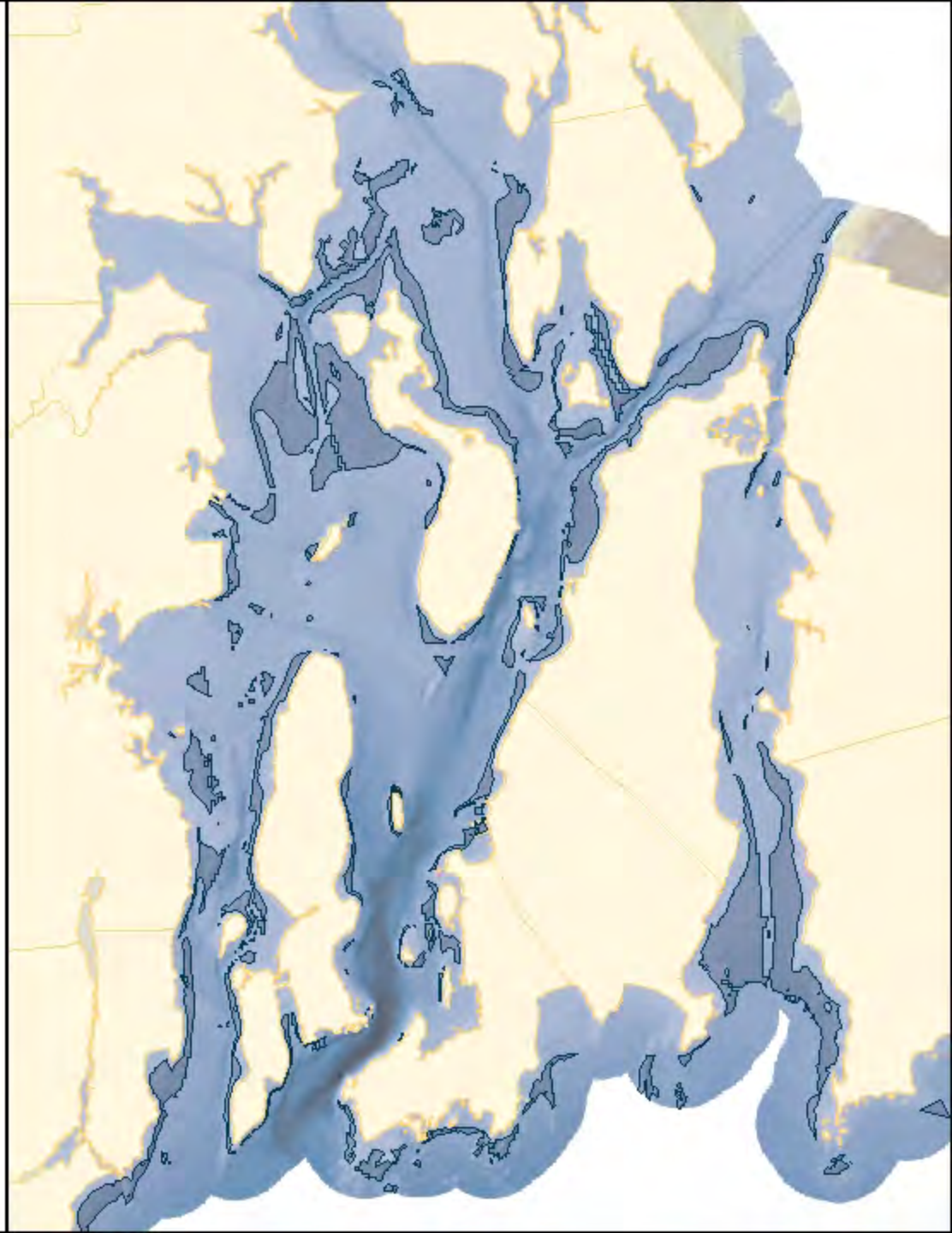
Mapping SAV in RI Coastal Waters
URI, STB, NBNERR, 2012

Narragansett Bay

Artifical Reef
Site Selection Model

Exclusion Mapping

Suitable (non-excluded) Area



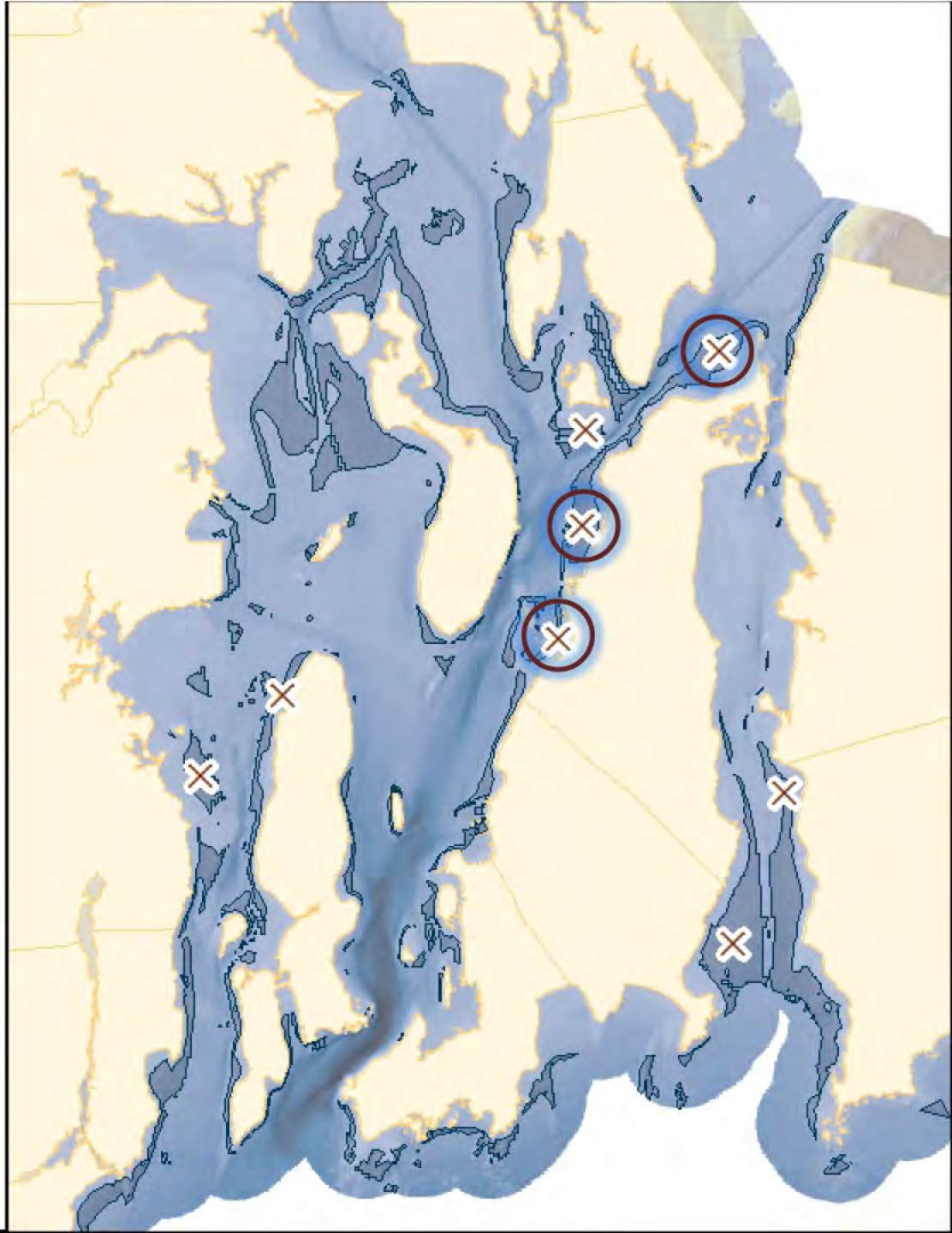
Narragansett Bay

Artifical Reef
Site Selection Model

Exclusion Mapping

Suitable (non-excluded) Area

Potential Sites



Narragansett Bay

Artifical Reef
Site Selection Model

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Suitable (non-excluded) Area

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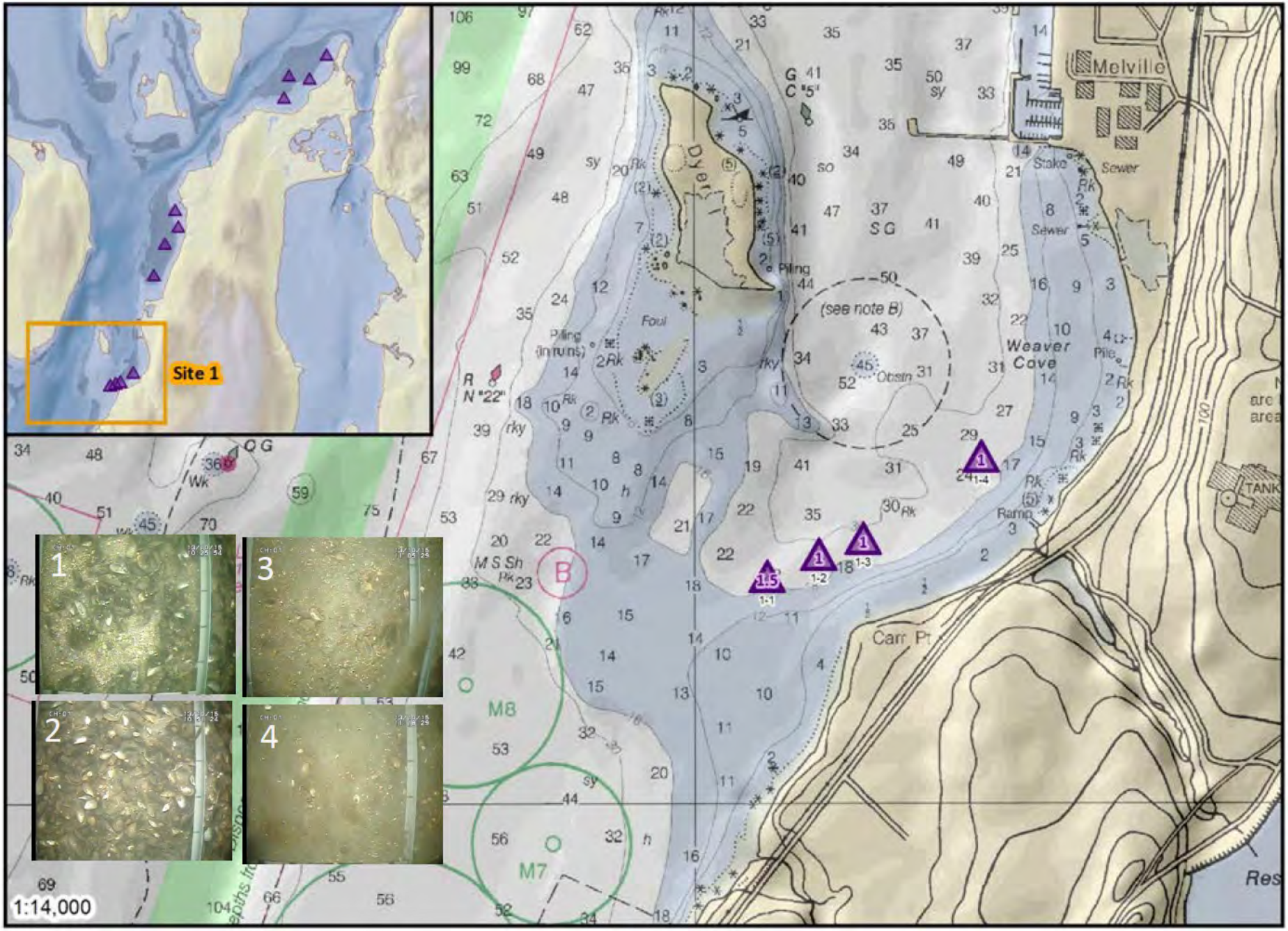
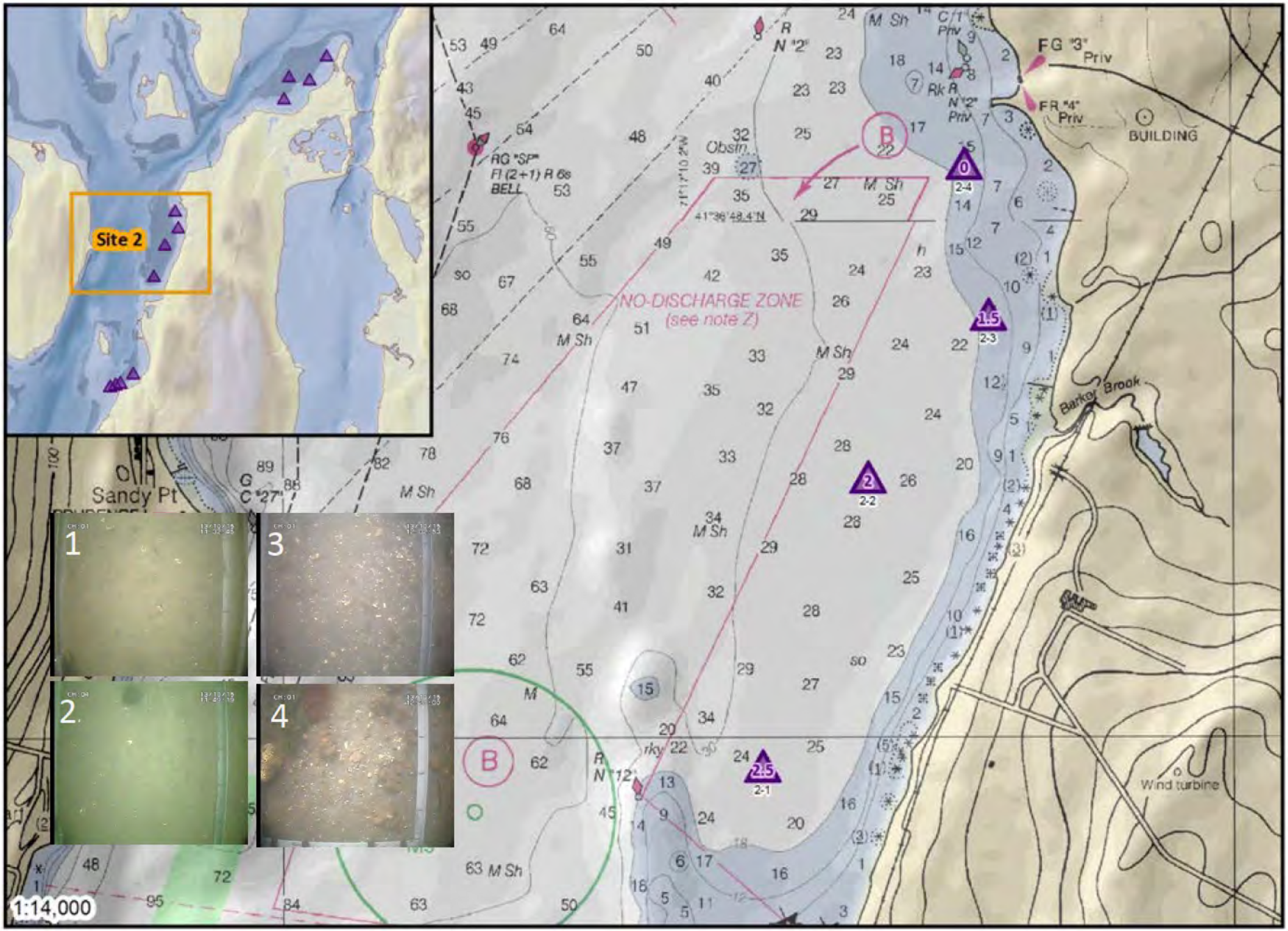
Narragansett Bay

Artifical Reef Site Suitability (0=suitable 3=not suitable)



Narragansett Bay

Artifical Reef Site Suitability (0=suitable 3=not suitable)



Narragansett Bay

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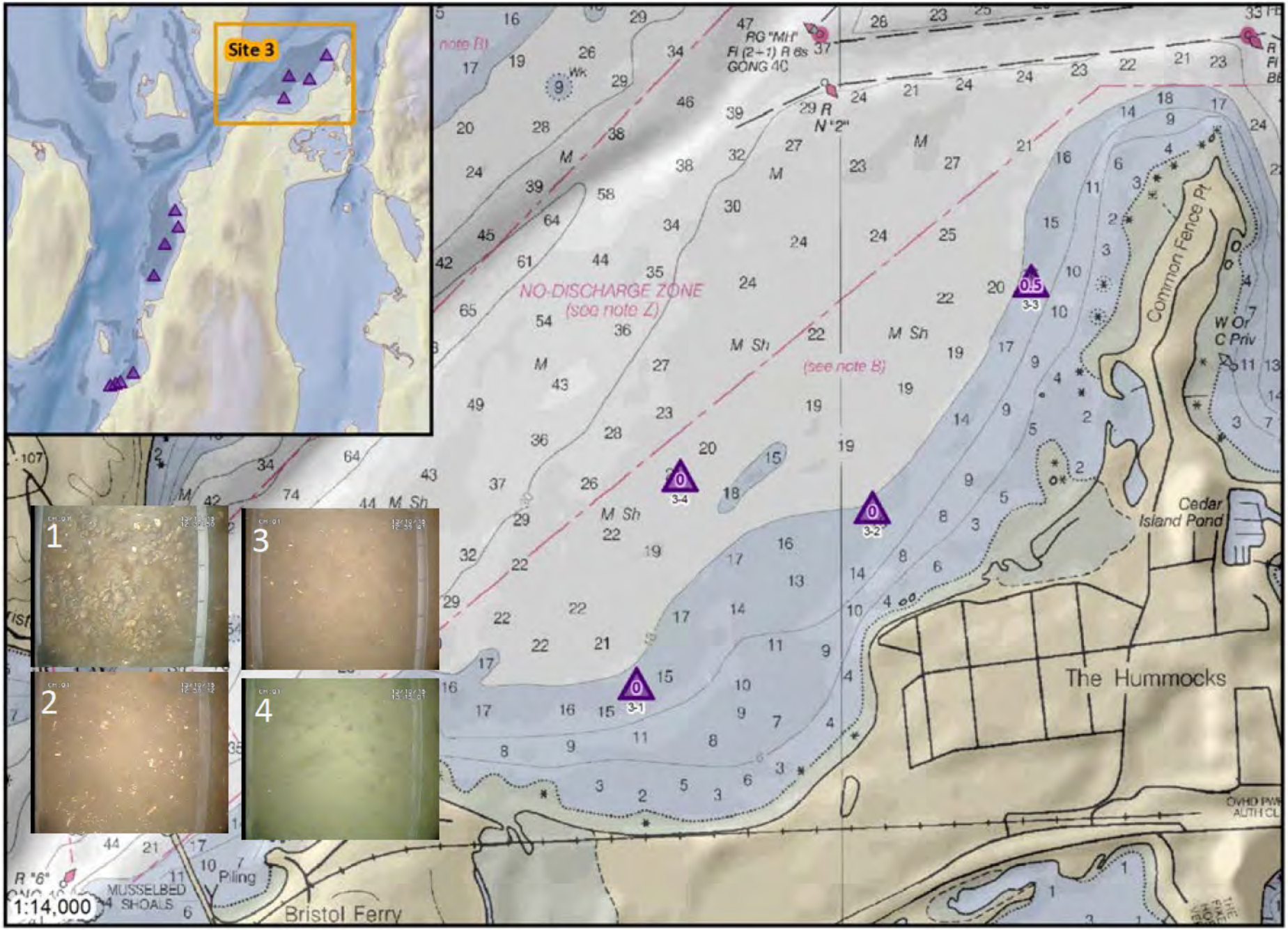

D·E·M

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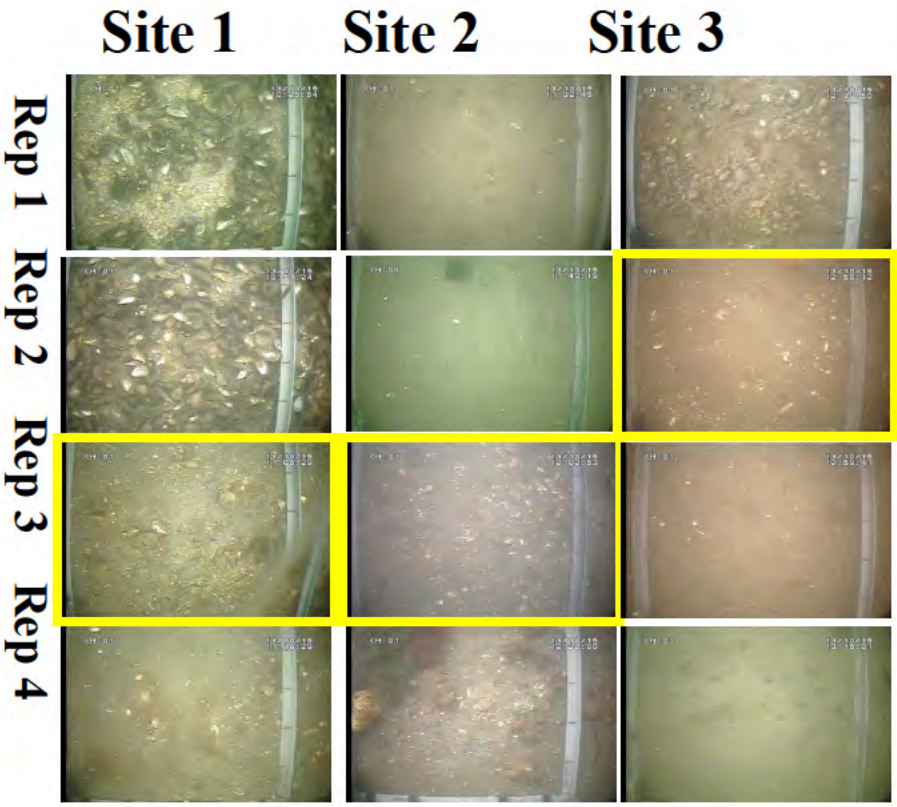

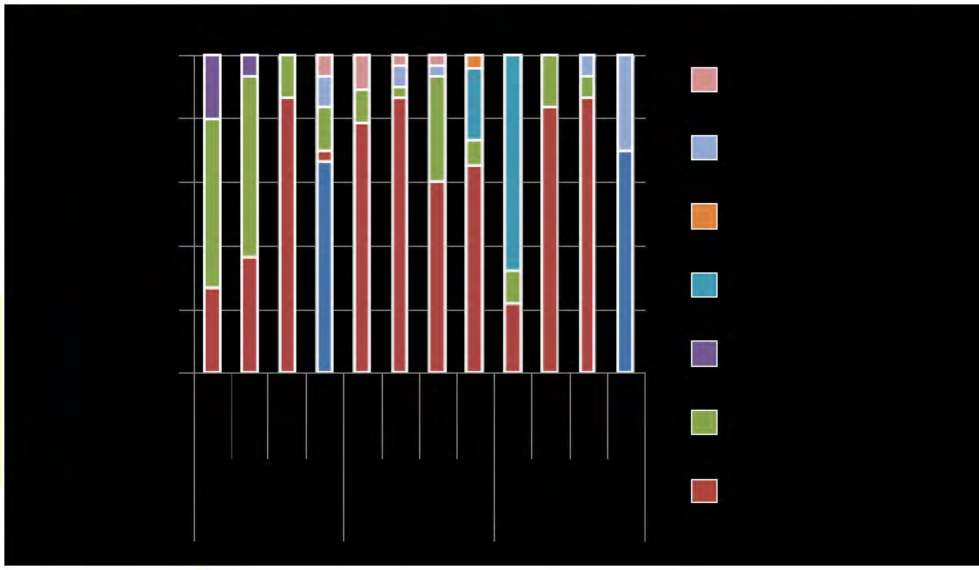

Optimal Locations

- Site 1-3
- Site 2-3
- Site 3-2

Next steps

- Construct and deploy
- Establish baseline data
- Monitor (tags, video, traps)
- Crunch the data