Seafloor Habitat Mapping in Eastern Long Island Sound

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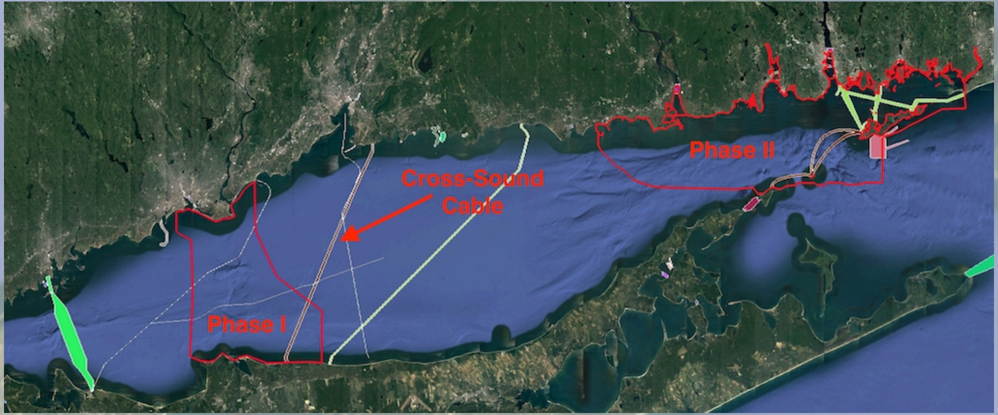
Outline

- Background/context
- Prioritization
- Phase II
  - Site selection process
  - Methodologies
  - Field work results
  - Early observations/results
  - Next steps/coordination
  - EPE
- Phase I Summary
  - Development of the Habitat Map

Background

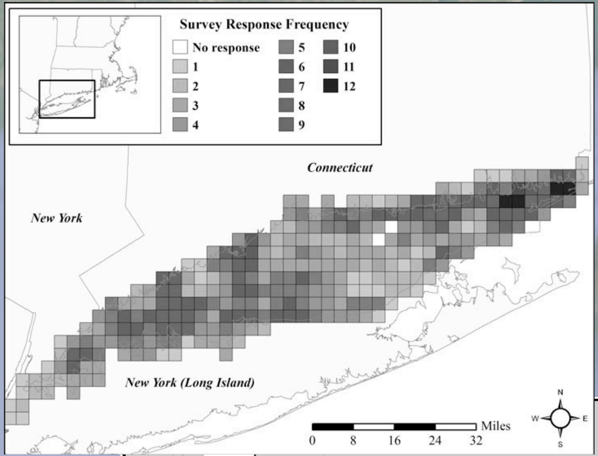
- Cross Sound Cable:
  - Electrical transmission line across LIS
  - Information available failed to adequately identify submerged bedrock
  - Permitee unable to comply with conditions requiring cable to be buried at a suitable depth (6’)
  - Law suit settled in 2004 for $6.1M established the Long Island Sound Cable Fund Habitat Mapping Initiative to be focused on:

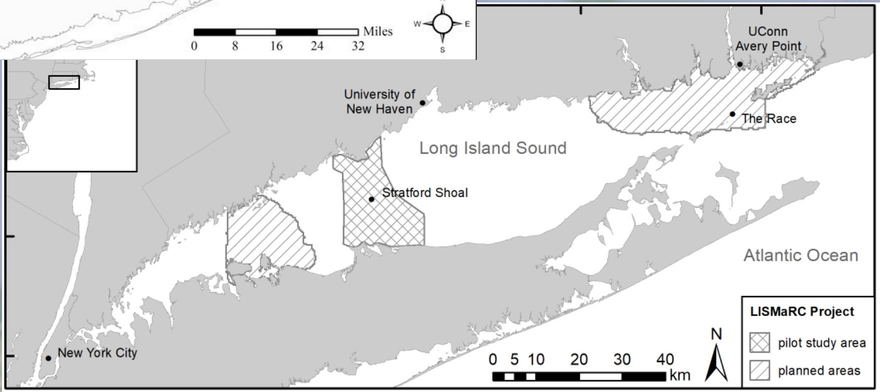
“benthic mapping as a priority need, essential to an improved scientific basis for management and mitigation decisions.”



Setting Habitat Mapping Priorities

- Spatial prioritization workshop held in 8/2011 to identify management applications, priority areas to map and derived products needed
- Decision-support tools and participatory geographic information system (PGIS)
- Survey of state/federal agencies, academic institutions, and NGO's
- Resulting spatial prioritization identified three priority areas



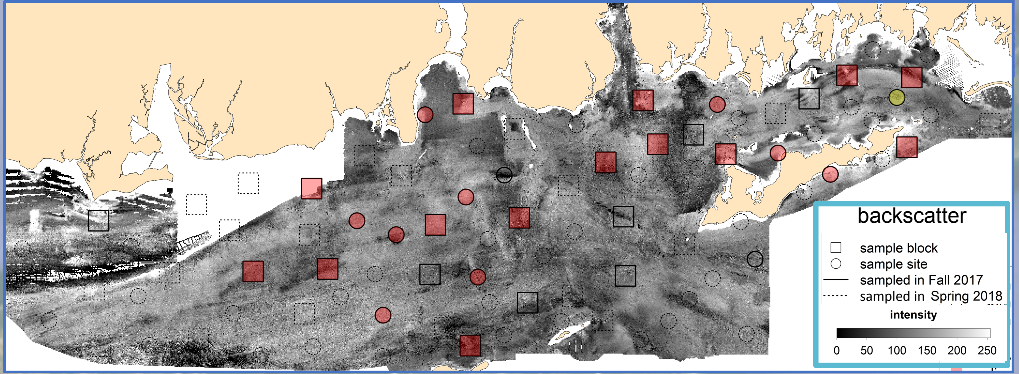


Tim Battista & Kevin O'Brien (2015) Spatially Prioritizing Seafloor Mapping for Coastal and Marine Planning, Coastal Management, 43:1, 35-51, DOI: 10.1080/08920753.2014.985177

Phase II Sample Design

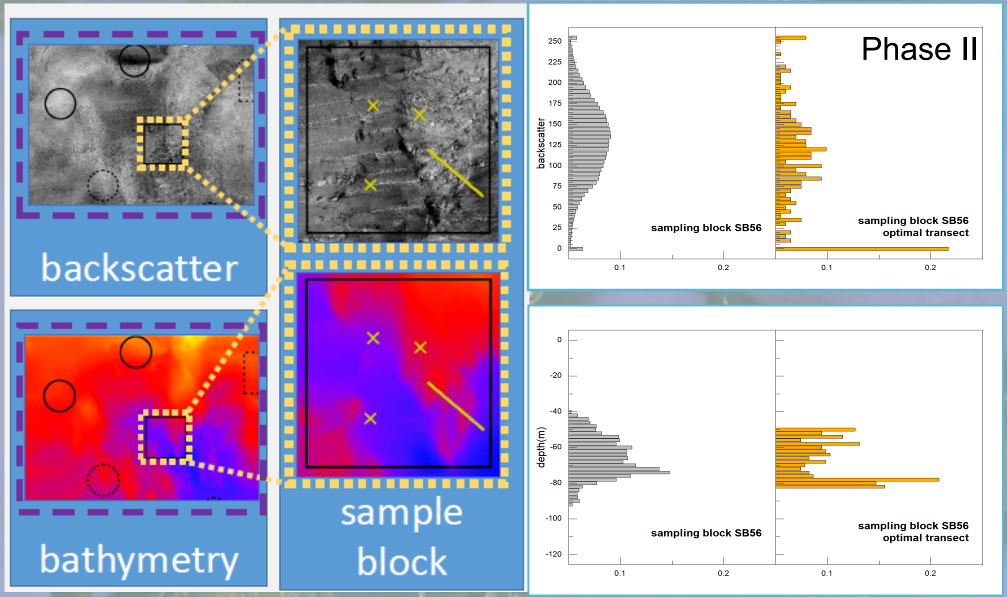
Eastern Long Island Sound

- Backscatter again used as a surrogate for habitat type and first order site selection
- 40 sample blocks with three sediment grab samples and one 400m transect with digital still and video imagery
- 50 sample sites with one sediment grab and one 400m transect
- Total of 120 sediment samples and 90 transects

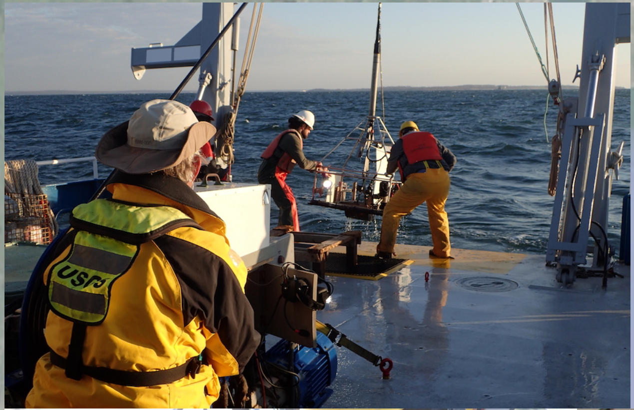


Refining Sample Locations

- Backscatter and bathymetry data used to refine the sediment sample and transect locations within the 1 km2 sample blocks
- Sediment samples (yellow X's): 3 per block/1 per site selected in different sedimentary habitats and transitions
- Transects were selected to maximize seafloor complexity & sediment transitions from one habitat type to another to delineate and validate boundaries between habitats
- Image/video transects (yellow lines) selected from 1000 randomized transects per block/ site, ranked by range and variance of backscatter and bathymetry
- The transects with the most variance were selected

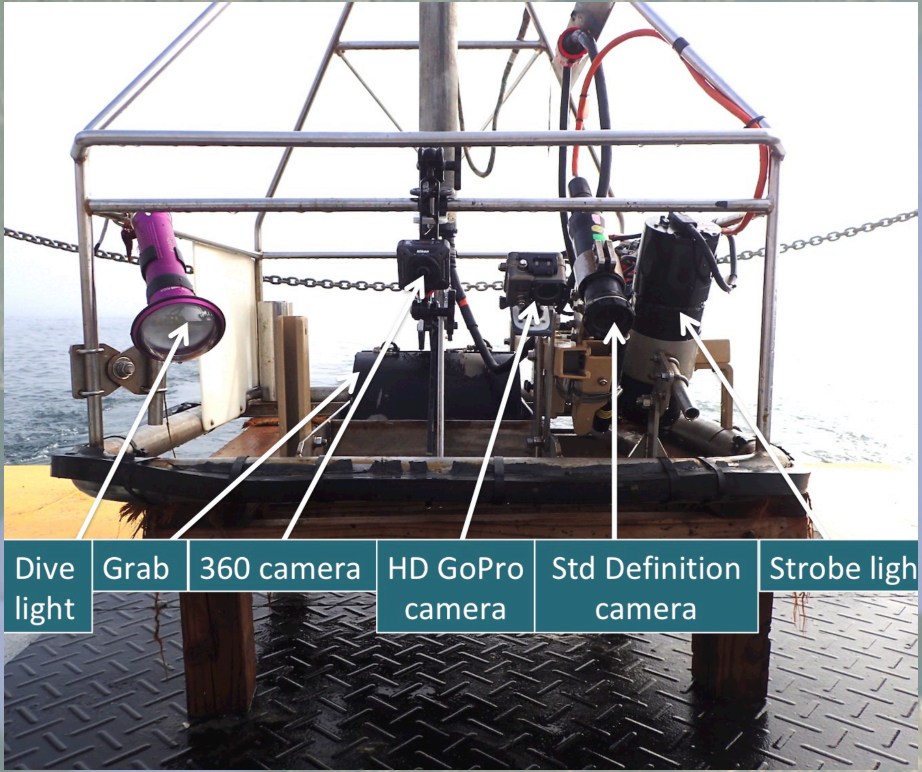


Methods – Sediment Grain Size & Infauna



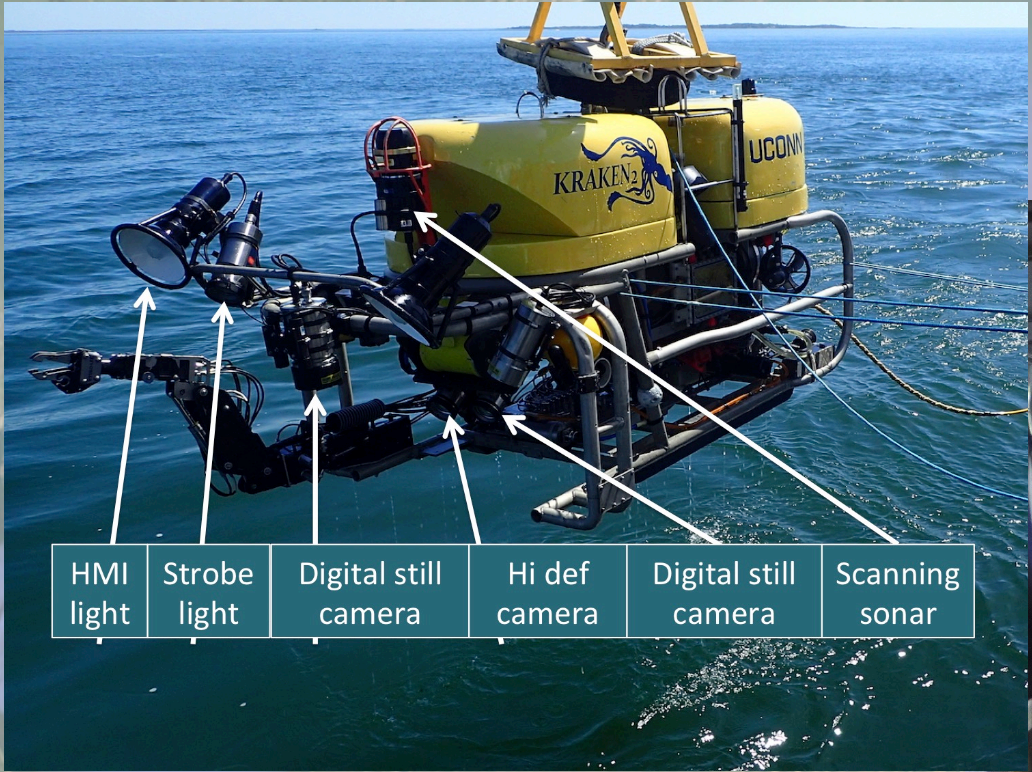
- USGS SEABOSS was used in the Fall, 2017 and Spring, 2018

Methods – Epifaunal Imaging



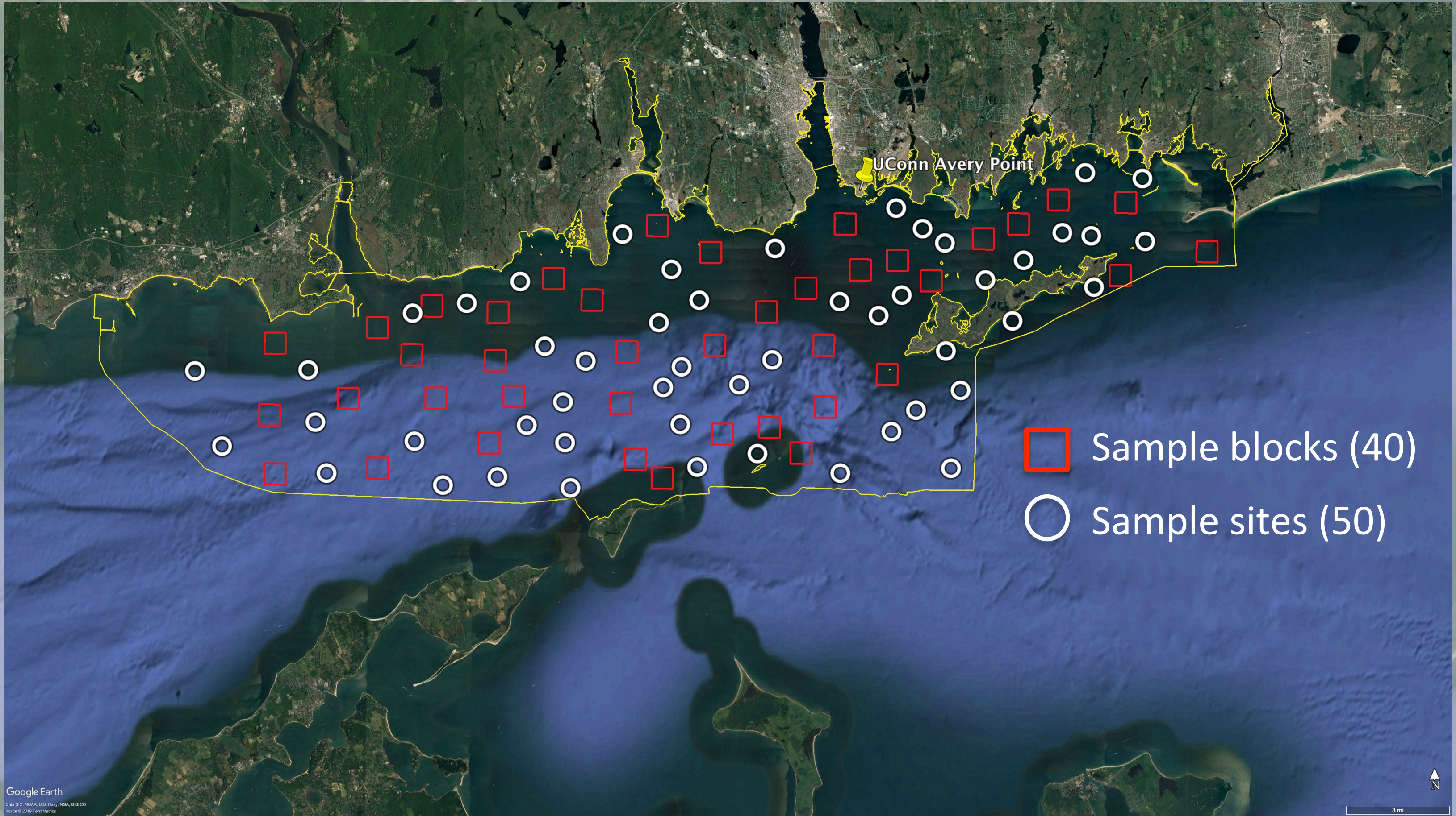
USGS SEABOSS used in the Fall, 2017 and Spring, 2018

Methods – Epifaunal Imaging

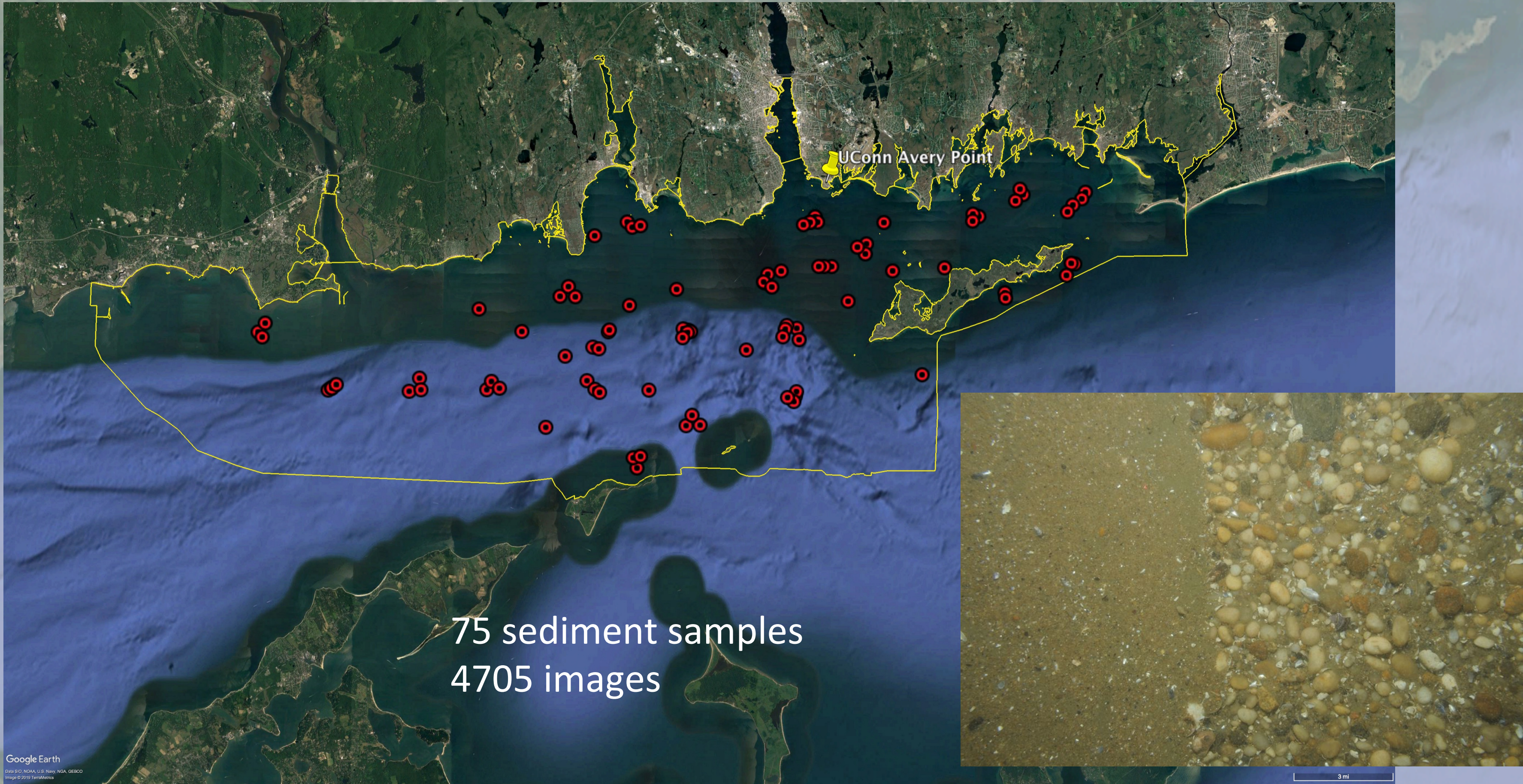


UConn's Kraken2 ROV used in Spring, 2018

Sampling Location Design

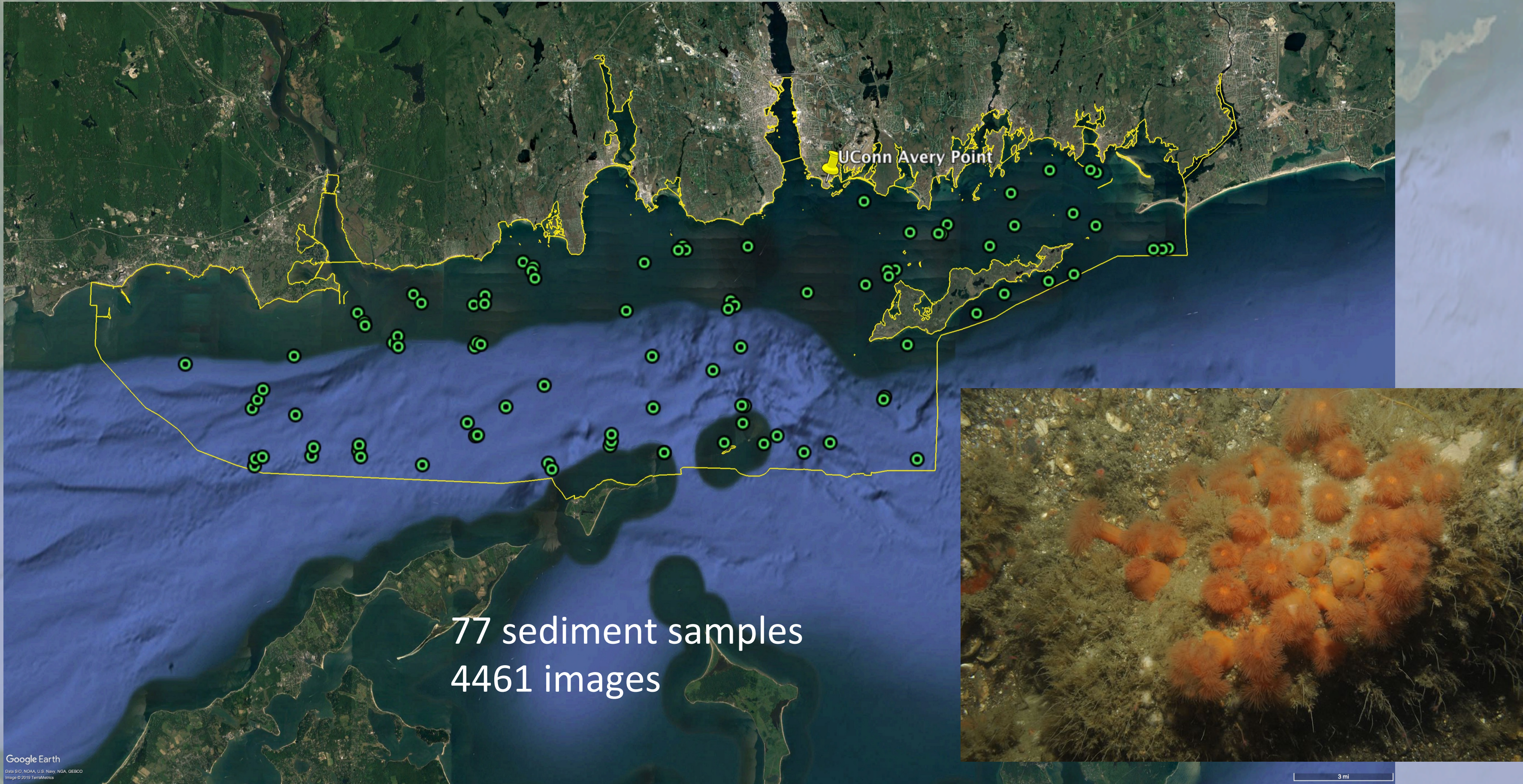


Fall 2017 SEABOSS

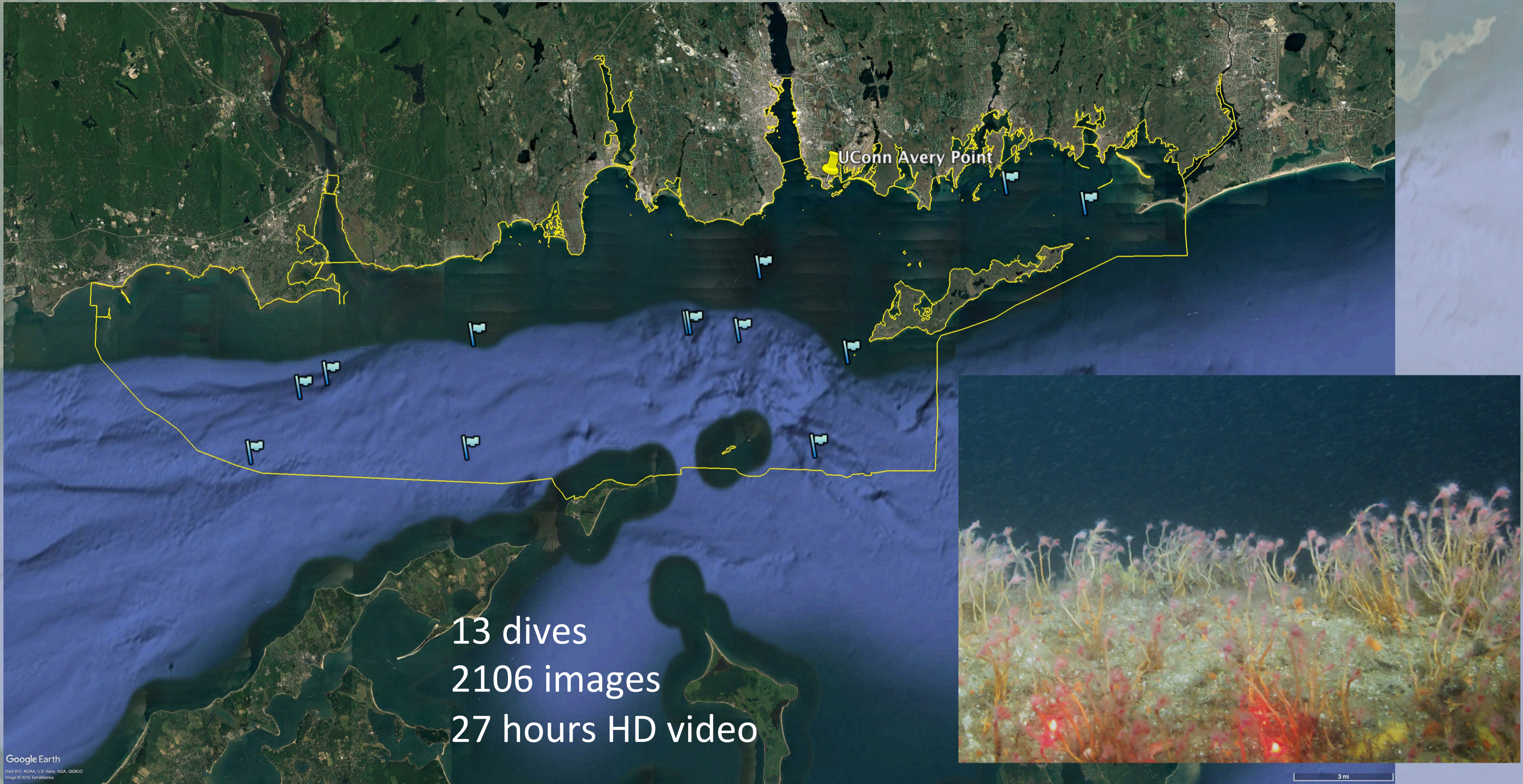


75 sediment samples
4705 images

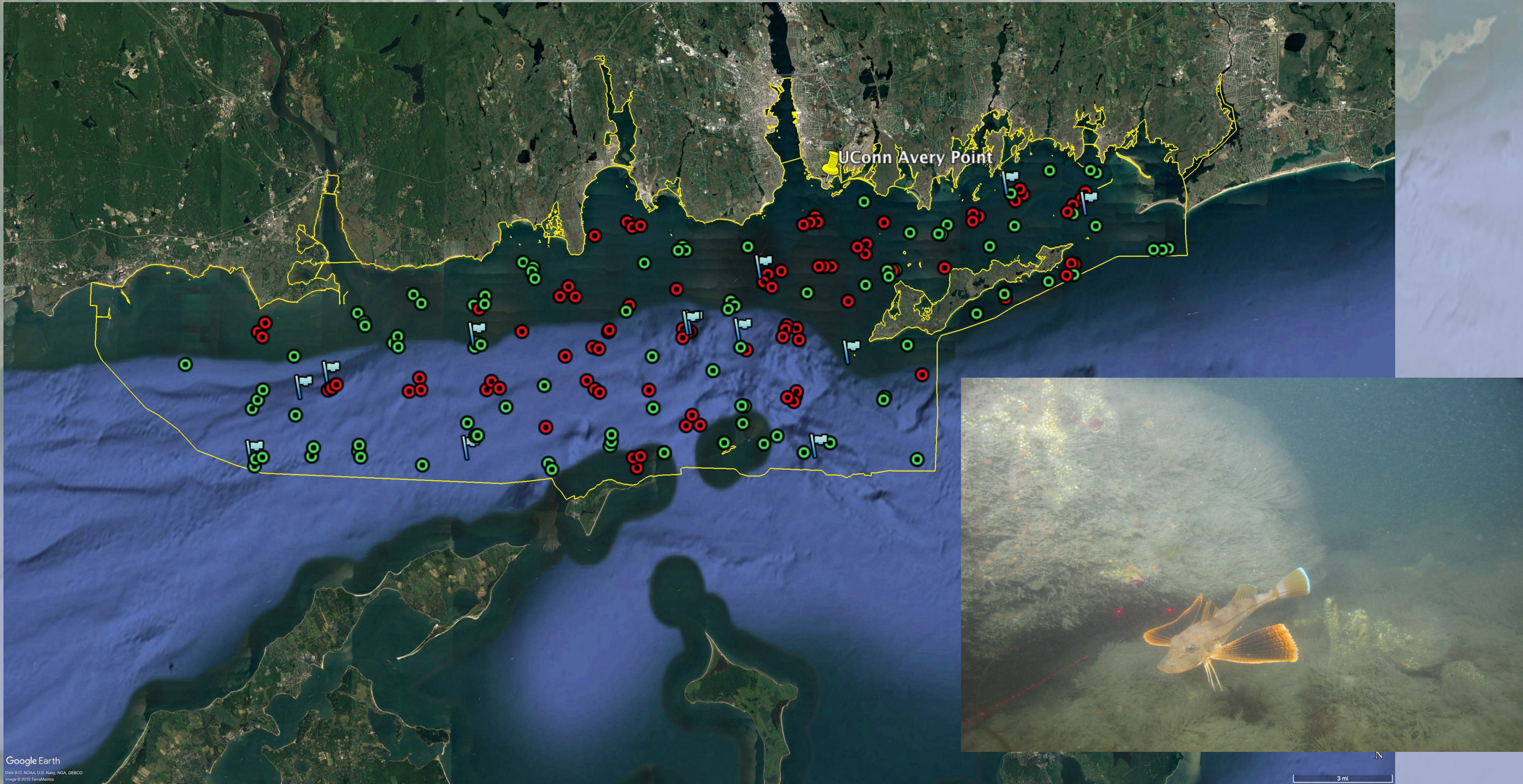
Spring 2018 SEABOSS



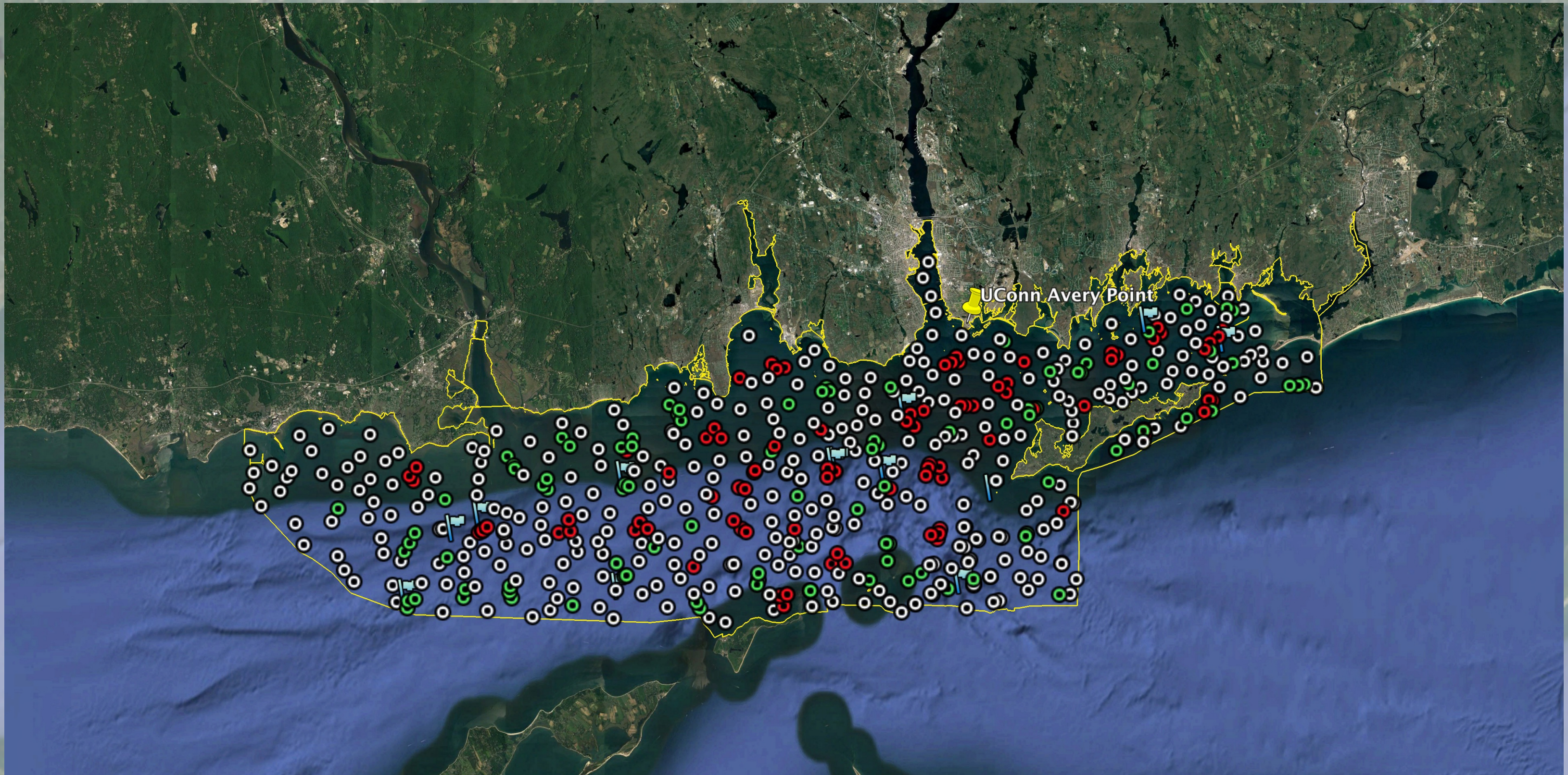
Spring 2018 K2 ROV



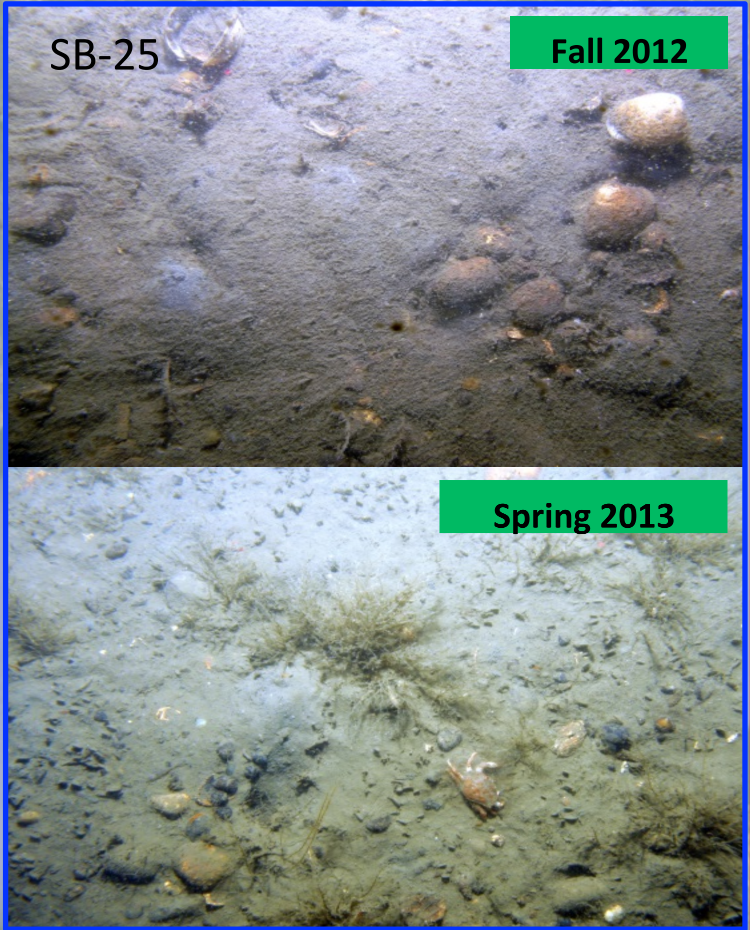
Total Phase II Sampling

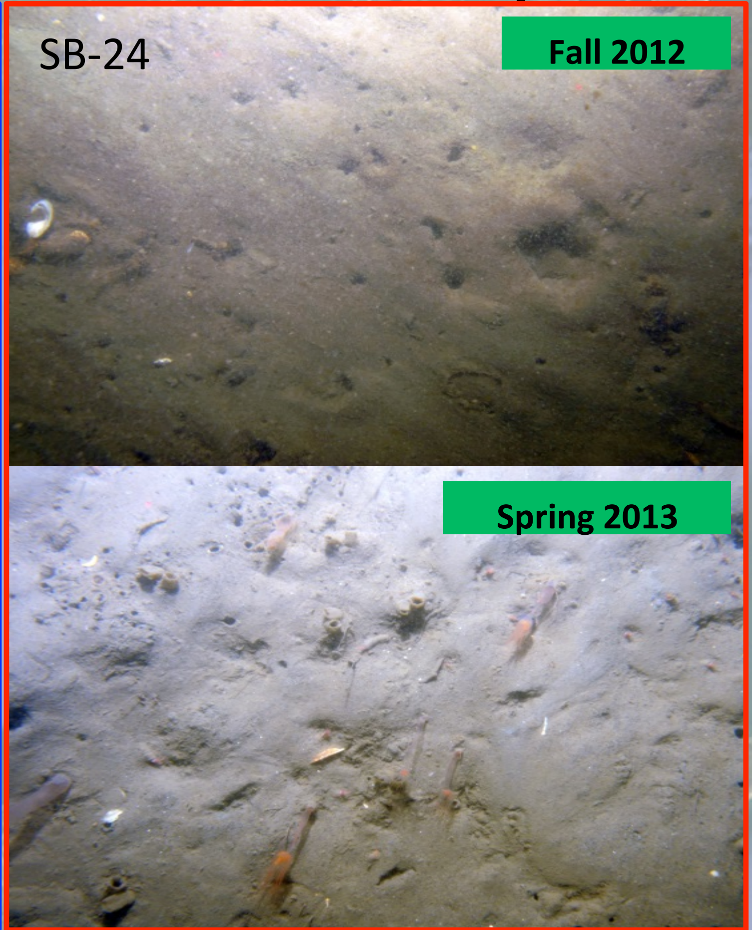


Phase II Sampling
LISMaRC and LDEO Combined



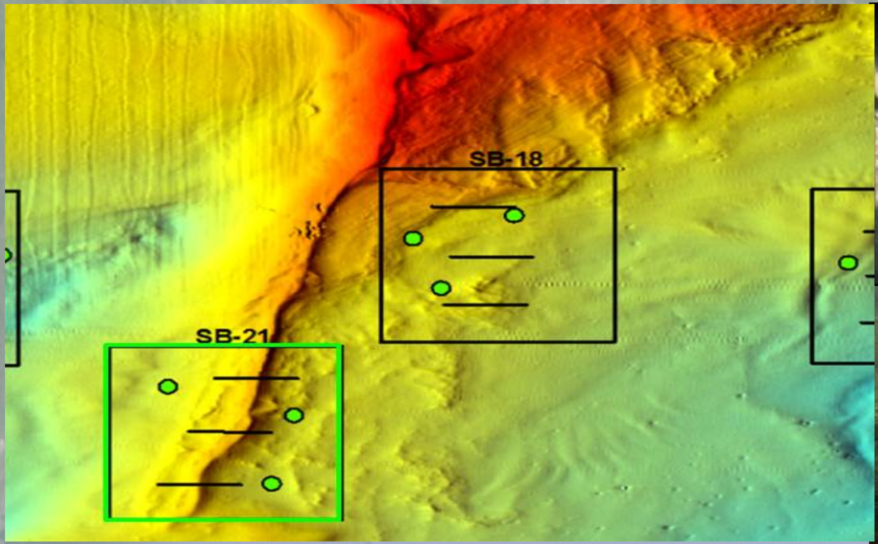
Phase I Results – Inter-seasonal Dynamics





Phase I Results – Inter-seasonal Stability

Phase 1 Results - Boulder Reef Long-term Shift

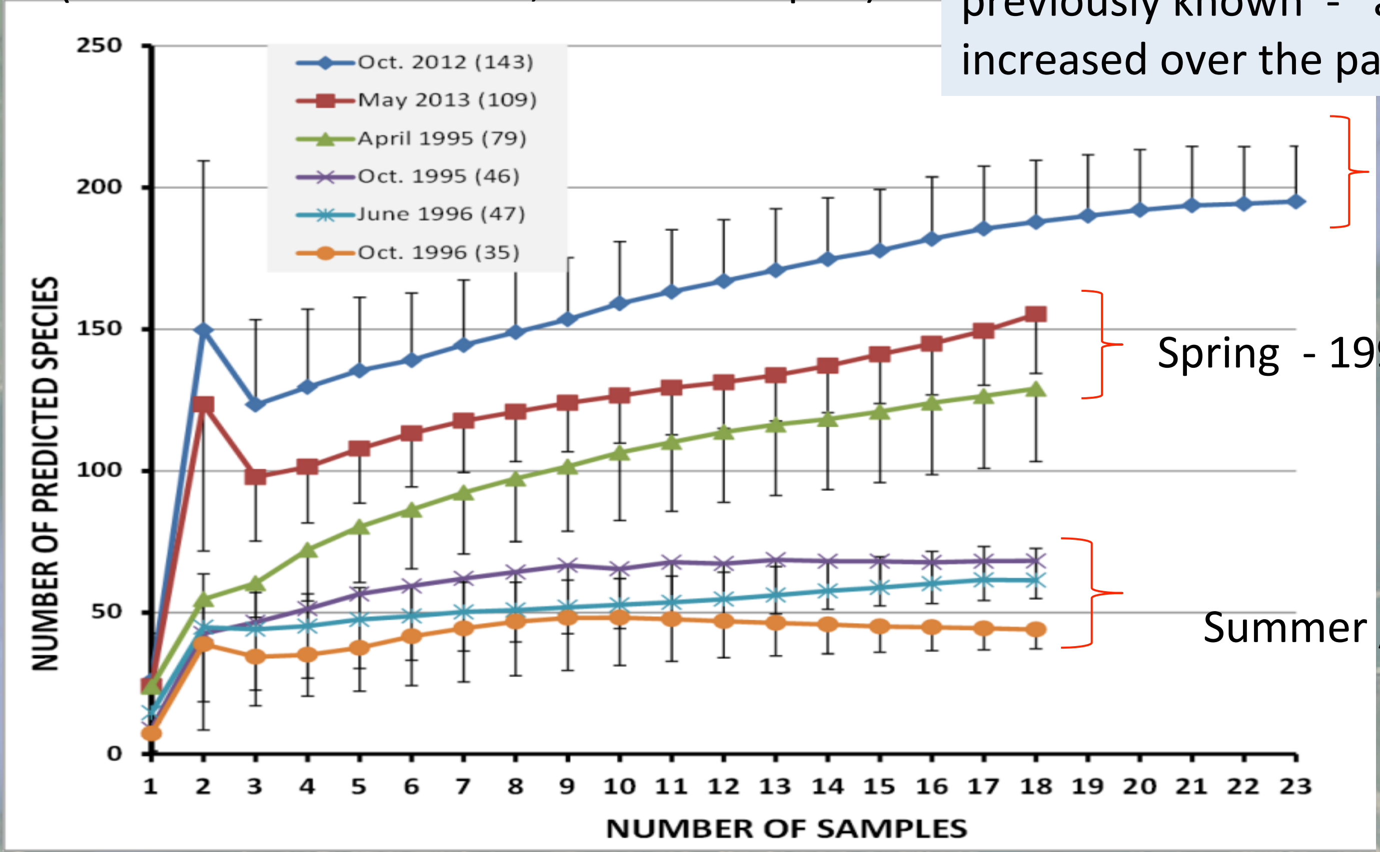


- 1991-2010: *Haliclona oculata*, *Astrangia poculata*, *Mytilus edulis* and branching bryozoa were reef dominants
- 2012-2013: *Haliclona* absent from reef fauna
- A number of mechanisms (e.g., species interactions, disease, recruitment failure, thermal stress, sediment load, freshwater input) may have contributed, individually or synergistically, to the change in this community

Phase I Results - Long-term temporal trends in LIS ecological characteristics

Same area , same sampling design, sieve sizes differ (finer mesh in 94 and 95, smaller sampler)

LIS benthic biodiversity is higher than previously known - and/or has increased over the past several decades.



Fall 2012

Spring - 1995 & 2013

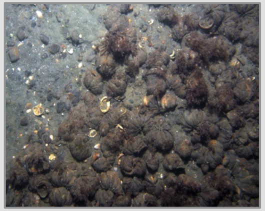
Summer / Fall 1995-1996

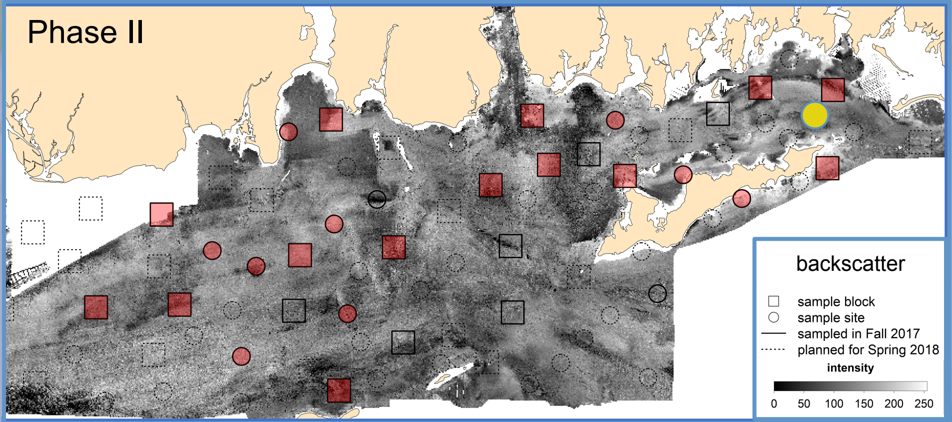
Phase II – Long-term Ecosystem Shift

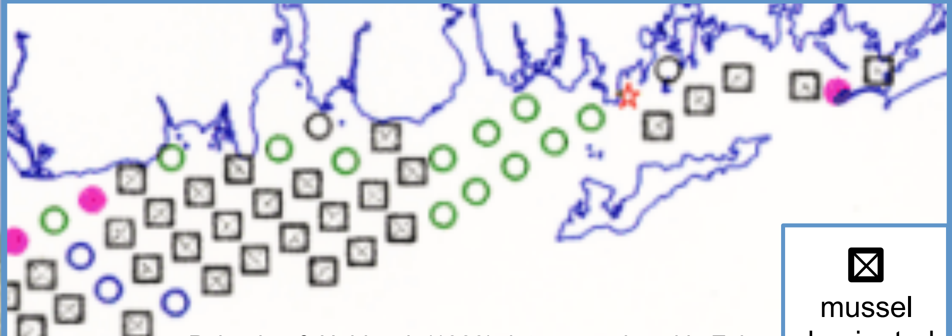
- Compared recent benthic samples with historical data (Zajac, 1998)
- Observed a change from mussel to slipper shell dominated communities
- New research opportunities – e.g is this change food related?

mussels

slipper shells



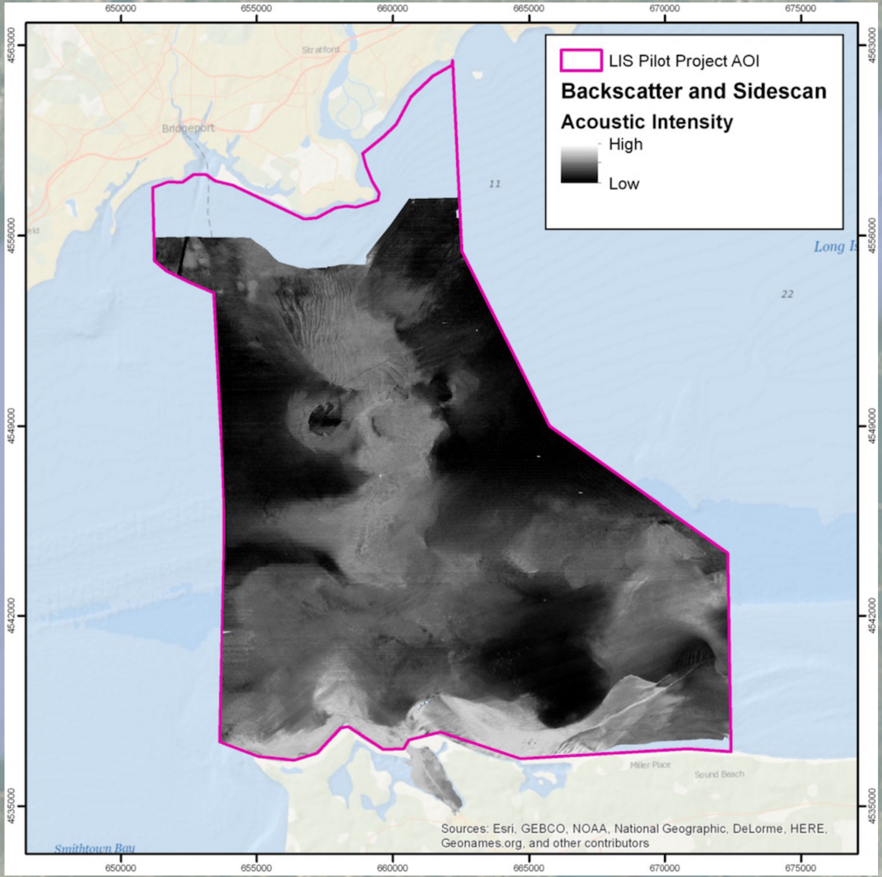




Pelegrino & Hubbard, (1983) data re-analyzed in Zajac (1996)

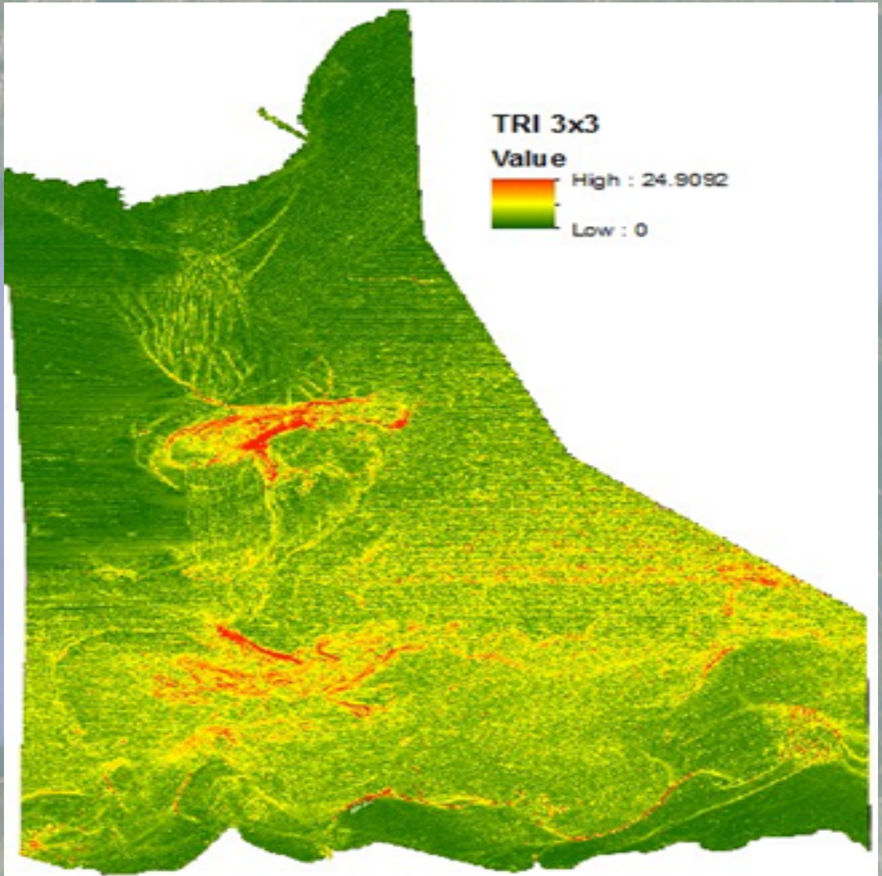
Developing a Habitat Map – Phase I

Backscatter as the proxy for habitat type formed the base layer



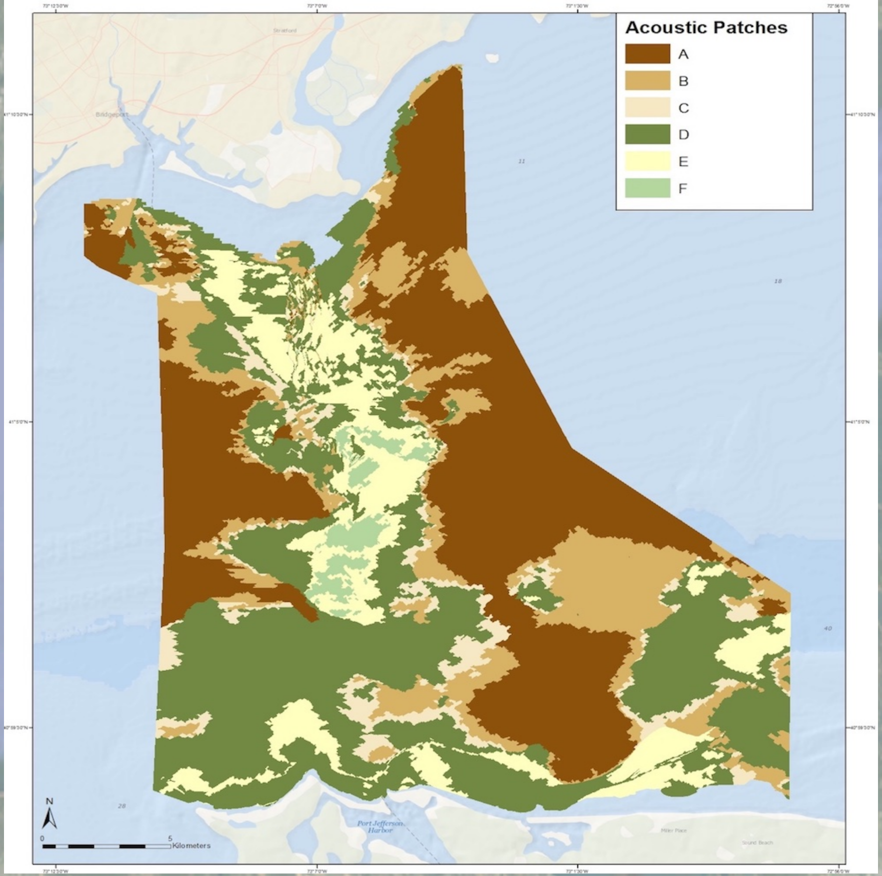
Other Physical Attributes

Bathymetry data was analyzed to develop derived products such as topographic roughness index (TRI)



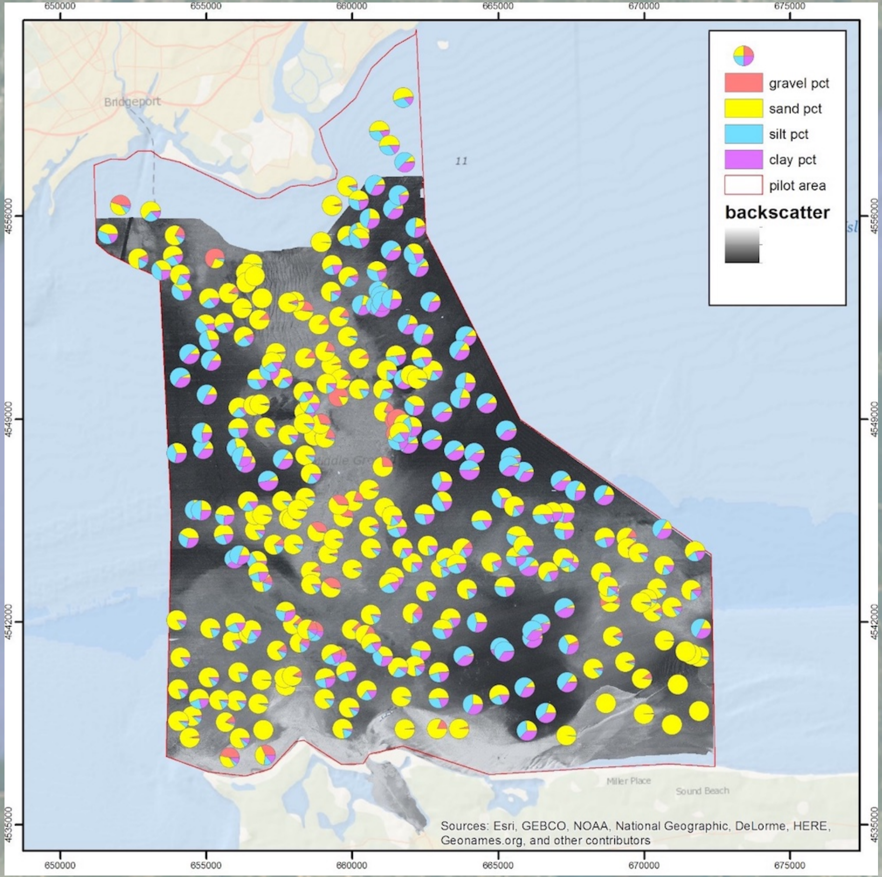
Classifying the Acoustic Signals

eCognition software parsed the acoustic data into 6 classes or “patches” based upon the return strength value. These patches formed the basic units of the Habitat Map.



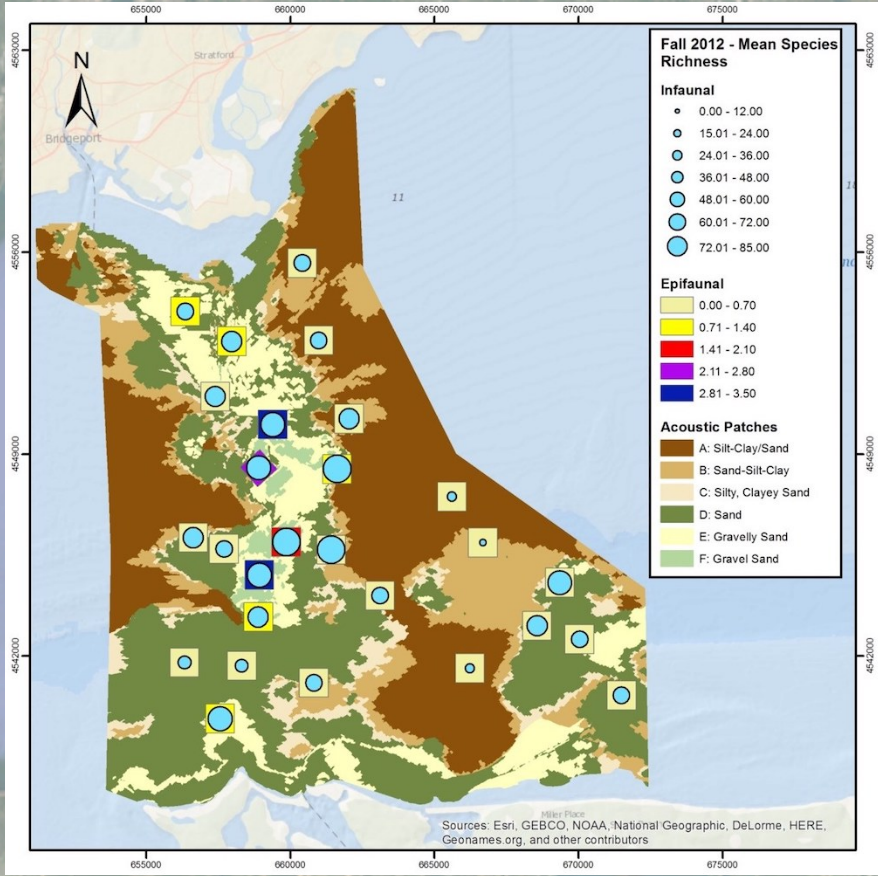
Refining the Acoustic Patches

The acoustically derived patches were ground-truthed to relate them to the real world nature of the seafloor by sediment grain size analyses.



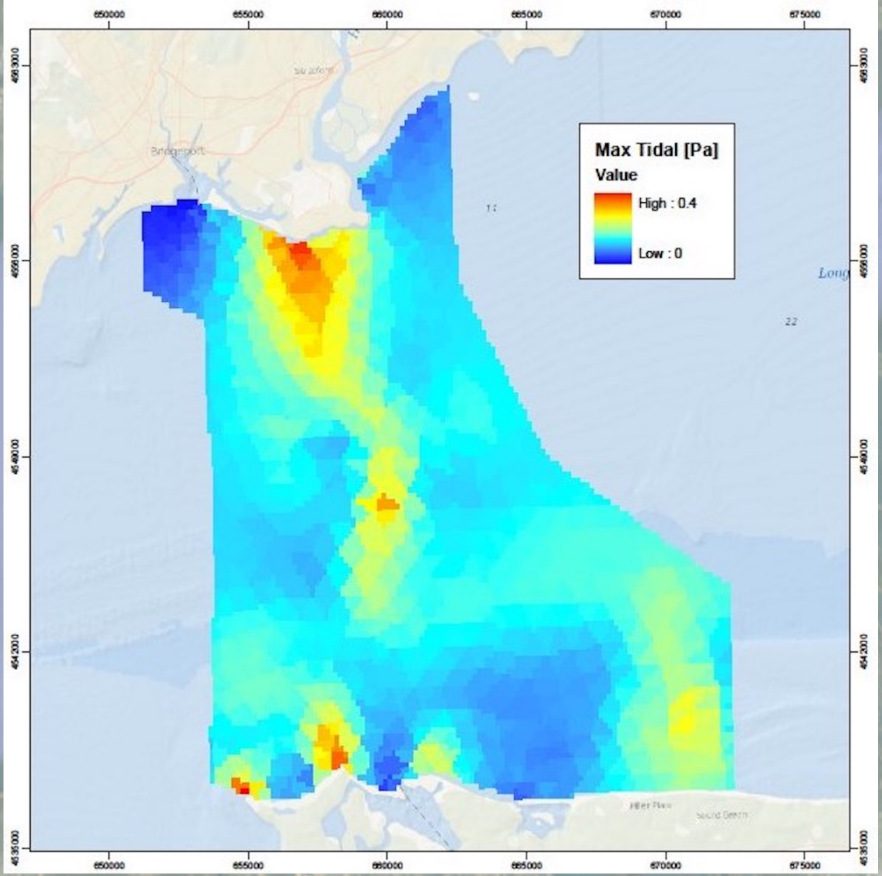
Integrating Ecological Data

Both infaunal data derived from sediment analyses and epifaunal data derived from image and video analyses were integrated into the map. Ecological data was collected in both fall, 2012 and spring, 2013.



Considering the Physical Environment

Physical oceanographic predictions of tidal stress were also integrated into the habitat map. The models were developed from long-term observations in the Phase I site

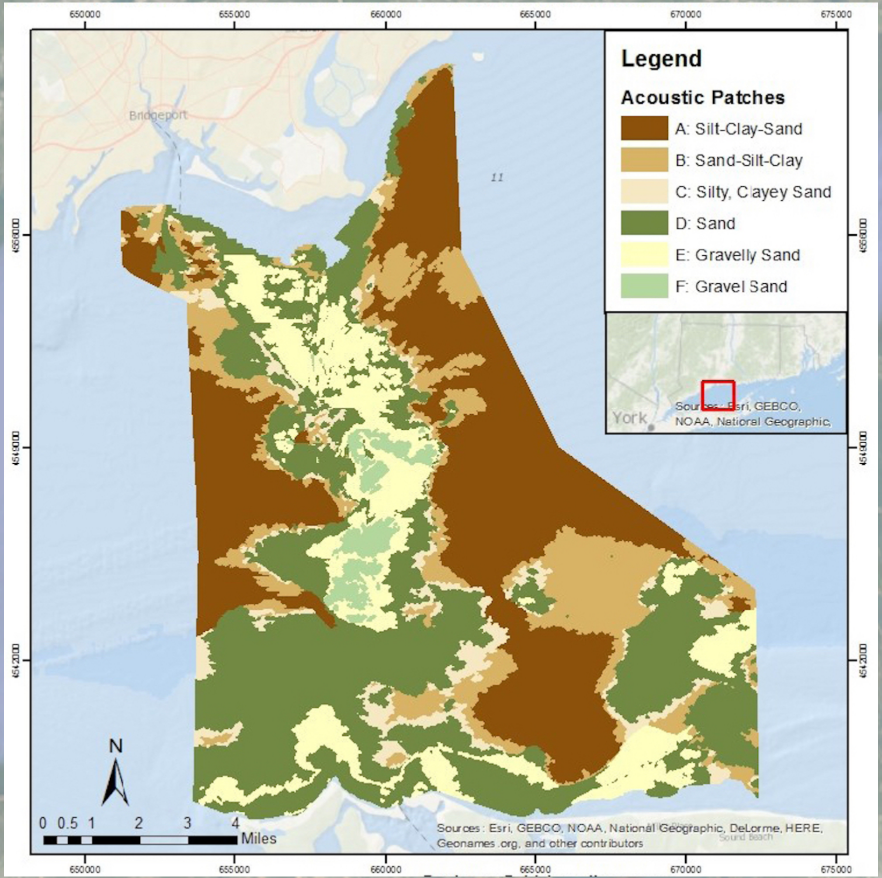


The Final Habitat Map

The integrated Habitat Map began with backscatter data segmentation

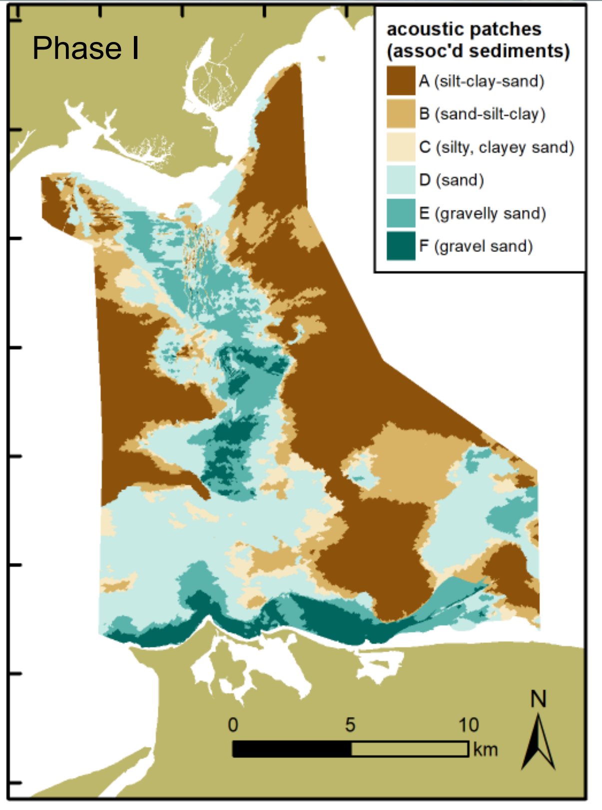
Abiotic characterization was added including sediment grain size, bathymetry, slope, rugosity, and bottom stress

Biotic characterization included both dominant infauna/epifauna community metrics

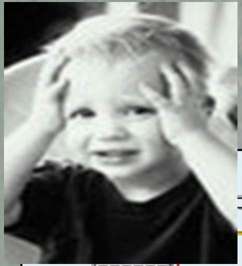


Comprehensive Habitat Map

Physical and Ecological Characteristics of Acoustic Patches					
Acoustic Patch	**Bottom Stress**	**Backscatter Intensity Range**	**Infauna**	**Epifauna**	**Biogenic Features**
A	low – medium	0 – 55	mixed burrowing and tubiculous taxa	*Bostrichobranchus pilularis*, *Mytilus*	shell, burrows
B	low – high	55 – 77	tubiculous taxa, motile surface feeders	bivalve, *Corymorpha*, *Bostrichobranchus pilularis*	shell
C	medium	77 – 87	variable mix of tubiculous taxa and burrowers	*Mytilus*, *Corymorpha*, *Bostrichobranchus pilularis*	burrows, shell
D	high – medium	87 – 130	small tubiculous taxa, high density of bivalves	hydroids, *Mytilus*, barnacles	high coverage of shell patches and burrows
E	high	130 – 173	Oligochaetes and Archiannelids, small tubiculous taxa, deep burrowing taxa	hydroids, *Mytilus*, *Astrangia*	high coverage of shell patches
F	high	173 – 254	Oligochaetes and Archiannelids, small tubiculous taxa, moderate bivalve abundances	*Crepidula*, *Diadumene*, *Astrangia*	high coverage of shell patches



Habitat Mapping as a Tool for Better Coastal and Marine Spatial Planning & Management

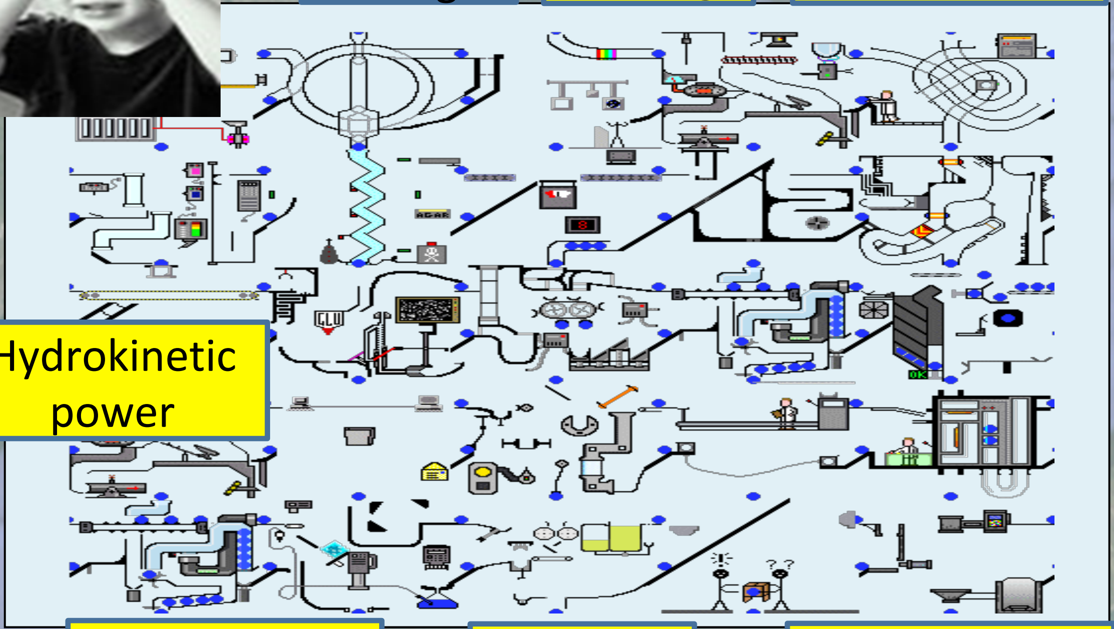


Climate Change

Fishing

Aquaculture

Hydrokinetic power



Wind power

Pipelines

Power cables

- Site selection
  - Ecological criteria and function
  - Necessary physical attributes
  - Stability and change
- Balance multiple uses
  - Economy
  - Energy
  - Fisheries
  - Tourism

Thanks to..

- Seth Ackerman, Dann Blackwood – USGS, SEABOSS
- Kevin Joy, Dennis Arbige – UConn, K2 ROV
- Crew of the RV Connecticut

Funded by..

- Long Island Sound Cable Fund
- Long Island Sound Study

Long Island Sound Study
A Partnership to Restore and Protect the Sound

Questions?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