USDA
United States Department of Agriculture

Coastal Zone Soil Survey

Natural Resources Conservation Service

Luis Hernandez, Soil Survey Region 12 Director
Donald C. Parizek, 12-TOL Soil Survey Project Leader
Debbie Surabian, State Soil Scientist for CT and RI

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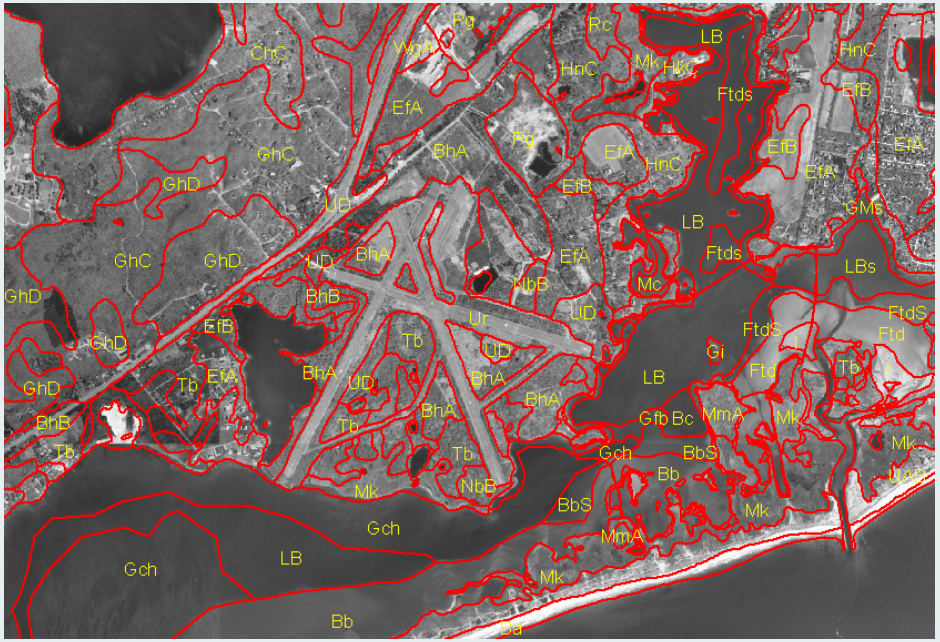
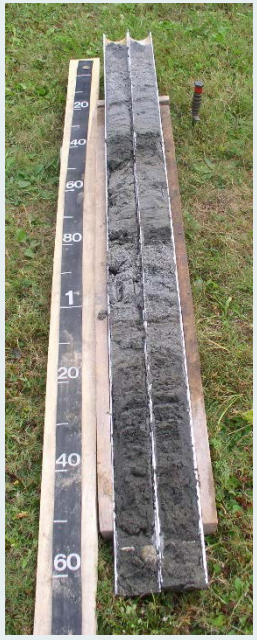
Helping People Help the Land

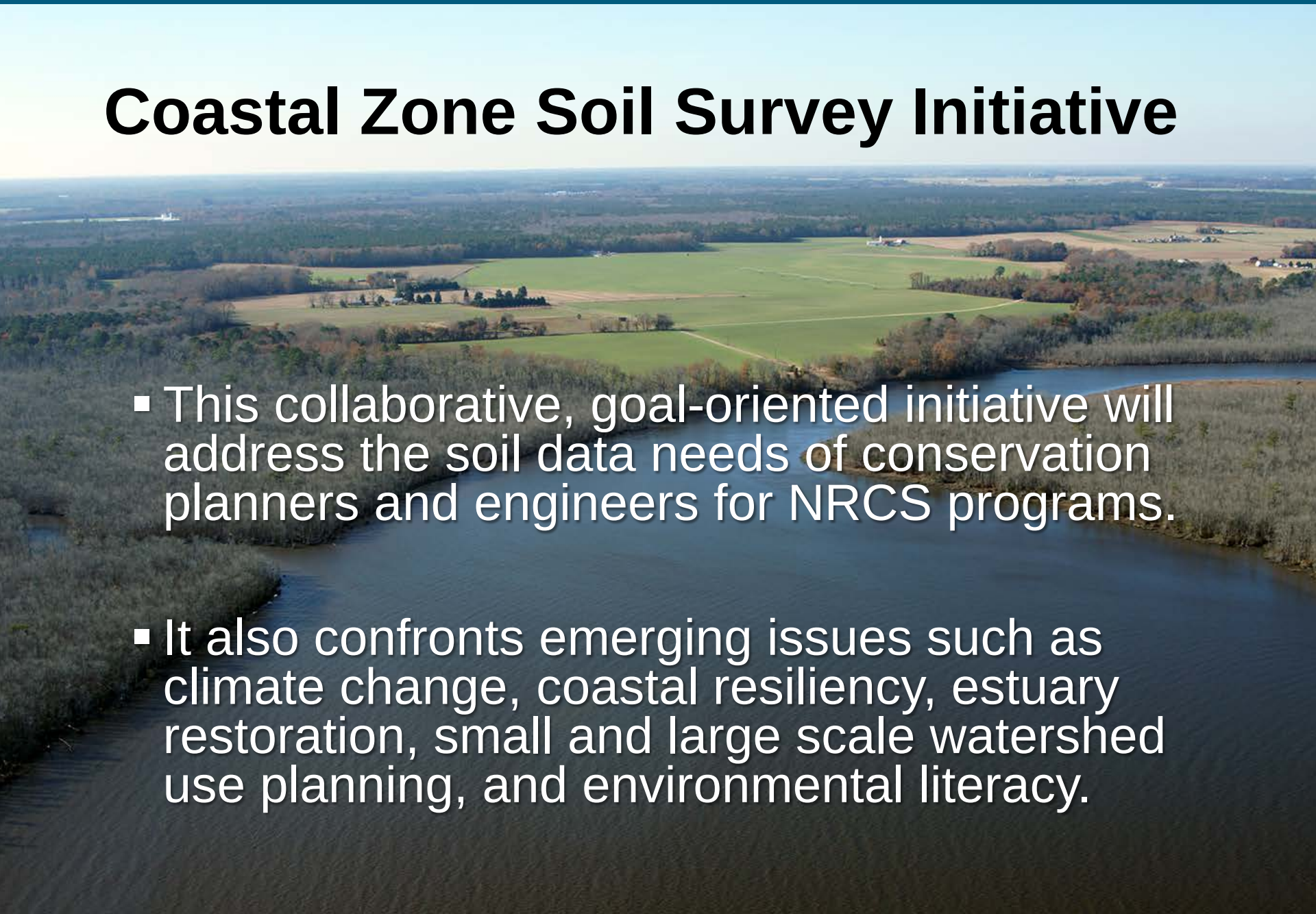
What are Coastal Zone Soil Surveys?

Coastal zone soil surveys include nearshore or subaqueous soils, along with adjacent terrestrial soils including upland tidal marshes or barrier beaches.





Coastal Zone Soil Survey Initiative



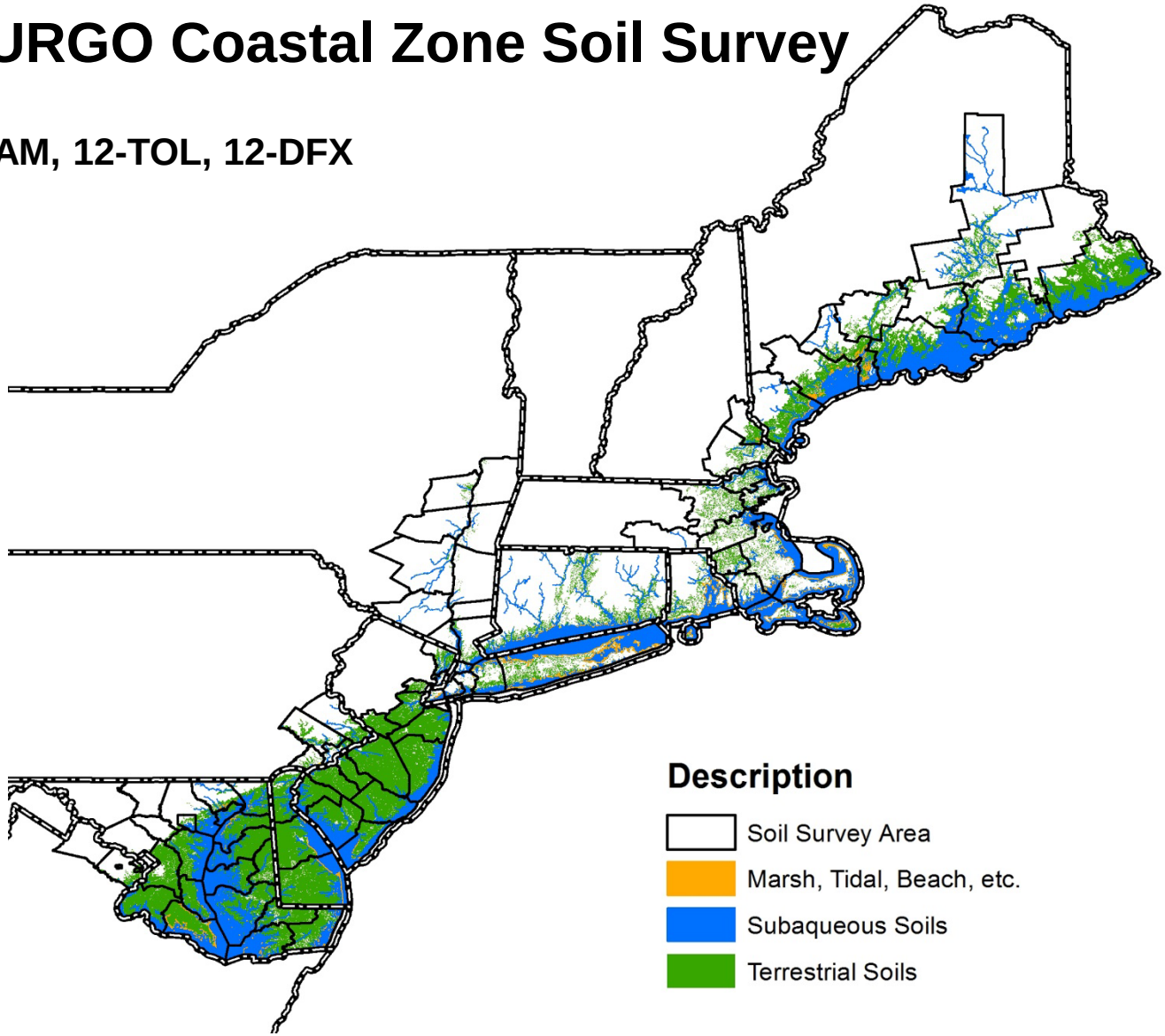
- This collaborative, goal-oriented initiative will address the soil data needs of conservation planners and engineers for NRCS programs.

- It also confronts emerging issues such as climate change, coastal resiliency, estuary restoration, small and large scale watershed use planning, and environmental literacy.

Potential SSURGO Coastal Zone Soil Survey

3-HAM, 12-TOL, 12-DFX

The main goal of this initiative is to complete a coastal zone soil survey encompassing portions of MLRA's 144A, 144B, 145, 149B, 149A, and 153D.



A Case For Costal Zone Soil Survey

- **Sea Level Rise — 0.4 to 0.1 inches per year** in the last 100 years

  (NOAA, 2016)

- Value of Aquaculture — Doubling current U.S. aquaculture could result in **50,000 jobs** and over a **$1 Billion in farm-gate value**

  (Source: G. Knapp, Offshore Aquaculture in the United States, NOAA Tech Memo NMFS F/SPO-103)

- **16.4 Million** U.S. residents live within the coastal flood zone

  (NOAA, 2012)

- **Ecological Site Descriptions** — A thorough understanding of the subaqueous and subaerial **soils systems** interactions for successful coastal zone restoration and conservation, an agency priority

A Case For Costal Zone Soil Survey…

- **The definition of soil** includes subaqueous soils *(Soil Survey Staff, 1999)*
- **Soil Science** is the fundamental building block for all other resource management
- **Carbon Accounting** and Climate Change Research, Blue Carbon
- **NRCS Programs** EWP — Coastal Flood Plain Easements $5 Million plus on approximately 90 parcels in CT alone, require updated soils information
- **Coastal Wetland Restoration Efforts**, require updated soils information
- **Building New Partnerships —** Expanding the customer base for Soil Survey
- **21st Century Soil Survey —** Making Soil Survey Relevant in the Future, New Issues and Interpretations

Super Storm Sandy Damage
Fair Haven, CT 2012

Oyster Farming in Long Island Sound

Barn Island Salt Marsh WMA,
Stonington, CT

Definition of Soil

A natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by one or both of the following:

- horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment *(Soil Survey Staff, 1999)*.

Wassents

Entisols that have a positive water potential at the soil surface for more than 21 hours of each day in all years.
(*Keys to Soil Taxonomy 12th Edition, 2014)*

Wassists

Other Histosols that have a positive water potential at the soil surface for more than 21 hours of each day in all years.
(Keys to Soil Taxonomy 12th Edition, 2014)

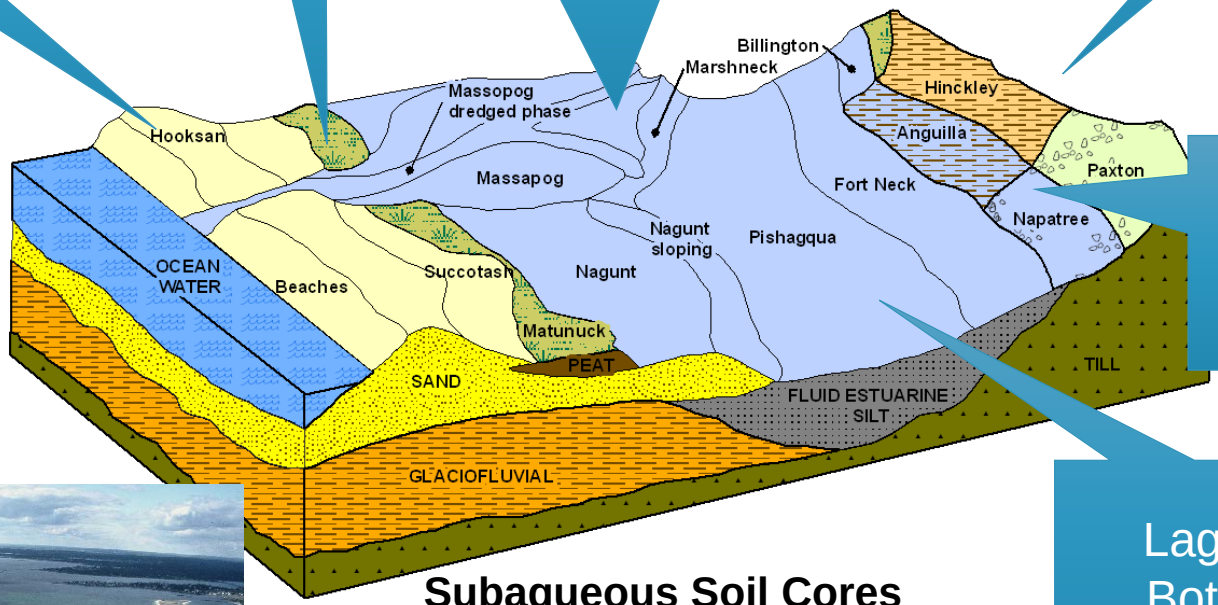
Coastal Zone Soil Systems

Coastal Dune

Salt Marsh

Washover fan Subaqueous

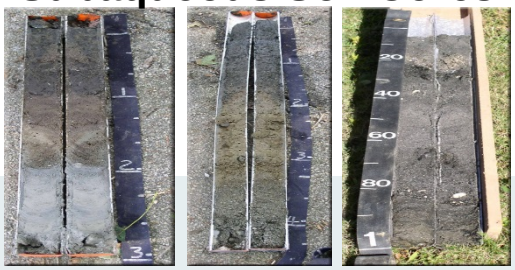
Uplands



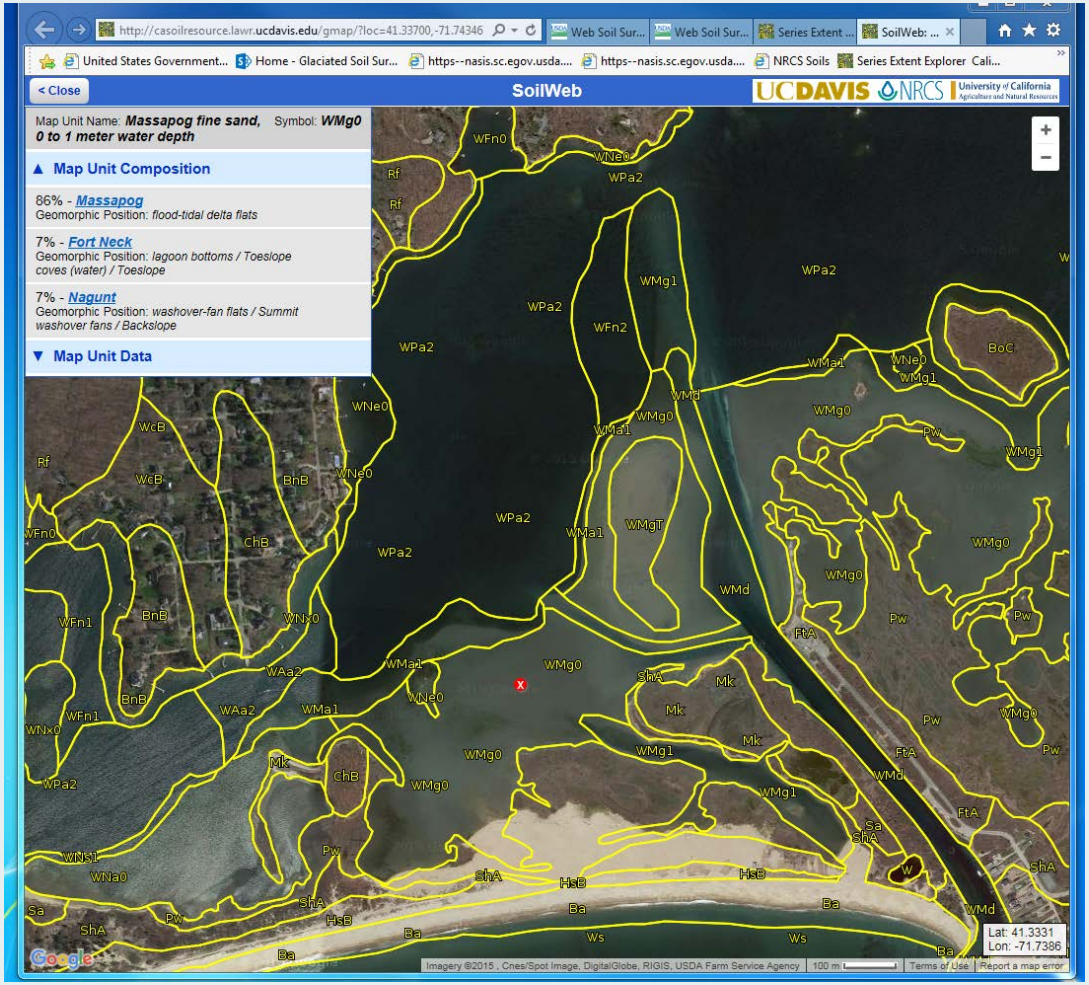
Submerged Headlands Subaqueous

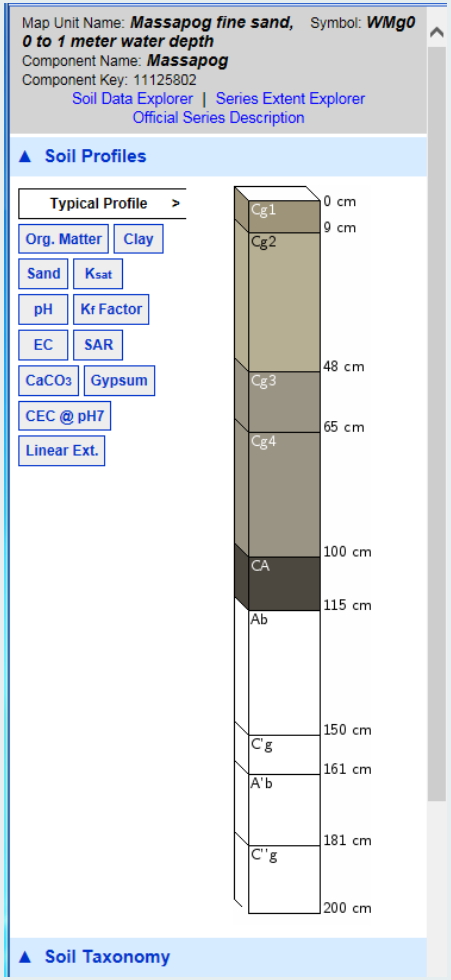
Lagoon Bottom Subaqueous

Subaqueous Soil Cores



Published Coastal Zone Soil Survey In Rhode Island





Subaqueous Soil Survey

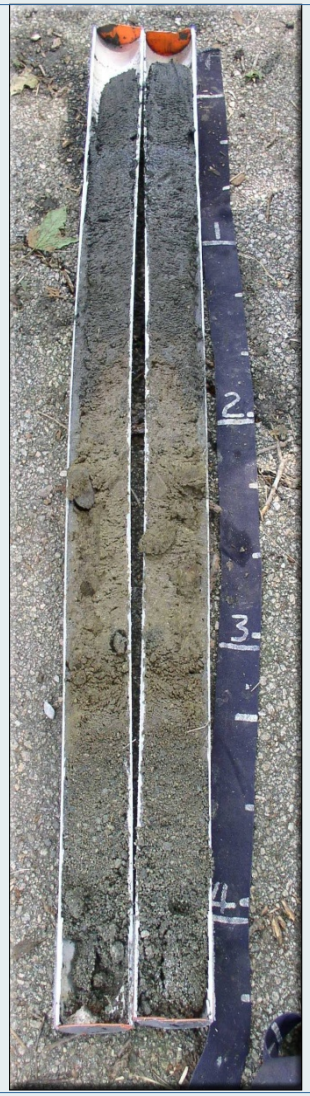
Subaqueous Soil Investigations Using a Bucket Auger — Little Narragansett Bay, 2006

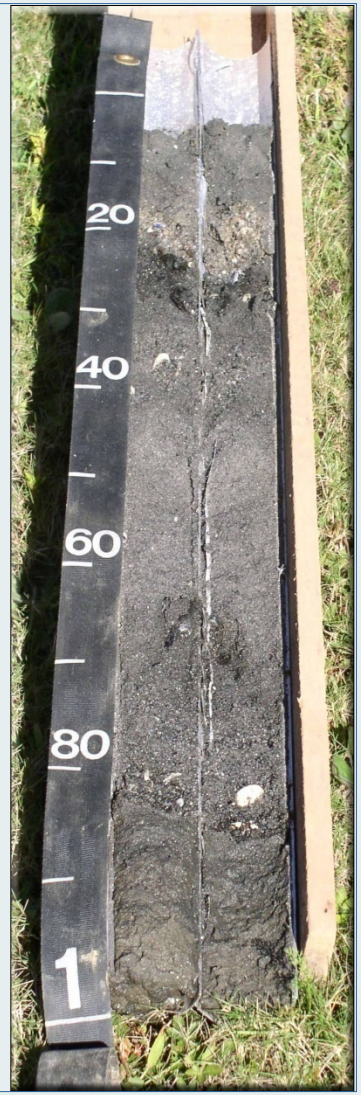
NRCS Soil Survey Staff Retrieving A Subaqueous Soil Core — Thimble Islands, Branford, CT 2014

Vibracoring in Little Narragansett Bay, 2006

Subaqueous Soils

- Horizons
- Texture
- Color
- Consistence
- Additions
- Losses
- Transfers
- Transformations

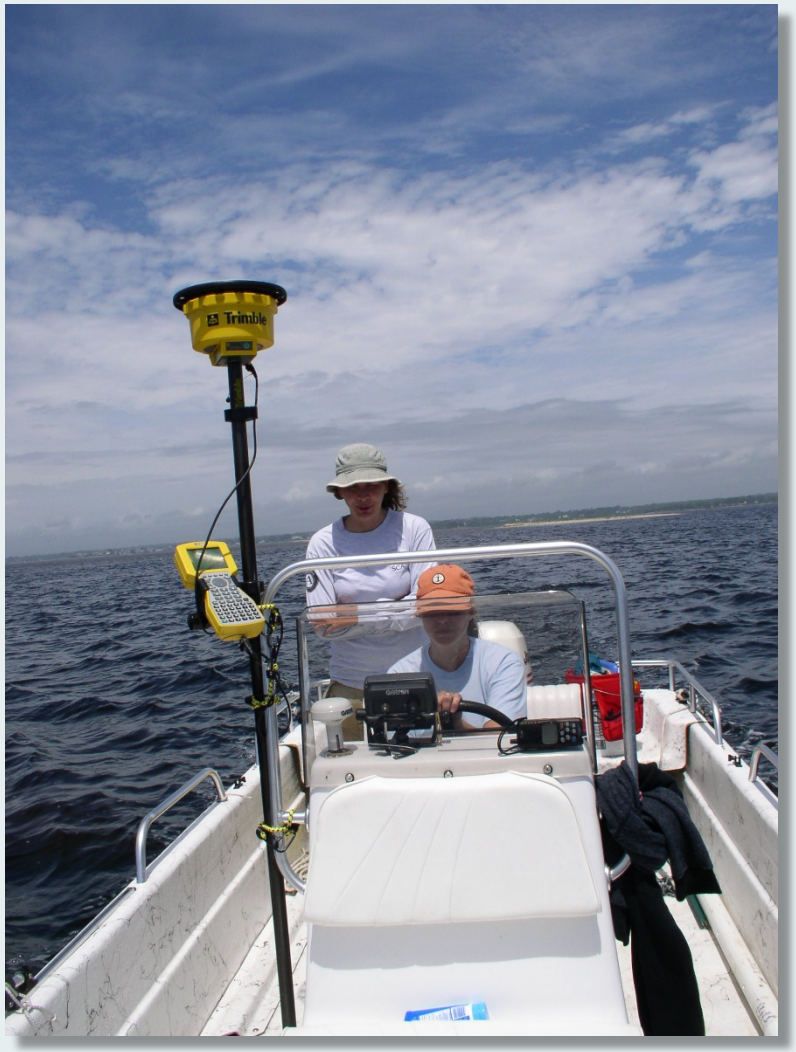




Subaqueous Soils and The Stratigraphic Record

- Record of Past Environments
- Current Conditions
- Prediction Model for Sea Level Rise

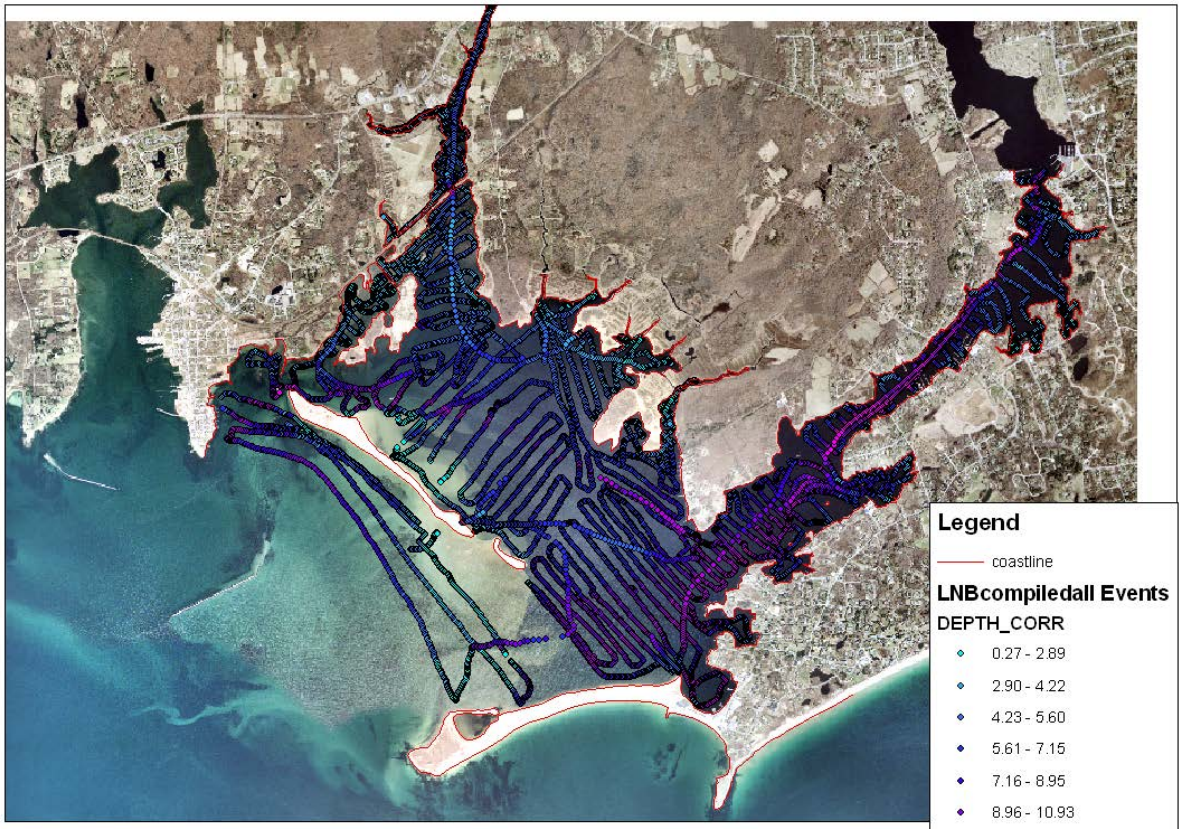
Collecting Bathymetry



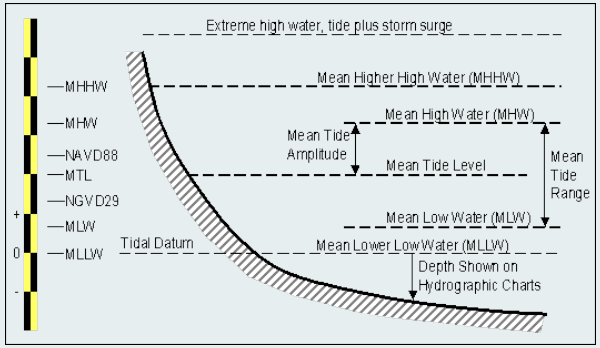
- Tidal Corrections, NAVD88
- GPS and RTK Survey Equipment
- Fathometer
- Tidal Gages and the Lunar Cycle

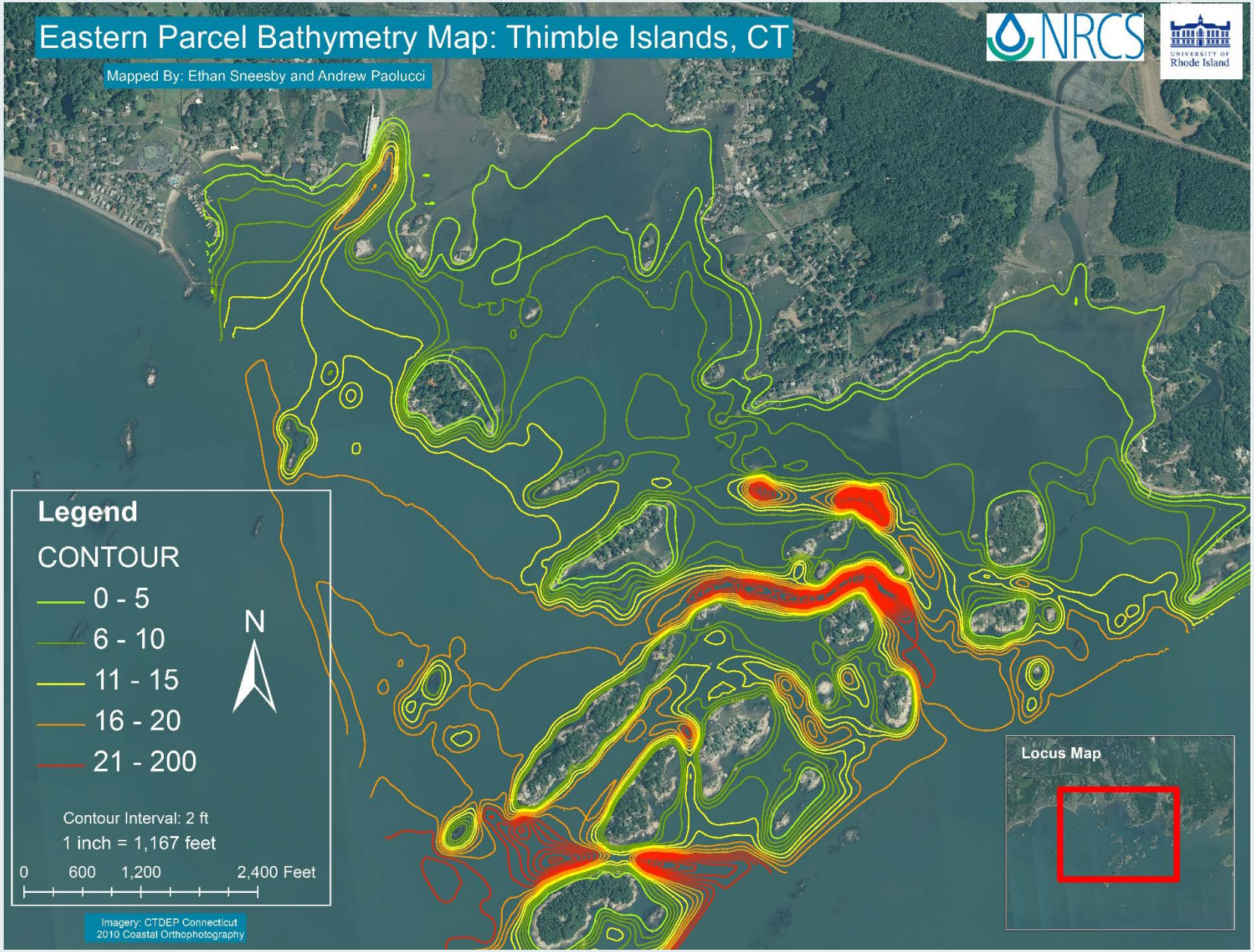
Bathymetry Tracks

“Mowing The Lawn”



- **Complete Coverage**
- **Time Consuming**
- **Post Processing Required**
- **Tidal Correlations Required**
- **The Base Map**




Eastern Parcel Bathymetry Map: Thimble Islands, CT
Mapped By: Ethan Sneesby and Andrew Paolucci
NRCS
University of Rhode Island
Legend
CONTOUR
0 - 5
6 - 10
11 - 15
16 - 20
21 - 200
N
Contour Interval: 2 ft
1 inch = 1,167 feet
0 600 1,200 2,400 Feet
Imagery: CTDEP Connecticut
2010 Coastal Orthophotography
Locus Map

Reconnaissance and Mapping

The Use of Traditional Tools in a New Way

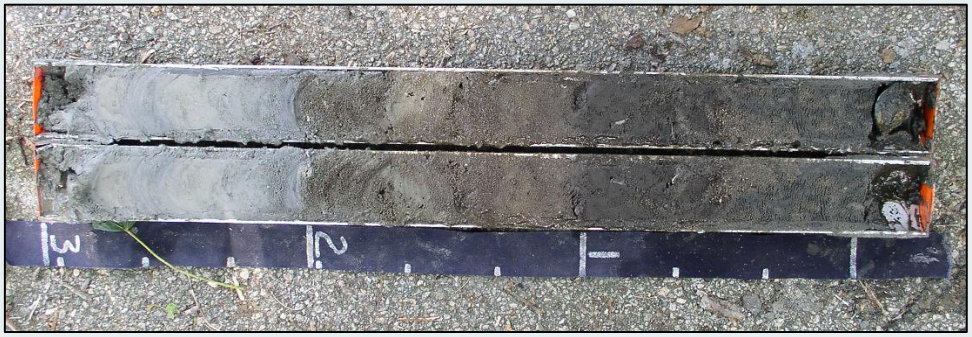
- Bucket Auger
- Peat Samplers
- Probes

The 1 Meter Peat Probe

Terrestrial Coastal Zone Updates

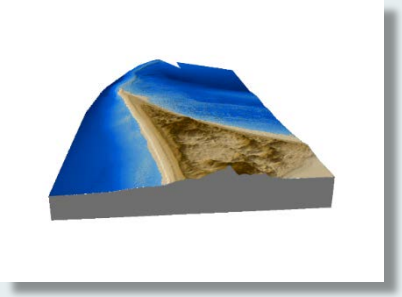
Vibracoring Techniques

Cutting the Cores

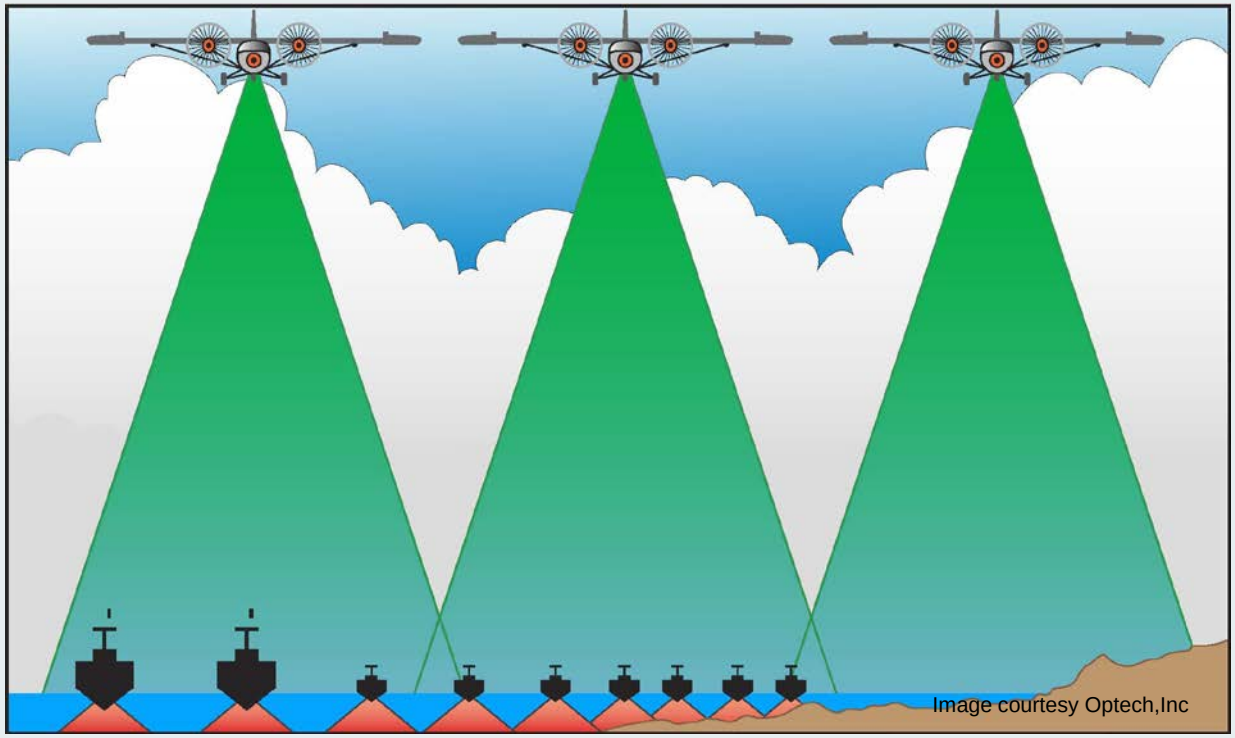


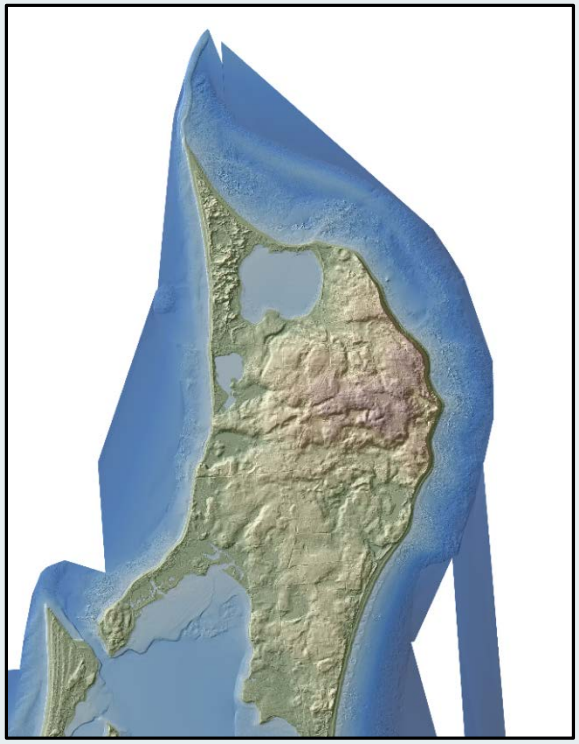
Describing Cores in the Lab

Green Laser LIDAR Topobathy

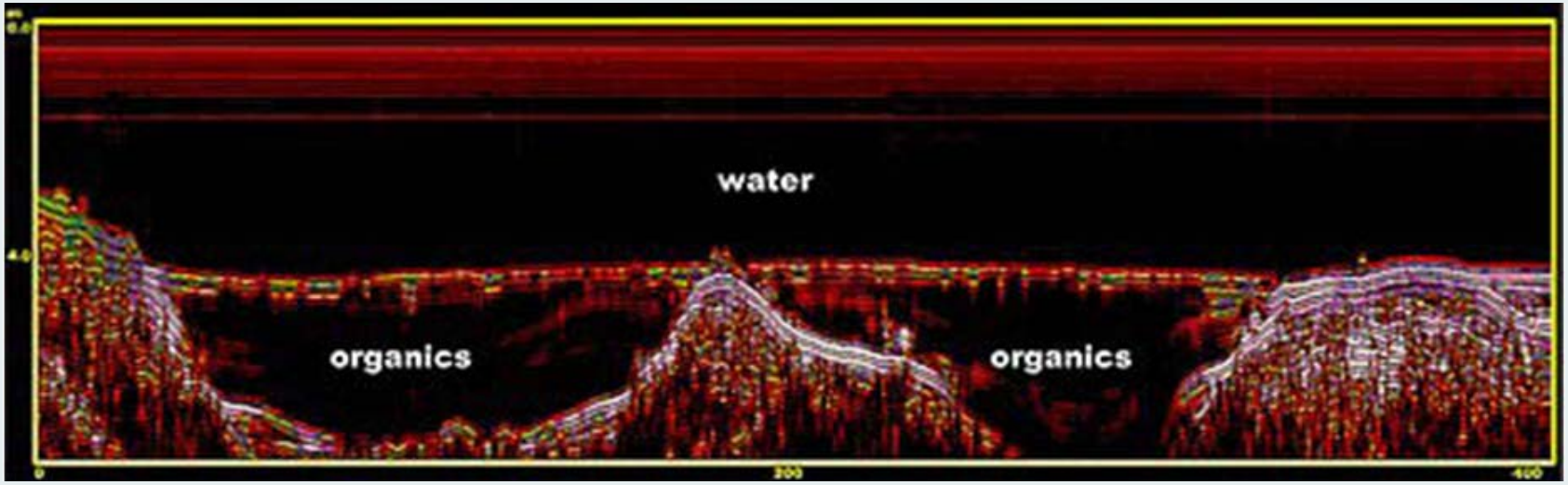


- Applicable to Nearshore Areas
- Affected by Turbidity
- Not continuous at this time
- Huge Potential for Base Mapping





Freshwater Subaqueous Soil Survey


water
organics
organics
0
300
400

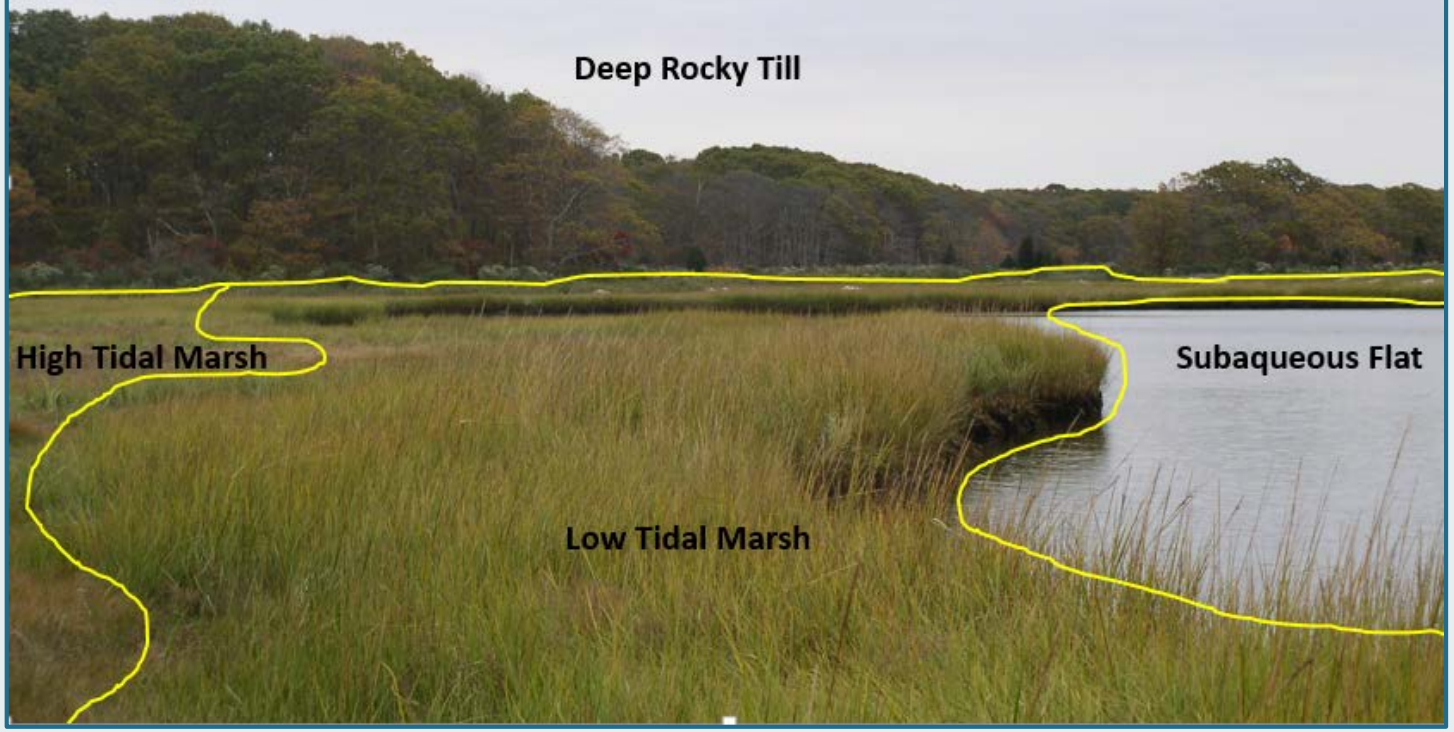
Safety

Starts With Proper Planning

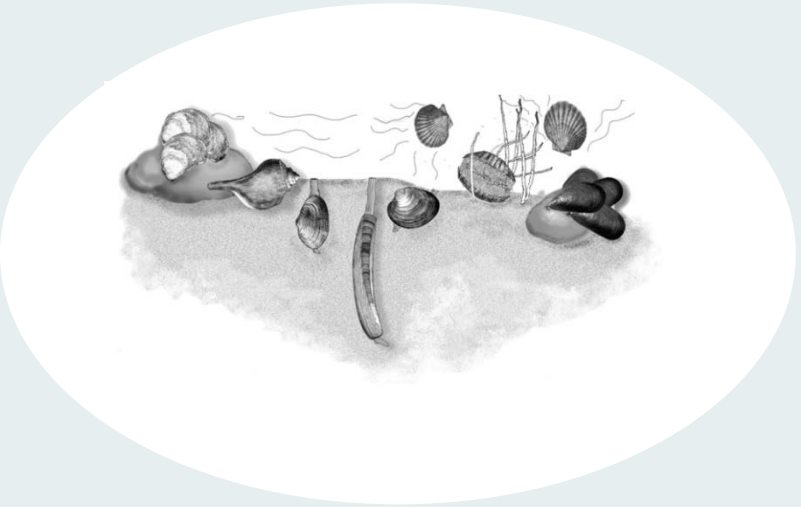
- Competent Boat Operators
- Well Maintained Boats Specific To The Task
- Watch the Weather and Tides
- File a Float Plan with your office or family
- Safety Equipment Aboard:
  - ✓ life jackets
  - ✓ flares
  - ✓ hard hats
  - ✓ ropes
  - ✓ anchors
  - ✓ first aid kits, etc.
- Communications Equipment
- Water and Soil Quality Concerns

Ecological Site Descriptions

An **ecological site** is a conceptual landscape division defined by recurring soil, landform, geological, and climate characteristics. A site produces distinctive kinds, amounts, and proportions of vegetation and **responds similarly to management actions and natural disturbances.**



Soil based interpretations that could be developed:



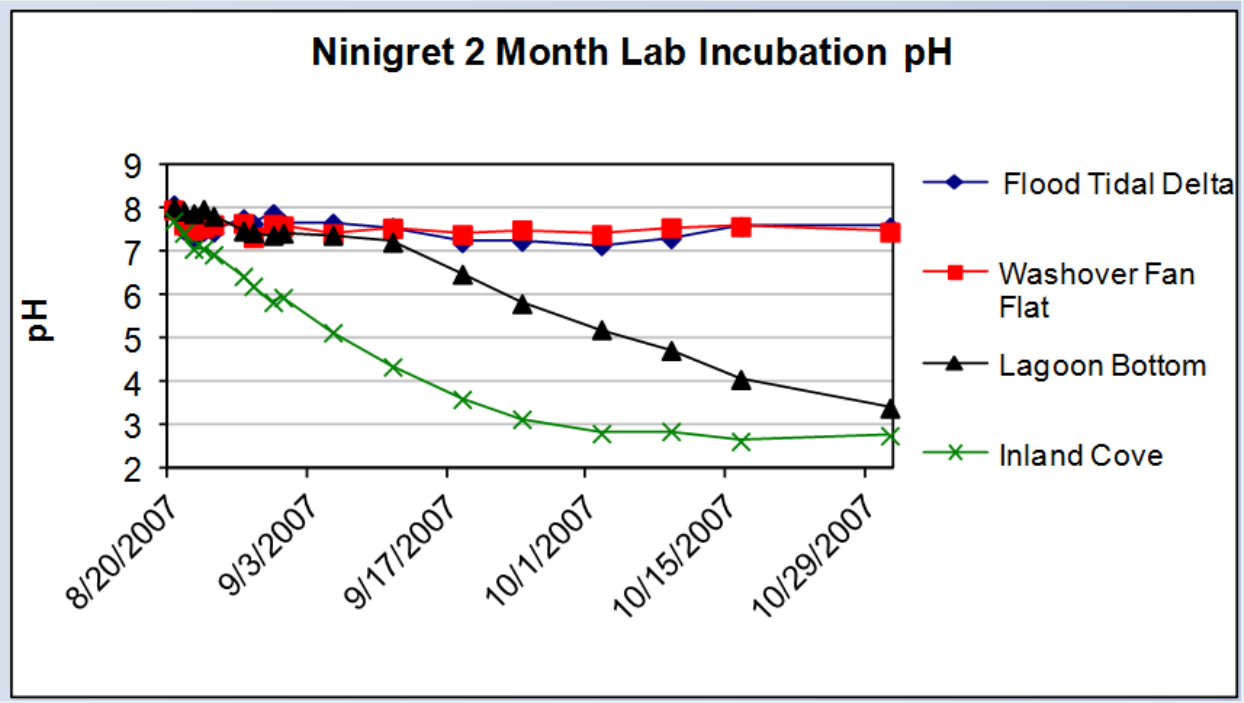
- Soil Potential for Coastal Acidification **
- Soil Suitability for Hard Clam Habitat**
- Soil Suitability for Eastern Oyster Habitat Restoration**
- Soil Suitability for Eelgrass Restoration**
- Moorings – Deadweight and Mushroom Anchors **
- Land Utilization of Dredge Materials**
- Shoreline Erodibility
- Climate Change vulnerability
- EPA ESI Shoreline Cleanup (oil spills)
- Tidal Marsh Protection and Creation
- Blue Carbon Assessment
- Crab Habitat
- Horseshoe Crab Habitat
- Lobster Habitat
- Nutrient Reduction
- Wading Shore Birds and Migratory Waterfowl
- Diamondback Terrapin Nesting Areas
  Endangered in Rhode Island and Threatened in Massachusetts
- Navigational Channel Creation/Maintenance
- Dune/Beach Maintenance and Replenishment
- Carbon Sequestration
- Dock Development and Maintenance
- Living Shorelines

**currently being developed

Upland Placement of Estuarine Dredged Material University of Rhode Island Mesocosm Experiment

- Fine textured materials reached acidic conditions in less than 2 months and formed acid sulfate soils (oxidized pH test)

- As little as 5 percent of fine textured materials may influence the extent and duration of the development of acidic conditions



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Land Utilization of Dredge Materials

USDA United States Department of Agriculture

Presence of Sulfidic Materials

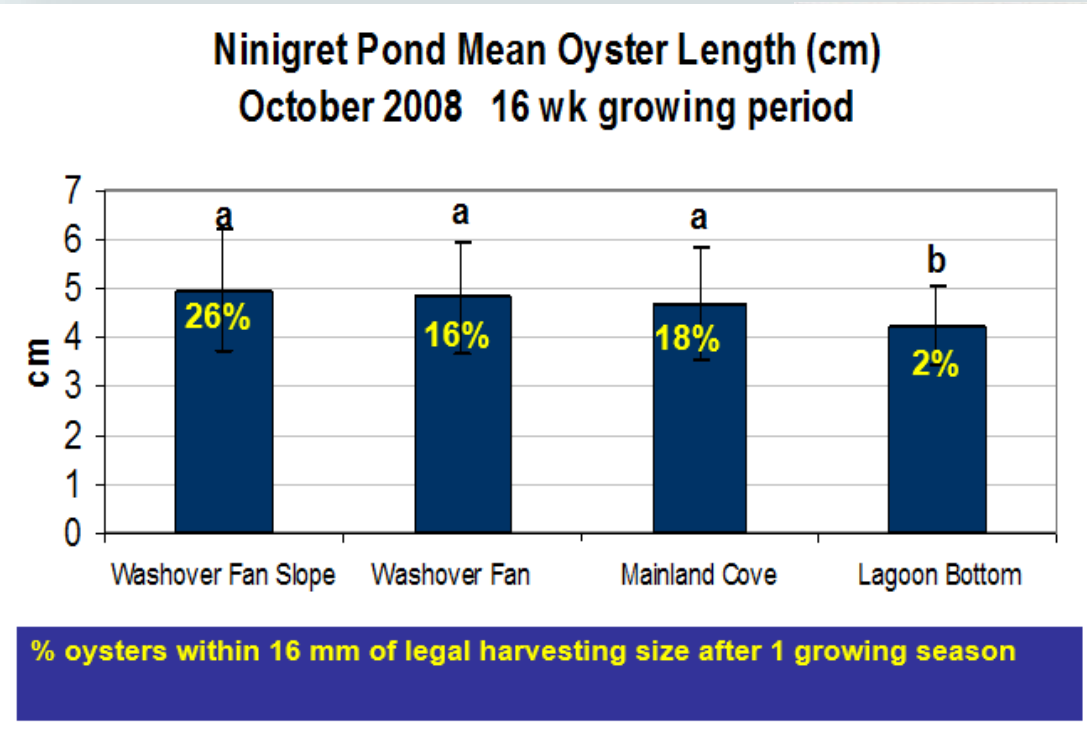
Sulfidic Materials **Not Rated**

These soils contain sulfidic materials in the soil profile. If drained or dredged and exposed to air, sulfides will oxidize and create acid sulfate drainage causing serious environmental damage.

Areas of sulfidic materials mapped as water may exist outside of the Coastal Zone Soil Survey of Little Narragansett Bay and on the Soil Survey of Connecticut and Soil Survey of Rhode Island. This map does not replace the need for an onsite soil investigation.

Shellfish Growth Research
University of Rhode Island

- Grain size of surface horizon predictor of oyster growth
- Shellfish grew faster on coarser textured soils
- Soil surveys can provide managers with a tool for locating future aquaculture farms



Success of Eelgrass Restoration Projects in the Northeastern United States

Location	Project	Sites attempted	Sites successful	Size	Reference
Maine	Wells NERR Project	2	0	T	Short et al. (1993)
New Hampshire	NH Port Mitigation Project	5	2	2.52 ha	Short et al. (1995), This study
	NH TERFS™ Method Development	6	2	T	Short et al. (2002)
Massachusetts	NOAA New Bedford Harbor Project	8	5	1.62 ha	Kopp & Short (2000), This study
	EPA Boston Harbor Project	2	0	T	P. Colarusso & M. Chandler (pers. comm.)
Rhode Island	RI Aqua Fund Project	6	1	T	Kopp et al. (1994) B. S. Kopp (unpubl. data)
	NOAA 'World Prodigy' Mitigation	10	2	T	Fonseca et al. (1997) M. S. Fonseca (pers. comm.)
	RI DEM Narragansett Bay Project	2	0	T	Adamowicz (1994)
	Save the Bay, Wickford Harbor	1	1	T	Richardson (pers. comm.)
	NOAA/NERR Seeding Project	3	1	T	S. Granger (pers. comm)
Connecticut	Niantic River Pilot Eelgrass Restoration	1	1	0.04 ha	Short (1988)
New York	NY Sea Grant, Great South Bay Project	1	1[a]	T	Churchill et al. (1978)
New Jersey	NOAA/NMFS Raritan Bay Project	5	0	T	Reid et al. (1993)

[a]Survival monitored for less than 1 yr

Short et al./Mar Ecol Prog Ser 227 (2002) 253-267

Eelgrass Restoration Research Data

University of Rhode Island

Percent eelgrass cover varies by soil-landscape unit. Soils with relatively high levels (>90ug/g) of acid-volatile sulfides, high salinity levels (34 to 44 ppt), fine textures (silt loams), and relatively high total nitrogen levels (>0.15%) had the highest eelgrass cover.

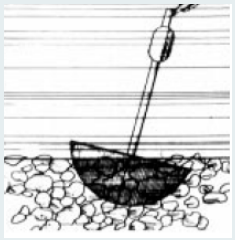
The model indicated that eelgrass distribution could be explained by three soil properties:

1. Acid-volatile sulfides
2. Total nitrogen
3. Organic carbon

Moorings

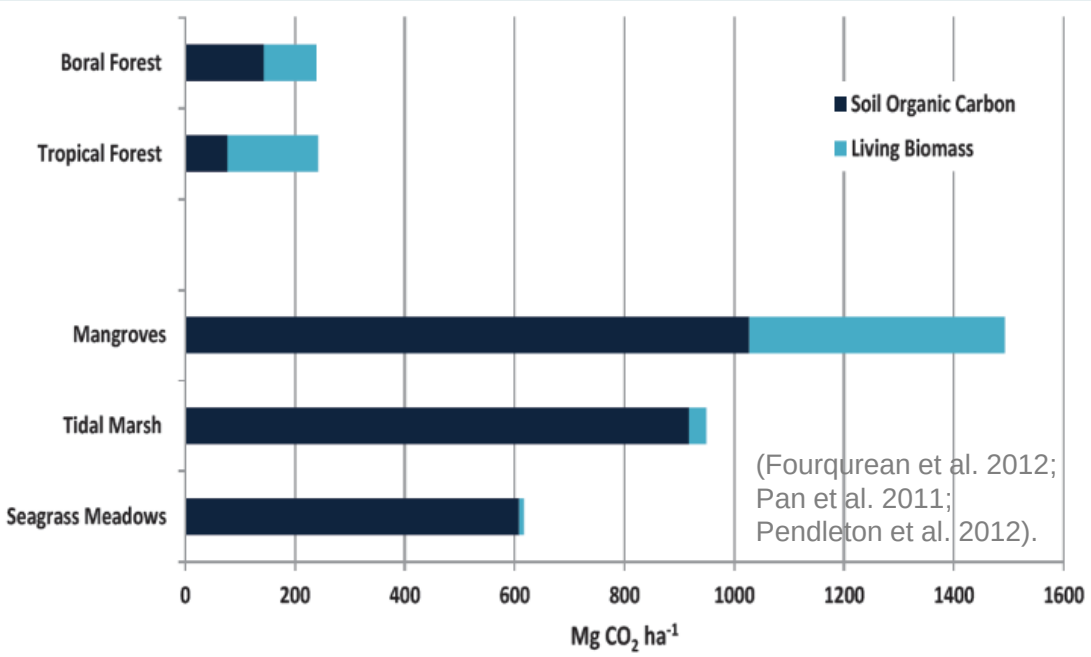
Deadweight

Mushroom



Map Symbol and Soil Name	Mooring Type	
	Mushroom Anchor	Deadweight
301 Beaches Udipsamments	-------- --------	-------- --------
800 Wamphassuc Wequetequock	Not Limited Not Limited	Very Limited soft bottom Very Limited soft bottom
810 Napatree	Very Limited hard bottom	Not Limited

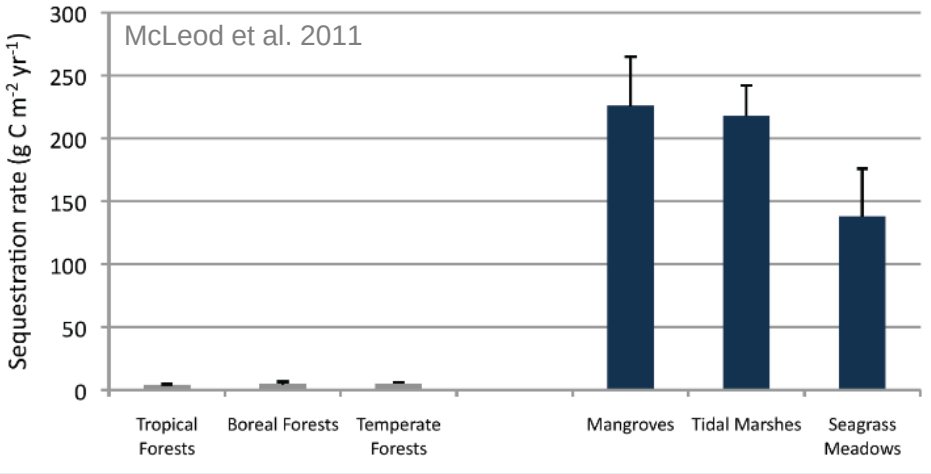
Coastal Blue Carbon is the carbon stored by and sequestered in coastal ecosystems, which include tidal wetlands, mangroves, and seagrass meadows.



(Fourqurean et al. 2012; Pan et al. 2011; Pendleton et al. 2012).

Mean carbon storage above and below ground in coastal ecosystems versus terrestrial forest.

Annual mean carbon sequestration rates for blue carbon habitats per unit area compared to terrestrial forest habitats.



What about blue carbon inventories of subaqueous soils?

Hydropedology Symposium: 10 Years Later and 10 Years into the Future

Estuarine Subaqueous Soil Organic Carbon Accounting: Sequestration and Storage

Christina M. Miilar
Adiza Ama Owusu Aduomih
Brett Still
Mark H. Stolt*
Dep. of Natural Resources Science
Coastal Institute–Kingston
Univ. of Rhode Island
Kingston, RI 02881

Subaqueous soils have largely been overlooked in soil C accounting studies. Recent work suggests that shallow, subtidal soils along the Atlantic Coast contain soil organic C (SOC) pools that are equal to or greater than comparable upland pools. In this study, we investigated the spatial relationships between SOC pool size and subaqueous soil landscape units in three coastal lagoons in Rhode Island and estimated SOC sequestration rates for these soils. Fifty-two pedons were sampled to 1 m and analyzed for SOC content and bulk density to calculate SOC pools. Pools varied significantly among soil landscape units and subaqueous soil Great Groups. Average SOC pools for the upper

URI research suggests that subaqueous SOC pools and sequestration rates are essentially equivalent to regional forest subaerial mineral soils.

Soil Classification (subgroup)	n	Mean SOC (Mg ha^{-1})	CV (%)	Reference
Typic Udipsamments	20	110	15	Davis et al., 2004
Typic Dystrudepts	29	136	29	Davis et al., 2004
Aeric Endoaquepts	20	187	31	Davis et al., 2004
Aeric Endoaquepts	29	246	39	Ricker et al., 2013
Typic Haplosaprists	30	586	20	Davis et al., 2004
Fluventic Psammowassents	9	47	43	This Study
Sulfic Psammowassents	5	57	82	This Study
Typic Fluviwassents	5	109	50	This Study
Haplic Sulfiwassents	10	123	43	This Study
Typic Sulfiwassents	5	141	42	This Study
Fluventic Sulfiwassents	5	196	28	This Study
Thapto-Histic Sulfiwassents	3	494	35	This Study

Tidal Marsh Loss, Regional Coastal Subsidence, and Thin Layer Deposition

Five Mile River Marsh, Darien, CT

Niering,1972

Shadeland Turek, 2000

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