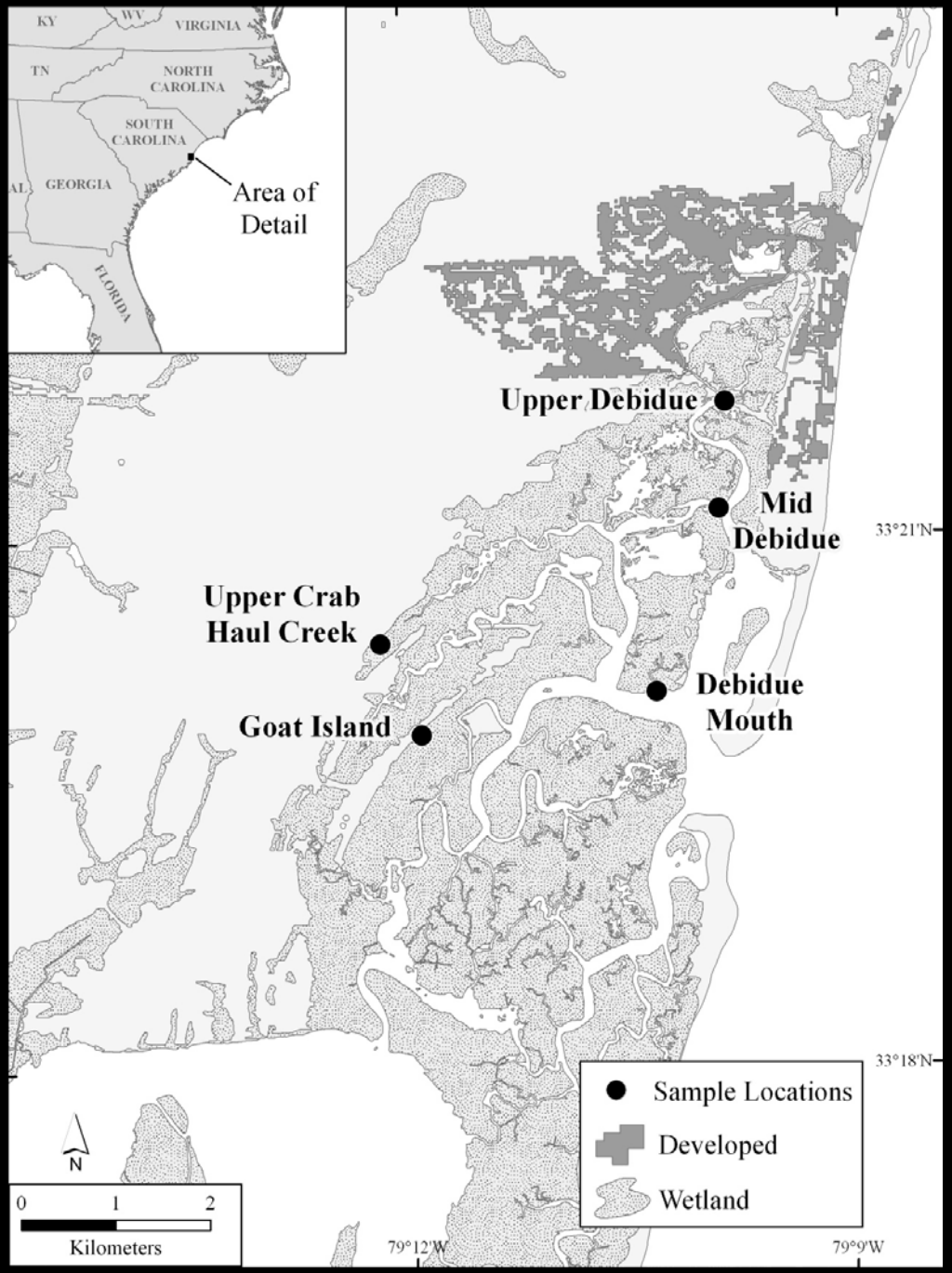
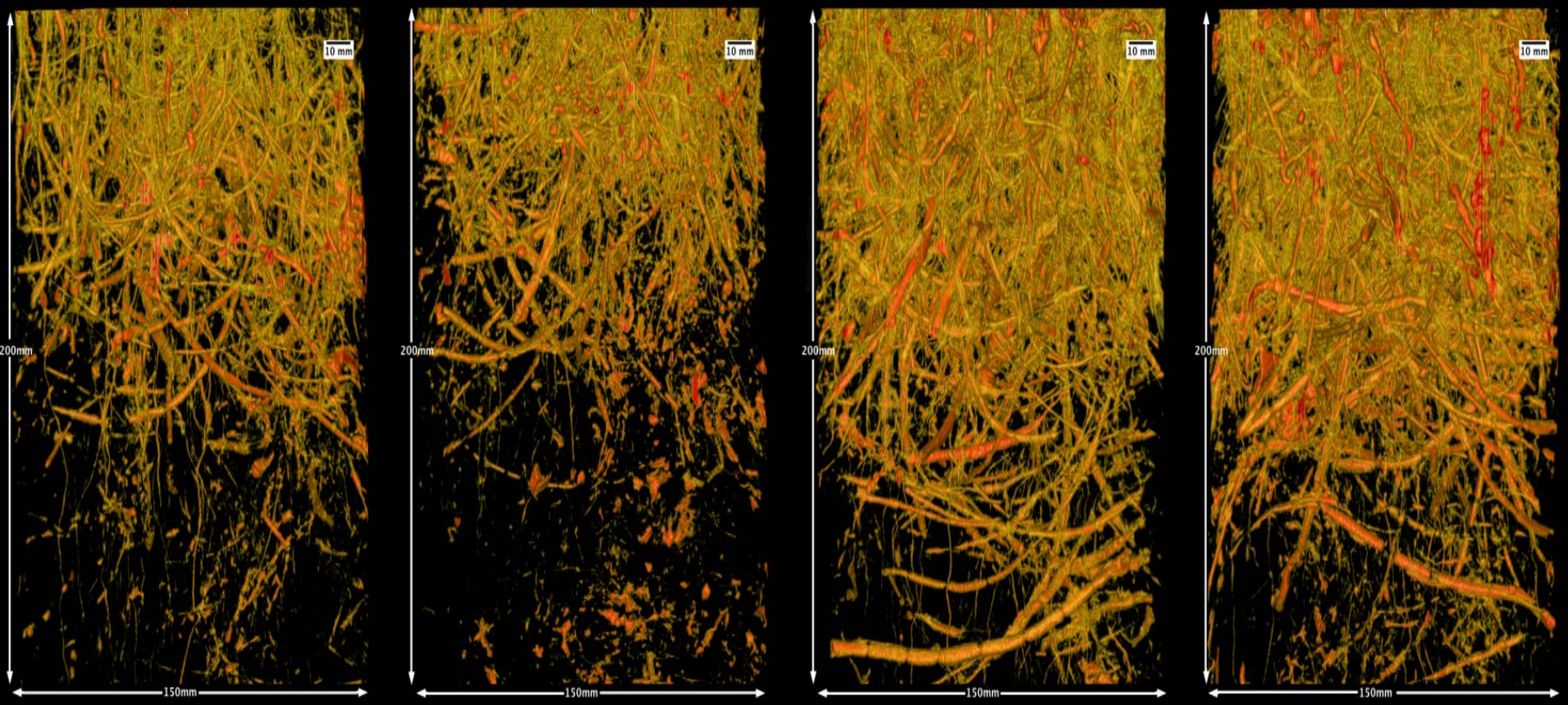
Is nutrient enrichment a marsh stressor?

Minerogenic marsh system,
High sediment loads,
20 mg/L

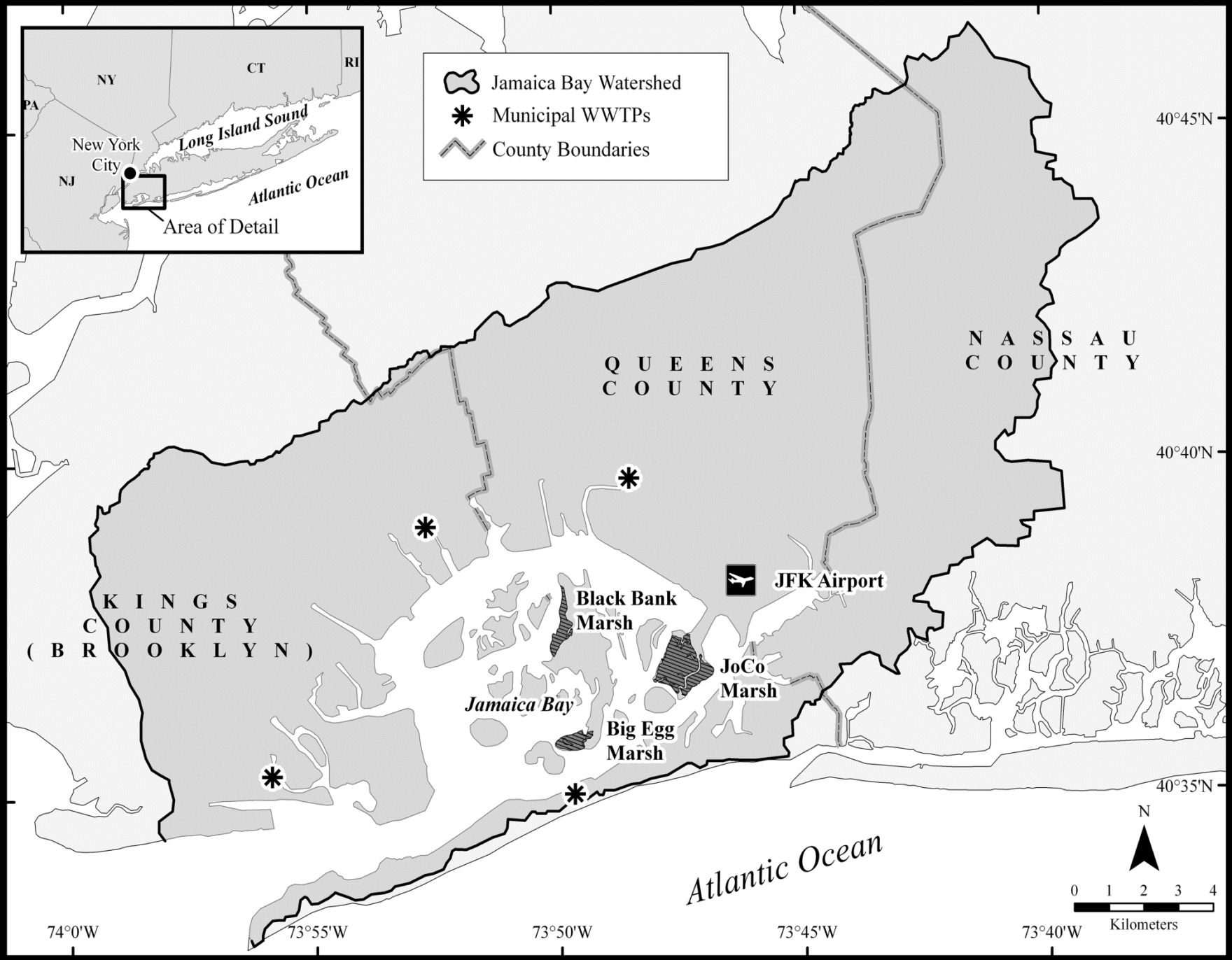




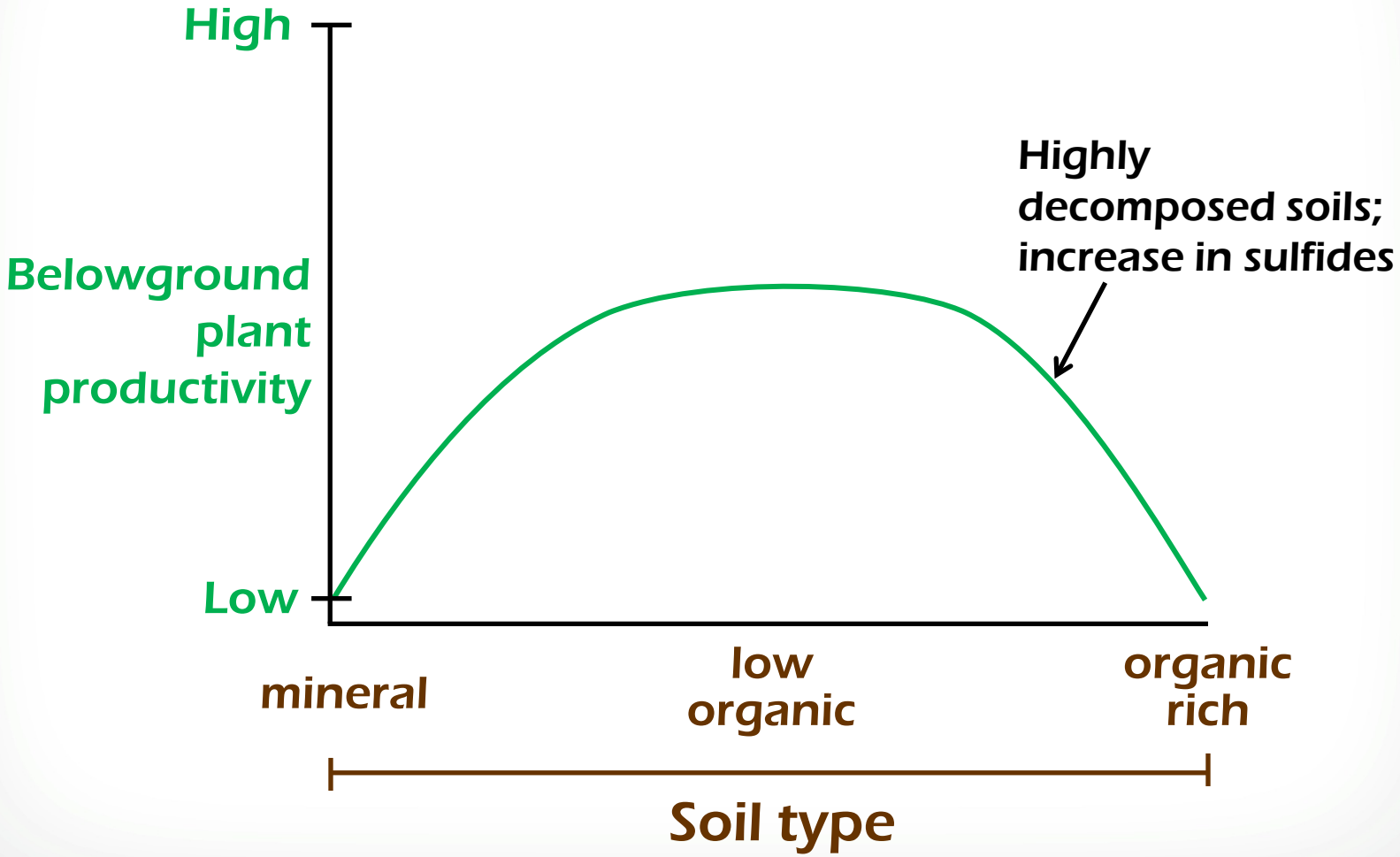
control +P +N +N+P

South Carolina Fertilization Experiment

Wigand et al., *Estuaries and Coasts*, in review.

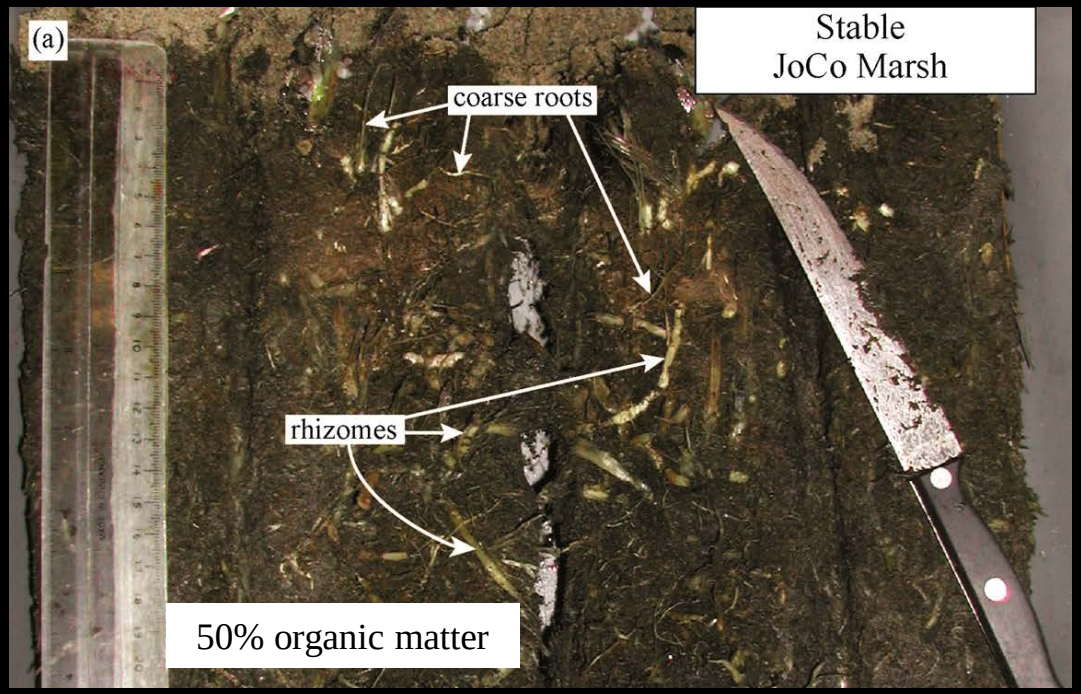

NY
CT
RI
PA
NJ
New York City
Long Island Sound
Atlantic Ocean
Area of Detail
Jamaica Bay Watershed
Municipal WWTPs
County Boundaries
QUEENS COUNTY
NASSAU COUNTY
KINGS COUNTY (BROOKLYN)
JFK Airport
Black Bank Marsh
JoCo Marsh
Big Egg Marsh
Jamaica Bay
Atlantic Ocean
40°45'N
40°40'N
40°35'N
74°0'W
73°55'W
73°50'W
73°45'W
73°40'W
N
0 1 2 3 4
Kilometers

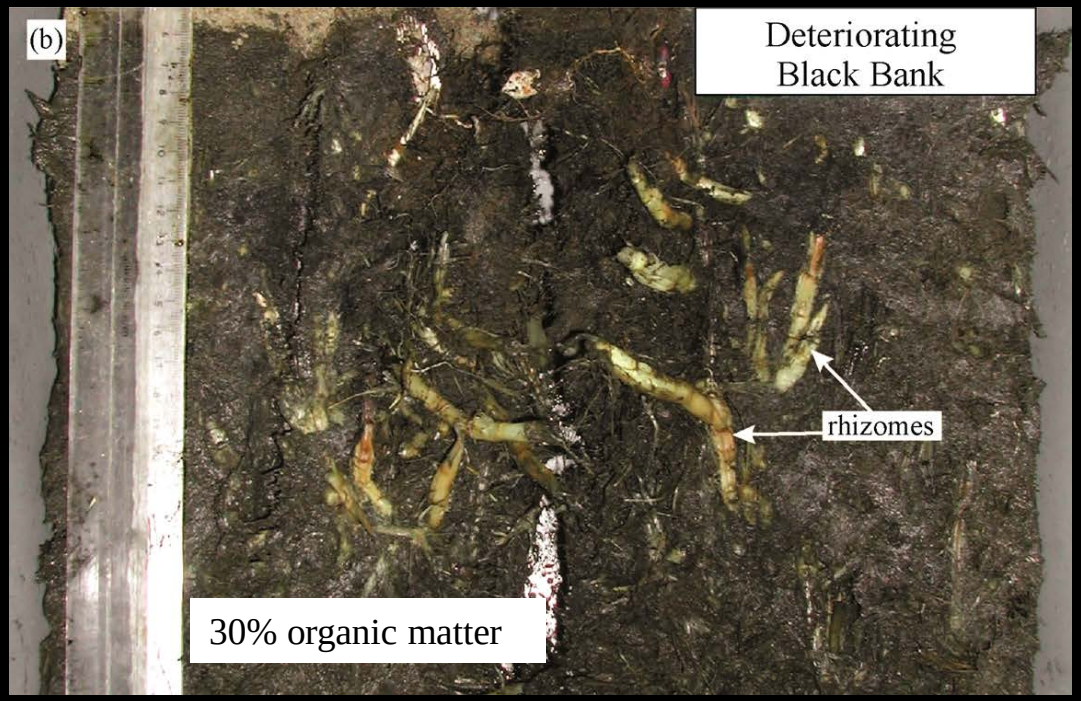
Effect of Nutrient Addition on a Salt Marsh System with Low Sediment Supply and High Inundation



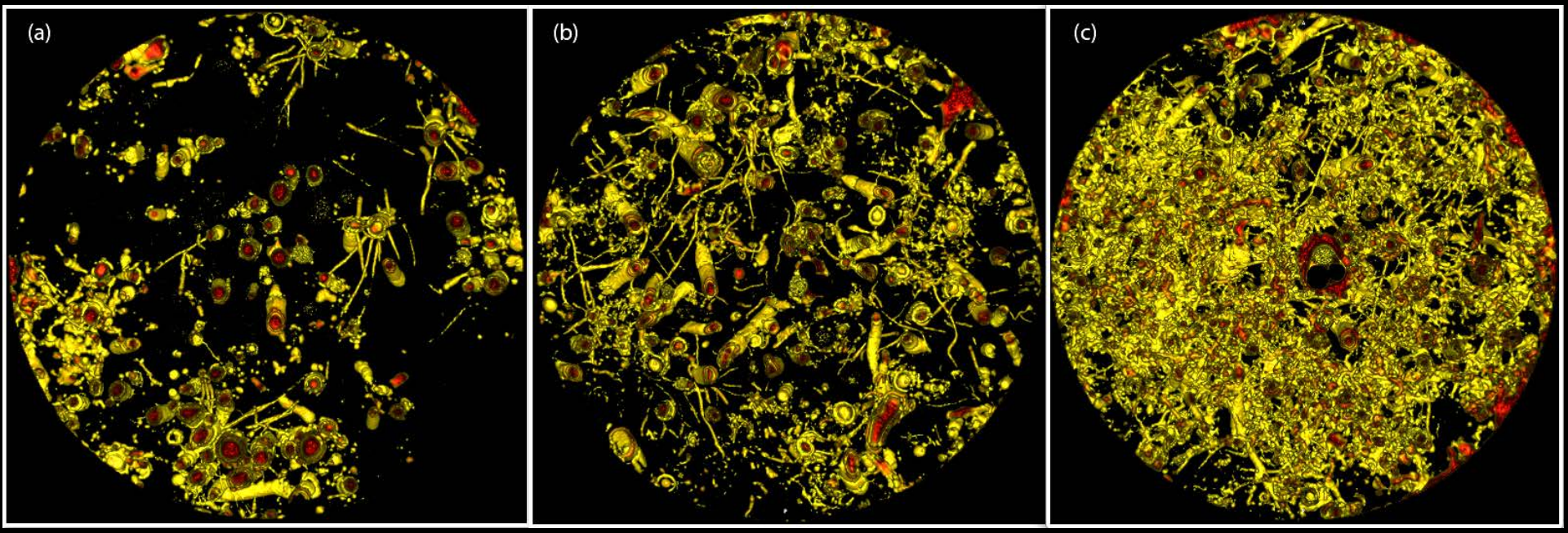
Biogenic systems depend upon plant production and sub surface expansion to build up peat.

Very little sediment input in Jamaica Bay!





CT cross section images of Jamaica Bay



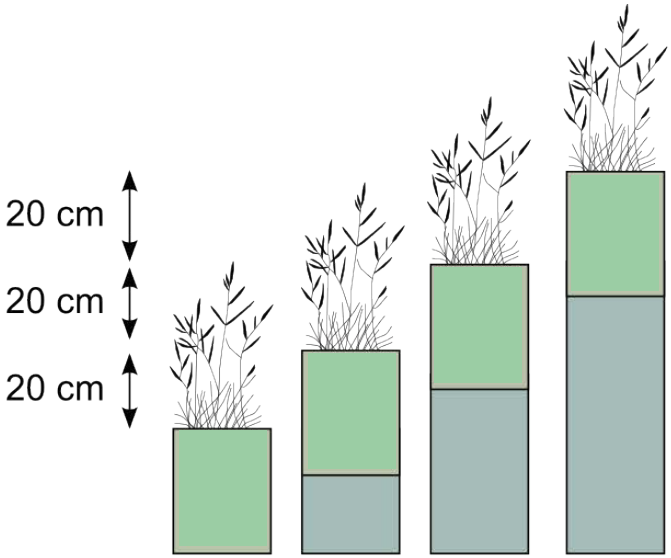
Most deteriorated:
Big Egg

Moderately deteriorated:
Black Bank

Stable:
JoCo marsh

Wigand et al. 2014, *Ecological Applications*

Field mesocosm experiment



Watson et al., *Climatic Change*, 2014

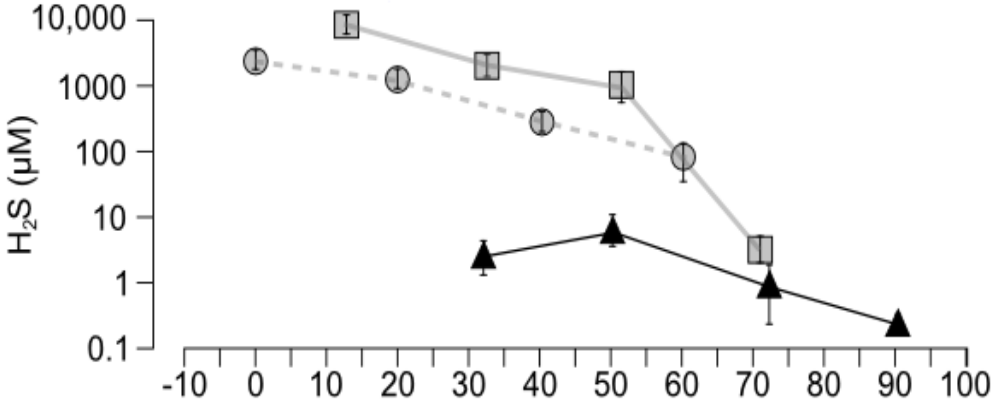
Coastal marsh ‘organ’ experiments:

- Conducted at three Narragansett Bay locations
- Sites varied in nutrient load
- Monitored porewater through growing season

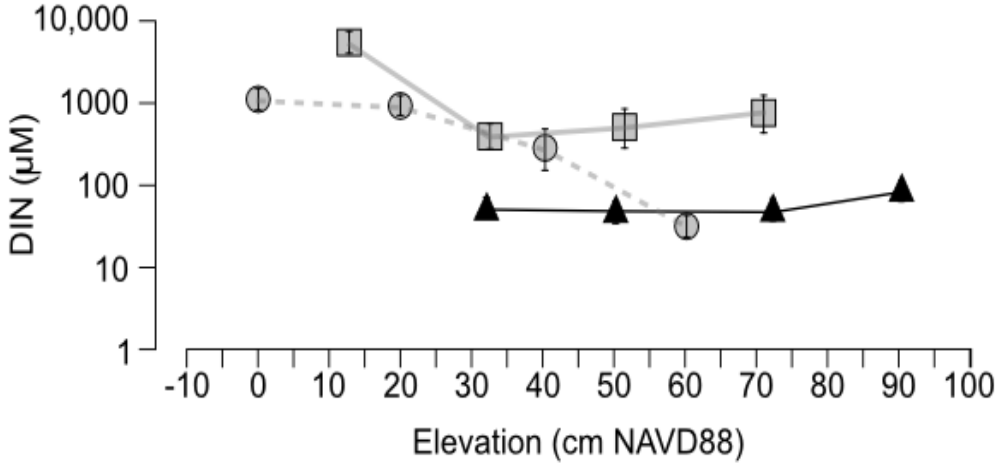
Field mesocosm experiment

- Sulfide concentration varies with elevation
- More anoxic and reduced conditions favor sulfate reduction
- Low elevations have higher DIN
- Plants cannot take up nutrients (they are stressed)
- Or, plants are more exposed to water column DIN loading

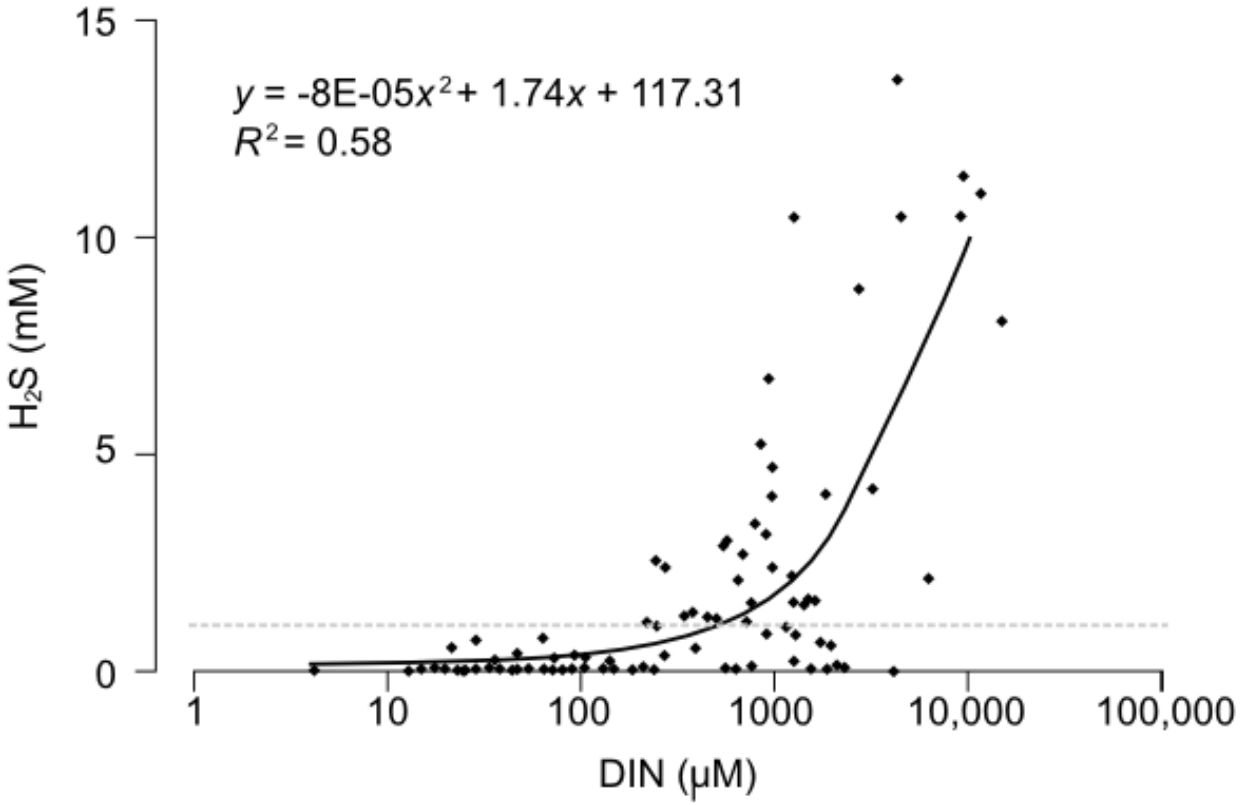
Porewater sulfide concentration vs. elevation
For three sites



Porewater DIN concentration vs. elevation
For three sites



Field mesocosm experiment



- At very high nutrient concentrations, there is a positive correlation between sulfide and DIN
- At lower nutrient concentrations, there is no relationship

Field mesocosm experiment

Sulfide concentrations vary with elevation and nutrient inputs

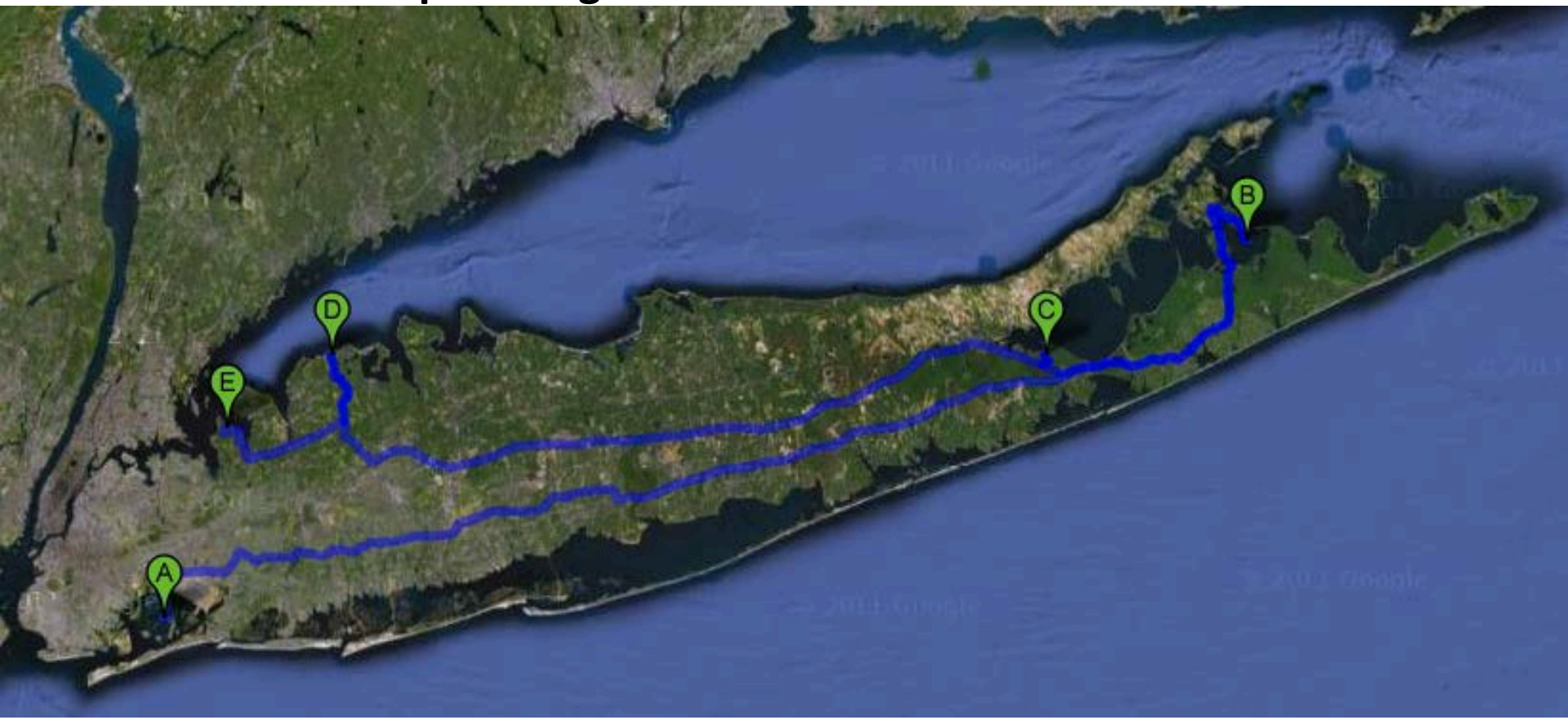
High nutrient loads + high inundation = anoxic soils

Sulfate reducation → Toxic effects on plants

High nutrient loads + low inundation = oxic soils

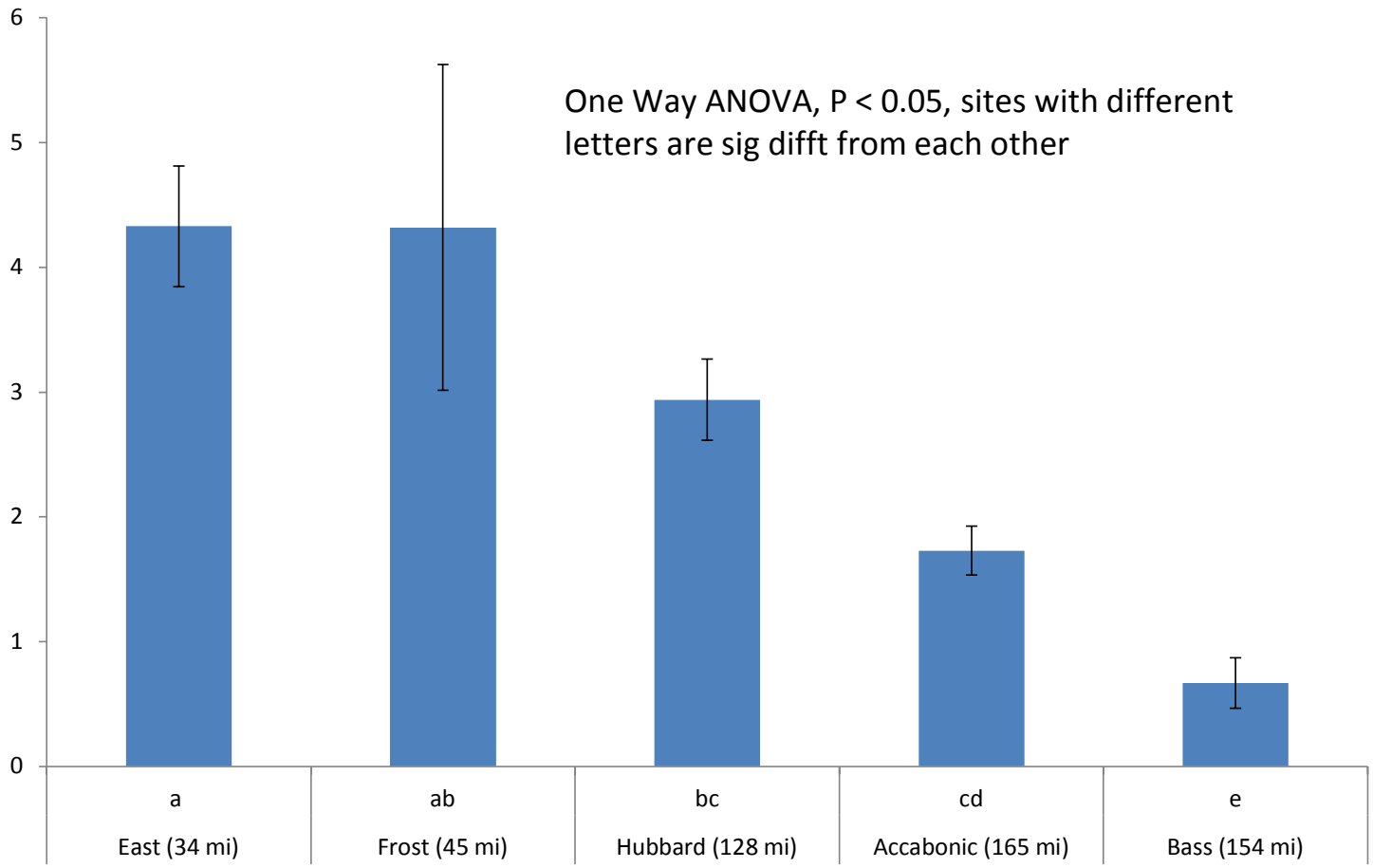
Higher nutrient avail. No sulfate reduction → Beneficial effects to plants

Map of Long Island NY Core Collection Sites



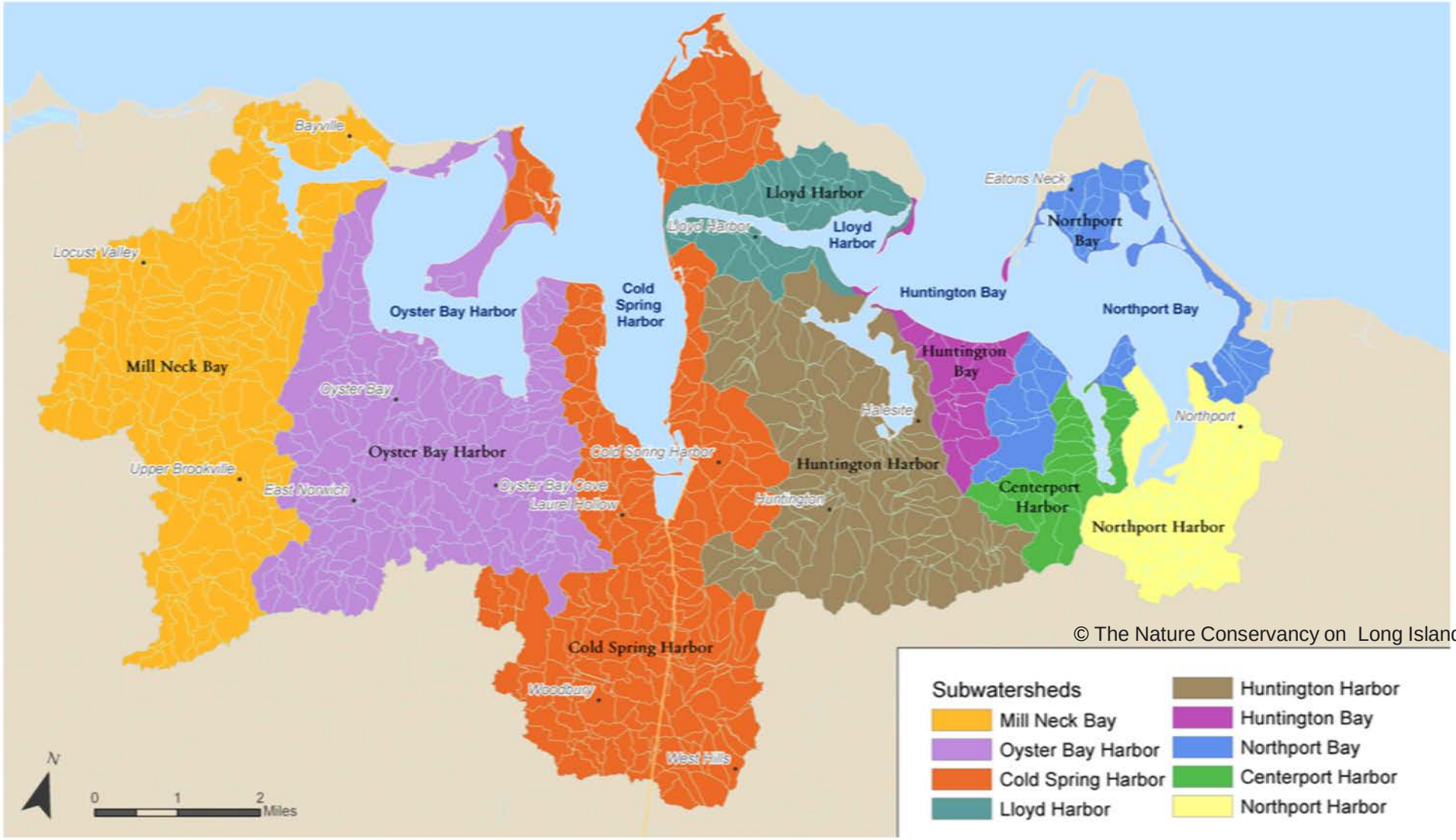
- A. Gateway National Recreation Area, Jamaica Bay
  - JOCO
  - Black Bank
- B. Bass Creek
- C. Hubbard Creek,
- D. Frost Creek
- E. East Creek

Long Island marsh creeks at varying distance from NY Harbor
Mean soil respiration µmol/m²/s (2009/2010)



The Nature Conservancy
Protecting nature. Preserving life.™

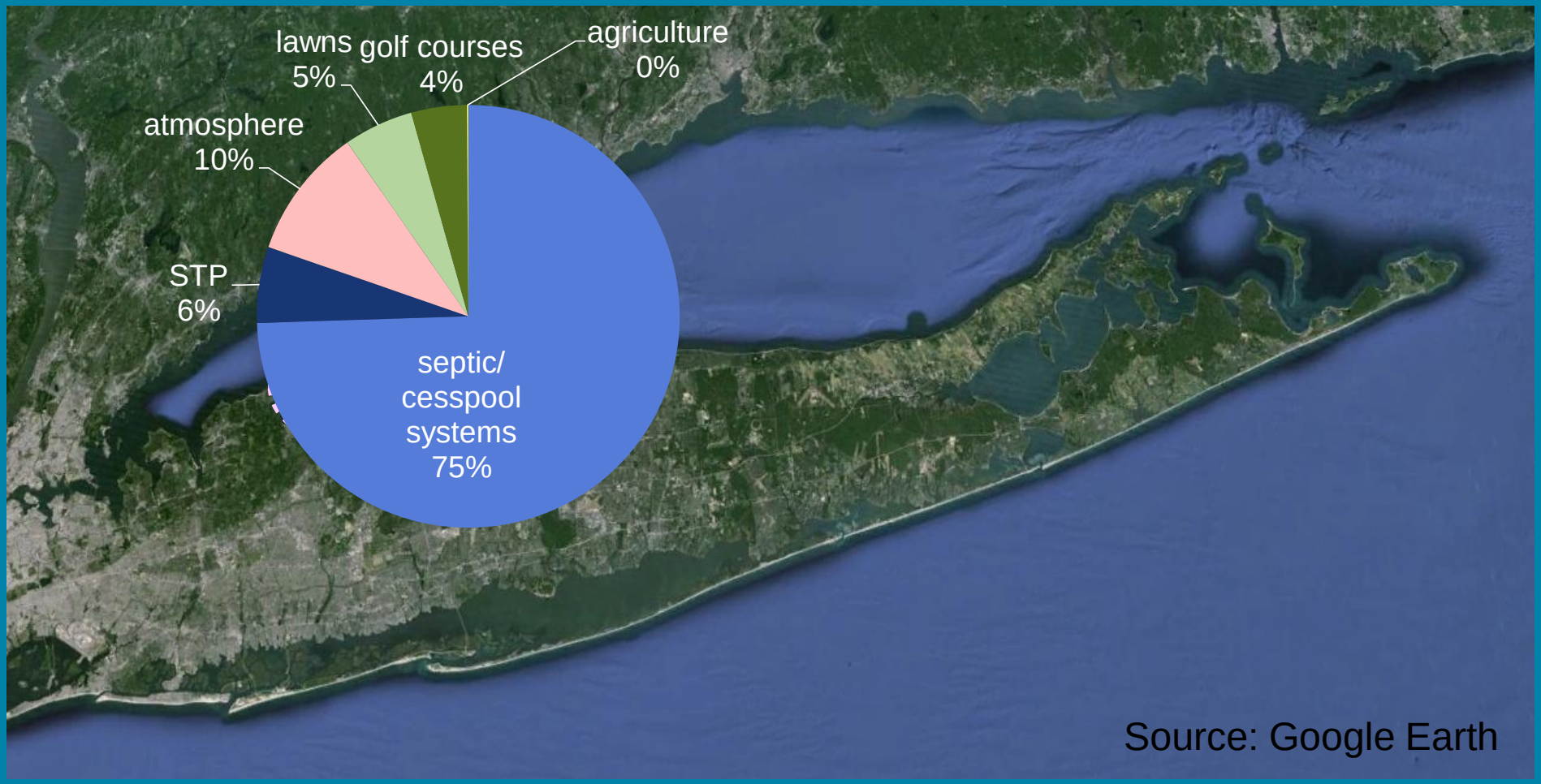
Subwatershed Delineations



Total Nitrogen Loads from watersheds

Huntington/Oyster Bays: 331,000 kg N/yr

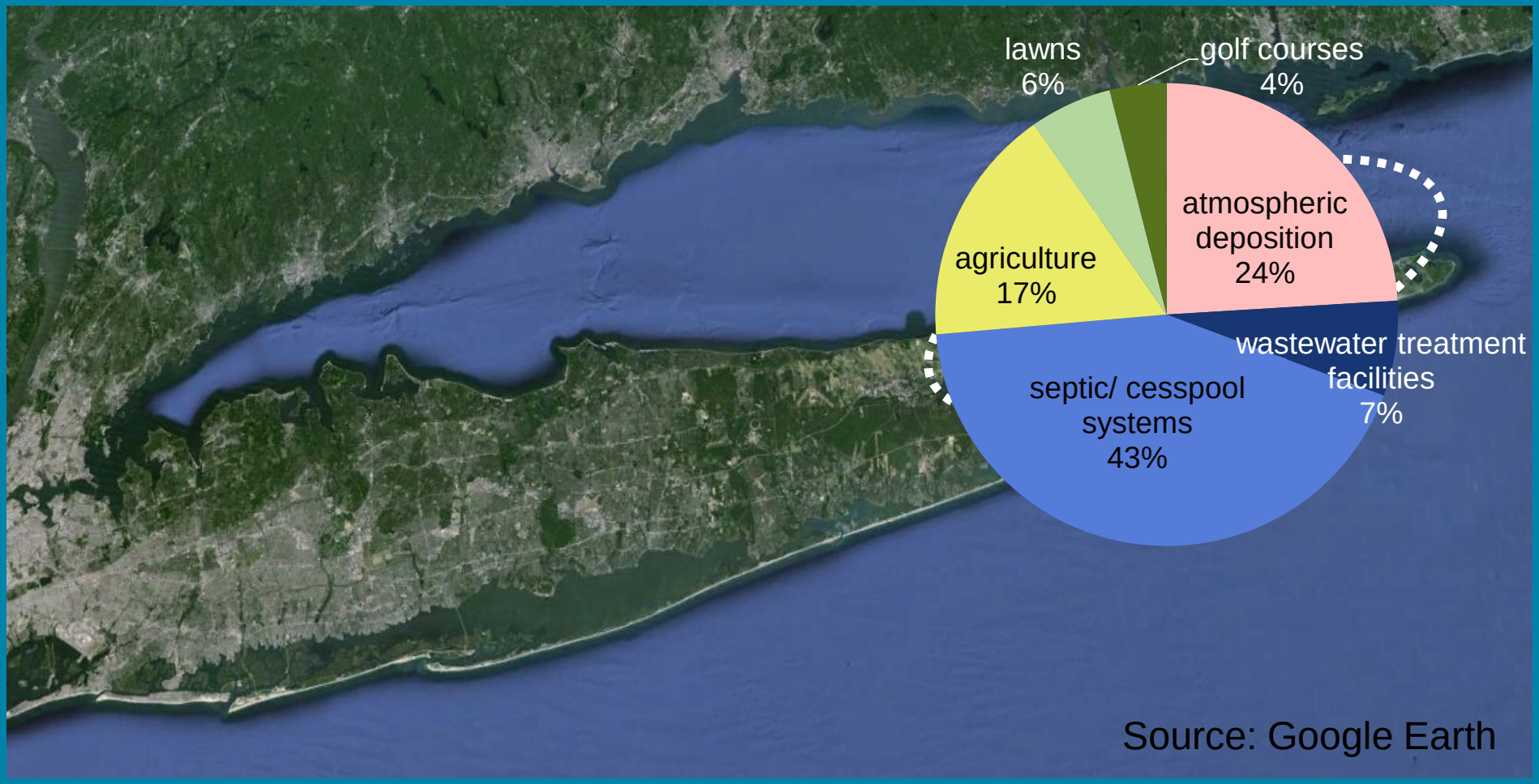
DRAFT RESULTS



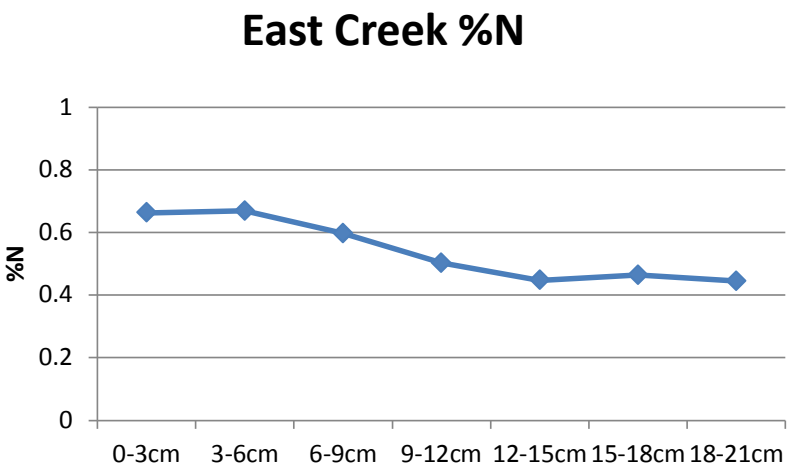
Source: Google Earth

Total Nitrogen Loads from watersheds

Peconic Estuary: 267,000 kg N/yr



Frost Creek, western LIS


East Creek %N
%N
1
0.8
0.6
0.4
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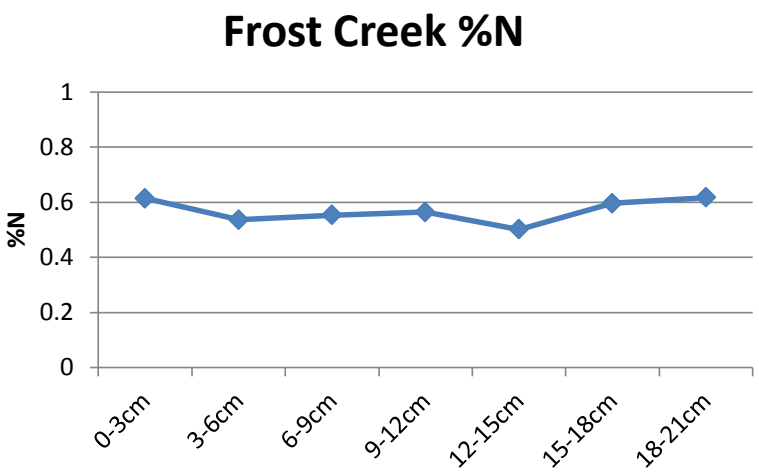
0-3cm
3-6cm
6-9cm
9-12cm
12-15cm
15-18cm
18-21cm


Frost Creek %N
%N
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0.8
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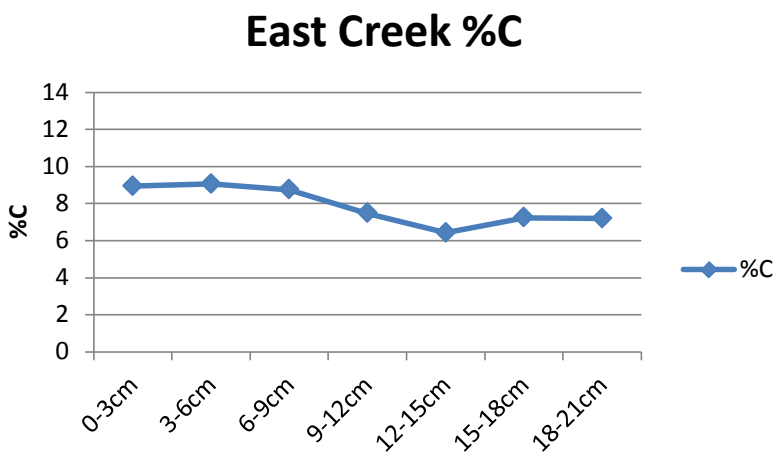
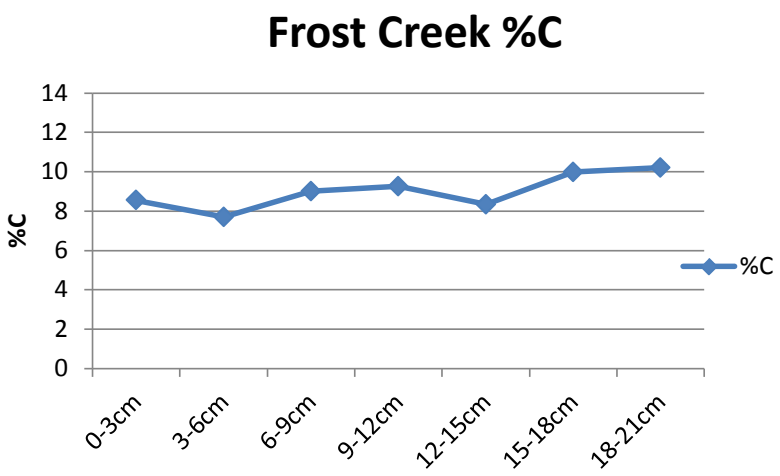
6-9cm
9-12cm
12-15cm
15-18cm
18-21cm


East Creek %C
%C
14
12
10
8
6
4
2
0
0-3cm
3-6cm
6-9cm
9-12cm
12-15cm
15-18cm
18-21cm
%C


Frost Creek %C
%C
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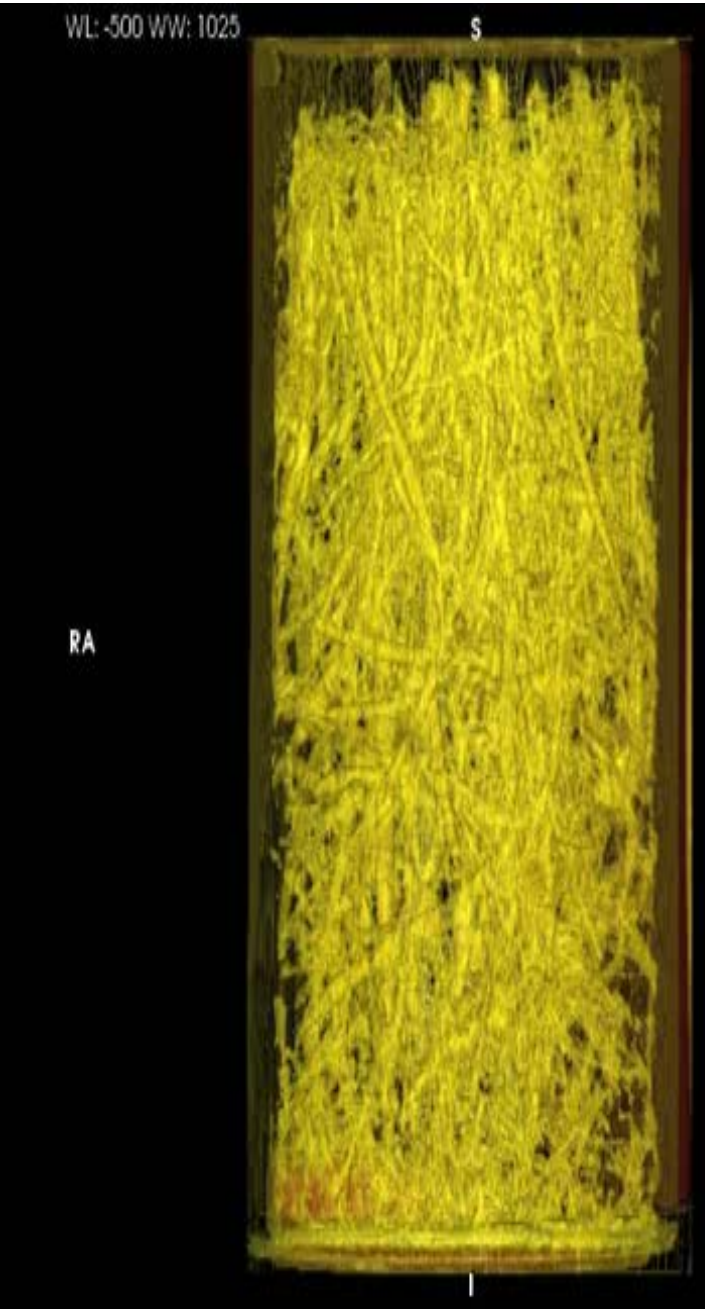
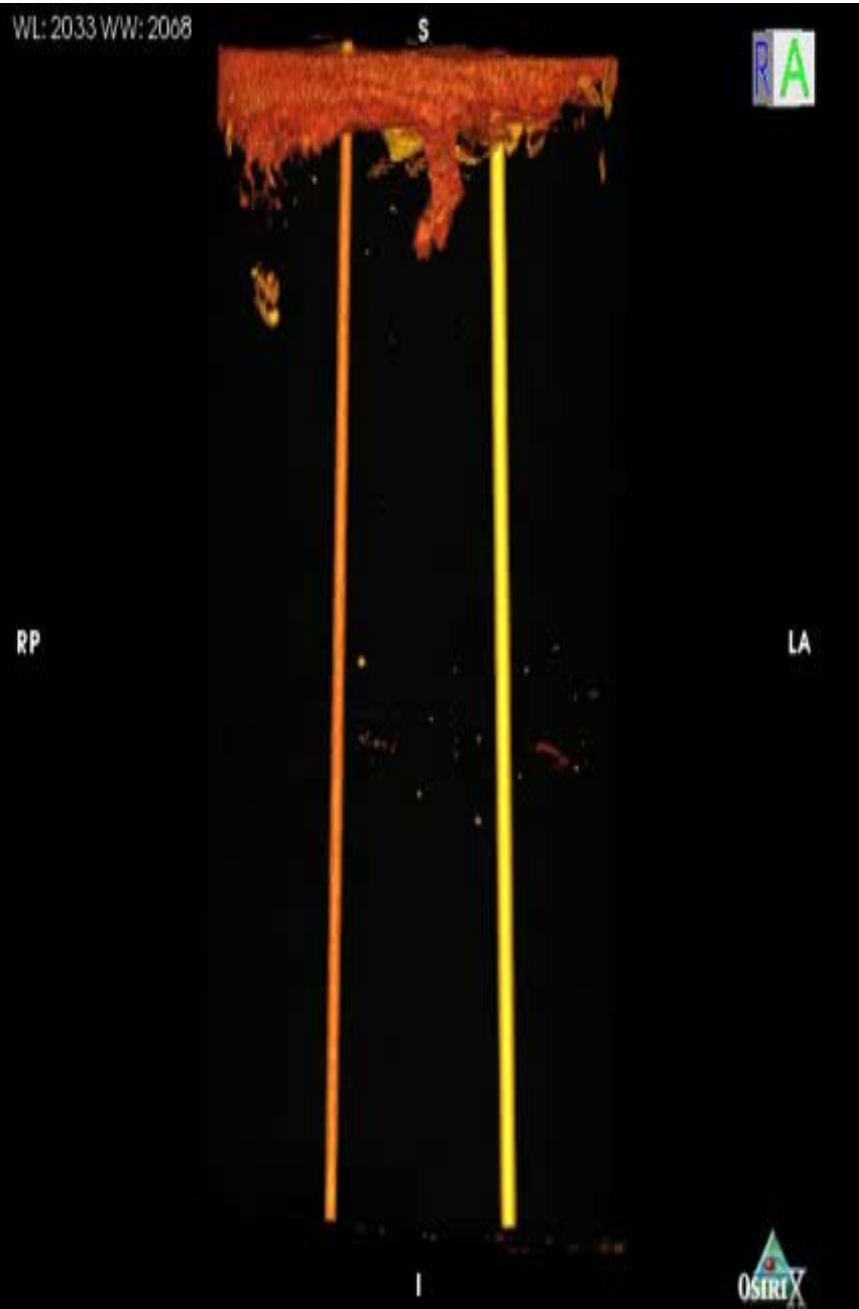
12
10
8
6
4
2
0
0-3cm
3-6cm
6-9cm
9-12cm
12-15cm
15-18cm
18-21cm
%C

East Creek

Coarse Roots & Rhizomes

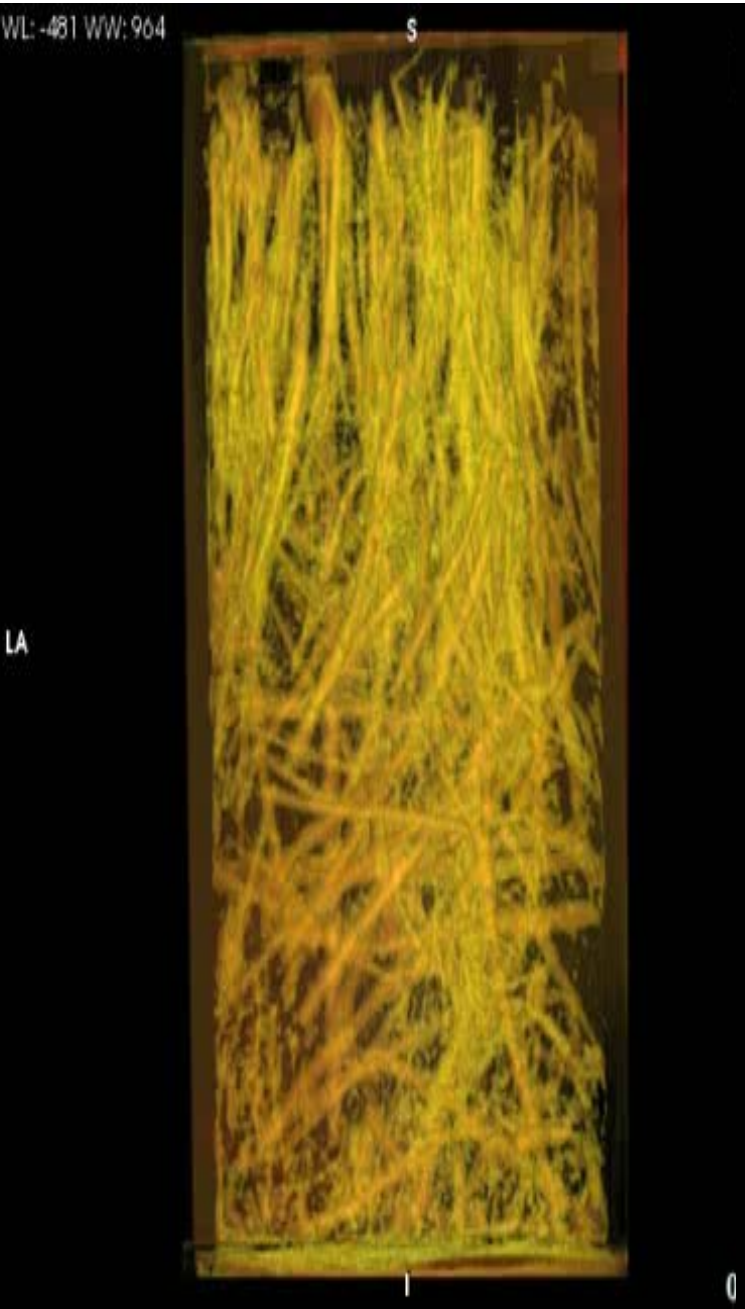


Sand & Shells

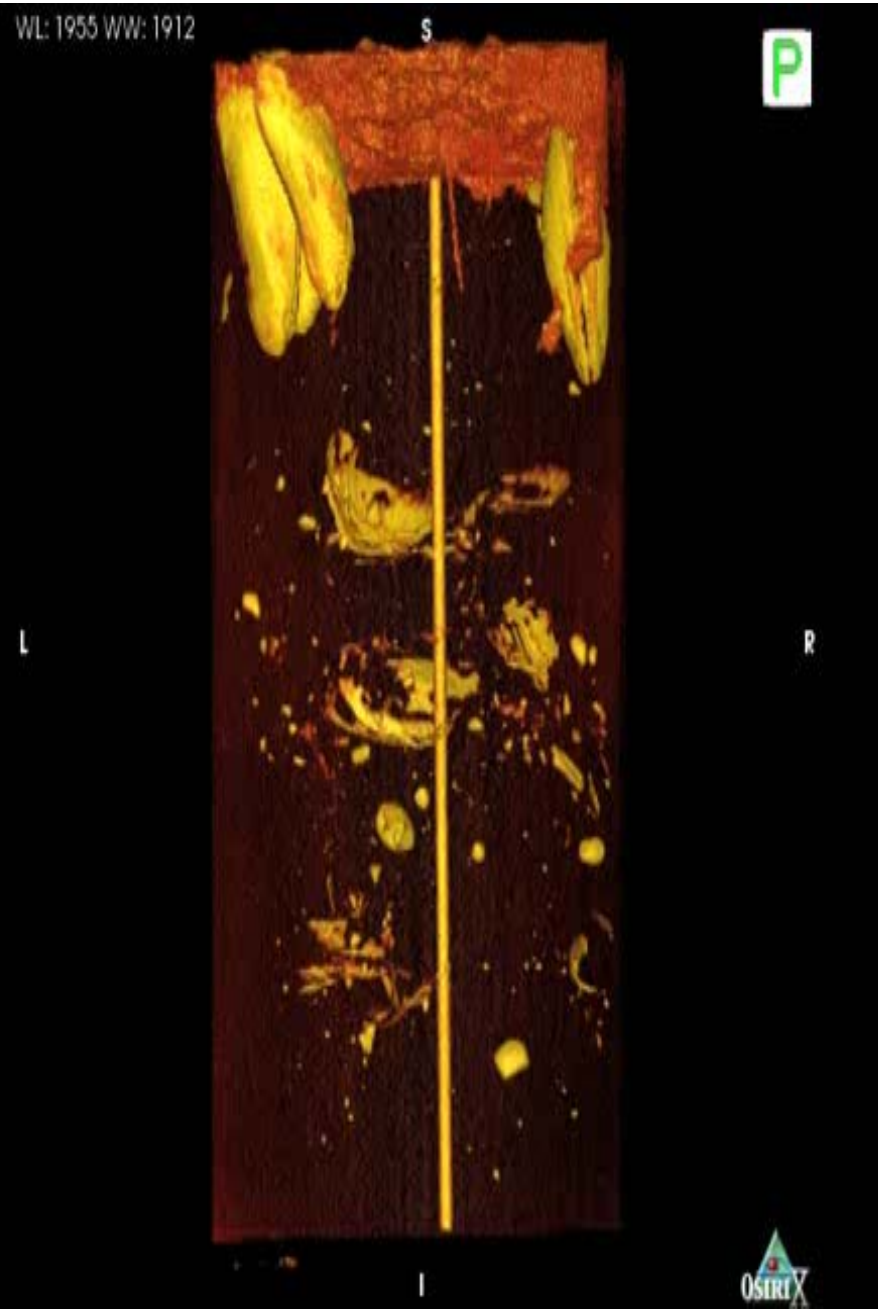


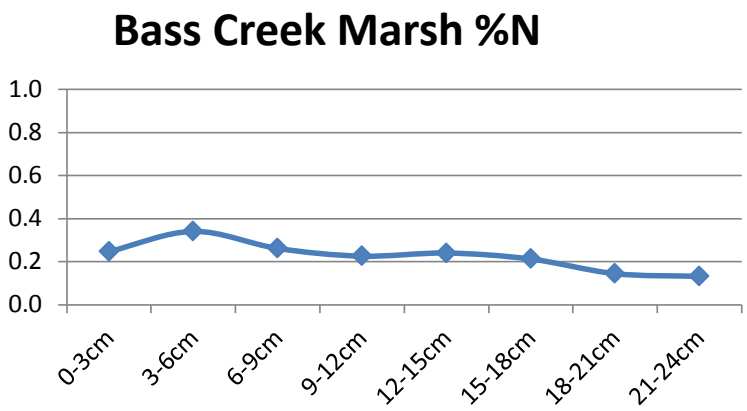
Frost Creek

Coarse Roots & Rhizomes



Sand & Mussels




Bass Creek Marsh %N
1.0
0.8
0.6
0.4
0.2
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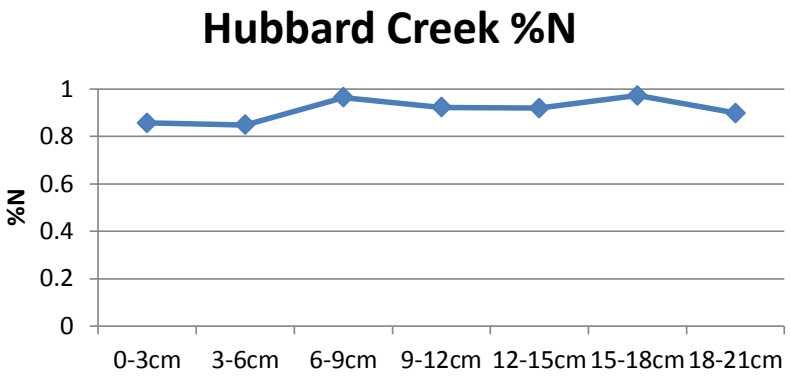
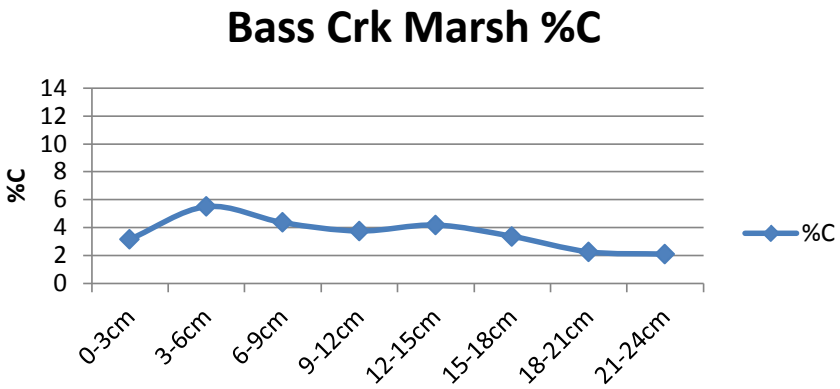
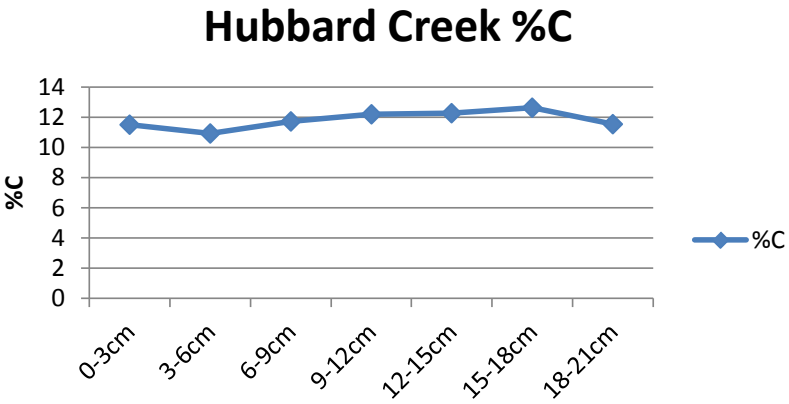
0-3cm
3-6cm
6-9cm
9-12cm
12-15cm
15-18cm
18-21cm
21-24cm


Hubbard Creek %N
%N
1
0.8
0.6
0.4
0.2
0
0-3cm
3-6cm
6-9cm
9-12cm
12-15cm
15-18cm
18-21cm


Bass Crk Marsh %C
%C
14
12
10
8
6
4
2
0
0-3cm
3-6cm
6-9cm
9-12cm
12-15cm
15-18cm
18-21cm
21-24cm
%C


Hubbard Creek %C
%C
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12
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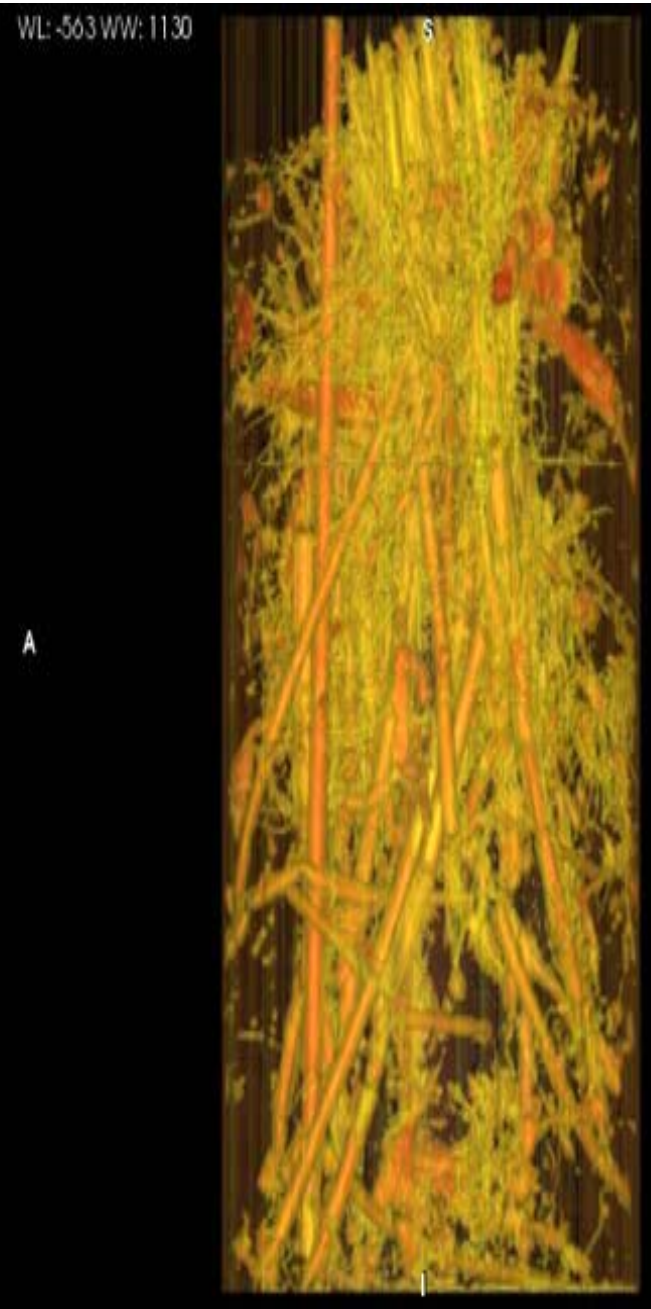
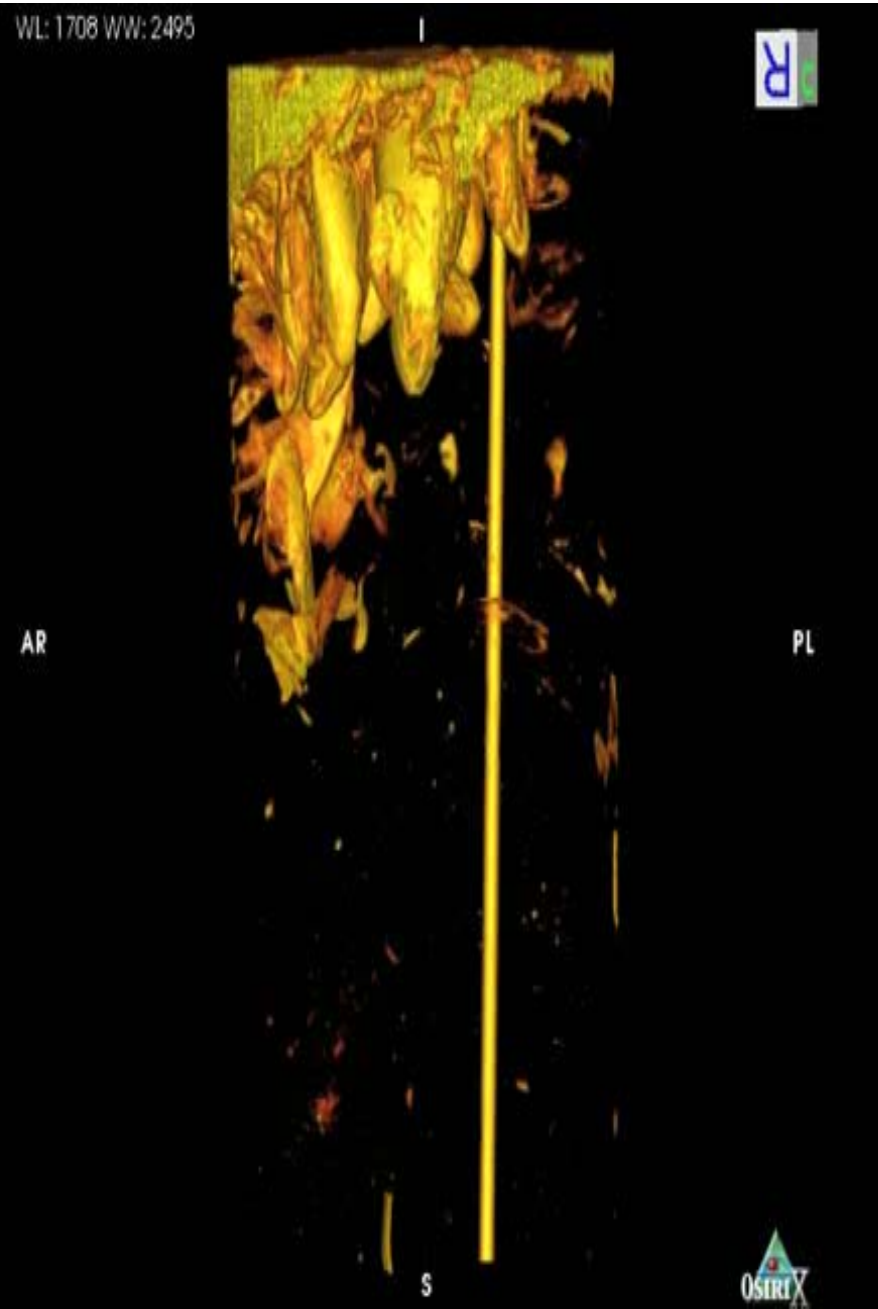
4
2
0
0-3cm
3-6cm
6-9cm
9-12cm
12-15cm
15-18cm
18-21cm
%C

Hubbard Creek

Coarse Roots & Rhizomes



Sand & Mussels



Lawrence Marsh, Hempstead Bay