MultiState Projects

Subaqueous Soils and Water Quality in Shallow Embayments

Building Use and Management Interpretations for Subaqueous Soil Inventories

NRCS

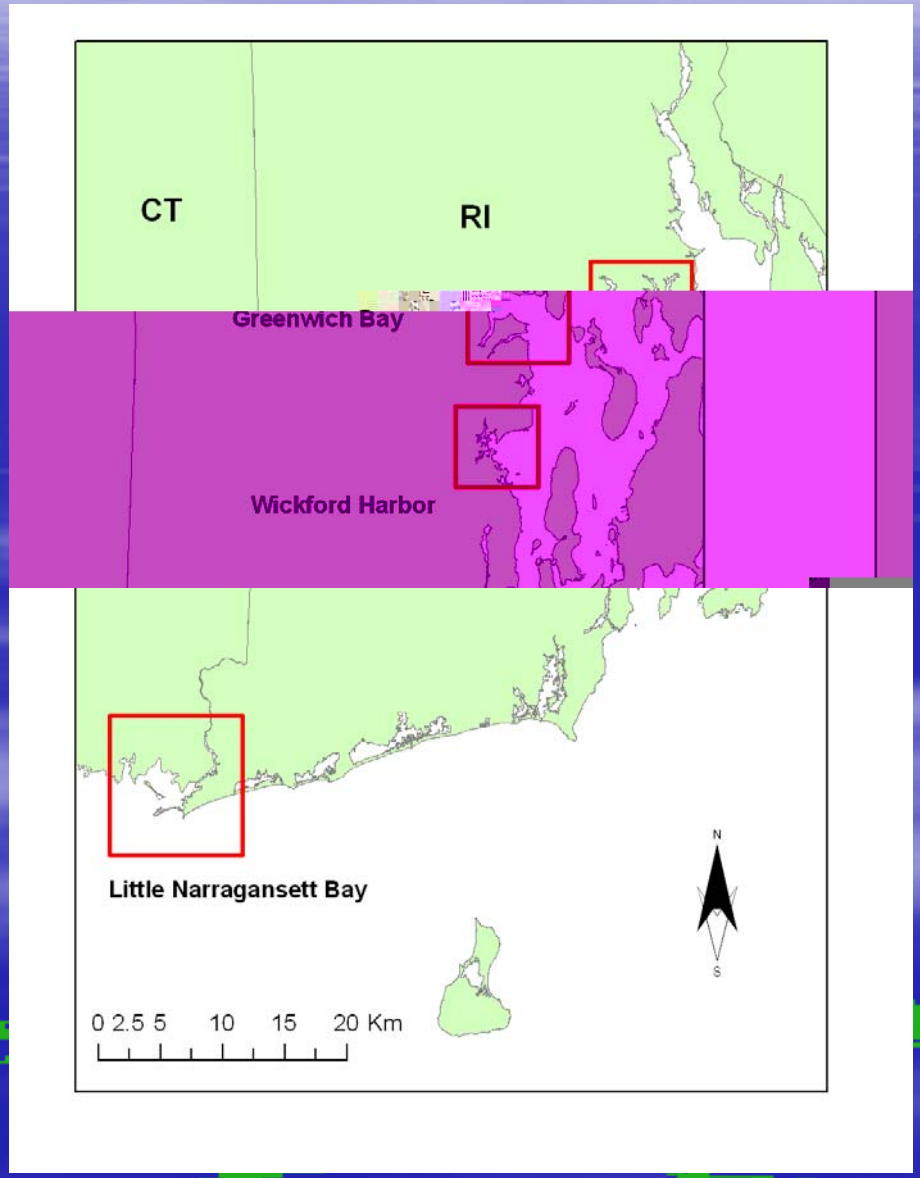
riaes
RI Agricultural Experiment Station

Landscape-Level Assessment of Subaqueous Soils and Water Quality in Shallow Embayments

Maggie K. Payne

Embayment Locations

- Greenwich Bay (1200 ha)
- Wickford Harbor (160 ha)
- Little Narragansett Bay (1000 ha)



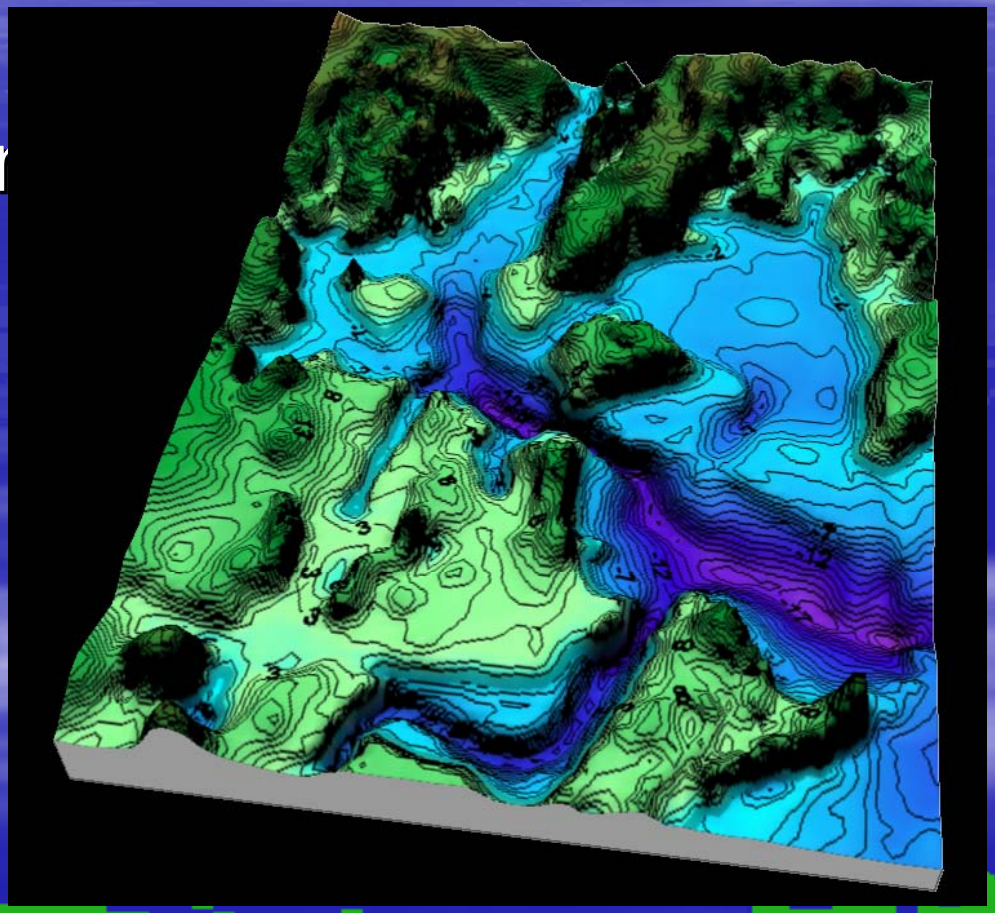
Focus of Study

- Soil-Landscape Relationships
- Soil-Water Quality Relationships
- Sulfide Distribution

Identify Landscape Units

Processes:

- Bathymetric mappi
  - Fathometer
  - RTK GPS
- Sidescan sonar
  - Geosciences



Soil Sampling and Analysis

- Field descriptions
  - Horizon, color, texture, n-value
- Particle size distribution
- Bulk density
- Nitrogen (N)
- Carbon (C)
- Calcium Carbonate ($CaCO_3$)
- Salinity
- H_2O_2 oxidized salinity
- Incubated pH
- Sulfide content

Greenwich Bay

Cove

Fluviomarine Bottom

Bayfloor

Platform

Drowned River Channel

Depositional Beach

Greenwich Bay

Common Landscape Units

Landscape Unit	Percent of Bay Area		
	Wickford	Greenwich	LNB
Bayfloor	29	32	2
Cove	12	4	8
Depositional Beach	8	25	-
Drowned River Channel	9	5	3
Fluviomarine Bottom	6	4	9
Platform	4	3	-
Shoal or Spit	2	-	1

Subaqueous Soil Classification

- Entisols
  - **Wassents**
    - Frassiwassents
    - **Psammowassents**
      - Sulfic
      - Fluventic
      - Typic
    - **Sulfiwassents**
      - Haplic
      - Fluventic
      - Typic
    - Hydrowassents
    - Fluviwassents
    - Haplowassents
  - Aquents
  - Arents
  - Psamments
  - Fluvents
  - Orthents

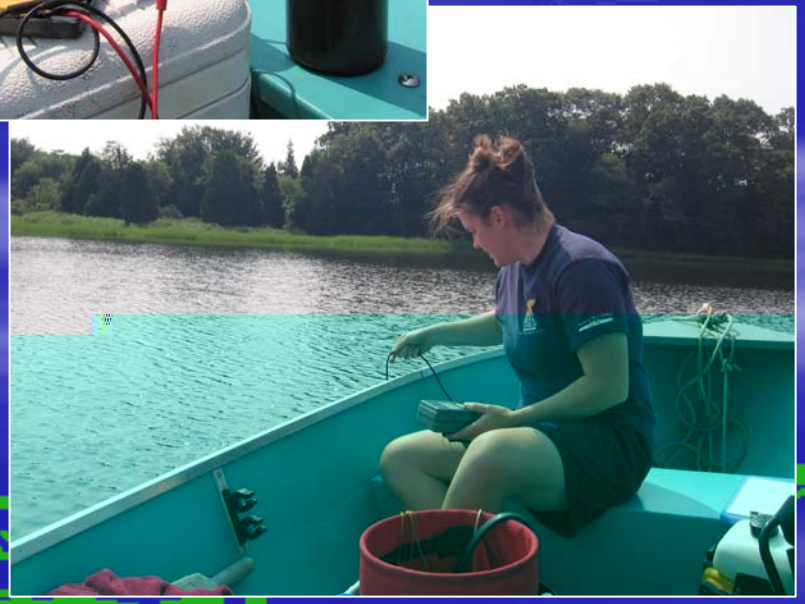
Landscape Unit	Subgroup Classification (# of occurrences)	Taxonomic Purity
Bayfloor	**Fluventic Sulfiwassents (3)**	**50%**
	Haplic Sulfiwassents (3)	
Cove	**Fluventic Sulfiwassents (6)**	**46%**
	Haplic Sulfiwassents (6)	
	Typic Hydrowassents (1)	
Depositional Beach	**Typic Psammowassents (5)**	**50%**
	Fluventic Psammowassents (3)	
	Haplic Sulfiwassents (1)	
	Sulfic Psammowassents (1)	
Drowned River Channel	**Fluventic Sulfiwassents (3)**	**75%**
	Thapto-histic Sulfiwassents (1)	
Fluviomarine Bottom	**Fluventic Sulfiwassents (5)**	**83%**
	Haplic Sulfiwassents (1)	
Platform	**Typic Psammowassents (2)**	**50%**
	Sulfic Psammowassents (1), Typic Haplowassents (1)	
Shoal	**Typic Psammowassents (2)**	**50%**
	Haplic Sulfiwassents (1), Typic Fluviwassents (1)	

Conclusions

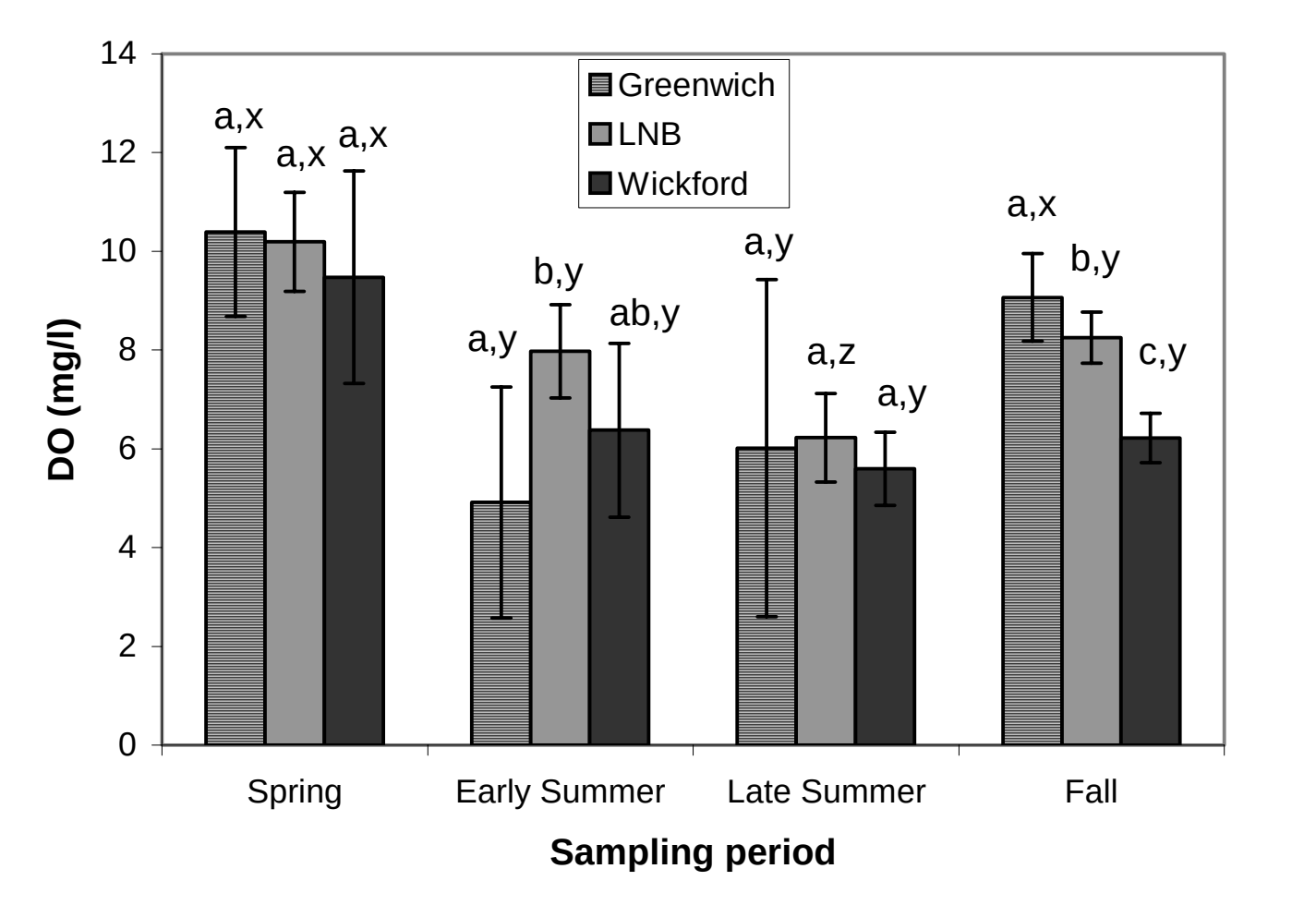
- Soil-landscape models can be used to effectively make the first cut for the various soils when mapping shallow embayments

Water Quality Assessment

- Four sampling periods
  - Spring (May-June)
  - Early Summer (July)
  - Late Summer (August)
  - Fall (September – November)
- Water Quality
  - Dissolved Oxygen (DO)
  - Chlorophyll *a* (Chl *a*)
  - Total Suspended Solids (TSS)
  - Salinity
- Redox Potential
  - Profile of top 15 cm



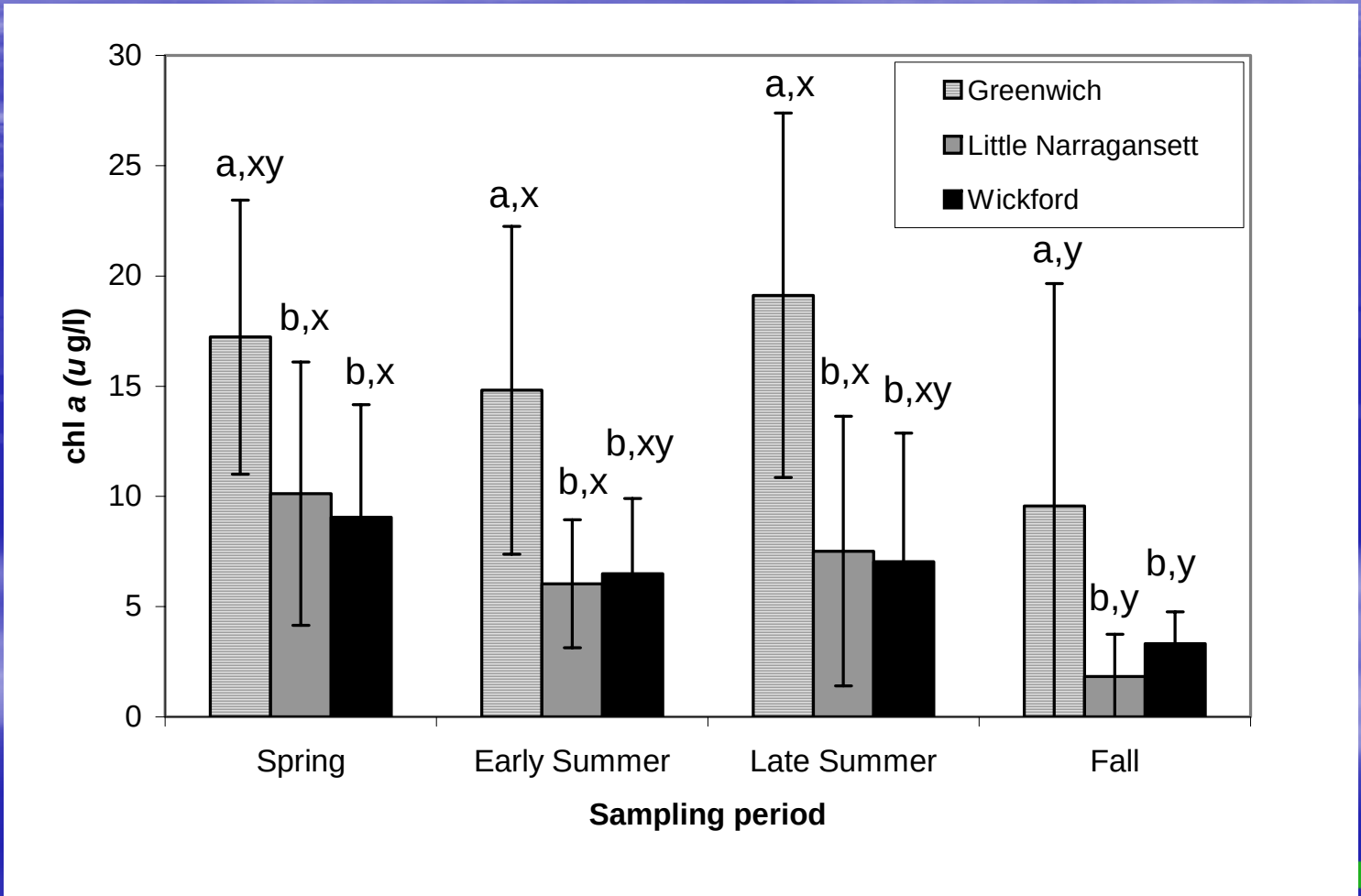
Dissolved Oxygen



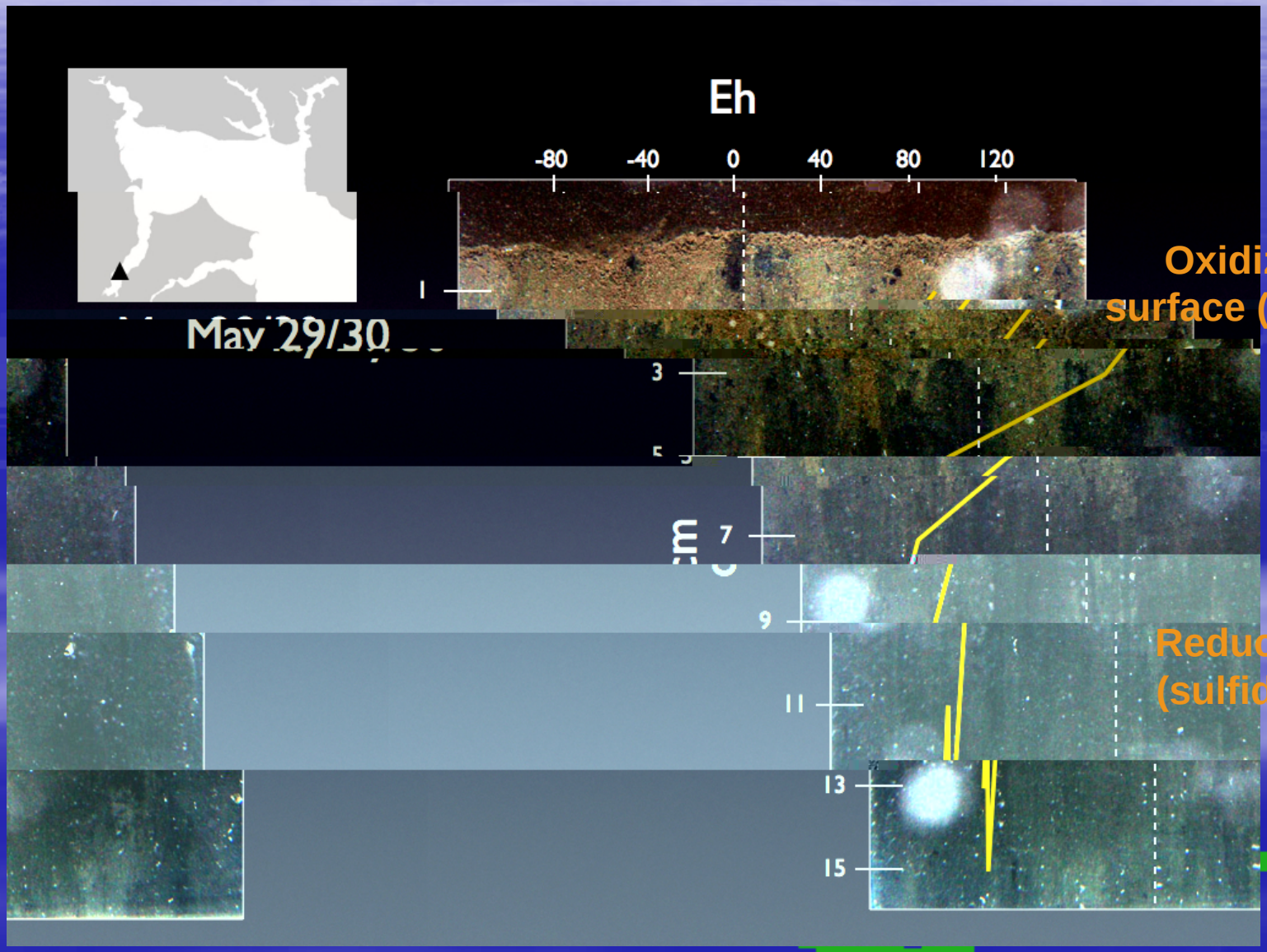
a,b,c – among bays within season

x,y,z – among seasons within bays

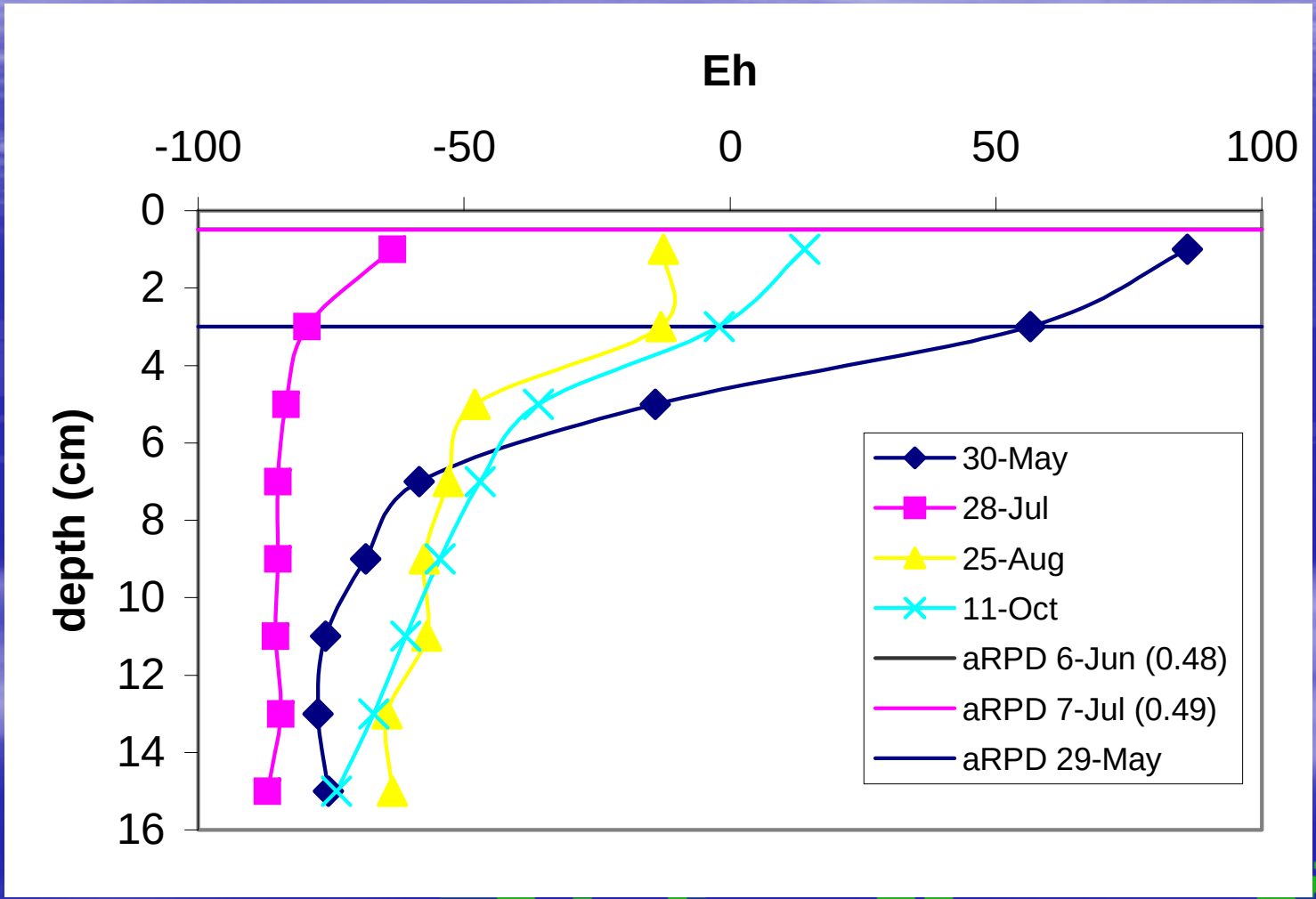
Chlorophyll *a*



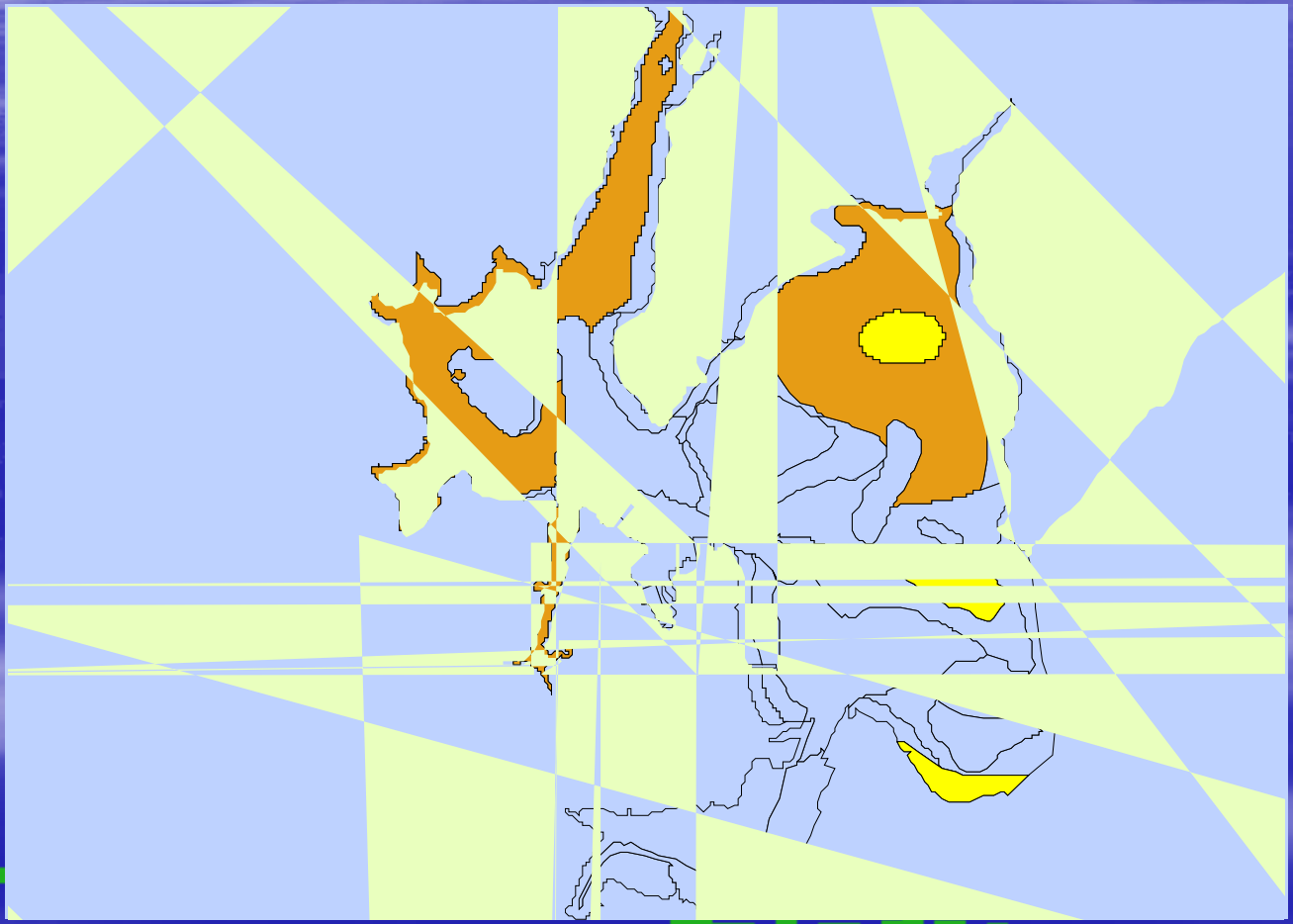
Sediment Profile Imaging (SPI)



SPI and Redox



Wickford DO and Bottom Type



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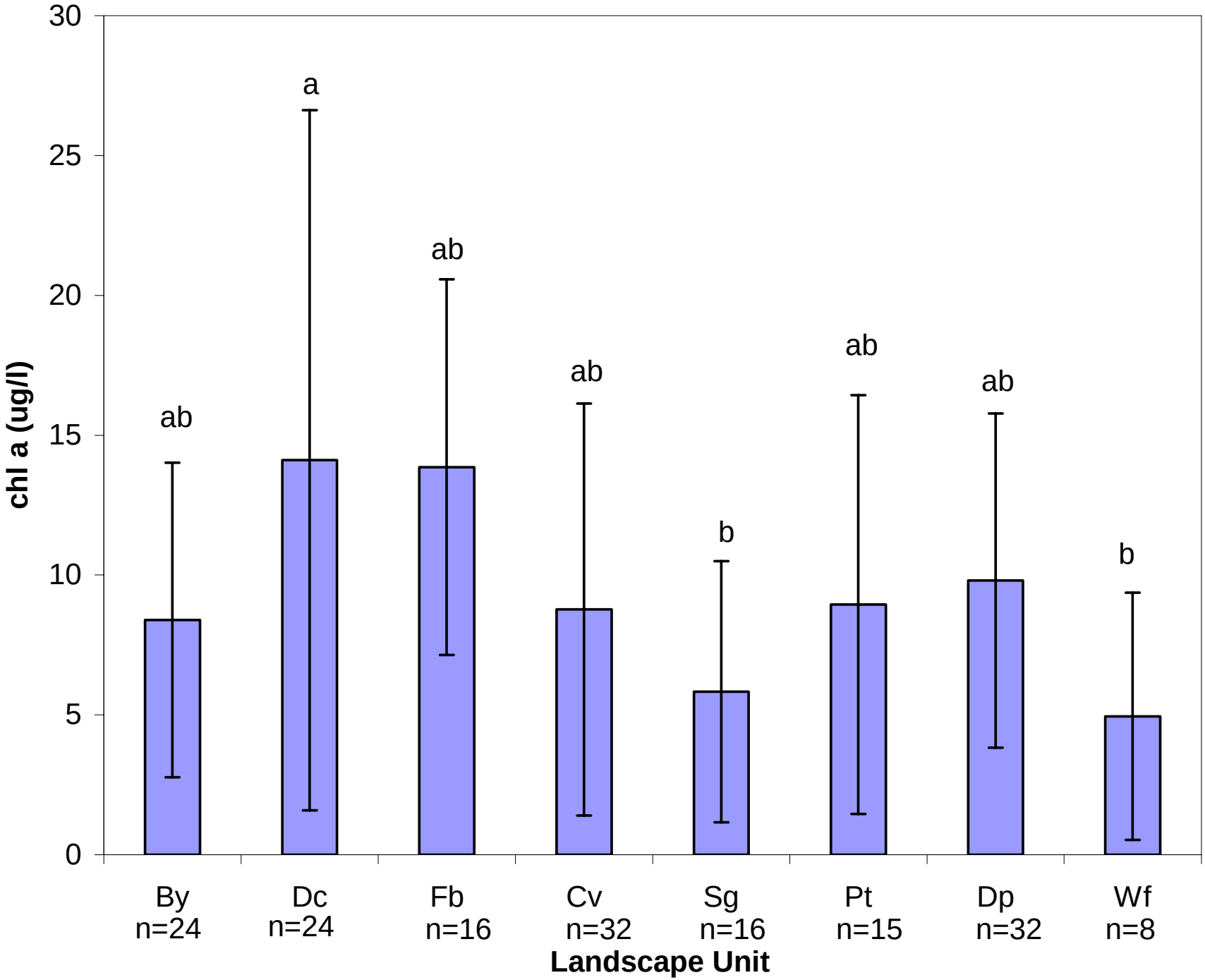
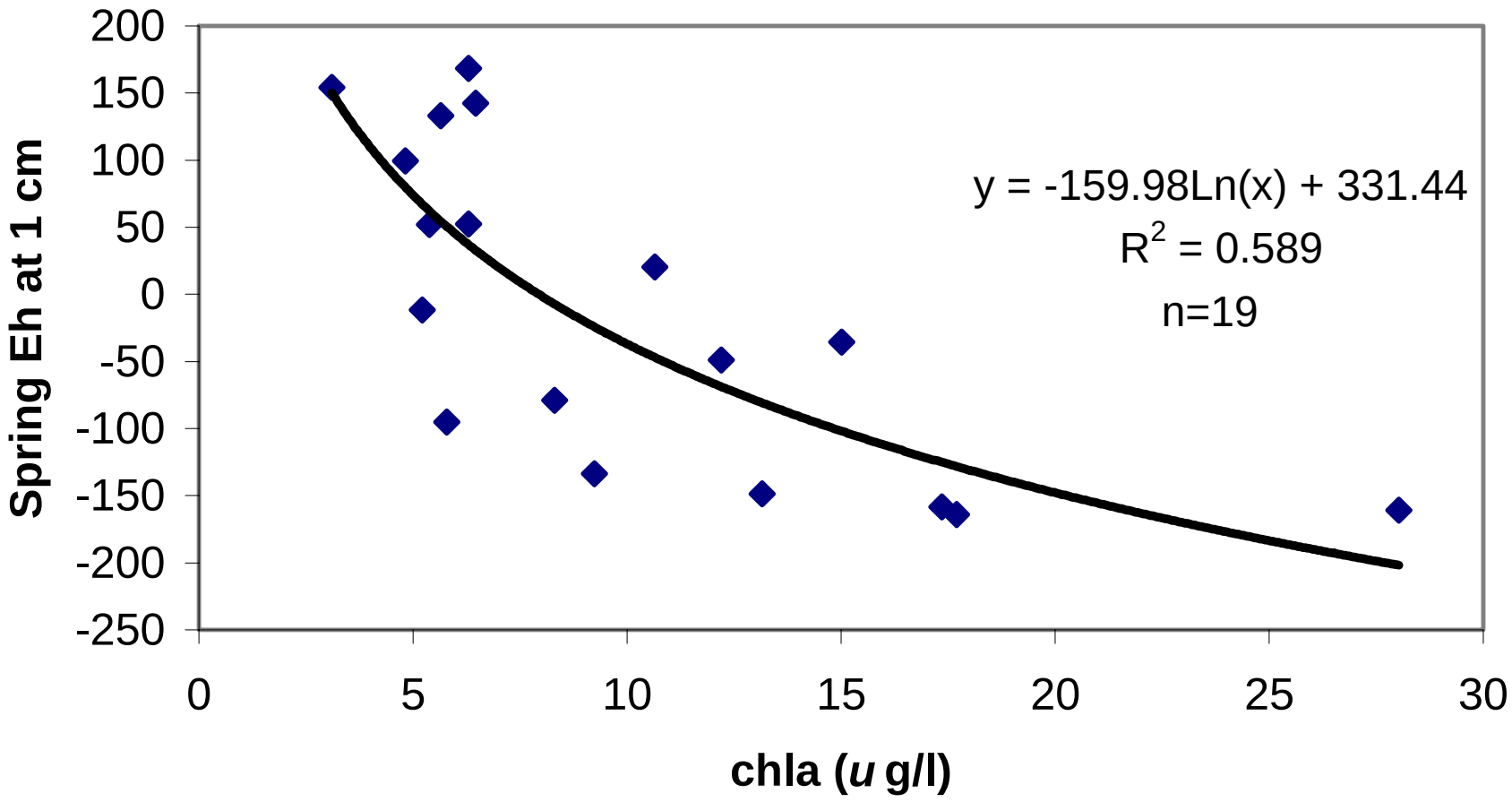

30
25
20
15
10
5
0
chl a (ug/l)
a
ab
ab
ab
b
ab
ab
b
By
n=24
Dc
n=24
Fb
n=16
Cv
n=32
Sg
n=16
Pt
n=15
Dp
n=32
Wf
n=8
Landscape Unit

Redox Potential and Water Quality



Conclusions

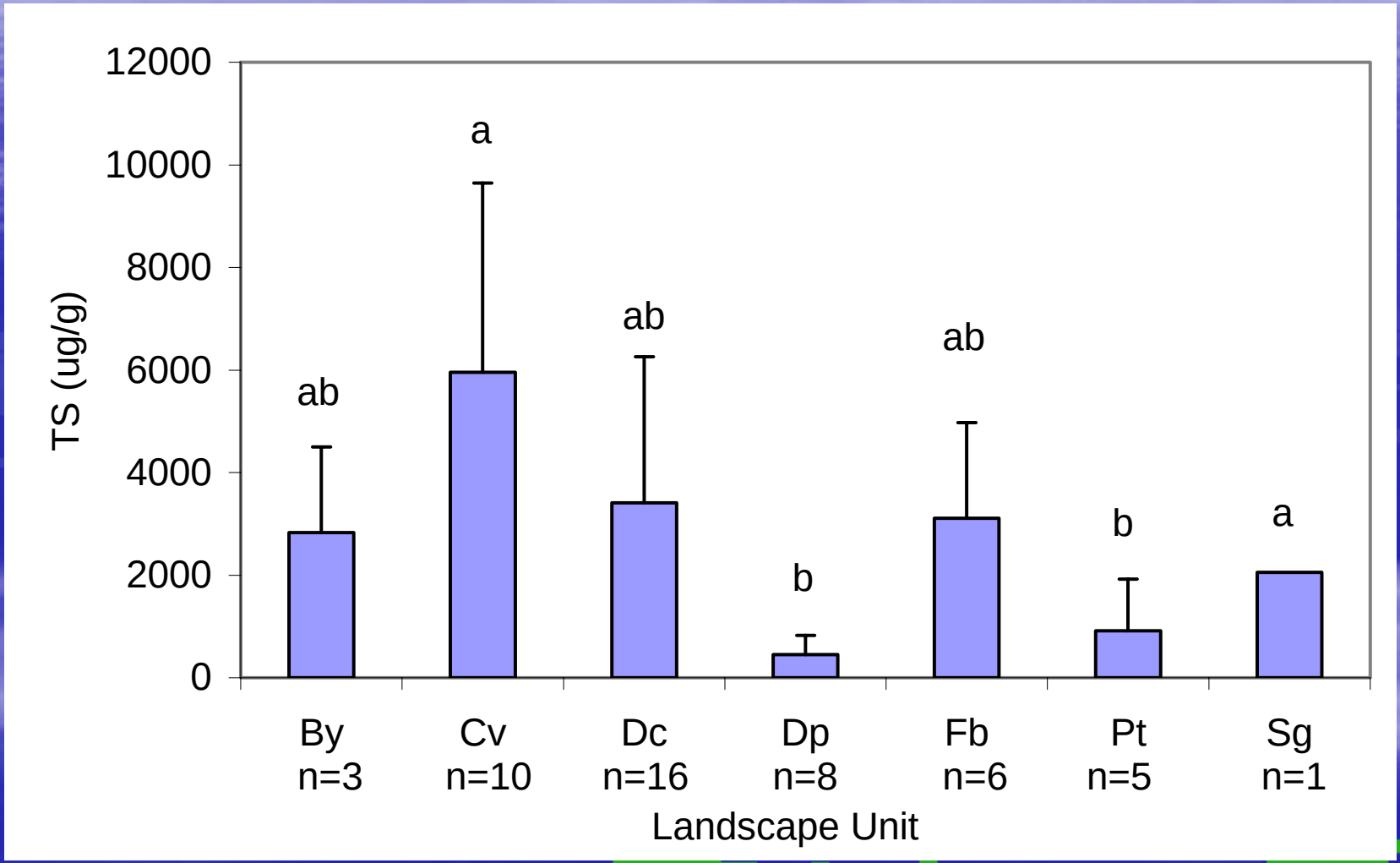
- Water quality can be assessed using a geographic/landscape model
  - Low DO and high Chl *a* in low energy landscape units
  - Redox potential indicative of long-term organic enrichment from high Chl *a* levels

Sulfides

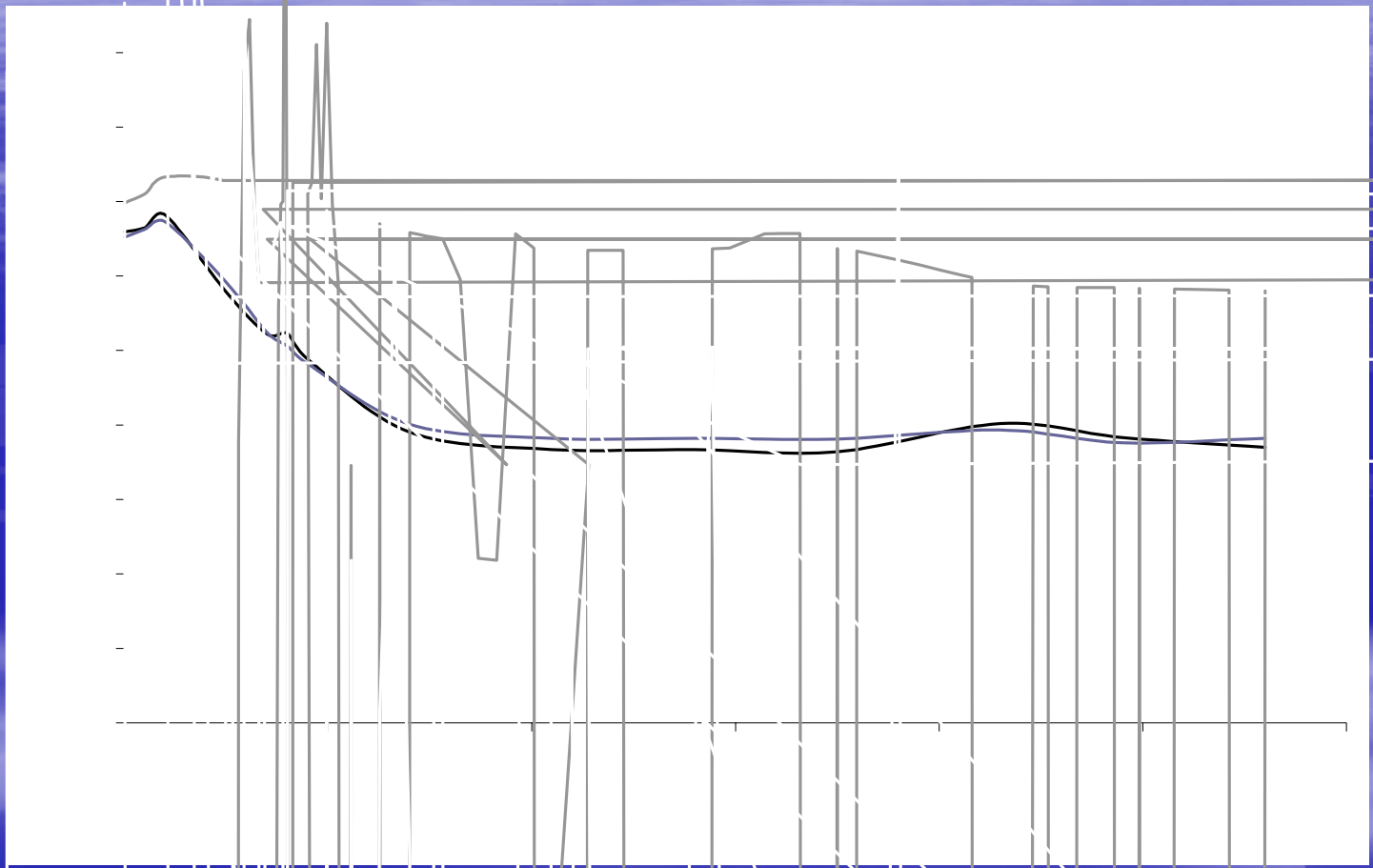
Goals:

- To assess distribution of sulfides
- To assess sulfide estimation techniques
  - Incubation pH
  - H_2O_2 oxidized salinity
  - Physical soil properties

Sulfide Distribution



Incubation pH



- Incubation pH ≤4 after 8 weeks is currently used to define sulfidic materials

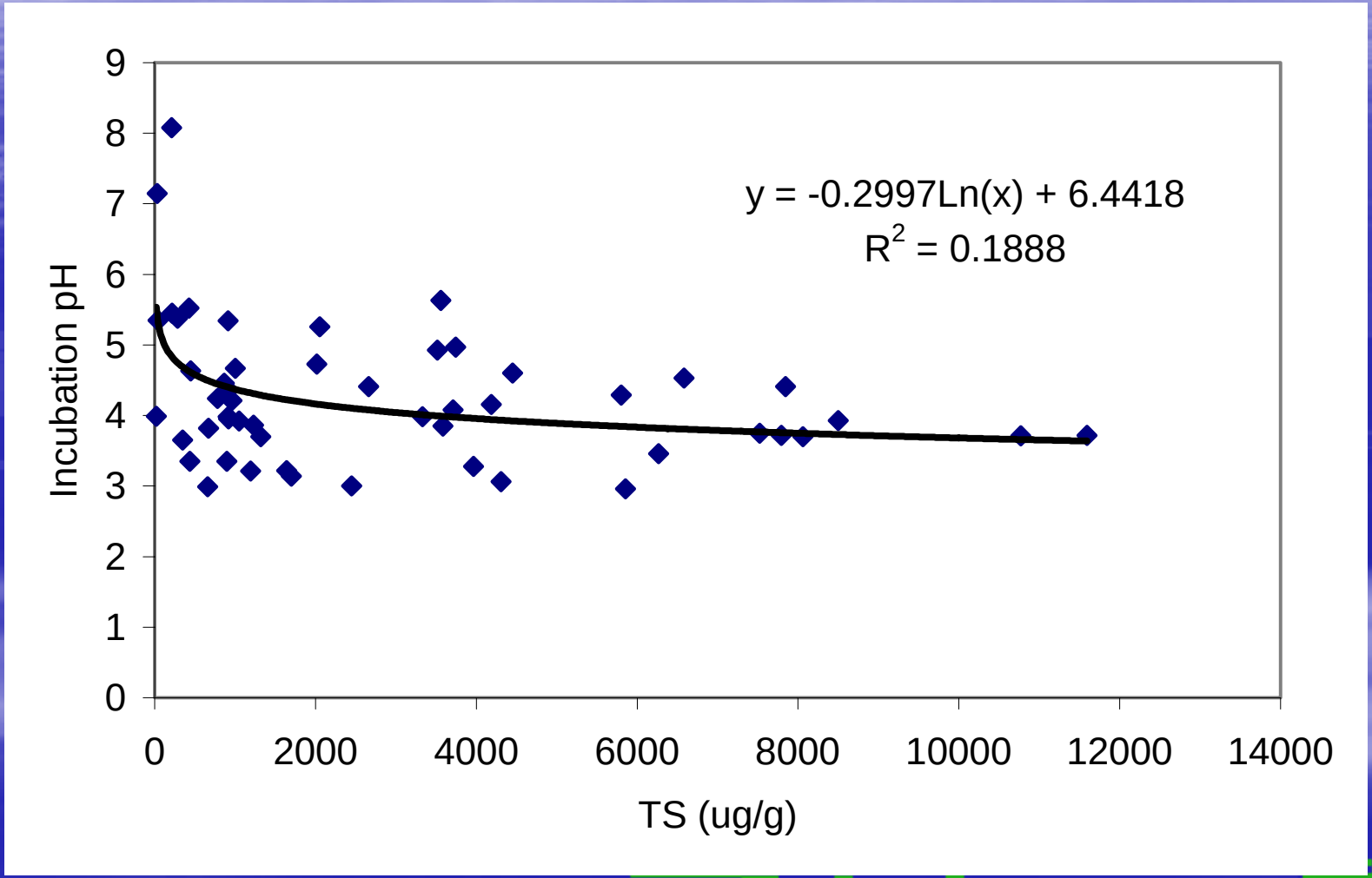
Incubation pH

(Balduff, 2007)

Length of time to drop below pH 4	Number of samples†	% of Samples that eventually show a drop in pH<4
4 weeks	25 (16%)	20
8 weeks	73 (45%)	57
12 weeks	104 (64%)	81
16 weeks	117 (72%)	91
20 weeks	125 (77%)	98
24 weeks	128 (78%)	100

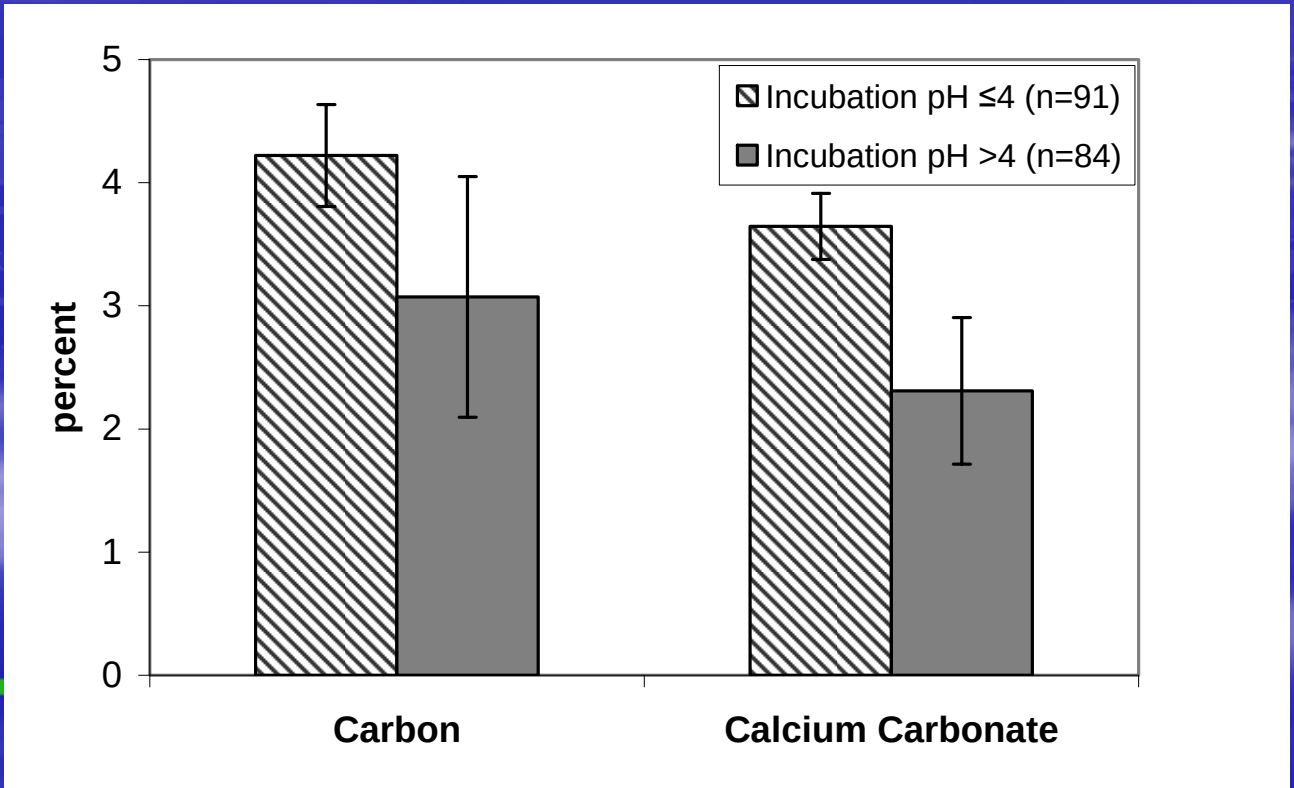
† 46 samples were only incubated for 16 weeks

Incubation pH

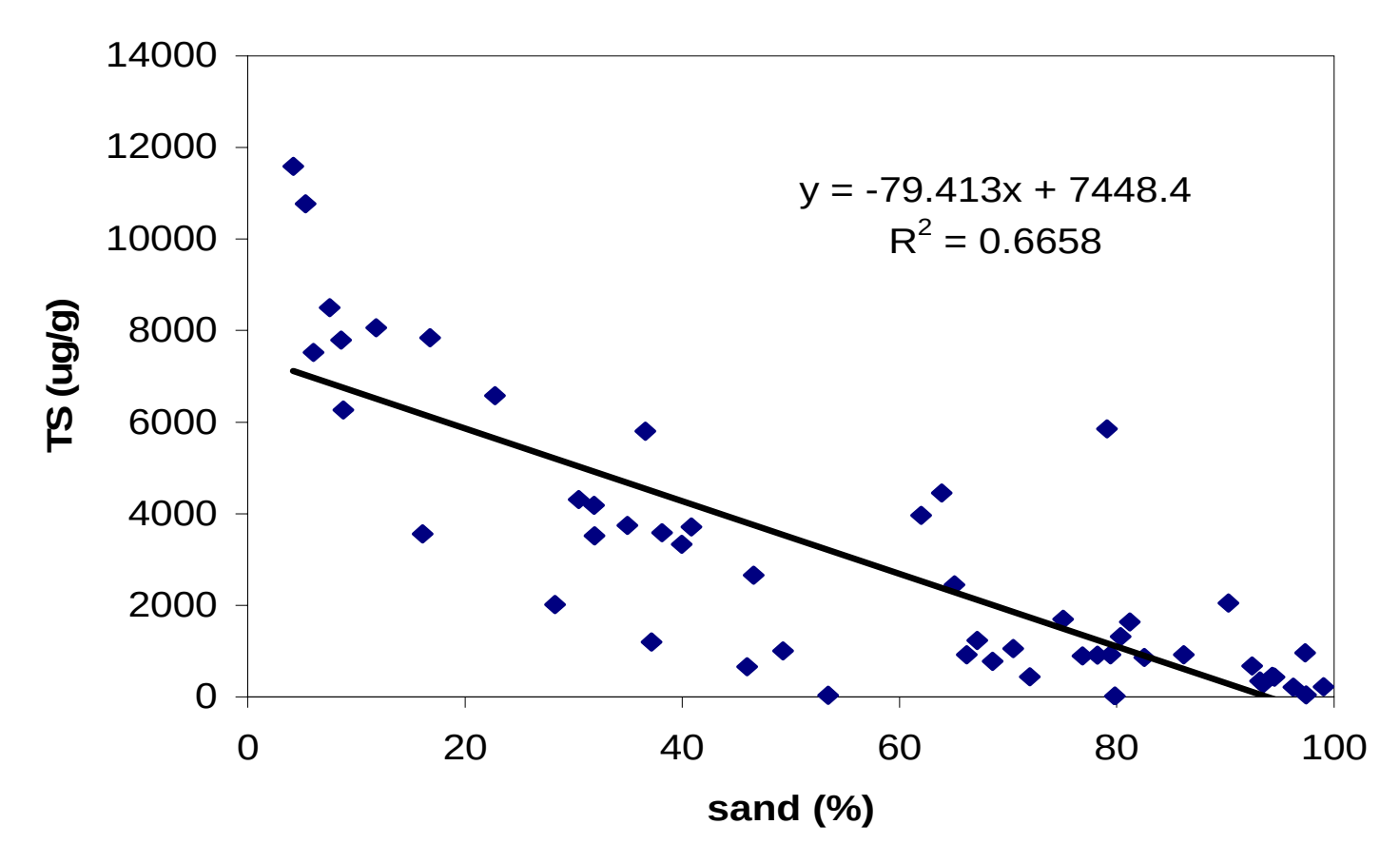


Incubation pH

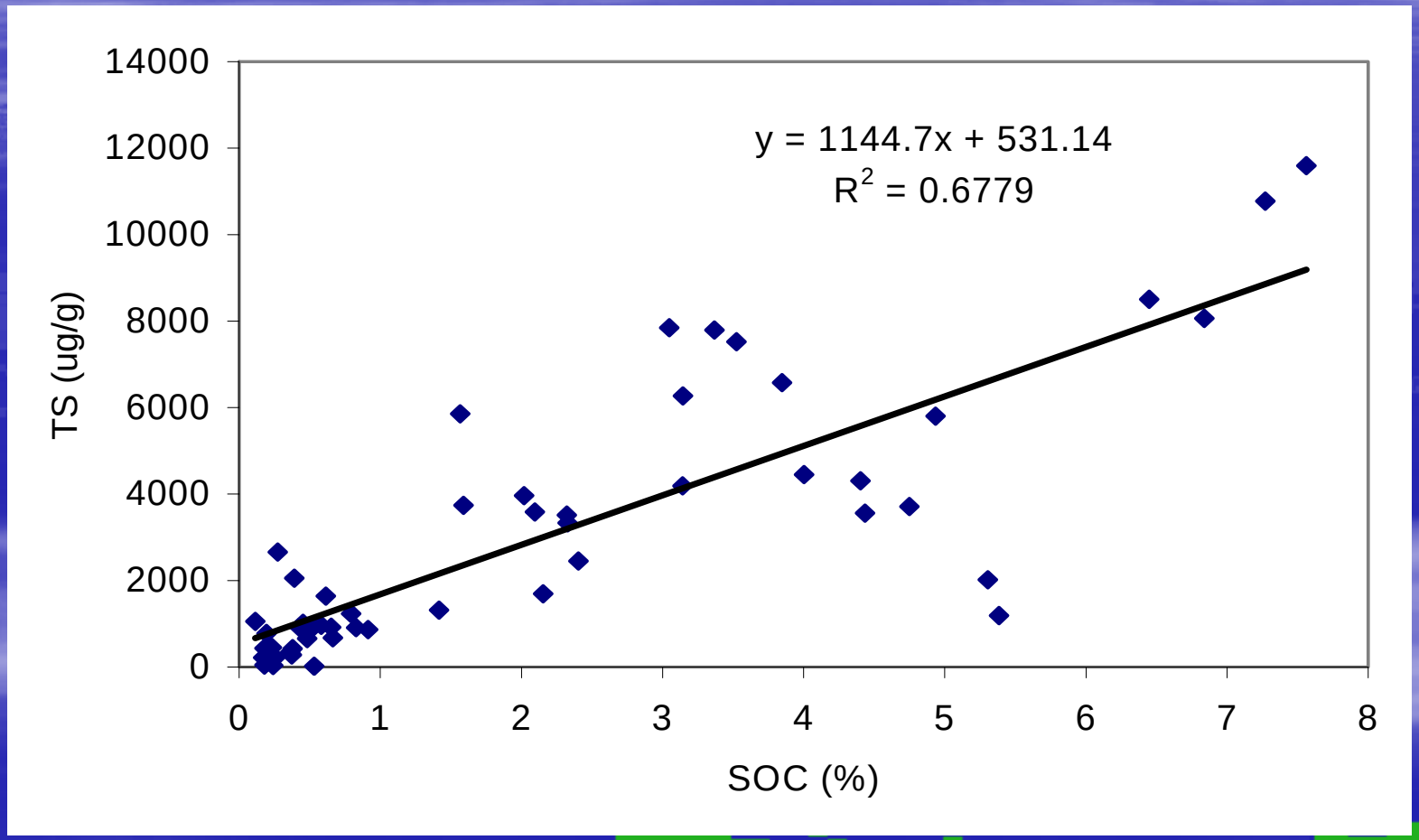
- Buffering from carbon and calcium carbonate were not significant factors in incubation pH values



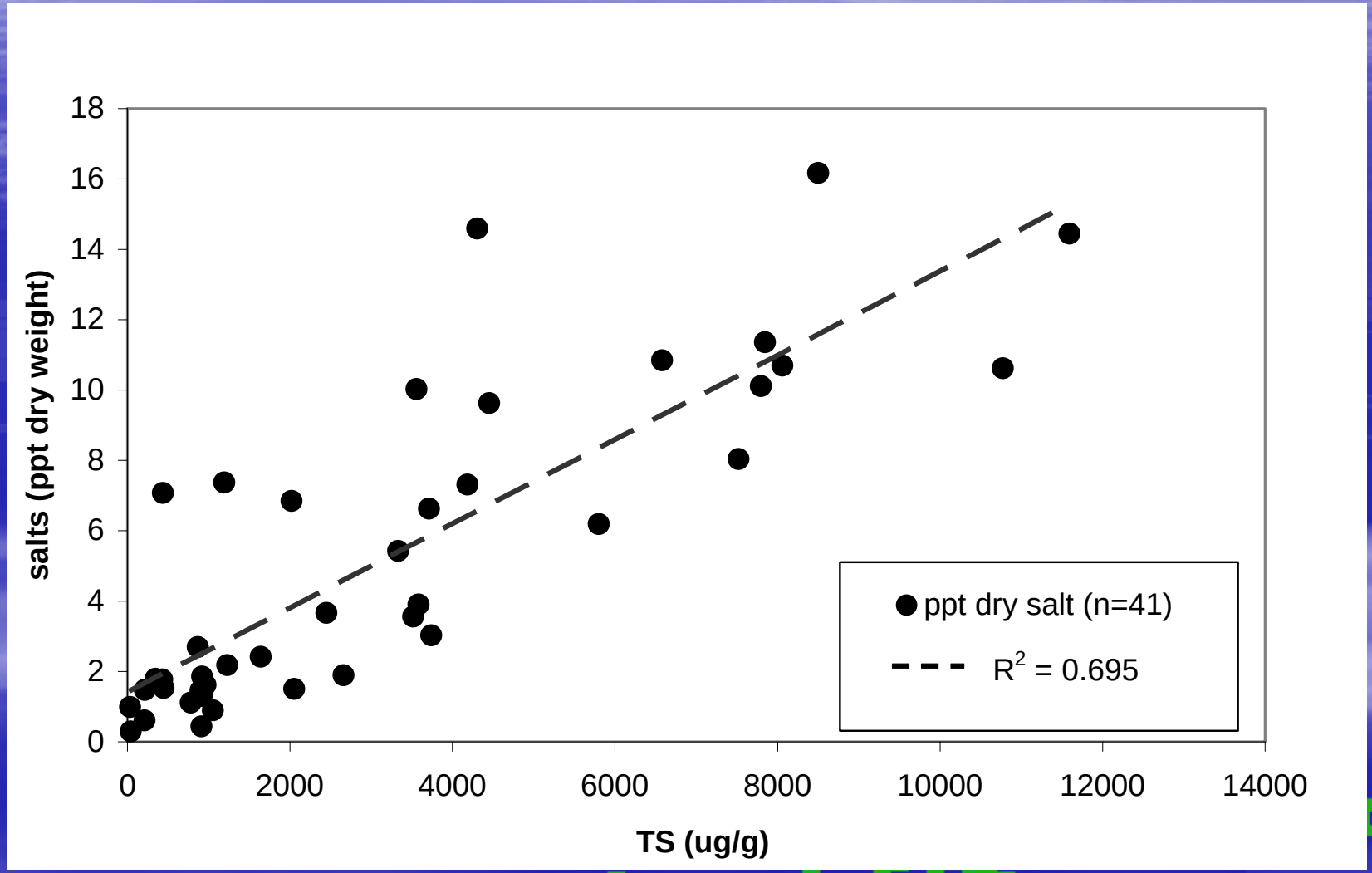
Sulfide Distribution



Sulfide Distribution



H_2O_2 Oxidized Salinity



Conclusions

- Sulfide distribution is correlated with landscape unit
- Incubated pH after 8 weeks may not be an accurate indicator of sulfide levels
  - Neutralization from biogenic $CaCO_3$ is not a factor in incubated pH values
- Sulfide content is correlated with SOM and particle size
- H_2O_2 oxidized salinity reflects sulfide content

Subaqueous Soil Interpretations Dredged Material

Alexander Salisbury

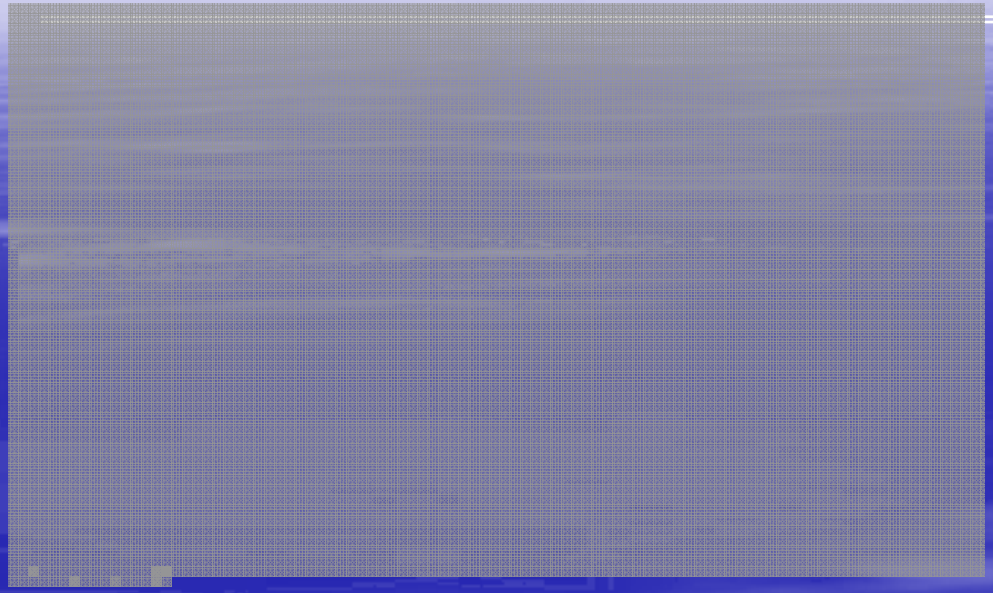
Subaqueous Soil Interpretations
Dredged Material

Soil Carbon, Eelgrass Restoration, Shellfish Productivity

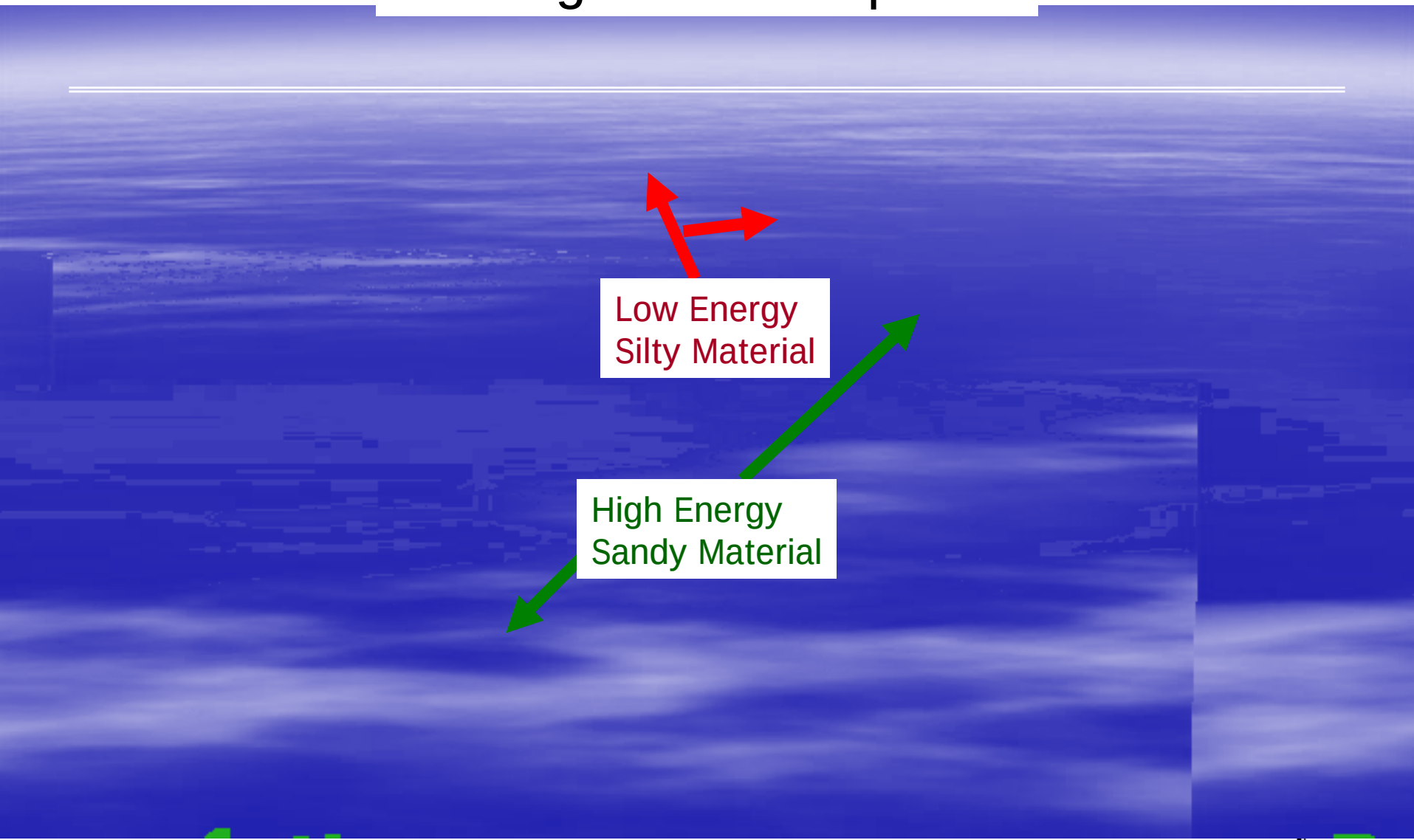
Methods

- Mesocosm study
- Locations
  - Embayments: Wickford Cove and Greenwich Bay
  - Coastal Ponds: Ninigret and Quonochontaug
- Soil Landscapes
  - Sandy Spit, Mainland Shoreface, Bay Bottom, Cove
  - Washover Fan, Flood Tidal Delta, Lagoon bottom, Mainland Cove
- 4 Mesocosms per Landscape
  - Total of 64 mesocosms

Mesocosms



Ninigret Landscapes

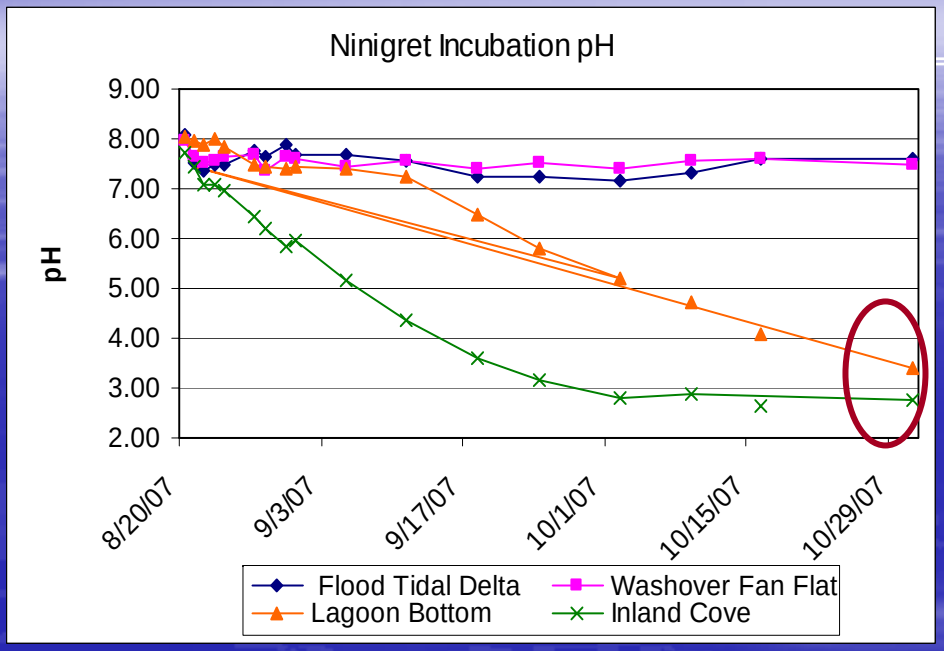


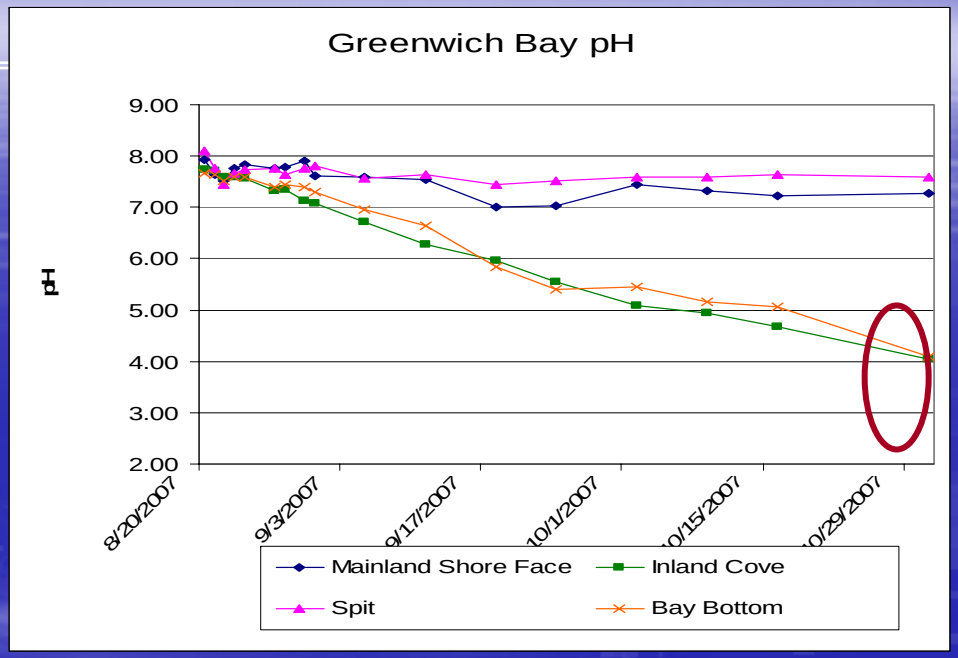
Alexander Salisbury NRS, URI

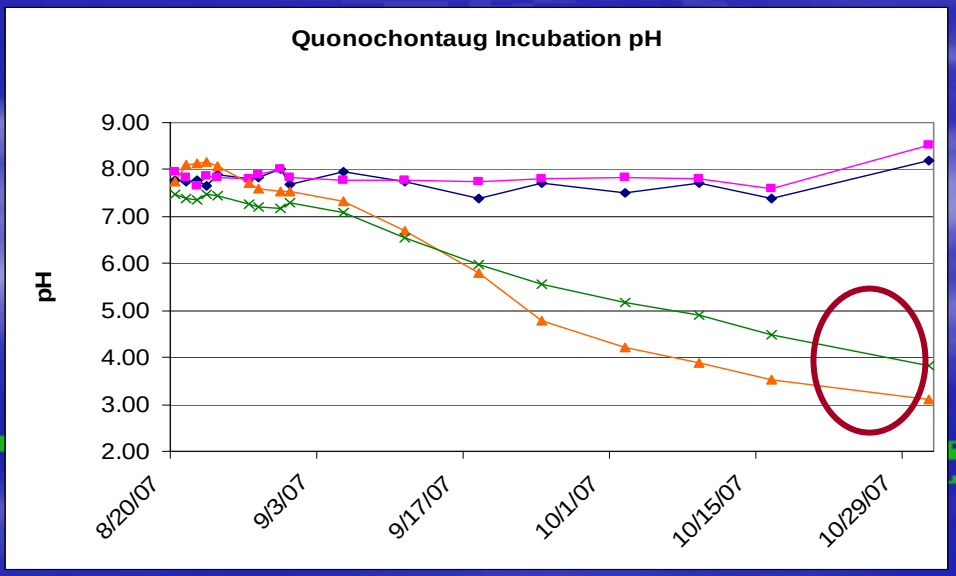
0 250 500 1,000 Meters

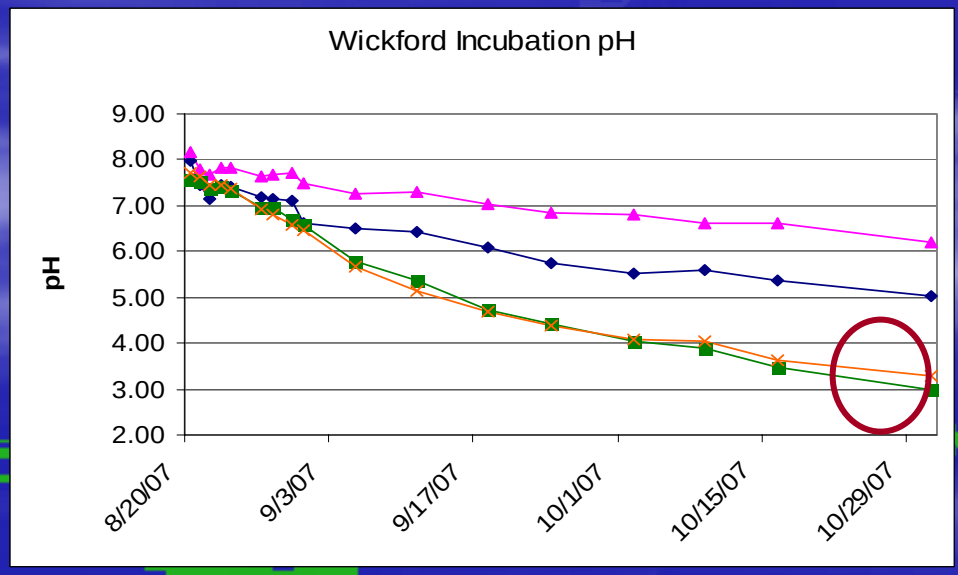
W E S

Lab Incubation pH

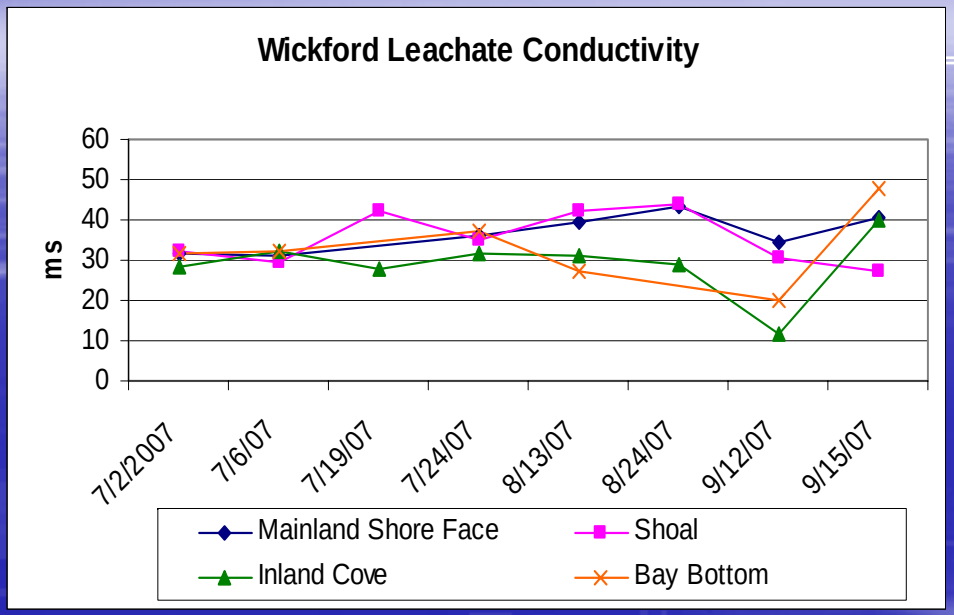


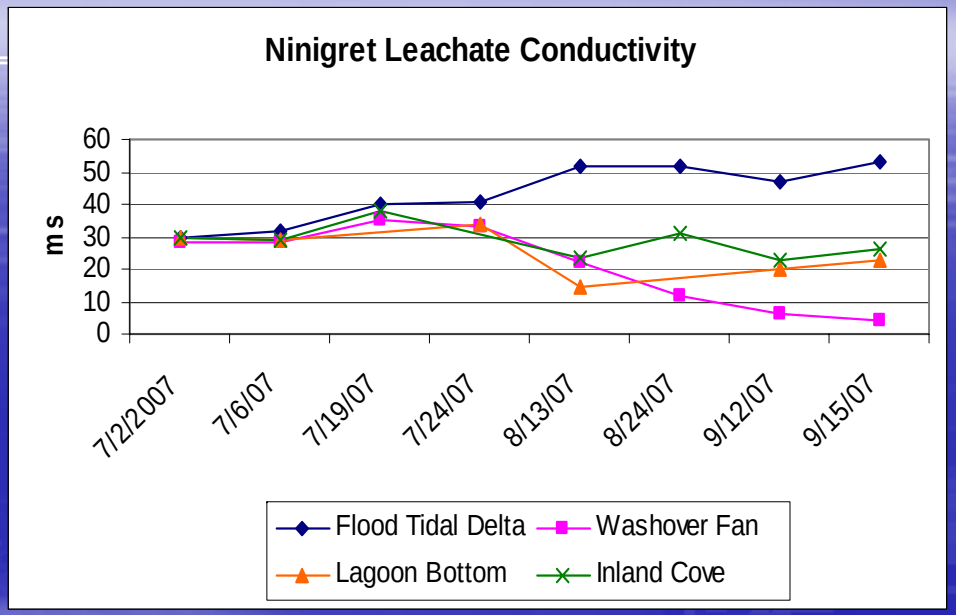


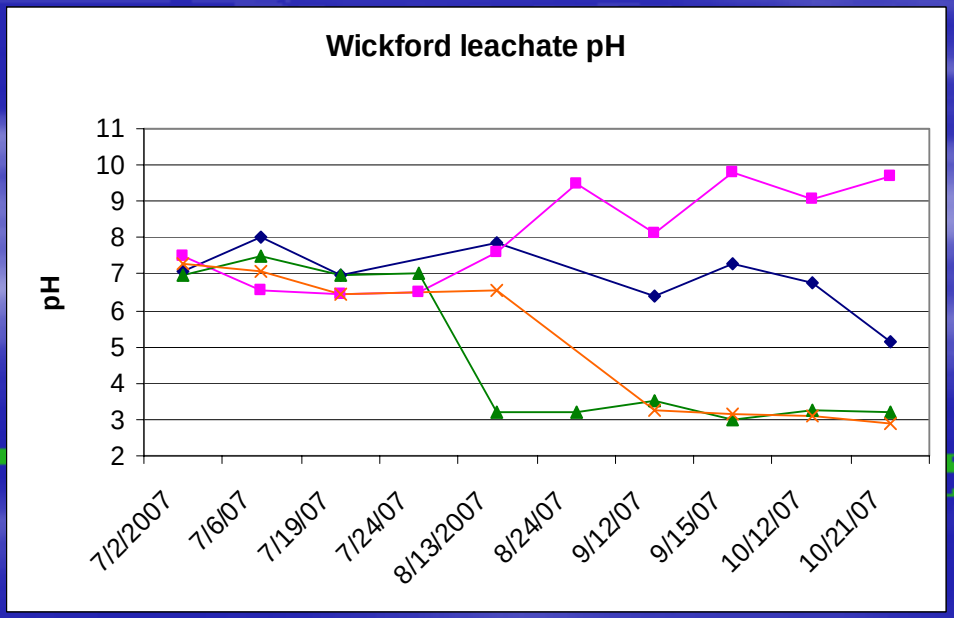


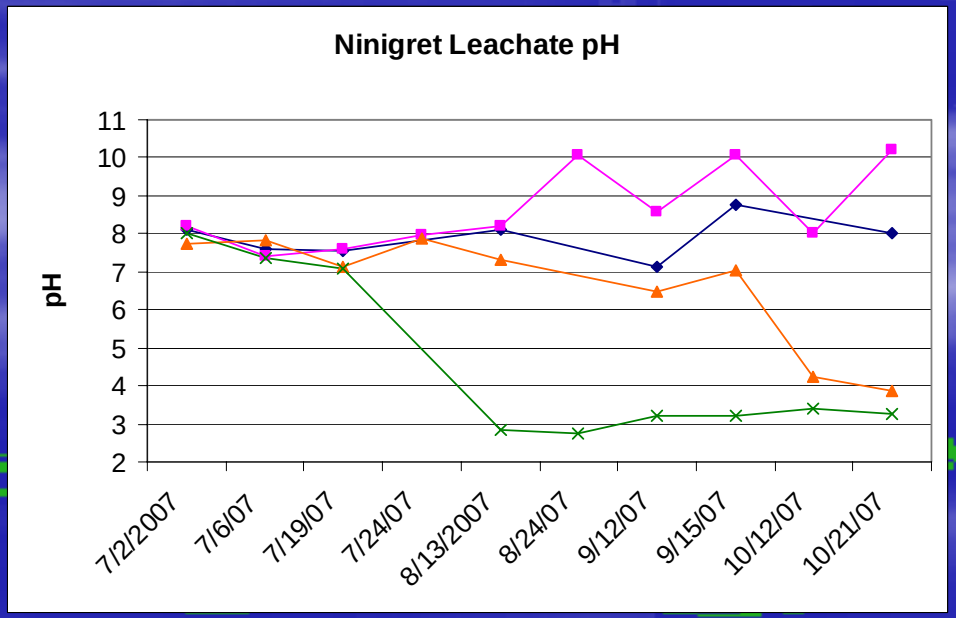


Leachate Conductivity and pH (2007)

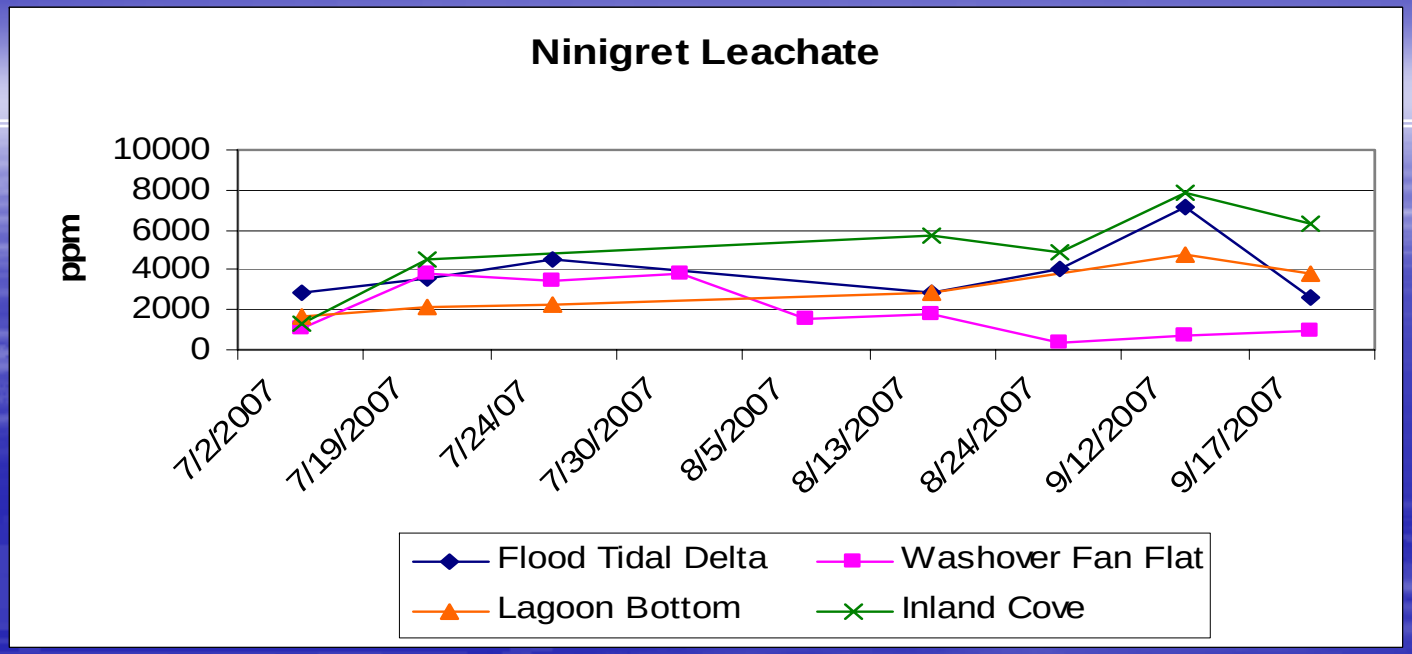


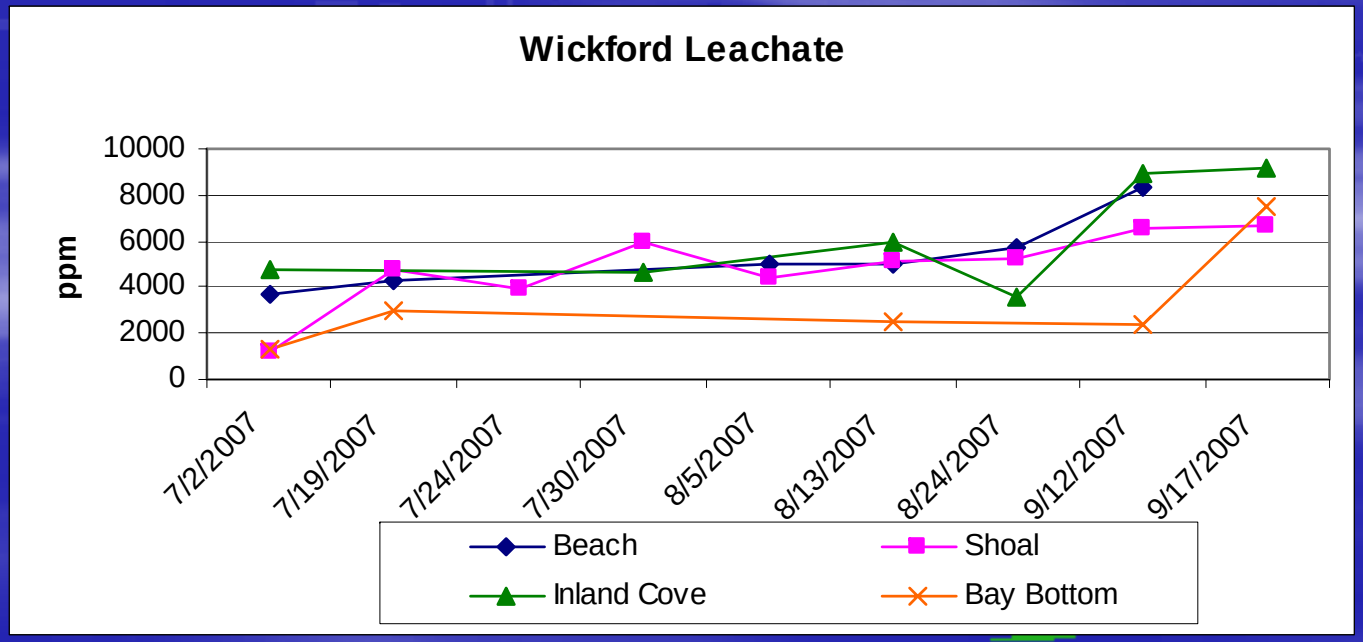






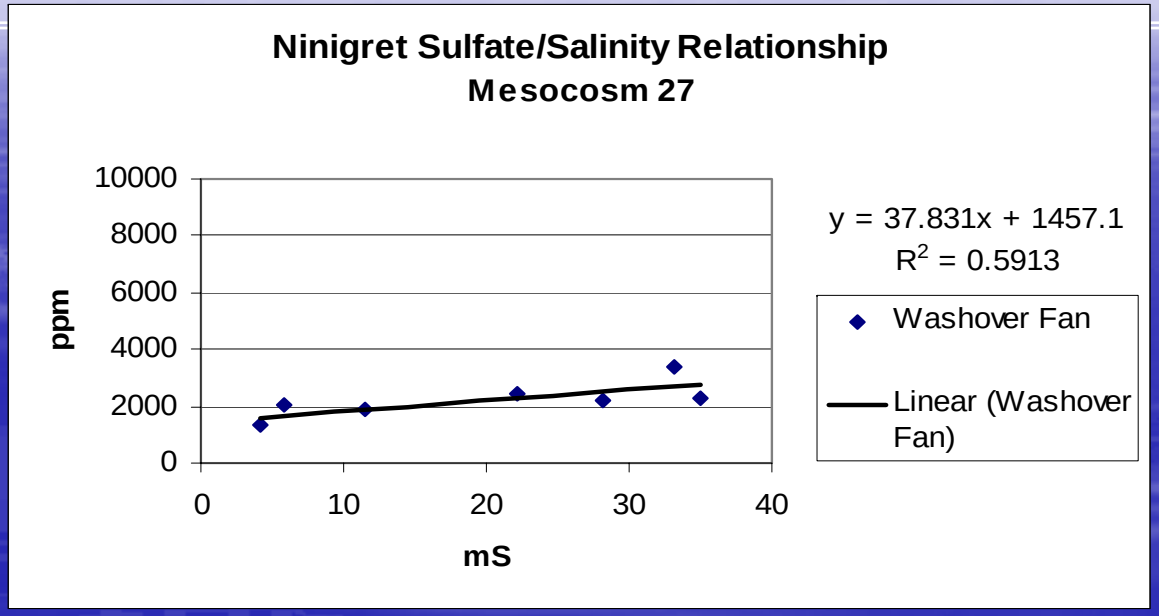
Leachate Sulfate Content

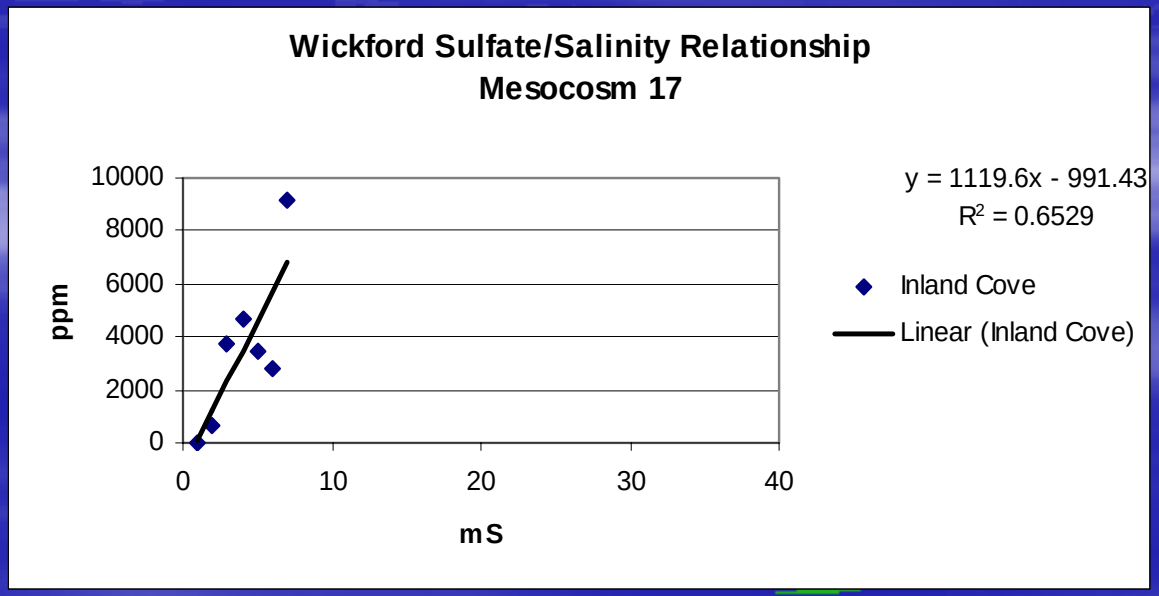




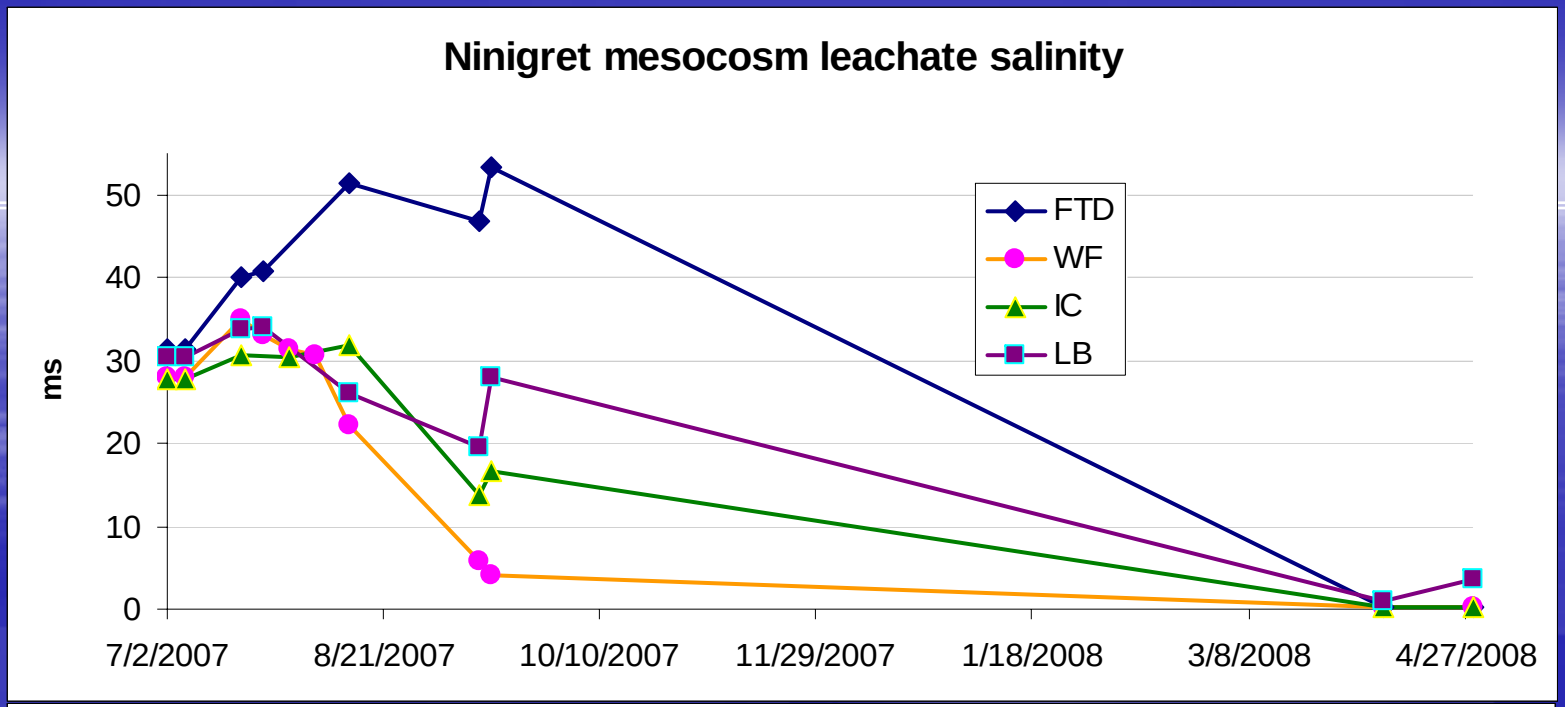
Seawater SO_4^-
URI Bay Campus
1928ppm

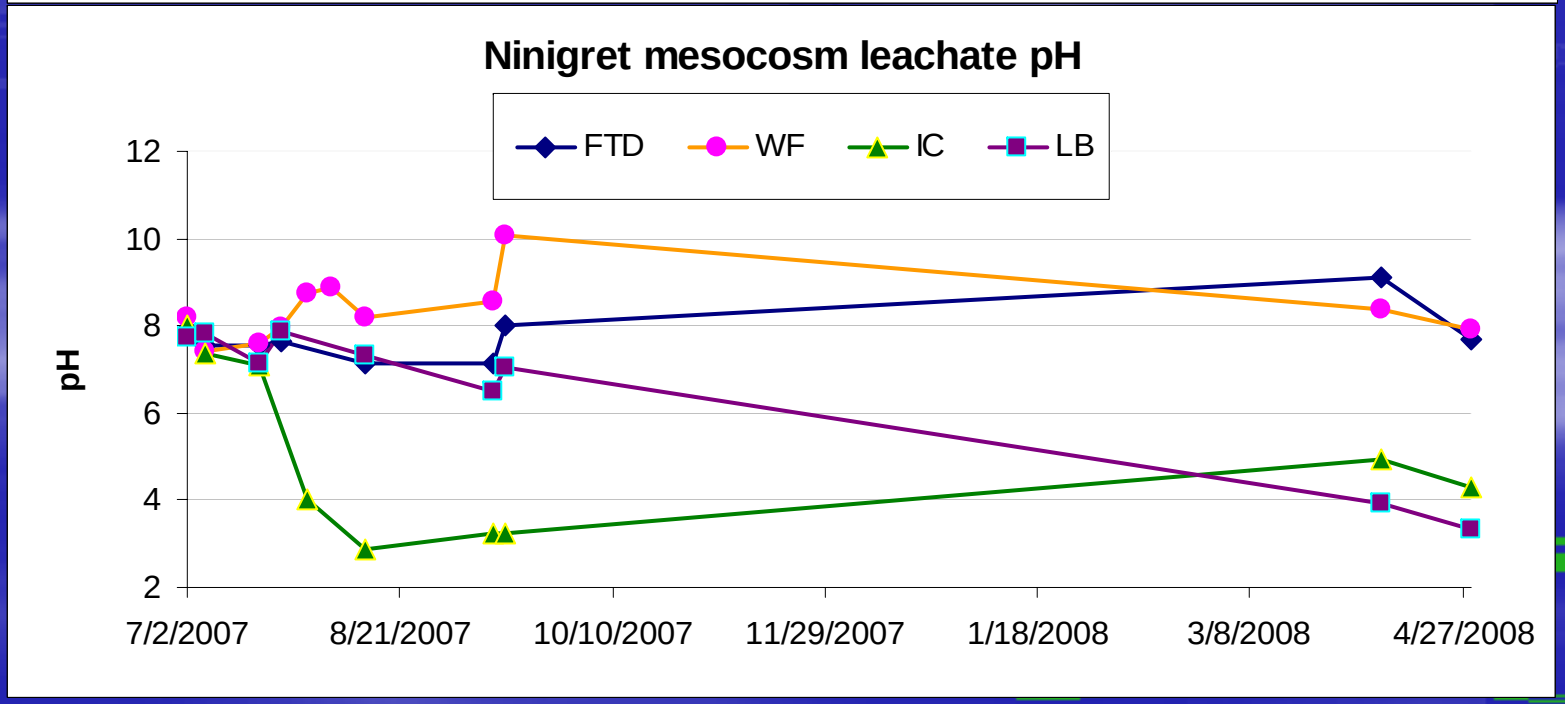
Sulfate/ Salinity Relationships

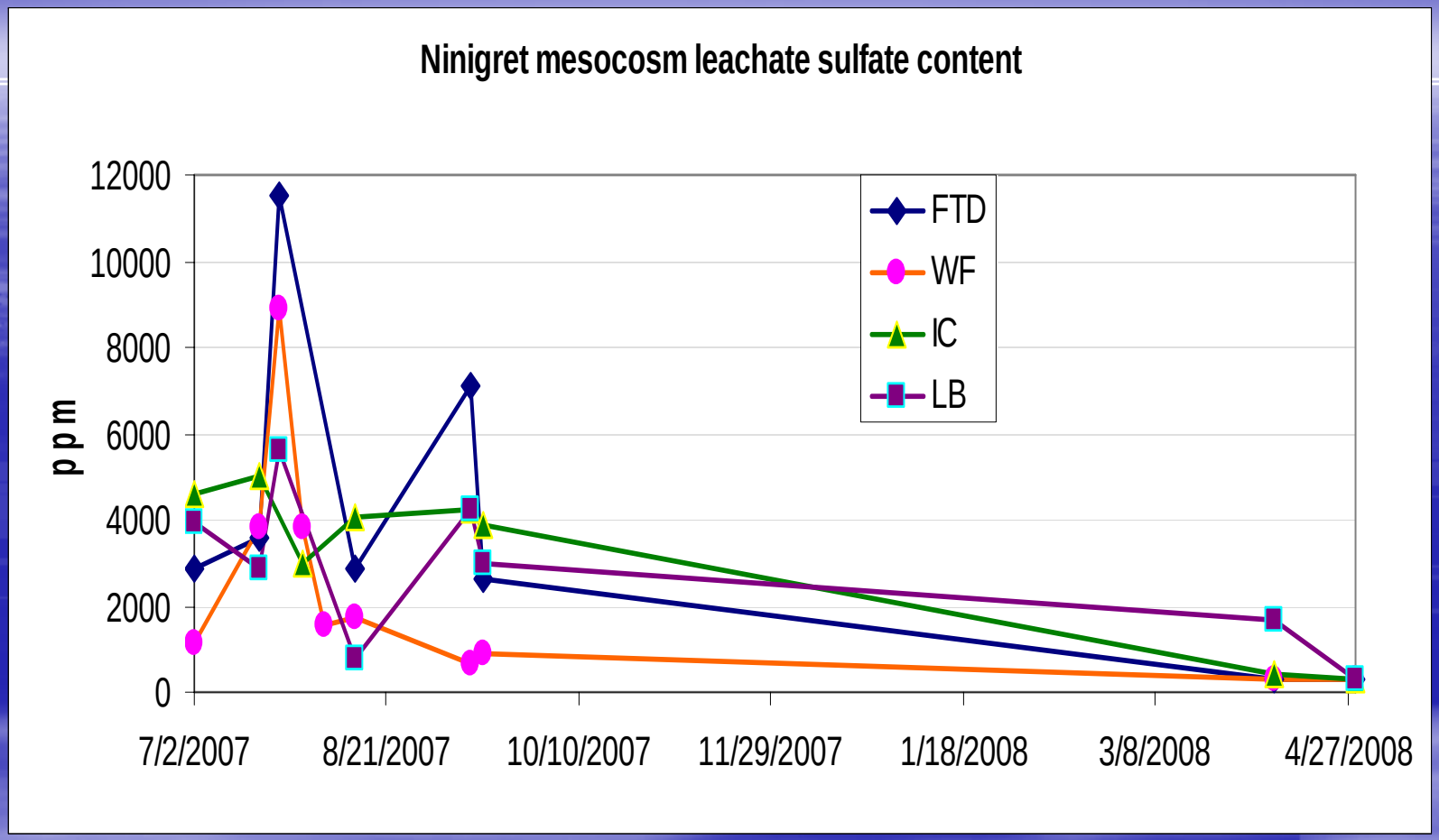
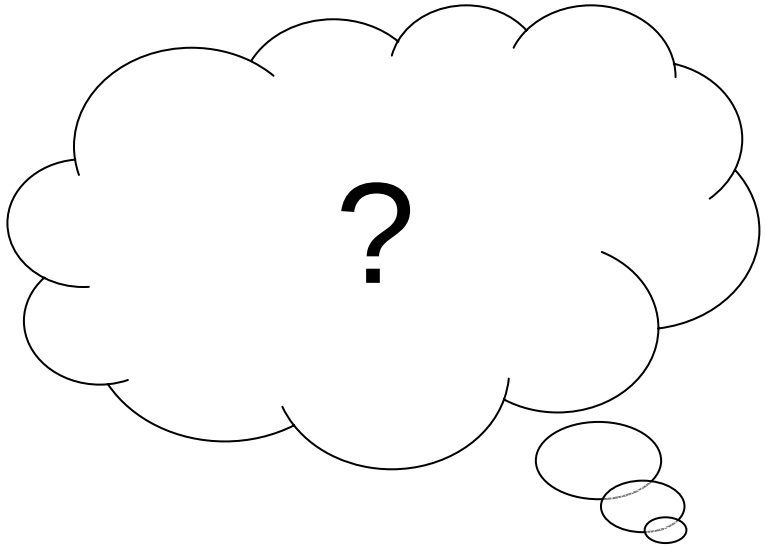




Seawater SO_4- URI Bay Campus 1928ppm


Ninigret mesocosm leachate salinity
ms
50
40
30
20
10
0
7/2/2007
8/21/2007
10/10/2007
11/29/2007
1/18/2008
3/8/2008
4/27/2008
FTD
WF
IC
LB


Ninigret mesocosm leachate pH
pH
12
10
8
6
4
2
7/2/2007
8/21/2007
10/10/2007
11/29/2007
1/18/2008
3/8/2008
4/27/2008
FTD
WF
IC
LB


Ninigret mesocosm leachate sulfate content
ppm
12000
10000
8000
6000
4000
2000
0
7/2/2007
8/21/2007
10/10/2007
11/29/2007
1/18/2008
3/8/2008
4/27/2008
FTD
WF
IC
LB