

# Tidal Marshes of the Saco

The Saco Science Symposium  
June 16, 2014

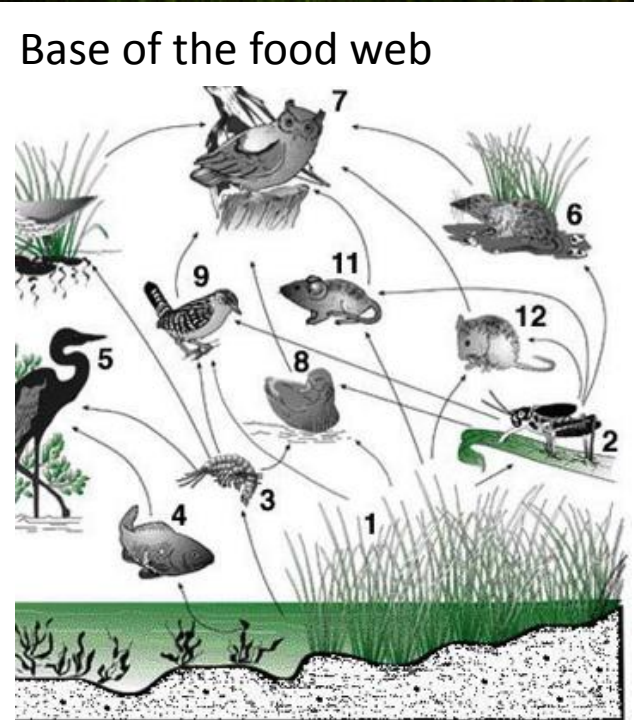
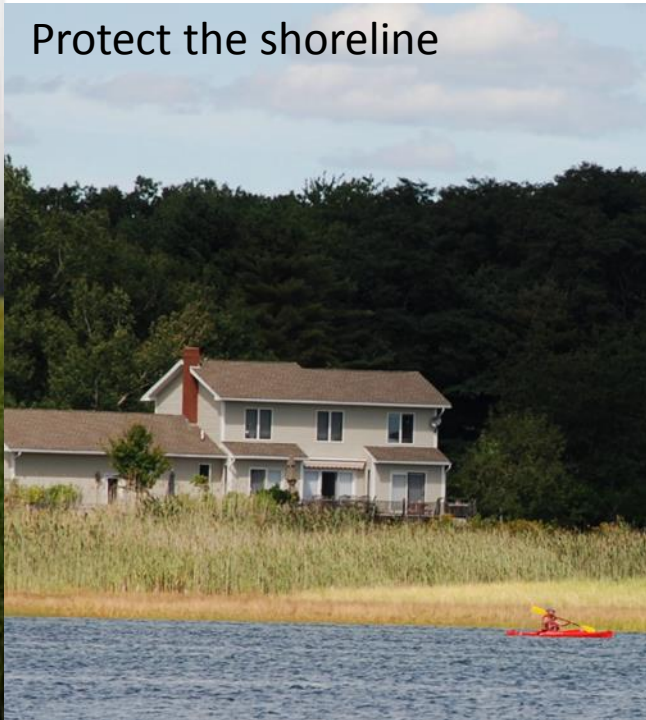
Dr. Pamela Morgan  
Department of Environmental Studies  
University of New England



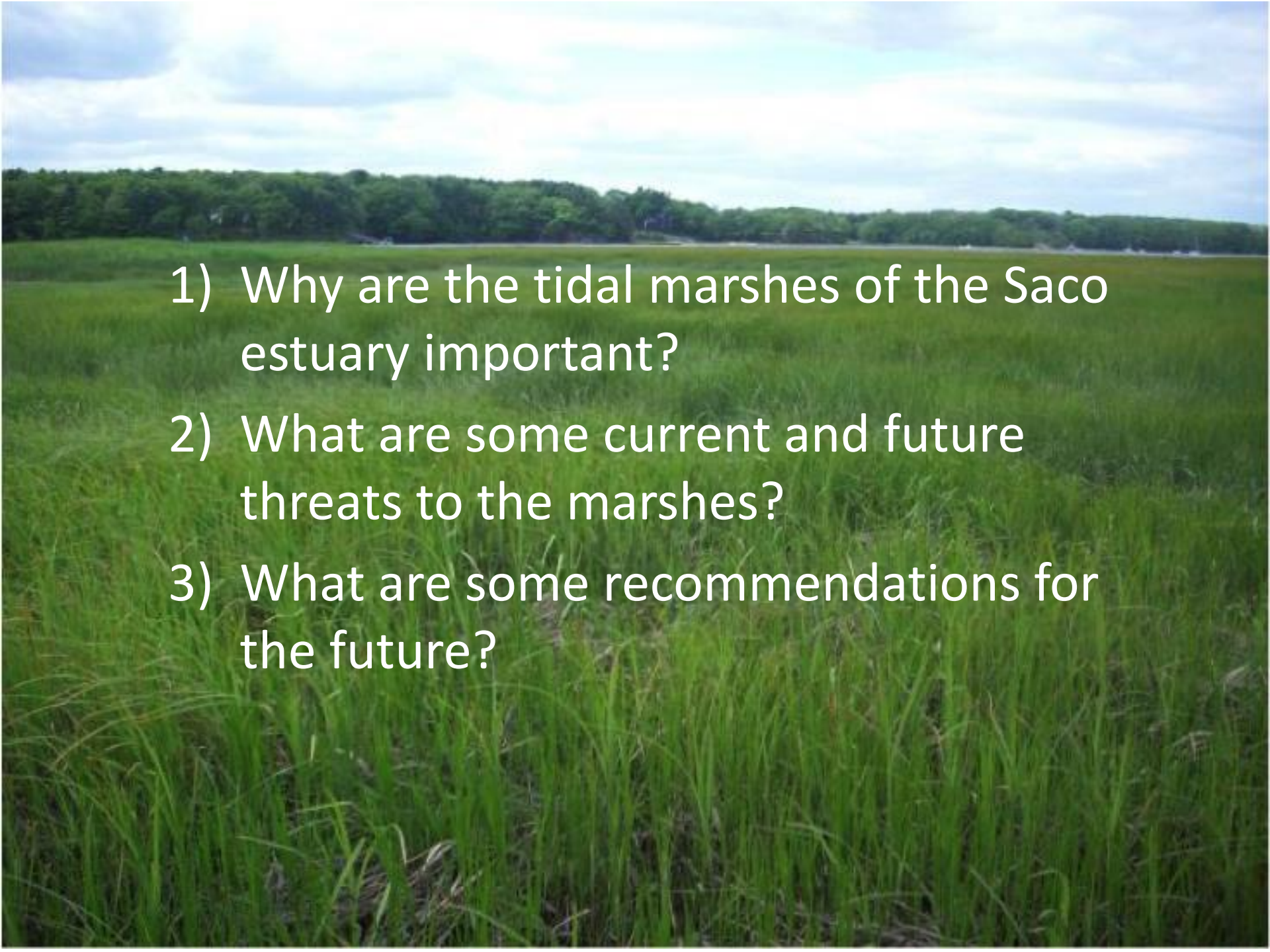
# Why should we care about tidal marshes?









- 
- 1) Why are the tidal marshes of the Saco estuary important?
  - 2) What are some current and future threats to the marshes?
  - 3) What are some recommendations for the future?



# There are three types of tidal marshes on the Saco river

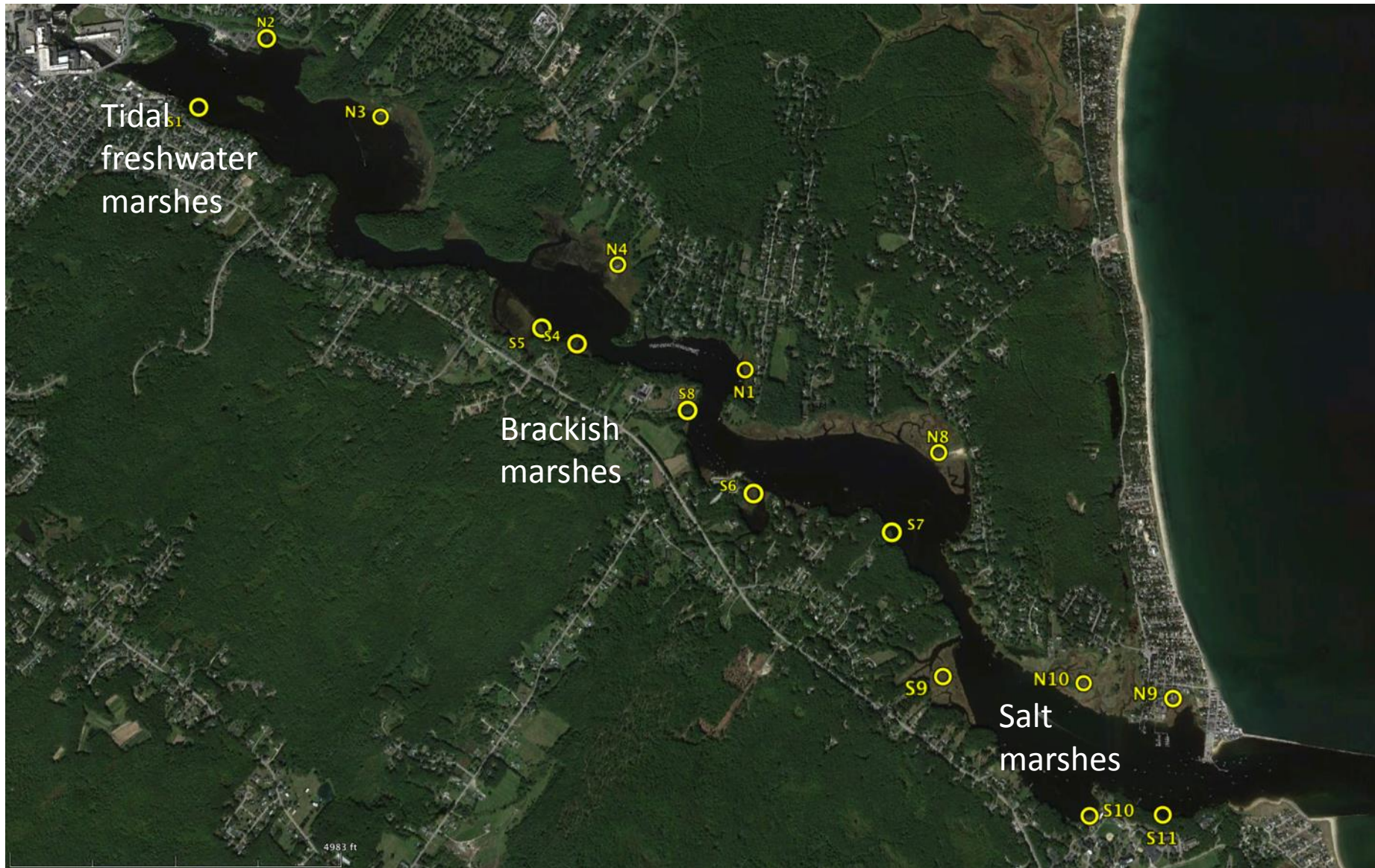
Salt Marshes

Brackish Marshes

Tidal Fresh Marshes



# Saco estuary marsh study sites



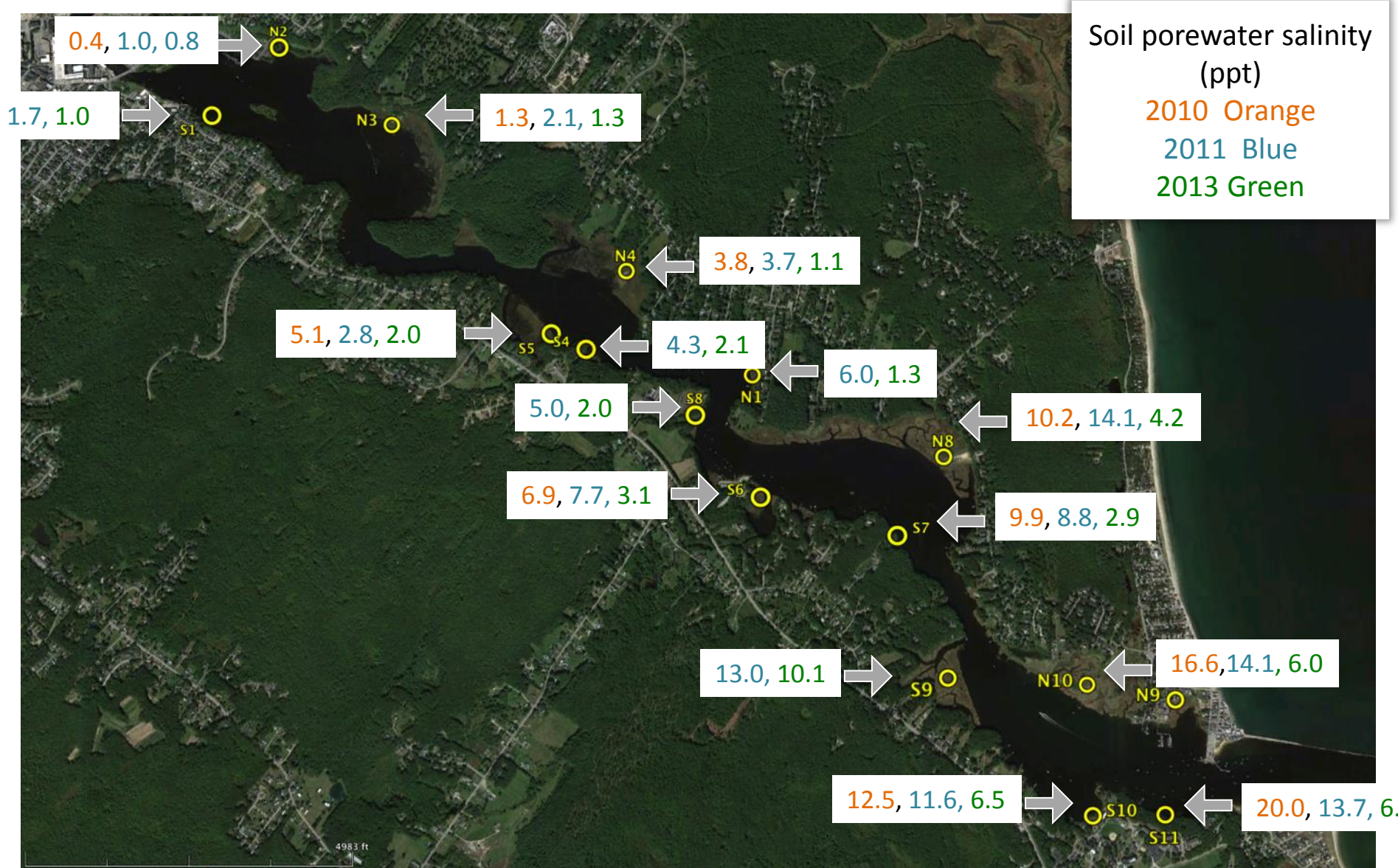


# Salinity drives the ecology of tidal marshes





# Salinity drives the ecology of tidal marshes





# Plant species diversity in the Saco's tidal marshes

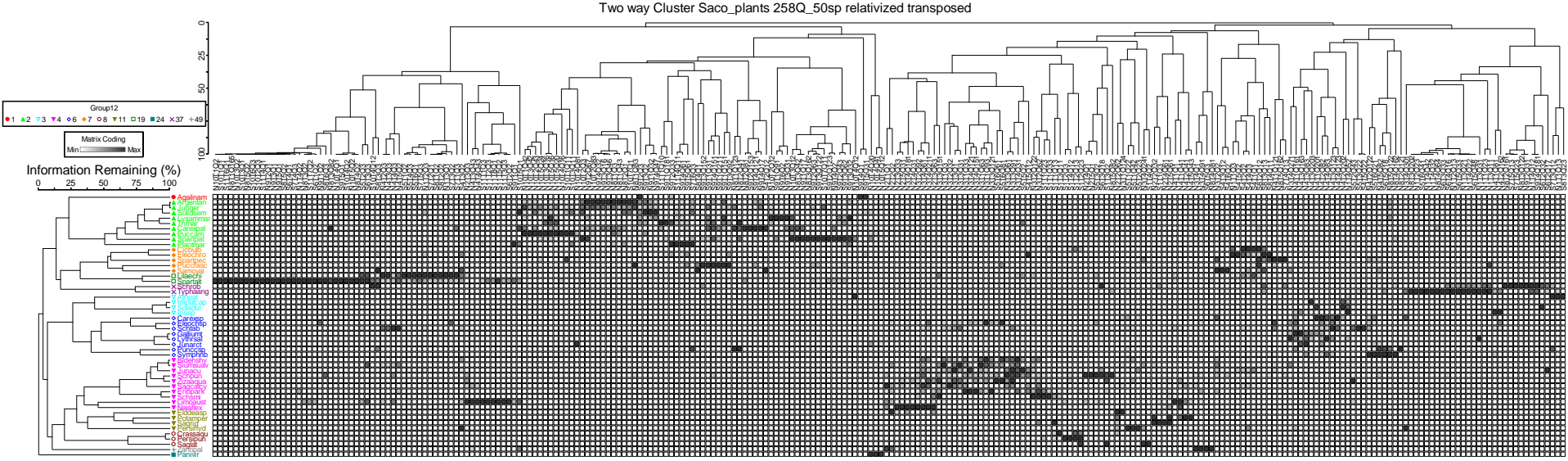






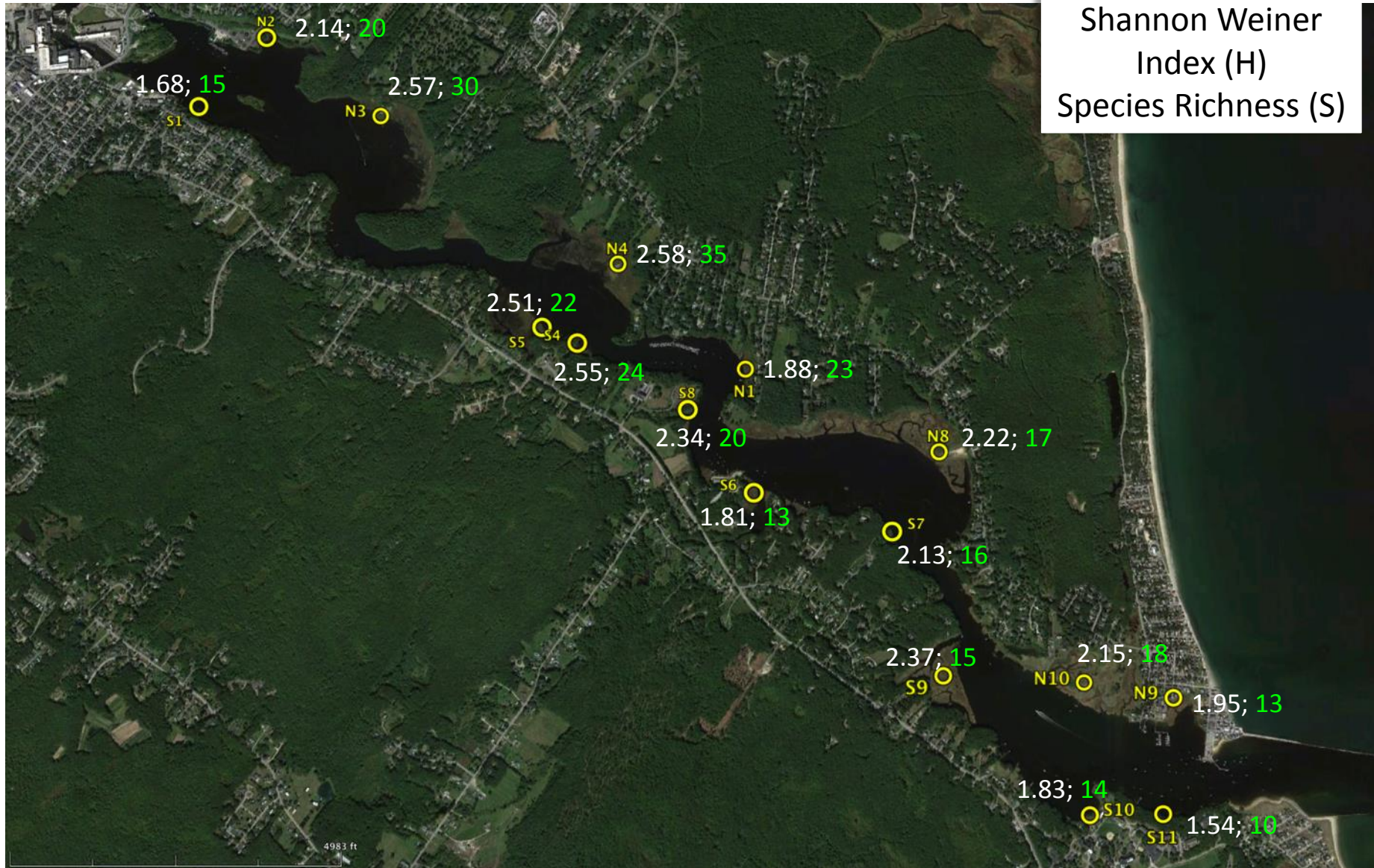


# Plant diversity in the tidal marshes



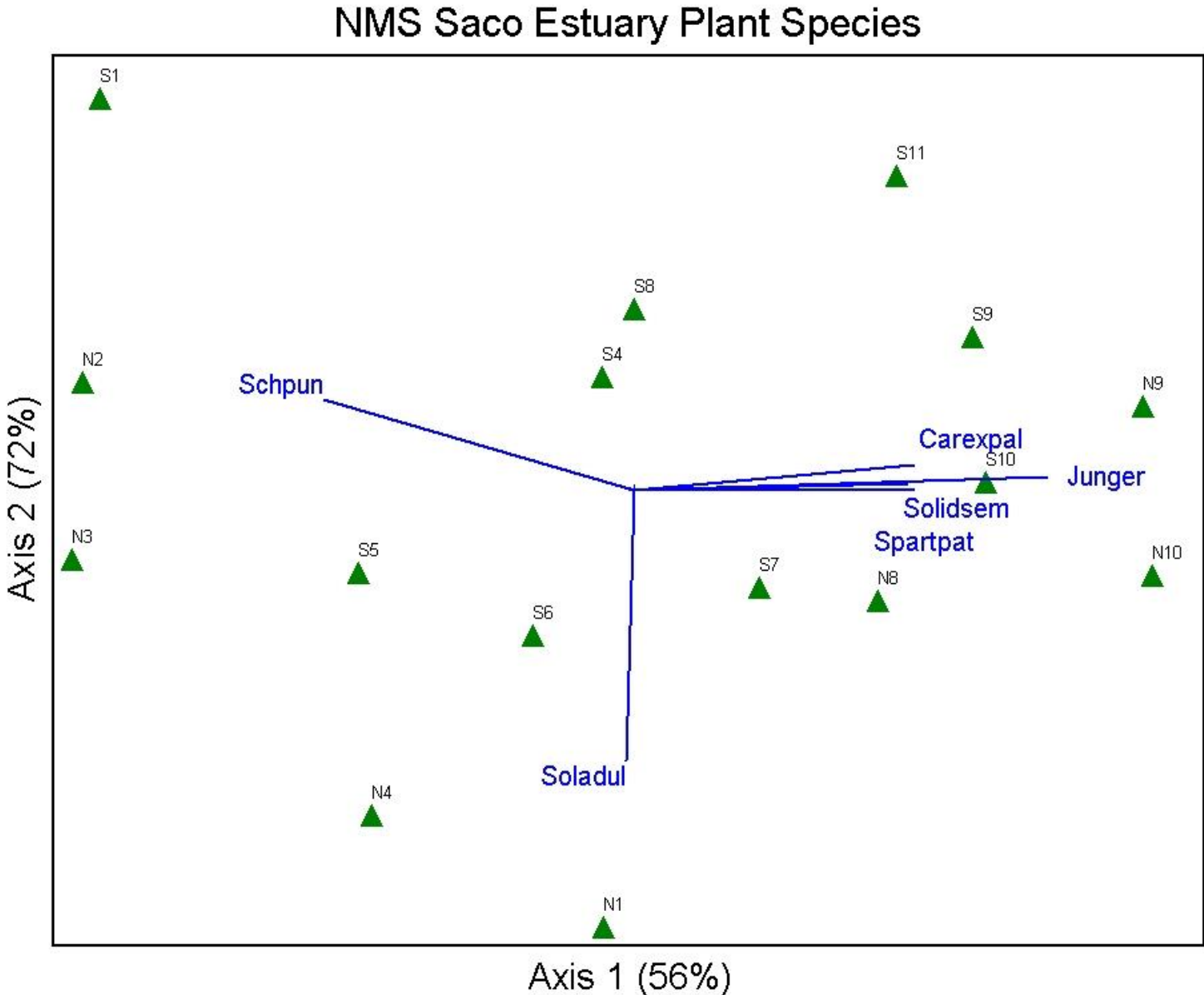


# Plant diversity in the tidal marshes





# Plant diversity in the tidal marshes





# Most common plant species



Salt Meadow Hay  
(*Spartina patens*)



Black Grass  
(*Juncus gerardii*)



Smooth Cordgrass  
(*Spartina alterniflora*)



# Most common plant species



Northern Wild Rice  
(*Zizania palustris*)<sup>1</sup>



Chaffy Sedge  
(*Carex paleacea*)<sup>1</sup>



Three-square Bulrush  
(*Schoenoplectus pungens*)<sup>1</sup>

<sup>1</sup> Photos from New England Wildflower Society  
<https://gobotany.newenglandwild.org/>



Rare plant species





# Rare plant species



Lilaeopsis  
*Lilaeopsis chinensis* (T)



Parker's Pipewort  
*Eriocaulon parkeri* (SC)



Mudwort  
*Limosella australis* (SC)



Water Pimpernel  
*Samolus valerandi* (SC)



Spongy Arrow-head  
*Sagittaria calycina* (SC)



Estuary Bur-marigold  
*Bidens hyperborea* (SC)



# Rare plant species



Pygmyweed  
*Crassula aquatica* (SC)



Stiff arrow-head  
*Sagittaria rigida* (T)



Horned pondweed  
*Zizania palustris* L. (SC)



Saltmarsh false-foxglove  
*Agalinis maritima* (SC)



<b>Scientific Name</b>	<b>Common Name</b>	<b>StateRank</b>	<b>State Status</b>
<i>Bidens hyperborea</i>	Estuarine Beggar-ticks	S3	SC
<i>Crassula aquatica</i>	Pygmyweed	S2S3	SC
<i>Eriocaulon parkeri</i>	Parker's or Estuary Pipewort	S3	SC
<i>Lilaeopsis chinensis</i>	Eastern Lilaeopsis	S2	T
<i>Limosella australis</i>	Atlantic or Southern Mudwort	S3	SC
<i>Sagittaria calycina</i>	Tidal Sagittaria (Hooded Arro	S3	SC
<i>Sagittaria rigida</i>	Stiff Arrowhead	S2	T
<i>Samolus valerandi</i>	Water Pimpernel	S3	SC
<i>Zannichellia palustris</i>	Horned Pondweed	S2	SC
<i>Agalinis maritima</i>	Saltmarsh False-foxglove	S3	SC

### State Rank:

\* S2 Imperiled in Maine because of rarity (6-20 occurrences or few remaining individuals or acres) or because of other factors making it vulnerable to further decline.

\* S3 Rare in Maine (20-100 occurrences).

### State Status:

T - THREATENED; Rare and, with further decline, could become endangered; or federally listed as Threatened.

SC - SPECIAL CONCERN; Rare in Maine, based on available information, but not sufficiently rare to be considered Threatened or Endangered.



# What are the current and future threats to the marshes?

- Pollutants
- Watershed and shoreline development
- Invasive species
- Climate change
  - Sea level rise
  - Changing freshwater inputs



# Shoreline development

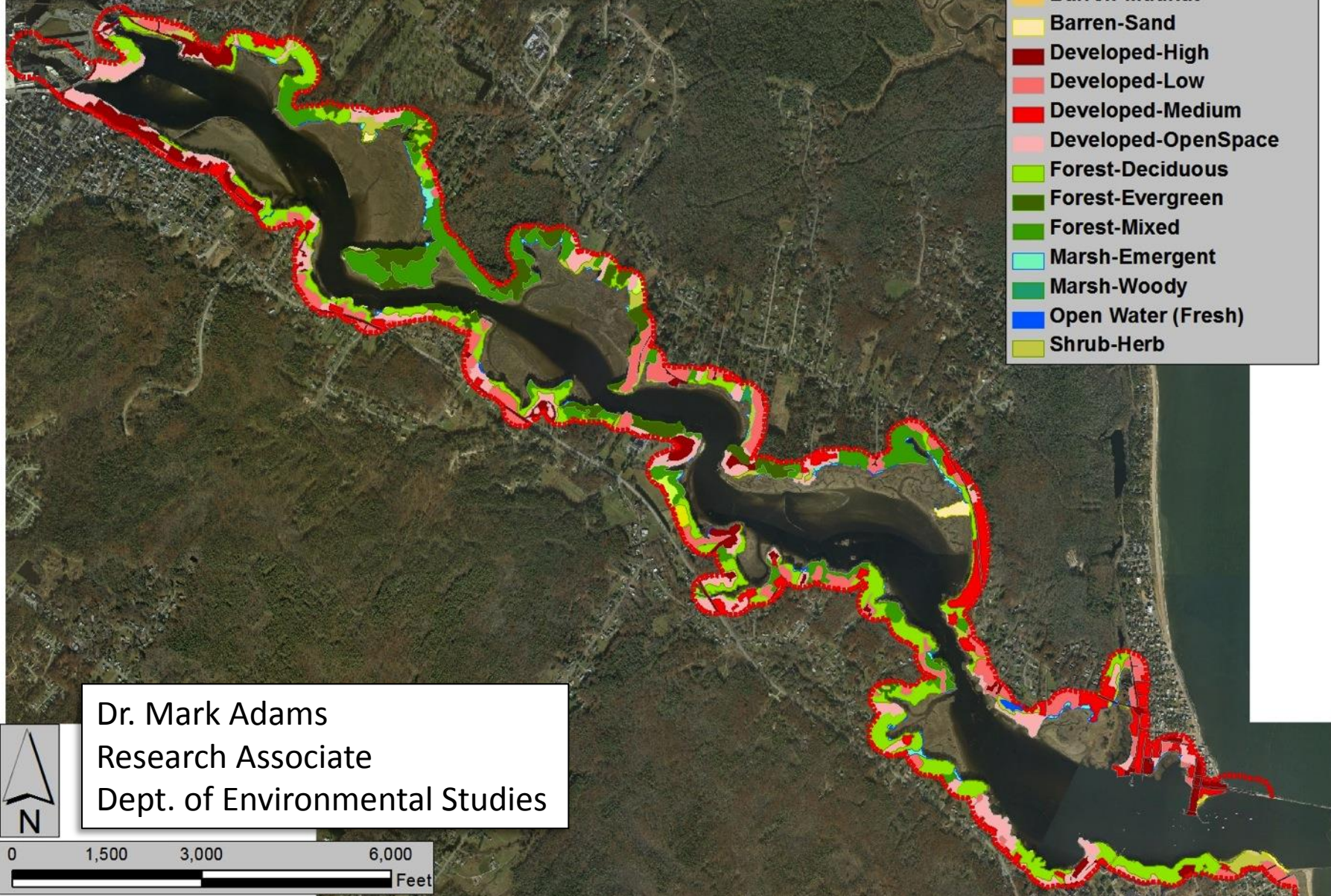
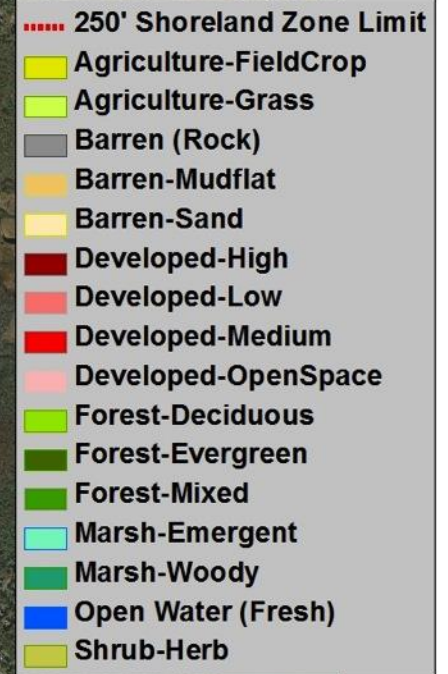




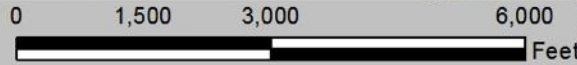




**2009 Land Cover  
250 Foot Shoreland Zone Buffer  
1: 24,000**



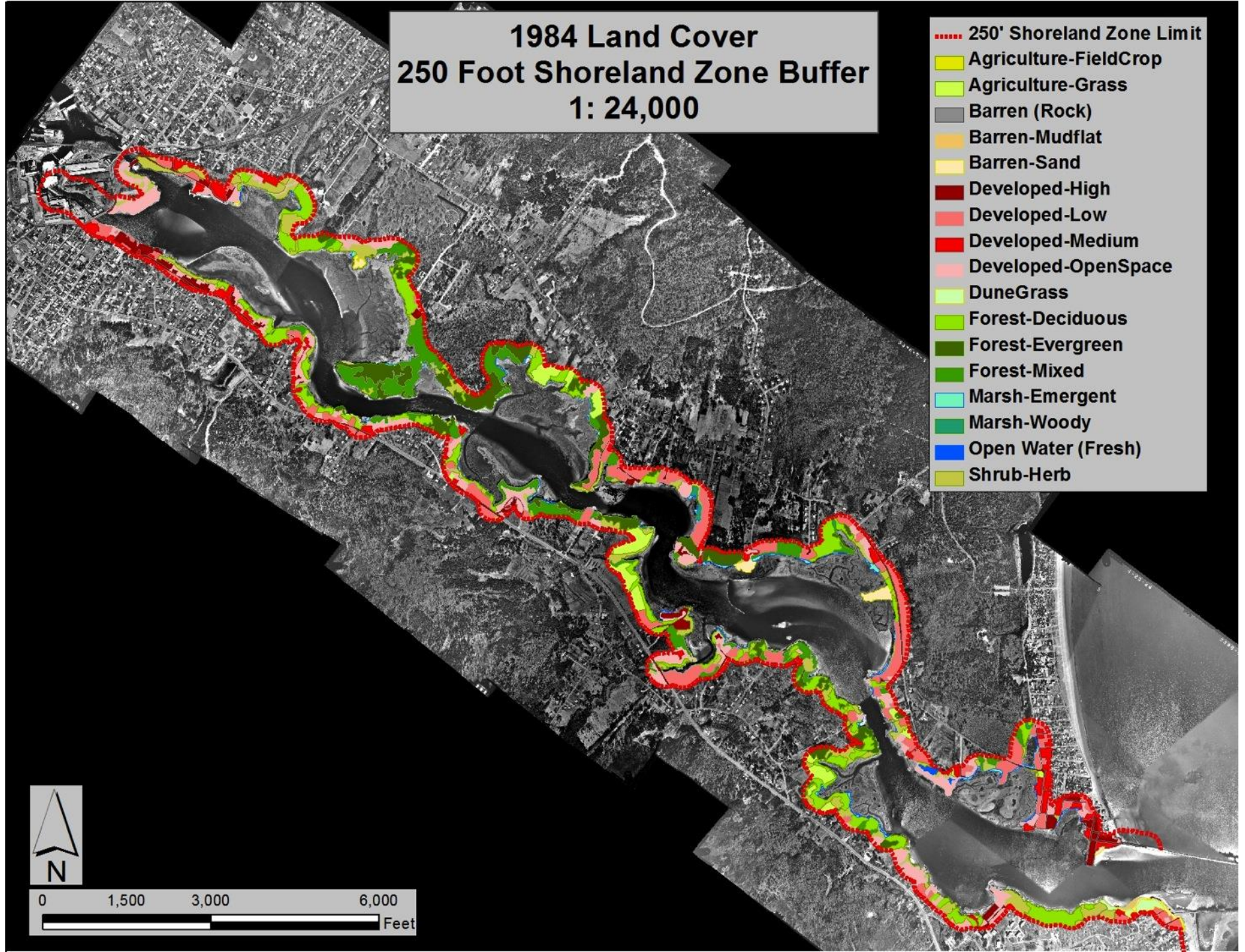
Dr. Mark Adams  
Research Associate  
Dept. of Environmental Studies





**1984 Land Cover  
250 Foot Shoreland Zone Buffer  
1: 24,000**

- ..... 250' Shoreland Zone Limit
- Agriculture-FieldCrop
- Agriculture-Grass
- Barren (Rock)
- Barren-Mudflat
- Barren-Sand
- Developed-High
- Developed-Low
- Developed-Medium
- Developed-OpenSpace
- DuneGrass
- Forest-Deciduous
- Forest-Evergreen
- Forest-Mixed
- Marsh-Emergent
- Marsh-Woody
- Open Water (Fresh)
- Shrub-Herb



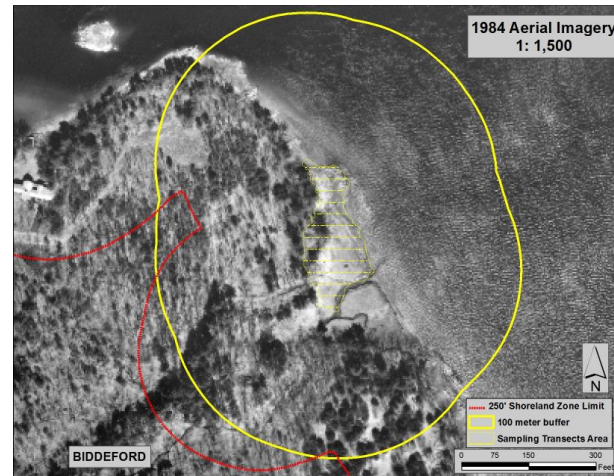


# Land cover change analysis 1984-2009

Within the 100m buffer areas around the 16 marsh study sites

+ 54 hectares of forest area  
 - 68 hectares of shrub-herb area

Marsh site	Change in Forest cover	Change in Shrub-herb cover
N2	+20.6%	-18.1%
N3	+1.7%	- 2.7%
N4	-0.7%	+3.6%
N1	+5.3%	+ 3.3%
N8	+5.2%	- 2.8%
N10	-6.7%	(*)
N9	-	(*)
S1	(*)	8.6%
S5	+5.7%	- 2.6%
S4	+9.3%	- 2.5%
S8	+8.6%	- 14.4%
S6	+11.4%	- 6.8%
S7	+10.2%	- 14.0%
S9	+5.5%	- 8.5%
S10	+11.0%	- 9.6%
S11	-18.0%	- 4.5%

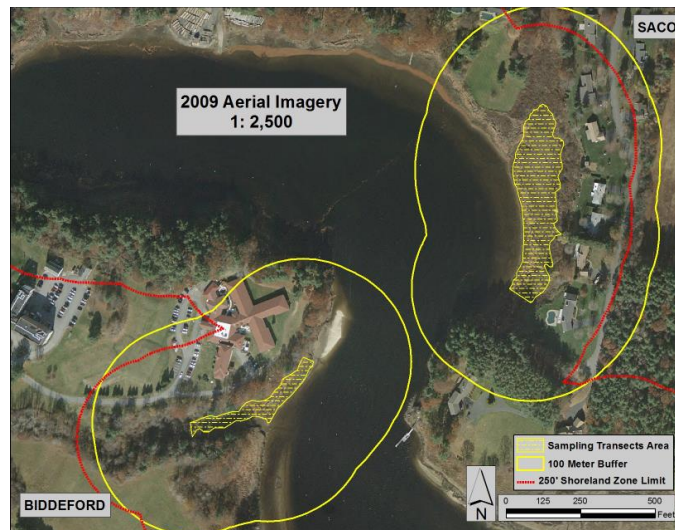
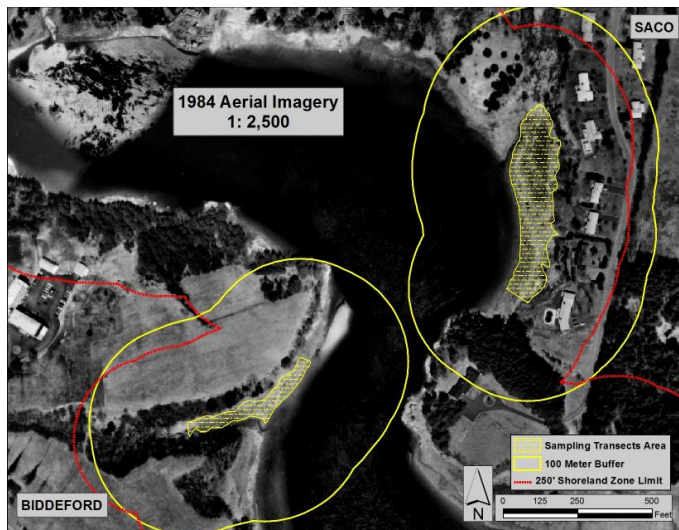




# Land cover change analysis 1984-2009

Within the 100m buffer areas around the 16 marsh study sites

For the majority of the sites in the estuary there was relatively little change in the amount of development.

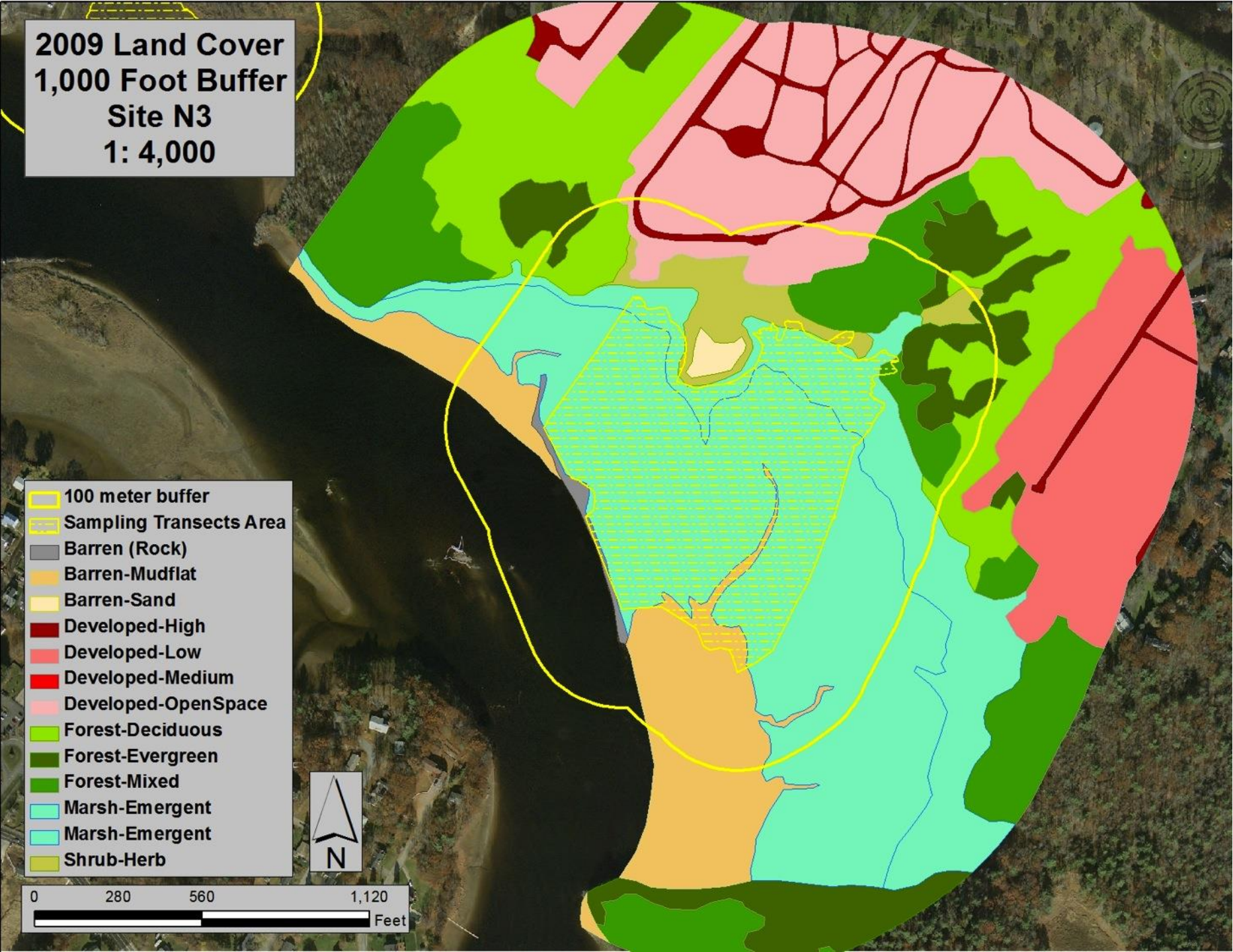
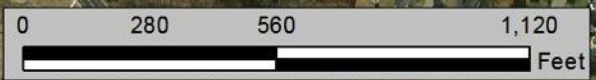


Marsh site	Change in developed area
N2	- 1.4%
N3	- 0.2%
N4	+ 2.9%
N1	- 6.4%
N8	- 2.6%
N10	<b>+ 11.9%</b>
N9	+ 5.1%
S1	+ 5.3%
S5	- 1.1%
S4	- 4.5%
S8	<b>+ 43.9%</b>
S6	+ 2.3%
S7	+ 7.3%
S9	+ 5.8%
S10	+ 0.5%
S11	<b>+ 24.8%</b>



**2009 Land Cover  
1,000 Foot Buffer  
Site N3  
1: 4,000**

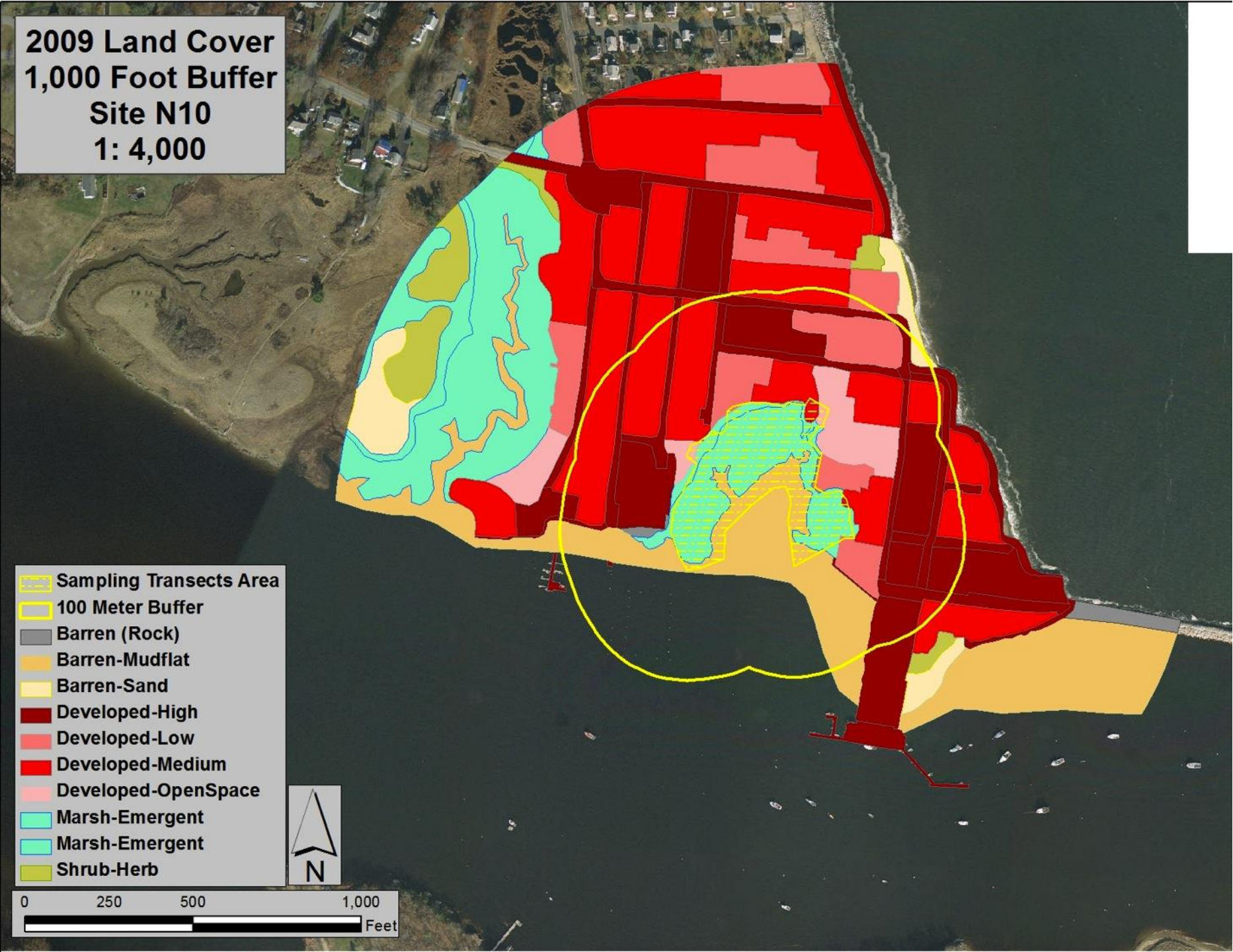
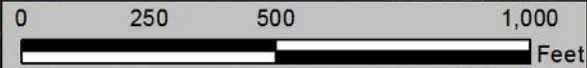
- 100 meter buffer
- Sampling Transects Area
- Barren (Rock)
- Barren-Mudflat
- Barren-Sand
- Developed-High
- Developed-Low
- Developed-Medium
- Developed-OpenSpace
- Forest-Deciduous
- Forest-Evergreen
- Forest-Mixed
- Marsh-Emergent
- Marsh-Emergent
- Shrub-Herb





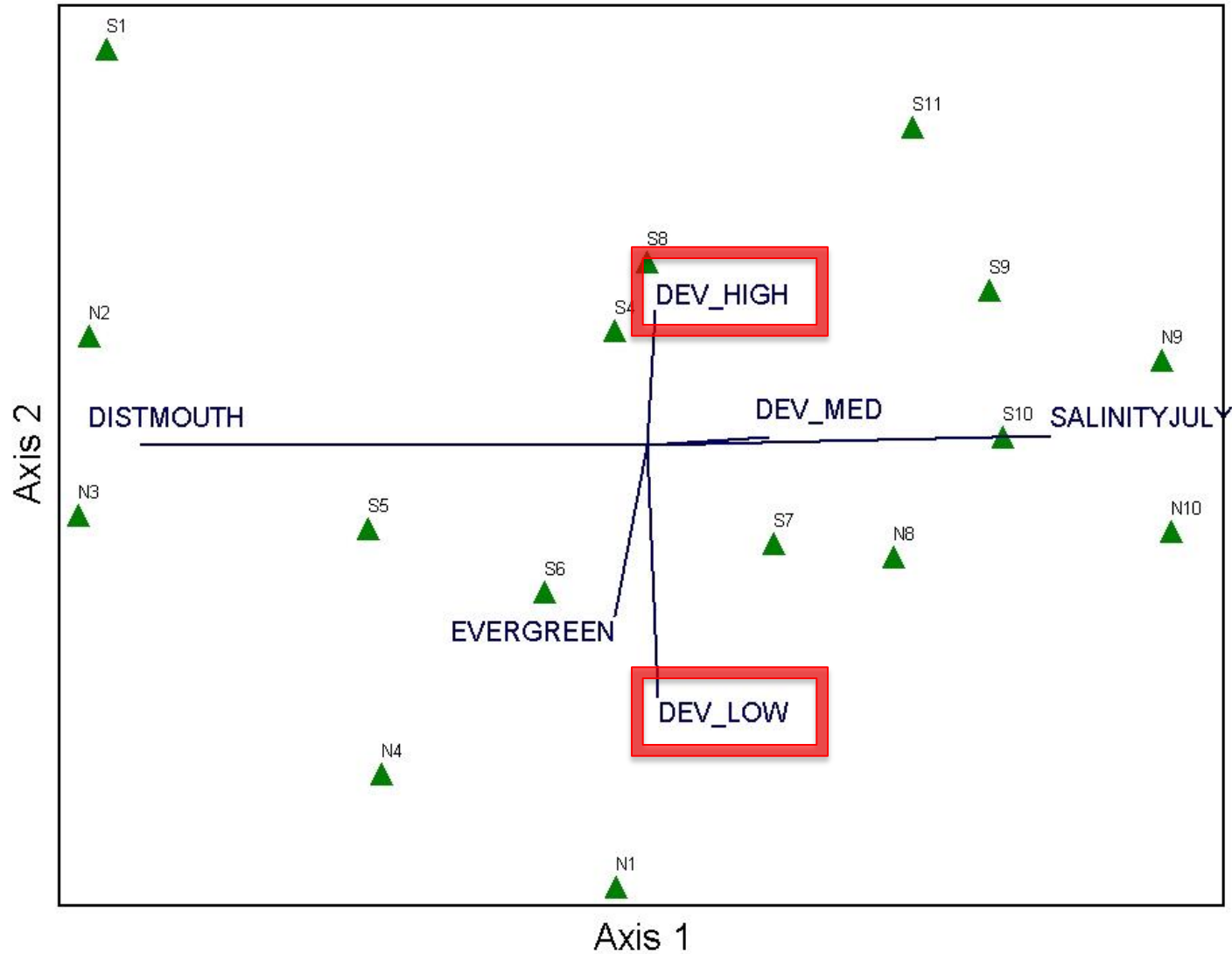
**2009 Land Cover  
1,000 Foot Buffer  
Site N10  
1: 4,000**

- Sampling Transects Area
- 100 Meter Buffer
- Barren (Rock)
- Barren-Mudflat
- Barren-Sand
- Developed-High
- Developed-Low
- Developed-Medium
- Developed-OpenSpace
- Marsh-Emergent
- Marsh-Emergent
- Shrub-Herb





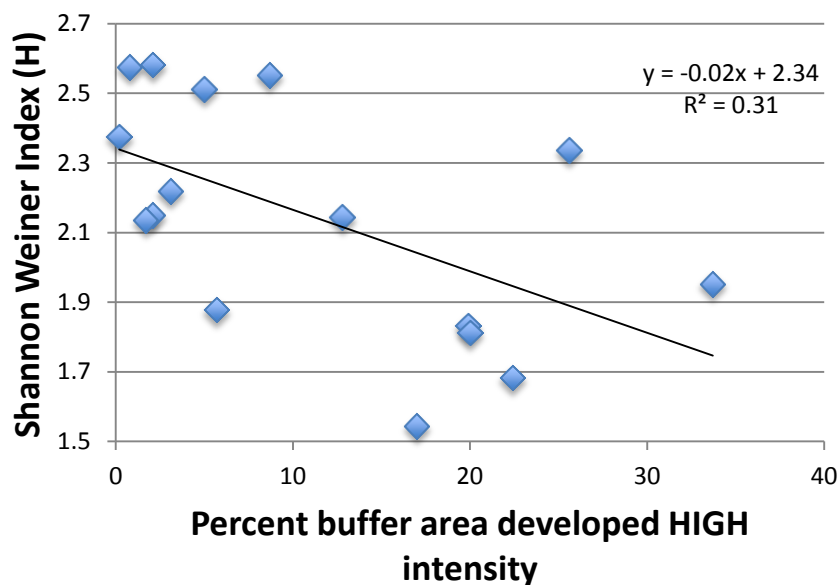
# Marsh plant diversity and environmental variables



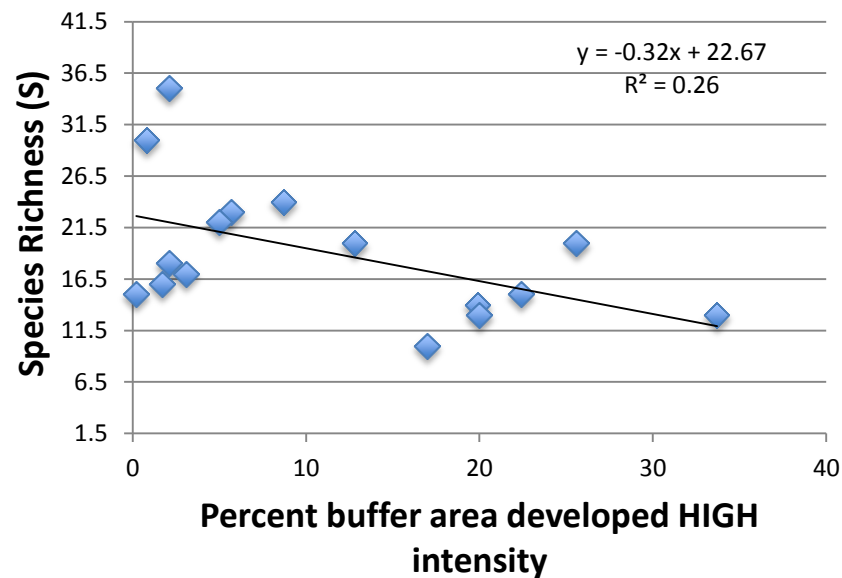


# Marsh plant diversity and adjacent land use

## DEVHIGH vs. H

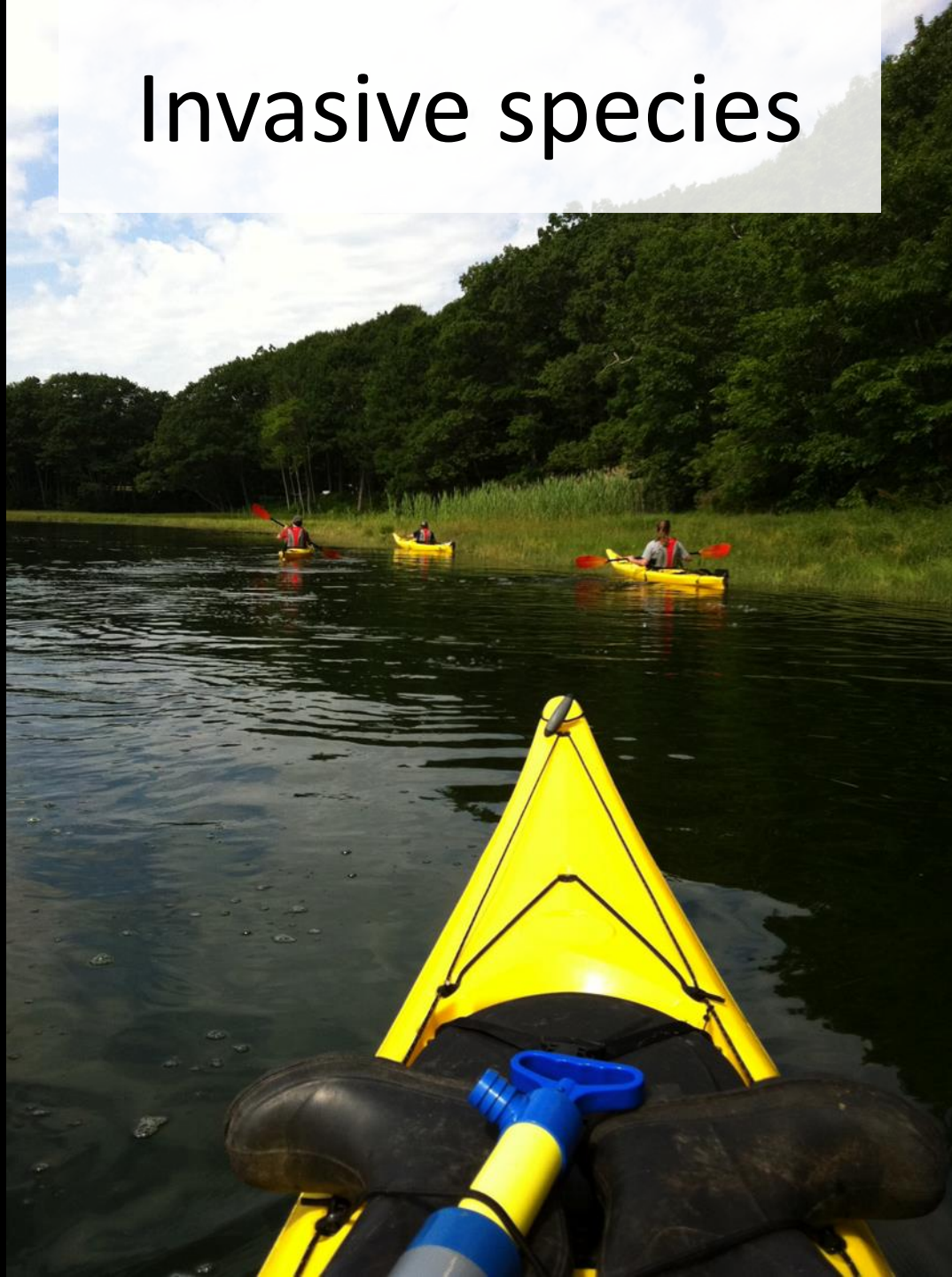


## DEVHIGH vs. S





# Invasive species







*Phragmites australis*















# How does *Phragmites australis* get established and spread?

- Patches expand from underground stems (18% increase in patch size per year)
- Underground stems (rhizomes) break off and are buried at new sites
- Seeds spread from existing patches to new sites

- Freshwater inputs to the marsh – reduce salinity
- Development in the watershed and along the shoreline
- Increased nitrogen inputs to the marsh

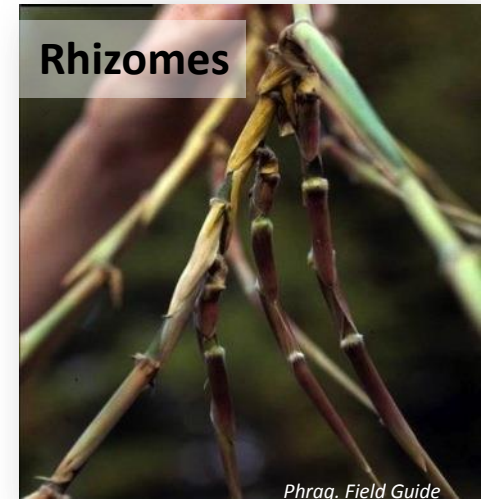


# *Phragmites australis* spread in the Saco estuary

- Michelle Slater

## Purpose:

1. Determine how *Phragmites australis* spreads in the Saco estuary
2. Use findings for management recommendations



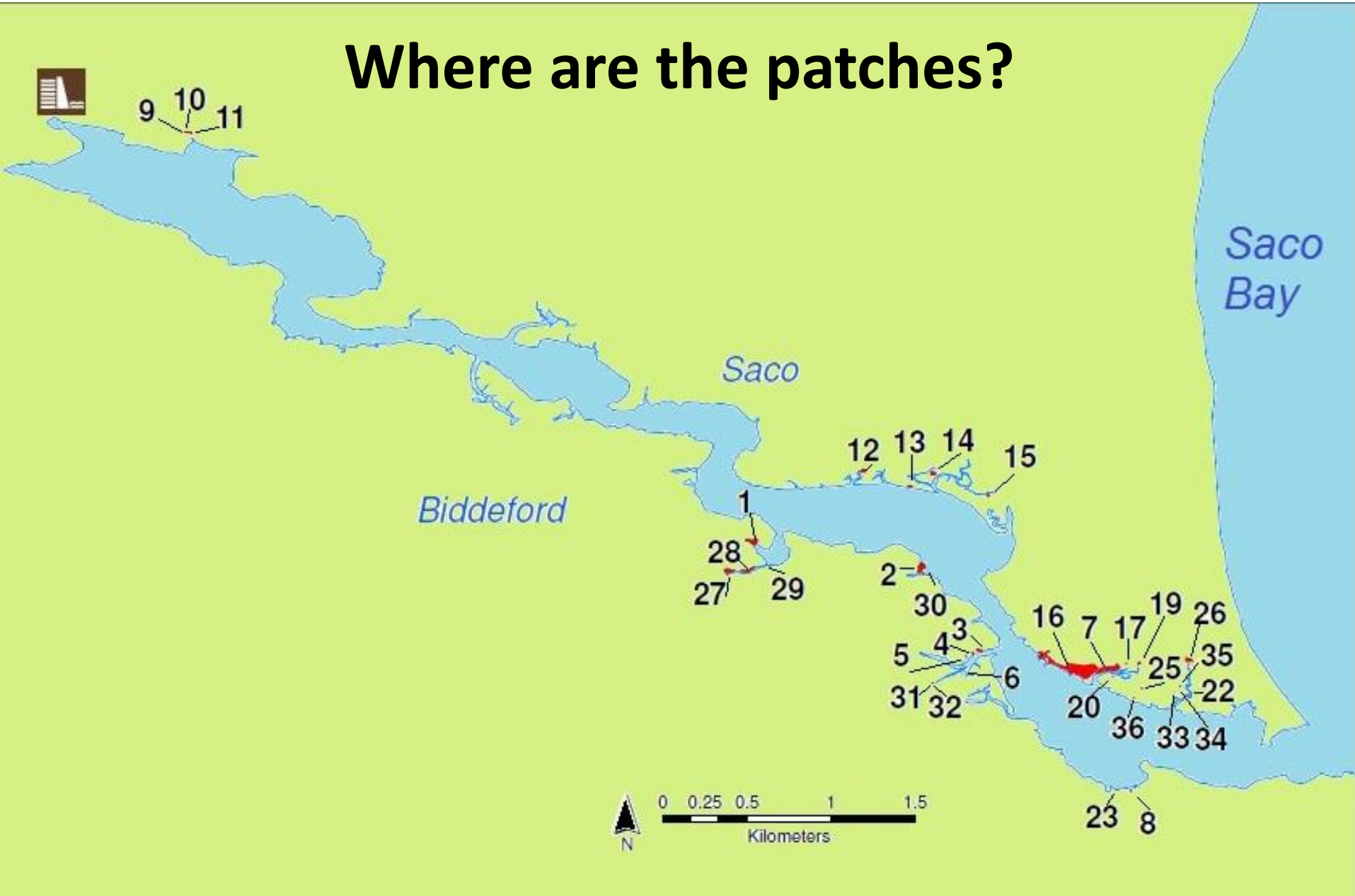


# Mapping *Phragmites australis* using GPS



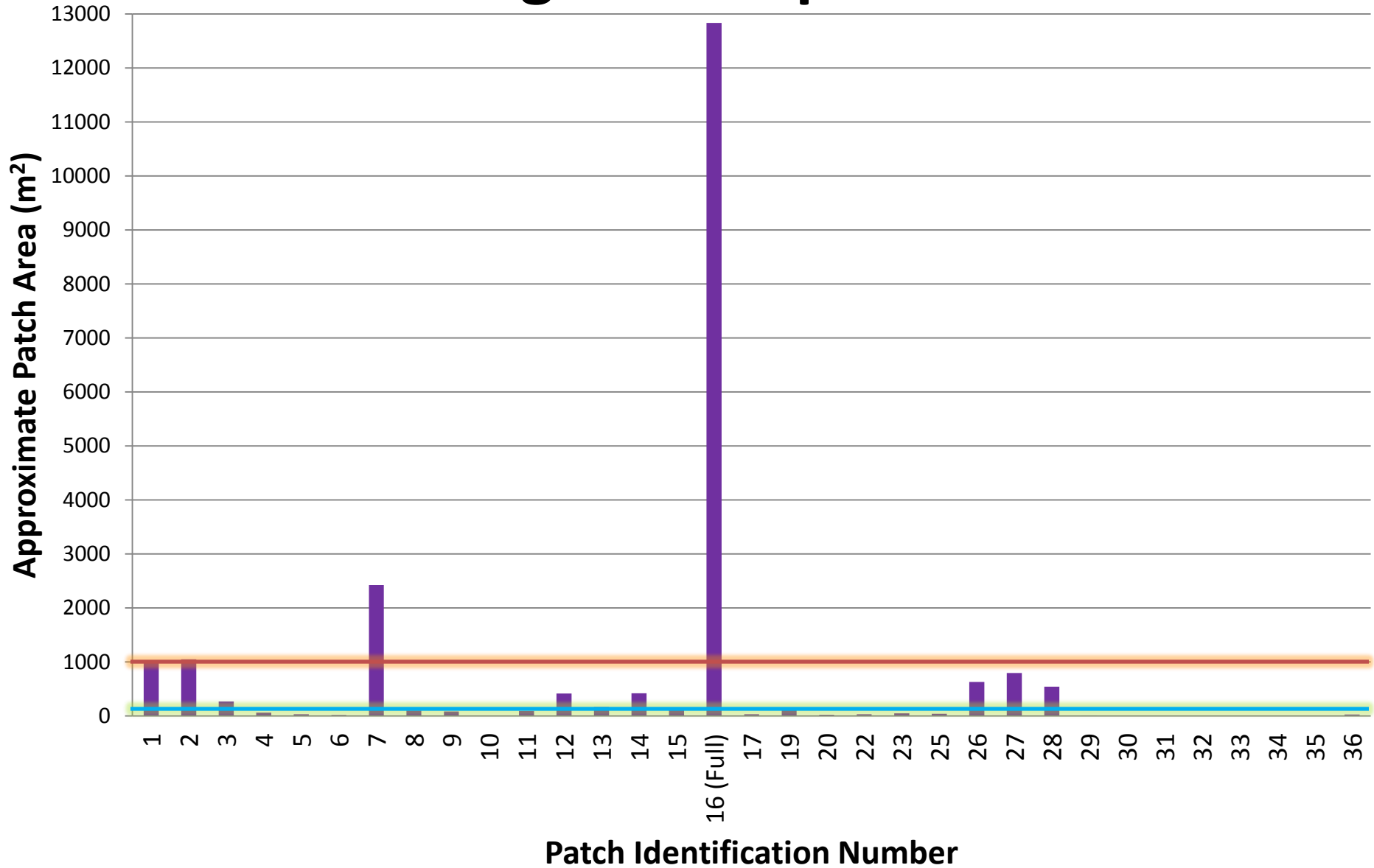


# Where are the patches?





# How big are the patches?





# Where do the *Phragmites* fragments and seeds go?

Fruit

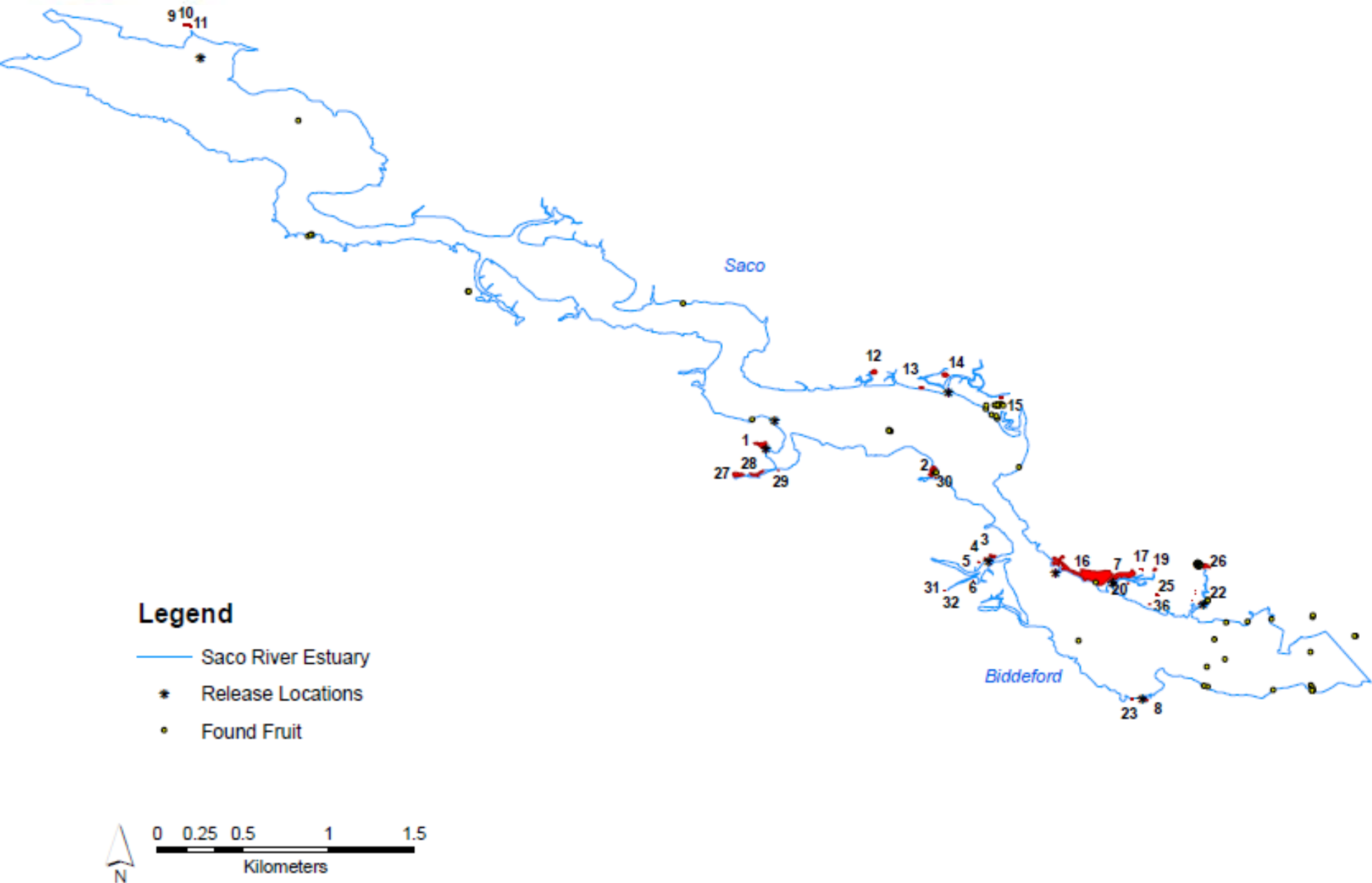


Buckets





# Where do the *Phragmites* fragments and seeds go?





# An example of an area of concern







- Invasive or native?

- Seed viability  
0 – 3.2%



- Genetic diversity  
within & among patches

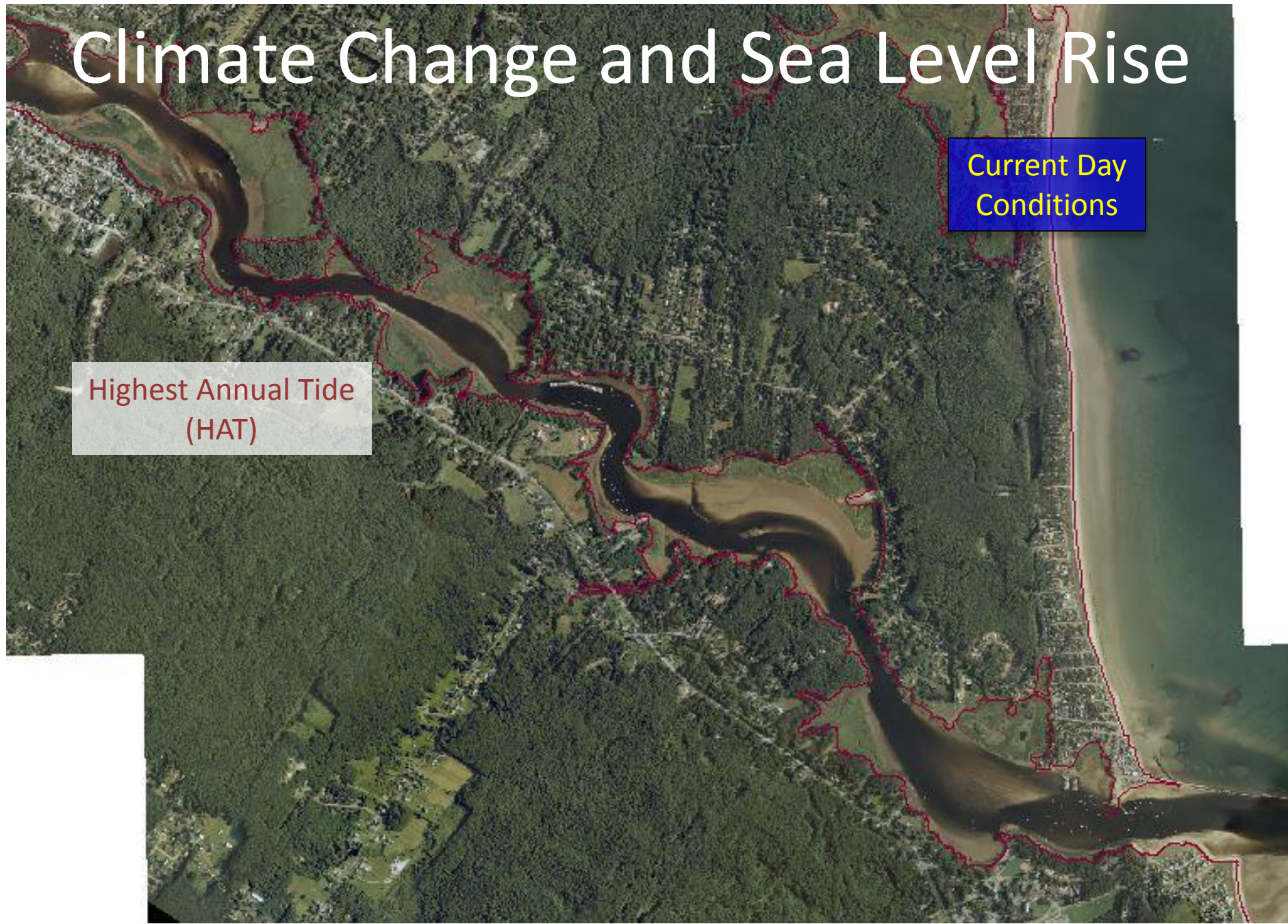


# Recommendations

- Focus on small and large patches
- Use multiple approaches to controlling *Phragmites*
  - *Herbicides*
  - *Mowing*
    - *Prevents seed production*
    - *Reduces stem density and height*
- Monitor uninvaded areas, especially those identified as “at risk”
- Monitor *Phragmites* patches as well as native plant species into the future
- Identify concerned marsh owners and develop a Citizen Science Initiative



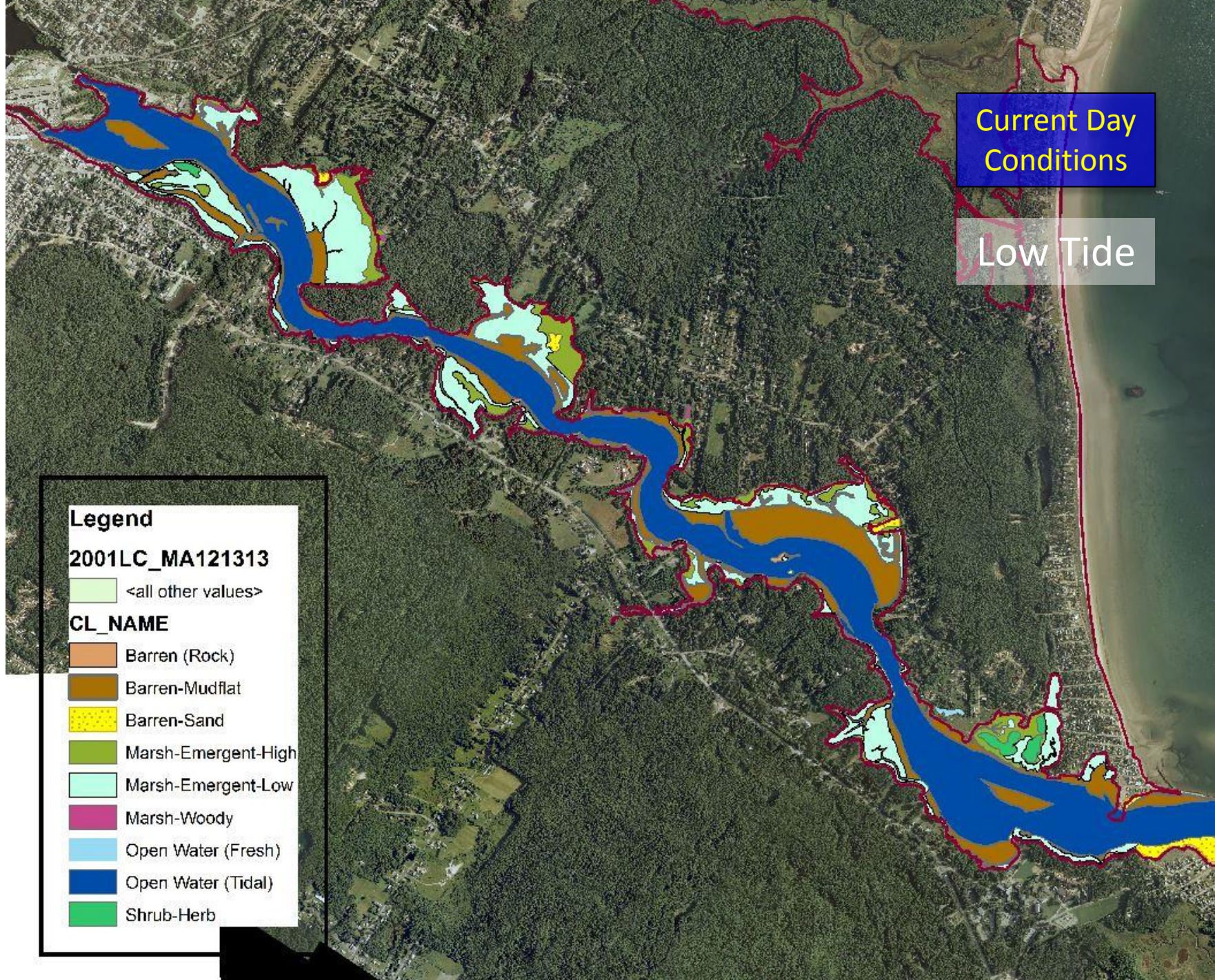
# Climate Change and Sea Level Rise



Current Day  
Conditions

Highest Annual Tide  
(HAT)







3 Foot Sea Level Rise

Low Tide

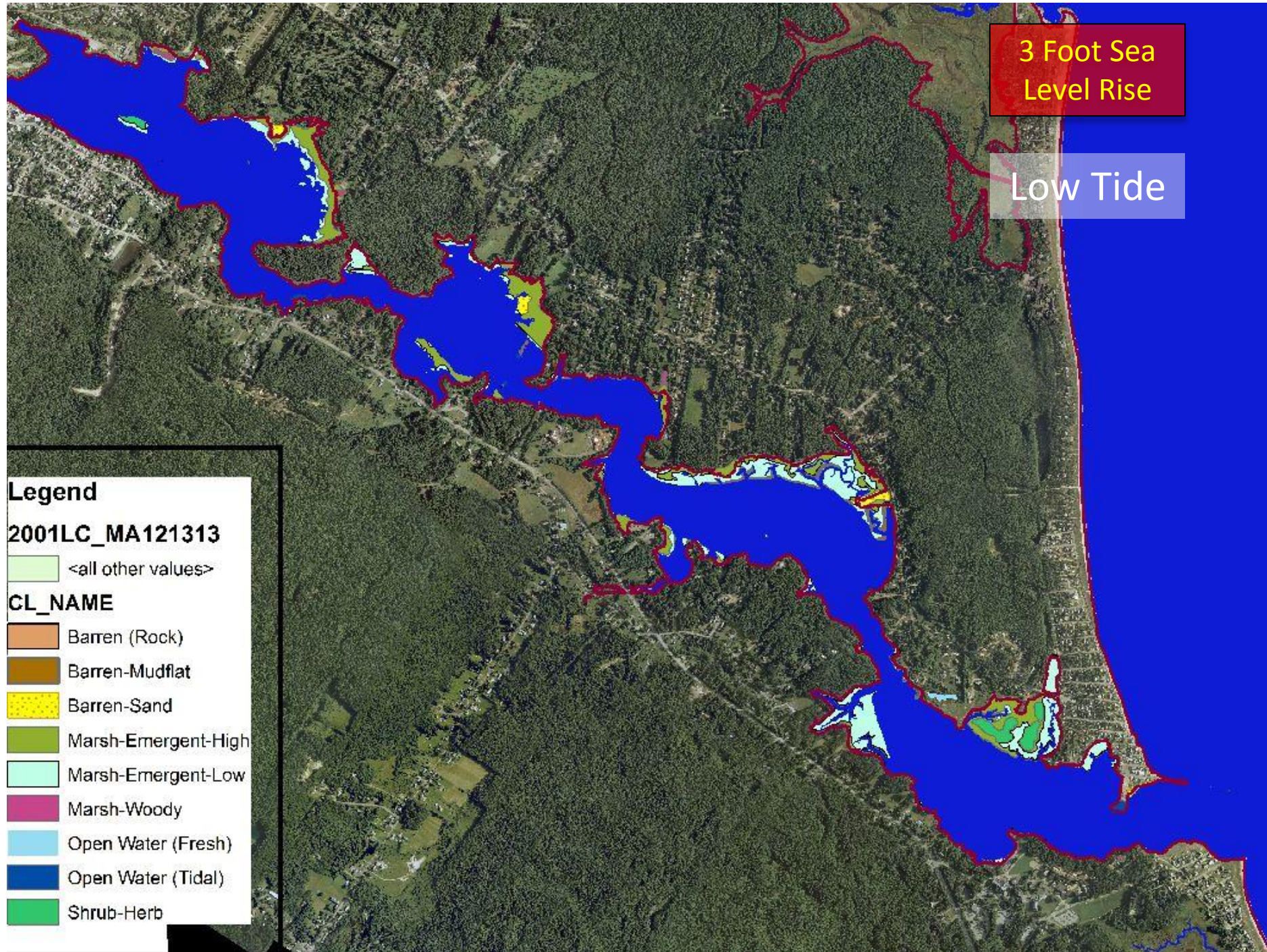
**Legend**

2001LC\_MA121313

<all other values>

**CL\_NAME**

- Barren (Rock)
- Barren-Mudflat
- Barren-Sand
- Marsh-Emergent-High
- Marsh-Emergent-Low
- Marsh-Woody
- Open Water (Fresh)
- Open Water (Tidal)
- Shrub-Herb





Where could the marshes go?

Marsh migration

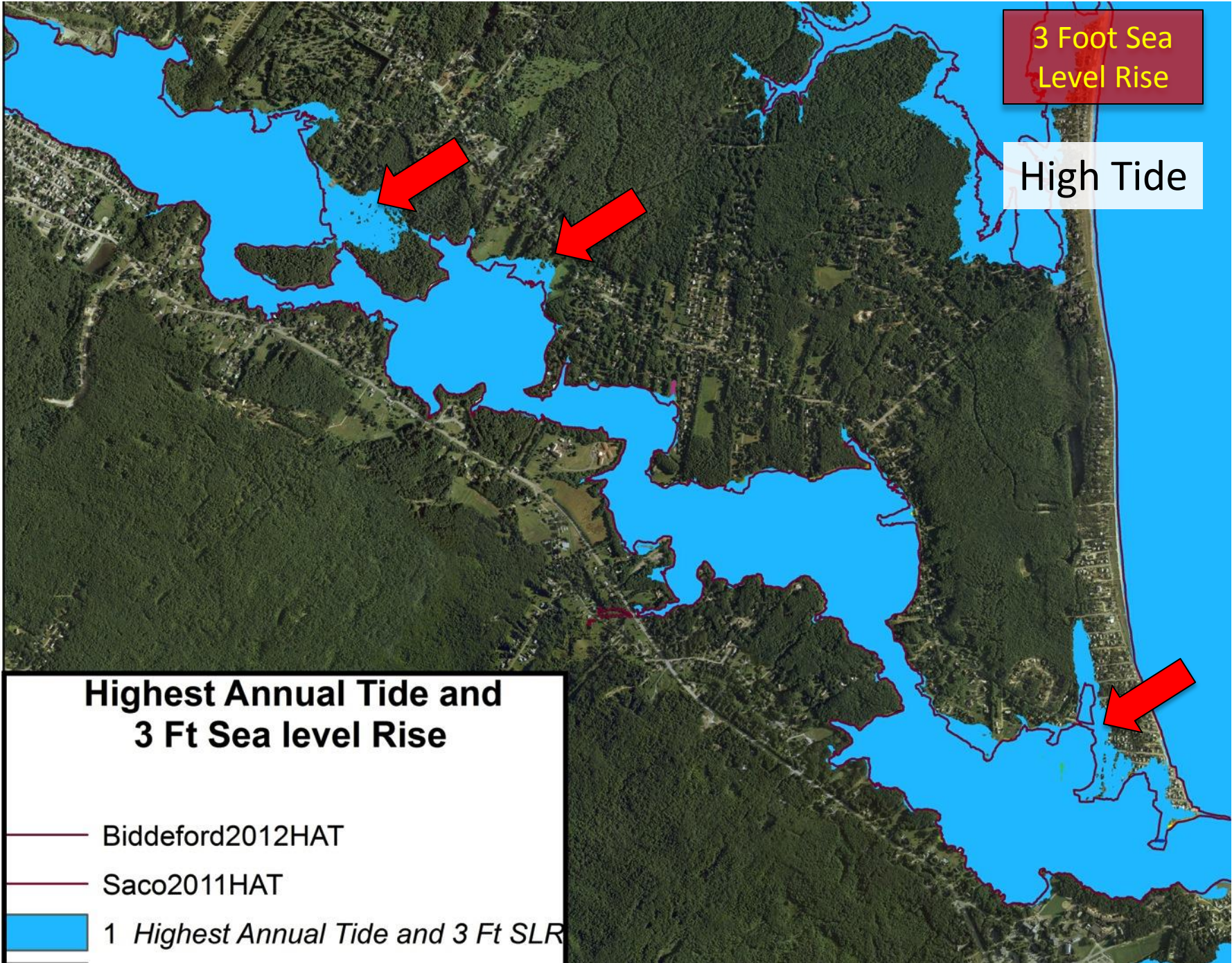


3 Foot Sea Level Rise

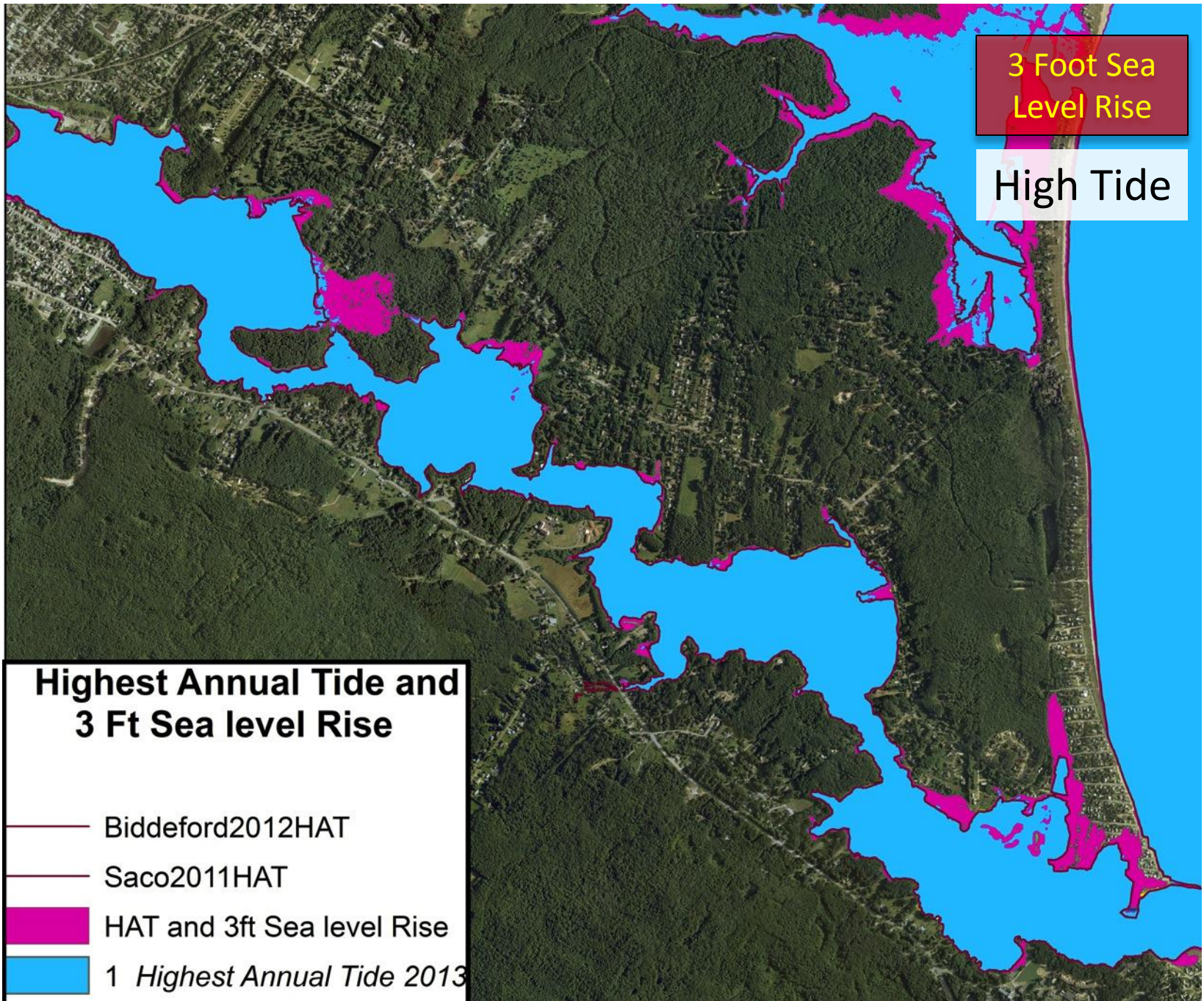
High Tide

### Highest Annual Tide and 3 Ft Sea level Rise

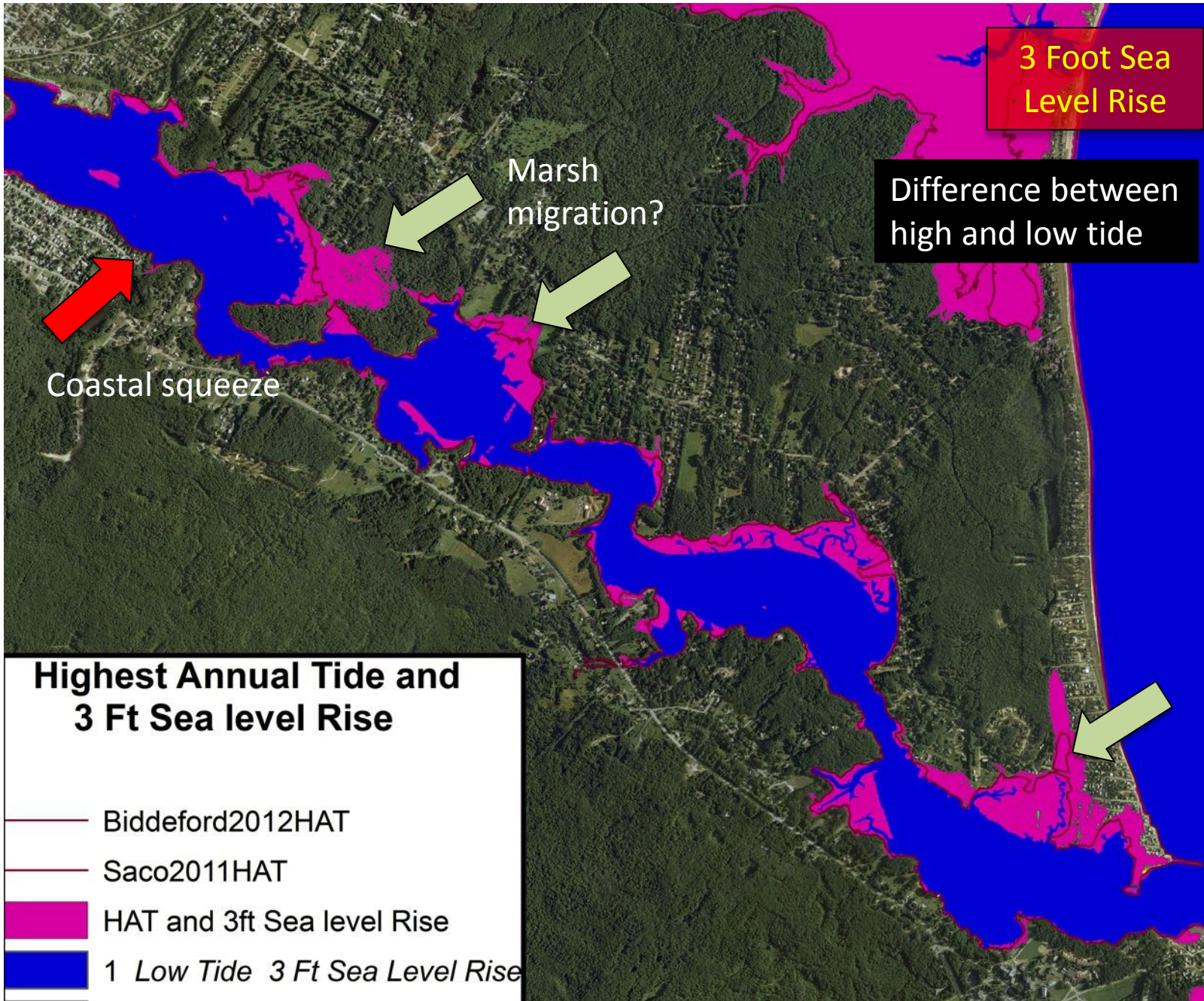
- Biddeford2012HAT
- Saco2011HAT
- 1 Highest Annual Tide and 3 Ft SLR









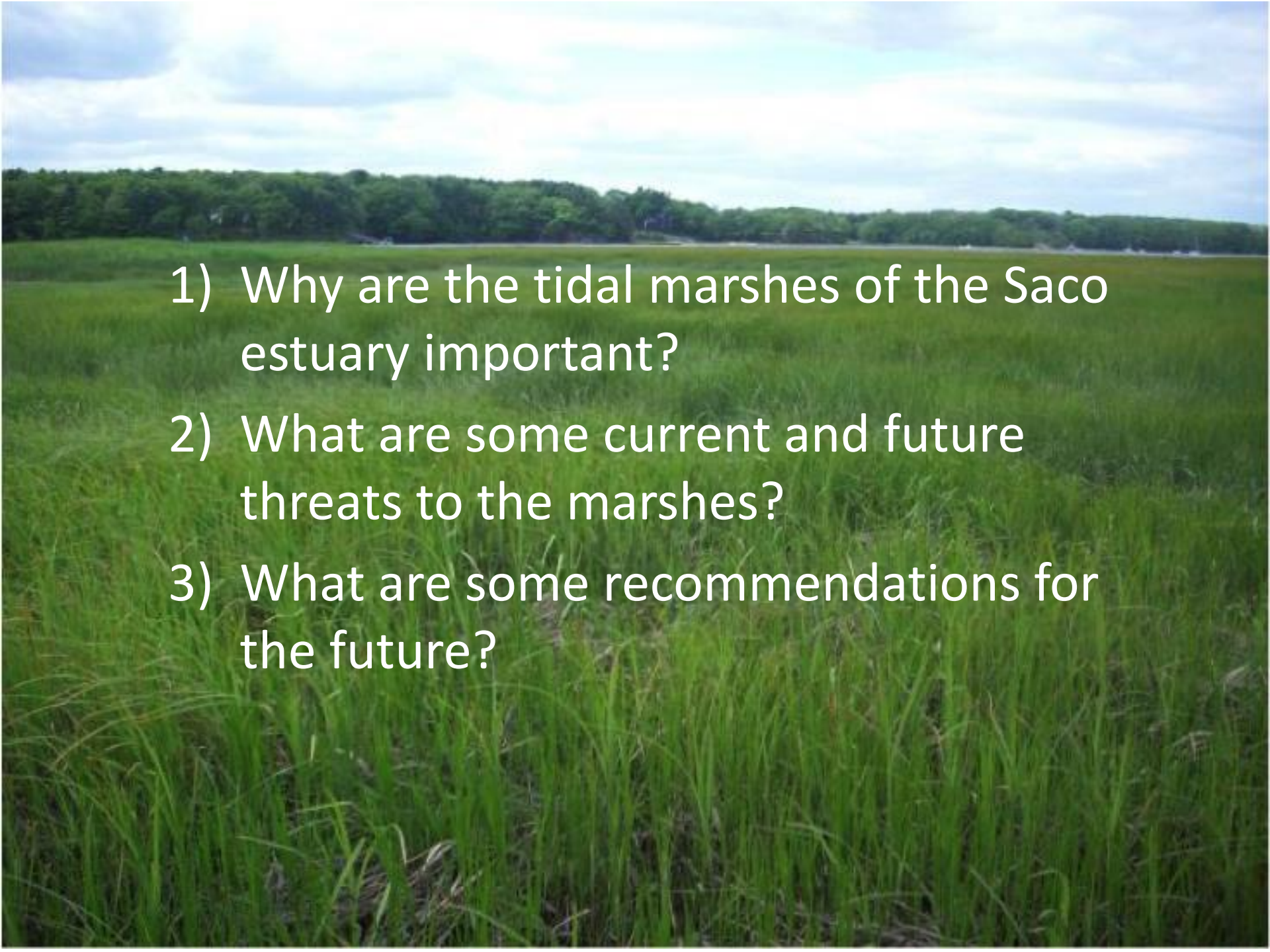




# Conclusions and next steps

- With SLR, we will lose marshes and marsh area in the Saco estuary
- Marshes will be lost due to “coastal squeeze”
- Some marshes could “migrate” landward
- Can we plan for marsh migration by targeting areas for conservation?



- 
- 1) Why are the tidal marshes of the Saco estuary important?
  - 2) What are some current and future threats to the marshes?
  - 3) What are some recommendations for the future?















# Acknowledgements

- UNE's College of Arts and Sciences
- Dr. Ed Bilsky, Vice President for Research and Scholarship, and UNE's Office of Research
- National Science Foundation award #EPS-0904155 to Maine EPSCoR at the University of Maine
- Too many students to list!



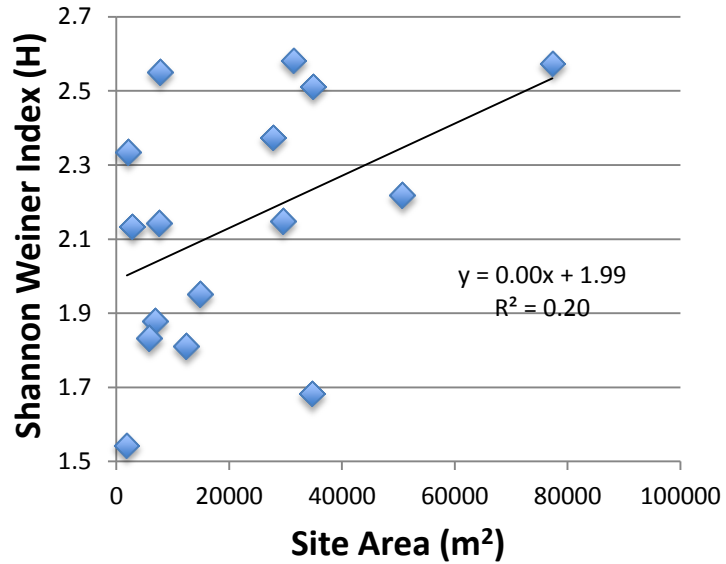


# Appendix Slides

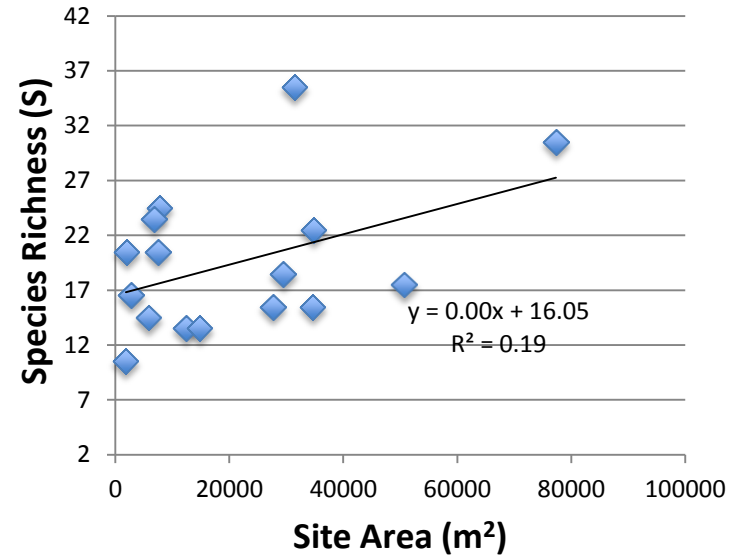
- Additional data on sampling sites and biodiversity analysis



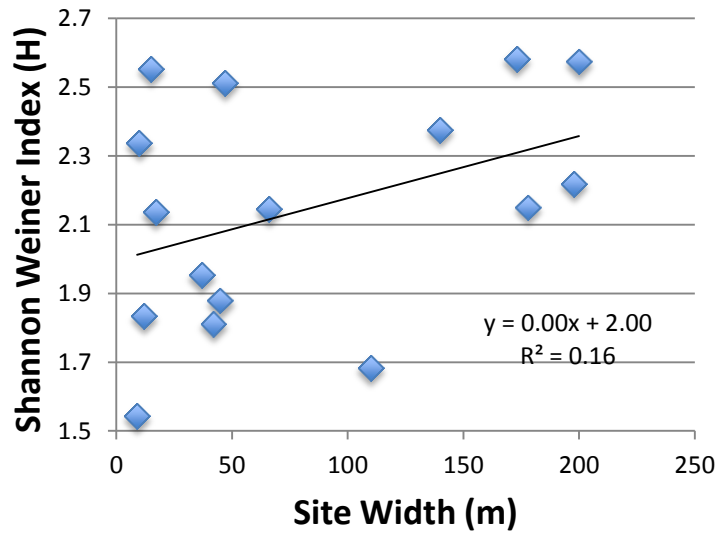
### SITE AREA vs. H



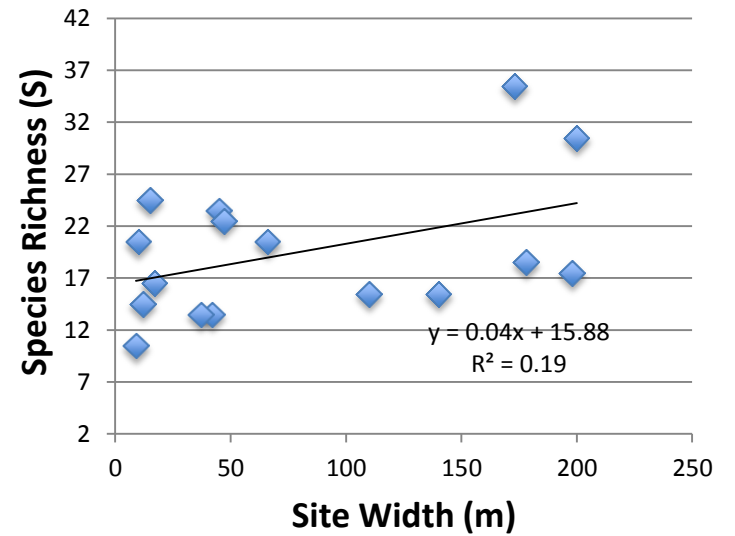
### SITE AREA vs. S



### WIDTH vs. H



### WIDTH vs. S





# Saco River Project Site 2010 and 2011

