SCHOOL of MARINE and ATMOSPHERIC SCIENCES

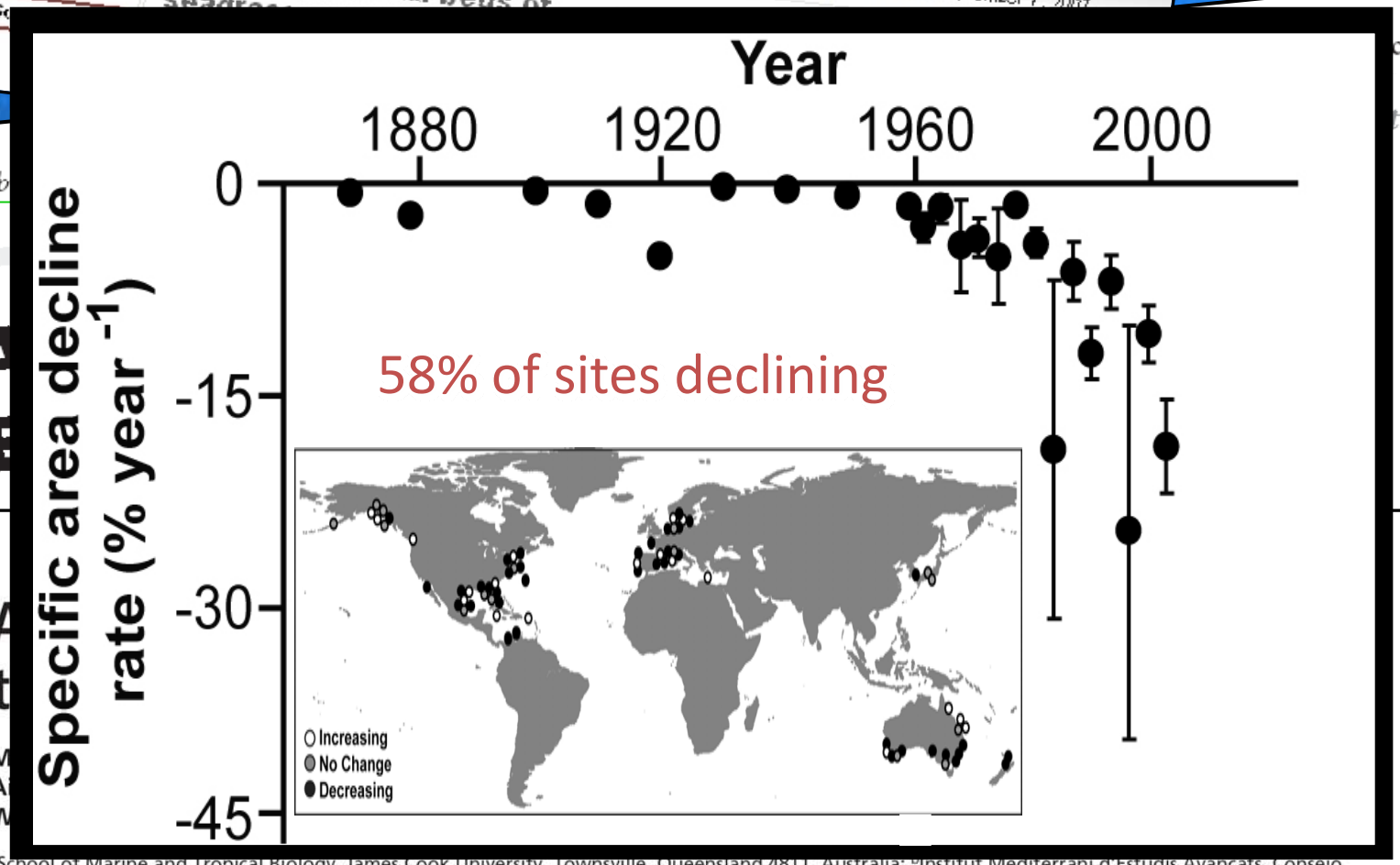
SoMAS

# *Water Quality & Seagrass Monitoring at Fire Island National Seashore*

**Dr. Bradley J. Peterson**

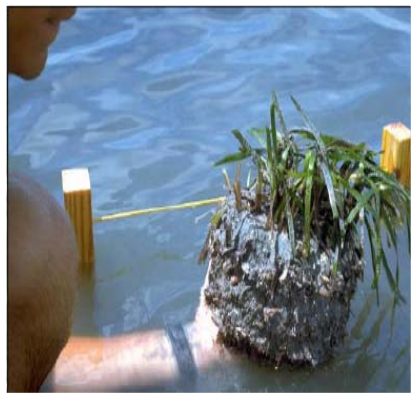
marine sciences research center state university of new york

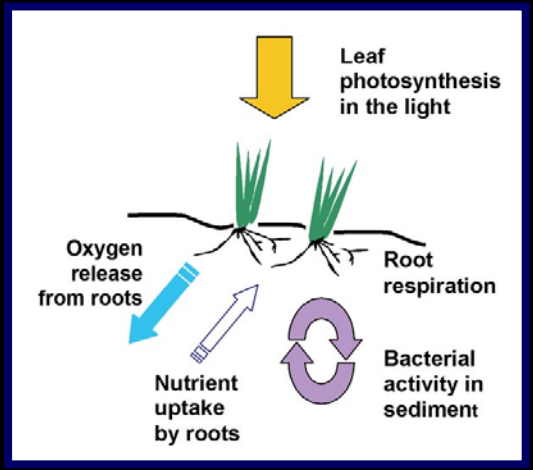
STONY BROOK STATE UNIVERSITY OF NEW YORK



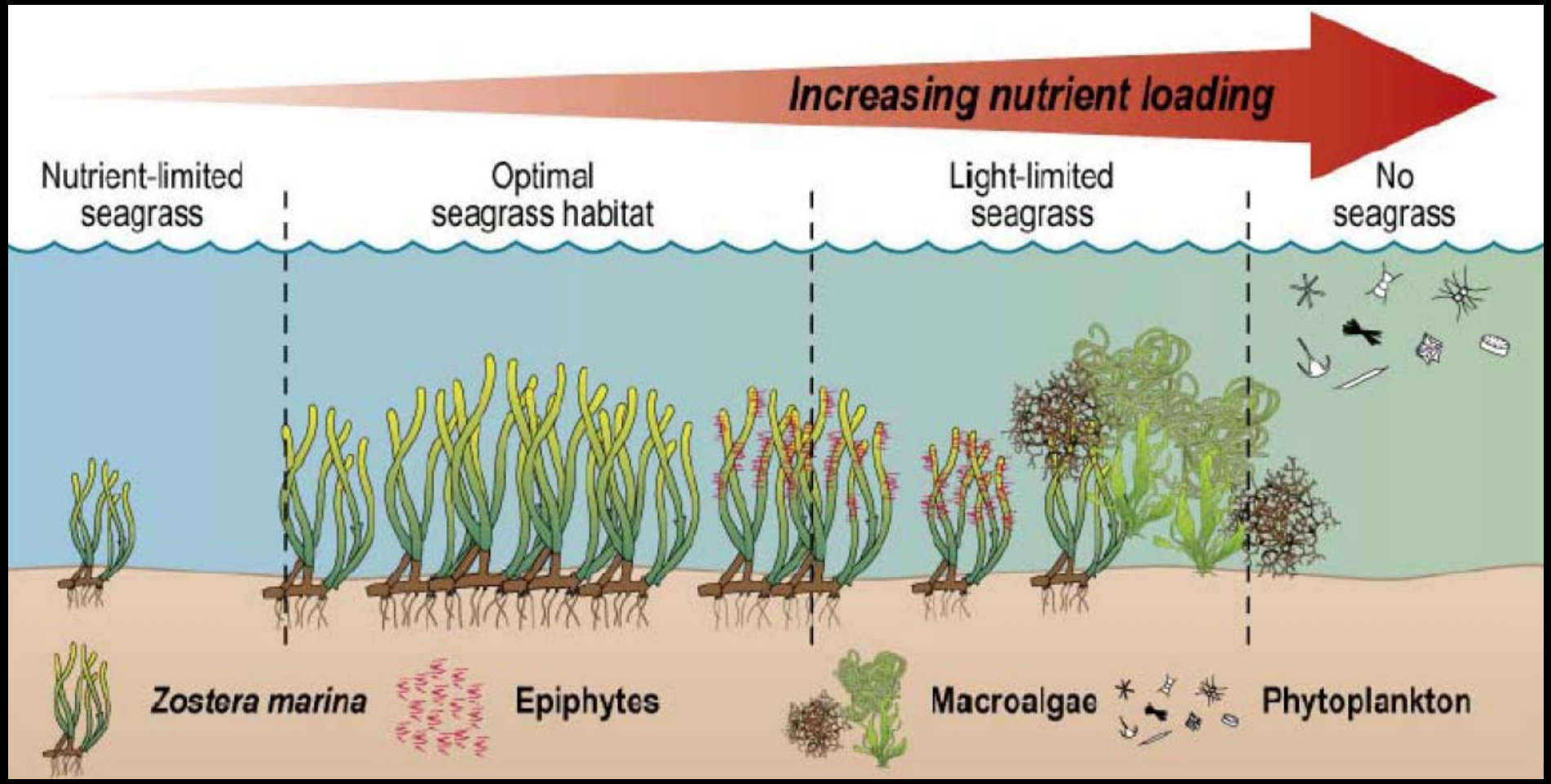

[a]School of Marine and Tropical Biology, James Cook University, Townsville, Queensland 4811, Australia; [b]Institut Mediterrani d'Estudis Avançats, Consejo Superior de Investigaciones Cientificas (Spain)–Universitat de les Illes Balears, Miquel Marqués 21, 017190 Esporles, Spain; [c]University of Maryland Center for Environmental Science, Cambridge, MD 21613; [d]Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA 23062; [e]Bodega Marine Laboratory, University of California at Davis, Bodega Bay, CA 94923; [f]Southeast Environmental Research Center, Florida International University, Miami, FL 33199; [g]Dauphin Island Sea Laboratory, Dauphin Island, AL 36528; [h]University of South Alabama, Mobile, AL 36608; [i]School of Plant Biology, The University of Western Australia, Crawley, Western Australia 6009, Australia; [j]Center for Coastal Fisheries and Habitat Research, National Ocean Service, National Oceanic and Atmospheric Administration, Beaufort, NC 28516; and [k]Jackson Estuarine Laboratory, University of New Hampshire, Durham, NH 03824

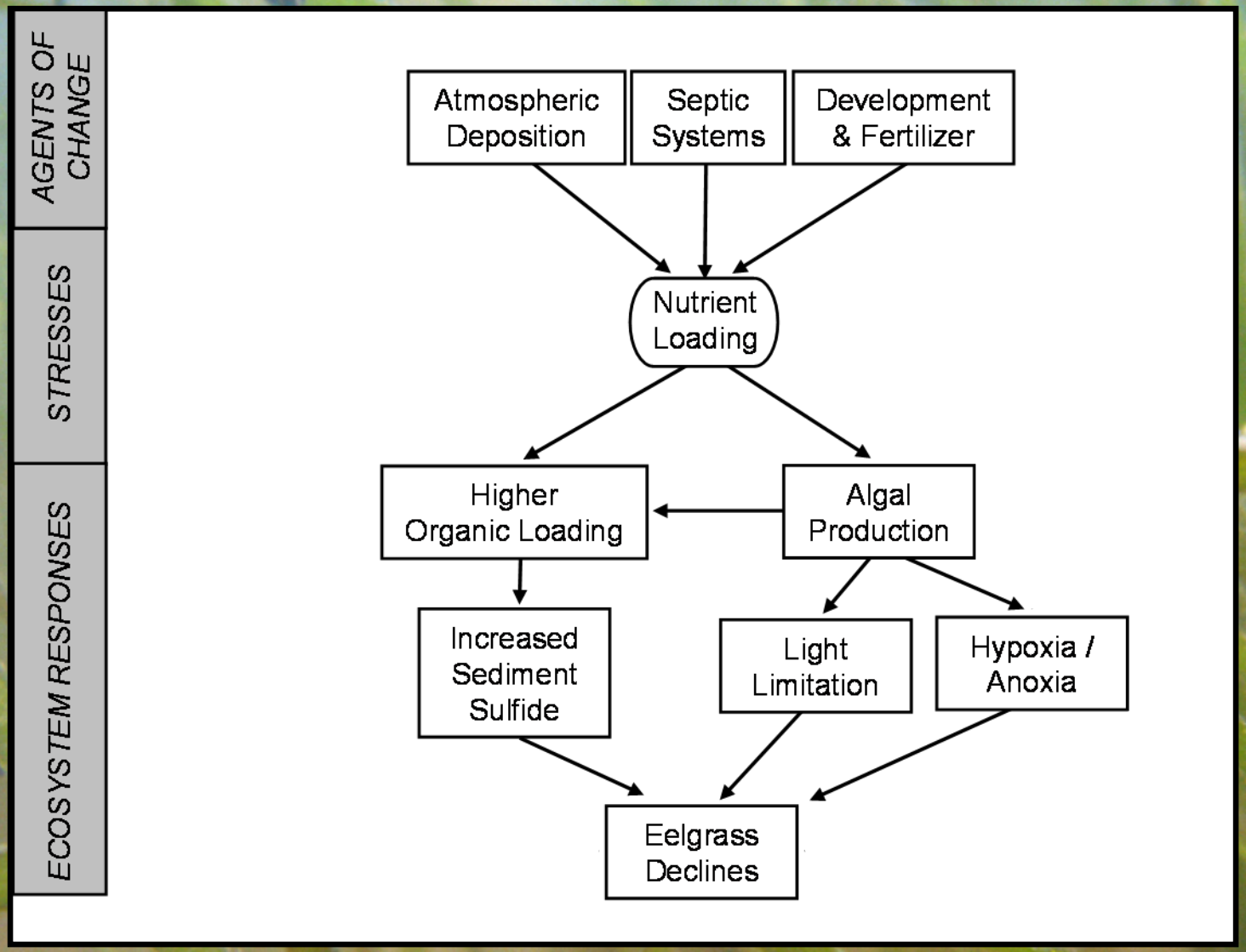
# Ecosystem Functions

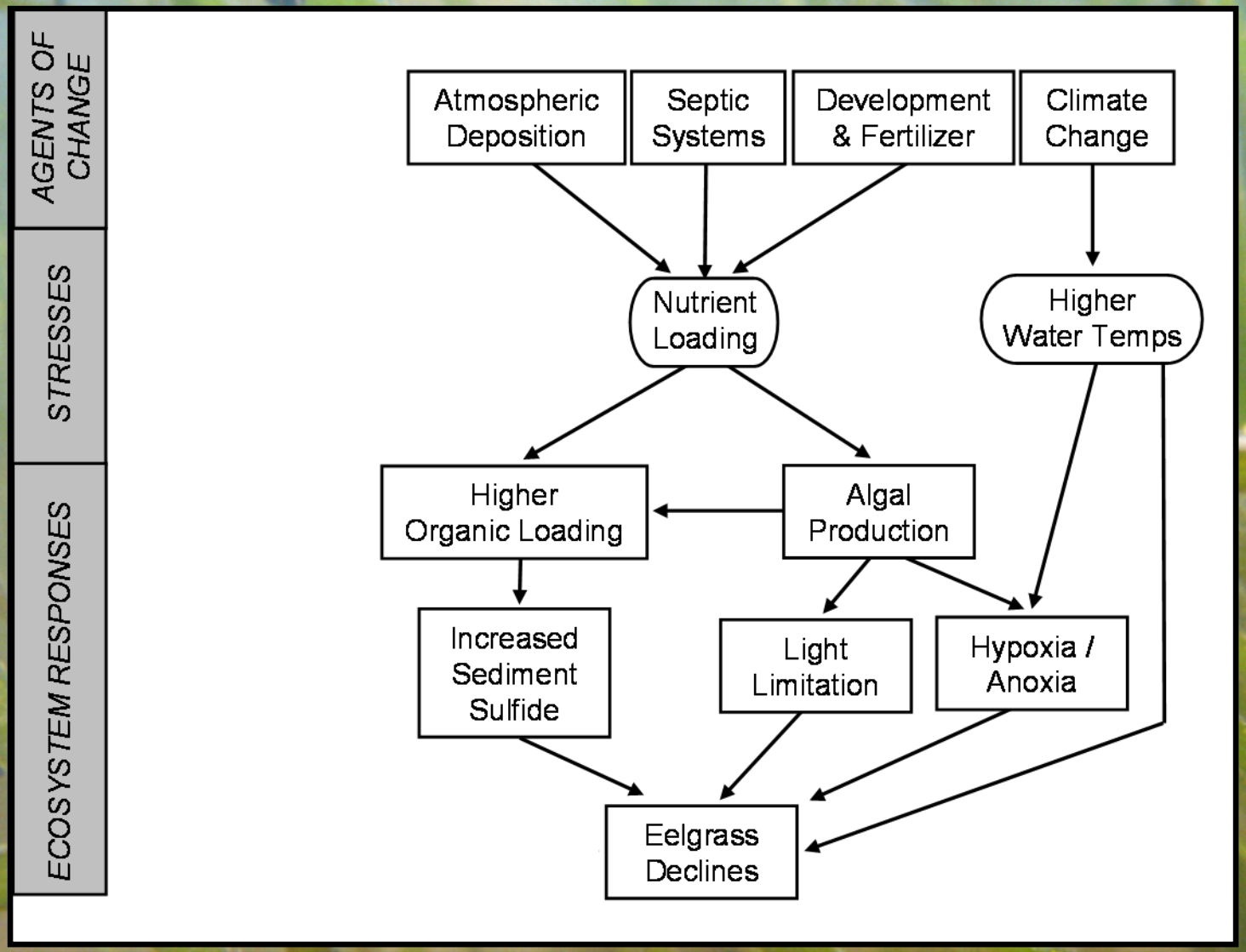


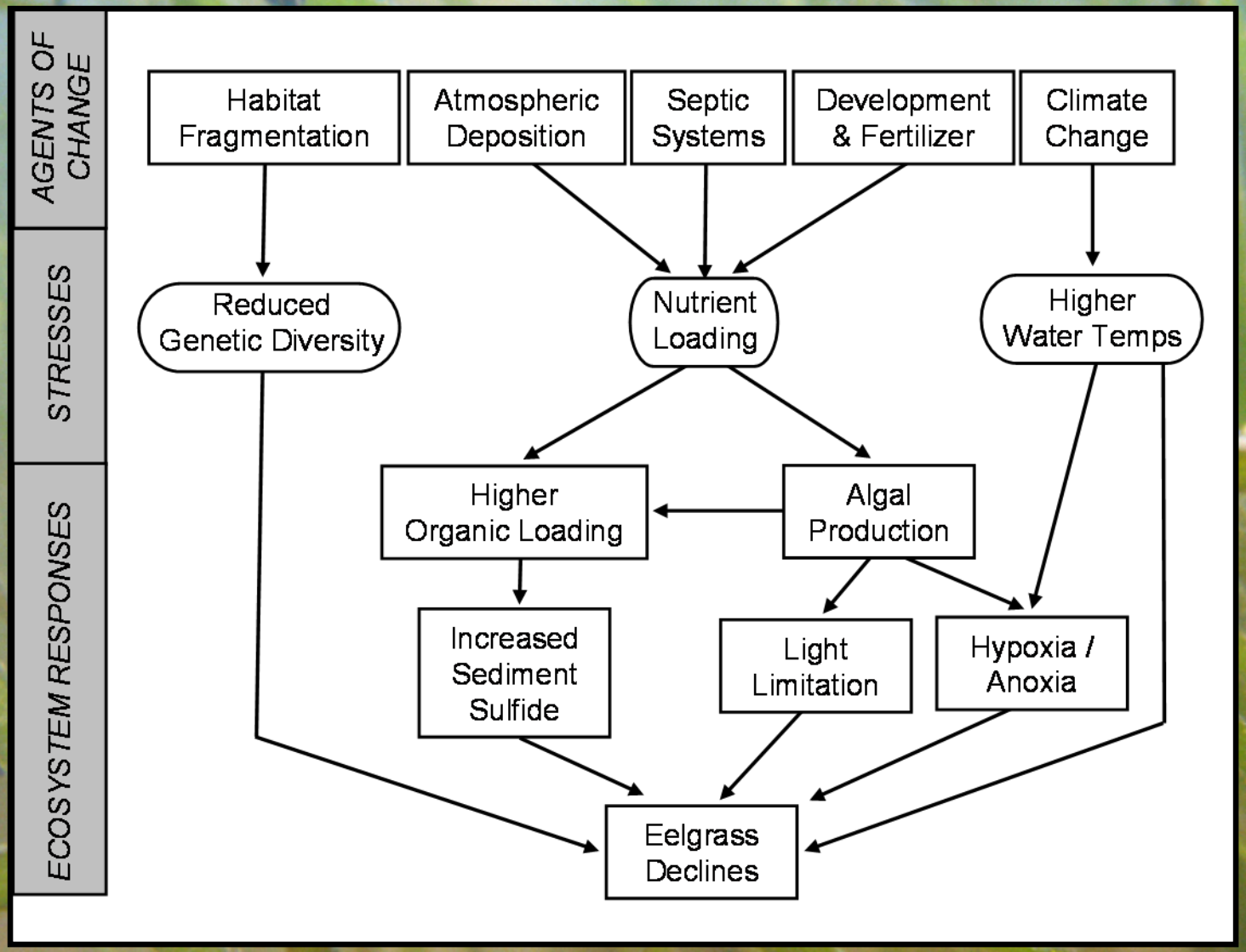


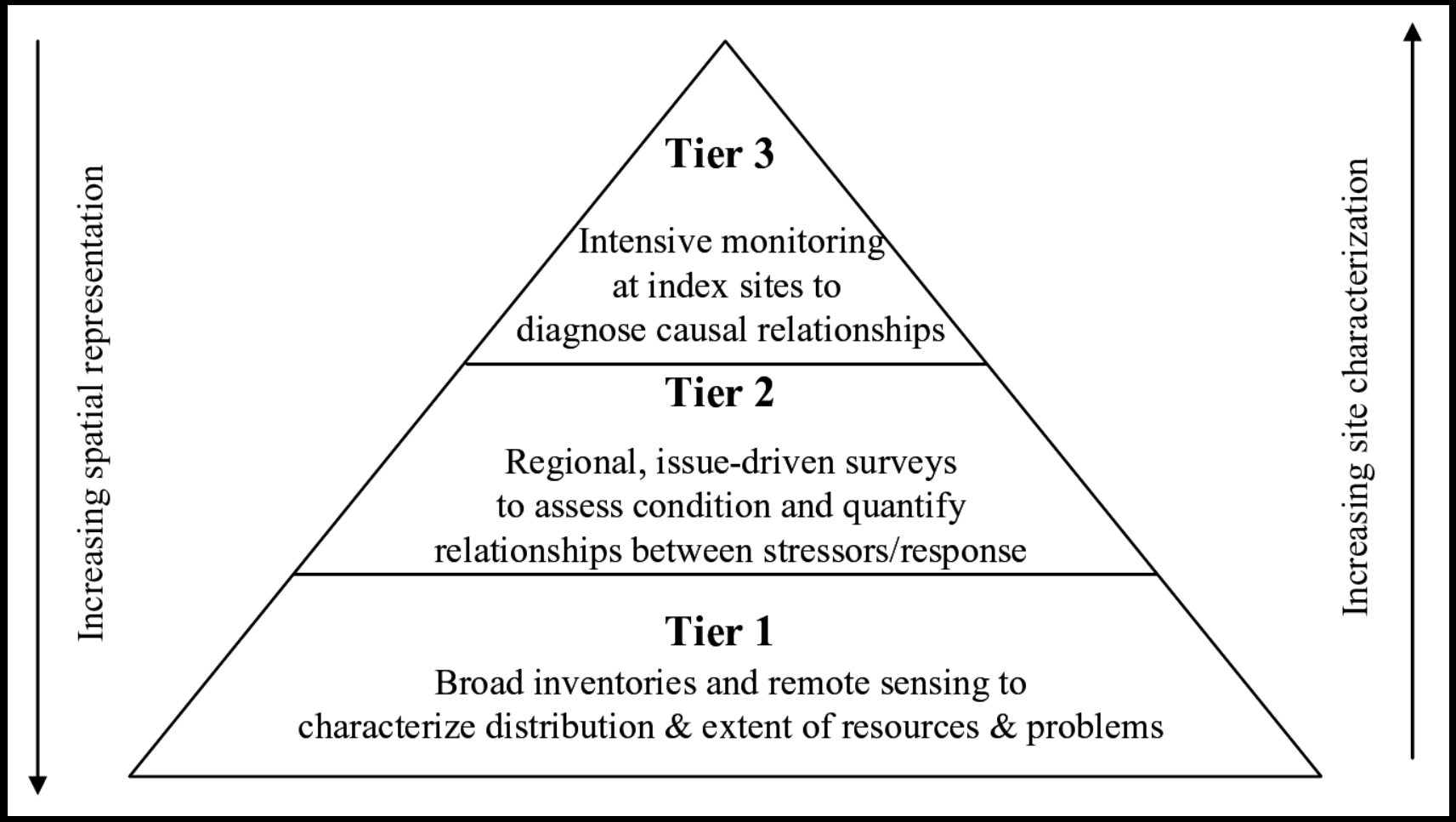
# Progression of Nutrient Enrichment

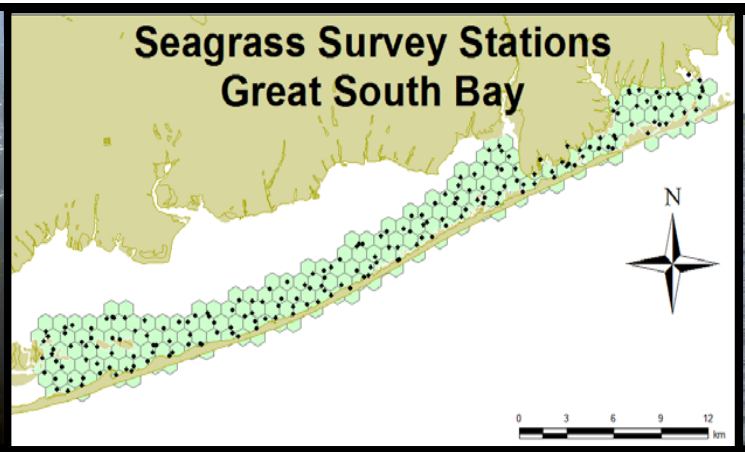


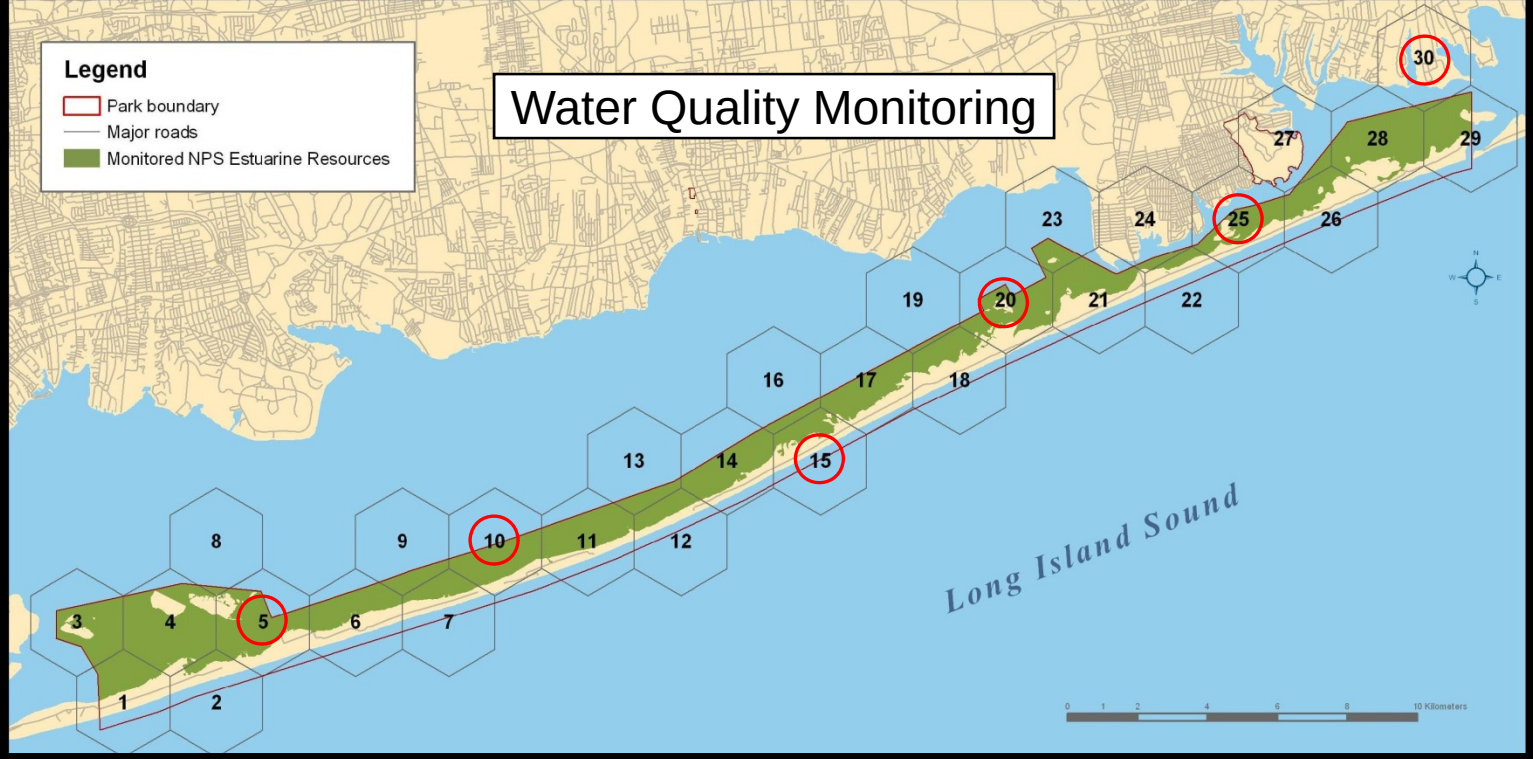

AGENTS OF CHANGE
STRESSES
ECOSYSTEM RESPONSES
Atmospheric Deposition
Septic Systems
Development & Fertilizer
Nutrient Loading
Higher Organic Loading
Algal Production
Increased Sediment Sulfide
Light Limitation
Hypoxia / Anoxia
Eelgrass Declines


AGENTS OF CHANGE
STRESSES
ECOSYSTEM RESPONSES
Atmospheric Deposition
Septic Systems
Development & Fertilizer
Climate Change
Nutrient Loading
Higher Water Temps
Higher Organic Loading
Algal Production
Increased Sediment Sulfide
Light Limitation
Hypoxia / Anoxia
Eelgrass Declines


AGENTS OF CHANGE
STRESSES
ECOSYSTEM RESPONSES
Habitat Fragmentation
Atmospheric Deposition
Septic Systems
Development & Fertilizer
Climate Change
Reduced Genetic Diversity
Nutrient Loading
Higher Water Temps
Higher Organic Loading
Algal Production
Increased Sediment Sulfide
Light Limitation
Hypoxia / Anoxia
Eelgrass Declines

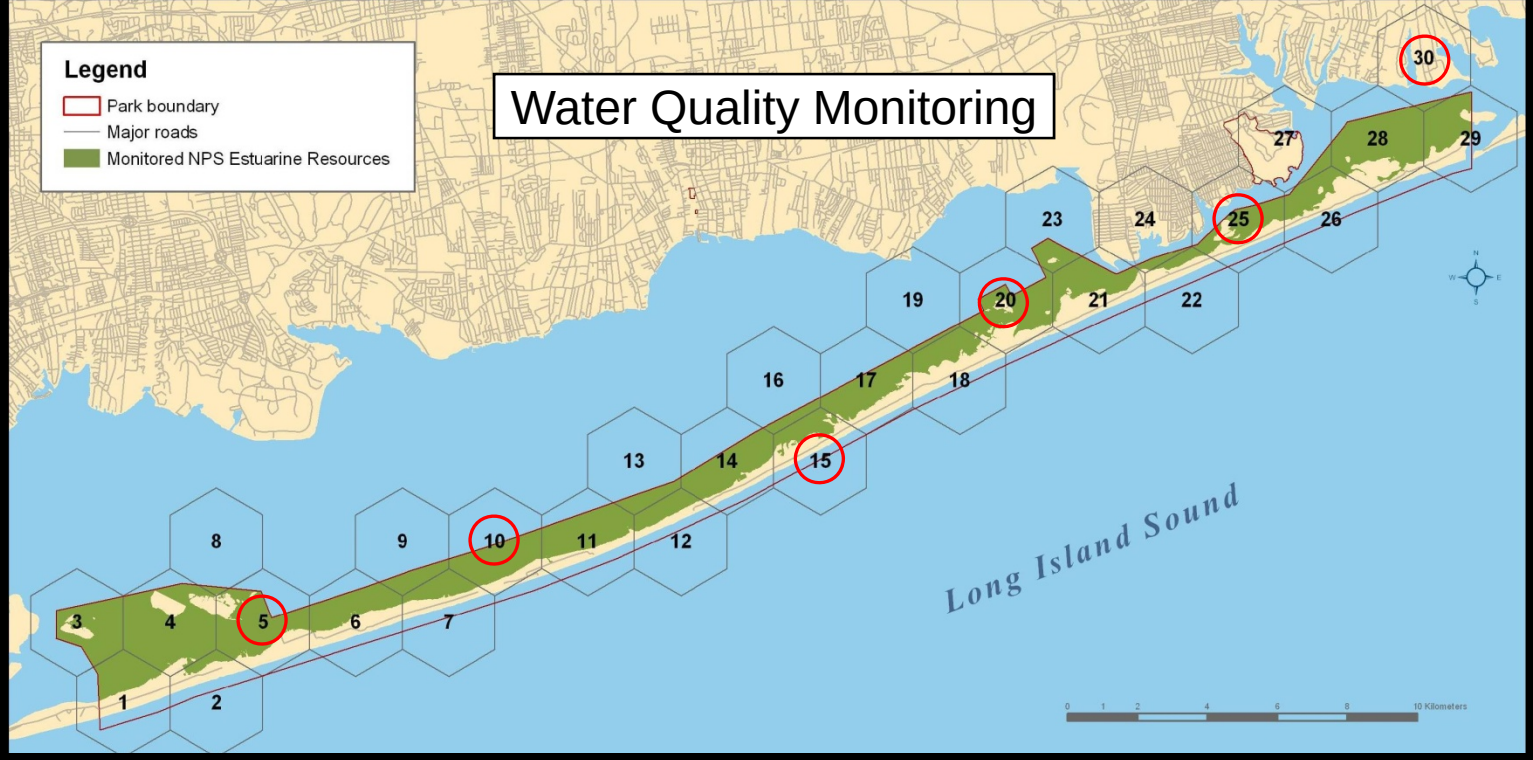

Increasing spatial representation
Tier 3
Intensive monitoring
at index sites to
diagnose causal relationships
Tier 2
Regional, issue-driven surveys
to assess condition and quantify
relationships between stressors/response
Tier 1
Broad inventories and remote sensing to
characterize distribution & extent of resources & problems
Increasing site characterization

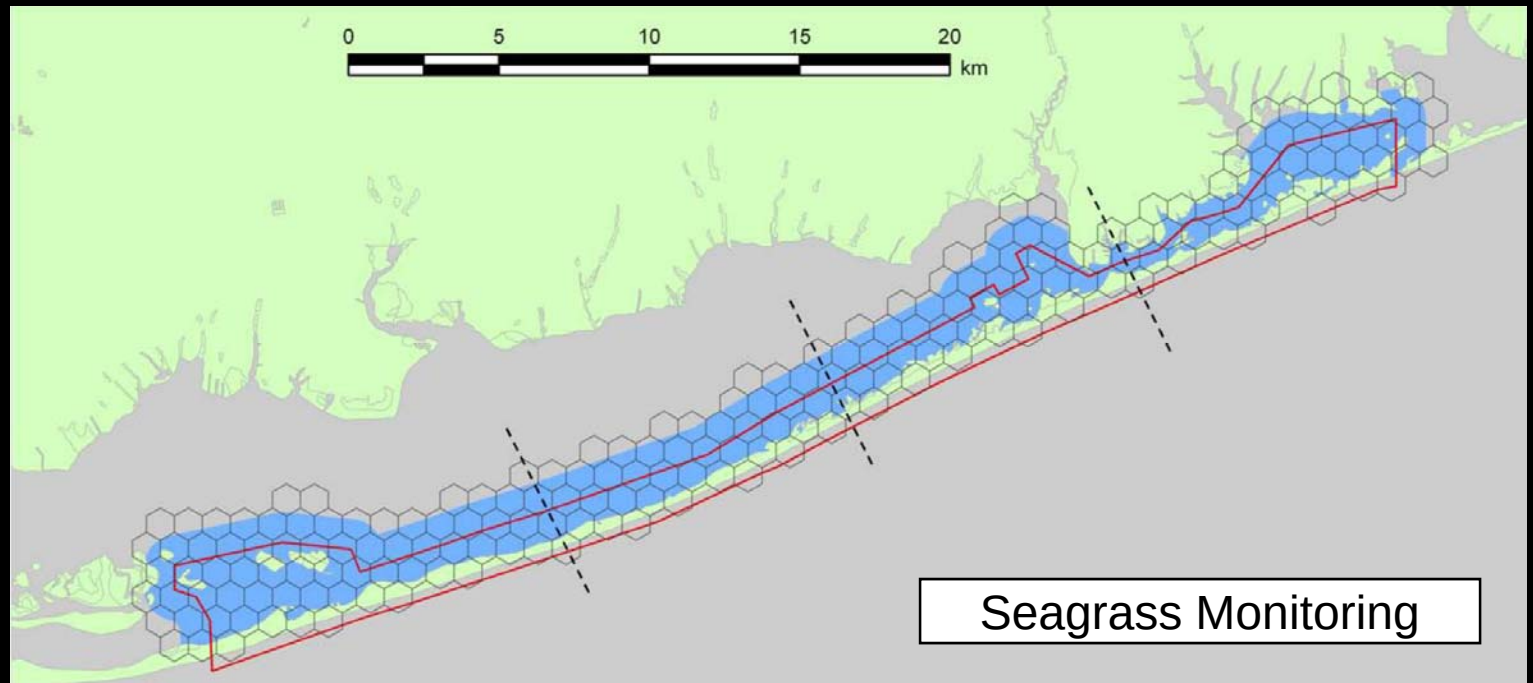

Seagrass Survey Stations
Great South Bay
N
0
3
6
9
12
km




<u>Parameters measured</u>

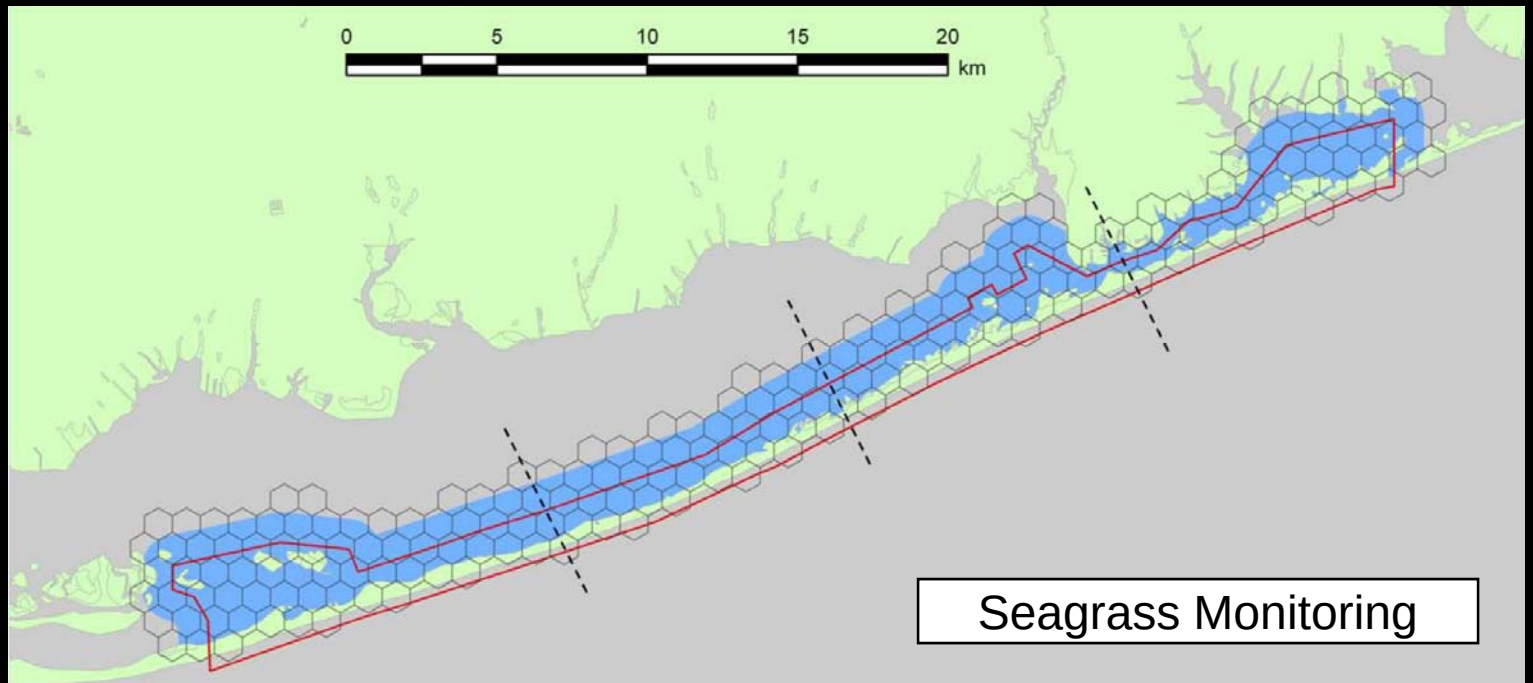
- Temperature (surface, mid and bottom)
- Salinity (surface, mid and bottom)
- Turbidity (surface, mid and bottom)
- Dissolved Oxygen (surface, mid and bottom)
- Chl *a* (surface)
- PAR (photosynthetically active radiation)

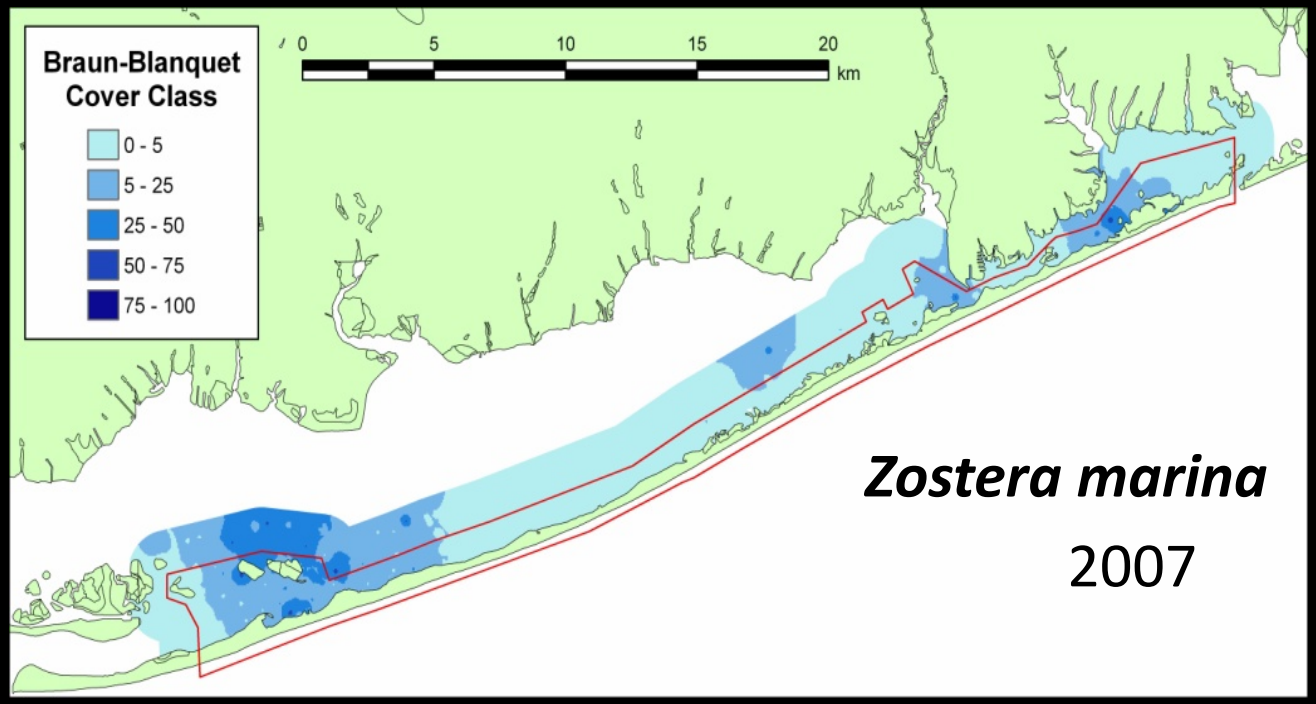

Water Quality Monitoring
Legend
Park boundary
Major roads
Monitored NPS Estuarine Resources
Long Island Sound
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30

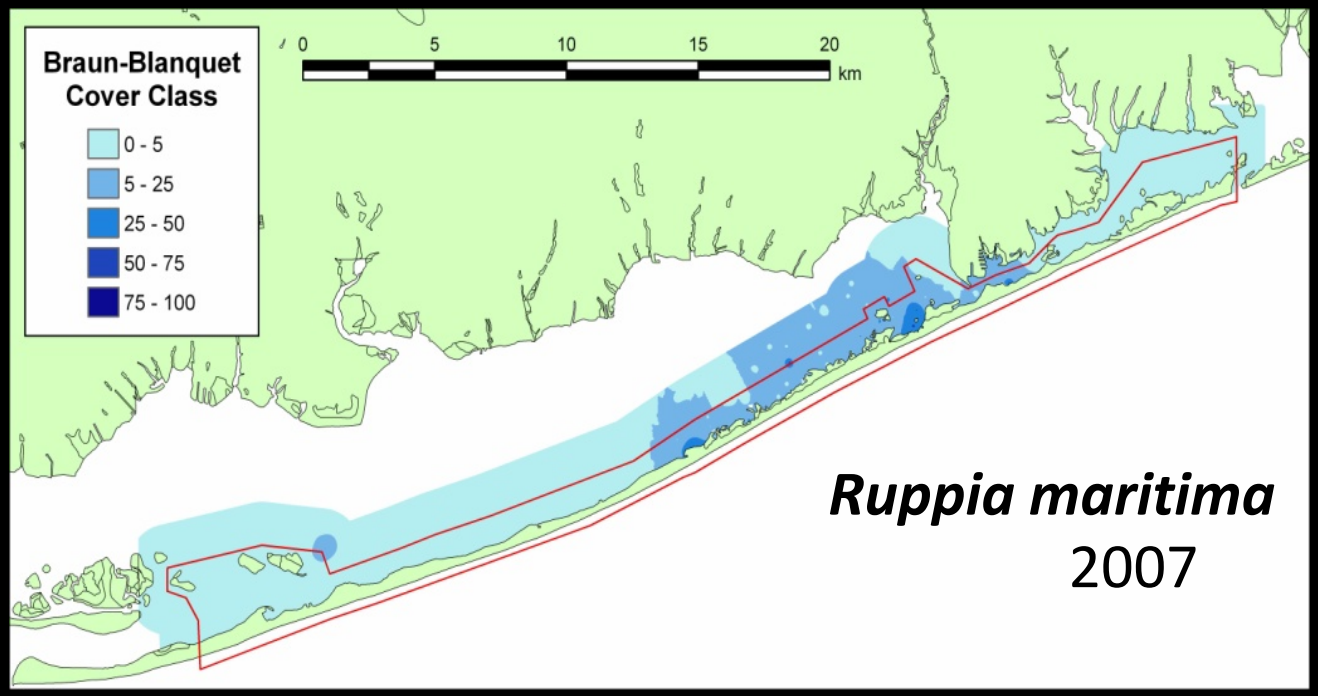

0
5
10
15
20
km
Seagrass Monitoring

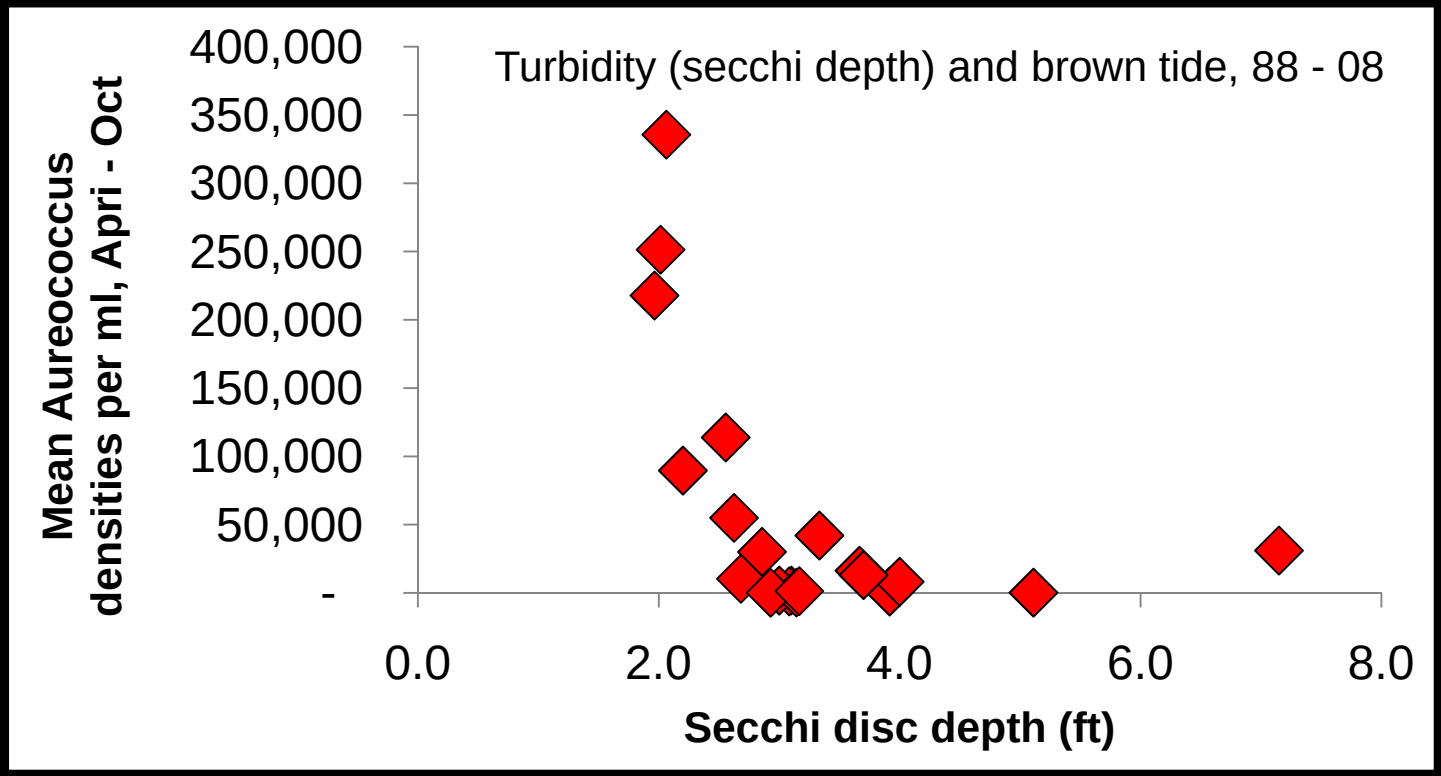
Parameters measured
- % organic carbon in surface sediments
- SAV % cover
- Seagrass biomass

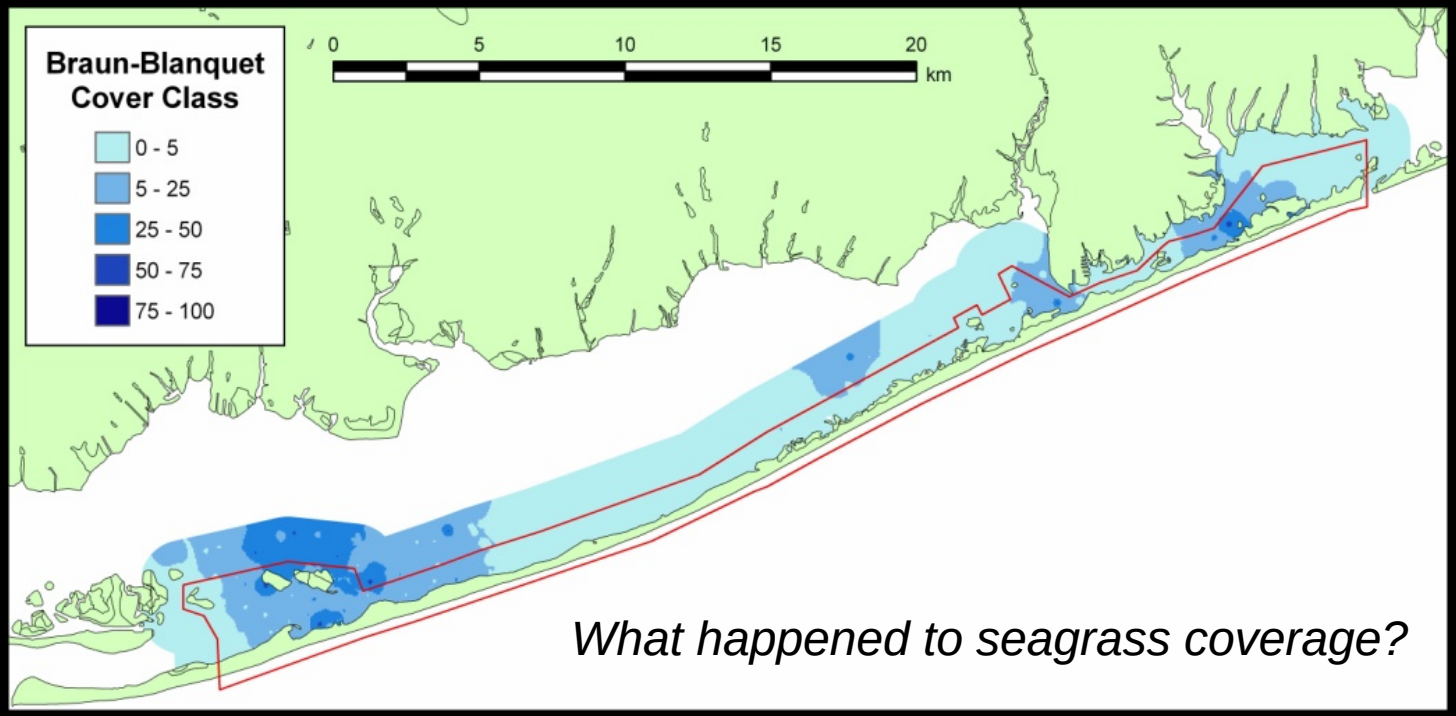
(2009 – porewater sulfide concentration and eelgrass genetic samples)




Braun-Blanquet
Cover Class
0 - 5
5 - 25
25 - 50
50 - 75
75 - 100
0
5
10
15
20
km
Zostera marina
2007

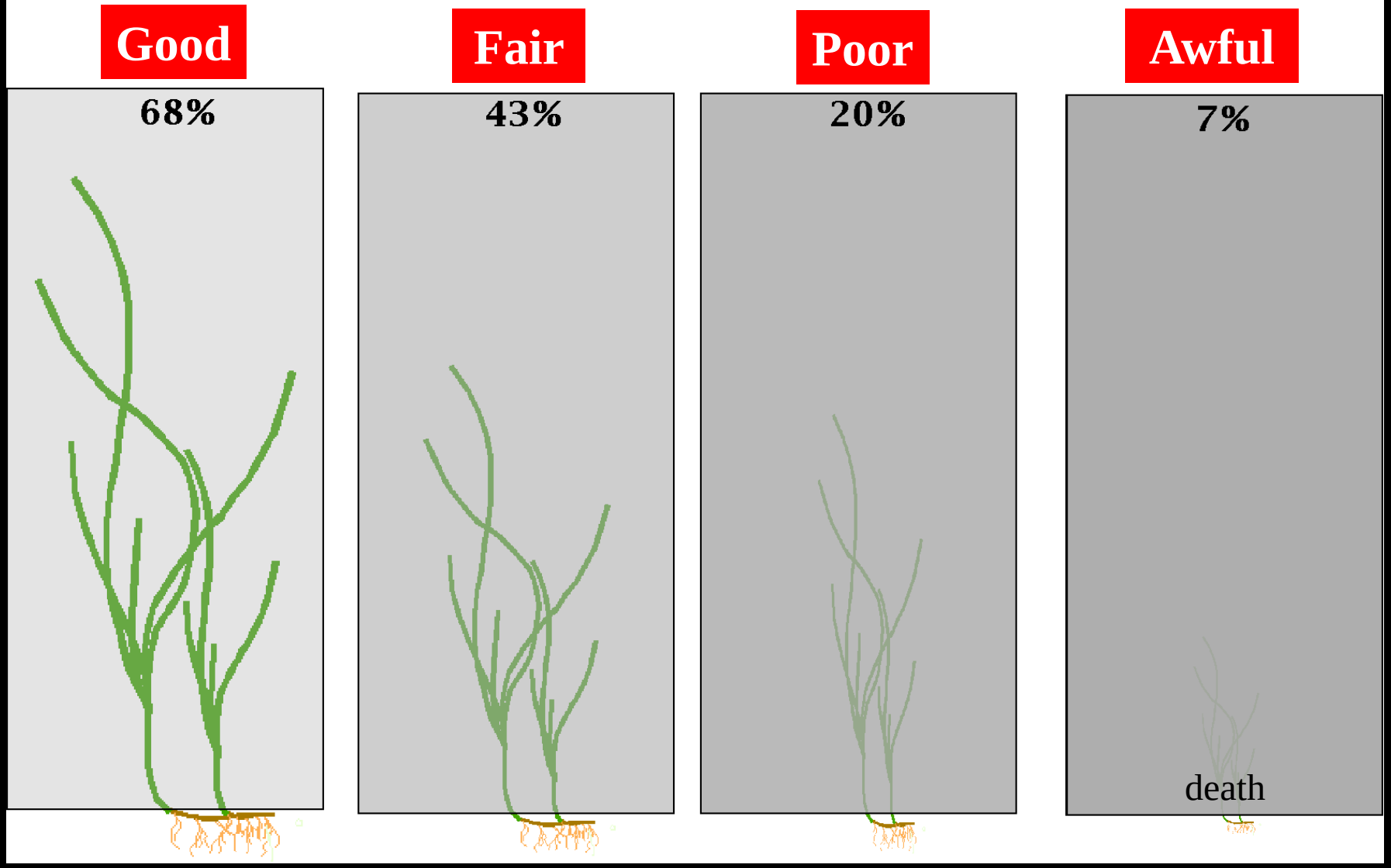

Braun-Blanquet
Cover Class
0 - 5
5 - 25
25 - 50
50 - 75
75 - 100
0
5
10
15
20
km
Ruppia maritima
2007


Turbidity (secchi depth) and brown tide, 88 - 08
Mean Aureococcus densities per ml, Apri - Oct
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
0.0
2.0
4.0
6.0
8.0
Secchi disc depth (ft)



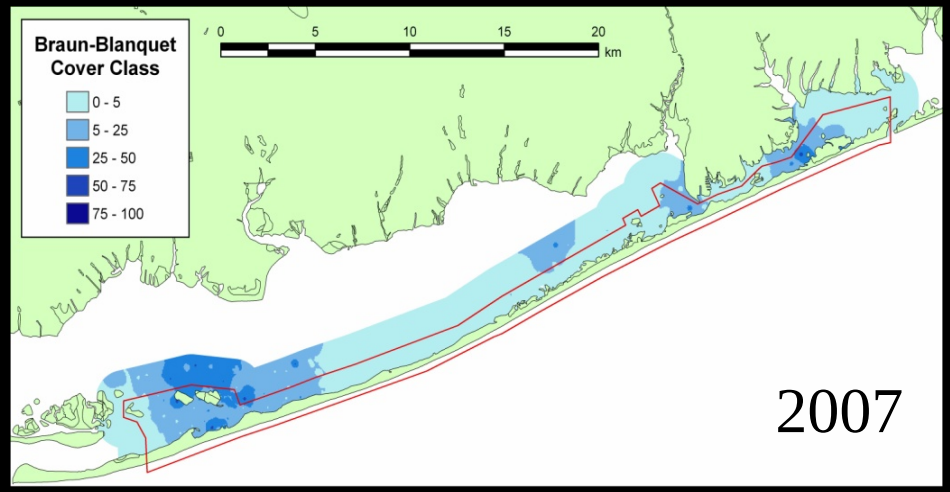

*What happened to seagrass coverage?*

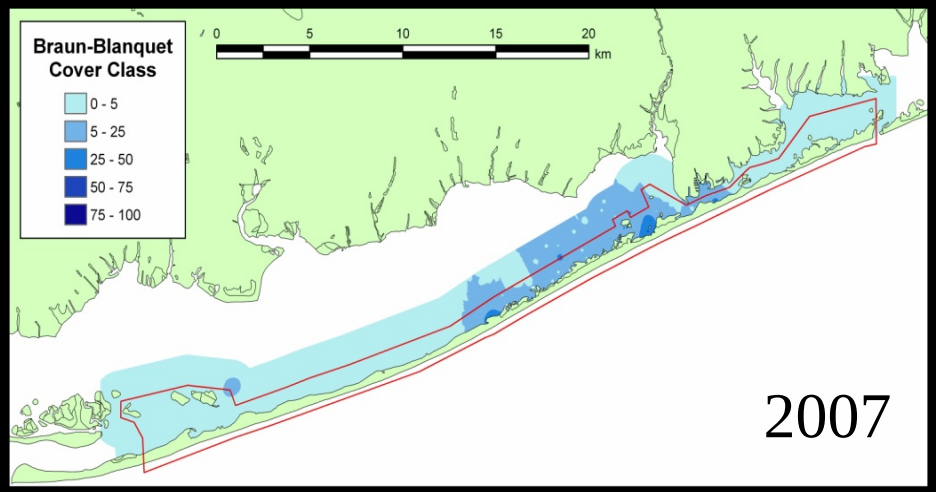
# Water quality and light

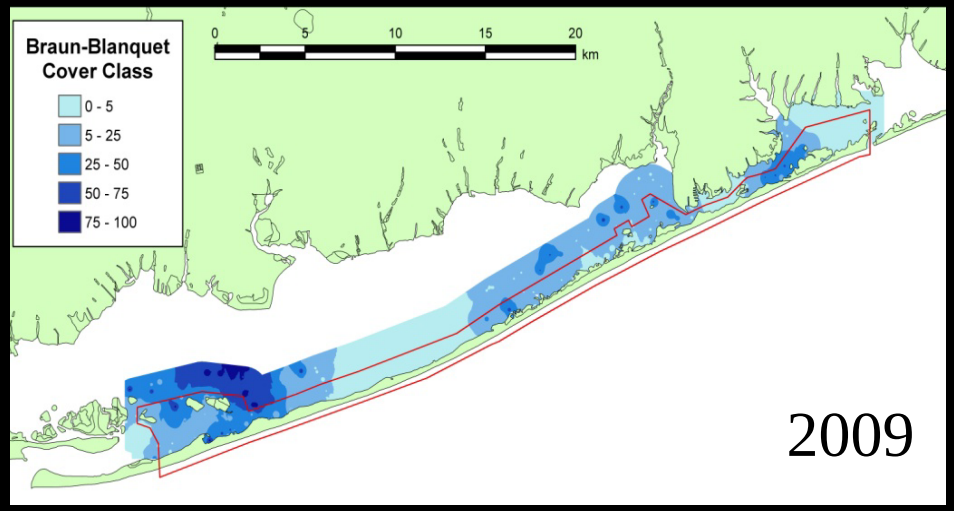


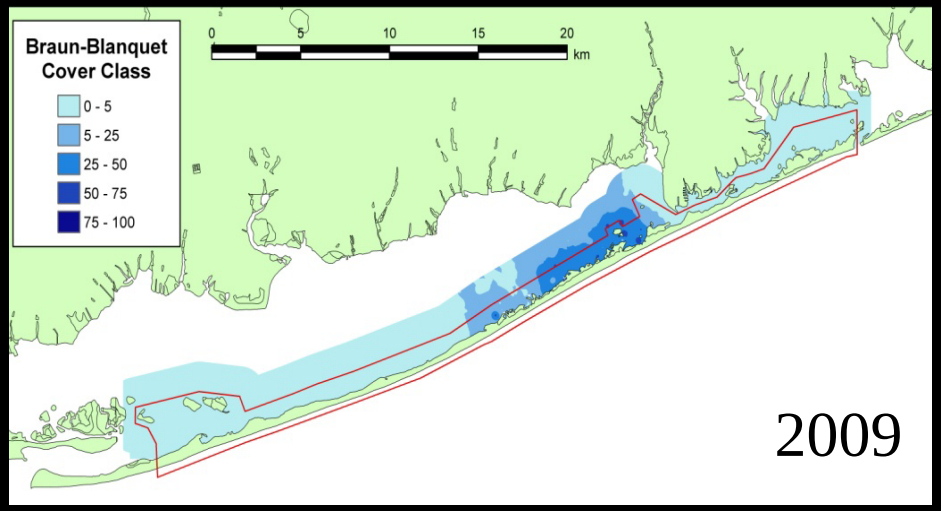
# Seagrass Percent Cover Status and Trends
# Fire Island National Seashore

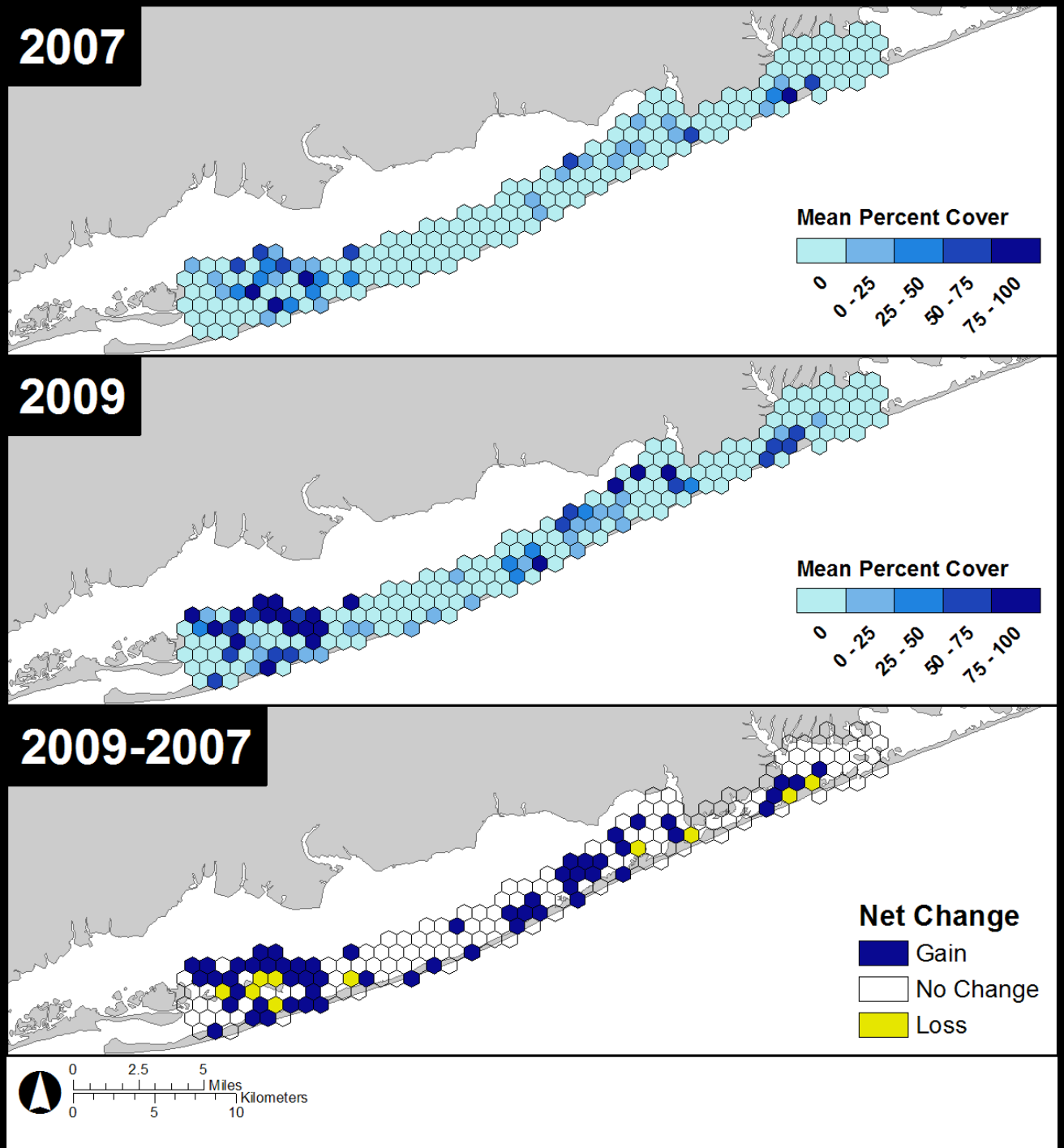
***Zostera marina*** ***Ruppia maritima***

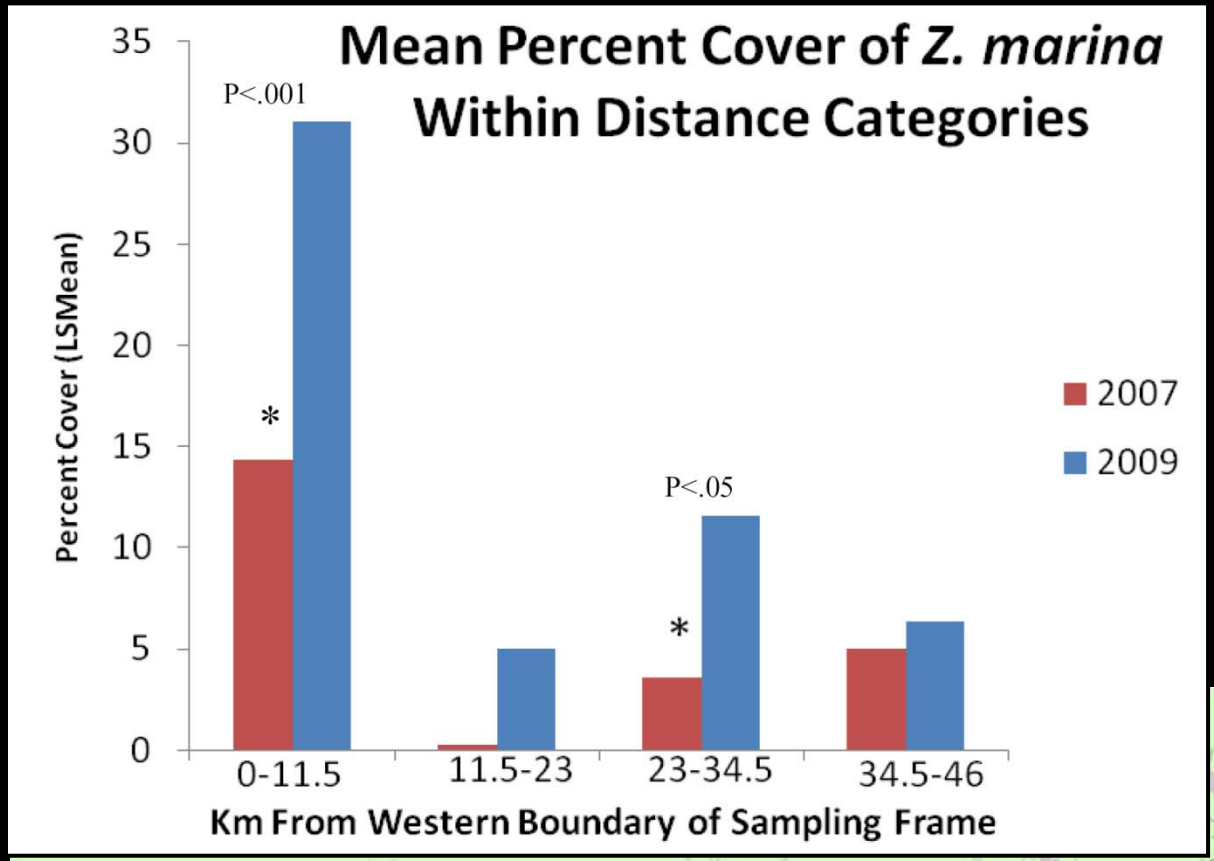


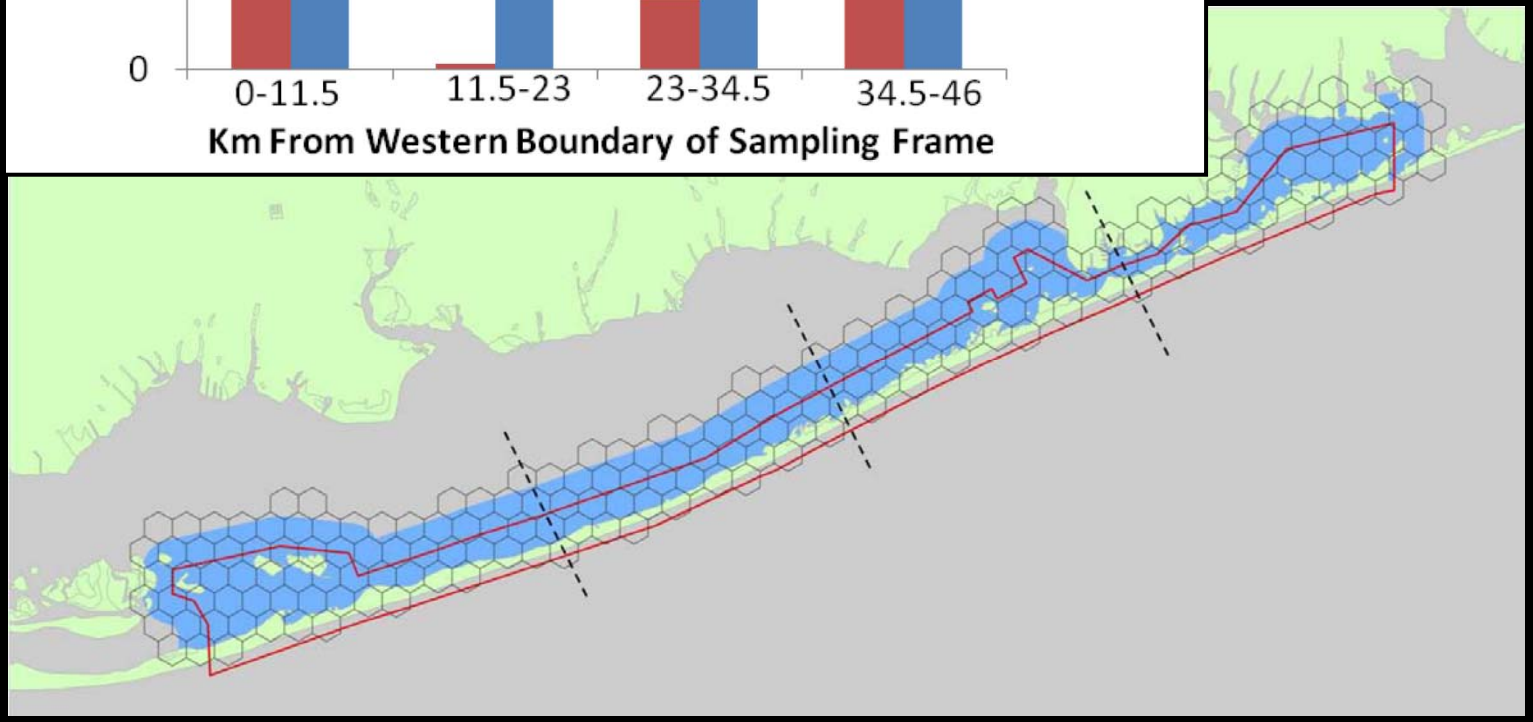



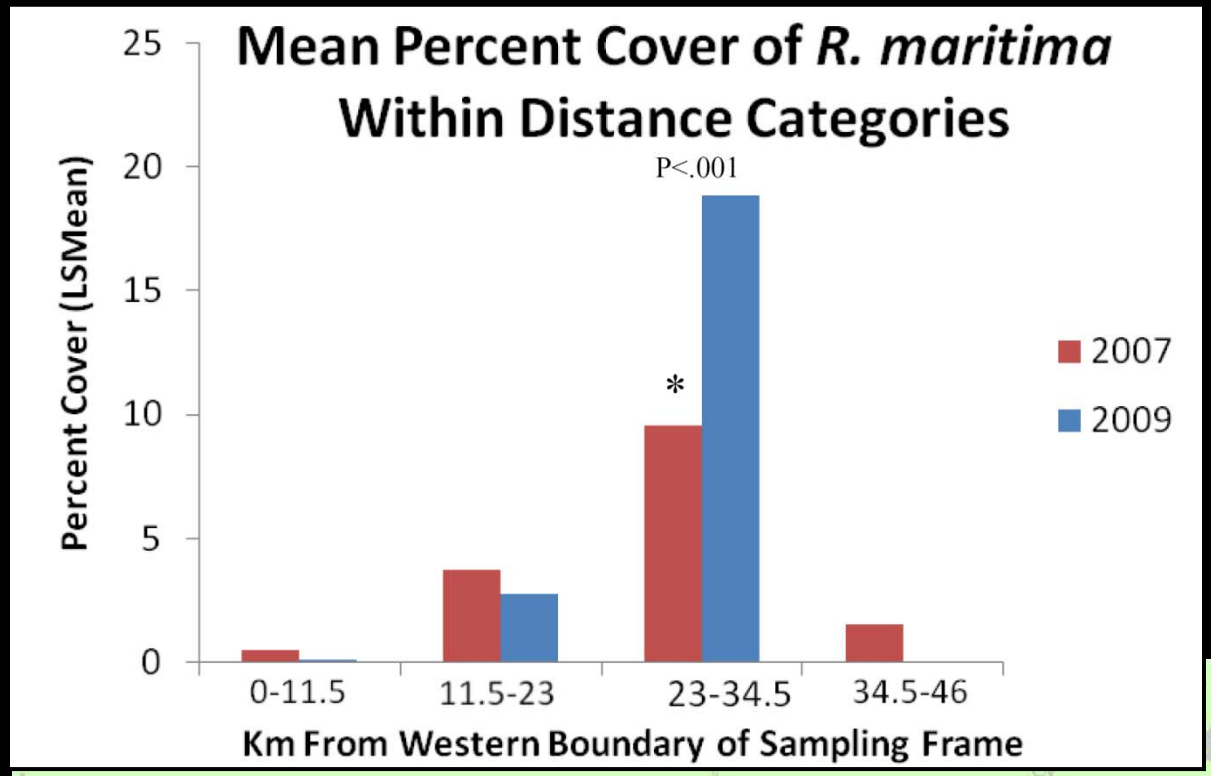



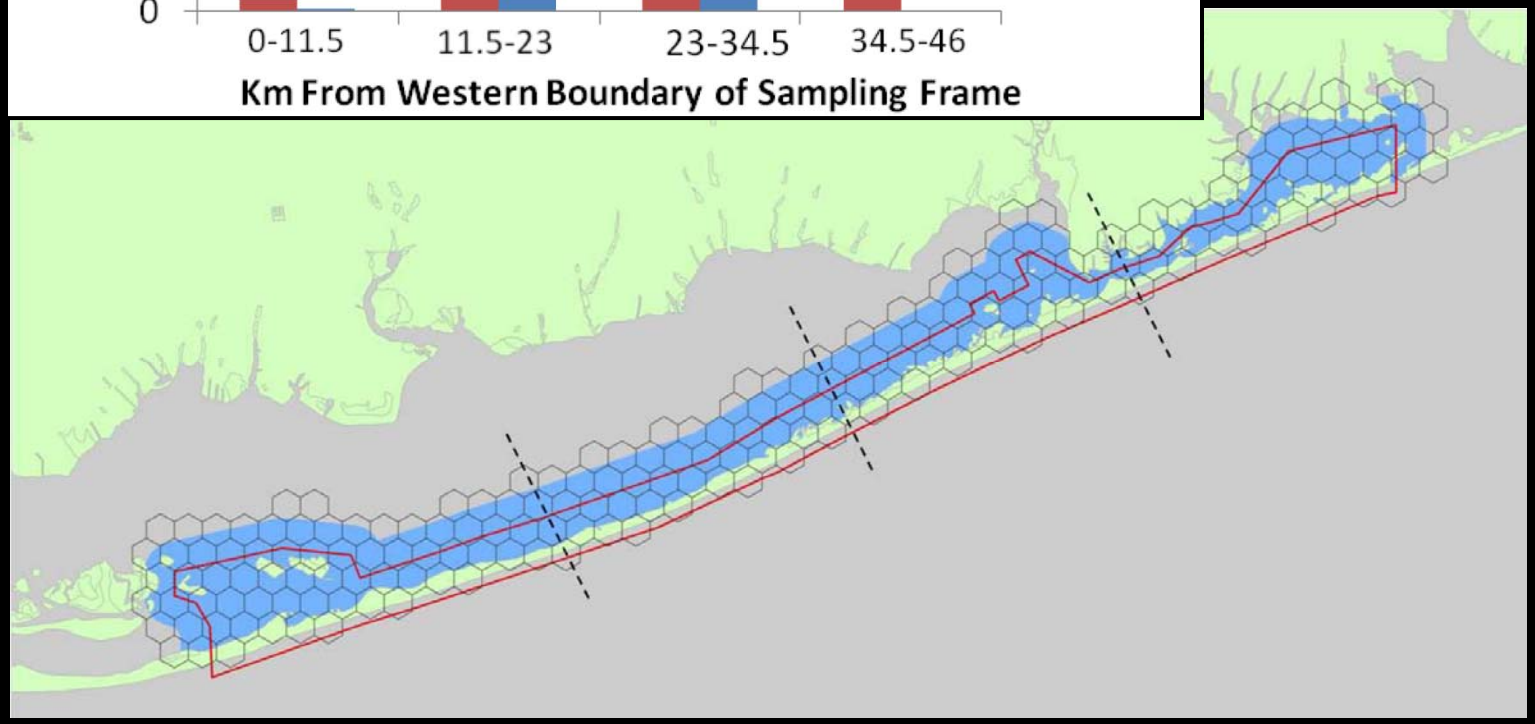



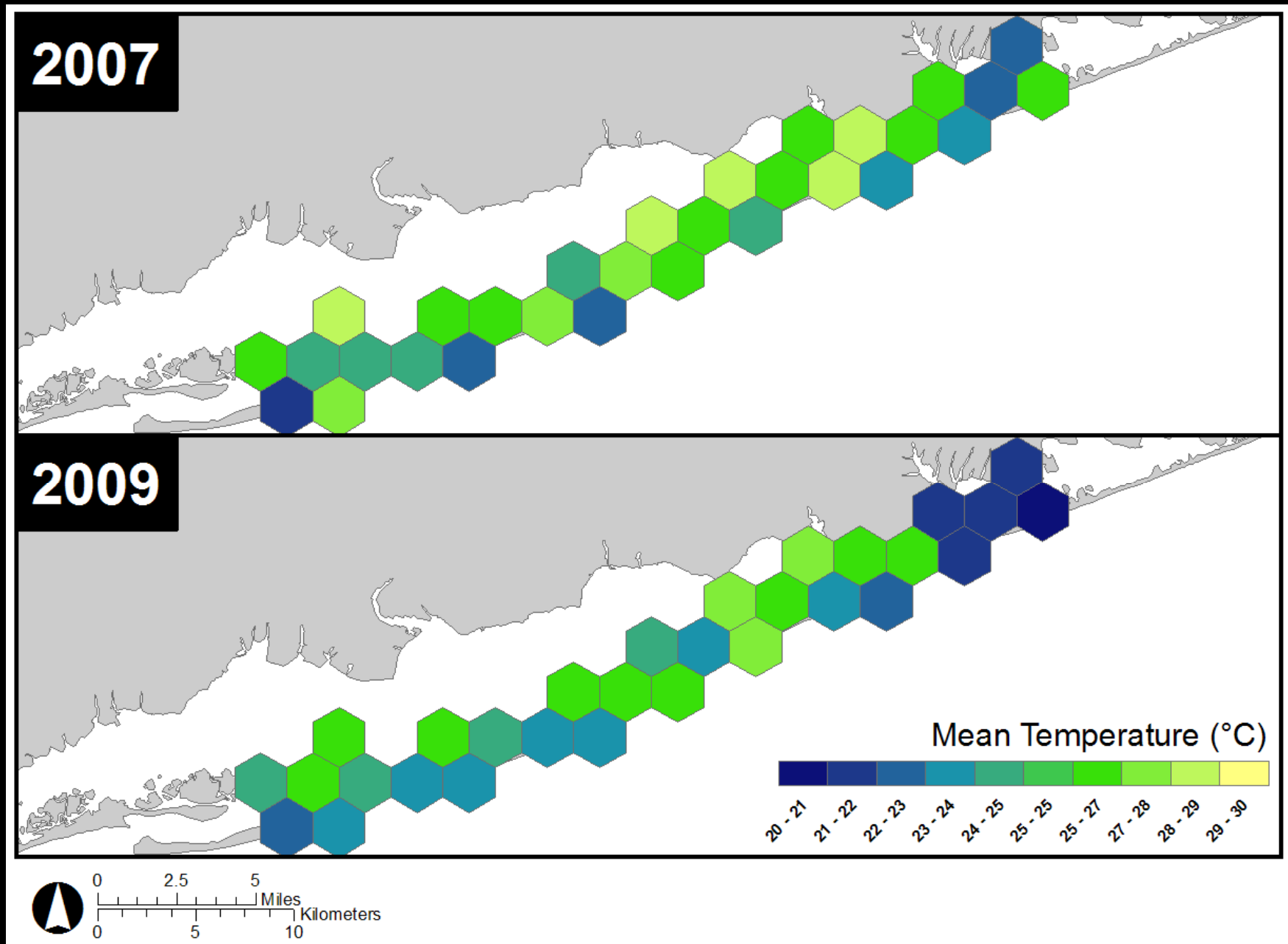

2007
Mean Percent Cover
0
0 - 25
25 - 50
50 - 75
75 - 100
2009
Mean Percent Cover
0
0 - 25
25 - 50
50 - 75
75 - 100
2009-2007
Net Change
Gain
No Change
Loss
0
2.5
5
Miles
Kilometers
0
5
10

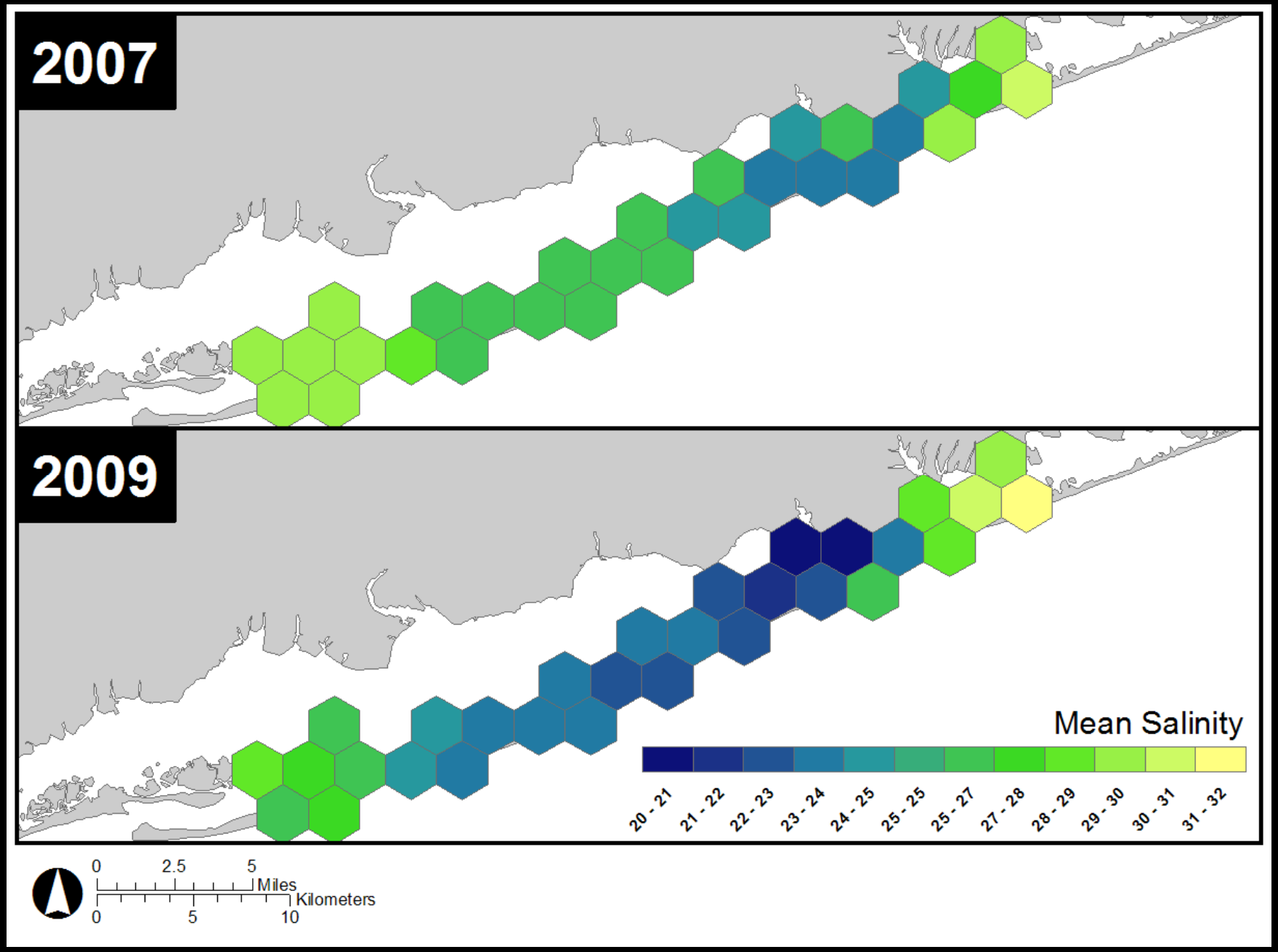

Mean Percent Cover of Z. marina
Within Distance Categories
Percent Cover (LSMean)
35
30
25
20
15
10
5
0
P<.001
*
P<.05
*
2007
2009
0-11.5
11.5-23
23-34.5
34.5-46
Km From Western Boundary of Sampling Frame

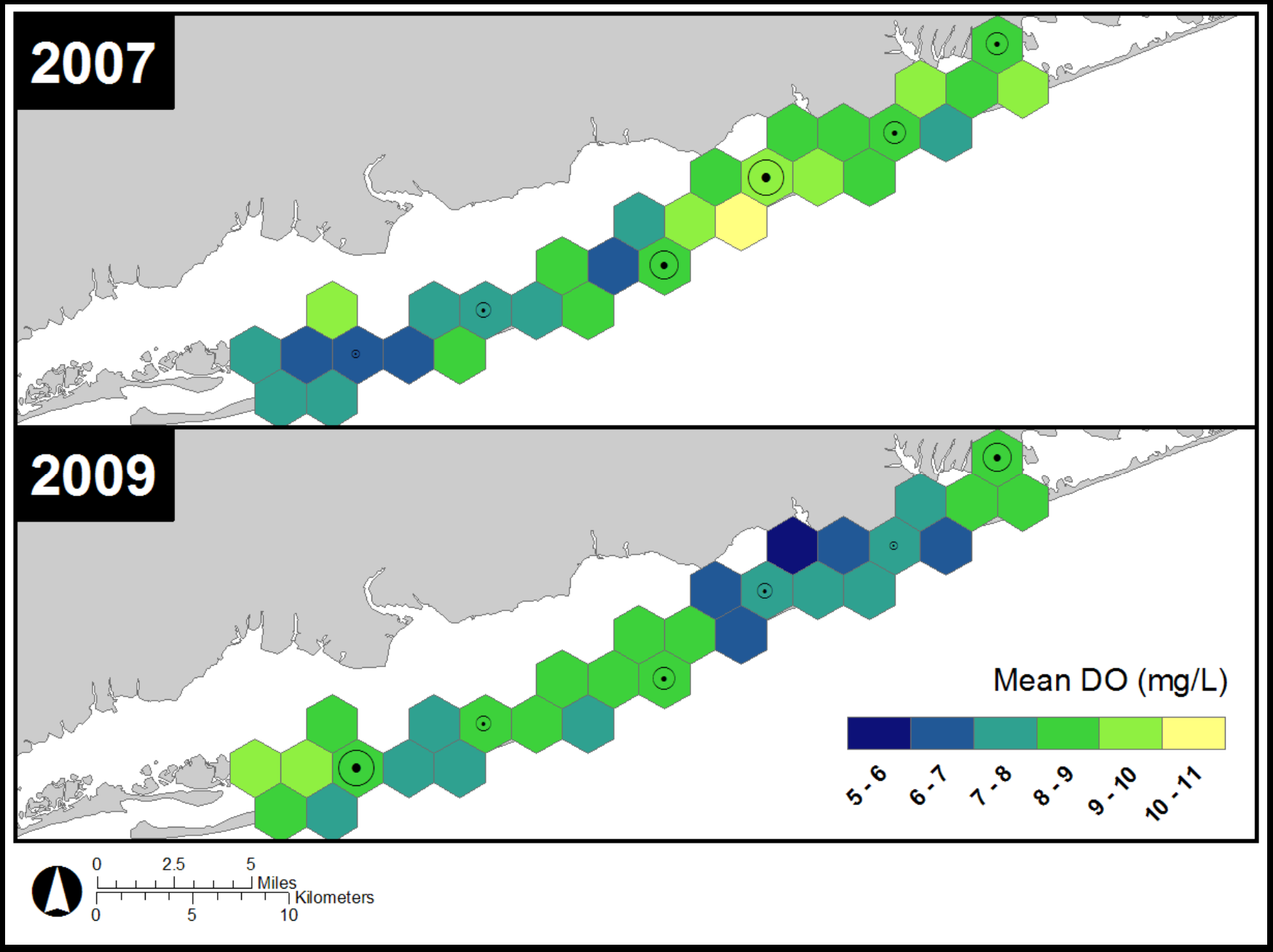


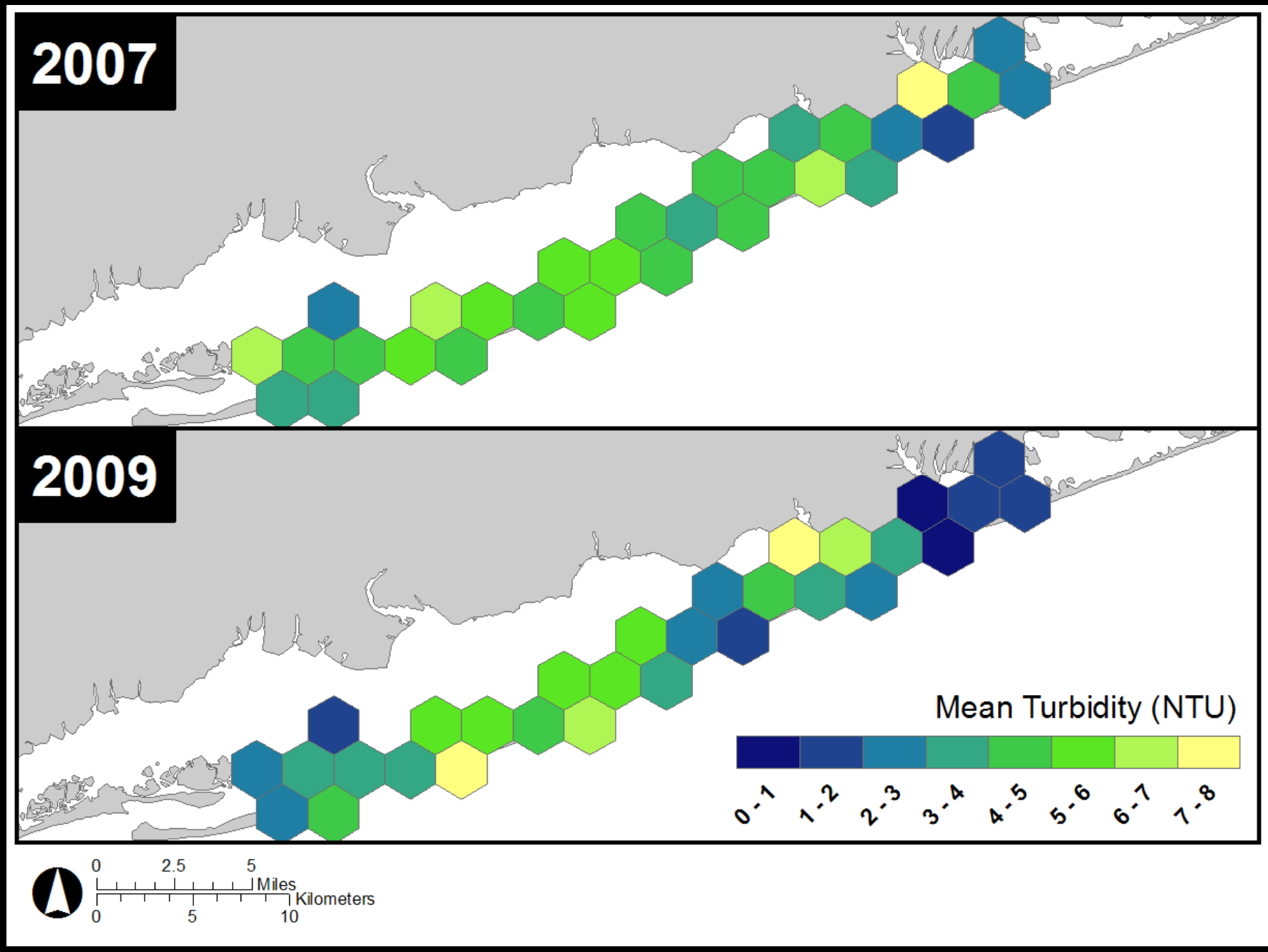

Mean Percent Cover of R. maritima
Within Distance Categories
P<.001
*
Percent Cover (LSMean)
25
20
15
10
5
0
0-11.5
11.5-23
23-34.5
34.5-46
Km From Western Boundary of Sampling Frame
2007
2009

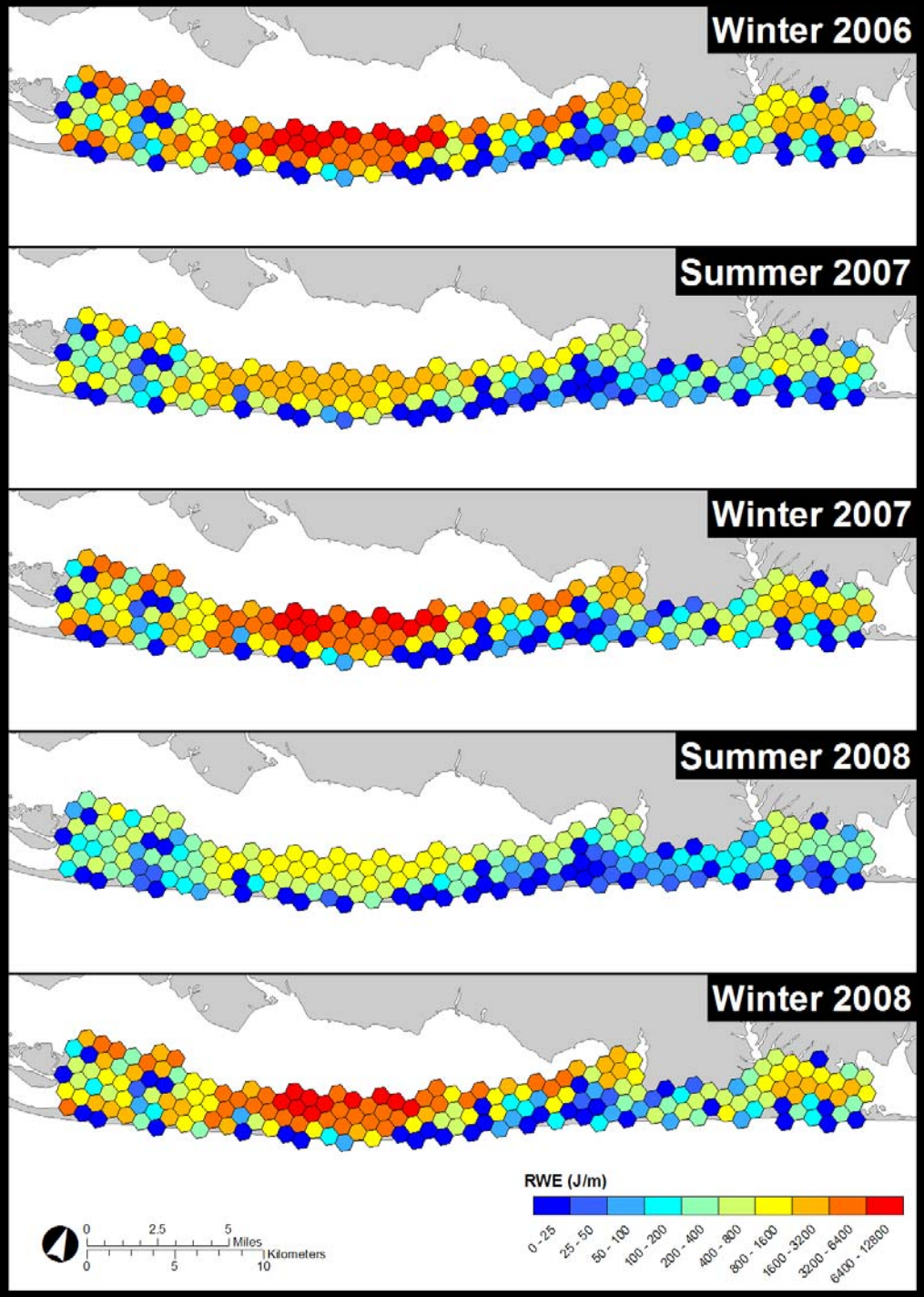



2007
2009
Mean Temperature (°C)
20 - 21
21 - 22
22 - 23
23 - 24
24 - 25
25 - 25
25 - 27
27 - 28
28 - 29
29 - 30
0
2.5
5
Miles
Kilometers
0
5
10

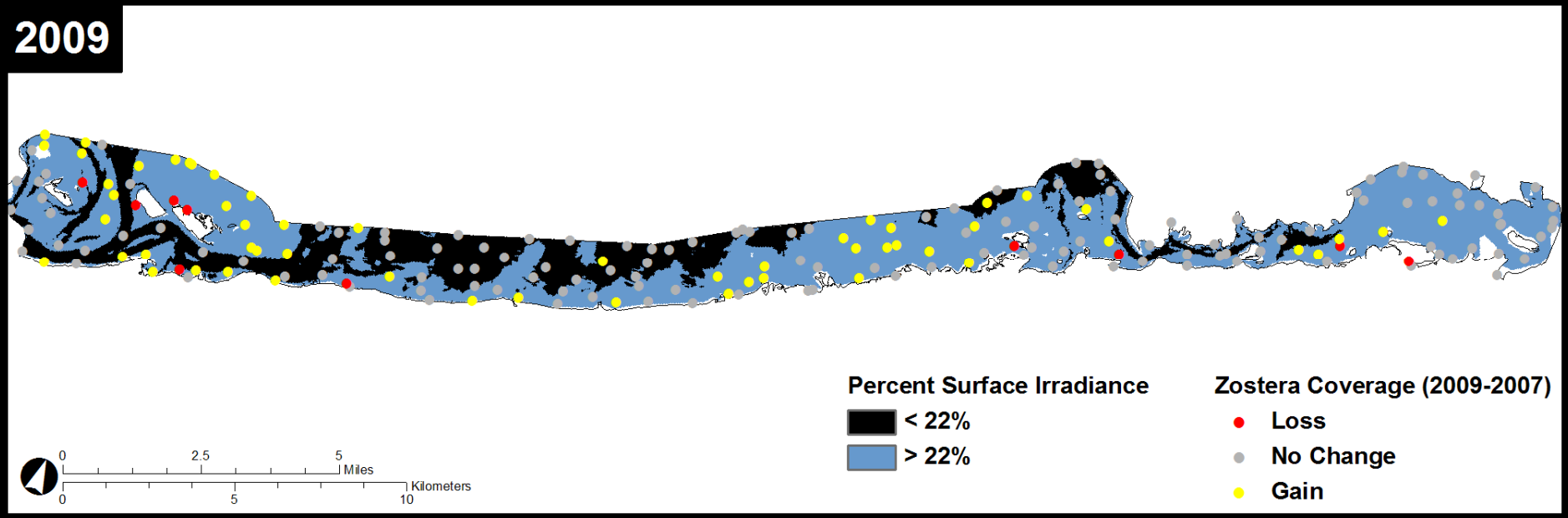

2007
2009
Mean Salinity
20 - 21
21 - 22
22 - 23
23 - 24
24 - 25
25 - 25
25 - 27
27 - 28
28 - 29
29 - 30
30 - 31
31 - 32
0
2.5
5
Miles
Kilometers
0
5
10

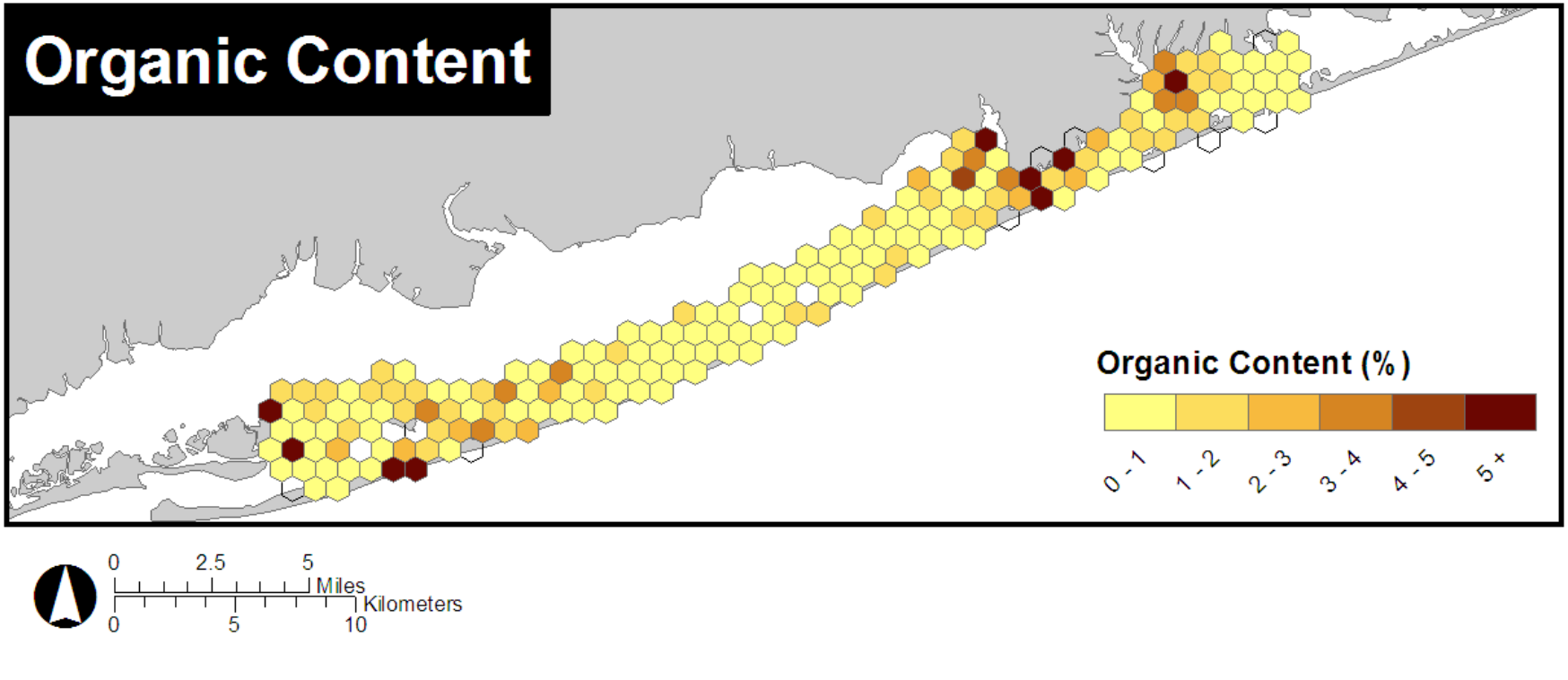

2007
2009
Mean DO (mg/L)
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
0
2.5
5
Miles
0
5
10
Kilometers

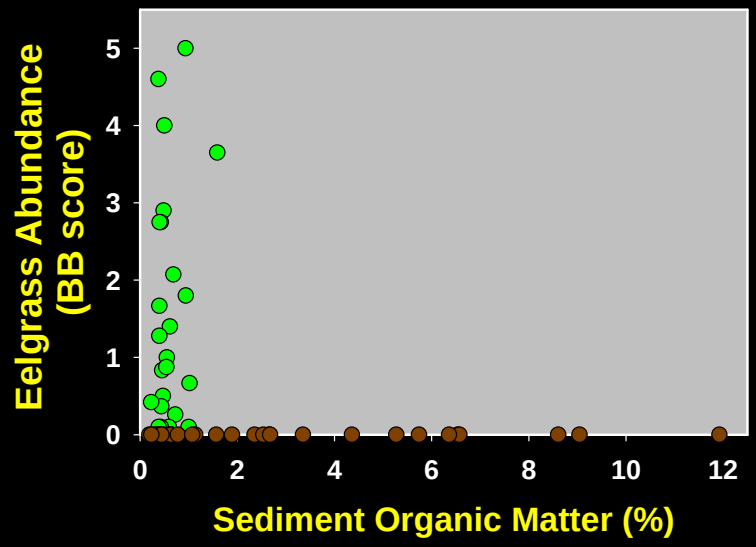

2007
2009
Mean Turbidity (NTU)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
0
2.5
5
Miles
0
5
10
Kilometers


Winter 2006
Summer 2007
Winter 2007
Summer 2008
Winter 2008
RWE (J/m)
0 - 25
25 - 50
50 - 100
100 - 200
200 - 400
400 - 800
800 - 1600
1600 - 3200
3200 - 6400
6400 - 12800
0
2.5
5
Miles
0
5
10
Kilometers

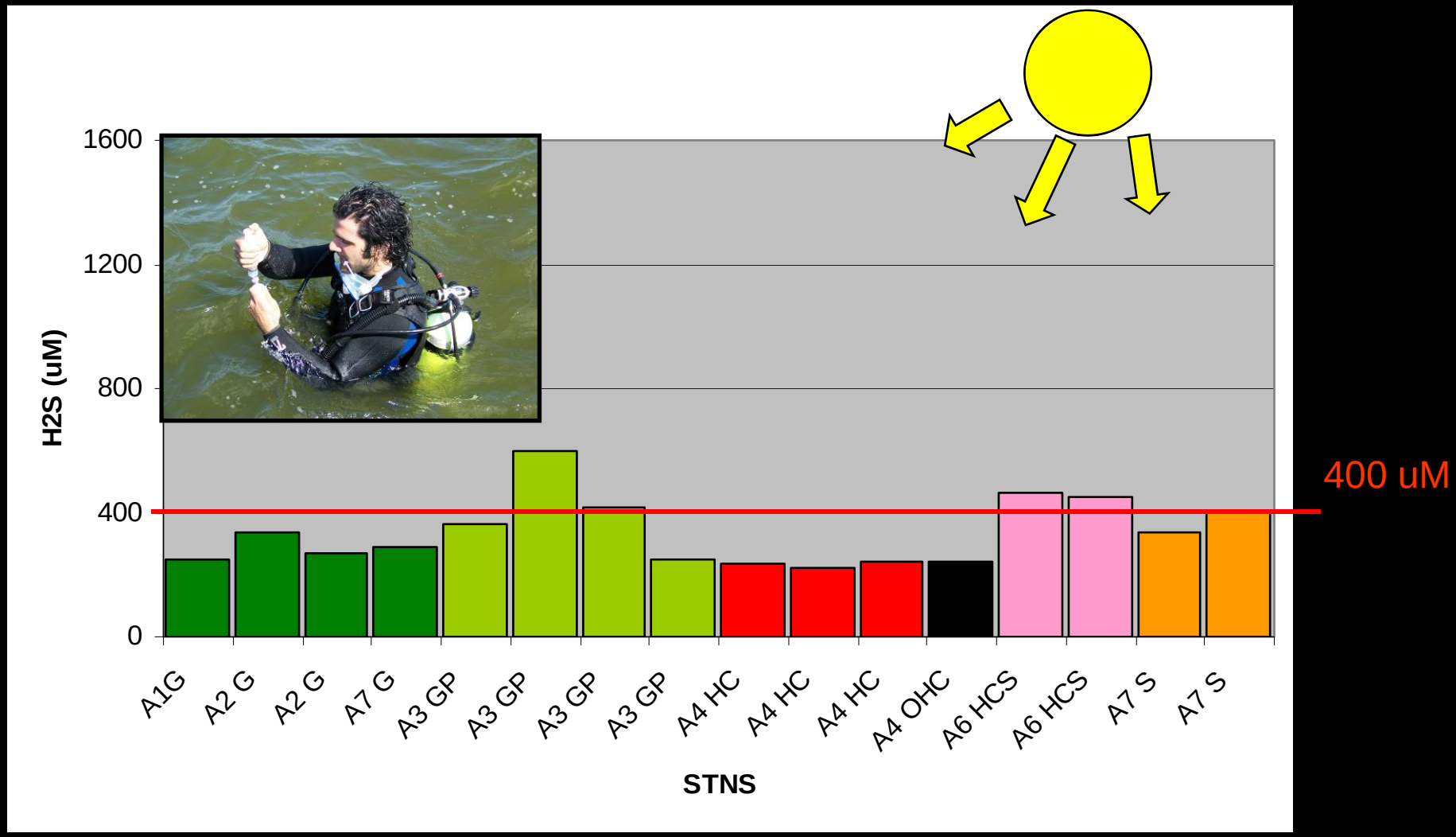
Correlation of *Zostera* biomass increases with more that 22% incident light reaching the sediment surface.




Organic Content
Organic Content (%)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 +
0
2.5
5
Miles
Kilometers
0
5
10

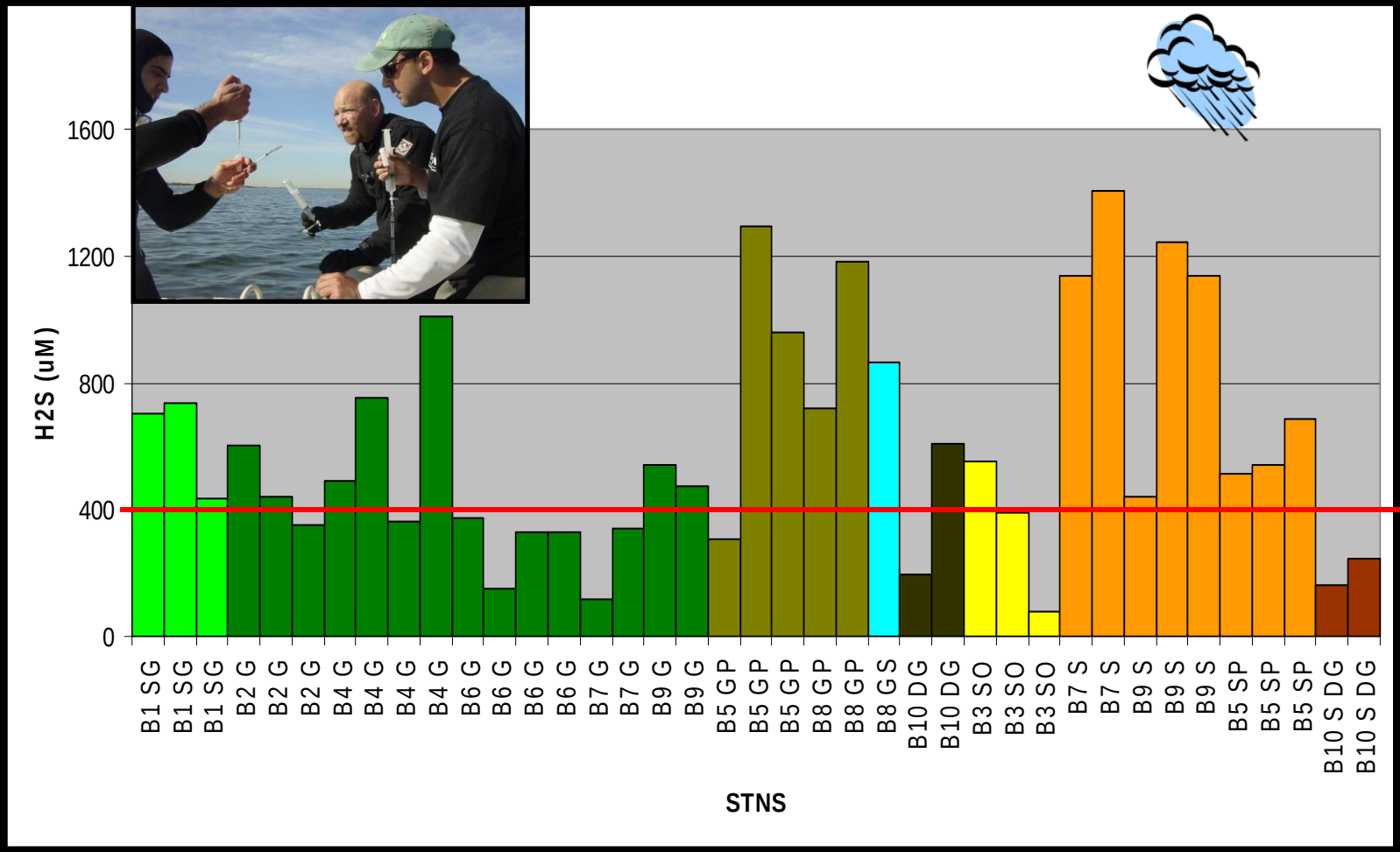

Eelgrass Abundance
(BB score)
0
1
2
3
4
5
0
2
4
6
8
10
12
Sediment Organic Matter (%)

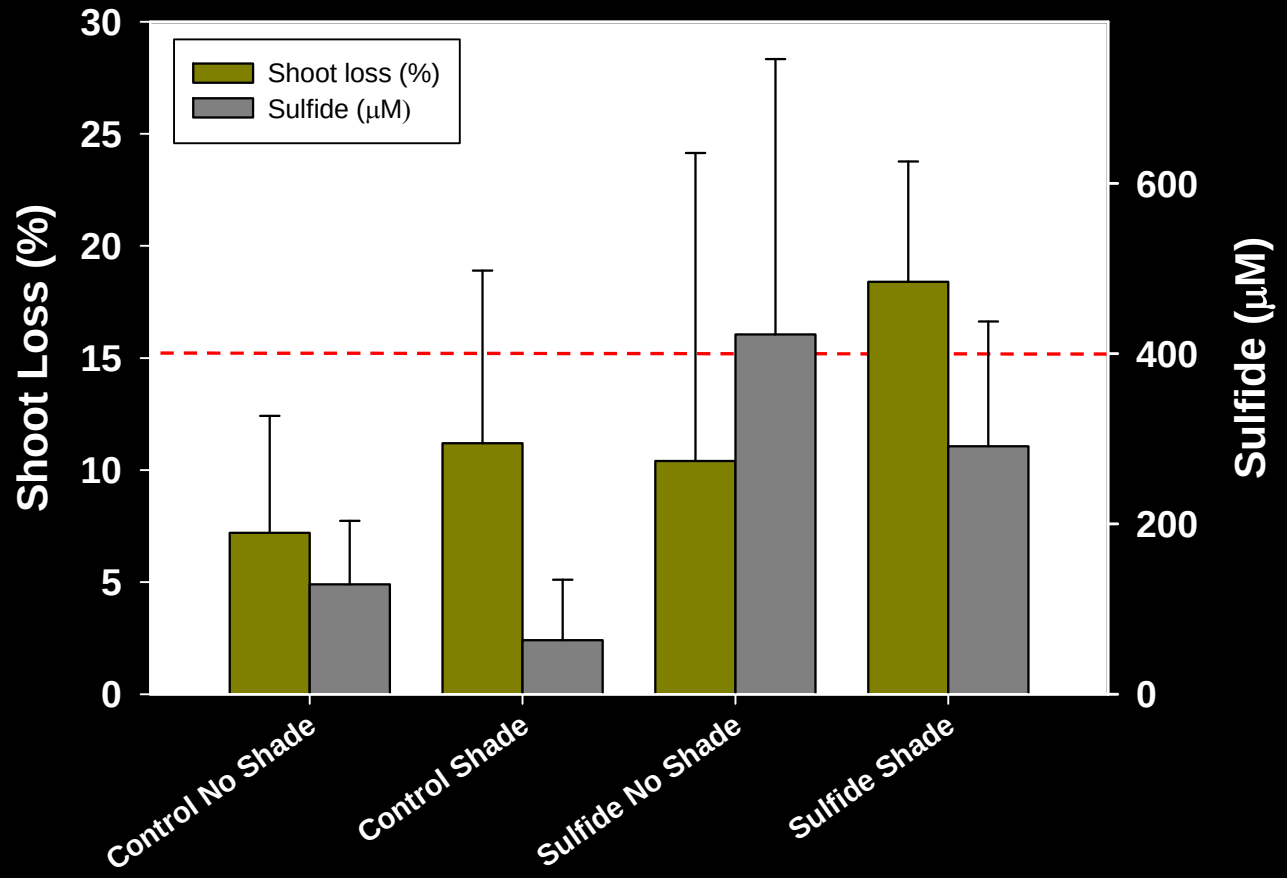
# Do we see toxic concentrations of sulfides in GSB?

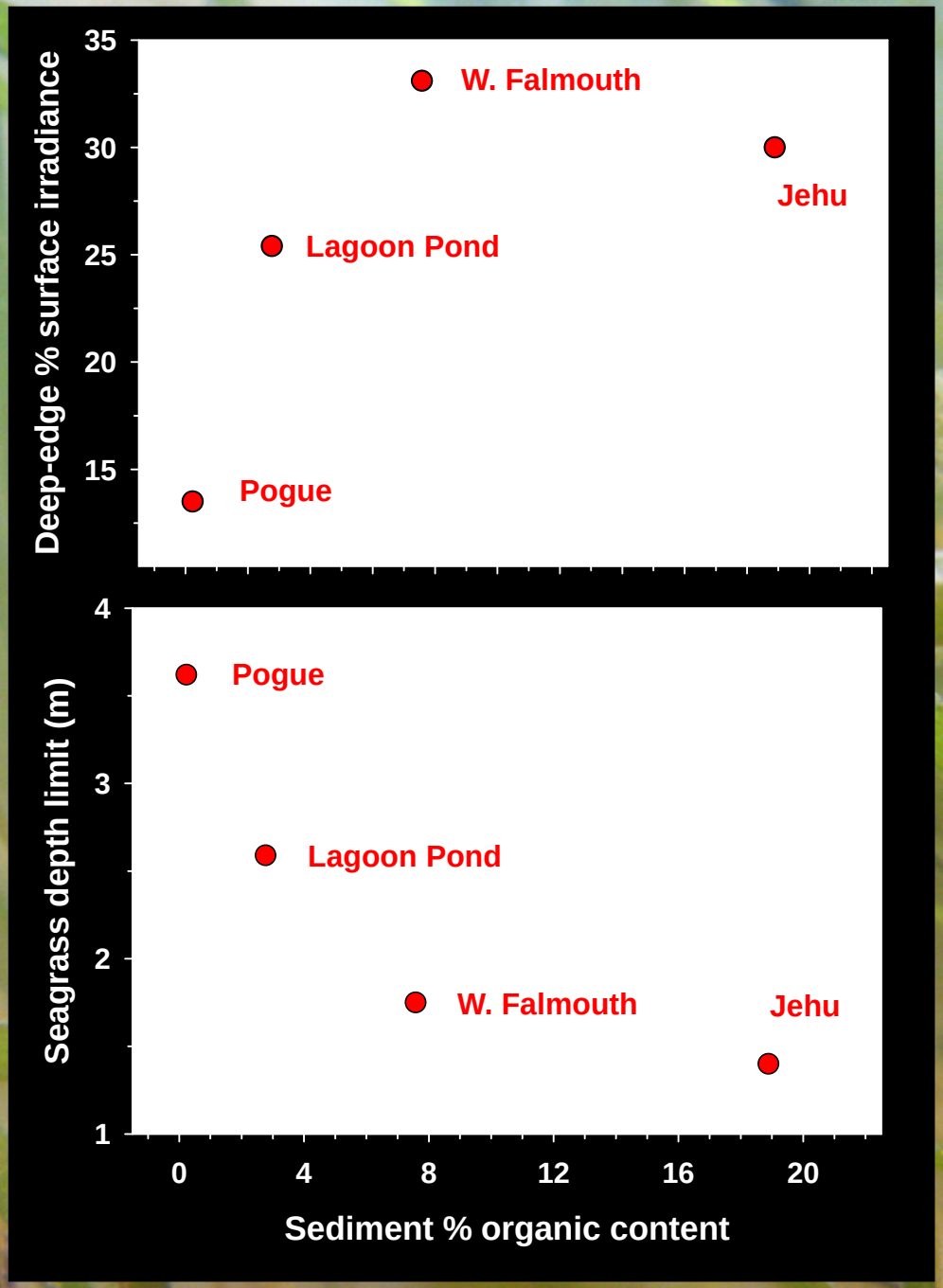



(*Goodman et al. 1995)

# Great South Bay Porewater Survey



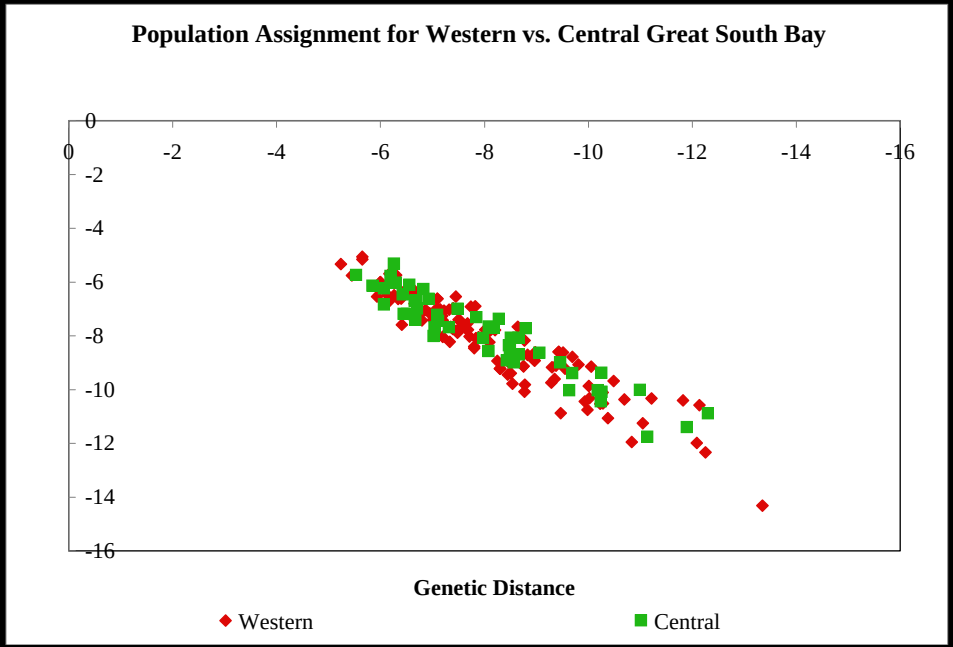

Shoot loss (%)
Sulfide (μM)
Shoot Loss (%)
Sulfide (μM)
0
5
10
15
20
25
30
0
200
400
600
Control No Shade
Control Shade
Sulfide No Shade
Sulfide Shade

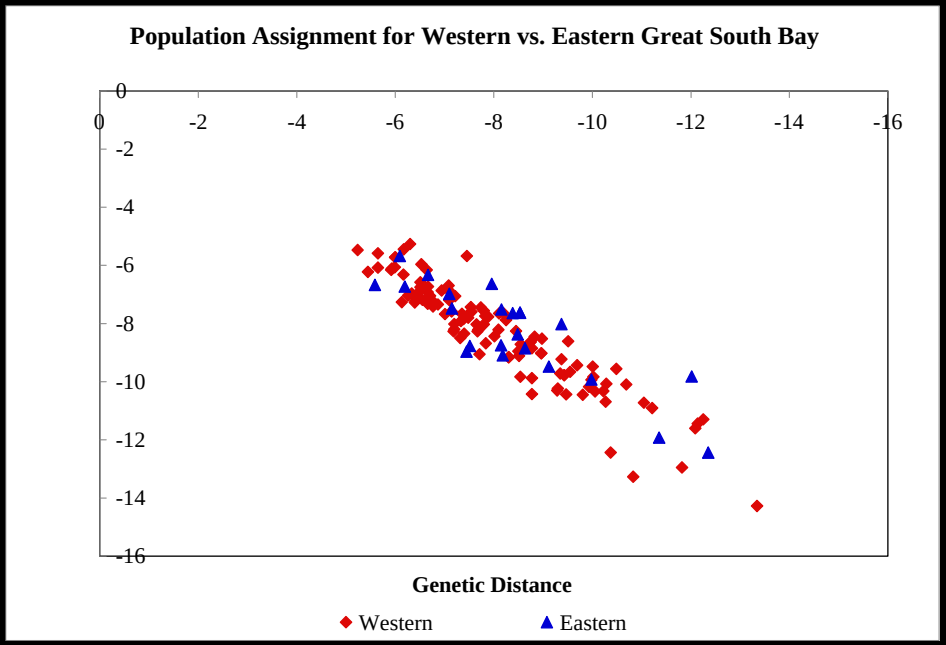


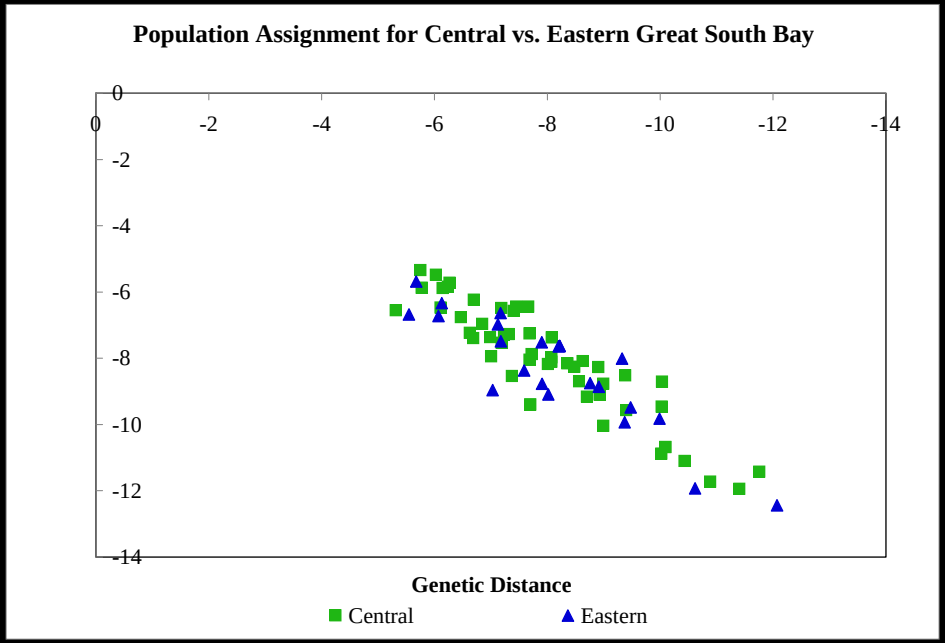

Gallegos et al. 2009

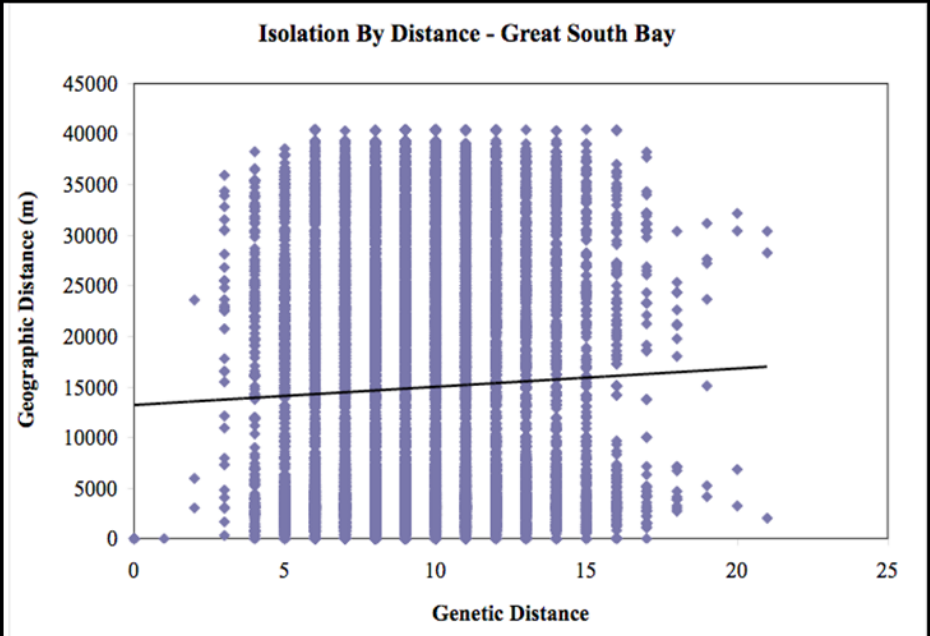
# Conclusions

- 2008 Brown tide event did not result in a substantial loss of seagrass
- Turbidity (more than algal biomass) appear to be drive light restrictions on seagrass
- Sediment organic content may dictate seagrass light requirements in GSB


Population Assignment for Western vs. Central Great South Bay
0
-2
-4
-6
-8
-10
-12
-14
-16
Genetic Distance
Western
Central


Population Assignment for Western vs. Eastern Great South Bay
0
-2
-4
-6
-8
-10
-12
-14
-16
Genetic Distance
Western
Eastern


Population Assignment for Central vs. Eastern Great South Bay
0
-2
-4
-6
-8
-10
-12
-14
Genetic Distance
Central
Eastern


Isolation By Distance - Great South Bay
Geographic Distance (m)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
5
10
15
20
25
Genetic Distance