Barnegat Bay-Little Egg Harbor Estuary: Ecosystem Assessment

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RUTGERS
MARINE & COASTAL
SCIENCES

Coastal Lagoons

Barnegat Bay-
Little Egg Harbor

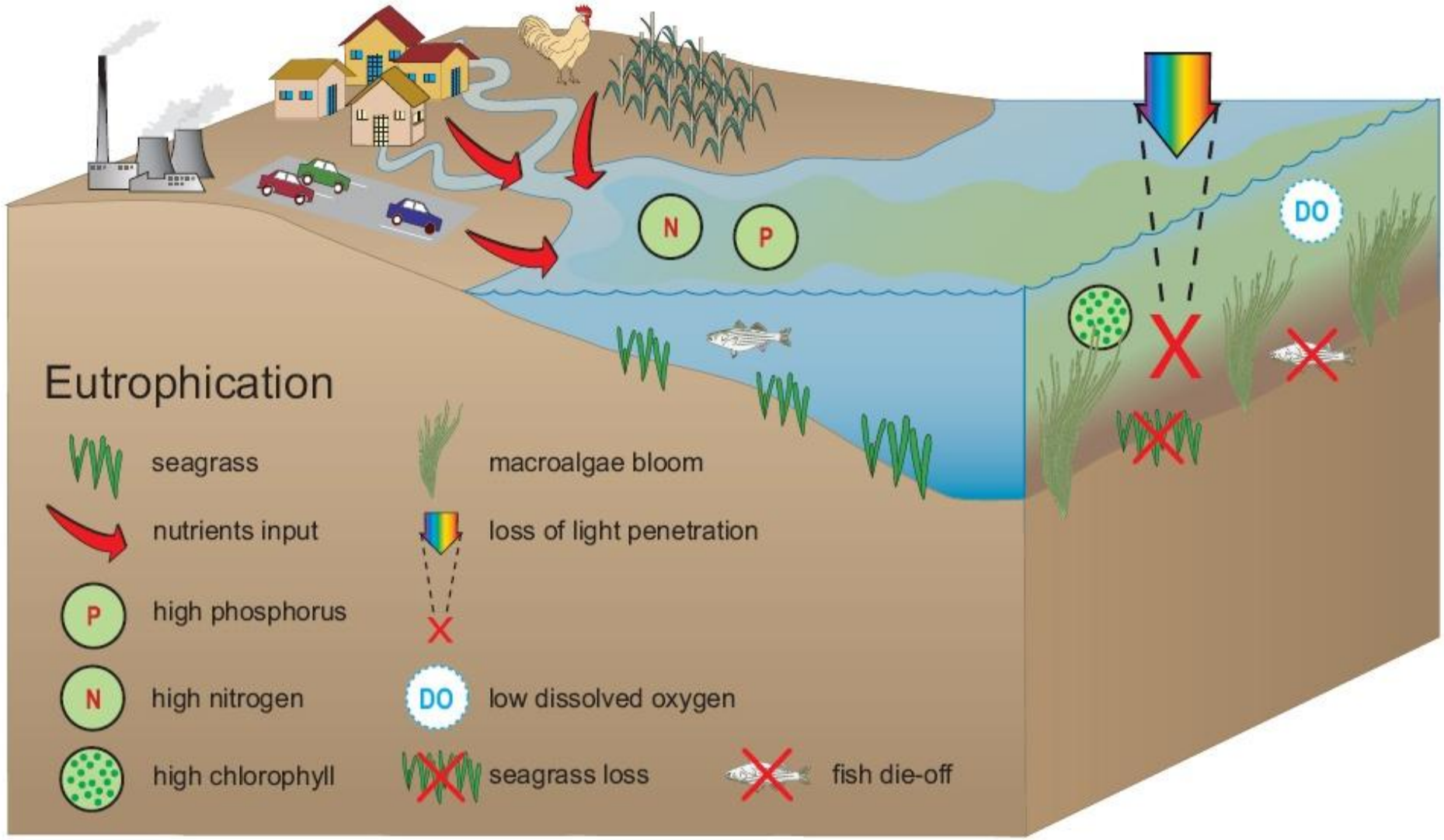
TIMELINE OF ECOSYSTEM EVENTS

- 1995 NEP Established for Barnegat Bay-Little Egg Harbor Estuary
- 1995 Recurring Brown Tide Blooms Begin
- 1997 Hard Clam Harvest Declines 10 Fold (1989-1997)
- 1998 Recurring Macroalgal Blooms Begin
- 1999 NOAA Reports Barnegat Bay as Highly Eutrophic
- 2000 Sea Nettles Observed and Recurring Eruptions Documented
- 2001 Bologna Indicates 60% SAV Decline in LEH and 30% Estuary-wide
- 2001 USGS Reports ~790 Tons of Nitrogen Loading Per Year
- 2001 DEP Reports 66% Decline of Hard Clam Stock in LEH (1986-2001)
- 2006 High Epiphytic Infestation of Seagrass Documented by Rutgers
- 2006 Seagrass Biomass Declines by 50-88%
- 2006 No Bay Scallops Found in Seagrass Beds
- 2007 Hard Clam Harvest Declines by >99% (1977-2007)
- 2007 NOAA Reconfirms the Estuary as Highly Eutrophic
- 2008 Low DO Recorded in the Northern Segment of the Estuary
- 2009 Rutgers Finds Lowest Seagrass Biomass Since Surveys Began in 2004
- 2010 USGS Reports Two-Thirds of Nitrogen Loading from Surface Runoff

ANTHROPOGENIC EFFECTS*

1. Eutrophication (Cascading Ecosystem Decline)
2. Power Plant Operation
   Impingement, Entrainment, Thermal Discharges
3. Habitat Loss and Alteration (Estuary and Watershed)
4. Stormwater/Pathogens
5. Hardened Shorelines/Reduced Biodiversity (Jivoff)
6. Reduced Freshwater Input/Altered Salinity/Susceptibility
7. Invasive Species (Sea Nettles, Chinese Mitten Crabs)
8. Dredging/Boating/Jet Skis
9. Marina Operations
10. Climate Change/Sea-Level Rise
11. Chemical Contaminants
12. Trash/Floatable

*Estuary Impaired for Human Use and Aquatic Life Support

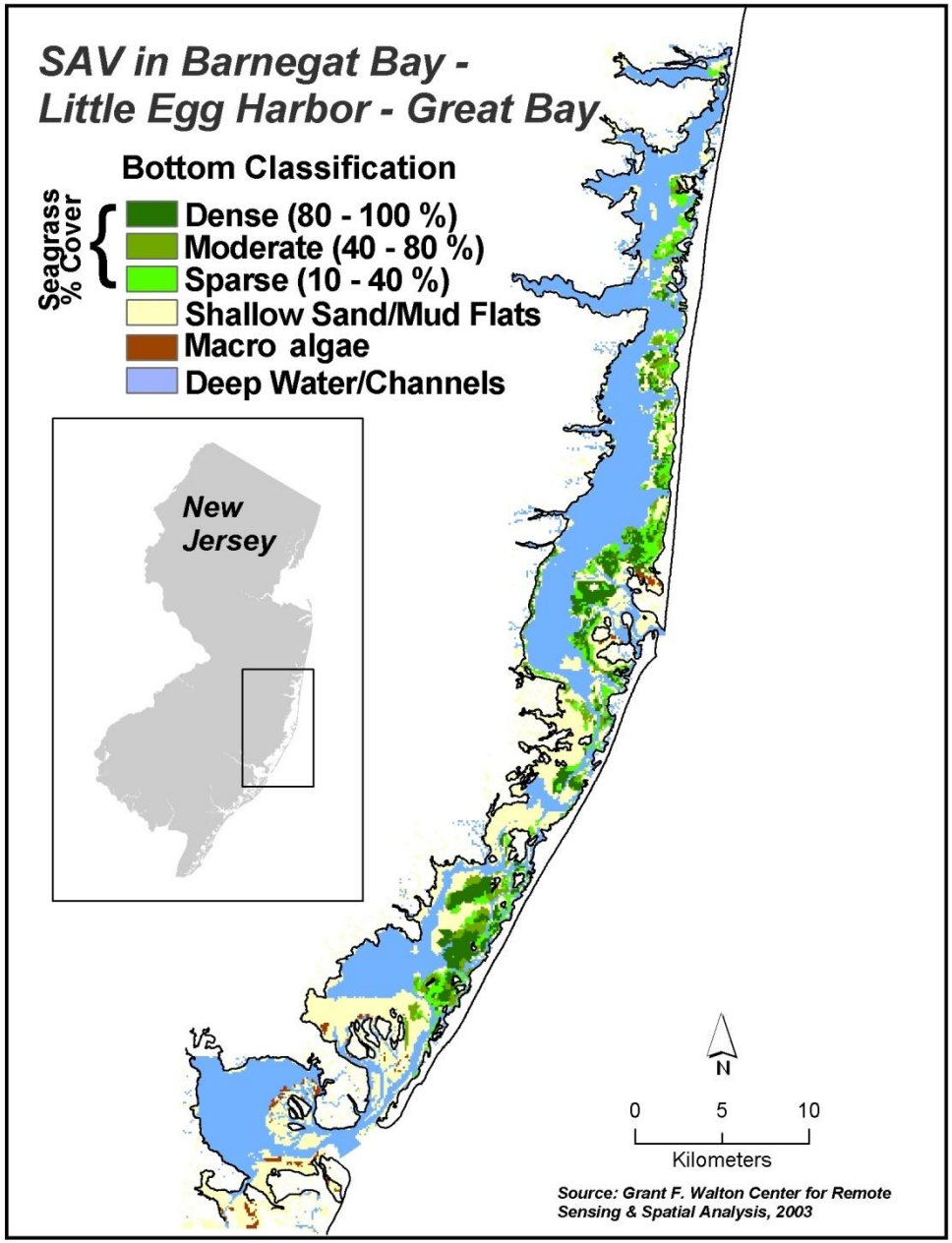

N
P
DO
Eutrophication
seagrass
nutrients input
P
high phosphorus
N
high nitrogen
high chlorophyll
macroalgae bloom
loss of light penetration
DO
low dissolved oxygen
seagrass loss
fish die-off

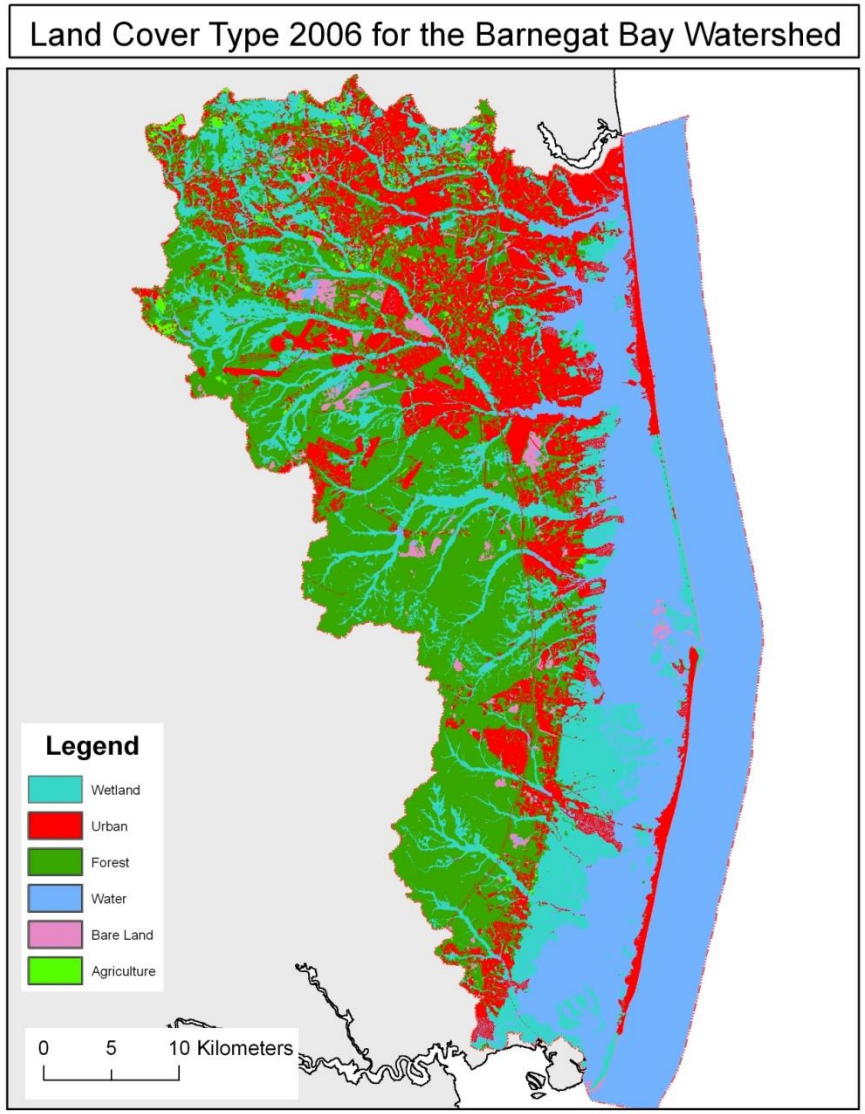
Eelgrass Decline

>60% in Little Egg Harbor (1975-2000)

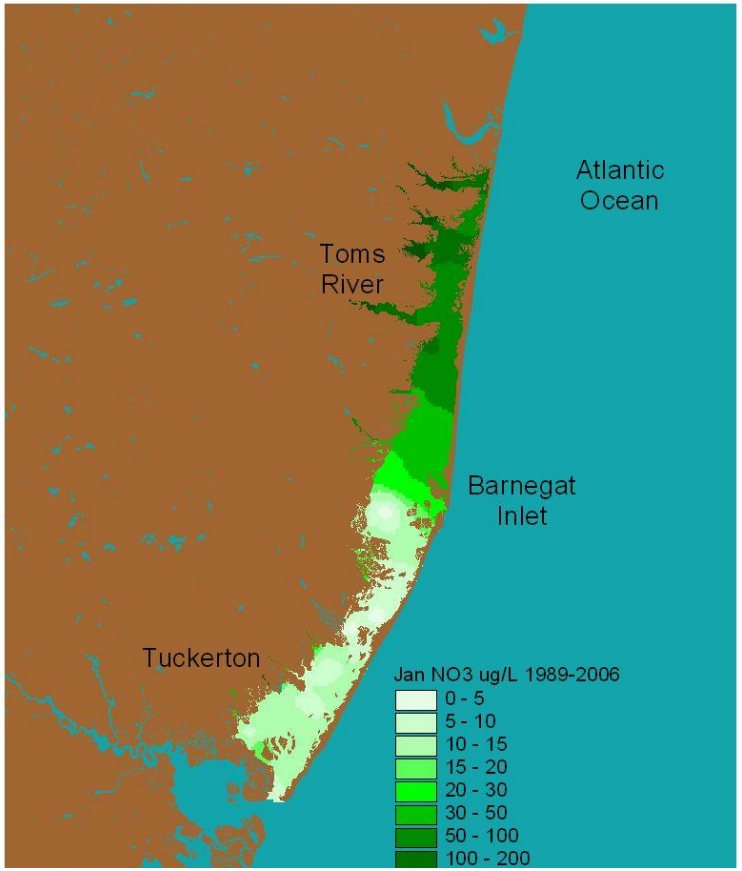
>30% in Entire Estuary

(Bologna, et al. 2000)

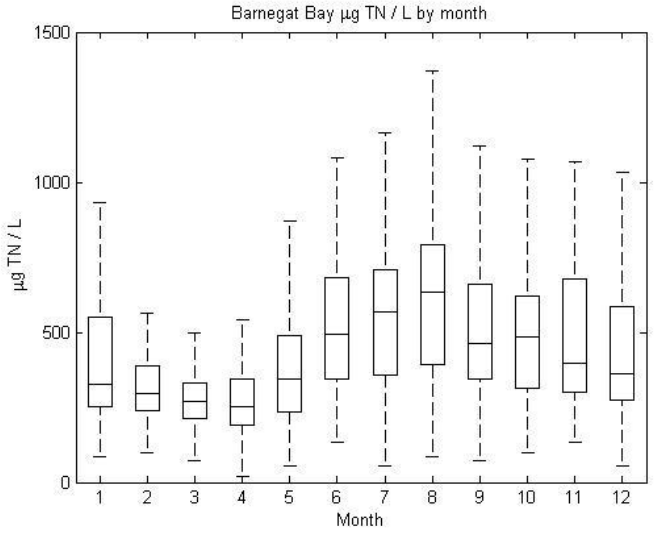


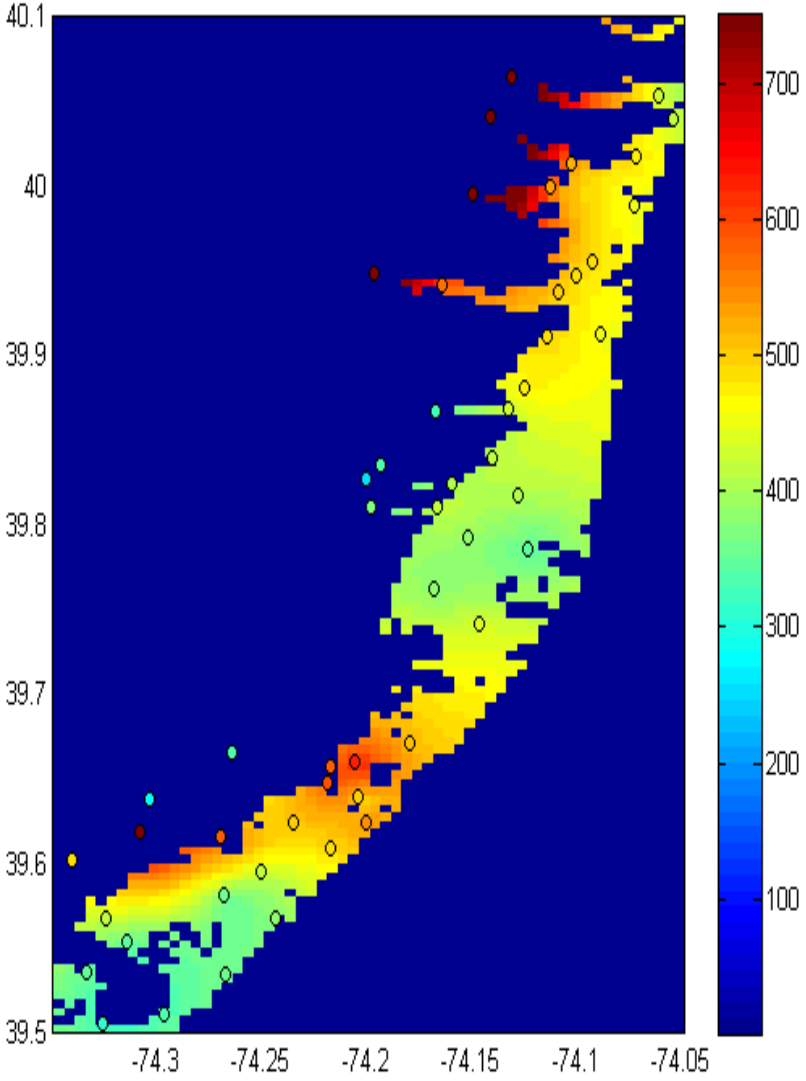


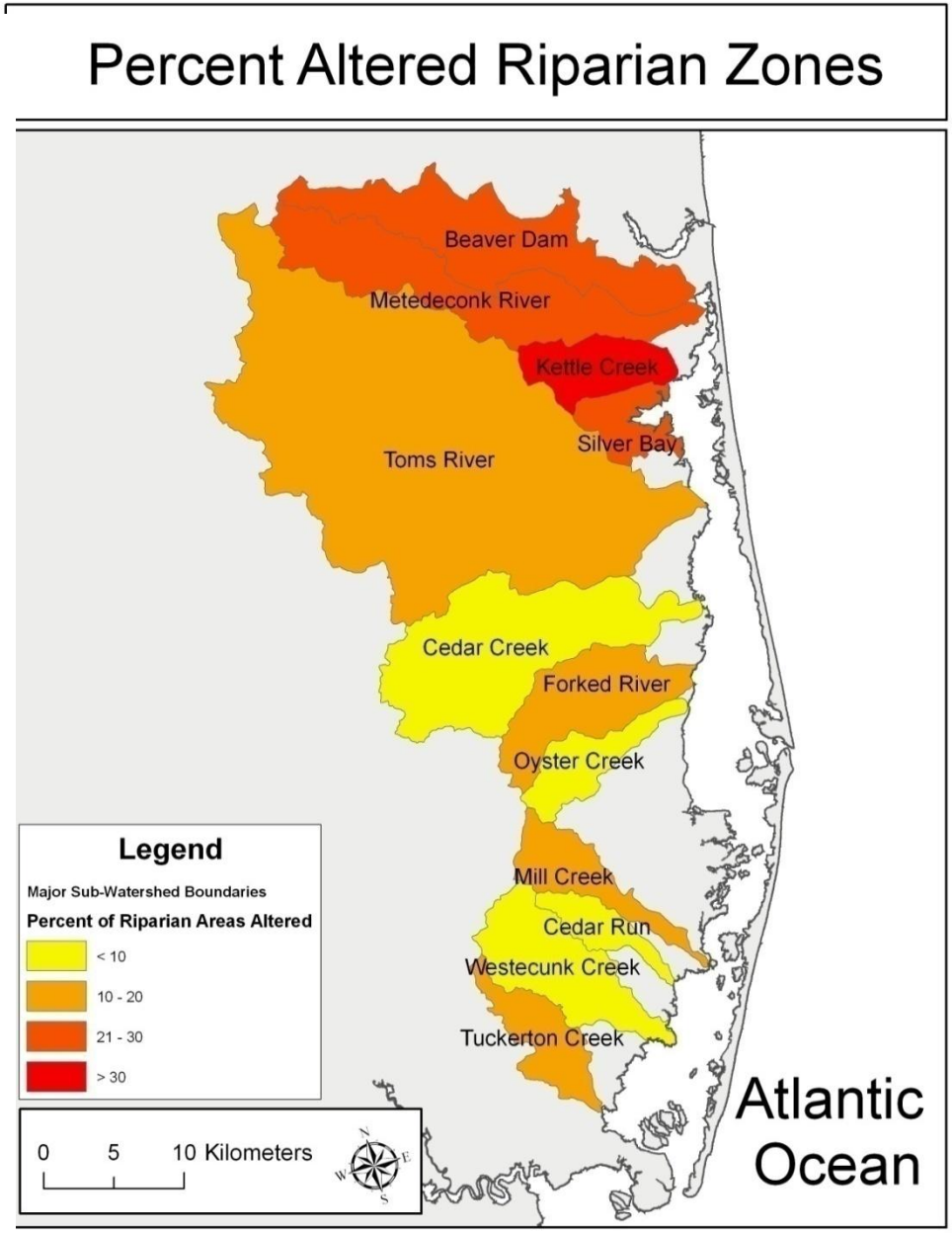
(Lathrop and Haag 2008)



(Data from NJDEP, Bureau of Marine Water Quality Monitoring)

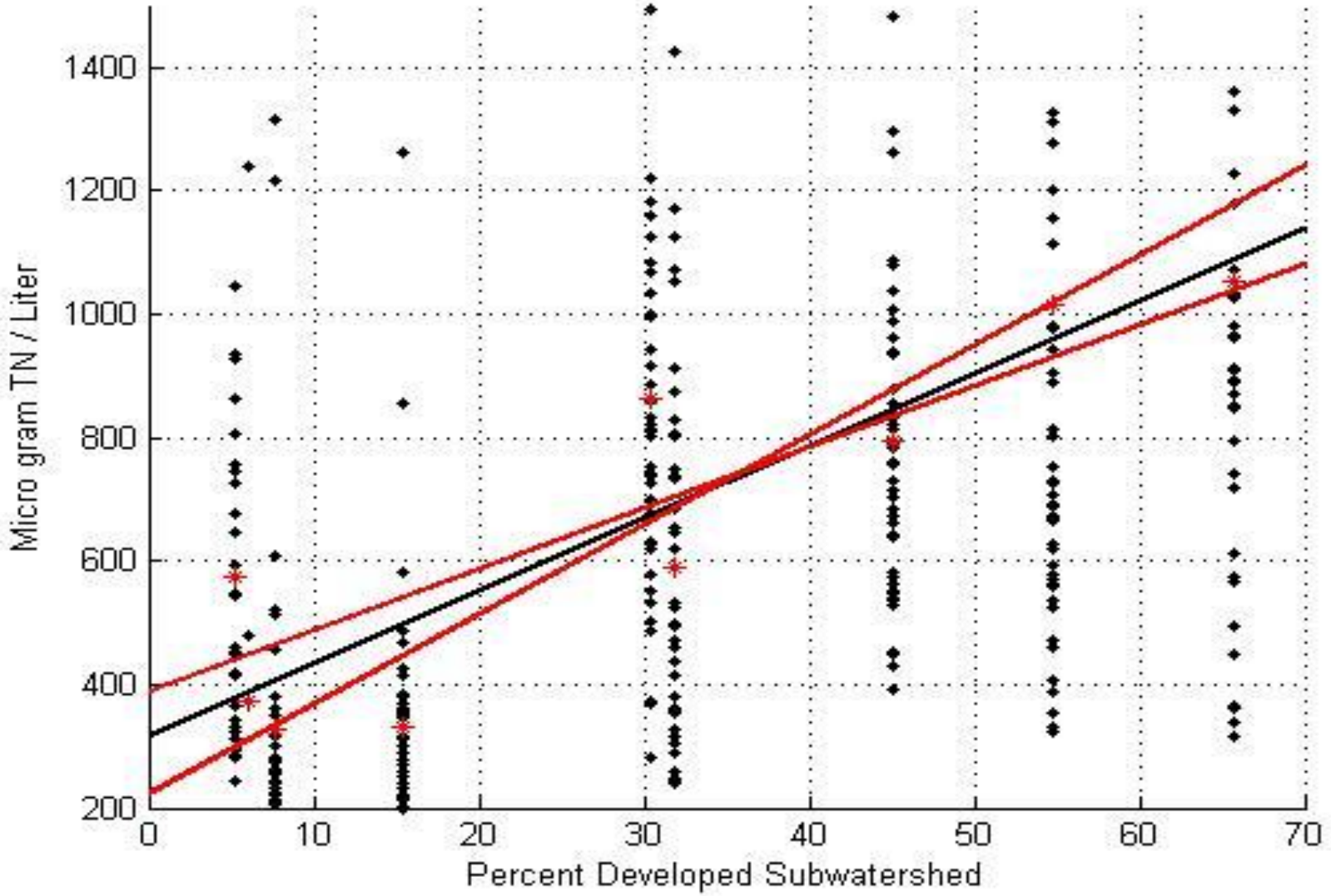




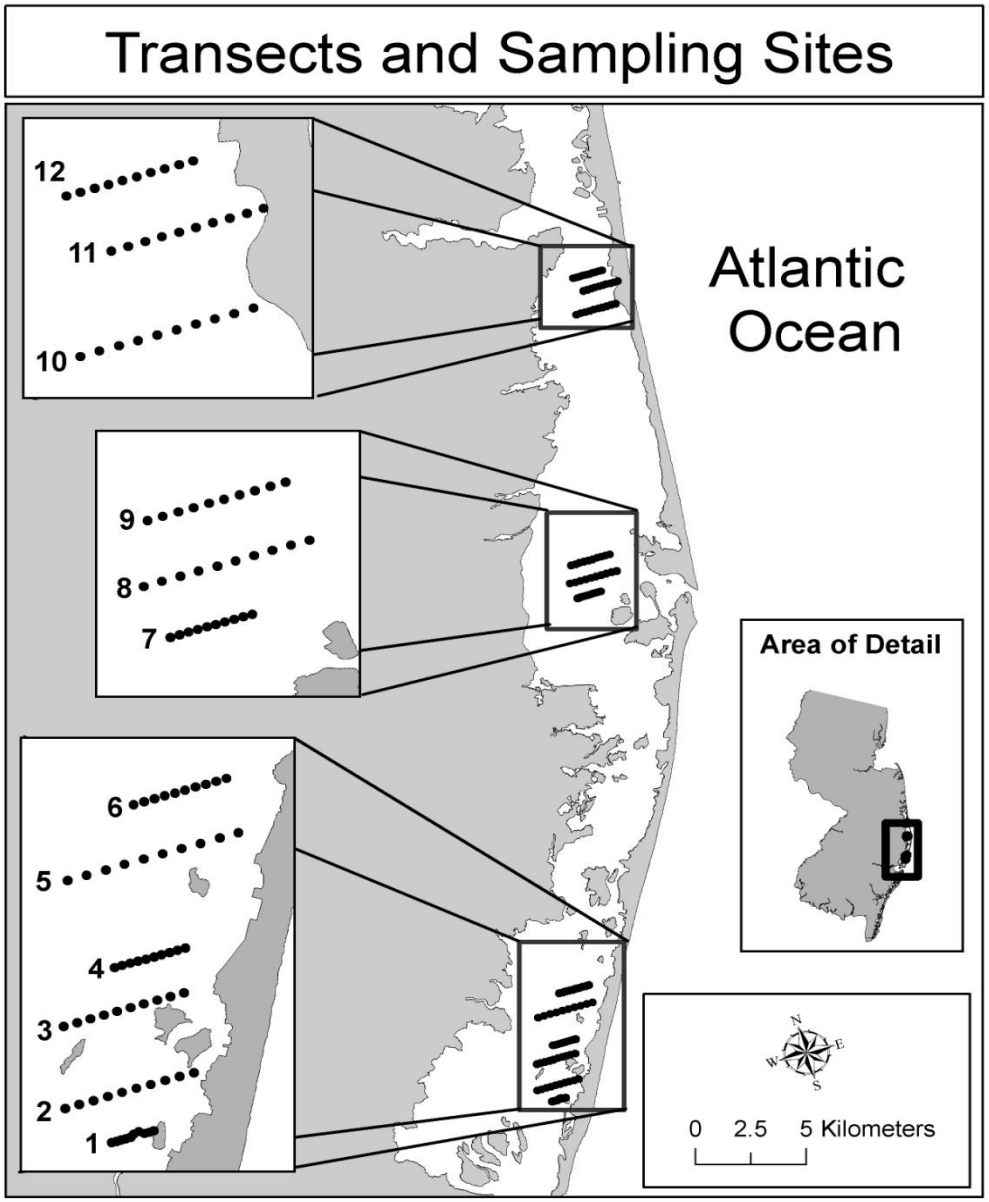


(Data from NJDEP, Bureau of Marine Water Quality Monitoring Figure from Haag 2010)

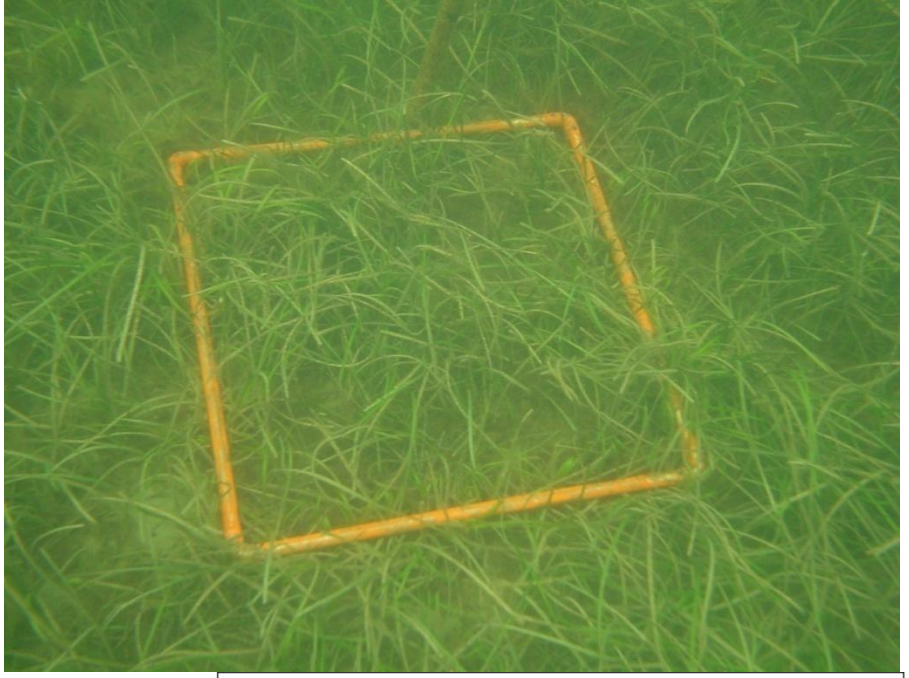
(Lathrop and Haag 2007)

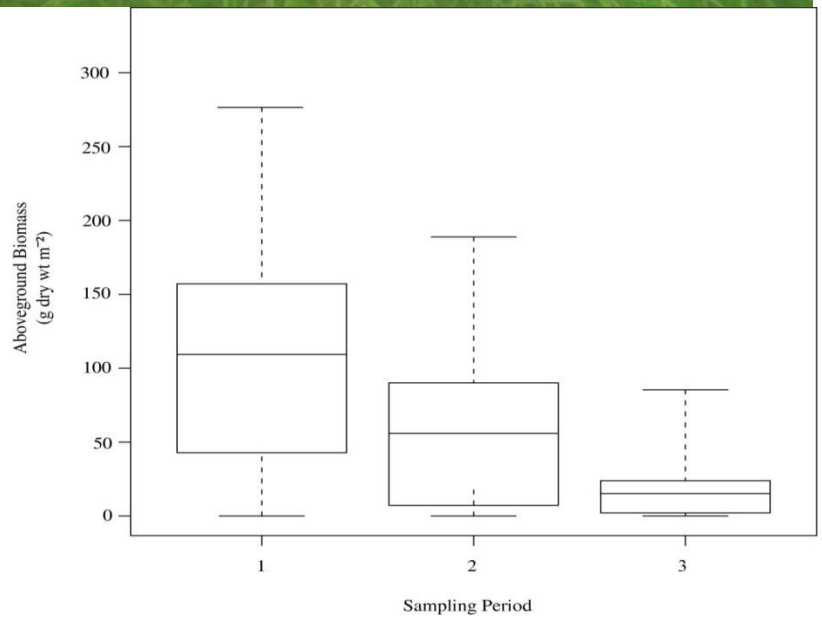


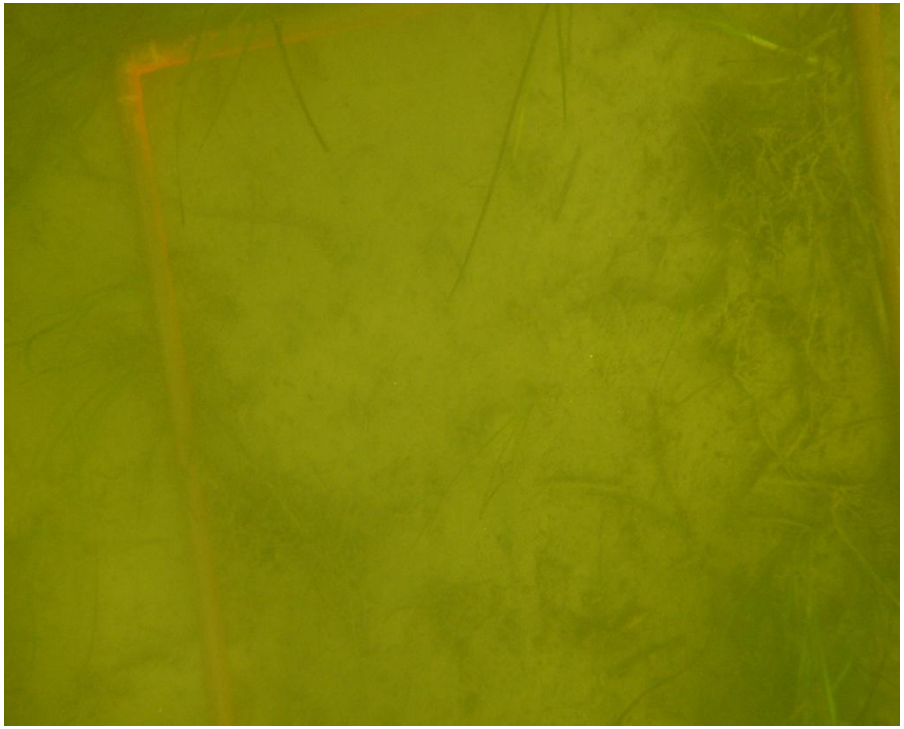
(Data from NJDEP, Marine Water Quality Monitoring; Figure from Haag 2010)



(Figure from Kennish et al. 2008)







(From Kennish, Haag, and Sakowicz 2007, 2008)

Sea Lettuce

(From Kennish, Haag, and Sakowicz 2007, 2008)

(From Kennish, Haag, and Sakowicz 2007)

SEAGRASS LOSS (2004-2006)

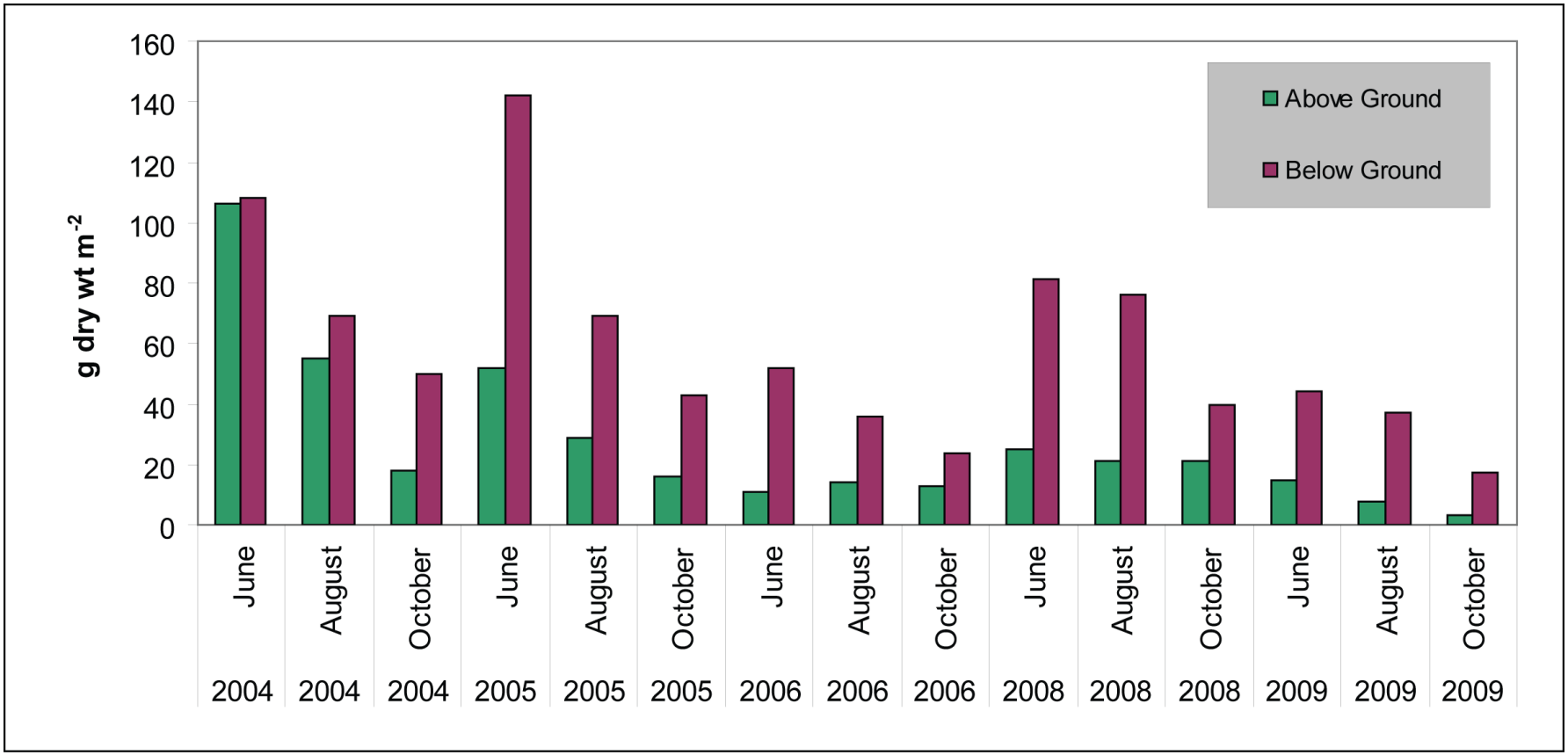
- Heavy Epiphytic Growth
- Aboveground Biomass
  (Reduced ~50-88%)
- Belowground Biomass
  (Reduced ~50-59%)
- Percent Cover
  (Decreased 28.9%)
- Shoot Density
  (Decreased 21.1%)
- Blade Length
  (Decreased 42.2%)

(Data from Kennish, Haag, and Sakowicz 2007)

SEAGRASS BIOMASS (g dry wt m^{-2})

	Jun	Aug	Oct
2004	106	55	18
	108	69	50
2005	52	29	16
	142	69	43
2006	11	14	13
	52	36	24
2008	25	31	23
	81	76	40
2009	15	8	3
	44	37	17

(Data from Kennish, Haag, and Sakowicz 2007, 2008 ; Unpublished 2008, 2009)



(**Data from Kennish, Haag, and Sakowicz 2007, 2008 ; Unpublished 2008, 2009)**

Algal Blooms

- Phytoplankton
  (Chl *a* 10-18 μg l^{-1})

(Data source: NJDEP Marine Water Quality Monitoring)

- *Zostera marina* (Biomass)
  50-200 g AFDW m^{-2}

(Data source: Bologna)

- Macroalgae (Blooms)
  > 400 g AFDW m^{-2}

(Data source: Bologna)

- Benthic Microalgae

Phytoplankton Production

(Up to ~500 g C m^{-2} yr^{-1})

Nixon Trophic Classification

(From Moser 1998; Seitzinger et al. 2001; Bowen et al. 2007)

Brown Tide Blooms

1-2 million cells ml^{-1}

(1995, 1997, 1999-2002)

(From Gastrich et al. 2004a, b)

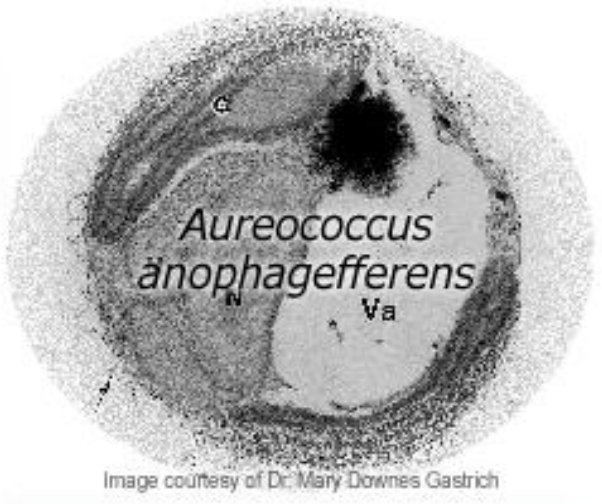


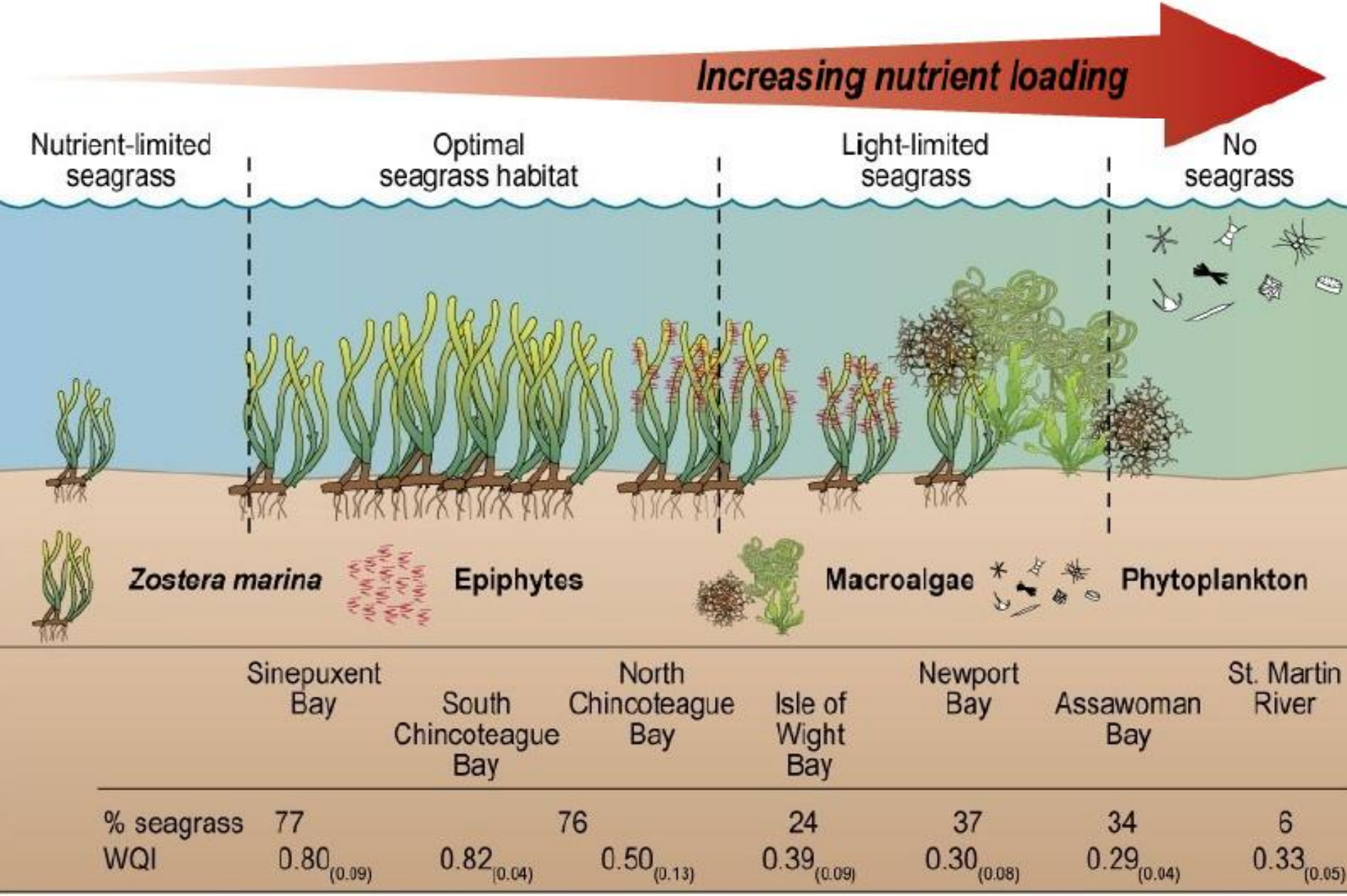
Image courtesy of Dr. Mary Downes Gastrich

Phytoplankton Species Shift

Diatoms to Microflagellates

Raphidophytes, Pelagophytes

(From Livingston 2000, 2002; Gastrich et al. 2004a, b)



	Sinepuxent Bay	South Chincoteague Bay	North Chincoteague Bay	Isle of Wight Bay	Newport Bay	Assawoman Bay	St. Martin River
% seagrass	77	76		24	37	34	6
WQI	0.80 (0.09)	0.82 (0.04)	0.50 (0.13)	0.39 (0.09)	0.30 (0.08)	0.29 (0.04)	0.33 (0.05)

(Figure from Wazniak et al. 2007, Ecological Applications, Vol. 17, No. 5, Supplement, pp. S64-S78.)

CURRENT RESEARCH

(Collaboration: RUTGERS, NJDEP, USGS, EPA, NEIWPCC)

1. **Biotic Index of Ecosystem Condition (RMAP)**
2. **Cause and Effect: Biotic Responses to Nutrient Loading**
3. **Nitrogen Threshold Levels of Biotic Impairment**
4. **Biotic Index of Eutrophic Condition (NEIWPCC)**
5. **Water Quality Indicators (DO, Chl *a*, N-L, Secchi Depth)**
6. **Bioindicators (Seagrass, Algae, Epiphytes, Shellfish)**
7. **Nuisance and Toxic (Brown Tide) Algal Blooms**
8. **SAV Demographics (Seagrass, Macroalgae)**
9. **Epiphytic Tracking**
10. **Shellfish Resources (Hard Clams, Bay Scallops)**
11. **Benthic Invertebrates**
12. **Residence Time/Flushing Rate (Susceptibility)**

MANAGEMENT ACTIONS

N-LOAD REDUCTION

- Development and Population Growth
- Open Space Preservation, Buffer Protection
- Improve Stormwater Controls
- Address Septic Systems
- Best Management Practices (BMPs), Ordinances
- Impervious Cover Reduction
- Air Pollution Controls (Federal)
- Policy Controls: Nutrient Criteria/Standards


The End