

# Using multiple data streams to develop eelgrass-based nutrient criteria for New Hampshire's Great Bay Estuary

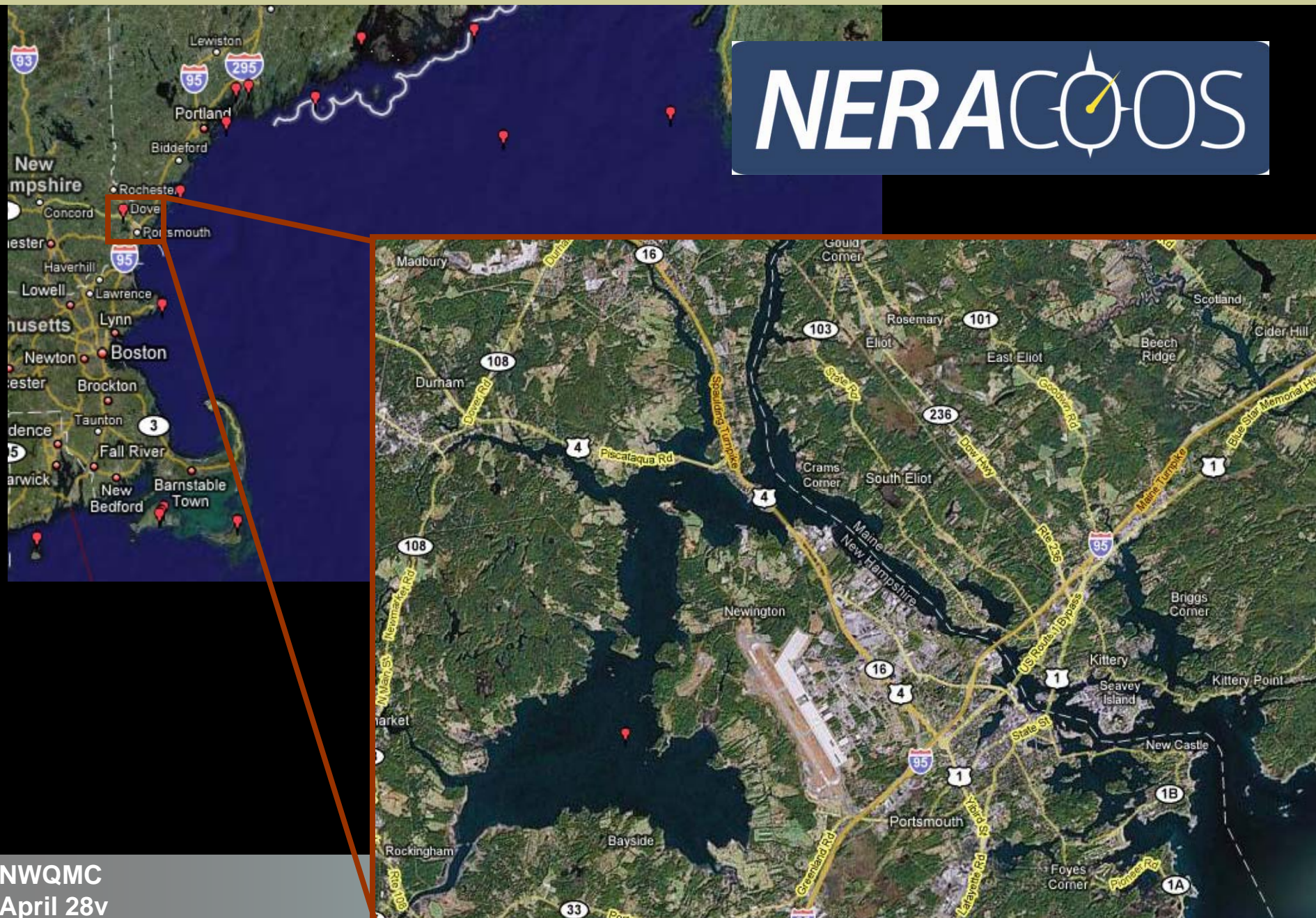
J. Ru Morrison (NERACOOS),  
Phil Trowbirdge (PREP/NHDES),  
Paul Carrier (NHDES),  
Shachak Pe'eri (UNH)  
Frederick T Short (UNH)



# IOOS Observation Registry

## Sensor Platforms Map

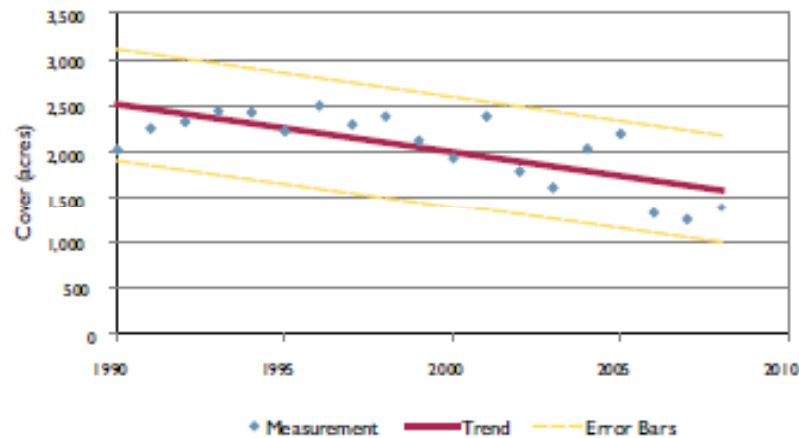
NERACOOS



NWQMC  
April 28v

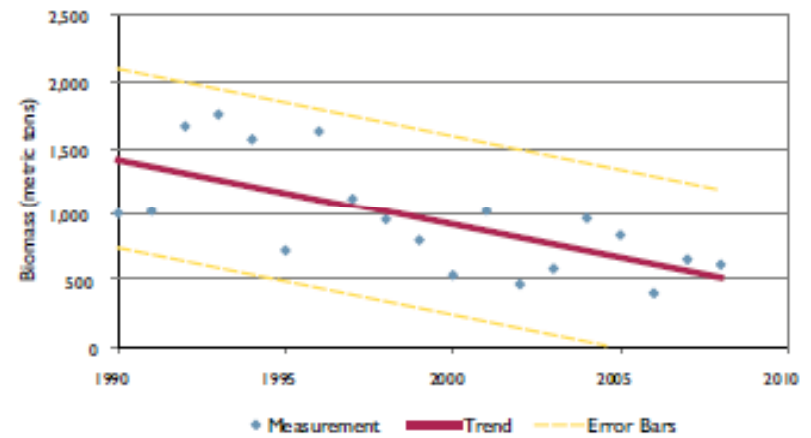
# Water Quality Issue

**Eelgrass cover in Great Bay (Figure 14)**



Data Source: UNH Jackson Estuarine Laboratory, Seagrass Ecology Group

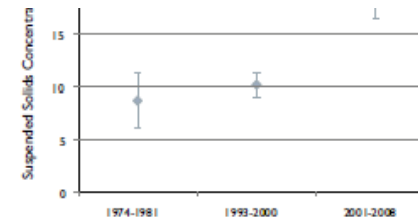
**Eelgrass biomass in Great Bay (Figure 15)**



Data Source: UNH Jackson Estuarine Laboratory, Seagrass Ecology Group



PISCATAQUA REGION  
Estuaries  
Partnership



Data Source: UNH Jackson Estuarine Laboratory

1974-1981 Data recovered as part of the buoy data discovery process

- NWQMC
- April 28

# User Community

- *Coastal and inland managers including NH Department of Environmental Services(NHDES) and the Piscataqua Region Estuaries Project (PREP); scientists;*
- *public and industry in the watershed of the Great Bay Estuary*

# Process

Great Bay Data from Many monitoring efforts including:

- NERR
- PREP
- IOOS funded NERACOOS buoy
- EPA funded Hyperspectral Aerial Imagery

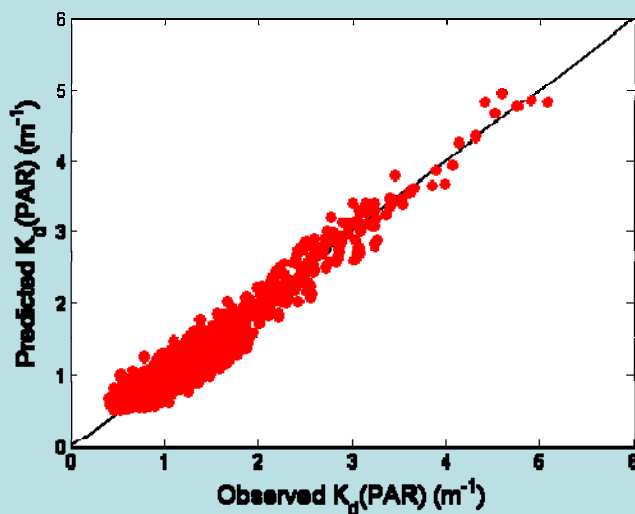
# IOOS – Buoy Measurements

- Surface Irradiance (Hyperspectral 350 nm – 800 nm)
- Subsurface Irradiance (1.1 m)
- FLNTUS – Chlorophyll and Turbidity
- FLCDS – CDOM



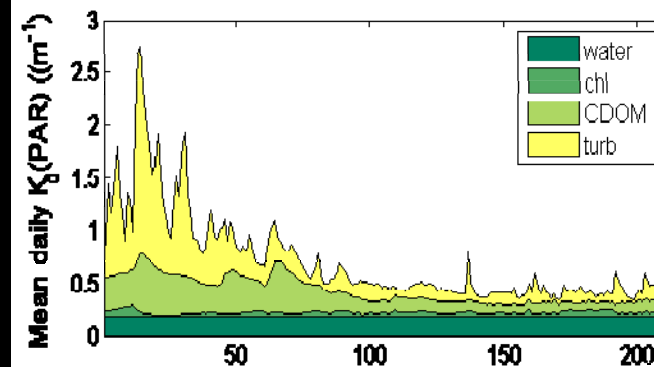
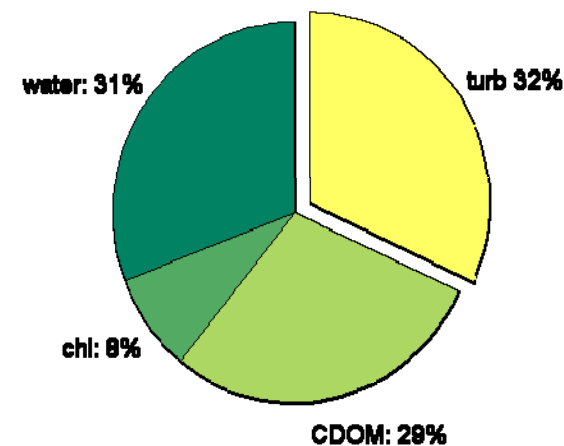
And much more.....

# Buoy relationship –PAR



$$\frac{K_d(PAR)}{D_o} = 0.2449 + 0.0188.[Chl] + 0.0101.[CDOM] + 0.0784.[NAP]$$

$r^2 > 0.95$





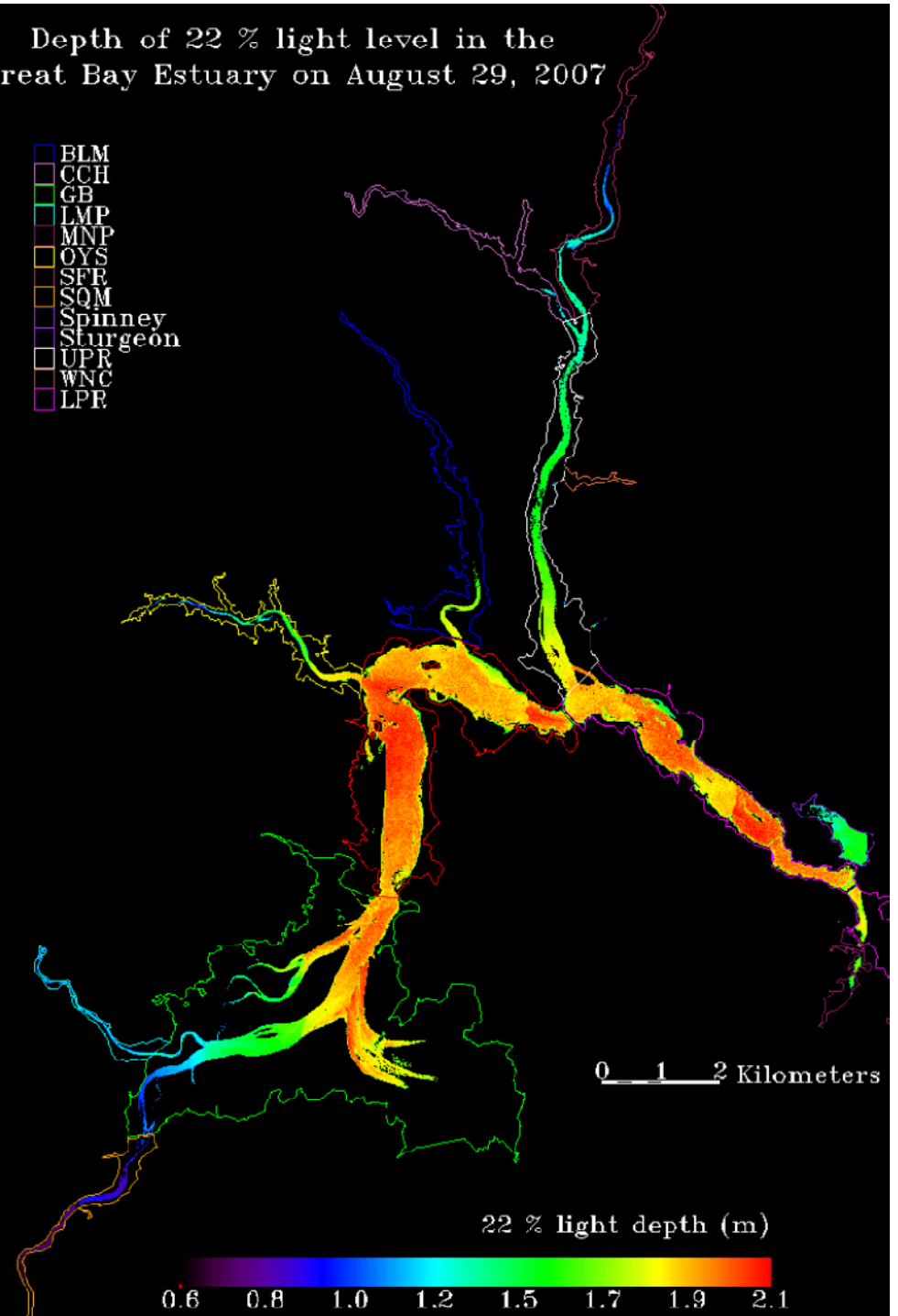
NWQMC  
April 28

# Eelgrass Survival Depth.

$$z_{survive} = \frac{\ln(22/100)}{K_d(PAR)}$$

Depth of 22 % light level in the  
Great Bay Estuary on August 29, 2007

BLM  
CCH  
GB  
LMP  
MNP  
OYS  
SFE  
SQM  
Spinney  
Sturgeon  
UPR  
WNC  
LPR



# Great Bay Eelgrass & Macroalgae



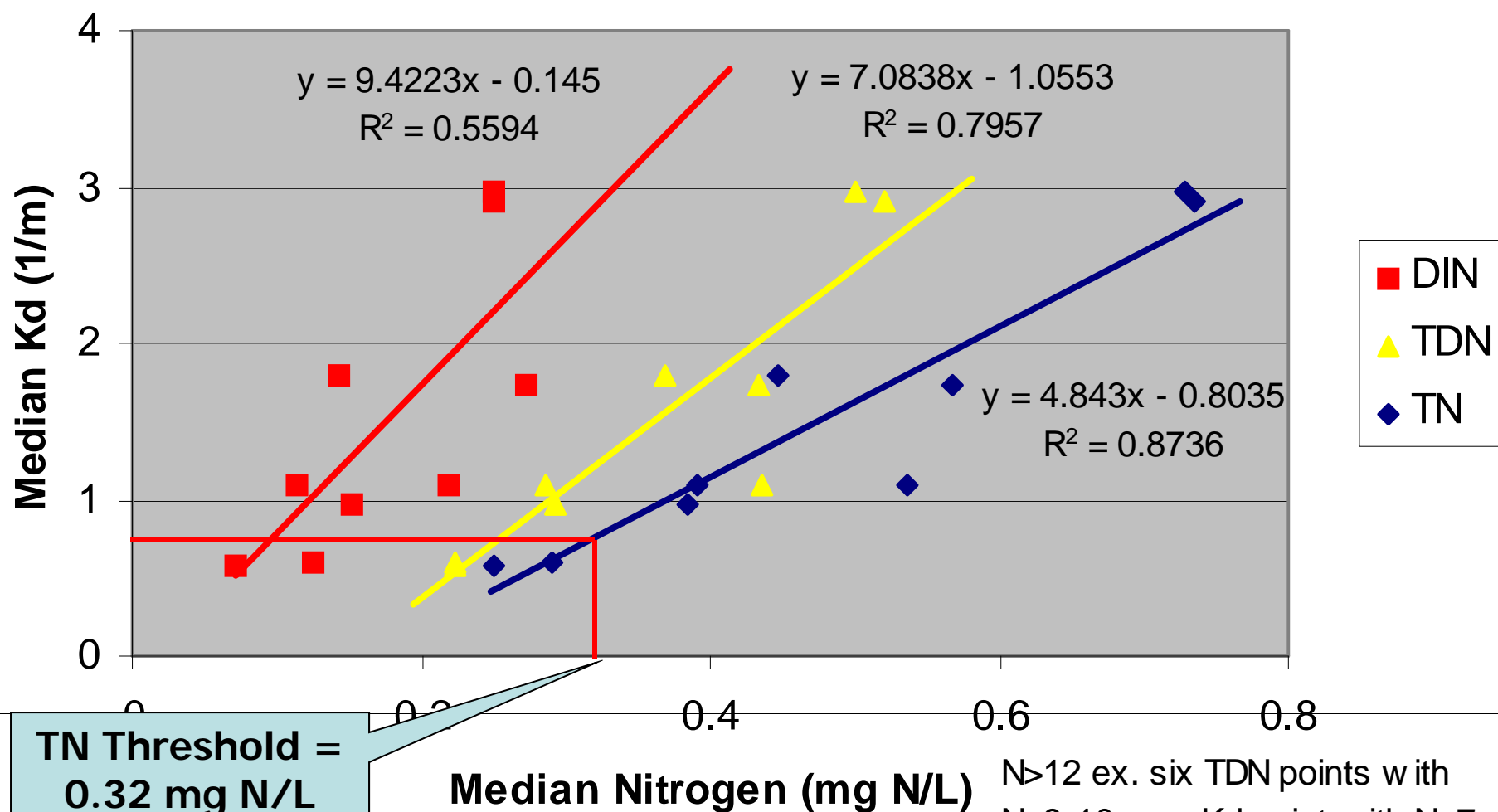
Eelgrass



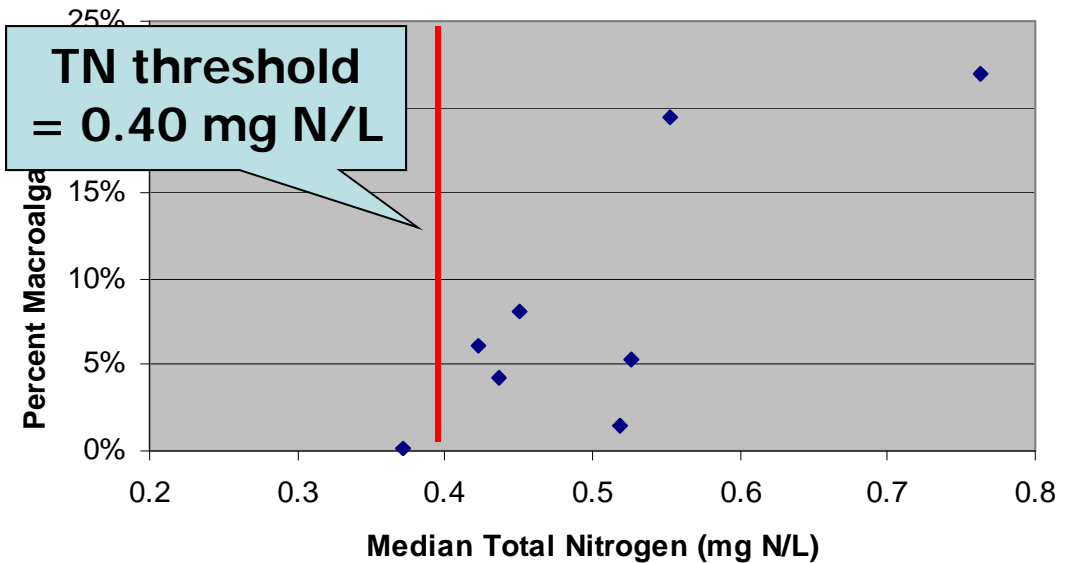
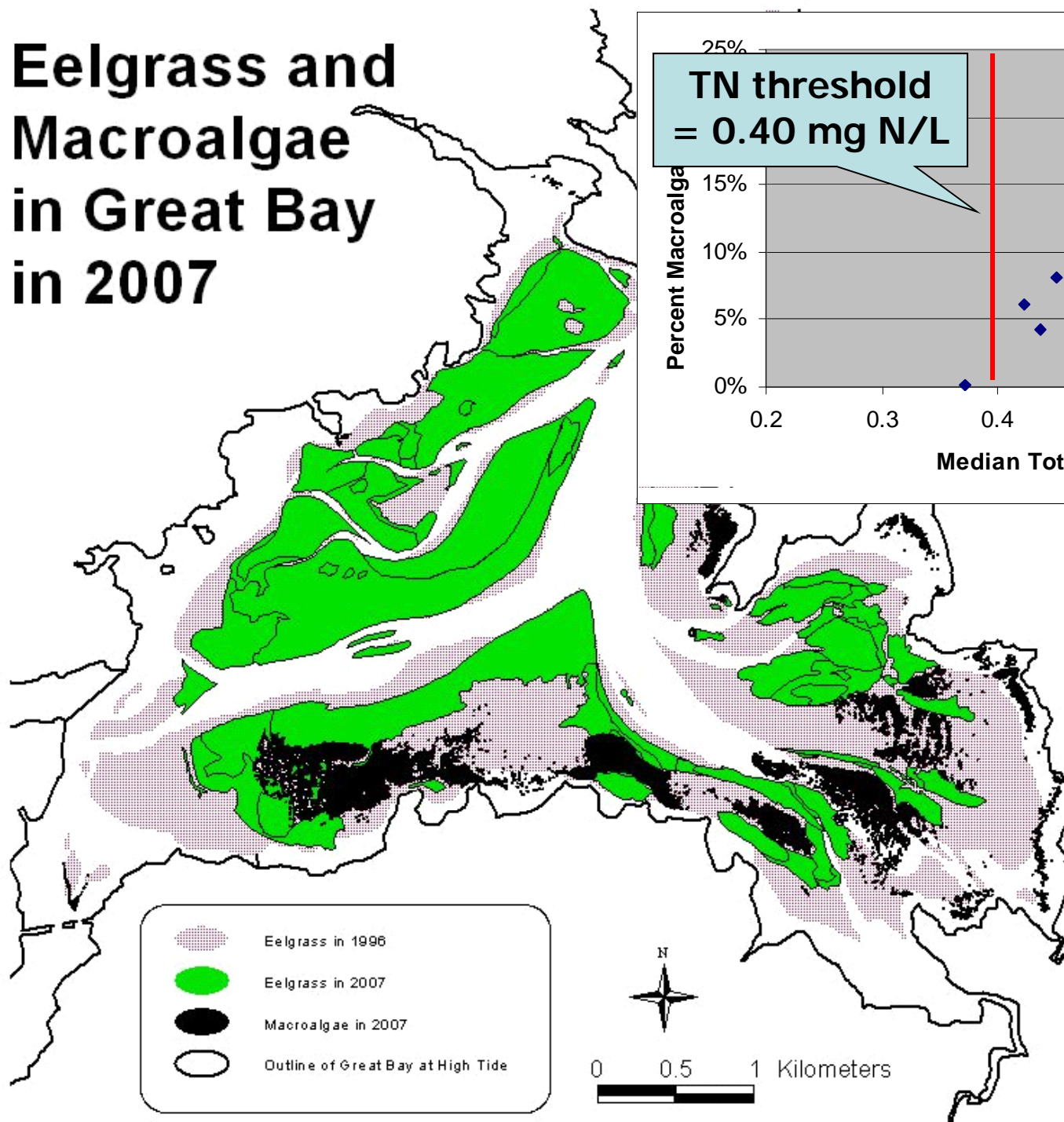
Macroalgae



# Water Clarity Decreases with Increasing Nitrogen Concentrations



# Eelgrass and Macroalgae in Great Bay in 2007



Median TN in  
Great Bay =  
0.42 mg N/L

An Area with  
Obvious  
Macroalgae  
Proliferation

From Pe'eri et  
al. (2008)

# Nutrient Criteria to Prevent Eelgrass Loss

- Maximum light attenuation coefficient to maintain eelgrass
  - $K_d = 0.75$  (1/m)
- TN associated with  $K_d$  threshold from regressions
  - TN = 0.32 mg N/L
- Macroalgae proliferation
  - No problems for TN < 0.40 mg N/L
- Ocean background
  - TN = 0.24 mg N/L
- Reference concentration where eelgrass still exists (Portsmouth Hbr)
  - TN = 0.32 mg N/L (75<sup>th</sup> percentile)
- TN thresholds set for other estuaries in NE
  - TN = 0.35-0.38 mg N/L (Mass. Estuaries Project, Nantucket Sound)
- Weight of evidence threshold
  - TN threshold for eelgrass in GBE = 0.32 mg N/L

# Outcomes - Proposed Numeric Nutrient Criteria for the Great Bay Estuary

Designated Use / Regulatory Authority	Parameter	Threshold	Statistic	Comments
Primary Contact Recreation <sup>1</sup> (Env-Wq 1703.14)	Chlorophyll-a	20 ug/L	90 <sup>th</sup> percentile during summer	Applies to all areas of the Great Bay Estuary
Aquatic Life Use Support – to protect Dissolved Oxygen <sup>1</sup> (RSA 485-A:8)	Total Nitrogen	0.45 mg N/L	Median	Applies to all areas of the Great Bay Estuary
	Chlorophyll-a	12 ug/L	90 <sup>th</sup> percentile during summer	
Aquatic Life Use Support – to protect Eelgrass <sup>1,2</sup> (Env-Wq 1703.14)	Total Nitrogen	0.32 mg N/L	Median	Portsmouth Harbor, Little Harbor, Piscataqua River, Great Bay, Little Bay, and areas of tidal tributaries where eelgrass has existed in the past
	Light Attenuation Coefficient (Water Clarity)	0.75 m <sup>-1</sup>	Median	

# Outcomes - Management Implications for Nitrogen Impairments

- NPDES permitted sources for nitrogen must hold their loadings at the existing levels (e.g., WWTFs, MS4s).
- New permitted sources (e.g., AoT or CGP permittees) within the upstream watershed of an impaired waterbody would have to demonstrate zero additional loads of nitrogen or arrange for trading within the watershed.
- The “hold the load” restriction would continue until a TMDL is completed, at which point the load allocations from the TMDL would become effective. The TMDL allocations will likely require reductions in loading.

# Acknowledgements

Thanks to:

- Mike Novak, Anna Brook, Tom Gregory, Paul Currier
- All those who collected the historical data
- Dave Shay and the faculty and staff of Jackson Estuarine Laboratory
- Chris Hunt and Shawn Shelito for help with the flow through measurements
- The captain and crew of the R/V Gulf Challenger
- Rich Lagan and Jon Pennock, University of New Hampshire
- Darrell Adams, Cyril Dempsey, and all at Satlantic Inc.
- Andrew Barnard, Ian Walsh, Alex Derr, Ron Zaneveld and all at WET Labs, Inc.
- EPA and NOAA for the funding
- NHEP and NHDES
- SpecTIR who flew the HS mission