A Multi-metric Approach to Establishing Restoration Objectives For Eelgrass in Long Island Sound

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Status, Trends, and Conservation of Eelgrass in the Northeast

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Establishing restoration objectives for eelgrass in Long Island Sound

- Review of relevant literature.
- Evaluation of habitat criteria guidelines for use in LIS.
- Analysis of three case study sites.
    - Applying habitat criteria.
- Review of the effect of N-load.
- Website development.

Multi-metric Approach to Managment

http://www.lisrc.uconn.edu/eelgrass/index.html

Data, technical reports, and overview of results available on the web.

Access via the Long Island Sound Resource Center's homepage.

Overview

Partners and Funding

Bibliography

Related Web sites

Literature Reviews

Case Studies
- Mumford Cove
- Niantic River
- Little Narr Bay

Habitat Criteria

Available Data

Prepared by the University of Connecticut and the Connecticut DEP, with the support of researchers and organizations throughout the Long Island Sound watershed.

Establishing Restoration Objectives For Eelgrass In Long Island Sound

Overview

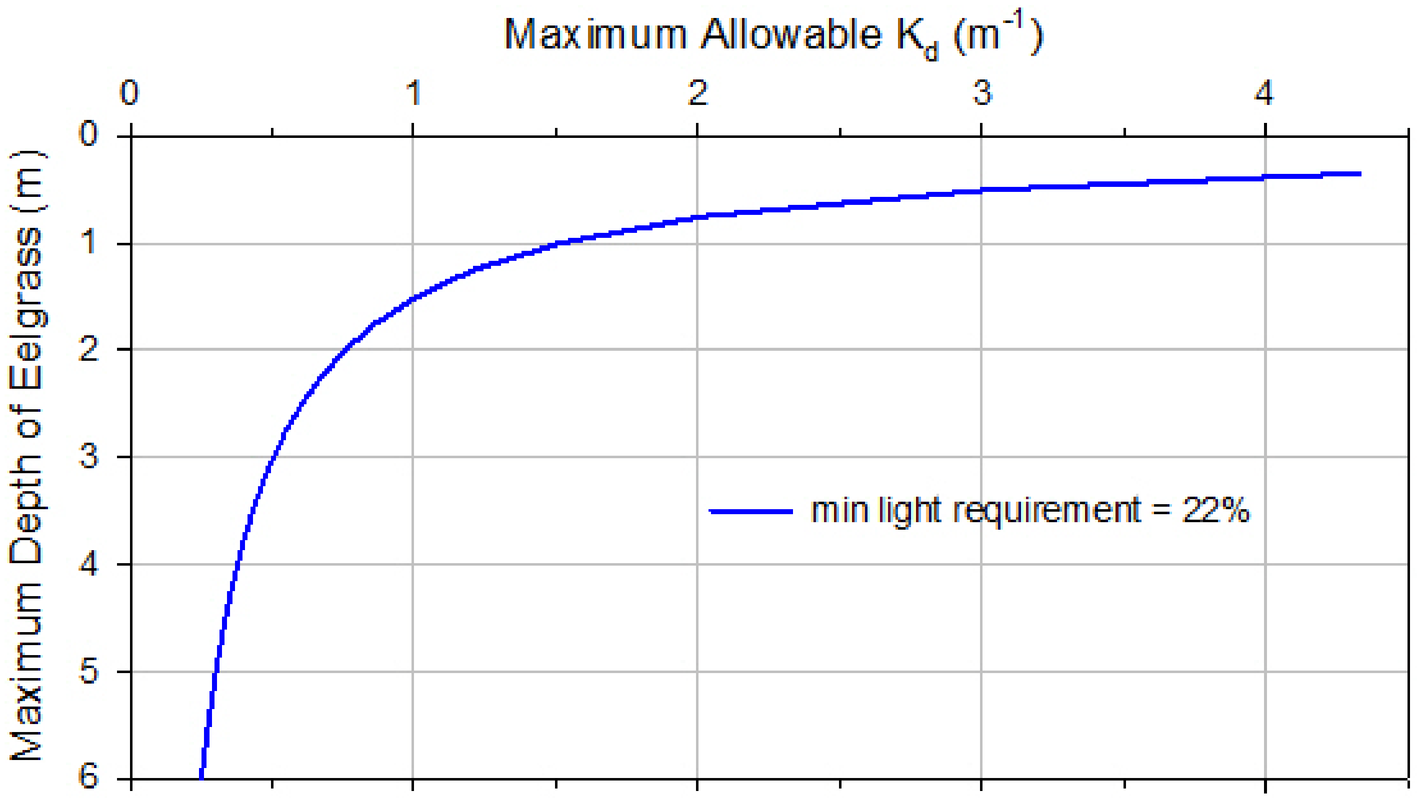
Zostera marina is a vascular, rooted plant found along the east coast of the United States, south to North Carolina and all along the West coast, including Alaska. (photo courtesy of P. Auster, University of Connecticut)

The Connecticut Department of Environmental Protection (CTDEP), the U.S. Geological Survey (USGS) and the Long Island Sound Study (LISS) are implementing a project to establish restoration objectives for eelgrass (Zostera marina) beds in the coastal waters of Long Island Sound. Both the LISS Habitat Restoration Work Group and CTDEP are concerned about the long-term, demise of eelgrass in Long Island Sound (LIS). Eelgrass restoration is one of the habitat restoration goals listed in the 1994 LISS Comprehensive Conservation and Management Plan.

The project focused primarily on how nitrogen loading may be affecting eelgrass in Connecticut's coves, embayments and tidal rivers and management measures that can be taken as appropriate. Scientific research has established a strong relationship between nitrogen loading and eelgrass growth and survival. Excess nitrogen favors the growth of phytoplankton, epiphytes and macroalgae, which out-compete eelgrass for light and space. There are other biotic and abiotic factors that

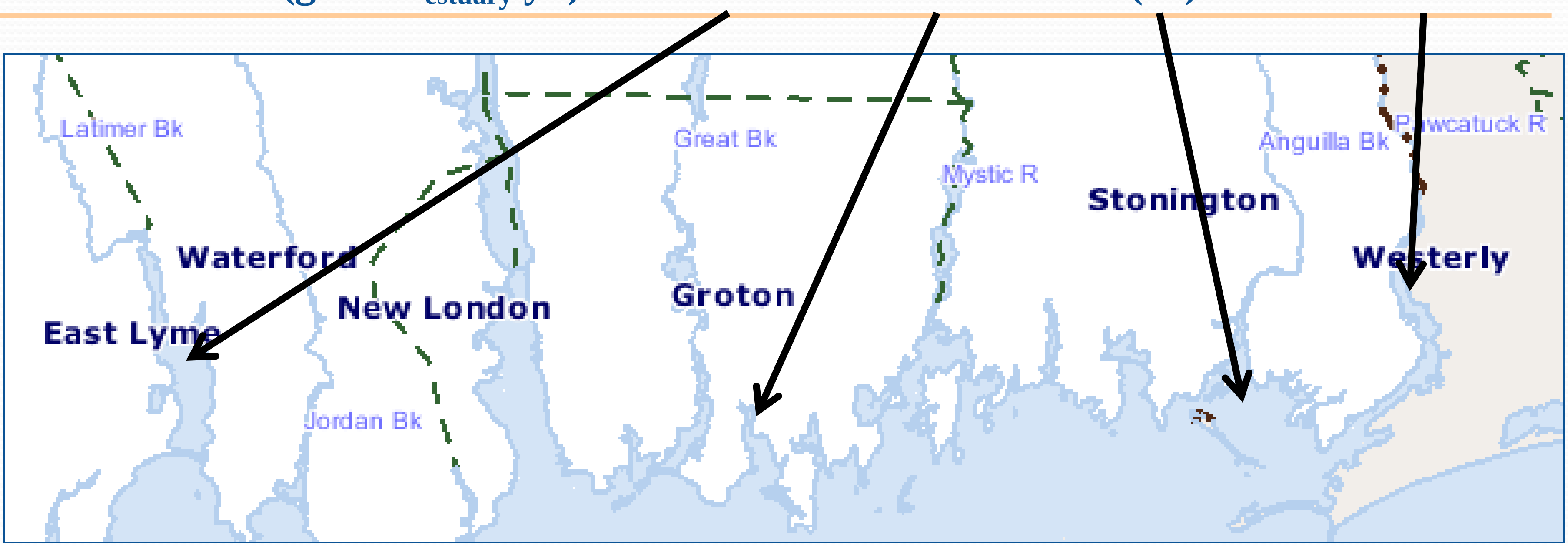
	Chesapeake Bay Guidelines	Guidelines for LIS (Yarish et al. 2006)	Guidelines for LIS (Case Study Sites)
Min. Light Requirement at the leaf surface (%)	> 15		> 15
Water Column Light Requirement (%)	< 22		< 22
Kd (1/m)	< 1.5	< 0.7	< 0.7
Chlorophyll-*a* (μg / L)	< 15	< 5.5	< 5.5
Dissolved Inorganic Nitrogen (mg/L)	< 0.15	< 0.03	< 0.03
Dissolved Inorganic Phosphorus (mg/L)	< 0.02	< 0.02	< 0.02
Total Suspended Solids (mg/L)	< 15	< 30	no data
Sediment Organics (%)	0.4 to 12	3 to 5	0.4 to 10
Vertical Distribution (m)	Zmax = 0.5m + Zmin	Zmax = 1m + Zmin	Zmax = 1m + Zmin
Sediment Grain Size	0.4 - 30 % fines	< 20% silt and clay	no data
Sediment Sulfide Concentration (μM)	< 1000	< 400	no data
Current Velocity (cm/s)	5 < X < 180	5 < X < 100	no data

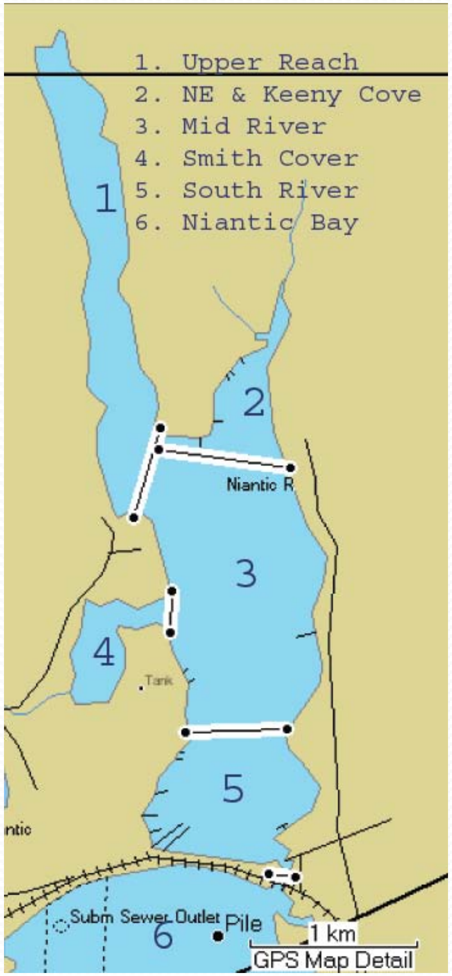
Max K_d for the Desired Eelgrass Depth



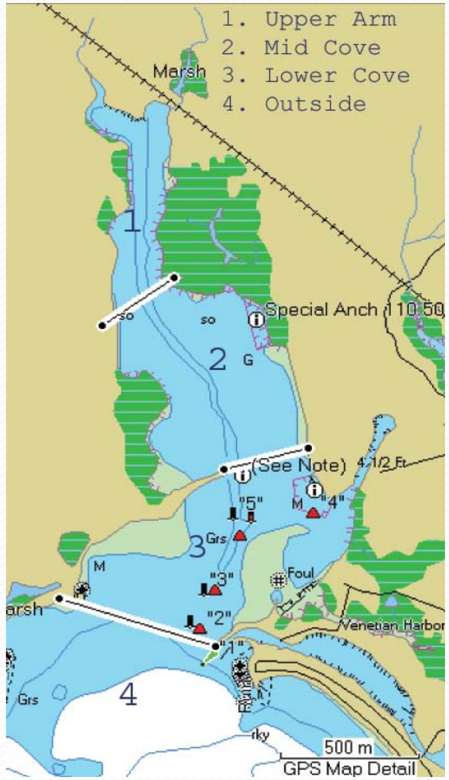
Case Studies

	Niantic River	Mumford Cove	Little Narragansett Bay	Pawcatuck River
Area (ha)	270	50	965	272
Mean Depth (m)	2.6	1.0	2.0	1.8
Freshwater Residence Time (d)	27	3.5	3	surf - 1.3 bott - 6.5
N-Load Rate (kg N y^{-1})	38,400	6,035	(555,000)	453,900
N-Load Rate (kg N $ha^{-1}_{estuary}$ y^{-1})	142	121	(575)	1,669
N-Load Rate (g N $m^{-2}_{estuary}$ y^{-1})	14	12	(58)	167



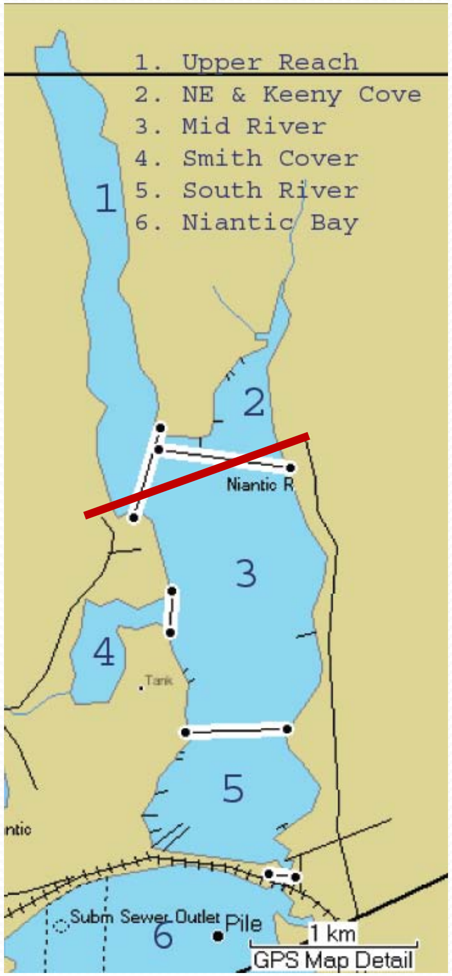


Niantic River
6 sections



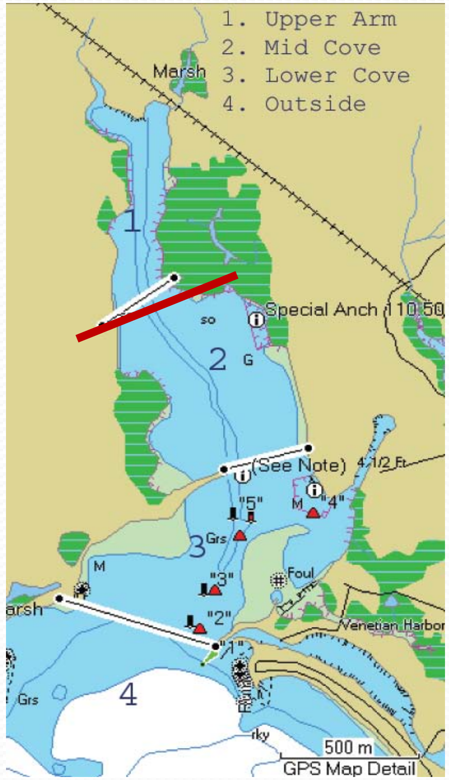
Mumford Cove
4 sections

Pawcatuck River and Little Narragansett Bay
13 sections



Niantic River

~~6 sections~~



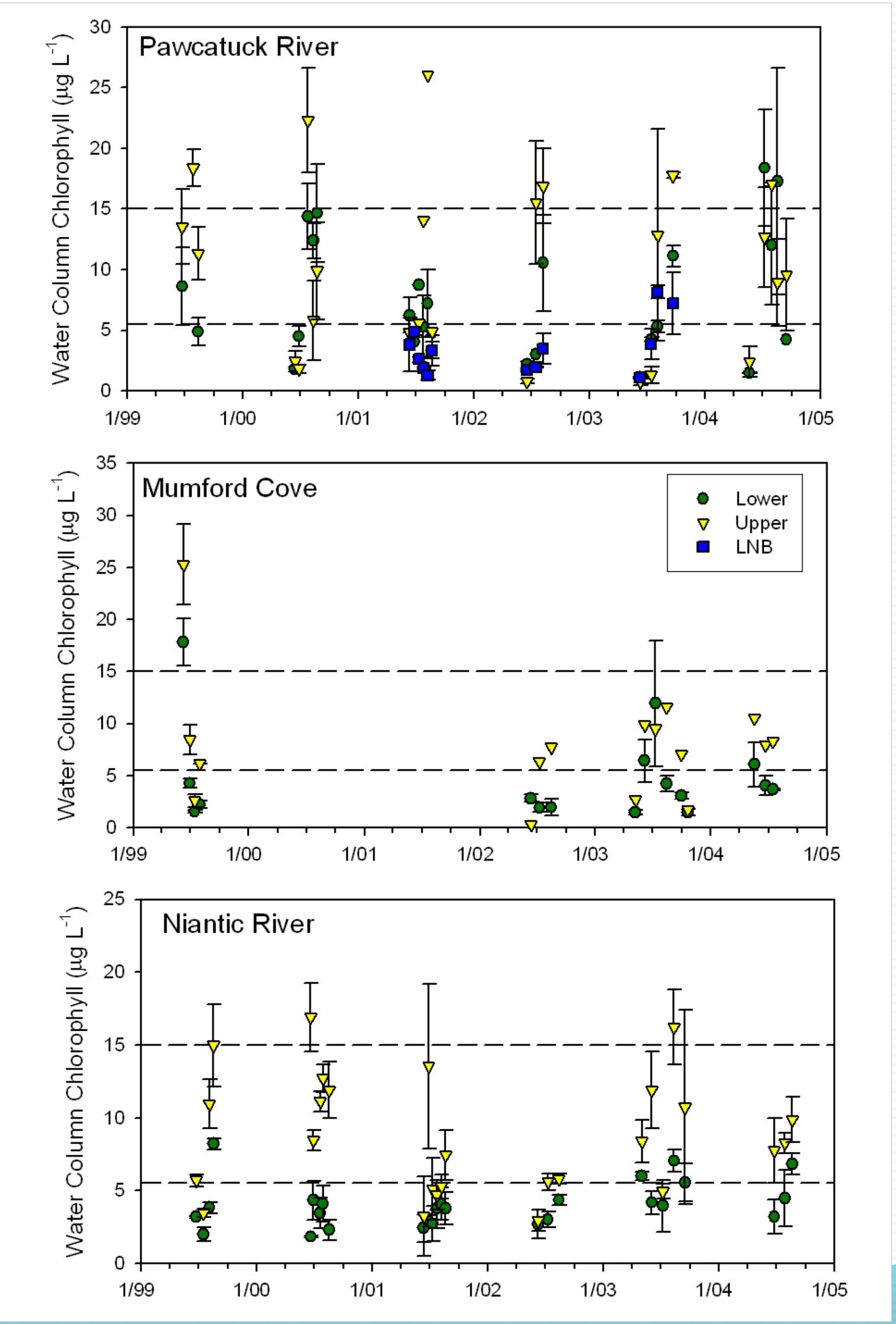
Mumford Cove

~~4 sections~~

Pawcatuck River and Little Narragansett Bay

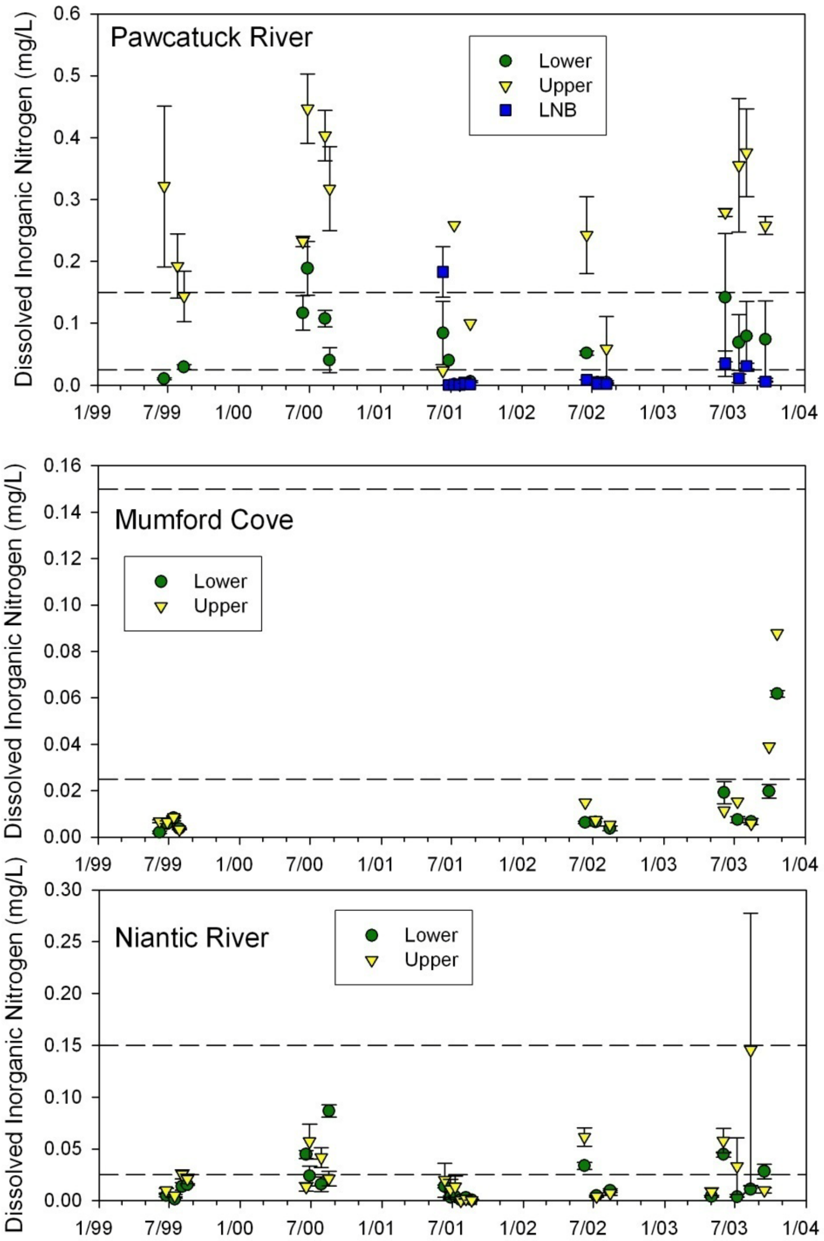
~~13 sections~~

Upper , Lower, LNB (Little Narragansett Bay)



Water Column Chlorophyll

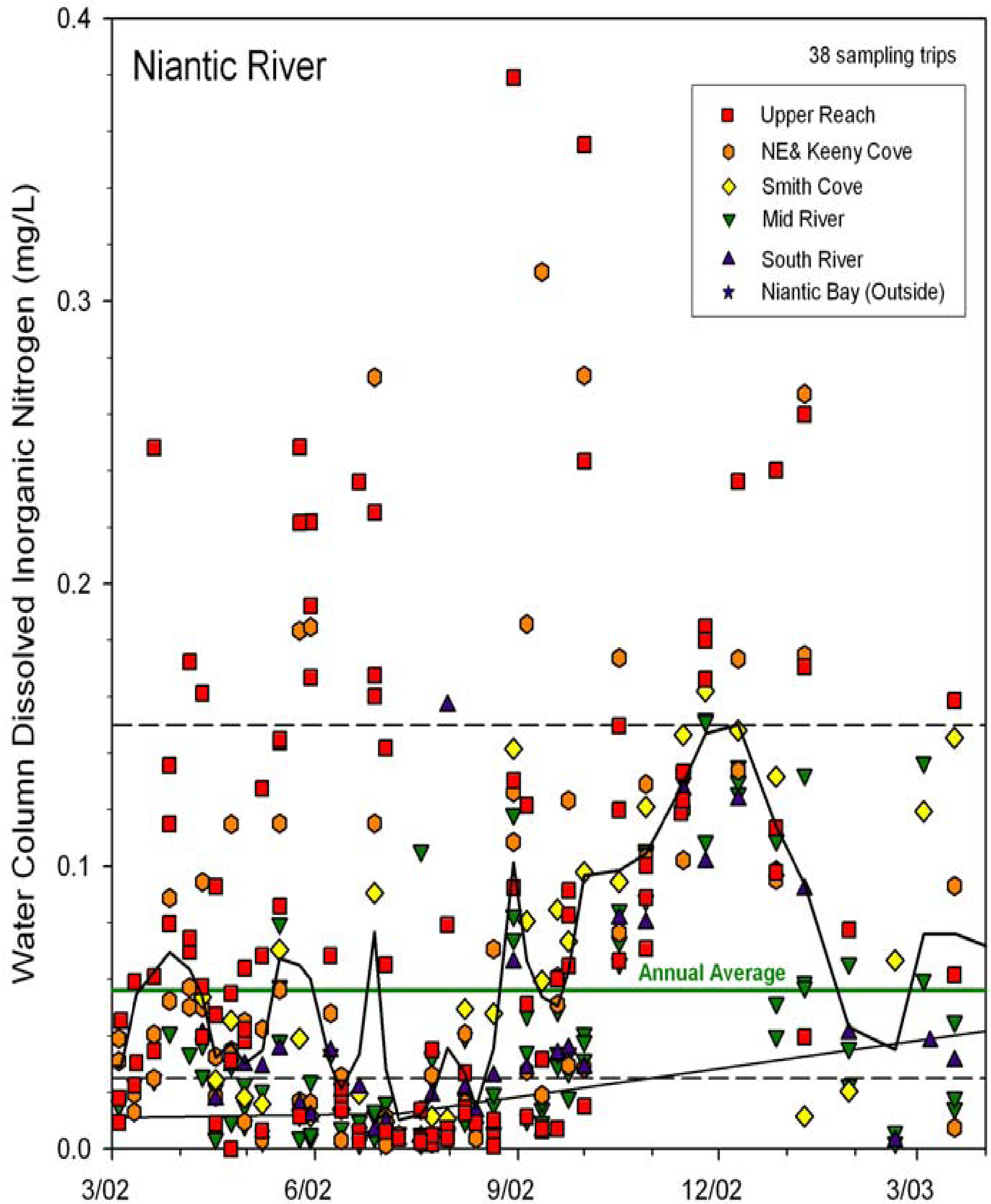
< 5.5 ug / L



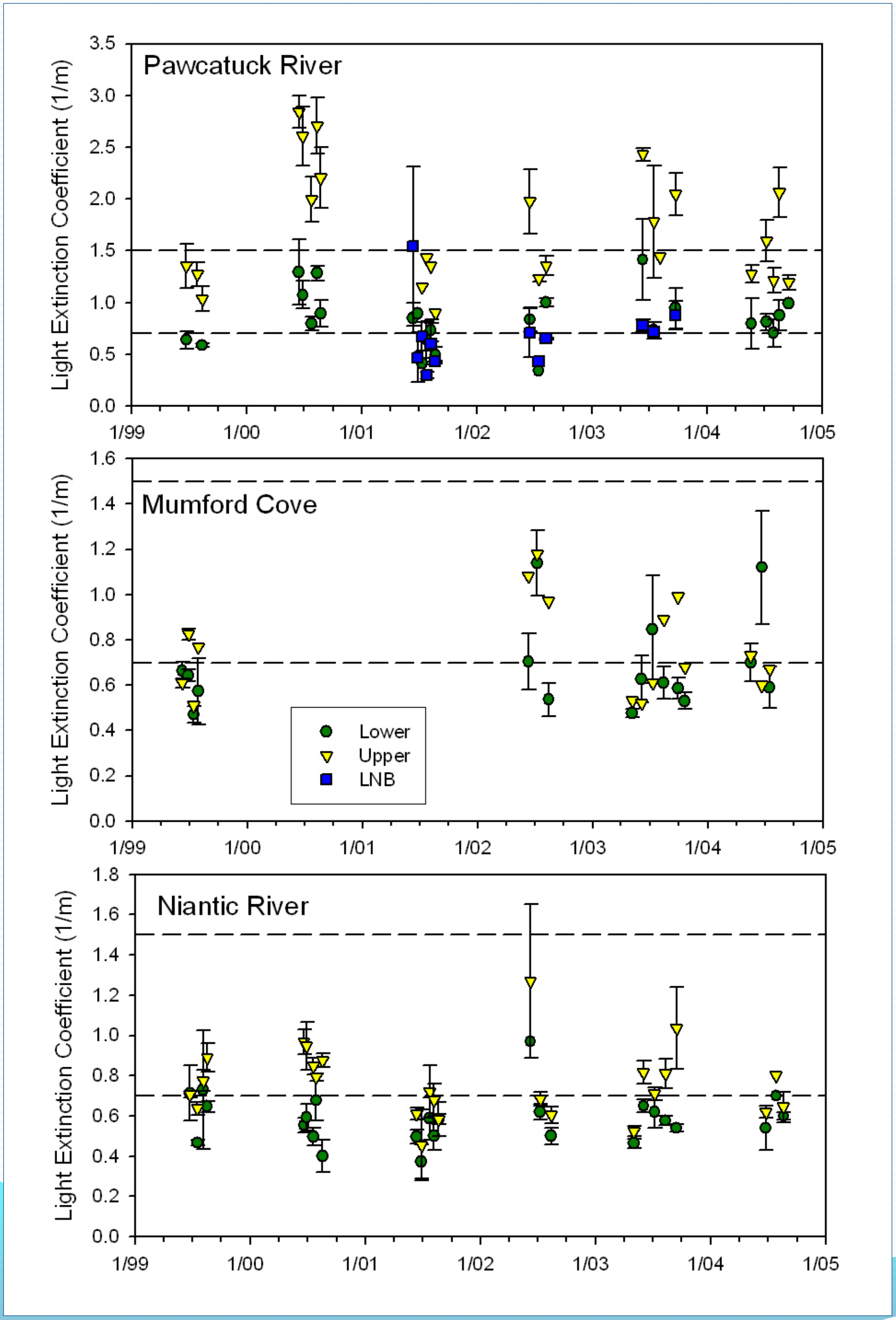
Dissolved Inorganic Nitrogen

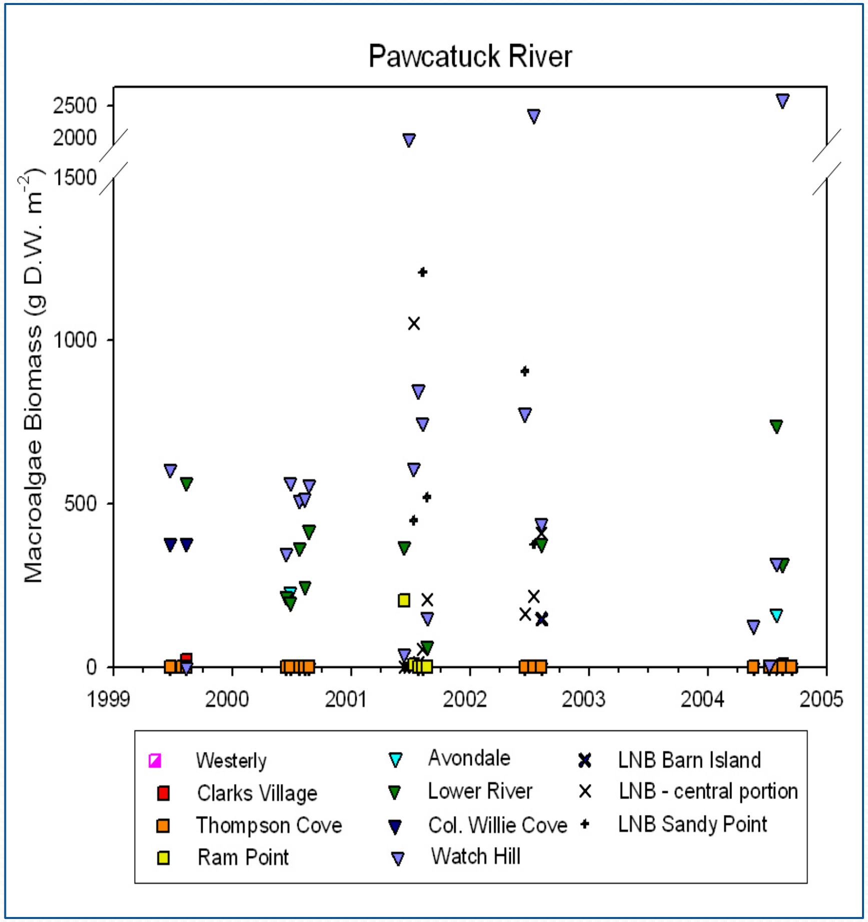
< 0.03 mg/L

Sites usually below the value.



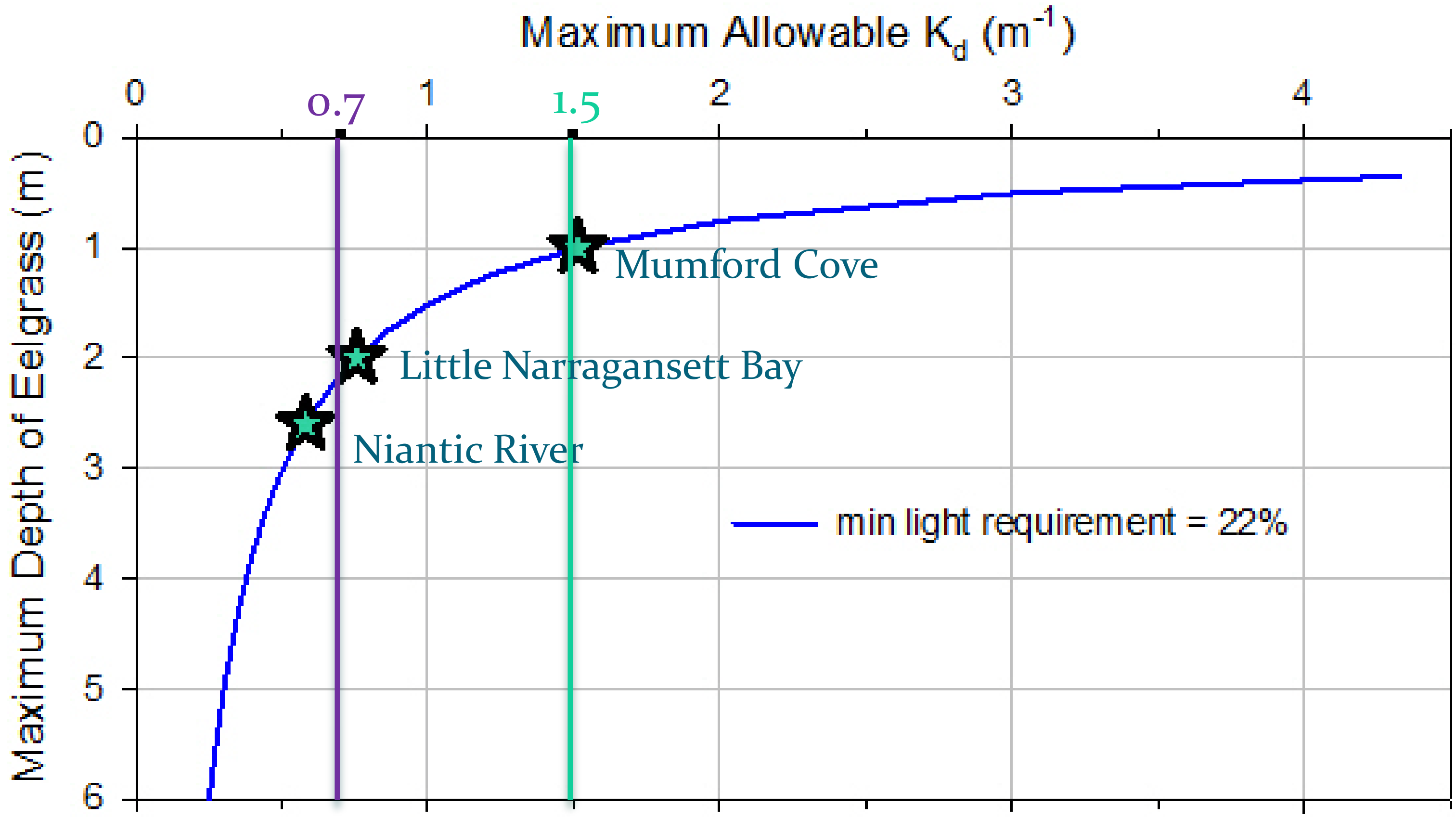
Niantic River
38 sampling trips
Upper Reach
NE& Keeny Cove
Smith Cove
Mid River
South River
Niantic Bay (Outside)
Annual Average
Water Column Dissolved Inorganic Nitrogen (mg/L)
0.0
0.1
0.2
0.3
0.4
3/02
6/02
9/02
12/02
3/03

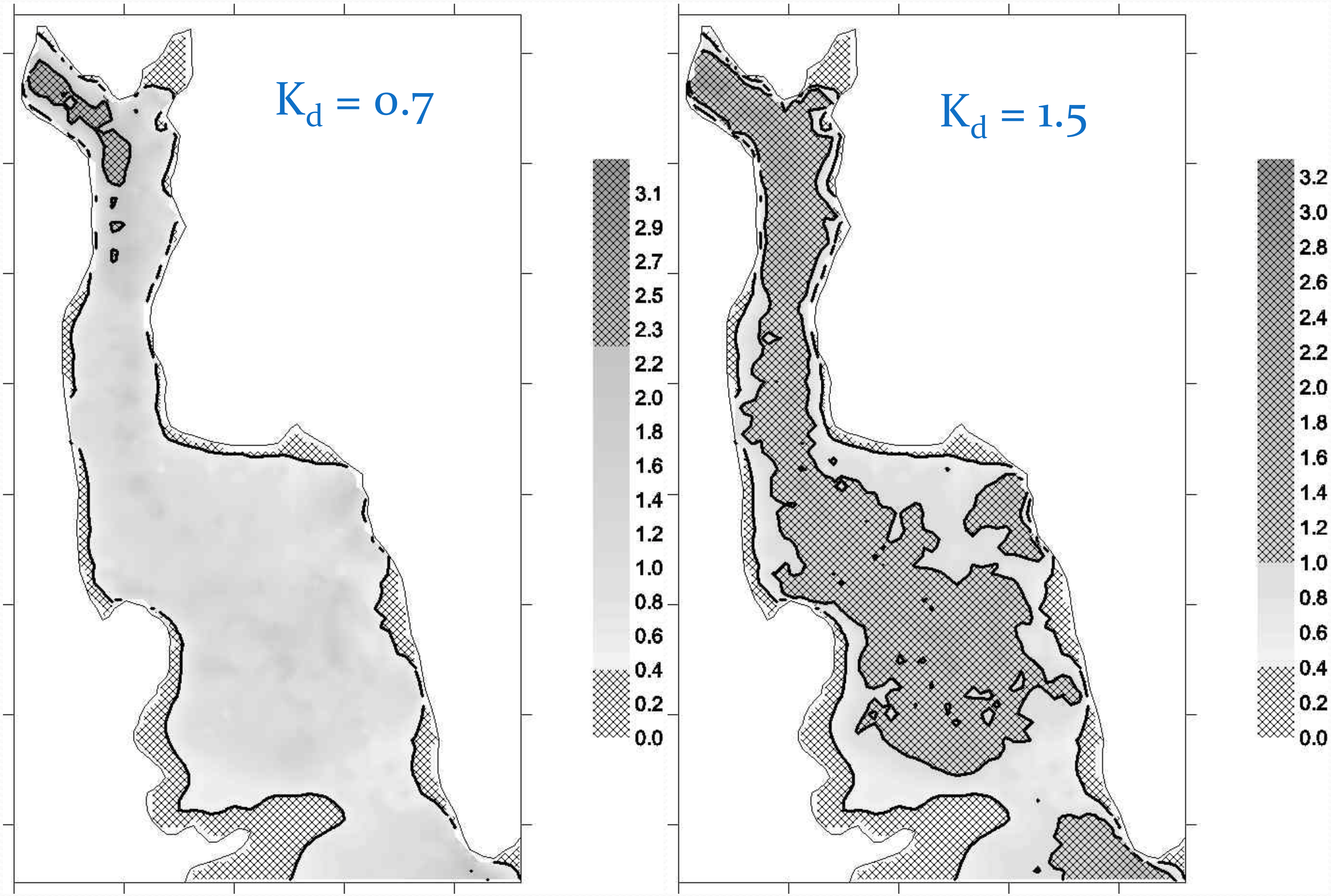




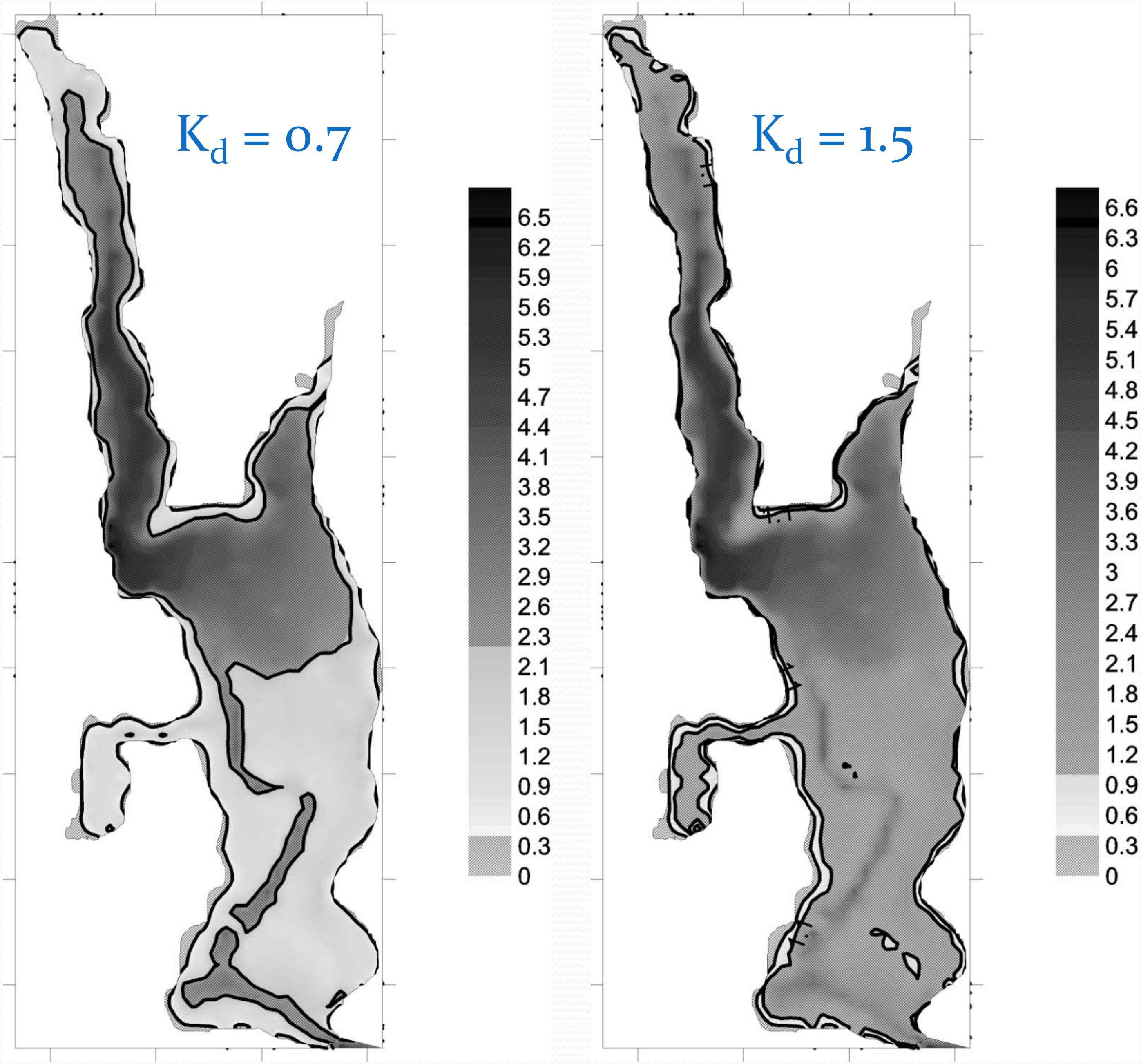
Light Extinction Coefficient (K_d)

Max K_d for the Desired Eelgrass Depth (don't oversimplify…)

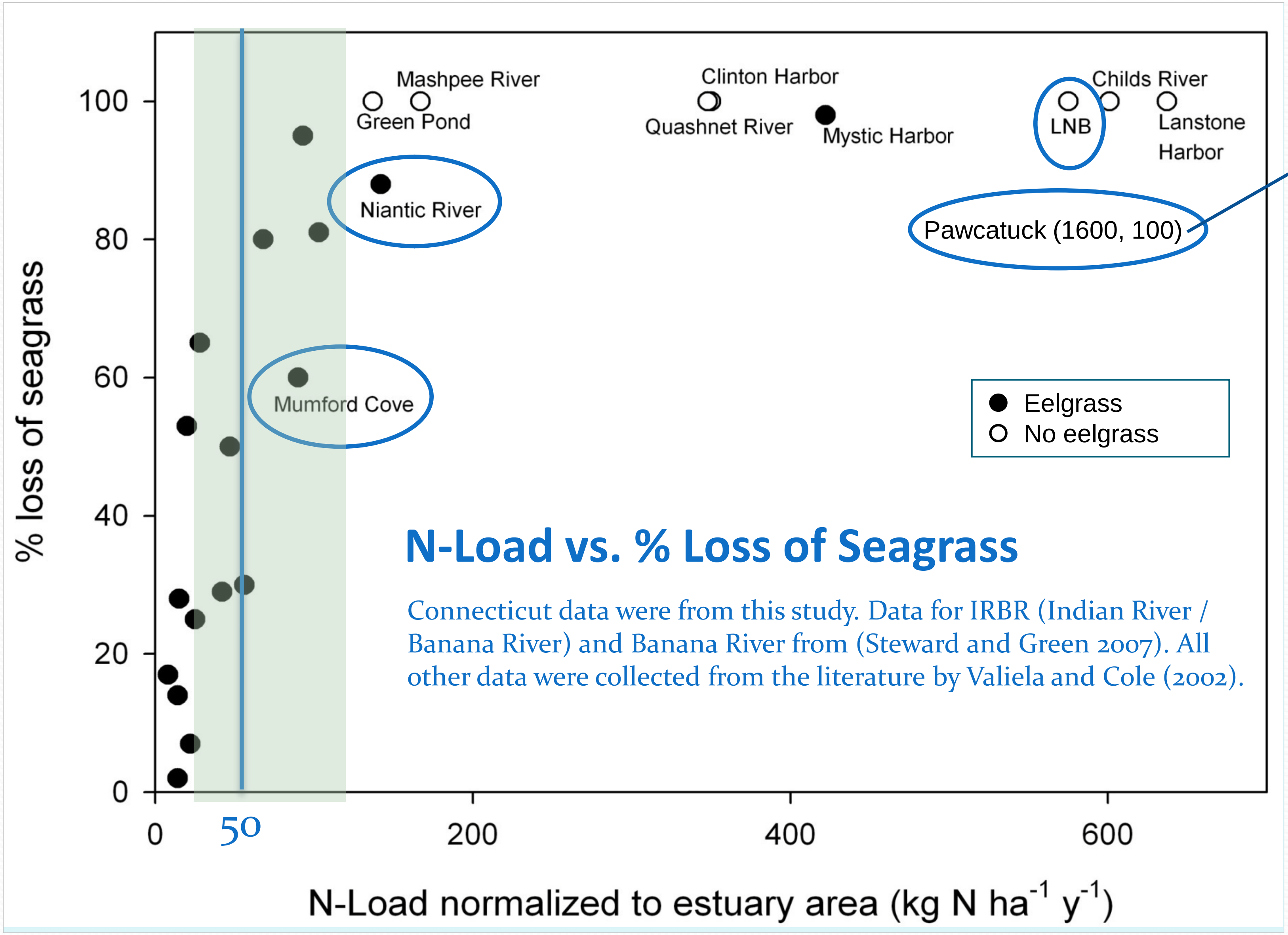




$K_d = 0.7$
3.1
2.9
2.7
2.5
2.3
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
$K_d = 1.5$
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0



$K_d = 0.7$
$K_d = 1.5$
6.5
6.2
5.9
5.6
5.3
5
4.7
4.4
4.1
3.8
3.5
3.2
2.9
2.6
2.3
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0
6.6
6.3
6
5.7
5.4
5.1
4.8
4.5
4.2
3.9
3.6
3.3
3
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0



> 50 kg N ha^{-1} y^{-1} = substantial loss

25 – 100 kg N ha^{-1} y^{-1} = secondary factors affect success

marshes, flushing, TSS, CDOM

Recommendations for Management

- Develop maps of potential eelgrass habitat, based on current water clarity and desired or historic water clarity.
  - critical step for knowing when you've reached the goal
- Target N-loads to around 50 kg N $ha^{-1}_{estuary}$ y^{-1}.
  - could include some allowances for higher limits if ameliorating factors are present

- Determine the current % loss of seagrass, relative to restoration target.
  - currently 100% for most of the embayments, LIS is doing better
- Continue to monitor the areal distribution of eelgrass, especially maximum depth limits.
- Continue to collect data on the water quality of small embayments.