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FISHERIES**

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Milford Aquaculture Seminar, February 2014

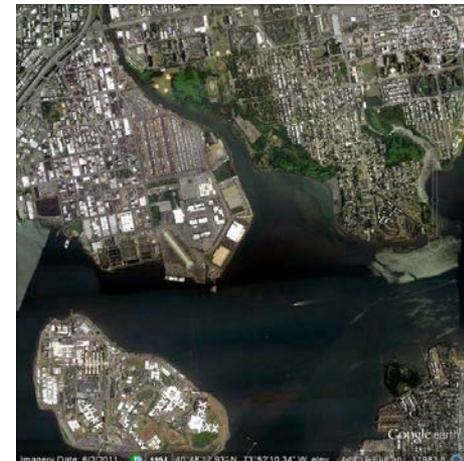
# What we learned growing ribbed mussels at Hunts Point.

Gary H. Wikfors, Eve Galimany, Julie M. Rose, Mark S. Dixon, Judy Yaqin Li,  
Shannon L. Meseck (NOAA Fisheries Service, NEFSC, Milford, CT 06460),

Carter Newell (Maine Aquaculture Research & Development, Damariscotta,  
ME 04543),

Lynn Dwyer (National Fish and Wildlife Foundation, Patchogue, NY 11772),

Mark Tedesco (EPA Long Island Sound Office, Stamford, CT 06904).



# How did this get started?

- 1) Recognition that lowering nutrient loading will not restore eutrophic estuarine habitat (benthic hypoxia)
- 2) A great idea imported from Sweden (Odd Lindahl)

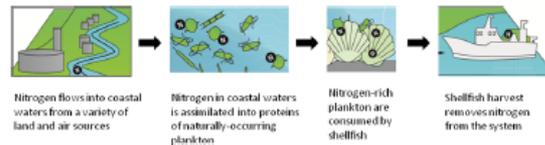
## A Role for Shellfish Aquaculture in Coastal Nitrogen Management

Julie M. Rose,<sup>\*,†</sup> Suzanne B. Bricker,<sup>‡</sup> Mark A. Tedesco,<sup>§</sup> and Gary H. Wikfors<sup>†</sup>

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<sup>‡</sup>NOAA NCCOS, 1305 East West Highway, Silver Spring, Maryland 20910, United States

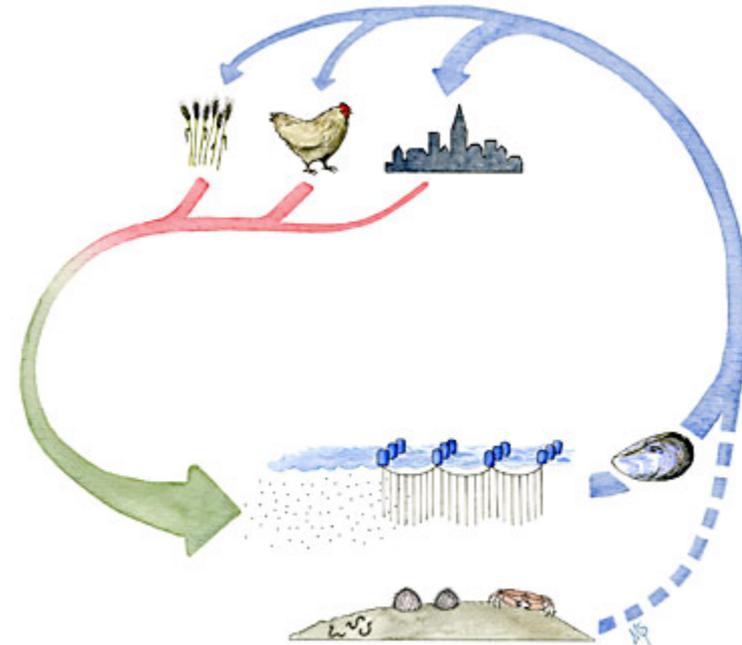
<sup>§</sup>U.S. EPA Long Island Sound Office, 888 Washington Blvd, Suite 9-11, Stamford, Connecticut 06901, United States



Excess nutrients in the coastal environment have been linked to a host of environmental problems, and nitrogen reduction efforts have been a top priority of resource managers for decades. The use of shellfish for coastal nitrogen remediation has been proposed, but formal incorporation into nitrogen management programs is lagging. Including shellfish aquaculture in existing nitrogen management programs makes sense from environmental, economic, and social perspectives, but challenges must be overcome for large-scale implementation to be possible.

but recent work suggests that quantification methods may be improving.<sup>20</sup>

The use of shellfish aquaculture for coastal nutrient remediation has been proposed.<sup>2,2,2,3</sup> A variety of local, state, and federal agencies in the region around Long Island Sound, U.S., recently have been exploring the application of these concepts in the Northeastern United States.<sup>24,25</sup> This concept is being called “nutrient bioextraction” by scientists and resource managers involved in the Long Island Sound effort (Figure 1). Nitrogen in the coastal environment comes from a variety of sources, but inorganic (and some organic) forms can be assimilated by phytoplankton. The phytoplankton then are filtered and consumed by shellfish, and nitrogen from the phytoplankton is incorporated into shellfish tissues and shell. When the shellfish are harvested from natural beds or from a farm setting, the nitrogen contained in their bodies is removed



# How did this get started?

3) 2009 Workshop in Stamford, CT

4) Call for a “demonstration project”

INTERNATIONAL WORKSHOP

3-4 DECEMBER | UCONN, STAMFORD

## BIOEXTRACTIVE TECHNOLOGIES *for* NUTRIENT REMEDIATION

*Explore the potential benefit of bioextractive technologies such as seaweed and shellfish cultivation and harvesting to the nearshore estuarine environment of Long Island Sound*

### TOPICS WILL INCLUDE

Alternatives for nutrient management for federal, state and municipal agencies and managers

- There was agreement among the panelists that a pilot program is a necessary next step and that it is worth investing valuable time and resources into further exploration of nutrient bioextraction in Long Island Sound.

Rose JM, Tedesco M, Wikfors GH, Yarish C. 2010. International Workshop on Bioextractive Technologies for Nutrient Remediation Summary Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 10-19; 12 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/nefsc/publications/>

# Why the Bronx?

- 1) Previous GAIA Institute proposals
- 2) Bronx River Watershed Initiative, NY AG Settlement Fund



## An Adaptive Paradigm:

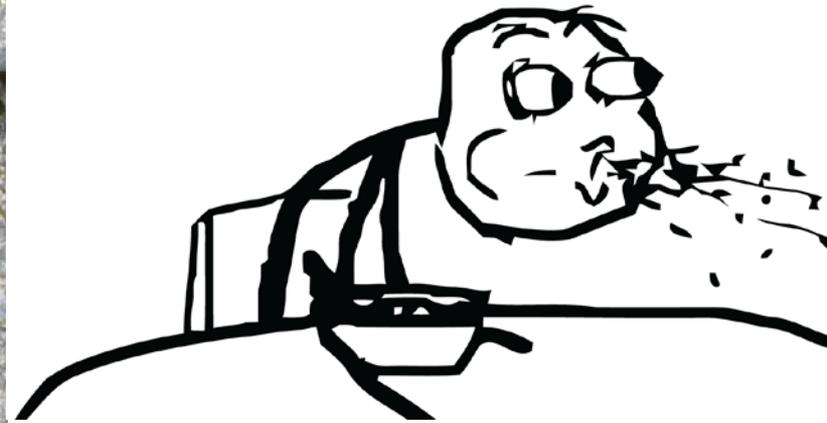
Coupling water & waste flows with ecological development to enhance environmental quality, increase biodiversity, ecological productivity, and protect human health



- A new framework for urban development:  
Layering biogeochemical networks onto city structure

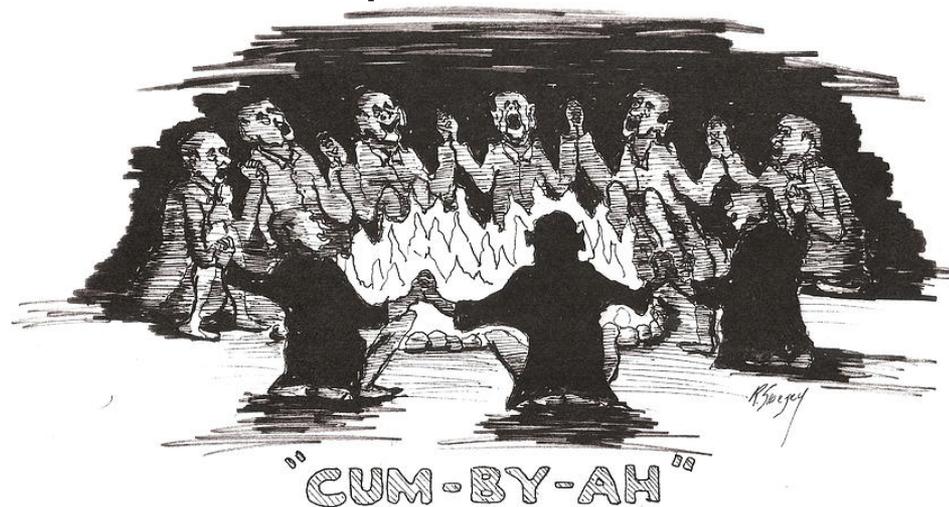
# Why ribbed mussels?

- 1) Native species displaced by urbanization
- 2) Not a commercial species (so not an attractive nuisance)

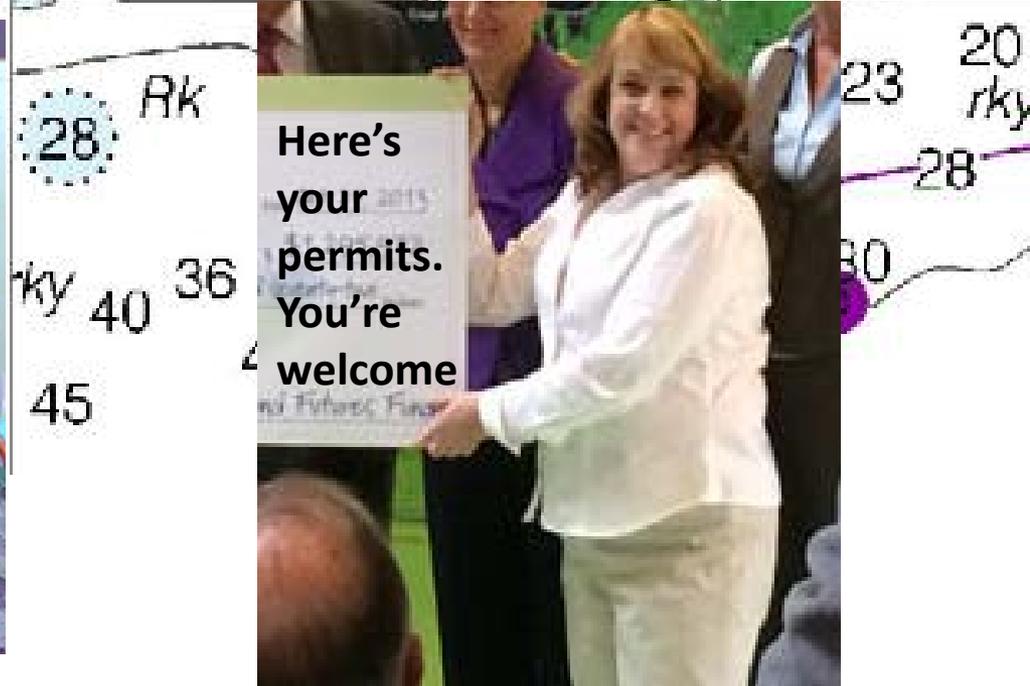
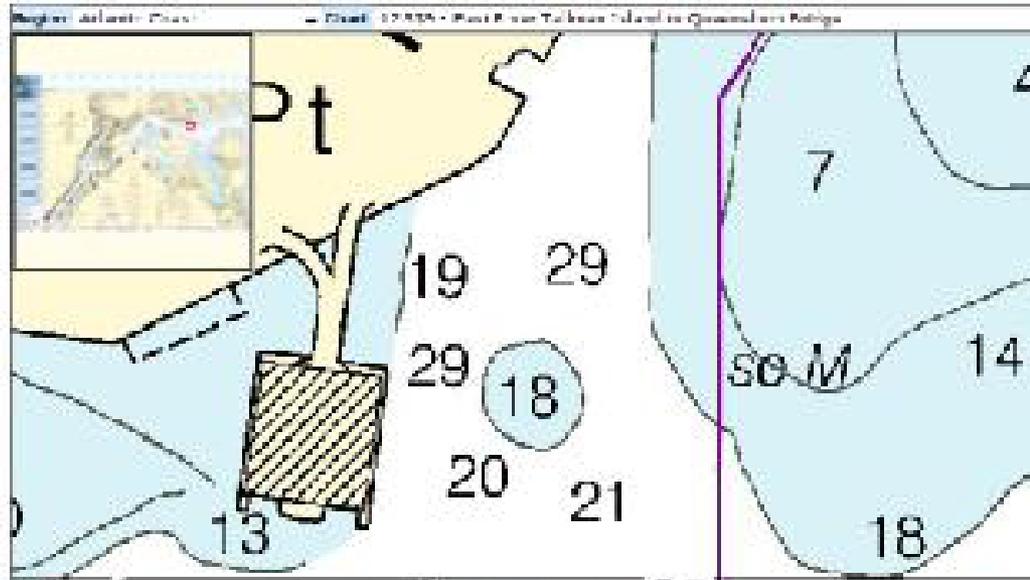


# Who was involved? “It takes a village”... and at least a year...

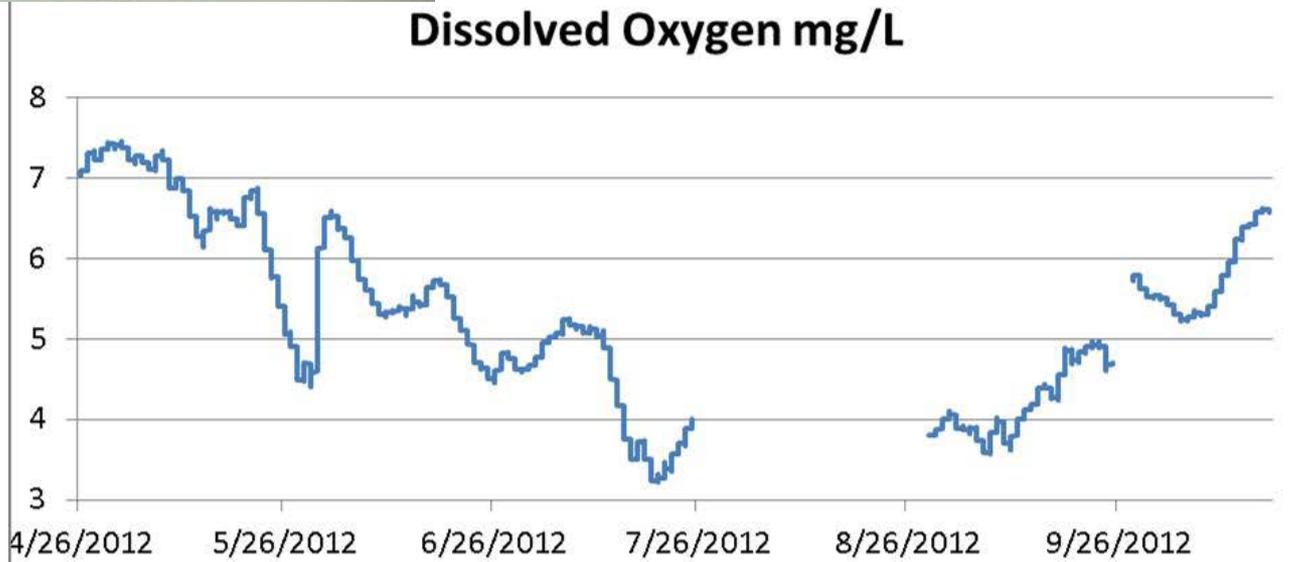
- 1) EPA LISS – Organization, sponsorship, and funding
- 2) NYS Attorney General Office – funding and political support
- 3) National Fish & Wildlife Foundation – grant admin., +++
- 4) Maine Aquaculture Res. & Dev. -- industry smarts and skills
- 5) Rocking the Boat – water access and public outreach
- 6) Montclair State U. – contract for fouling community analysis
- 7) UCONN – co-located macroalgal pilot project
- 8) NEFSC Milford Lab – quantification...



# What we did (too much to list)... 2011



# What we did (too much to list)... 2012



# What we learned about pilot projects:

- 1) Cooperation, patience, and adaptability are essential!
- 2) Anything new is viewed with suspicion by regulators and delayed or prevented if possible.



## Permits:

Joint and individual ACOE,  
NYS DEC,  
NYC Department of Planning,  
NYS Department of State,  
US Coast Guard,  
NOAA,  
NYC DEP,  
NYC Dept. of Sanitation.

NY State insurance brokers and agencies were **not familiar with a mussel raft and were hesitant to underwrite liability** on an unknown structure. Needed to redefine to characterize structure as a floating dock (which it was).

# What we learned about pilot projects:

3) People want solutions to environmental problems!



## How Mussel Farming Could Help to Clean Fouled Waters

*Along the shores of New York Harbor, scientists are investigating whether this ubiquitous bivalve can be grown in urban areas as a way of cleansing coastal waters of sewage, fertilizers, and other pollutants.*

by paul greenberg

deVerdieping  
**Trouw**

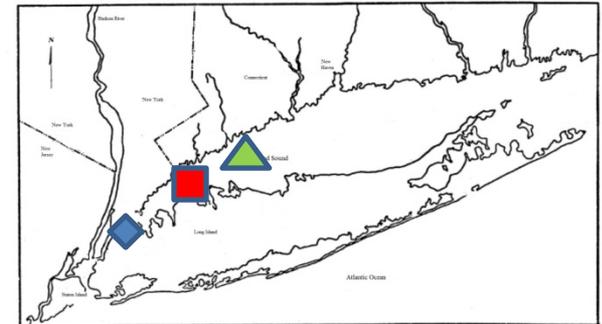
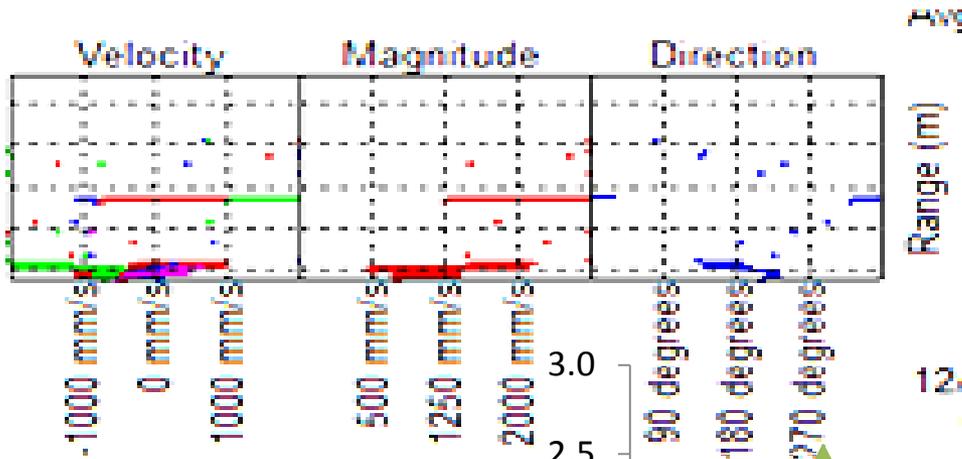
Hoe schaaldieren New York schoonmaken

Menno van den Bos – 03/12/12, 22:00

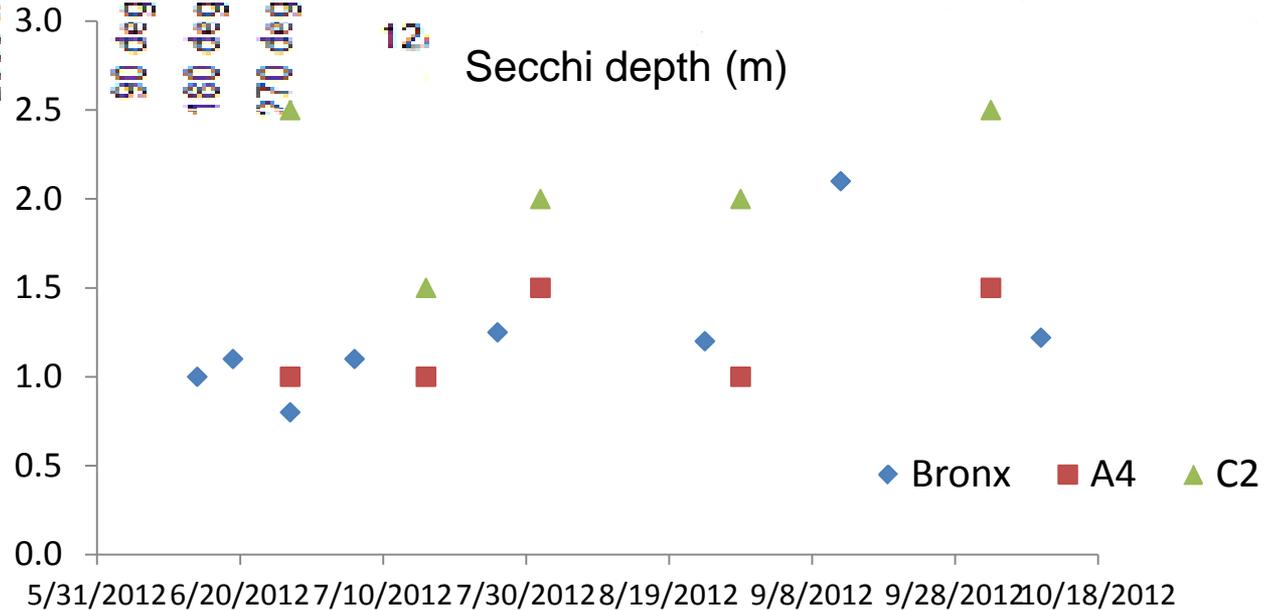


# What we learned about Hunts Point

- 1) It's really turbulent! (not stratified)
  - 2) The water is really muddy! (not much light penetration)
- More on this from Judy Li!



Secchi depth (m)



# What we learned about Hunts Point

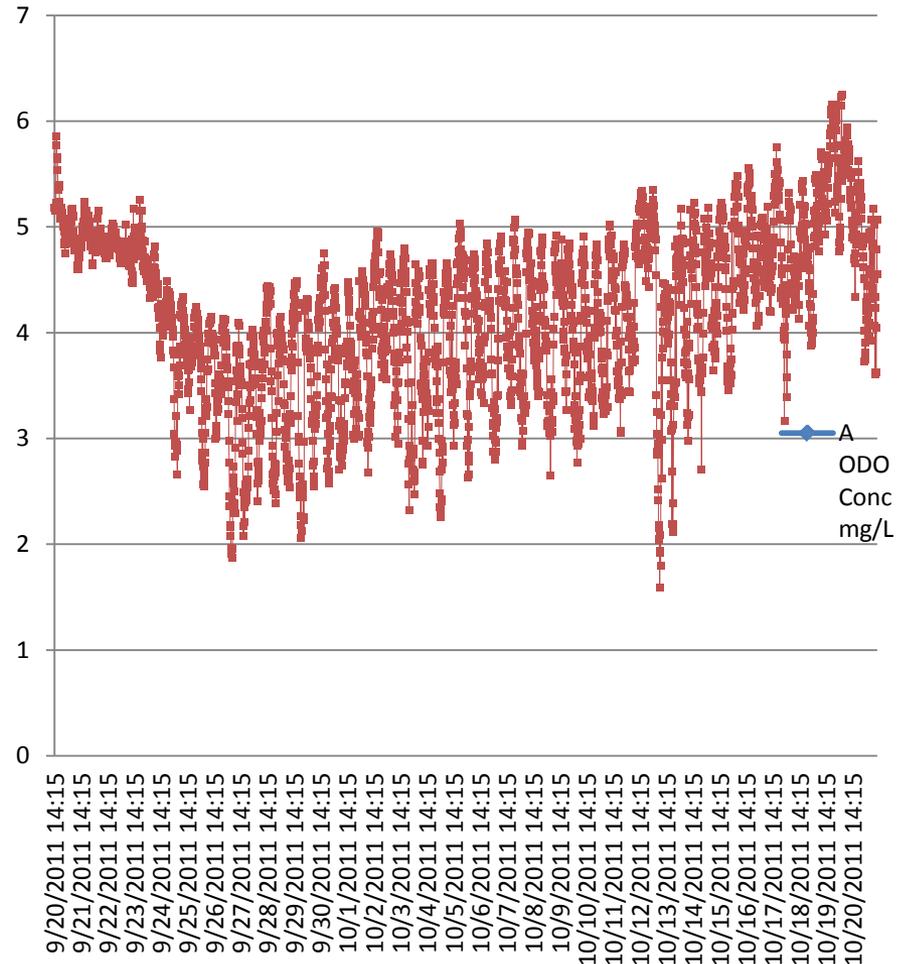
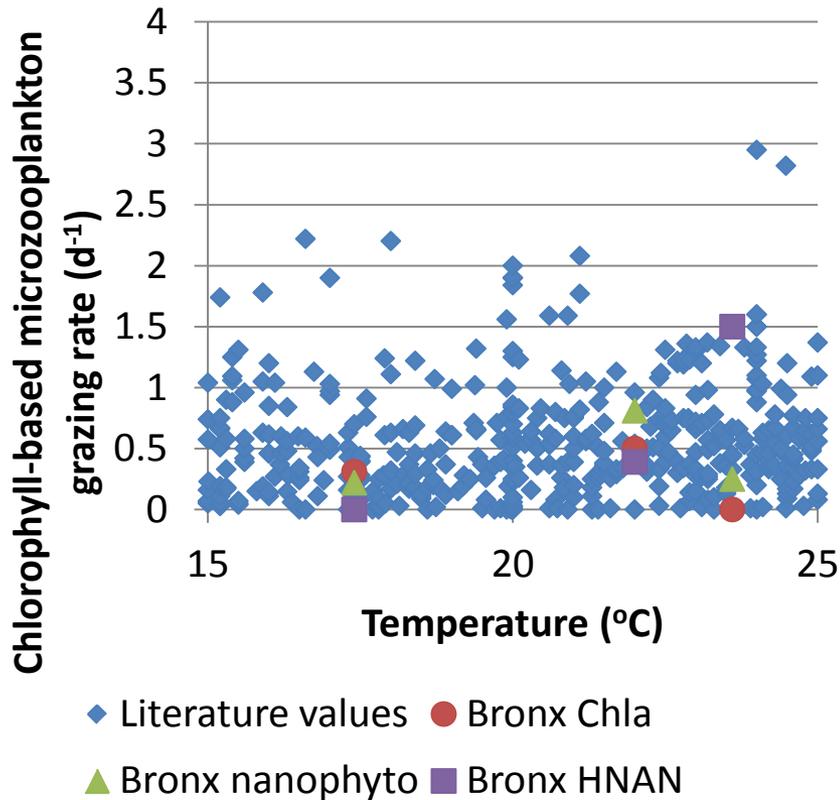
- 3) Fouling wasn't as big a deal as we thought it would be.
- 4) Oysters and blue mussels set on collectors at the site!



# What we learned about Hunts Point

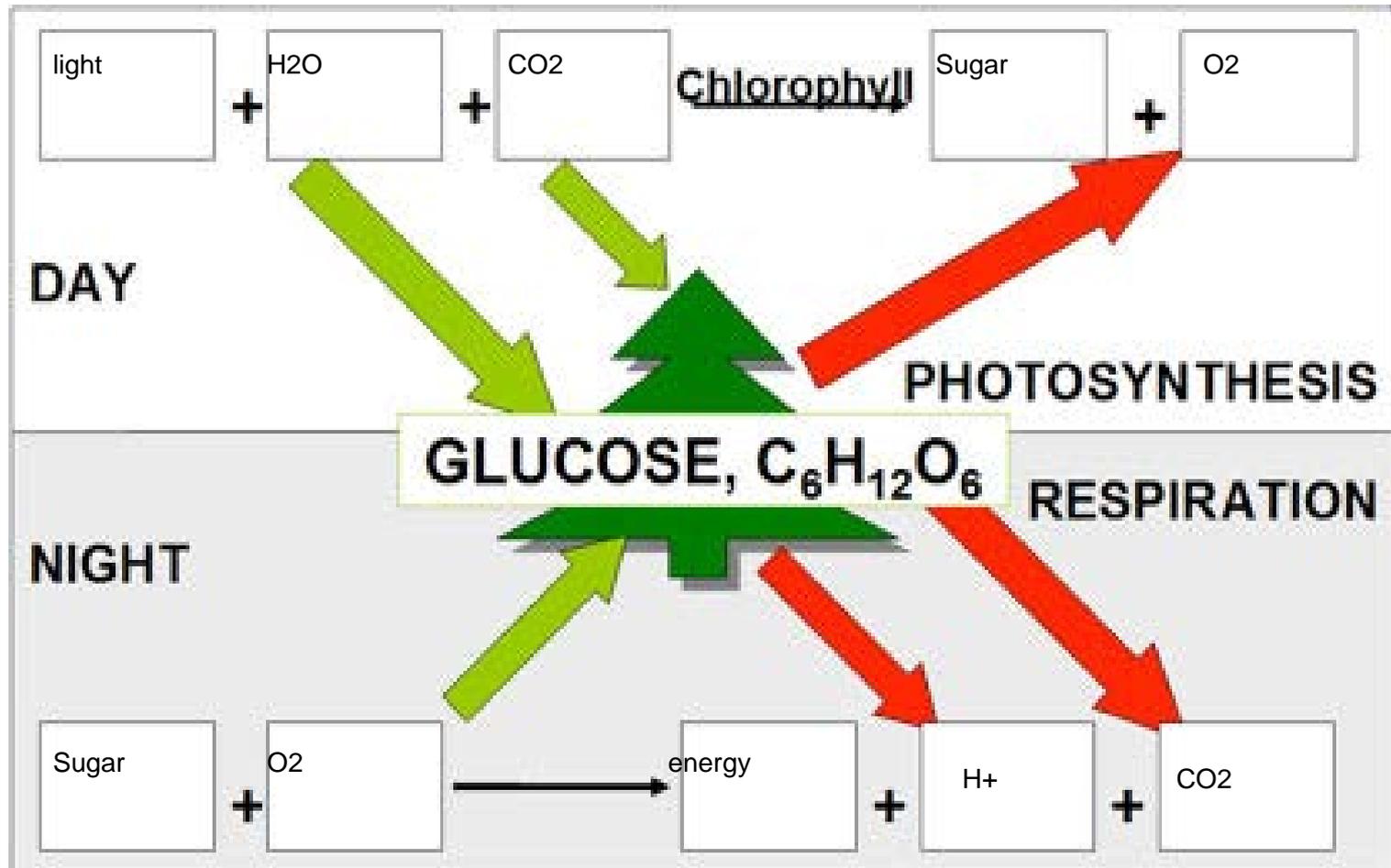
- 5) Microbial loop (bacteria, protozoans) is very active, so
- 6) Water becomes hypoxic top-to-bottom.

Grazing rate vs. temperature (from Chen et al 2012)



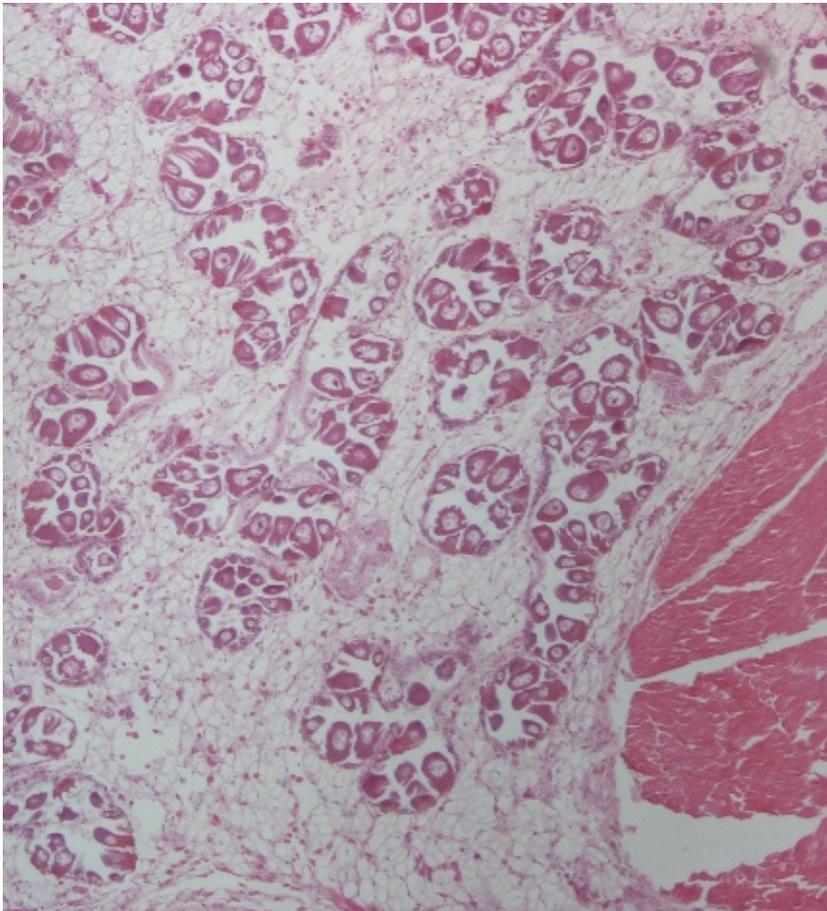
# What we learned about Hunts Point

The East River tidal strait “hypoxia incubator” is driven, partially at least, by turbulent suspension of sediment which limits daily photosynthetic re-charge of oxygen in surface waters.



# What we learned about ribbed mussels:

- 1) They appear ripe in June, but spawn in September or October
- 2) They don't settle on rope, or on coir logs or very much on anything we tried



# What we learned about ribbed mussels:

- 3) They adapt quickly to sub-tidal, suspension culture, but
- 4) They do not hold on to rope as blue mussels do

Aquacult Int  
DOI 10.1007/s10499-012-9608-3

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## **Short communication: adaptability of the feeding behavior of intertidal ribbed mussels (*Geukensia demissa*) to constant submersion**

**Eve Galimany · Jennifer H. Alix · Mark S. Dixon · Gary H. Wikfors**

“Results show that mussels taken from the intertidal population had significantly higher filtration than the submerged population initially, but after 3 days of submersion in the aquaria, this difference disappeared”.



# What we learned about ribbed mussels:

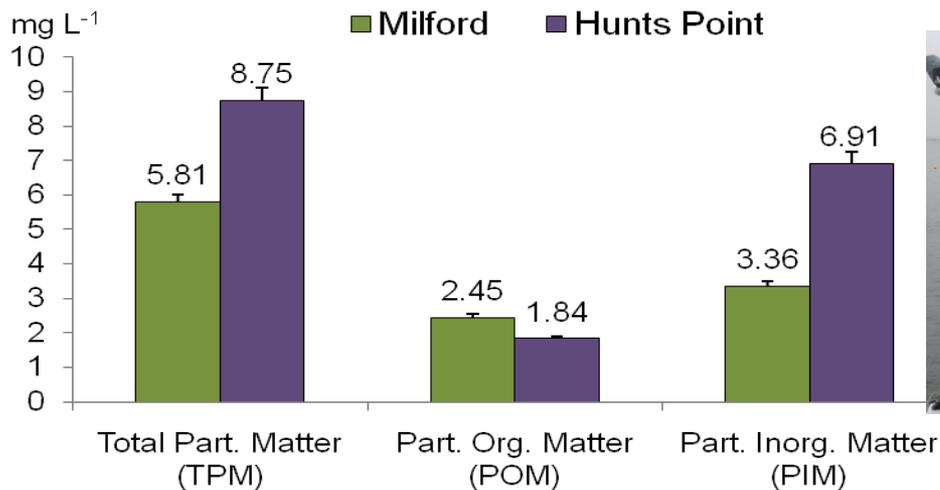
5) They are really good at adapting feeding to seston quality

a) Good at rejecting dust

b) Good at selecting organic particles to swallow

c) Slow filtration to save energy when food is abundant

d) Slow gut-transit time when food is scarce



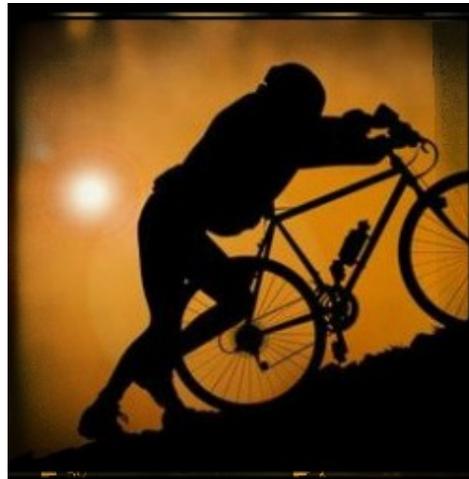
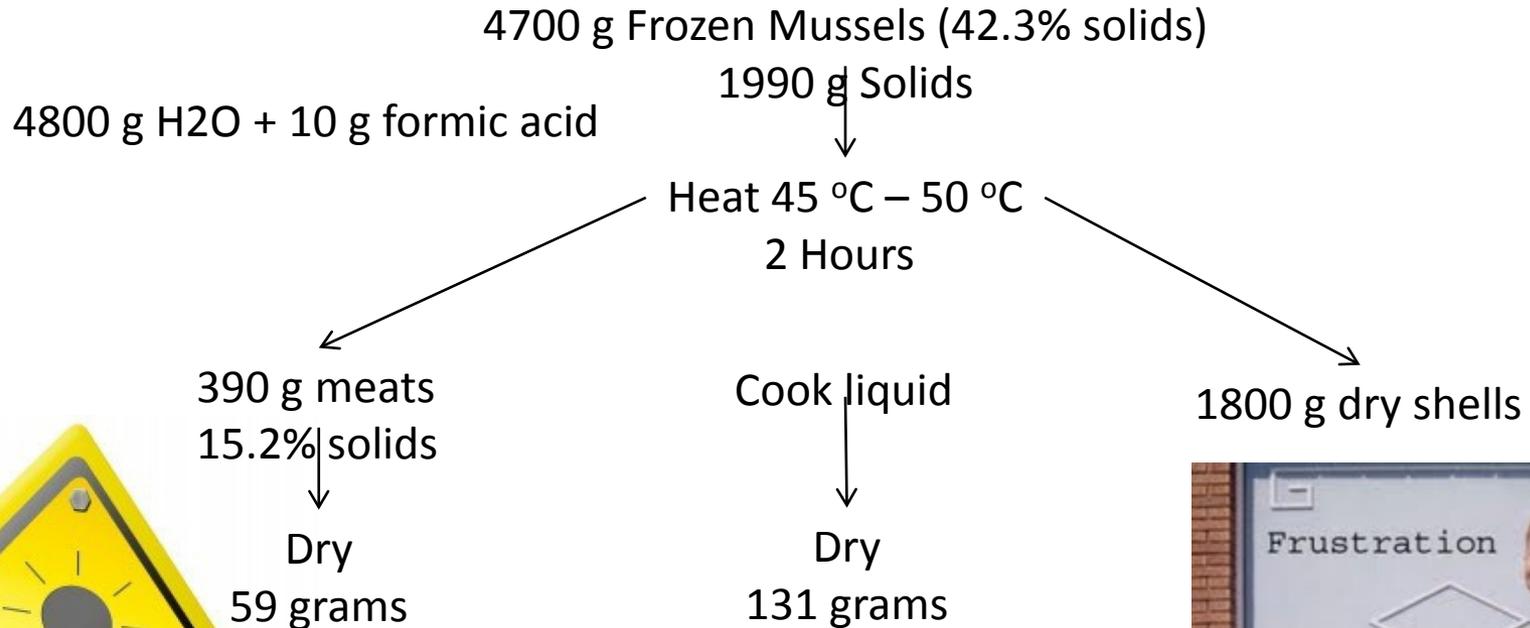
	Clearance	Filtration	Rejection	Absorption	Absorption
	Rate (L h <sup>-1</sup> )*	Rate (mg h <sup>-1</sup> )	Prop. (%)*	Rate (mg h <sup>-1</sup> )*	Efficiency

Milford (CT)  
Hunts Point (NY)

Average	2.38±0.10	12.50±0.46	35.62±1.50	3.25±0.18	0.71±0.01
Average	1.61±0.10	13.68±0.93	59.84±1.97	1.39±0.09	0.71±0.01

# What we learned about ribbed mussels:

## 6) They make good fish feed?



# What we learned about nutrient bio-extraction using ribbed mussel aquaculture at Hunts Point:

- 1) People want green solutions to environmental problems.
- 2) Ribbed mussels will work great in eutrophic waters.
-  3) A source of ribbed mussel seed is needed, now!
- 4) A pilot project identifies permitting challenges...
- 5) Nutrient and plankton ecology in the East River tidal strait is WAY different than expected!
-  6) Site evaluation must be done before even pilot-scale deployment!
-  7) Partnerships, planning, patience, persistence...

# Special Thanks To:

Genevieve Bernatchez, Kelsey Boeff,  
Marguerite Petit, Daphne Belfodil, Franck Brulle,  
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Sophie DeDecker, Yann Reynaud, Adam Green,  
Dawn Henning, The Rocking the Boat Interns, Joe  
Haas, Michael Rubino, NYC Department of Sanitation.



# What we learned about Hunts Point

