

2<sup>ND</sup> ANNUAL  
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CONFERENCE

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*Linking Science with Local Solutions and Decision-Making*

# Nitrogen Uptake in Shellfish: What's in our local oysters and clams

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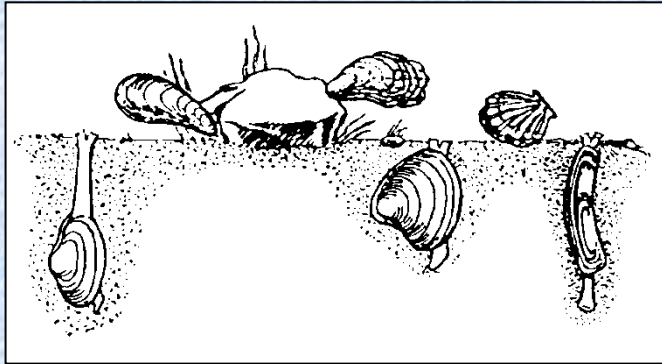
# The Mighty Bivalve ...to the N Problem Rescue?



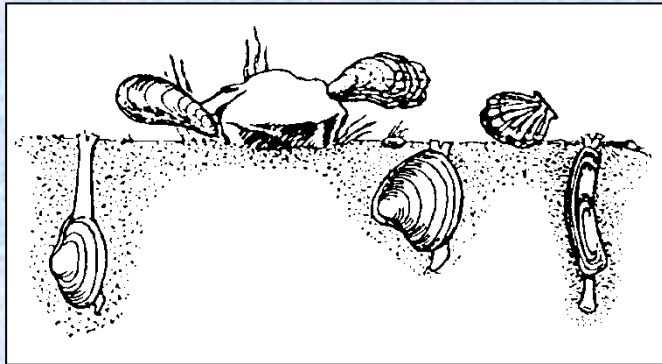
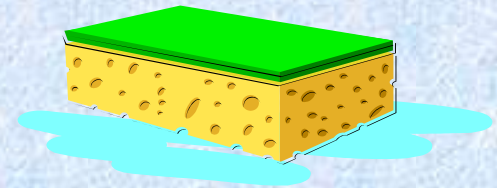
- So shellfish contain nitrogen...
- Still questions:
  - Where do shellfish fit in with nitrogen and potential removal of nitrogen?
  - **How much nitrogen is in our local shellfish?**
  - How do we credit shellfish?



# Shellfish and Nutrients



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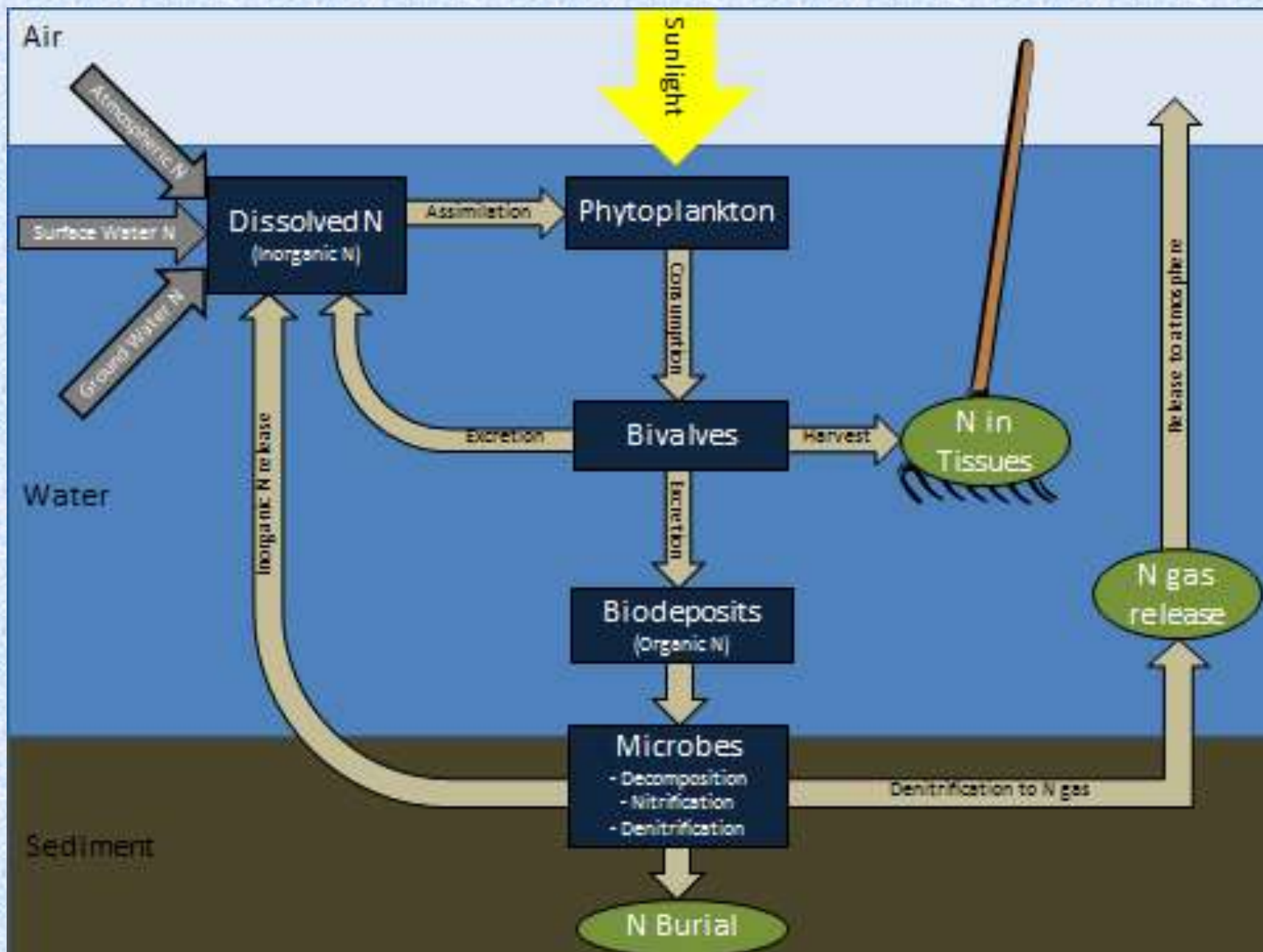


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# Areas for Potential Nutrient Removal (green ovals)

Adapted from: Newell et al. 2002 and <http://oyster.agecon.vt.edu/Nutrient.htm>



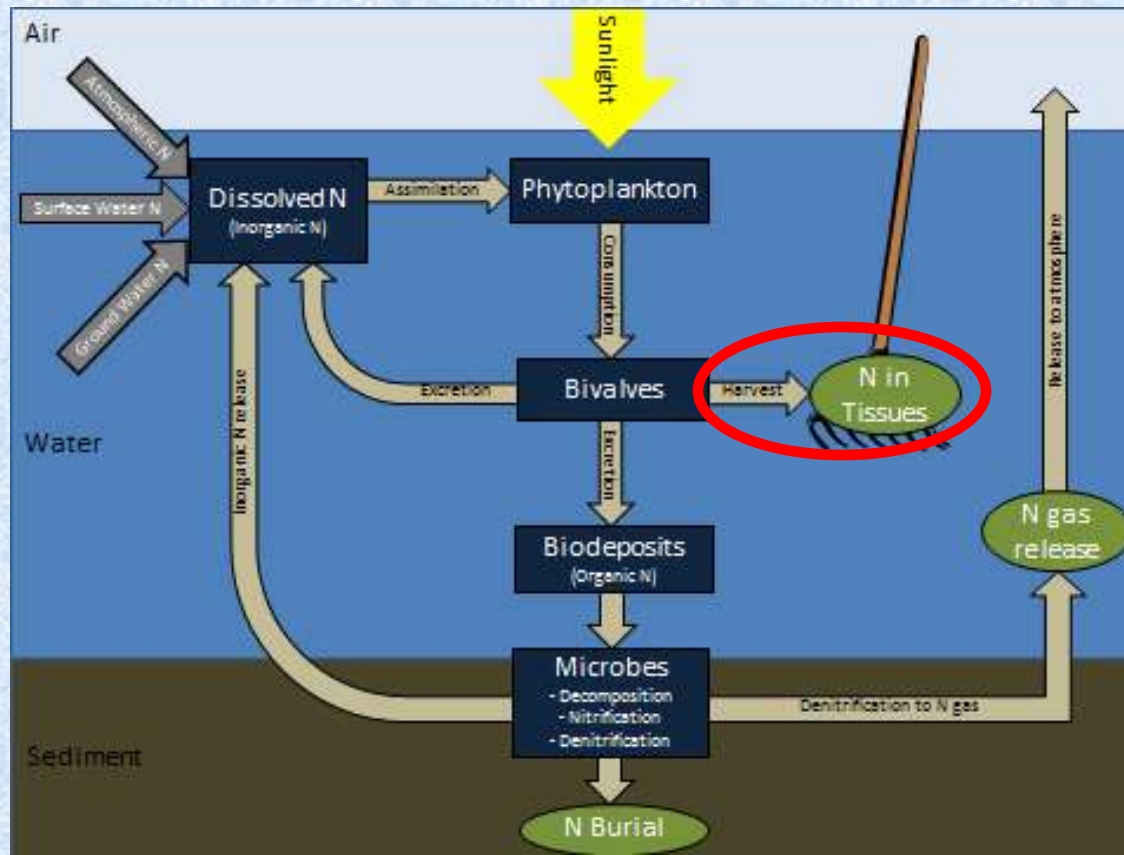
# Nitrogen Removal by Denitrification or Burial



- Many questions remain about these processes:
  - What are the levels of removal, or ranges?
  - Does species or density of bivalves make a difference?
  - How do these processes apply to shellfish aquaculture?
  - How variable are rates in different marine environments?
  - How would we credit or quantify these forms of N removal?

# Where do we start?

- 3 areas of potential removal
- Most easily measured and likely more consistent – N in tissues
  - Also can provide economic activity and jobs



# What's in our local shellfish?

- Sampled June and Oct 2012
- Selected 4 per group, at typical harvest size
- Quahogs: 1-1.5" hinge width - little necks
  - Wild – 6 sites
  - Cultured – 5-6 sites
- Oysters: 3-3.5" if at all possible
  - Wild – 4 sites
  - Cultured, on-bottom – 6 sites
  - Cultured, off-bottom (any gear) – 8 sites
- Cooperation from a lot of folks to get samples
  - Town shellfish programs and private growers
- We collected and measured them, Boston University did the shell and tissue analyses (the hard part)

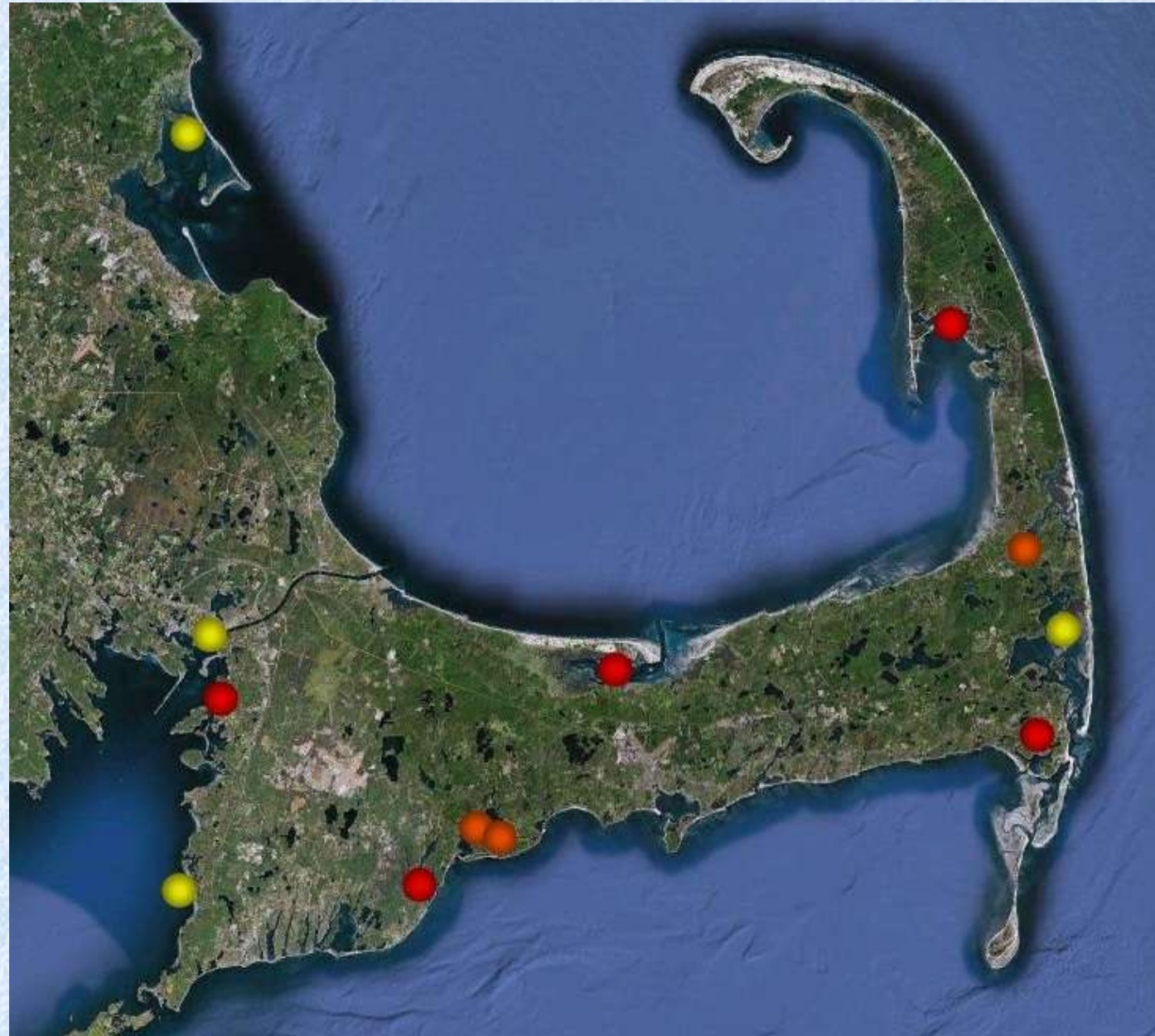


# Sample Sites

**Yellow:** just oysters

**Orange:** just quahogs

**Red:** both



Differences???:

- Species?
- Water body?
- Growing Conditions?



# Summary and Comparison

Cape Cod Oyster and Quahog Data Summary							
	Shell Length (mm)	Shell DW (g)	Tissue DW (g)	Tissue %N	Shell %N	Total N (g)	Total % N (DW)
<i>Overall average from Cape Cod</i>							
Oyster	83.8	40.9	2.43	8.01	0.24	0.28	0.69
Quahogs	56.1	31.2	2.22	7.69	0.18	0.22	0.67
<i>Oysters from Cape Cod</i>							
Wild	82.7	46	2.42	8.2	0.26	0.31	0.67
Cultured On	84.9	47.4	2.7	7.89	0.26	0.32	0.65
Cultured Off	83.1	35.7	2.36	7.95	0.21	0.26	0.7
<i>Quahogs from Cape Cod</i>							
Wild	57.1	32.6	2.43	7.5	0.18	0.24	0.67
Cultured	54.95	29.6	1.99	7.9	0.17	0.21	0.66
<i>Wild oysters from reefs in Chesapeake (Newell 2004)</i>							
	76	150	1	7	0.3	0.52	0.34
<i>Cultured floating cage oysters - Chesapeake (Higgins et al. 2011)</i>							
	85.5	37.6	1.58	7.28	0.17	0.18	0.45

Adapted from: Newell and Mann 2012

- Comparison with Chesapeake oyster data

# Quahogs & Oysters: Different Animals

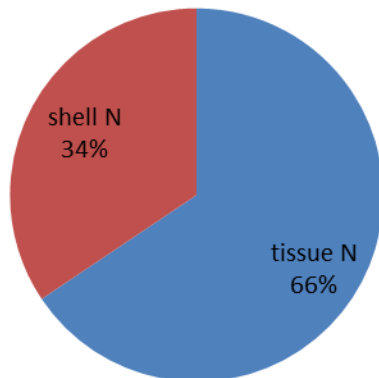
Cape Cod Oyster and Quahog Data Summary

	Whole Wt (g)	Shell DW (g)	Tissue DW (g)	Tissue %N	Shell %N	Total N (g)	Total % N (DW)
oysters	66.1	40.9	2.43	8.01	0.24	0.282	0.686
quahogs	51.7	31.2	2.22	7.69	0.18	0.221	0.665
Difference	*Yes	*Yes	No	*Yes	*Yes	*Yes	No

- Size is the biggest difference
- Oysters averaged higher %N in tissue and shell

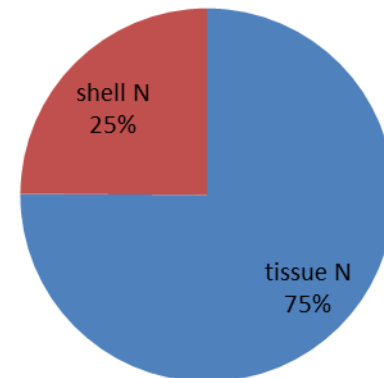
Oyster Nitrogen Contributions

0.282 g N  
Total



Quahog Nitrogen Contributions

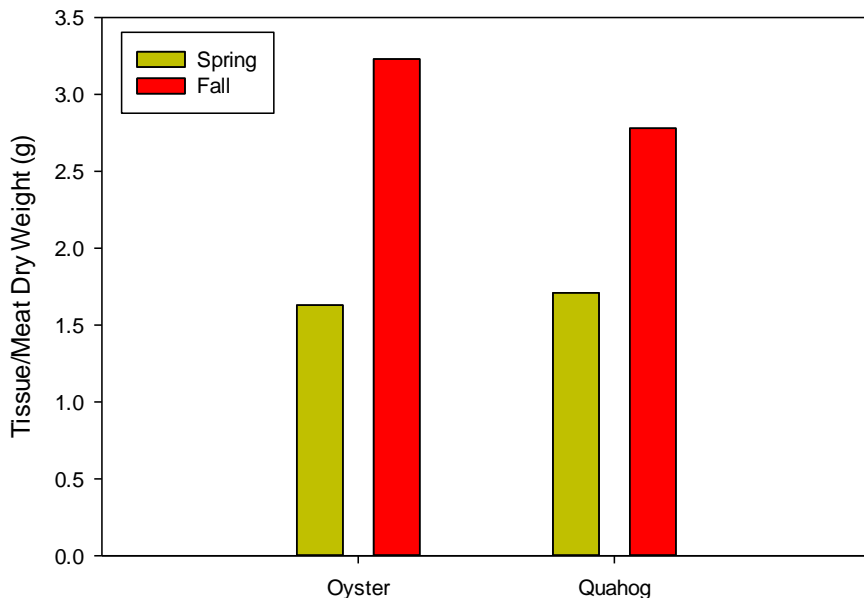
0.221 g N  
Total



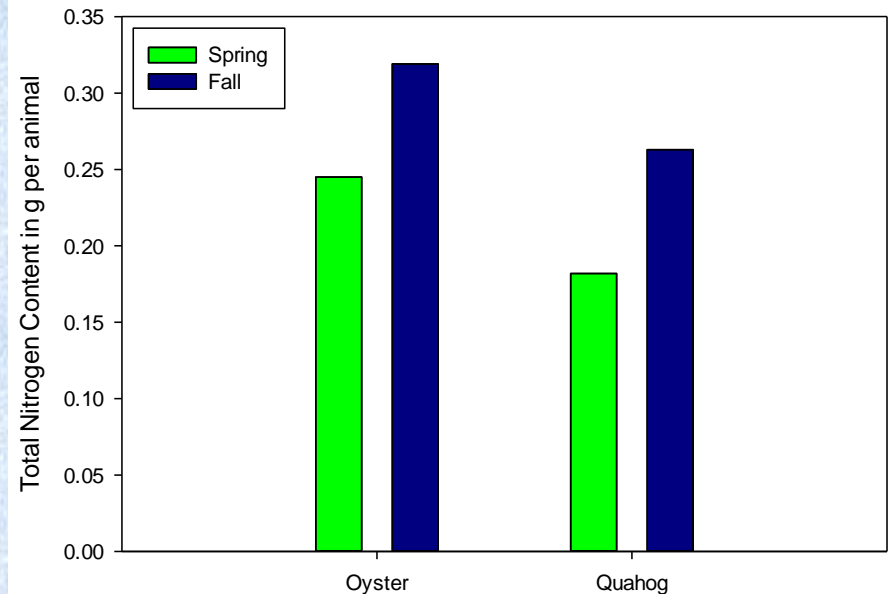
# Difference by Season

- Tissue or meat content was much higher in Fall
  - 98% and 63% more for oysters and quahogs respectively
- %N in the meat dropped a bit in fall
  - Tissues have more glycogen reserves, less % protein in fall
- Shell was similar, spring to fall

Differences in Oyster and Quahog Tissue by Season

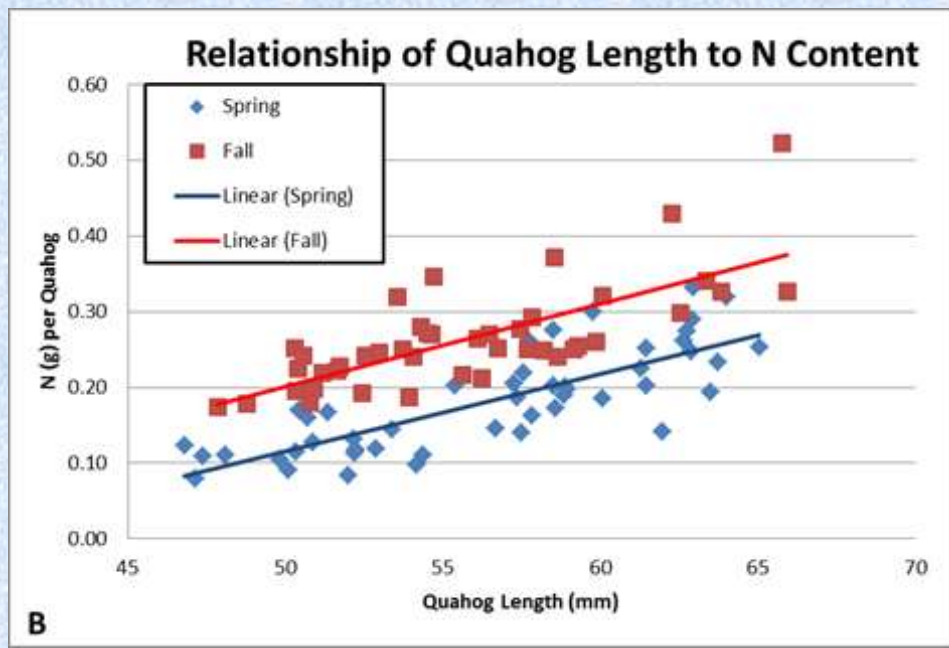
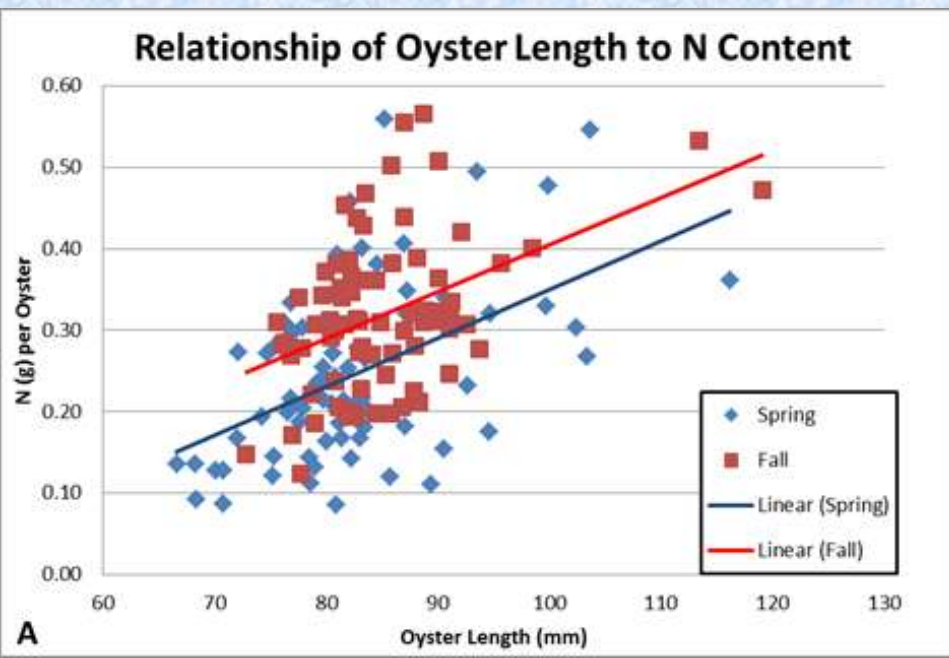


Oyster and Quahog Total N Content by Season



# Relationship of Size and N Content

- Despite our best intentions to sample the exact same size everywhere
- Direct relationship to length (and weight)



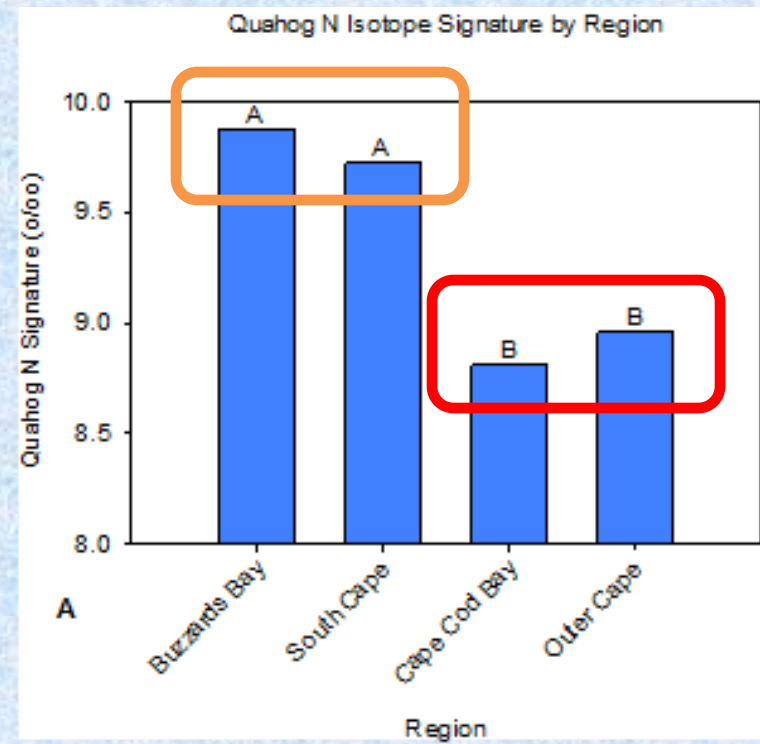
# Other Notable Comparisons....

- Wild quahogs were not any different from cultured quahogs
- Wild oysters, and those grown on the bottom had heavier shells than oysters grown off the bottom (or grown in the water column)
- There were small differences between water bodies
  - Health of animals at point of sampling was a factor we did not account for

# Isotope Signature Data

- Heavier N15 ratio with increased N from human sources – i.e. waste water
  - Signature 9-10 ‰ in quahogs indicates >50% N is wastewater (Carmichael et al. 2008)

- Differences by site
- Differ by water body
  - Cape Cod Bay
  - Buzz Bay/South Cape



# Extraction Potential???

- Oyster harvest from town propagation program:
  - Harvest of 5000 peck baskets, or 250,000 oysters
    - 50 oysters/peck = 250,000 oysters
  - On-bottom culture method average = 0.32gN/oyster
    - At ~3.5 inch average
  - Harvest would include 176 lbs of N
- N equivalent:
  - Conventional septic inputs from 26 homes
    - 2 people per household
  - Sewage treatment of 196 people  
(N values from <http://www.cbf.org>)



# Extraction Potential???

- 90,000 lbs. of quahogs harvested from a particular water body, about 1200 bushels
  - 3906 lbs of meat tissue x 7.7%N = 301 lbs N
  - 54,360 lbs of shell x 0.18%N = 98 lbs N
- Total 399 lbs of N removed with harvest
- N equivalent:
  - Conventional septic inputs from 59 homes
    - 2 people per household
  - Sewage treatment of 443 people  
(N values from <http://www.cbf.org>)





# Challenges...



- Available space
  - State approved waters, not infringing on protected
  - Limited/no user conflicts, NIMBY
- Environmental challenges
  - Extreme weather
  - Predators, pests, and disease
- Need accurate harvest size (# and weight) to accurately quantify
  - Commercial may be easier than recreational





# Summary



- Oysters at 3-3.5" - 0.282g N (0.69% of DW)
  - Shell weight varied
- Quahogs (littlenecks) - 0.221g N (0.67% of DW)
  - Not much difference wild or cultured
- Size and time of year make the biggest difference in amount of N contained
  - Fall more than spring
  - Bigger means more N – more tissue
  - Most accurate N removal would be measured by weight of shellfish harvested not #
- Denitrification/burial of N?????????

# Thank You

## Questions?

- Data is available in hard copy form:
  - Technical Report
  - Extension Bulletin
- Contact: Cape Cod Cooperative Extension or Woods Hole Sea Grant
  - [jreitsma@barnstablecounty.org](mailto:jreitsma@barnstablecounty.org)
  - 508-375-6950