



The problem of hard clam overwinter mortality

- Unexplained, highly variable, site specific winter mortalities are considered the principle obstacle for the development of aquaculture of this species
- Winter survival of the notata strain is as low as 0%
(Gionet et al. 2008)
- These losses create an unknown risk to the aquaculture industry
(Bricelj et al. 2007)



Stress response from pre-winter declining temperatures

Lipid remodeling in wild and selectively bred hard clams at low temperatures in relation to genetic and physiological parameters

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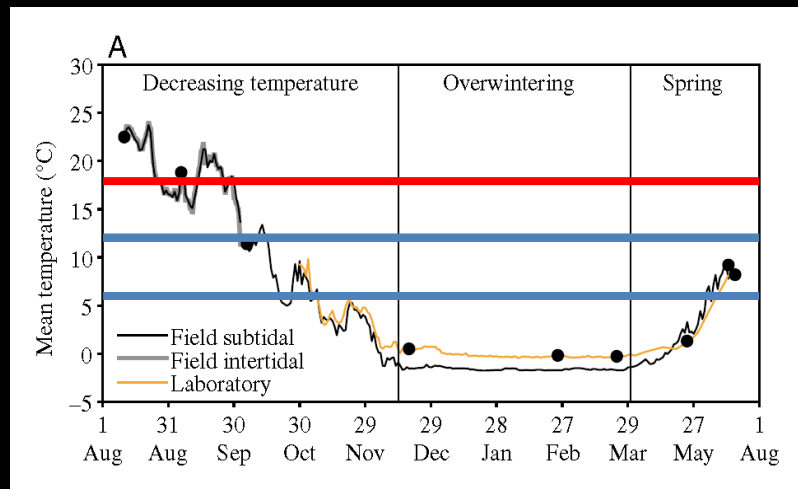
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Changes in fatty acids occurred during 2 phases of temperature decline (Pernet et al. 2006)

- 18°C to 12°C
- 12°C to 6°C



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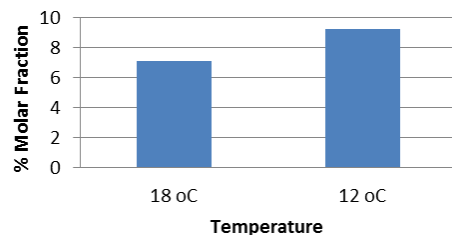
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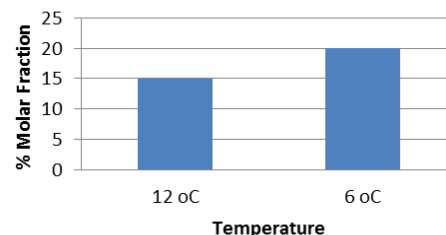
- 18°C to 12°C
- 12°C to 6°C:



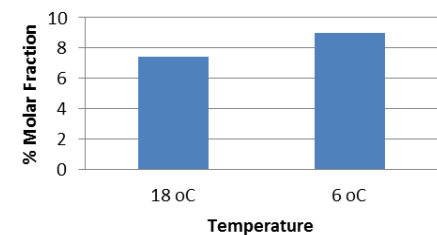
EPA 1st phase temperature decline:
29.4% increase



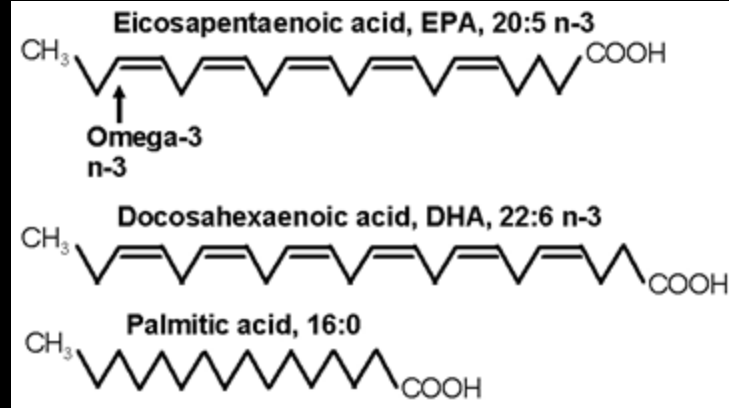
DHA 2nd phase temperature decline:
34.6% increase



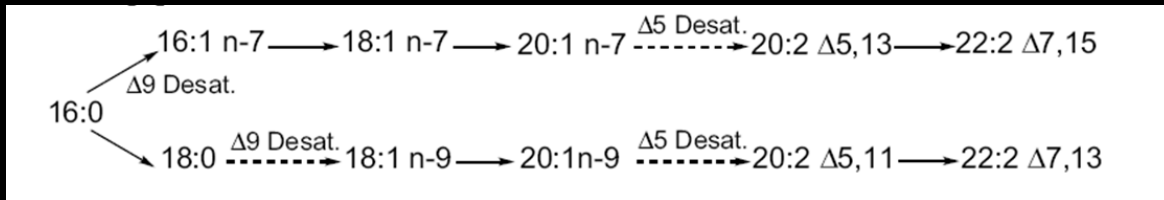
22:2 NMIs total temperature decline:
21.6% increase



What are 22:2 NMIs?



- NMI synthesis from 16:0, palmitic acid (Zhukova 1986):



- They have been found in reverse relation to EPA and DHA (Klingensmith 1982)



Why is lipid remodeling important?

Hard clams respond to the stress of thermal decline by regulating cell membrane viscosity according to HVA

Homeoviscous Adaptation—A Homeostatic Process that Regulates the Viscosity of Membrane Lipids in *Escherichia coli*

(spin-labeling/phase transitions)

MICHAEL SINENSKY

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Communicated by Konrad Block, October 2, 1973

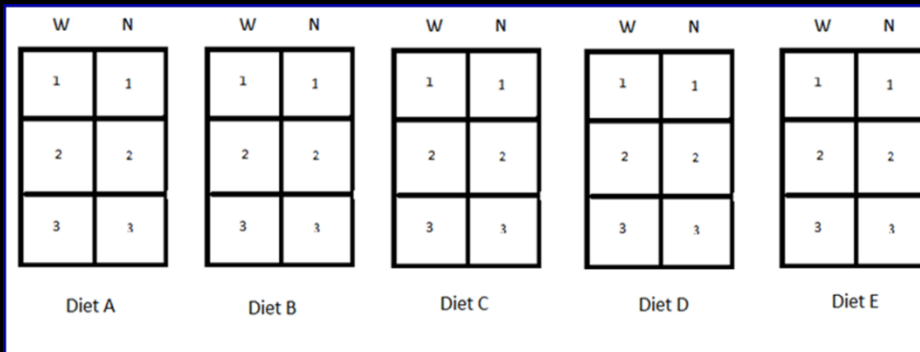
- Unsaturated FAs have been linked to lowering viscosity and increasing fluidity of cell membranes *with lower temperature* (Synensky 1974)



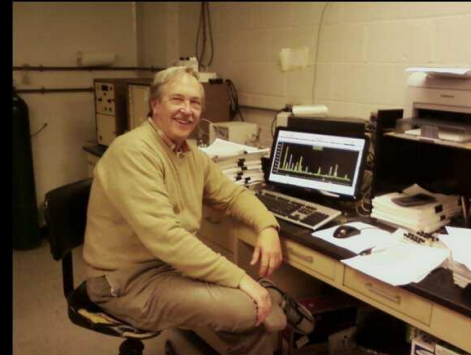
Experimental design

- Five groups of 1200 juvenile hard clams, *Mercenaria mercenaria*
 - Average size 8.1 mm (± 0.71 mm)
- Fed diets with varying amounts of EPA and DHA

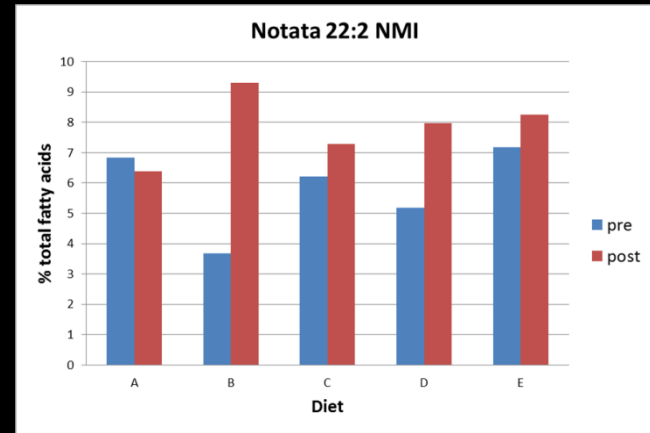
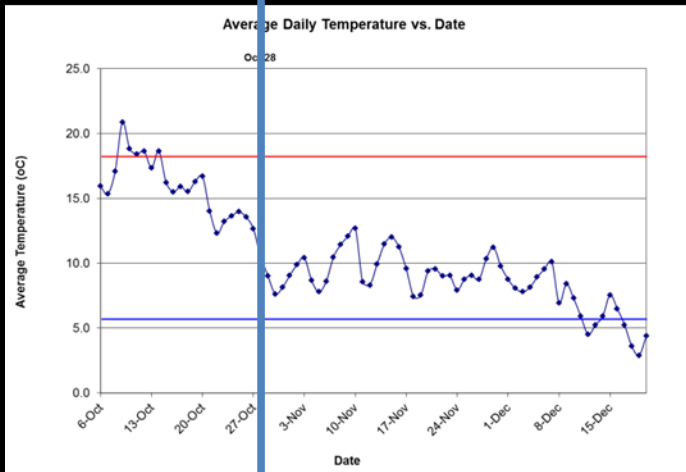
	Diet A	Diet B	Diet C	Diet D	Diet E
DHA	none	high	low	moderate	seston
EPA	none	very low	high	moderate	seston



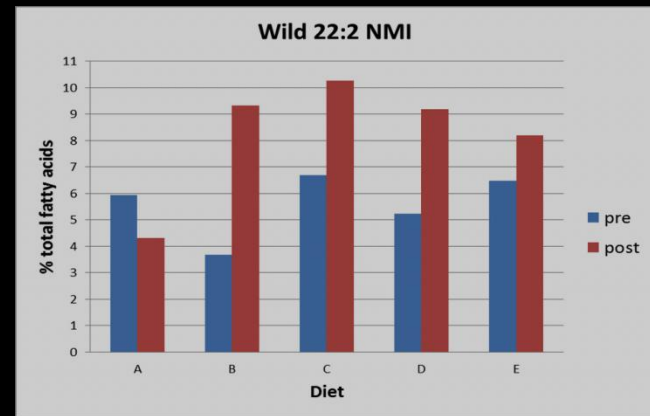
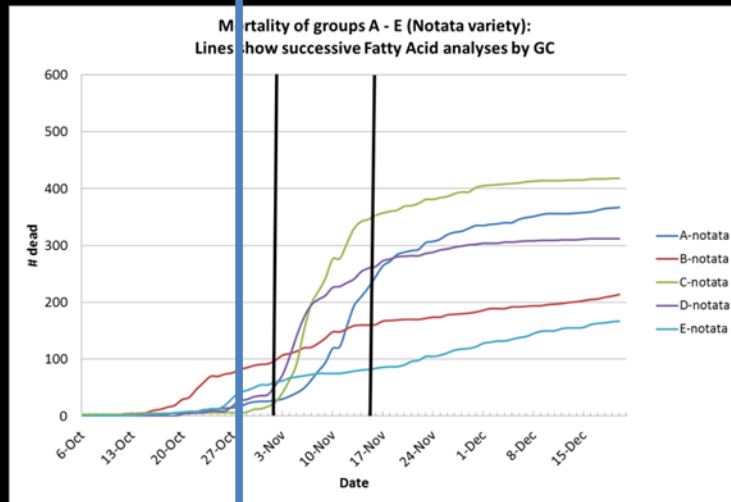
- Temperature regime provided by water bath drawn from benthic zone of Great South Bay, New York
- Mortality removed and counted daily
- FAME were measured by GC biweekly



An unexpected result:

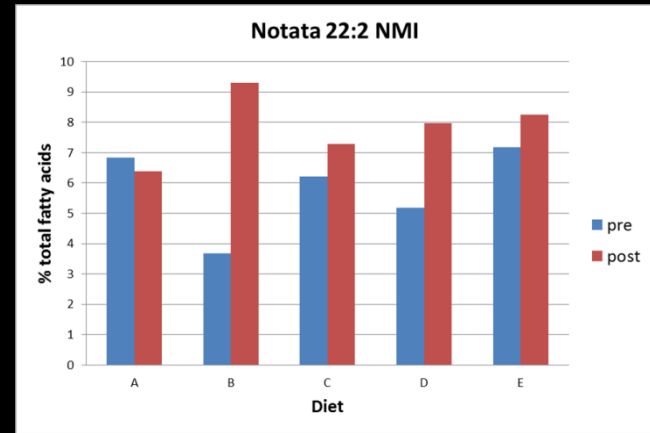
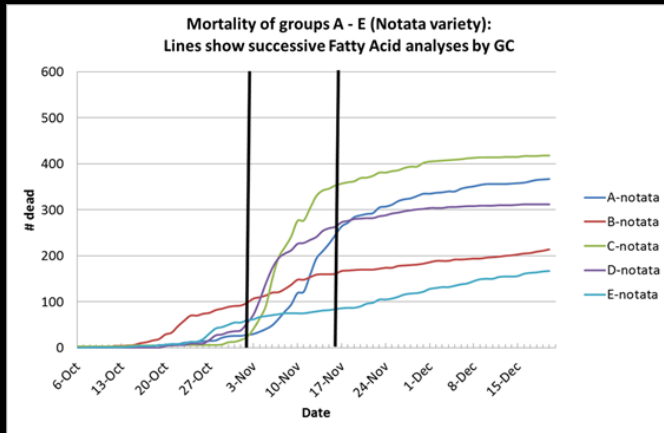


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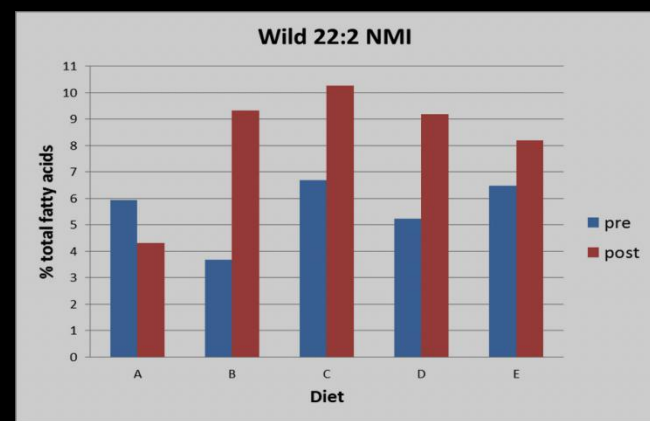
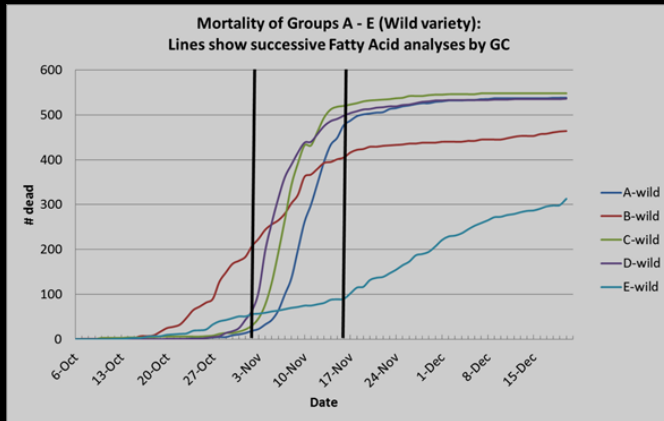


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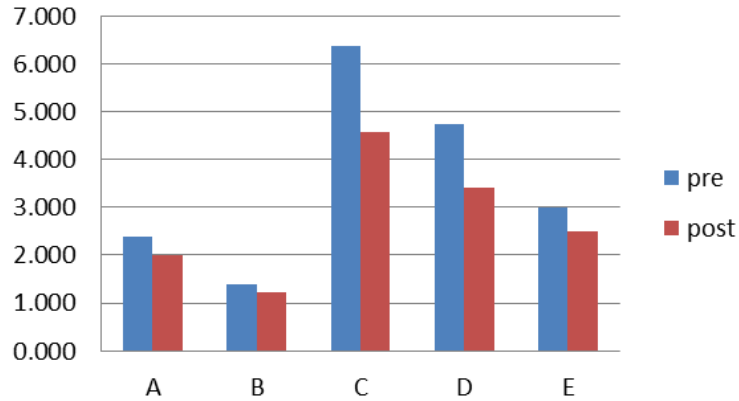
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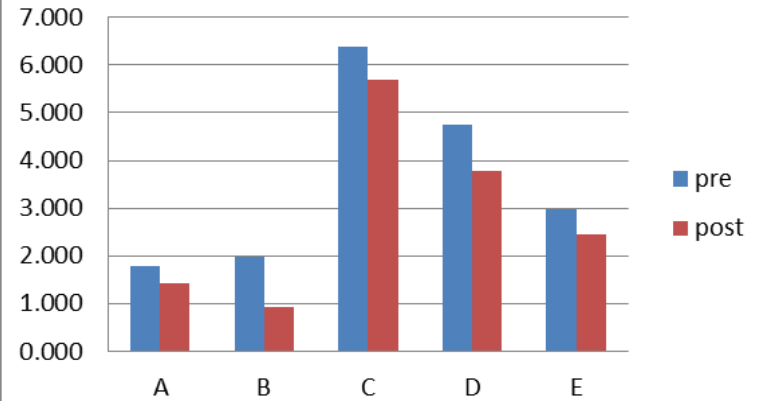
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EPA and DHA

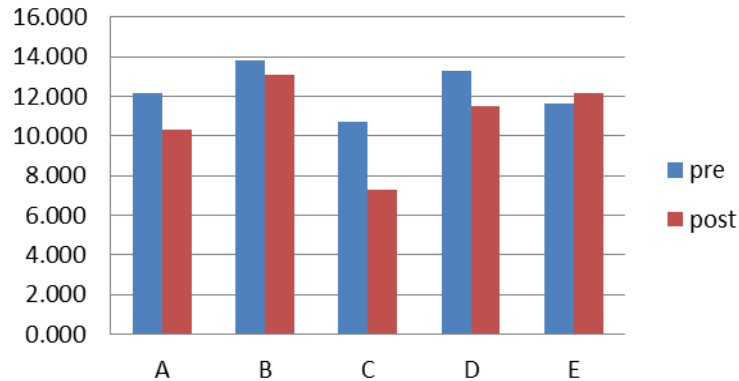
Notata EPA



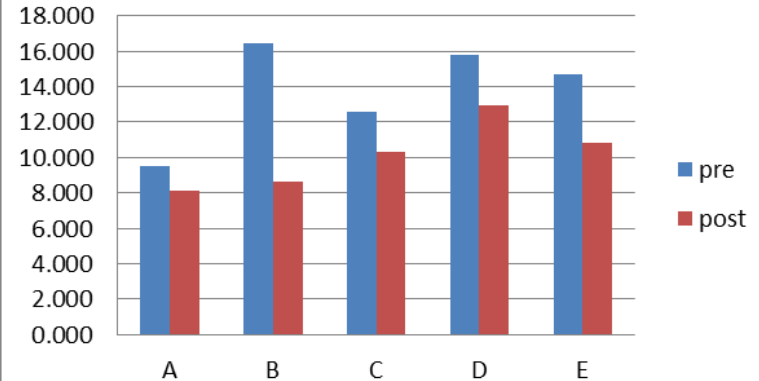
Wild EPA



Notata DHA

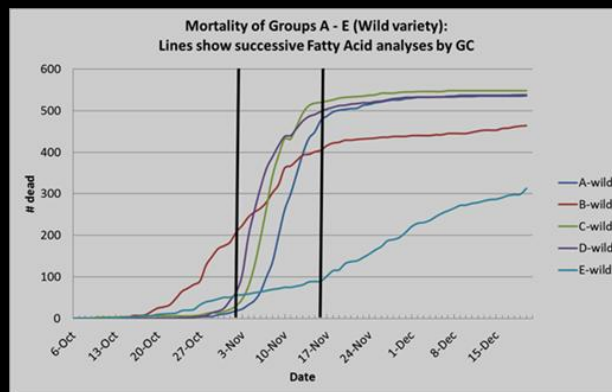
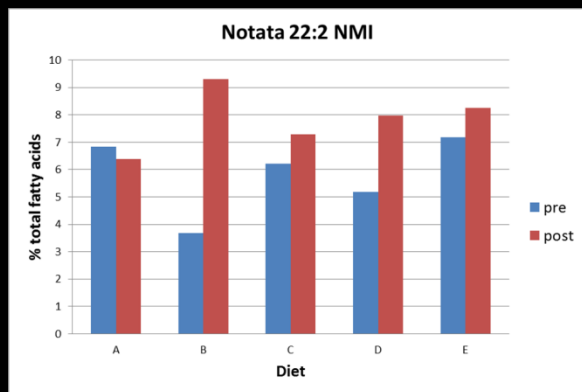


Wild DHA



Conclusions

- The group known as 22:2 NMI fatty acids were a prominent component of the pool of survivors of an abrupt temperature decline
- The only diet devoid of EPA and DHA, Group A, showed a *decrease* in 22:2 NMIs
- Inadequate levels of EFAs in their natural diet may lead to near total loss of juvenile hard clams
- A follow-up study is being performed to track FAs during mild and even temperature decline
 - (1°C per 5 days)
- Questions?



EPA and DHA: initial to post

