Impacts of ocean acidification on mussel byssal threads

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State of ocean acidification

- Certain groups heavily represented
- Limited understanding of mechanisms
- Limited ability to predict ecosystem changes
Ecosystem Questions

• What will ecosystems of the future look like?
Different approaches for different systems

Friday Harbor Labs offers a variety of resources for ocean acidification research
Mesocosm Experiments

• Takes a huge team
• Trying to understand impacts of CO2 on phytoplankton

• http://oceanacidificationfhl.wordpress.com/
FHL analytical chemistry

• Need specialized equipment to measure ocean chemistry

• FHL lab is available to assist outside users
Laboratory Manipulations

- Small aquariums allow manipulating chemistry
- Hold organisms under different CO$_2$ and see what changes
Ecosystem Questions

- What will ecosystems of the future look like?
Ecomechanics:
Hierarchical levels of analysis

Fitness (evolution)

Performance (ecology)

Function (physiology)

Morphology (structure/form)
Mussel Byssal threads

• Critical structure for attachment

• Known dependence on pH

• Unknown effects under realistic conditions

Photo: Matthew Harrington
Mussel Byssal Threads

- Threads are stiff, but with intermediate yield
- Byssus passively responds to forces from different directions

Illustration: Megan Rock
Tested variables

• Biomaterials
  – Byssal thread breaking force
  – Shell crushing

• General Physiology
  – Growth
  – Condition
  – Reproductive index
Mussels grew in all treatments

No noticeable effects on physiology

No effect on force to break shell
Byssus performance

- Decline in force required to break threads

Thread Regions

- No change in the proximal region
- No change in distal yield

Plaque Performance

- Plaques pop off the rock at a lower force

Model Tenacity

- Assume 50 threads
- Incorporate measured properties
- Force to remove in different directions

Mussel Summary

• Mussels under elevated CO₂ may have reduced tenacity

• Concern for ecosystems and aquaculture

• More such mechanistic stories needed
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