Impacts of ocean acidification on mussel byssal threads

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FHL OA lab team

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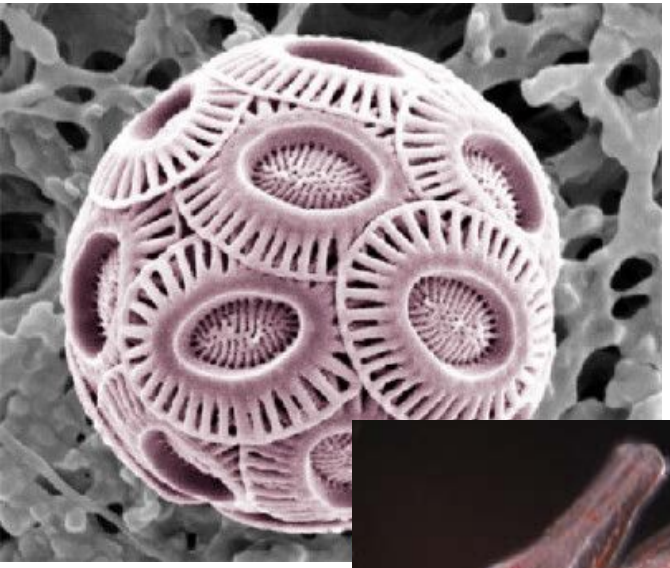
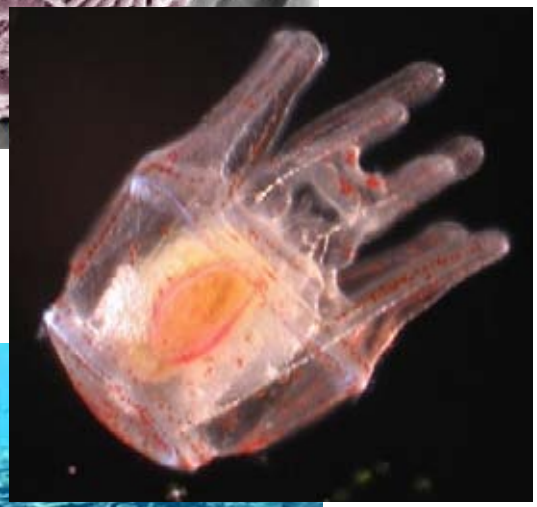
- Michelle Herko
- Laura Newcomb
- Becca Guenther
- Cory Bantam
- Molly Robertsx

State of ocean acidification





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

Ecosystem Questions

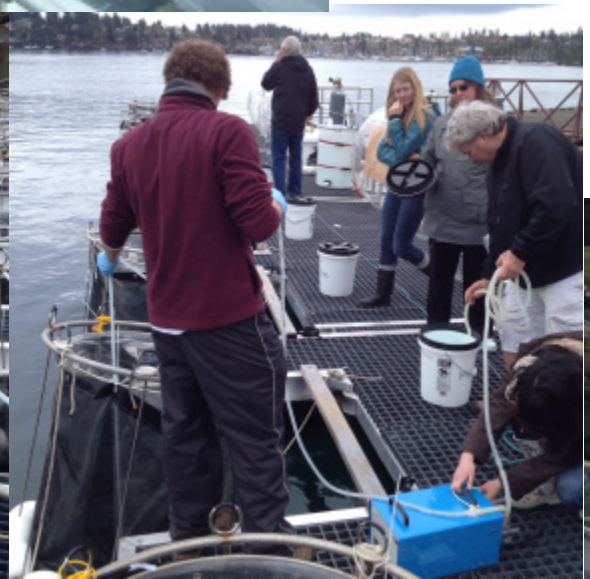
- What will ecosystems of the future look like?

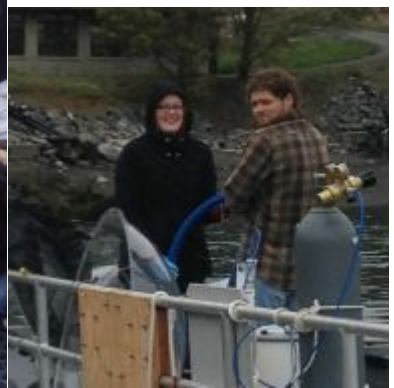
Different approaches for different systems

- 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)

^

v

Performance (ecology)

^

v

Function (physiology)

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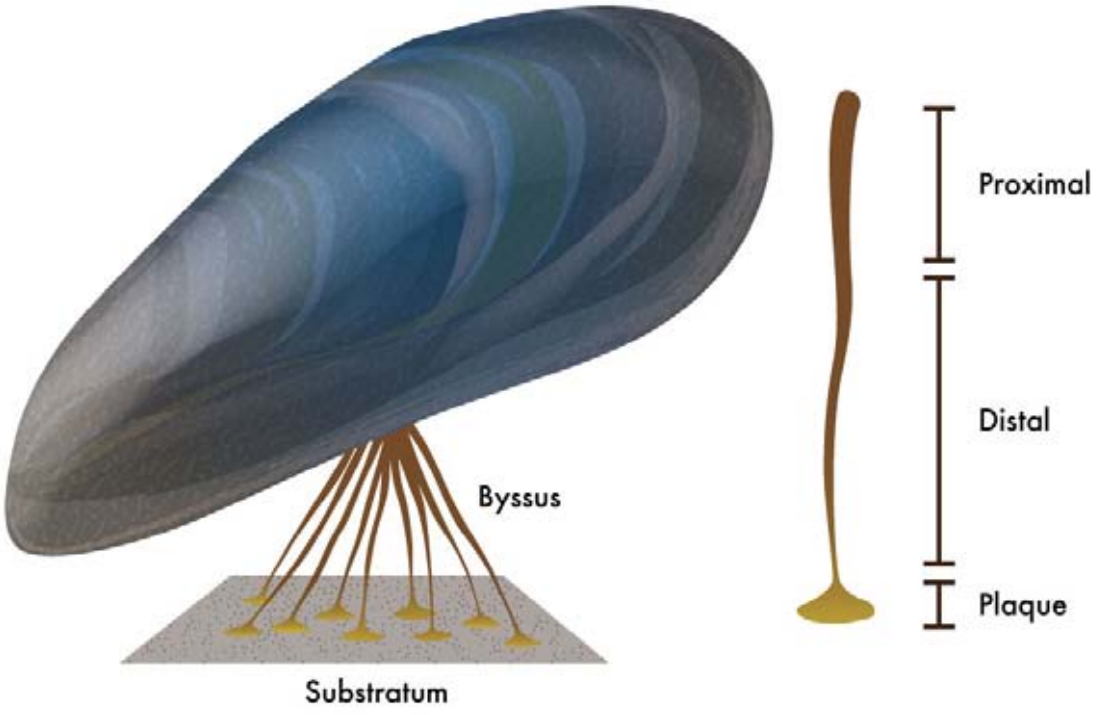
v

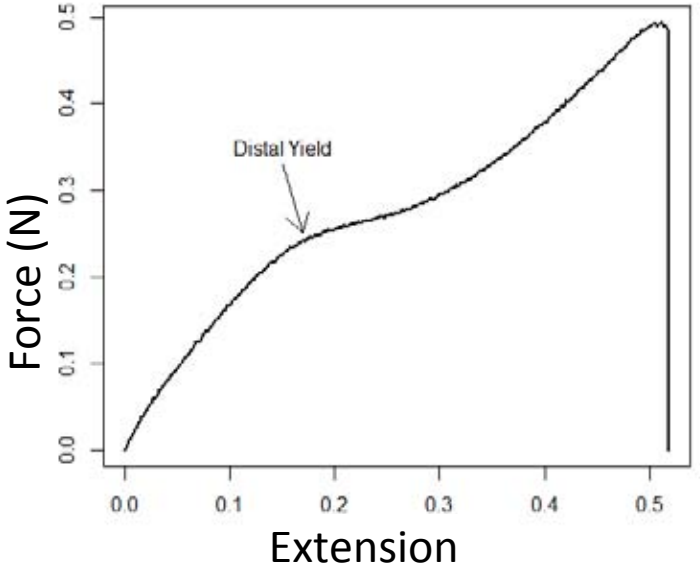
Morphology (structure/form)

Mussel Byssal threads

- Critical structure for attachment
- Known dependence on pH
- Unknown effects under realistic conditions

Mussel Byssal Threads





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

Illustration: Megan Rock

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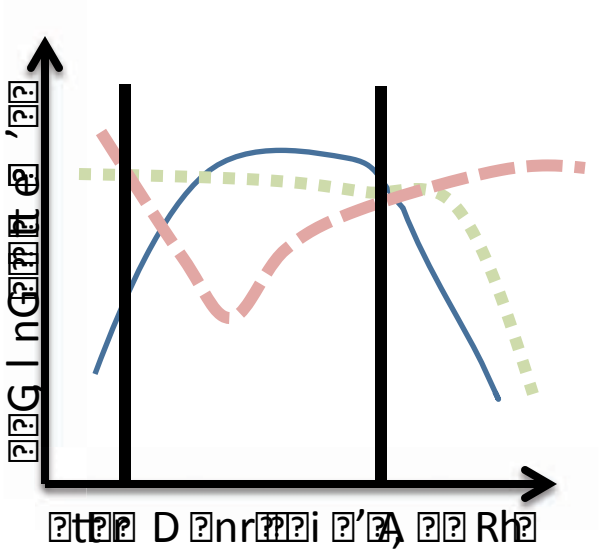

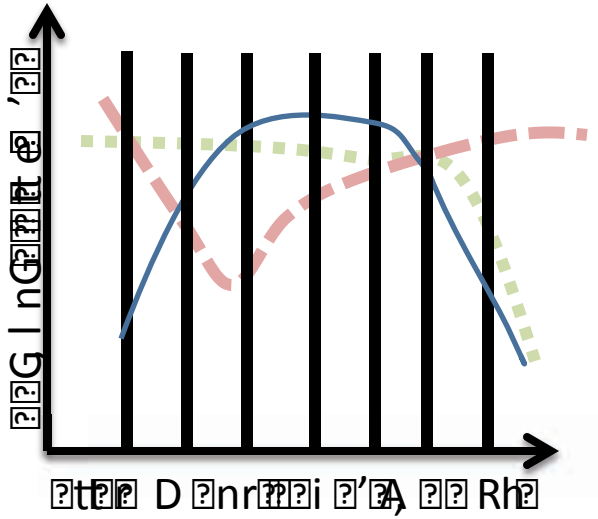

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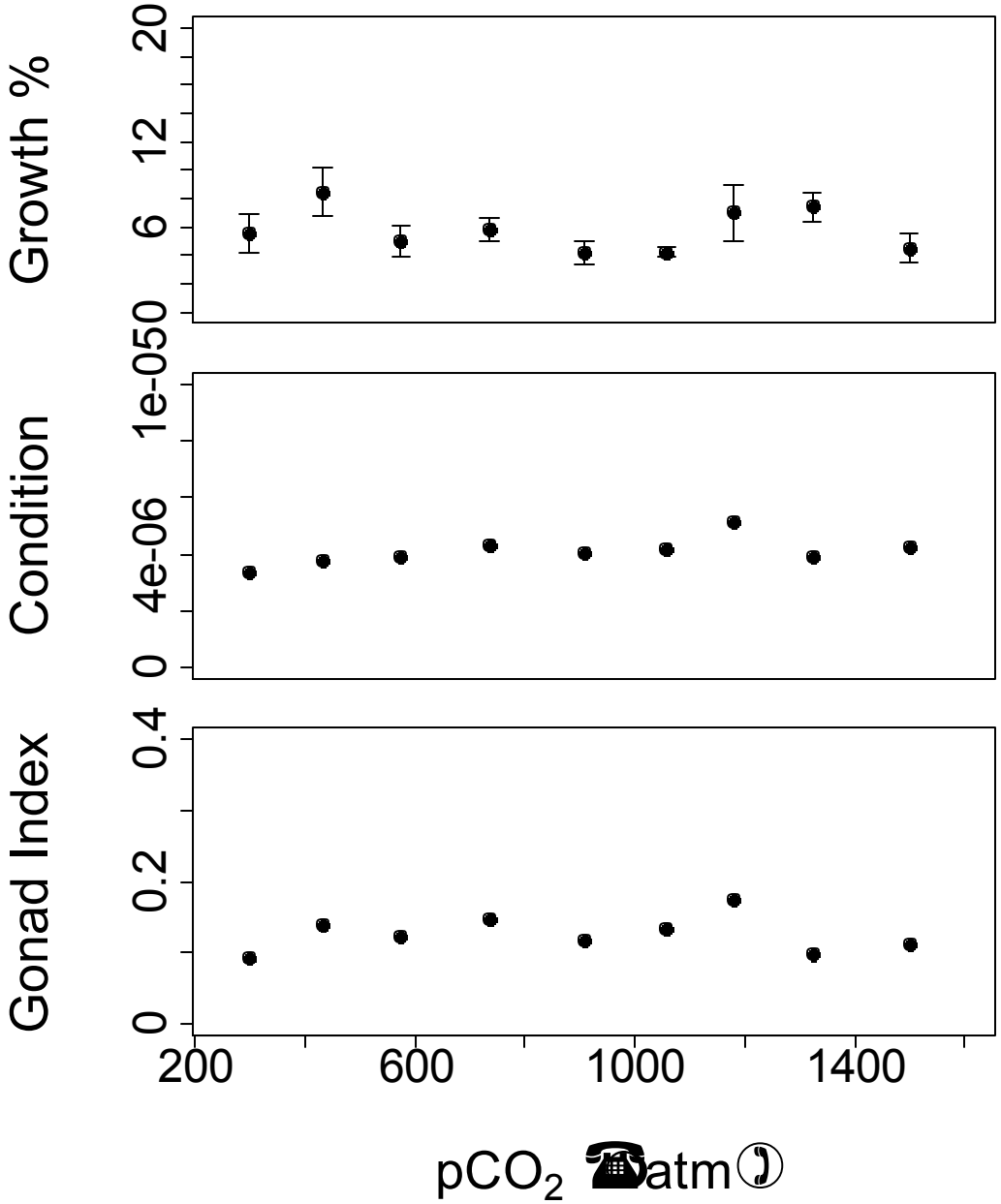
Tested variables

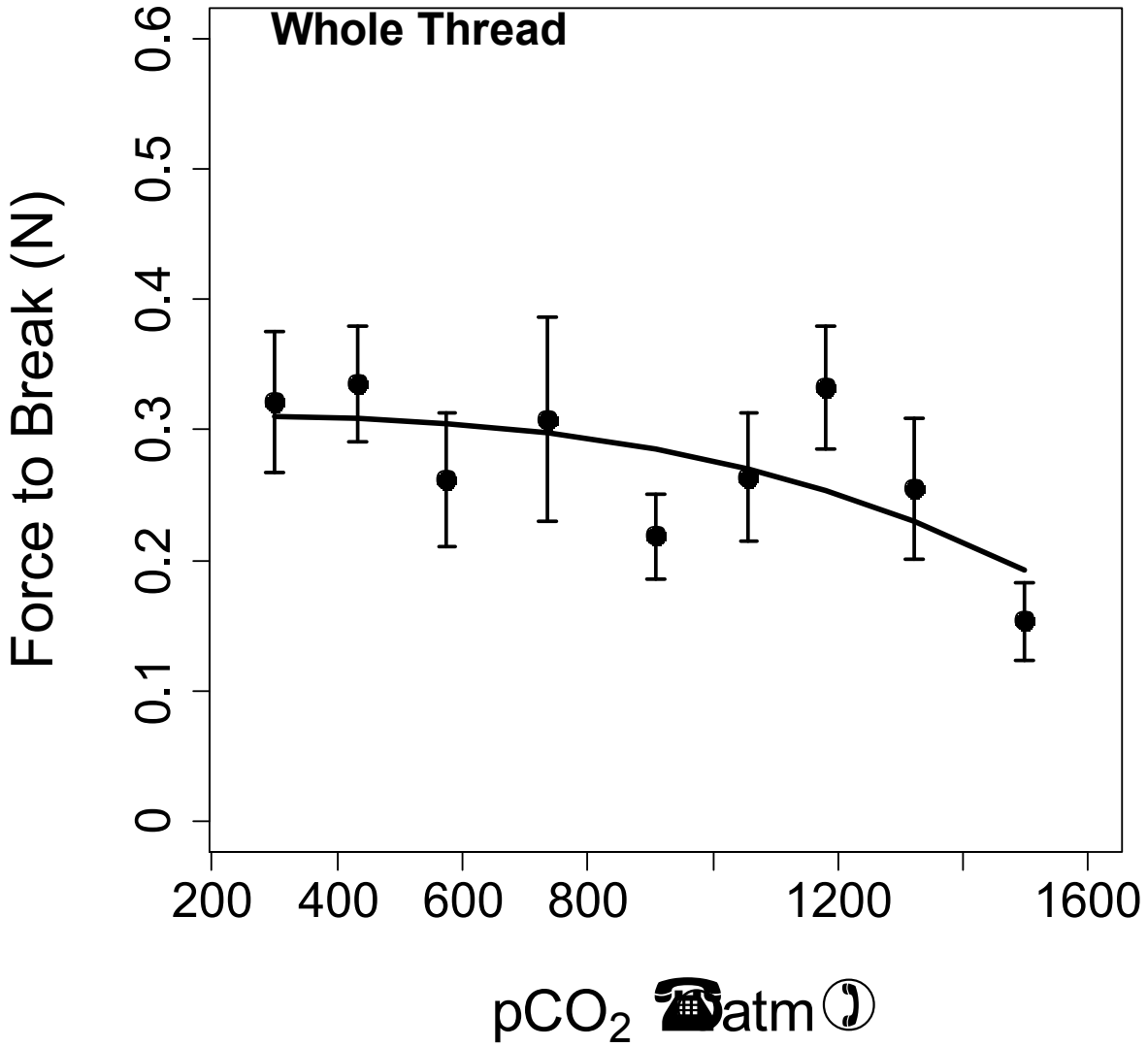
- Biomaterials
  - Byssal thread breaking force
  - Shell crushing
- General Physiology
  - Growth
  - Condition
  - Reproductive index

General Physiology



- Mussels grew in all treatments
- No noticeable effects on physiology
- No effect on force to break shell

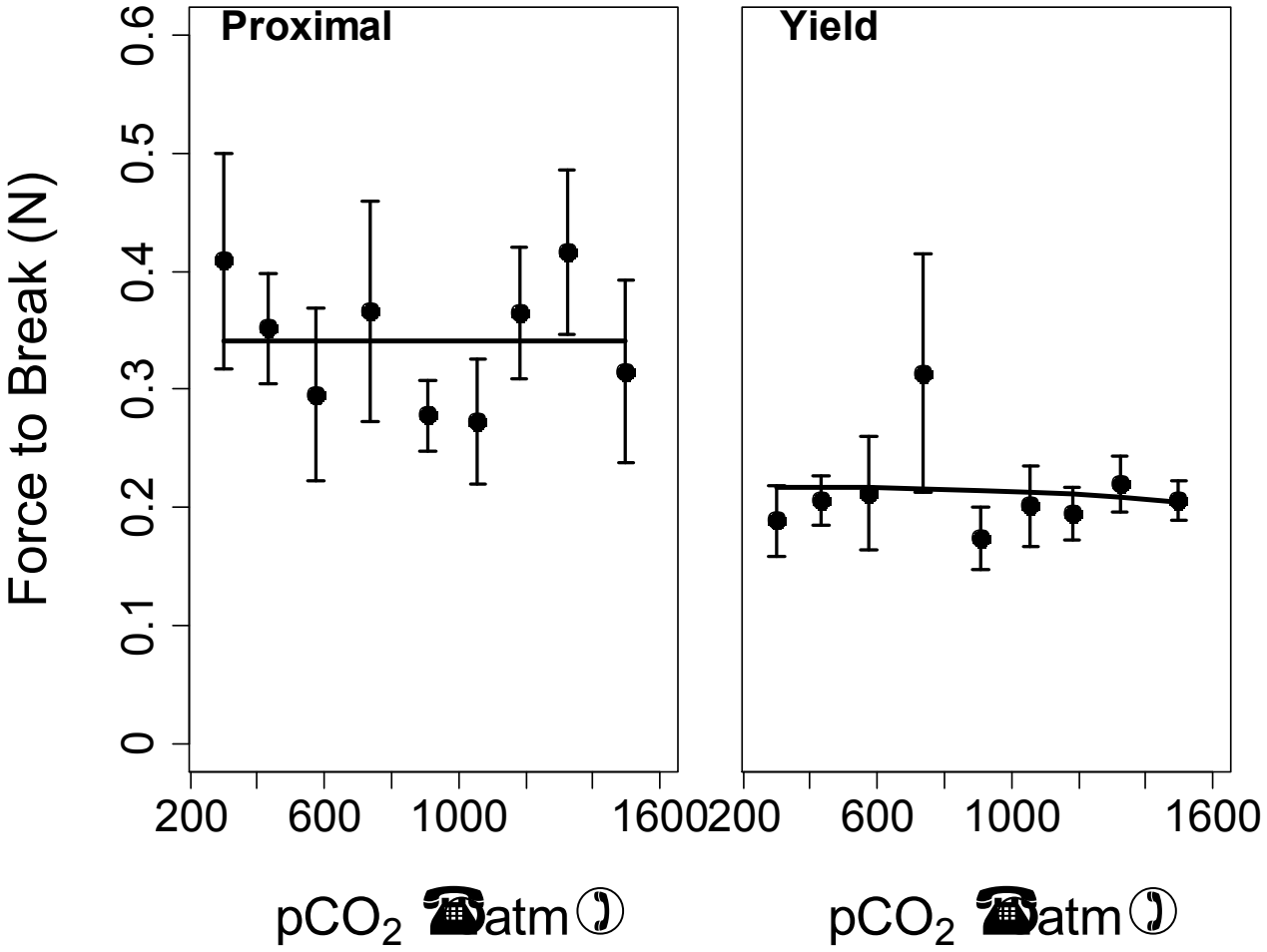
Byssus performance



- Decline in force required to break threads

O'Donnell, George, Carrington. Nature Climate Change (2013)

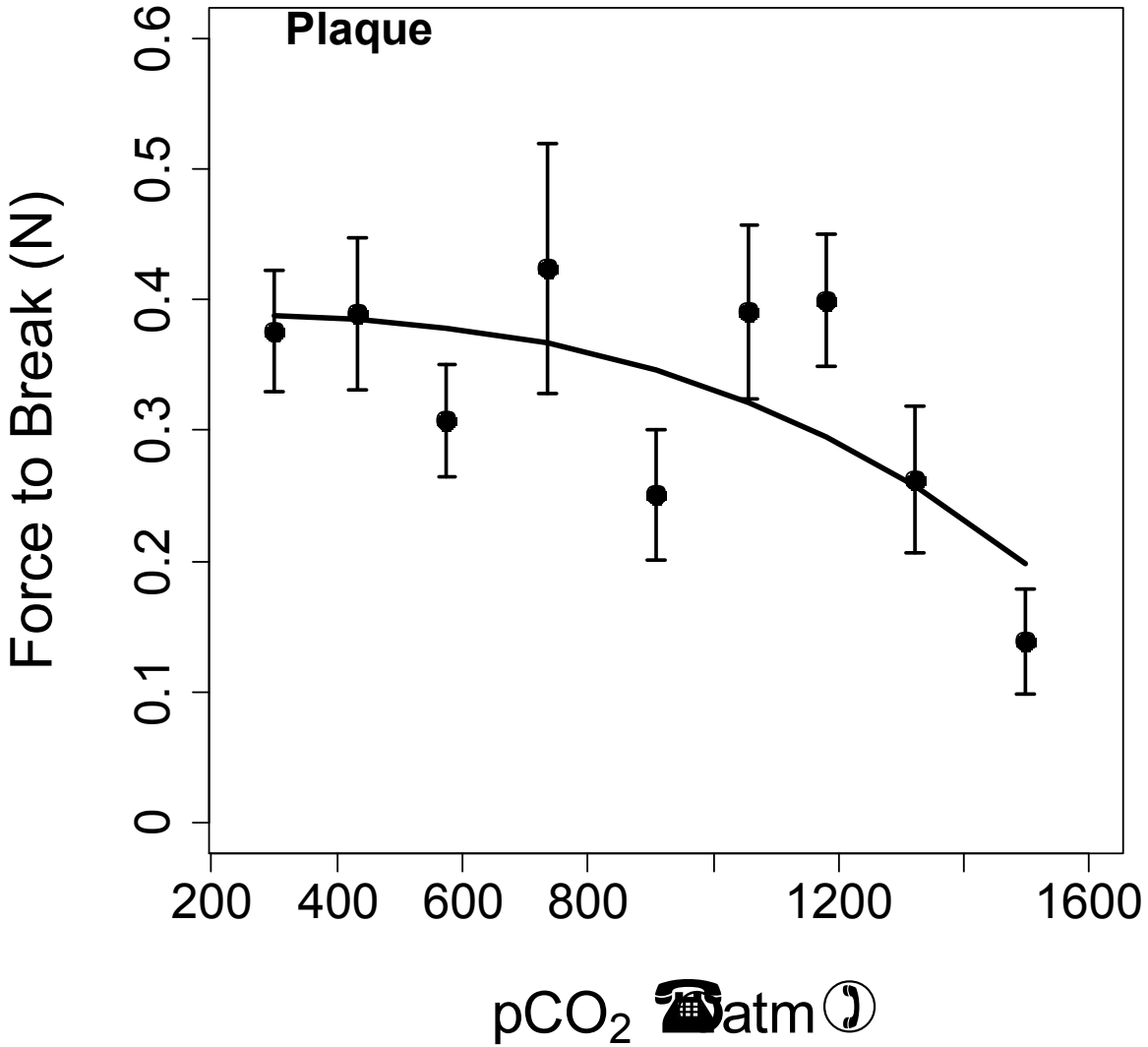
Thread Regions



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

O'Donnell, George, Carrington. Nature Climate Change (2013)

Plaque Performance



- Plaques pop off the rock at a lower force

O'Donnell, George, Carrington. Nature Climate Change (2013)

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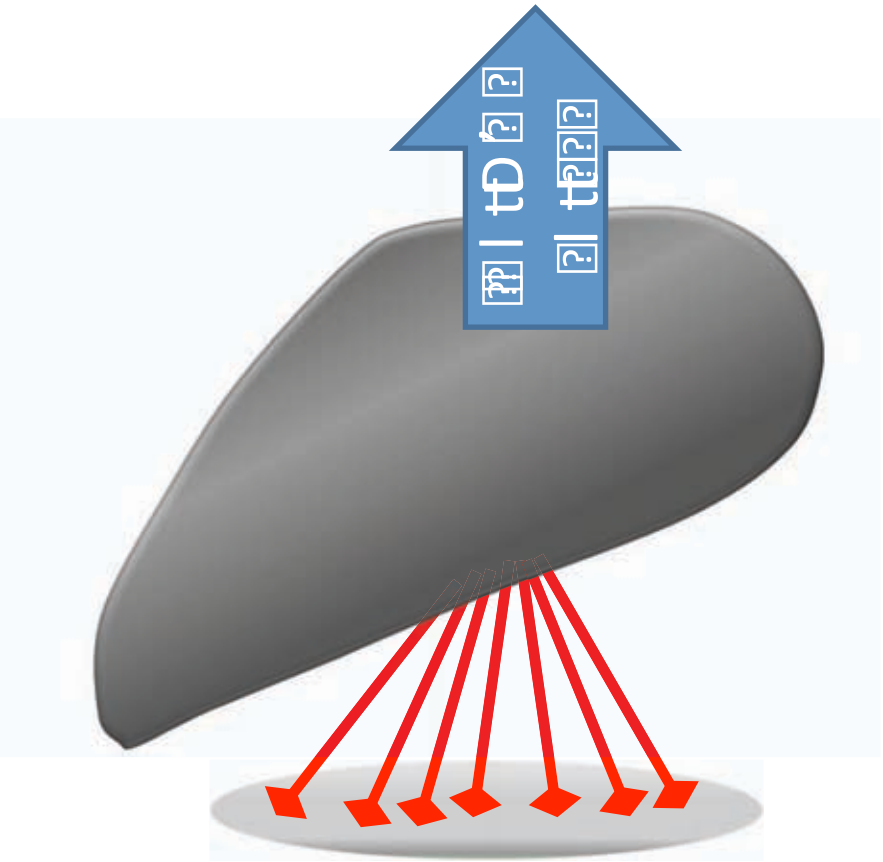

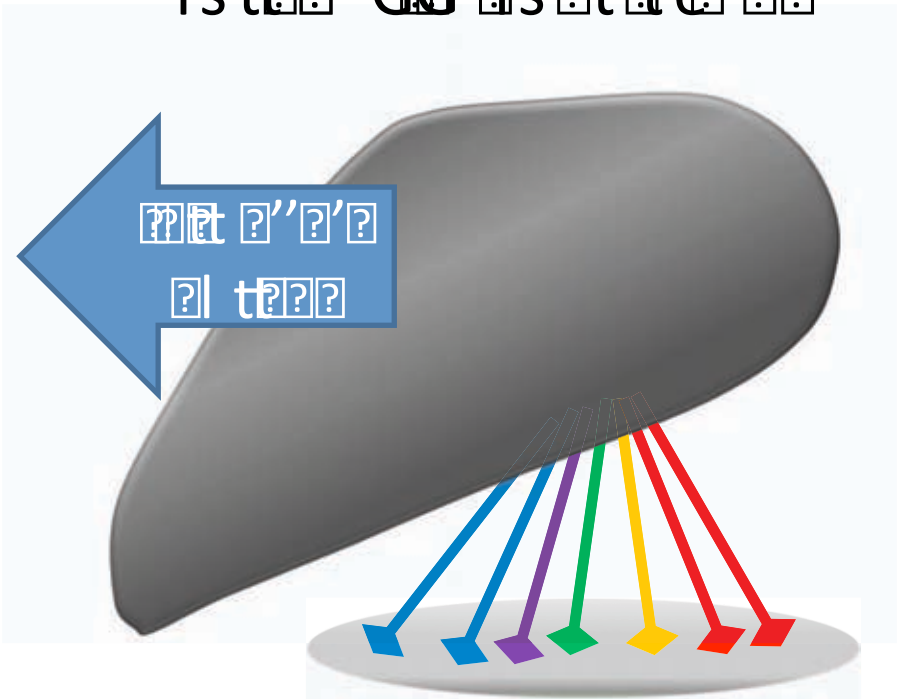

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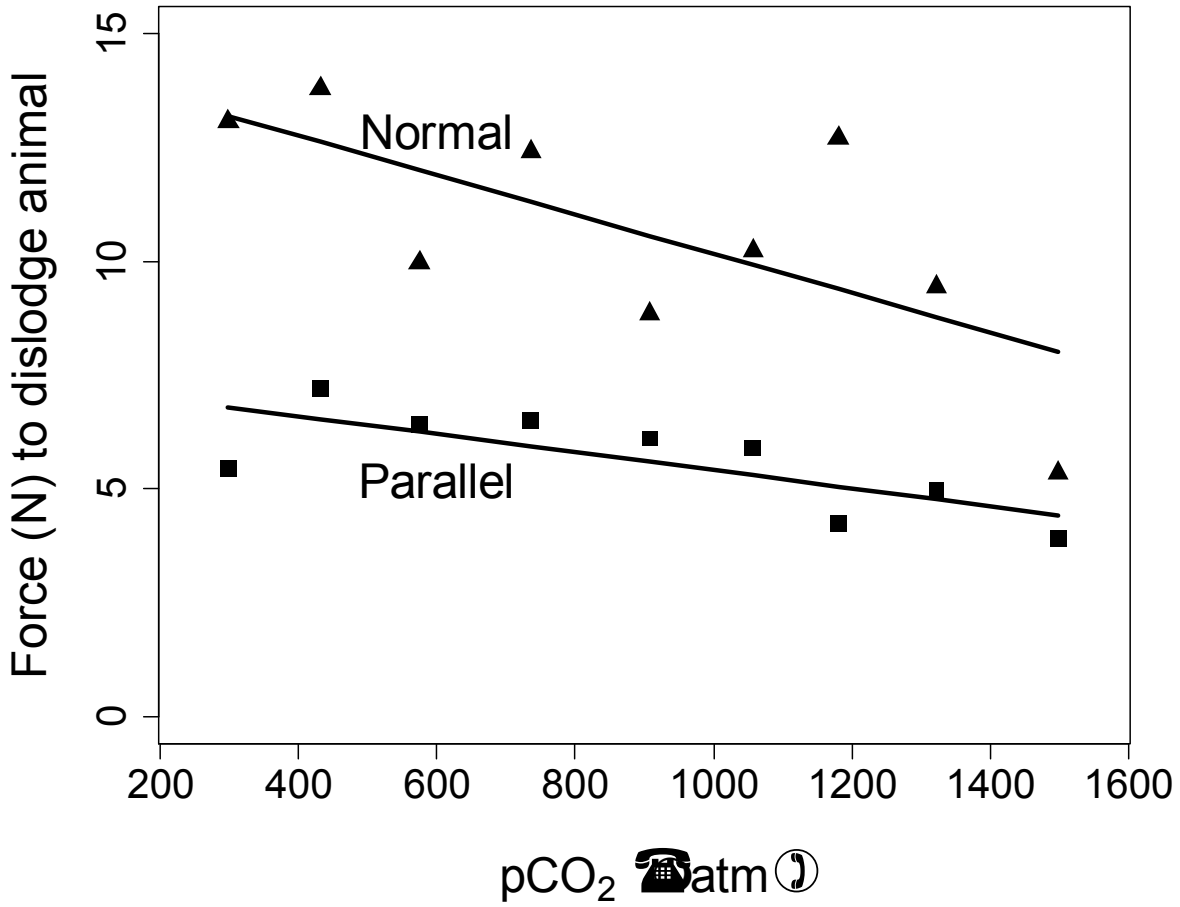
Model Tenacity



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

O'Donnell, George, Carrington. Nature Climate Change (2013)

Mussel Summary

Penn Cove Shellfish

- Mussels under elevated CO_2 may have reduced tenacity
- Concern for ecosystems and aquaculture
- More such mechanistic stories needed

Acknowledgments

- OA lab team
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  - Michelle Herko
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  - Cory Bantam
- FHL staff