Effects of Ocean Acidification on Shellfish

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Oysters & Ocean Acidification

*all life stages affected*

- Larval mortality in hatcheries (Barton et al. 2012)
- Juveniles with slower growth and higher mortality (Timmins-Schiffman et al. 2012)
- Broodstock with lower fecundity (Friedman & Davis unpub.)
Mussels & Ocean Acidification

*all life stages affected*

- Larvae with slower growth and reduced calcification (Kurihara et al. 2008; Gaylord et al. 2011)
- Adults with slower growth and higher mortality, especially with low food (Melzner et al. 2011) and/or high temperature (Gazeau et al. 2014)
Mussel “fall-off” occurs in natural and farmed populations

20-35% of population lost annually
OAEL
Ocean Acidification Environmental Laboratory

Mussels in controlled mixing reservoirs to manipulate:

\[ \text{pH, Temperature, Food Supply} \]

Byssal thread strength
Mytilus trossulus weak attachment at low pH

O'Donnell et al. 2013
Mytilus trossulus weak attachment at low pH

O’Donnell et al. 2013
Mytilus trossulus weak attachment at low pH and high temperature

O’Donnell et al. 2013

Newcomb et al., unpub.
Mytilus trossulus weak attachment at low pH and high temperature

O'Donnell et al. 2013

Newcomb et al., unpub.
Do mussels ever experience low pH (< 7.6) and/or high temperature >18°C?
“Testing the waters” at Penn Cove
Partnership with academia, industry, state and federal agencies
Real time observations
Real time observations
Do we see “low pH” conditions in the field?
Do we see “low pH” conditions in the field?
Do we see “high temperature” conditions in the field?
Native mussel attachment varies seasonally with temperature.

- Warmer temperatures lead to weaker attachment strength.
- Cooler temperatures lead to stronger attachment strength.

The graph shows the monthly temperature and attachment strength from July 2013 to July 2014, with shaded regions indicating the monthly low and high temperatures, and the monthly mean attachment strength.
Linking lab studies to field observations

- What triggers fall-off events? (Temp, pH, food...)
- Develop adaptation strategies (e.g., timing of resocking and harvesting)
- Predictions for future scenarios (↑CO₂, land use/runoff)
- Which species in which location?
Expanding Our Network of Observations

Mytilus trossulus

Mytilus galloprovincialis

Penn Cove Mussel Rafts (Penn Cove)

Mytilus galloprovincialis

Penn Cove Mussel Rafts (Quilcene Bay)

Mytilus galloprovincialis

Taylor Shellfish Mussel Rafts (Totten Inlet)
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