Climate change in past and modern ecosystems: Biogeochemistry, species assemblages, and ocean change

Emily Rivest & Catherine Davis, Hill Lab & BOAR
Hill Lab Research Themes

- Ocean acidification: Environmental variability and impacts on native species
- Archives of environmental change: Lessons from past species & biogeochemistry for future oceans
- Upwelling as a natural laboratory: Biological consequences of low pH, T, O₂
Gray illustrates the “paleoshoreline”

18,000 years ago

No OMZs in a glacial ocean!
California margin is cold, oxygenated and sea level is -120 meters lower than modern levels

14,000 years ago

Major OMZ expansion midway through deglaciation, OMZ evidence from 330-1,500 meters below sea level

4,000 years ago

After climate warming, OMZs retracted to a state that is similar to the modern OMZ

Red (severe hypoxia)
Orange (intermediate hypoxia)
Developing local species for use in paleothermometry
- Investigating species response to seasonal upwelling
- Understanding impact of low pH conditions on shell formation
Do ocean pH conditions affect future performance of mussels?

Rivest, E.

Project aims:
- Biological properties
- Thermo- and pH-tolerance
- Diversity of exposure by season and latitude
- Selection of larval phenotypes

Images: E. Sanford, Yu et al. 2011, C. Davis
Climate change and ocean acidification
Hill lab and BOAR group

- Science designed for innovative education & informed decision making
- Estuarine chemistry
- Coastal monitoring
- Industry collaborations
- Policy linkages
- Curriculum development
From large scale ocean observations to the organism at the shore – what is the mosaic of coastal ocean pH?

- 47 shoreline sites in WA, OR, CA
- Sampled every May & September since 2010,
- within 1 week of time

Depth of low pH (<7.75), low Ω water (spring 2007)

Feely et al 2008

Hill, Gaylord, Sanford et al., in prep
Documenting daily, seasonal, and annual variability:

- Temperature
- Salinity
- pH
- $O_2$
- $CO_2$
Communicating Science to Decision Makers

Also:

- “Fact Sheets” written for policy/public
- Contributions to IPCC, Global Ocean Acidification Network, NMS Climate Indicators
- Communicating Paleoclimate workshop (2016)
- Climate communication course (graduate level, 2016)
Climate change and ocean acidification...
in 6th grade classrooms

- Fellowships support MAST undergraduates in research experiences at BML
- MAST Seminars convert research experiences and real scientific data to 6th grade curriculum modules
- Collaboration with local school districts; classrooms using modules starting Spring 2015