

Plenary Speaker: Brian Gaylord Bodega Marine Laboratory

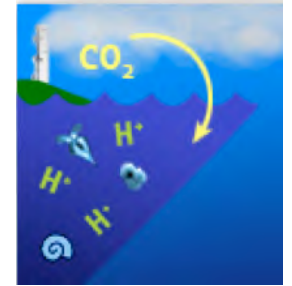
Interested in the interface between biomechanics and marine ecology

Working on OA effects on mussels and oysters

THEME 4: ECOLOGY AND SYSTEM RESPONSES

Ecology OA Projects

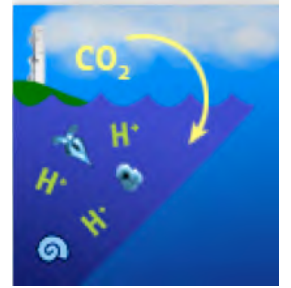
Break down by environment



Tropical coastal

- BEACON: BERMuda ocean Acidification and CORal reef investigation (**Andersson**, Bates, de Putron)
- Chemical ecology of sponges on Caribbean coral reefs (**Pawlik**)
- Influence of Temperature and Acidification on the Dynamics of Coral Co-infection and Resistance (**Harvell** and Mydlarz)
- The effects of ocean acidification on the organismic biology and community ecology of corals, calcified algae, and coral reefs (**Carpenter** and Edmunds)
- Measuring coral reef ecosystem scale calcification rates using the alkalinity method and residence time using the geochemical tracer Be-7 (**Langdon** and Kadko)
- Calcification in low saturation seawater: What can we learn from organisms in the proximity of low pH, undersaturated submarine springs? (**Paytan**)
- Ocean Acidification: assessing spatial patterns and temporal trends in cryptic invertebrate biodiversity of coral reefs around the globe (**Brainard**, Timmers, Toonen, Paulay, Meyer, Knowlton)
- Ocean Acidification: calcification rates of crustose coralline algae in the Pacific Islands (**Brainard**, Bruan, Price, Smith, Vroom)
- Coral growth and reef framework persistence of the Florida Reef Tract with accelerating ocean acidification (**Manzello**, Enochs)
- Effects on early life stages of spawning reef corals and algal interference (**Miller**, Langdon)
- Effects of ocean acidification on coral reef organisms (Kuffner, **Andersson**, Jokiel, Rogers, Mackenzie)
- Coral reef community calcification and metabolism (**Yates**)
- The Development of Microbial Associations in Major Reef Building Corals of the Pacific Ocean (**Rappe**)
- CAMEO: Comparative analyses of natural and human influences on coral reef community structure, diversity, and resilience (**Sandin**, Smith, Williams, Allen, Hampton)

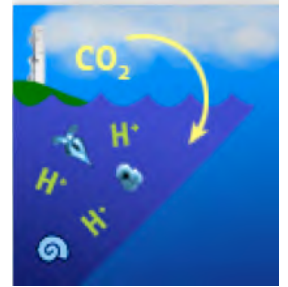
Ecology OA Projects



- Pelagic

- Patagonian Shelf Coccolithophores: Ecological Factors Regulating the Southern Hemisphere's Largest Recurring Coccolithophore Bloom (**Balch**)
- The Great Southern Coccolithophore Belt (**Lam/Bates/Balch**)
- Planktonic interactions in a changing ocean: Biological responses of *Emiliana huxleyi* to elevated pCO₂ and their effects on micro-zooplankton (**Olson**)
- Horizontal and Vertical Distribution of Thecosome Pteropods in Relation to Carbonate Chemistry in the Northwest Atlantic and Northeast Pacific (**Lawson**)
- Experimental studies to understand and evaluate acclimation of marine plankton assemblages to increased CO₂ and temperature (**Carons, Hutchins, Fu, Schnetzer**)

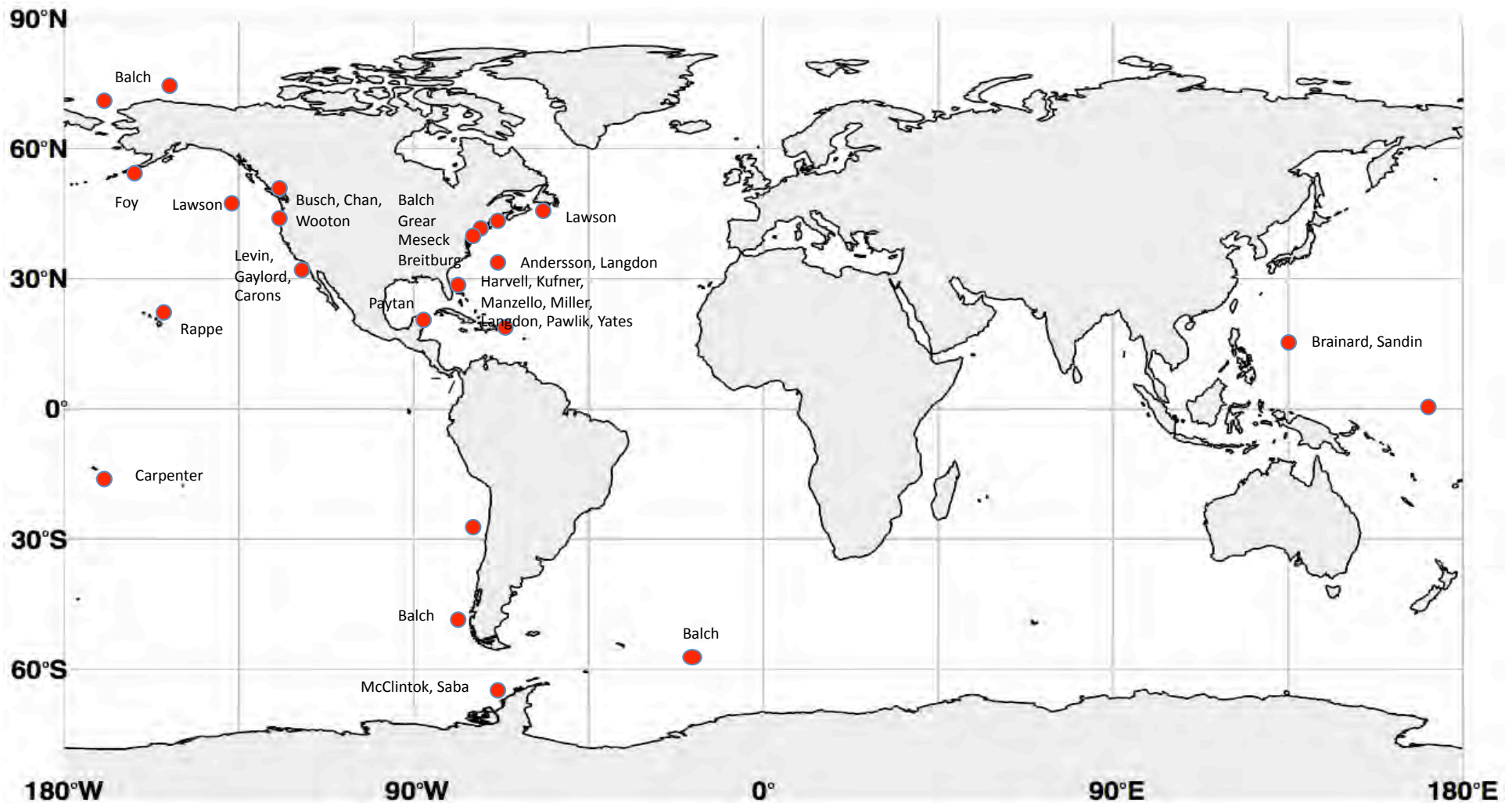
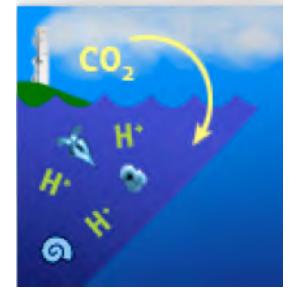
Ecology OA Projects



- Coastal/upwelling systems/temperate and high latitude
 - Acclimation and adaptation to ocean acidification of key ecosystem components in the California Current System (**Menge**, Barth, Chan)
 - Ocean acidification in a California upwelling zone: A sentinel site for impacts on open-coast and estuarine foundation species (**Gaylord**, Russel, Sanford, Hill)
 - Ecosystem Response to Changing pH (**Wootton**, Pfister, McCoy)
 - OA impacts on crab and fish (**Foy**) Kodiak, AK
 - Shallow water hypoxia – tipping the balance for individuals, populations and ecosystems (**Breitburg**, Targett, Rose, Townsend, Michaels)
 - Phytoplankton nutritional value for fishery-based food webs (**Meseck**, King, Wikfors, Milke)
 - Food web response to ocean acidification (**Busch**, McElhany, Harvey, Ainsworth, Samhuri, Cheung, Okey, Dunne)
 - Macrophyte-induced variability in coastal ocean pH and consequences for invertebrate larvae (**Levin**, Martz, Tanner)
 - The effects of ocean acidification and rising sea surface temperatures on shallow-water benthic organisms in Antarctica (**McClintock**, Amsler, Angus)
 - Effects of enhanced CO₂ on Antarctic plankton community structure and biogeochemical cycles (**Saba**, Schofield)
 - Predicting effects from population vs. cohort studies (**Grear**, Horowitz, Gutjahr-Gobell)

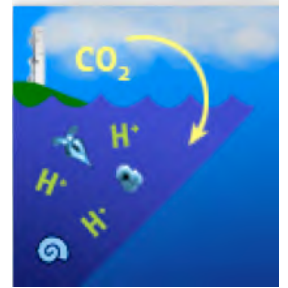
Ecological Responses

Project Locations



Ecology OA Projects

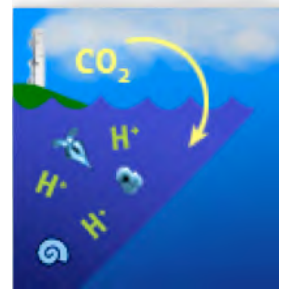
Community structure, Processes



- Calcification, dissolution, bioerosion
 - Andersson, Balch, Brainard, Carpenter, Kufner, Langdon, Manzello, Paytan, Yates
- Carbon and nitrogen cycling
 - Menge
- Species distribution and abundance, community structure
 - Balch, Breitburg, Chan, Gaylord, Lam, Lawson, Levin, Menge, Paytan, Saba, Carons, Wooton
- Food web interactions (grazer/algae, predator/prey)
 - Busch, McClintok, Meseck, Saba, Wooton
- Reproduction, larval development, settlement
 - Breitburg, Busch, Foy, Gaylord, Levin, Miller,
- Microbial associations, disease
 - Harvell, Rappe
- Allopathy
 - Pawlik
- Biodiversity
 - Brainard

Ecology OA Projects

Taxa



- **Planktonic**

- Bacteria
 - Harvell, Rappe
- Picoplankton
 - Caron
- Phytoplankton (coccolithophorids)
 - Balch, Olson
- Phytoplanton (other taxa)
 - Meseck, Lam, Saba, Schnetzer
- Zooplankton
 - Lawson, Saba, Grear

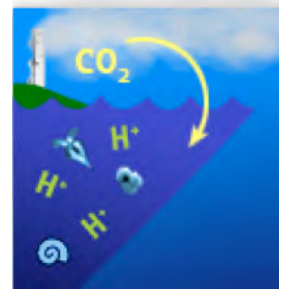
- **Fish**

- Breitburg, Foy

- **Benthic**

- Crustose coralline algae
 - Wooton, Carpenter
- Macrophytes
 - Levin, Carpenter, Chan, Miller
- Hard corals
 - Andersson, Brainard, Carpenter, Kufner, Langdon, Manzello, Paytan, Yates
- Sponges
 - Pawlik
- Clams, mussels, oysters
 - Breitburg, Busch, Gaylord
- Crabs
 - Foy
- Cryptic Invertebrates
 - Brainard

Panel members



Shallin Busch
NOAA-NWFSC



Margaret Miller
NOAA-SEFSC



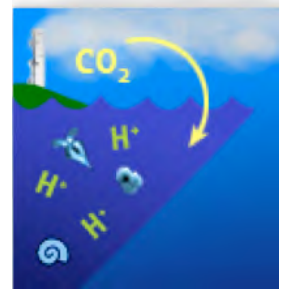
Justin Grear
EPA Narragansett



Michael O'Donnell
Friday Harbor Lab, UW

Panel Discussion

(15 min)



Goal: Where can collaborations be made, where are gaps in the research, what are the real frontiers?

Other questions:

- Are there new technologies/theoretical approaches/methods that may help?
- How can we identify the key organisms that are susceptible in an ecosystem?
- How do we scale up or generalize among ecosystems?
- What is needed to improve models? (Data mining, more sampling, etc.?)
- How do we scale from an experiment on a single species in the lab to predictions of population performance in the field?
- How do we best study species interactions and multi-species assemblages given the challenges of manipulating carbon chemistry?
- How do we incorporate evolution into ecological research on OA?
- Do we have the modeling tools needed to understand the ecosystem consequences of OA?