SEAFOOD CHOICES ALLIANCE
OCEAN ACIDIFICATION WORKSHOP

PORTLAND, MAINE
JUNE 26TH, 2009
MEETING NOTES

MEETING OVERVIEW:

Goals of the meeting:

1. Education on the issue of Ocean Acidification; understanding of potential impacts in the Gulf of Maine for participants
2. Discuss with and get feedback from participants on strategies for educating and engaging the seafood industry on the issue of ocean acidification.

Agenda:

- Welcome and Introductions
- Presentations
  - Scott Doney, Woods Hole Institute
    - ***Basics Behind Ocean Acidification***
  - Joe Salisbury, University of New Hampshire
    - ***Acidification from Land: Global Effects, Local Effects***
  - Mark Green, St. Joseph College
    - ***Susceptibility of juvenile bivalves to estuarine and ocean acidification: shell growth, mortality, and sediment rejection/acceptance***
- Lunch / Questions for Presenters
- Group Discussion: How to educate the seafood industry

Attendees:

- Anne Henshaw, Oak Foundation
- Jennifer Litteral, Island Institute
- Paul Dobbins, Ocean Approved (rope-grown mussels, edible kelps)
- Mark Green, St. Joseph's College (studies effect of pH on juvenile shellfish)
- Scott Doney, Woods Hole Oceanographic Institution
- Joe Salisbury, UNH (ecology & biogeochemistry of coastal regions)
- Kether Sharp Gray, Gulf of Maine Lobster Foundation
- Peter McDougal, freelance writer
- Chris Fream, North Atlantic Seafoods
- Brad Warren, Sustainable Fisheries Partnership
- Ned Daly, Seafood Choices Alliance
- James Wright, Seafood Business magazine
- Shelly Tallack, Gulf of Maine Research Institute
- Carl Wilson, Maine Department of Marine Resources
- Dan Holland, Gulf of Maine Research Institute
- Jen Levin, Gulf of Maine Research Institute
- Philip Chou, Seafood Choices Alliance
- Valerie Craig, Seafood Choices Alliance
- Sebastian Belle, Maine Aquaculture Alliance

MEETING NOTES:

Presentations

1. ***Basics Behind Ocean Acidification***
   Scott Doney: Woods Hole Oceanographic Institution
   - 2.5 billion tons of CO2 going into the oceans PER YEAR
   - good record of atmospheric CO2; steady rise with strong evidence for human causation
   - The chemistry: carbon dioxide combines with water to form carbonic acid (CO2 + H2O = H2CO3). Most of this converts to bicarbonate ion
     i. Higher acidity
     ii. Decreasing carbonate ion which is used for shell production (lower carbonate saturation)
   - Data from Hawaii shows CO2 levels in the ocean rising in a corresponding way to atmospheric levels; also shows lowering pH
   - Because CO2 stays in the system (atmosphere and oceans) for a very long time, we're going to see some level of acidification. The degree will depend on how fast we get atmospheric emissions under control.
   - If the ocean is moving to a lower saturation and most shell-producing organisms require high saturation for shell production, how might they and other biological organisms respond?
     i. Shell-forming plants & animals: reduced shell formation (calcification); lower reproduction & growth rates (warm water corals, pteropods – planktonic snails, scallops, clams, oysters, cold-water corals, lobsters, crabs, some plankton)
     ii. Habitat loss (reefs)
     iii. Less food for predators (humans, fish, whales)
     iv. Possible negative effectives effects on larvae
   - Not all calcifying organisms will behave the same. There may be a shift in dominant species
   - Effect on commercial fisheries? Most of the Eastern US fisheries (New England, mid-Atlantic, Gulf of Mexico) depend on calcifying organisms – lobsters, crabs, scallops, clams

   Questions:

   1. Projections into the future, are there monitoring programs?
      - There was a survey across US waters to look at this. Results showed upwelling regions on the west coast with upwelling of fairly corrosive waters that seem to be getting more corrosive over time.
      - No great monitoring stations/systems yet
      - President just signed an act that provides money for monitoring of ocean acidification (does not exist yet).

   2. North Atlantic seemed to be more stable over time – slower rate of change.
      - tropical waters shift more. Northern waters do shift though

   3. have seen that in Gulf of Maine, saturation could drop below 1.
      - regionally, on local/coastal scales
        - Gulf of Maine has variety of water sources and this can set up scenarios with spots that are more or less acidic

4. Would there be bigger impacts in high polluting areas like china?
    - Atmospheric CO2 mixes quite well globally.
        - However, other issues like acid rain do occur locally, so that additional acid contribution may have localized effects.

5. what about run off?
    - Depends on the river.
        - Some rivers may lower saturation.
        - However, the Mississippi seems to be getting more alkaline over time, so it really depends.

6. Is there difference in biology/chemistry of oysters and why would there be a difference in how different species react?
    - Need more research in this area.
        - Don't really know why some organisms are more susceptible than others (even when mineralogy is exactly the same)

2. ***Acidification from Land: Global Effects, Local Effects***
   Joe Salisbury, University of New Hampshire

- Most rivers of the world are acidic (Mississippi is an exception). They are acidic because most soils are acidic – decaying plant material (organic), weathering of minerals (inorganic), atmospheric deposition
- How does river chemistry affect biogeochemistry in coastal zone? Arctic estuaries are tremendously threatened by climate change – increased precipitation melting permafrost, which dramatically increases discharge of fresh water from rivers. Tropical rivers start out very low (very acidic) – as move out to the ocean, the ability to form shells increases. Other rivers start out high alkalinity to begin with so have less effect on estuarine environments.
- Oronoco and Amazon combined discharge highly acidic water, which has a big effect locally in the coastal zone
- Locally – many measurements done over the past few years (since 2004) in Gulf of Maine. Saturation state can be very low in coastal Gulf of Maine.
    i. Salinity has dramatic effect on saturation state.
    ii. Summer has higher saturation than winter (winter is more acidic)
    iii. Close to coast, saturation is very low – less than one up to 20 psu (salinity) [open ocean just over 30 psu]
- If saturation is low in places where shellfish production is high, what does that mean for the industry? (note, shellfish production generally in water at least 20-25 psu) Generally there is a plume of less saturated water – if the organism can get below the plume, there wouldn't be a big problem with shell production. In experiment with soft-shelled clams, they were okay at saturation of 2.0, but they stopped building shells at 1.6 and shells actually started to fall apart at 0.5.
- How often do we encounter conditions like 1.6 or lower saturation? In Maine, that level does intersect valuable clam beds in the Gulf. Hypothesis: If these low saturation events coincide with a spawning event that could cause a high stress situation. Generally though, high discharges occur March-May where spawning generally occurs June-August.

Questions:
- Is there any correlation between acidification and algal bloom?

i. Answer: no idea. There's been a lot of work on HABs, and there is definitely a link to inflows of fresh water and winds, but probably not linked towards acidification (fresh water may affect both though, although they're not linked) [note: Don Anderson and plume hypothesis]
ii. Side note: higher CO2 effect on finfish – more acidic water, fish have harder time.
iii. Deep low saturation horizon in North Atlantic. You can see local variability, not driven by water from the deep.

- In the West, the primary hypothesis is that it's caused by the upwelling. How long do you have to wait before you see mixing of deep undersaturated water with higher waters here?
    i. Answer: that horizon doesn't surface in the Atlantic although it does creep up. We're seeing biologic sensitivity well below that threshold. We're changing chemistry much faster than the organisms can react

3. ***Susceptibility of juvenile bivalves to estuarine and ocean acidification: shell growth, moratlity, and sediment rejection/acceptance***
Mark Green and George Waldbusser, St. Joseph's College of Maine
    - bivalves are broadcast spawners. Spawn settle to underlying seafloor and set to sediments. In a number of weeks, lose the vast majority of the spawn – low overall survival rate, but that is the nature of broadcast spawning
    - mortality causes? Predation n the water column, "export" in tidal currents, burial, environmental – temperature, salinity, etc
    - "death by dissolution" is a (the?) leading cause of mortality for small bivalves. It's already occurring in acidified estuaries – possible indicator of things to come as pH in the open ocean continues to drop
    - coastal zones have been acidifying for decades... caused by eutrophication (the bacterial breakdown of organic matter causes release of CO2), changes to freshwater inputs (lower salinity water less well buffered), direct acid deposition (nitrogen and sulfer)
    - acidity in sediments does matter for sediment-dwelling bivalves. Buffering sediments with discarded shell material may be a viable strategy for increasing saturation (increasing pH). Addition of buffer can increase pH by 0.2-0.4. It's not possible to buffer the world ocean, but it could work at a local/estuarine level

    Questions:
    - Do we have a good time series going back to show what's occuring naturally, what organisms have evolved to handle.

    Answer:
        • Not a lot of long-term data. There's ample evidence of eutrophication, chronic low oxygen levels, etc. When that happens, as long as there is oxygen present, you're producing acid.
        • It's very different for estuaries where there's a eutrophication issue. On the West coast, it's an upwelling system so the same arguments can't be used

    - Can you use the archeological record to look at shell composition?

    Answer:
        • Sort of, but the time scales are off for comparison. Corals though are being looked at with boron isotopes. No one has yet taken boron isotopes for clamshells – it might be possible though.

- Buffering- did you buffer with anything other than shell? Answer: no, just buffered with soft-shell clam.

Lunch & Questions

Two Themes we would like to discuss:

1. What kind of research would be helpful to help further education on ocean acidification?
2. What are the other tools we could use to help educate people on the issue of ocean acidification.

Research:

1. Economic Impact. We need numbers about the potential different scenarios and how they'd affect the different industries.
2. Local strategies – the adaptation scenarios. What can growers and fishermen do?
3. We've heard a lot about mollusks and bivalves; more info is needed on what fishermen are after – lobster, crab, scallops
4. The research has been focused on bivalves and also on the coastal areas. A lot of this research is looking at lowering pH, but by causes other than climate change. The phenomenon is the same we might expect to see, but maybe it's not clear enough – need to better articulate what's really going on with climate change.
5. If there is research that could be conducted through the lobster industry, the lobster foundation (GoMLF) is a good liaison for that and would like to help do that.
6. There is an intermediate step that can happen – if you can show that x amount of loss will be x loss in revenues, that might be enough for people to do something---look at the incremental stages, like 5 year and 10 year.
7. The government – DMR – can only manage fishermen, but sometimes there are other things going on independent from the fishermen. You need to partner with others in the fishery to look at those things other than fishing that are affecting the fishery.
8. Need to pull together all the people/orgs that are "measuring".. lots of people working but it's not yet connected. If we can consolidate the data, its likely things would be found with existing data that are now unknown simply for lack of coordination.

Education Tools:

1. It would be good to have similar presentations for growers meetings for Maine Aquaculture Association. Particular interest to growers is sub-lethal effects to larval organisms – finfish in particular.
2. Places for outreach: grower's meetings, Maine Fishermen's Forum (http://www.mainefishermensforum.org/)
3. Regarding printed or electronic materials: They may be read if they come out as a member alert/bulletin/newsletter (through the associations like Maine Aquaculture Assoc., Maine Lobstermen's Assoc., Gulf of Maine Lobster Foundation). If it is released during slow times (February) it's more likely to be read than if it comes out during the busy season (summer)
4. Include solutions – adaptation and mitigation; involvement in policy
5. Communications: the best places to put out messages to fishermen are in the publications they read – Fishermen's News, etc.
6. Potential Venues: Working Waterfront Festival (New Bedford), joint Canadian-U.S. town hall meeting (you can get greater support because there are greater numbers up there);

Gulf of Maine Symposium (October) –A lot of US and Canadian scientists will be there... not industry but it could be good for information sharing.

7. On an individual level, most lobstermen will say they have to worry about $2 lobster prices this summer. You can treat fisheries as the canary in the coalmine. Use trade organizations as active partners because they can be the canary and speak to long-term generational impacts. The associations can take the long term view that individuals can't.