Governor's Blue Ribbon Panel on Ocean Acidification

Summary of First Meeting
Friday, March 30, 2012, 9:00 a.m. – 3:00 p.m.
Talaris Conference Center, Seattle, WA

Meeting documents are available on the Dept. of Ecology Ocean Acidification webpage:
http://www.ecy.wa.gov/water/marine/oceanacidification.html

Overview of the Blue Ribbon Panel on Ocean Acidification Challenge

In December 2011, Washington became the first state in the nation to have the Governor endorse an agreement among federal and state government, tribes, and the shellfish industry to respond and expand Washington's shellfish resources, promote clean-water commerce, and create family-wage jobs. The agreement builds on the National Shellfish Initiative created by NOAA (National Oceanic and Atmospheric Administration) to stimulate coastal economies and improve the health of ailing estuaries through increasing commercial shellfish production and native shellfish populations and habitats in our nation's waters.

As a part of the Washington Shellfish Initiative, and with strong support from the NOAA Administrator and scientists, Governor Gregoire has convened a Blue Ribbon Panel of leading tribal, state, federal and local policy makers; scientific experts; public opinion leaders; and industry representatives. The Blue Ribbon Panel will focus on documenting the current state of scientific knowledge, ways to advance our scientific understanding of the effects of ocean acidification, and recommend actions to respond to increasing ocean acidification, reduce harmful effects on Washington's shellfish and other marine resources, and adapt to the impacts of acidified waters.

The Makeup of the Blue Ribbon Panel on Ocean Acidification

Panel Co-Chairs: William Ruckelshaus (Madrona Venture Group) and Jay Manning (Cascadia Law Group)
Panel Members: Lisa Ayers (Pacific County Commissioner), Brian Blake (State Representative), Steven Bloomfield (Mason County Commissioner), Shallin Busch (NOAA Northwest Fisheries Science Center), Chris Davis (The Nature Conservancy), Bill Dewey (Taylor Shellfish Company), Richard A. Feely (NOAA Pacific Marine Environmental Laboratory), Carolyn Friedman (UW School of Aquatic & Fishery Sciences), Peter Goldmark (Commissioner of Public Lands), Sara Kendall (Weyerhaeuser Company), Terrie Klinger (UW School of Marine and Environmental Affairs), Micah McCarty (Makah Tribe), Dennis J. McLerran (EPA Region 10), Edward Miles (UW Center for Science and Earth System), Jan Newton (UW Applied Physics Laboratory), Betsy Peabody (Pacific Shellfish Institute & Puget Sound Restoration Fund), Kevin Ranker (State Senator), Jennifer Ruesink (UW Department of Biology), Ron Sims (Leadership Council, Puget Sound Partnership), Norma Smith (State Representative), Dan Swecker (State Senator), Ted Sturdevant (Department of Ecology), George

Waldbusser (OSU College of Ocean and Atmospheric Sciences), Brad Warren (Sustainable Fisheries Partnership), and Terry Williams (Tulalip Tribes).

Project management for the Blue Ribbon Panel on Ocean Acidification is being provided by: Hedia Adelsman (Ecology), Lara Whitely Binder (UW Climate Impacts Group) and Meg Chadsey (Washington Sea Grant).

Meeting Objectives and Attendance

The Blue Ribbon Panel on Ocean Acidification held its first meeting on March 30, 2012, at the Talaris Conference Center in Seattle, WA. The meeting was open to the public and broadcast as a webinar. The meeting was also recorded by TVW and NHK Japan Broadcasting.

All panel members and project managers were present at the first meeting except Dr. Richard Feely and Dennis McLerran (who was represented by EPA alternate Kate Kelly). Special guests invited to attend this meeting included: Simone Alin (Pacific Marine Environmental Laboratory), Michael Northrop (Rockefeller Bros. Fund), and Keith Phillips (Governor's Policy Office). Members of the public and interested stakeholders in attendance included private citizens and representatives from the Suquamish Tribe, the Tulalip Tribes of Washington, the Makah Tribal Council, the Quinault Management Council, COMPASS, Environmental Science Associates, Washington State Department of Agriculture, EPA, Friends of the Earth, The Nature Conservancy, Sustainable Fisheries Partnership, Crosscut, Washington Sea Grant, and the Department of Ecology.

There were two objectives for the meeting:

1. Brief panel members on the current understanding of ocean acidification (OA) science and impacts, with an emphasis on Washington state marine waters.
2. Review the goals and objectives of the panel and members' role in the process.

Welcome

William Ruckelshaus and Jay Manning, the panel co-chairs, welcomed the panel members to the first of the series of meetings that will be held before the final report to the Governor is submitted on October 1, 2012. They thanked participants for their commitment to the process, and acknowledged the groups and agencies contributing financial support to the panel.

Overview of the Panel's Charge

Keith Phillips, Executive Policy Advisor to Governor Gregoire, explained that the panel's charge is founded on the goals of the Washington State Shellfish Initiative. The panel was intentionally designed to include those with the scientific knowledge, affected stakeholders, policy makers familiar with the suite of policy options available to address the problem of ocean acidification, and opinion leaders who can call for action once the panel has submitted its recommendations. He stressed that if the panel's recommendations are to find traction, they must develop long term partnerships with stakeholders, including tribes, and engage the public on this issue. He is confident that the panel products will be of wide interest, regionally and nationally.

Presentations and Discussions:

All presentations have been posted on the Dept. of Ecology Ocean Acidification webpage (http://www.ecy.wa.gov/water/marine/oceanacidification.html); excerpts of the presentations can also be viewed on the TVW clips posted on this webpage.

Bill Dewey, Taylor Shellfish Farms

The Canary in the Coal Mine: A Cautionary Tale of Ocean Acidification and Shellfish. The Washington shellfish industry, which leads the country in oyster seed production, began seeing dramatic declines in oyster larvae survival in the mid-2000's. Regional scientists identified changing seawater chemistry as the likely culprit. Taylor Shellfish responded by ramping up oyster seed production at their Kona, HI facility (which has not experienced similar problems), and by collaborating with scientists to understand and adapt to the presence of corrosive waters at their hatcheries.

Senator Cantwell obtained $500,000 of funding for monitoring and adaptation, which has allowed Taylor to restore local production. Hatcheries are now equipped with continuous seawater monitoring equipment, which allows them to temporarily divert seawater intake when corrosive conditions are detected. This short-term solution has enabled them to raise oyster larvae through their most critical developmental stages (the first 2-3 days). Not all hatcheries have the ability to dodge corrosive conditions, however (e.g. Whiskey Creek hatchery on the Oregon coast).

Continued cooperation with scientific community is vital; growers need to know 1) how corrosive water affects larvae, 2) link between seawater chemistry and shellfish pathogens, 3) potential impacts on valuable emerging geoduck industry, and 4) possible long term adaptation strategies. The panel requested that Taylor provide a list of specific adjustments made by hatcheries to cope with acidification, as these may stimulate ideas for preserving wild shellfish populations.

Simone Alin, NOAA Pacific Marine Environmental Labs

Update on Ocean Acidification Science
This presentation reviewed Ocean Acidification chemistry, why acidification seems to be occurring earlier and more severely in Washington than anywhere else in the world, and what factors (natural and human) are contributing to the problem.

Acidity refers to the concentration of hydrogen ions [H^+] in a solution; the *higher* the concentration of H^+, the *more* acidic the solution. The pH scale describes a solution's acidity, with 0 being most acid and 14 the most basic (or 'alkaline'). Normal seawater has a pH of 8.1. This scale is logarithmic, so a seemingly small decrease from pH 8.1 to 7.9 actually represents a *30% increase* in acidity.

Continuous measurements of atmospheric CO_2 and marine pH (from the 1960's onward) show a steady increase in global atmospheric CO_2 (from fossil fuel combustion) correlating with a steady decrease in ocean pH. At current rate of emissions, acidity is expected to increase by *at*

least 100-150% by 2100—a rate of change higher than at any time in at least the last 300 million years.

In addition to reducing the pH of seawater, H^+ reacts with carbonate (CO_3^{2-}), making this essential chemical building block less available to organisms that form calcium carbonate shells (such as oysters, corals and pteropods). 'Aragonite' is a common form of calcium carbonate. The 'saturation state' of aragonite (symbolized by 'Ω_{arag}') is an indication of how easy it is for shell-forming organisms to obtain this mineral from seawater. When Ω_{arag} is greater than 1, forming shells is relatively easy; when Ω_{arag} is less than 1, shells dissolve faster than they can be formed. Seawater with Ω_{arag} less than 1 is 'corrosive'. Deep cold seawater is naturally more corrosive than surface water, but as the oceans become more acidic, corrosive water is migrating to increasingly shallower depths (3-6 feet closer to the surface/year).

Recent measurements of Ω_{arag} along the Washington coast found corrosive water at the surface much earlier than predicted. This is due to 'upwelling'—a wind-driven process that transports deep offshore water to the surface. The seawater upwelling now was last in contact with the atmosphere 50 years ago (what scientists mean when they talk about 50 year old water); hence, its pH reflects the much lower 1960's level of atmospheric CO_2. We can expect future upwelled seawater to be even more corrosive.

Upwelled water moves through the Straits of Juan de Fuca into Puget Sound, where additional drivers reduce the pH even further—summertime pH in Hood Canal has dropped as low as 7.4. The primary driver in Puget Sound is the decomposition of nutrient-fed algae blooms. Following a bloom, dead algae sink to the bottom, where they are decomposed by bacteria. This process consumes oxygen & releases more CO_2 (just as we do when we breathe), resulting in hypoxia and a further pH decline. Terrestrial human activity (agriculture, erosion and stormwater runoff) contributes substantially to nutrient overload. It is estimated that 17-26% of acidification in Puget Sound and 20% along the coast can be attributed to algal blooms fed by these (plus some natural) sources of nutrients.

Post-presentation discussion centered on estimates of current and future contributions to acidification from the various natural and anthropogenic drivers. A comprehensive and coordinated monitoring is needed to address these types of questions. There was a question about whether CO_2 could be removed from seawater by farming marine algae.

Shallin Busch, NOAA Northwest Fisheries Science Center

Update on the Biological Impacts of Acidification

This presentation reviewed what is known, and what can be inferred, about biological responses to acidification at the organismal and ecosystem levels. In addition to their central role in ocean acidification chemistry, CO_2, H^+, CO_3^{2-} and bicarbonate [HCO_3^-] also exert physiological effects on living organisms. Even organisms that do not form shells respond to changes in the levels of these chemicals; scientists have observed effects on respiration, photosynthesis, development, growth, reproduction and behavior. It is difficult to predict these effects; different organisms,

even closely related species, respond differently to changes in seawater chemistry (e.g. Atlantic vs. Pacific oysters under high CO_2 conditions).

Because of this variability, more research needs to be done on individual species—particularly commercially important ones. The science community has responded to this need, and many new studies will be published soon. Some vulnerable shell and carapace-forming organisms, such as pteropods (swimming snails), copepods and krill, are important prey species for salmon and other fish; impacts on these species will have significant impacts on the marine food web. Food web models can reveal new interactions, but they cannot necessarily predict outcomes. 30% of Puget Sound species calcify (form shells), and may be directly impacted by acidification, but there will be less-direct, sometimes non-intuitive impacts as well. (e.g. acidification interferes with one fish species' ability to smell predators; also, a harmful species of phytoplankton grows more quickly and produces a higher level of toxin under high CO_2 conditions).

Factors that may influence an organism's response to changing seawater chemistry are: the timing and degree of exposure, their ability to acclimate, and their genetic make-up. Species *do* have the capacity to adapt, but the current rate at which the marine environment is changing—on the order or decades, rather than millennia—presents an unprecedented challenge. Natural processes that restore the ocean's pH balance, such as rock weathering, occur very slowly; restoring ocean pH to the pre-industrial level though this process will take thousands of years.

Key points brought up during the discussion included: the relative susceptibility of various marine species (there is not enough data currently to rank them); what key Puget Sound prey species are currently under study (copepods, and several small forage fish); whether there are links between acidification and/or climate change and the apparent increase in harmful algal blooms; whether mitigation strategies that attempt to slow the *rate* of change—rather than avoiding a threshold pH—could be effective.

The Co-Chairs thanked Bill, Simone and Shallin for their presentations, and reminded the panel that they should seek a level of scientific understanding that will enable them to make informed policy decisions. Comments about the presentations, and particularly suggestions for areas of focus in the forthcoming science white paper, should be submitted to the Co-Chairs, Hedia Adelsman and Lara Whitely Binder before the next panel meeting.

Lara Whitely Binder, UW Climate Impacts Group

Looking Ahead: Future Meetings, Scoping of Tasks, and Other Matters
Two supporting white papers will be produced to help the Panel with its task of developing recommendations to address ocean acidification. The first is a science white paper synthesizing existing published literature on ocean acidification science and impacts in Washington State. A draft outline was presented. Work will begin on the science summary in April. The second white paper is a catalog of existing programs and policies in Washington that could be used for addressing ocean acidification. The panel will determine if and how those programs and policies will be used in the course of developing recommendations for action. The programs and policy white paper will be written by Ryan Kelly at Stanford's Center for Ocean Solutions.

Future Panel meeting dates were announced and are scheduled as follows: Wed, April 25, 2-4pm (webinar); Wed, May 23, 9-3pm; Wed, June 20, 9-3 pm; Fri, July 20, 9-3pm; and Tues,

September 18, 9-3pm. An additional meeting may be required in early September. A decision on this will be made after the May meeting.

Other business covered in this session included a review of the Panel ground rules; general information related to the production of meeting summaries, the anticipated timing of pre- and post-meeting materials distribution; public access to the process via webinars and the ability to attend meetings in person; and posting of agendas and other final documents on Ecology's website for the Panel (http://www.ecy.wa.gov/water/marine/oceanacidification.html). Use of DropBox for accessing and downloading internal draft documents was also explained.

Public Comment

One question was submitted via the webinar connection; all other questions and comments were submitted by those in attendance.

- Comment: inviting the public to attend panel meetings via Webinars is a good idea; future meeting should be more broadly advertised, with more advance notice.

- Question: What is the role of sediment delivery by rivers? Can the sediments released by dam removal have an impact on acidification? Answer: The time scale over which rivers deliver alkalinity is very long (millennia), and short pulses of sediment will not have a significant effect. Also, river water tends to have a lower pH than seawater.

- Question: How are the relative contributions by the various drivers of acidification calculated? Answer: The explanation is too complicated to attempt here; contact Simone Alin (NOAA Pacific Marine Environmental Laboratory CO2 group) directly.

- Comment: First, public education is going to be critical for policy change. We must find a way to consolidate and present this information to the public. Second, regional monitoring efforts by tribes, agencies, etc. must be coordinated and standardized. NANOOS (Northwest Association of Networked Ocean Observing Systems; http://www.nanoos.org/) is an example of effective coordination and dissemination of oceanographic data for scientific and public use.

Document Appendix

March 30, 2012 Blue Ribbon Panel on Ocean Acidification Meeting Agenda (http://www.ecy.wa.gov/water/marine/oa/20120330_agenda.pdf)