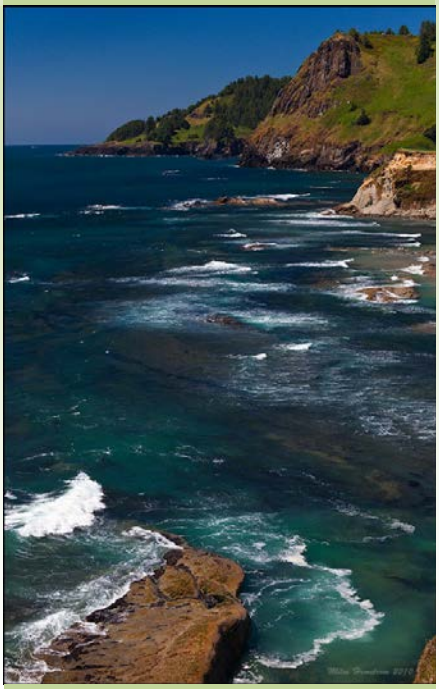
Institute for Natural Resources

March 2014

What science and information is needed to plan for and mitigate the effects of ocean acidifiation and hypoxia?

A Snapshot of Oregon Agency Responses



Background

In summer 2013, Governor Kitzhaber's Office signed a Memorandum of Agreement aligning Oregon and California efforts to implement the *West Coast Ocean Acidification and Hypoxia Science Panel.* The OSU Institute for Natural Resources (INR) is working with the California Ocean Science Trust (CalOST) to convene a panel of 20 west coast oceanography experts. The Panel is charged with synthesizing and interpreting knowledge from the diverse and rapidly evolving fields of ocean acidification and hypoxia science, and prioritizing research and monitoring critical to the west coast's future.

To help meet this charge and to better link research and science to management-relevant questions, CalOST and INR approached state and federal agencies in California and Oregon to provide input about their science and information needs related to ocean acidification and hypoxia. Driven by interviews with state and federal managers in spring 2013, CalOST oversaw the development of five ***core science questions*** for the Panel (see box at right). In fall 2013, INR asked Oregon state agency staff to consider these core questions in the context of Oregon, and to identify any additional or more specific science information needs that would better enable these agencies to meet their charges and goals.

What follows is a synthesized and condensed snapshot of initial responses from seven state agencies – Oregon Department of Fish and Wildlife, Department of Agriculture, Department of Land Conservation and Development, Department of Environmental Quality, Department of State Lands, the Oregon Health Authority and Oregon Parks and Recreation Department. This synthesis of Oregon feedback is intended to be revised and refined in coming months as INR solicits and receives further input. CalOST and INR are also working to incorporate all feedback received from west coast state and federal agencies into a more detailed synthesis document for the Panel.

Oregon scientists on the West Coast Science Panel

Jack Barth, OSU; Francis Chan, OSU; Burke Hales, OSU; Waldo Wakefield, OSU, NW Fisheries Science Center, NOAA Fisheries; and George Waldbusser, OSU

Panel's core science questions

Q1: What are the naturally occurring variations in acidification and hypoxia parameters in both space and time?

Q2: To what extent have, or are, we going to deviate from "naturally occurring variations" as identified in Q1?

Q3: How much do regional and local inputs affect the deviations identified in Q2?

Q4: What are the consequences of the deviations identified under Q2 for uses or ecological resources of our coastal oceans?

Q5: What research and monitoring would most efficiently fill critical information gaps encountered by the Panel in answering these questions?

Agency noted concerns: Ocean acidification and hypoxia impacts on Oregon's coastal ocean ecosystems, resources, and citizens

- What effects will ocean acidification have on ocean habitats and fisheries? What is the potential for significant economic, cultural and social impacts both local and statewide?
- How might population-level effects of ocean acidification cascade up (and down) ocean ecosystems?
- How can we continue to provide for beneficial uses and limit potential impacts on recreation, aesthetics, commercial and recreational fish and shellfish harvests? Will the quality of locally harvested seafood be compromised?
- What effects will ocean acidification have on Oregon estuaries?

"We are…concerned that information regarding these issues be made available to coastal communities in a timely manner and in formats useful to decision makers. Communicating the science underlying these issues to the local community is central to our organization's mission."

Charge to the Panel

The West Coast Ocean Acidification and Hypoxia Science Panel convenes high-level expertise to provide state-level decision makers with knowledge needed to evaluate and develop action plans for this complex issue. The Panel will:

- Address core science questions identified by resource managers as critical to advancing their understanding of these issues.
- Identify research and monitoring needed to contribute to a west coast-wide assessment of ocean acidification and hypoxia.
- Address information and data gaps critical to resource management decisions.
- Provide information updates throughout its tenure, rather than the traditional approach of only providing a final report at the end of its tenure.

Oregon agency priority information needs

How do ocean acidification and hypoxia vary in space and time along the Oregon coast? How do we distinguish between "normal" and anthropogenic change?

Are specific areas more prone to ocean acidification and hypoxia impacts and if so, what are their spatial footprints? Which species and habitats are most susceptible to ocean acidification and hypoxia impacts?

What are the effects of ocean acidification and hypoxia on Oregon native shellfish? How applicable are science findings from commercial shellfish hatcheries to Oregon native shellfish and their habitats?

What are the direct organismal effects of ocean acidification and hypoxia on exploited fishery resources, e.g. Dungeness crab survival and calcification? What is the potential for trophic cascades and indirect population-level effects on exploited fisheries?

What are the relationships between ocean acidification and hypoxia parameters in the open ocean and those in nearshore areas and estuaries? What are effects of ocean acidification and hypoxia on estuarine water quality?

How will ocean acidification and hypoxia affect important commercial and non-commercial species (i.e., Dungeness crab, clams, native and non-native oysters, rockfish, salmon) and saltmarsh and eelgrass communities in Pacific Northwest estuaries?

Should we attempt to monitor and limit local inputs, or will those efforts be neutralized by global inputs?

Are local nutrient sources or other pollutants exacerbating local ocean acidification and hypoxia conditions? If so, what are their sources and loads?

Are existing [water quality] standards adequately protective when considering ocean acidification and hypoxia?

Priority information needs (continued)

Are ocean acidification and hypoxia conditions seasonal or related to El Niño /La Niña, and the Pacific Decadal Oscillation? Where is Oregon now in terms of these natural episodic events?

Will ocean acidification and hypoxia result in significant public health impacts in Oregon, e.g. reduced quantity and quality of seafood consumed, or reduced water quality at ocean beaches?

How might ocean acidification and hypoxia indirectly affect recreation experiences at Oregon beaches, e.g. reduced water quality, reduced shellfish harvests, beach erosion, wildlife impacts?

Optimal Panel outcomes as identified by Oregon agencies

Identification of critical ocean acidification and hypoxia science knowledge gaps and specific research needed to understand the most likely impacts throughout the California Current marine/estuarine ecosystems.

Expansion of the types of information presented in the Washington Blue Ribbon Panel report to address unique aspects of ecology and oceanography off Oregon and California that may be different from those in Washington.

Development of a comprehensive research agenda to extend the technical findings generated inside commercial oyster hatcheries into the real world of Oregon bays and estuaries.

A clear understanding of the potential effects of ocean acidification and hypoxia on the quality and quantity of seafood harvests, especially for Dungeness crab.

A clear understanding of the rate of ocean acidification and hypoxia change and how that will impact specific species of concern or importance as ecological or commercial resources, e.g. impacts on fisheries.

"I'd like to raise the point that ocean acidification should not be addressed strictly as a marine resources management problem. My understanding is, rather, that it is a problem related to managing atmospheric systems (to the degree that is even possible). This framing doesn't compromise the importance of investigating effects on ocean systems, but it does insist that society's response shouldn't be limited to changing the way we use and manage ocean resources. Clearly this has strong implications for how you frame the Panel's scope and tasks."

Project Contacts

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Informing natural resource decision making through integrated knowledge and information

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West Coast Science Panel Convener

CALIFORNIA OST Ocean Science Trust
Connecting Science to Ocean Management

Panel homepage
http://westcoastoah.org/

Optimal panel outcomes (continued)

Identification of economically feasible ways to mitigate or slow the processes of ocean acidification and hypoxia.

A clear understanding of 1) how ocean acidification and hypoxia events will change in the future (short- and long-term) from past natural conditions, 2) the resulting ecological, social and economic impacts and, 3) how we can mitigate and minimize these adverse effects of ocean acidification and hypoxia.

A clear understanding of the influence of ocean acidification and hypoxia on estuarine processes and organisms.

A clear understanding of the likely effects of ocean acidification and hypoxia on Oregon beaches and nearshore areas, and the recreation activities, experiences and benefits they support.

Next steps with Oregon agencies

INR will continue to seek input from Oregon state agencies and other key stakeholders, and to integrate this input with feedback acquired in California, Washington and British Columbia. INR and CalOST are conveying agency input to the Panel, and working on an outreach strategy to assure that the science is broadly distributed and that there are mechanisms for two-way communication between decision makers and the Panel.

Panel meeting November 2013

In November 2013, CalOST hosted the first in-person workshop of the Panel at Stanford University. The Panel expanded upon the core science questions, discussed the form of potential outputs they will create and planned the next 6-12 months of their work. The Panel agreed on the need for a range of outputs to address different questions at different levels of detail. Subsets of the full Panel continue to work on topics including ecosystem and species impacts, management-relevant modeling, freshwater processes, variability, communicating FAQs, and other documents to link the science directly to managers. Panel products will likely include an FAQ/fact sheet on west coast ocean acidification and hypoxia issues, documents designed to transfer science knowledge to directly to decision-makers, and peer-reviewed open-source publications examining the five primary science questions.

Panel progress and products

After the November meeting, CALost set up a Panel homepage to share news, meeting summaries and other relevant information.

Panelists are developing outputs on ***hypoxia impacts*** (e.g. shoaling, distribution patterns, ecosystems, food webs for several west coast species, and what pH effects will add), ***ecosystem and food web impacts*** (e.g. effects on different species important to humans, ocean acidification in the context of an ecosystem-based management arena) and ***ocean and coastal dynamics*** (e.g. transition from open ocean to nearshore, oceanic impacts to coastal water, dominant patterns of exposure, seasonality and spatial structure, categorizing diversity of water systems along the west coast).

An Ecosystems subgroup held an in-person workshop in early February where six panelists began sketching out a manuscript to address how ocean acidification and hypoxia will affect west coast ecosystems. Participants left with their tasks and timelines. A Management Framework subgroup is working on a piece for *Environmental Science & Technology* on science needs of a new regulatory and management framework to address ocean acidification and hypoxia.

A workshop at the Southern California Coastal Water Research Project (led by panelist Martha Sutula) addressed modeling nearshore biogeochemical processes, and scoped the possibility of building a management-relevant model to help identify relative drivers, ultimately to help in understanding if the contribution from nutrient loading is having a meaningful impact on ocean acidification. Several panelists attended and the proceedings document will undergo review by them, and then the entire Panel, to map a plan forward.