The West Coast Ocean Acidification and Hypoxia Science Panel

Snapshot of Decision Makers' Science Needs
Organismal Physiology Working Group

Introduction

The need for greater understanding of ocean acidification and hypoxia (OAH) along the Pacific West Coast has arisen at multiple levels of government. The scope of decision making audiences for the West Coast Ocean Acidification and Hypoxia Science Panel (the Panel) includes managers, policymakers, and legislators at the state, regional, federal and international levels. This document provides a summary of decision maker information needs which the Panel's Organismal Physiology Working Group aims to address through their work.

Conversations with Decision Makers

To identify priority information needs related to the issues of OAH, Ocean Science Trust, in collaboration with the Institute for Natural Resources in Oregon, conducted a series of interviews with decision makers across the natural resource management and policy landscape. From these interviews, the Panel gained insight into core information needs relating to impacts of OAH to physiology of marine species. Beyond shaping the work of the Panel, the science needs identified here can help focus research and funding priorities for those with an interest in producing policy and management-relevant science to track and address these critical issues going forward.

Core Information Needs

Science needs have been divided by decision making audiences:

- Water Quality Managers
- Fishery and Wildlife Managers
- Land Use and Park Managers

Key science needs voiced across multiple agencies include understanding vulnerability of commercially important species, variation and species impacts to bays and estuaries, prioritization of ecosystem and species vulnerabilities, species adaptive capacity, and the need to develop predictive modeling tools. Species that live in environments with a lot of natural variability may be less impacted by a high rate of change. It's important to identify systems that might experience a high rate of change, but have low natural variability to determine the vulnerability of species that are unable to adapt.

Key Science Needs

- *Impacts to managed species*
- *Species adaptive capacity*
- *Impacts to food webs and trophic cascades*
- *Species' vulnerabilities at multiple life stages*
- *Impacts to commercial and recreational species*
- *Nearshore processes, especially in ecosystems inhabited by managed species*
- *Ability to forecast or predict responses and impacts*

Compiled by California Ocean Science Trust and Institute for Natural Resources on behalf of the West Coast Ocean Acidification and Hypoxia Science Panel

"What are the direct effects to exploited fishery resources on the Pacific West Coast? What is the potential for impacts to food webs?"

-State Fish and Wildlife Manager

Water Quality Managers

Impacts to Biology and Ecology

- Key species likely to be impacted and to what extent
- Species capacity to adapt to new conditions
- Variation in adaptive capacity in coastal waters compared to pelagic or offshore environments
- Biological response associated with various stressors

"We need scientists to quantify the biological response associated with various stressors. Is there more adaptive capacity in coastal waters than in pelagic or offshore environments?"

-Federal Water Quality Manager

Natural Variation and Drivers of OA and Hypoxia

- Identifying a "baseline" for natural conditions as a reference point for future changes
- Advancing tools to monitor and track ocean acidification
- Clarification of the link between OA and hypoxia, as well as identifying areas where they co-occur
- Valuable metrics to monitor in the environment beyond CO_2
- Greater understanding of daily, seasonal and geospatial (e.g., bays, shelf, estuaries) variation in pH/oxygen
- Define thresholds or what is an "acceptable" level of OAH
- Defensible model to predict rate of acidification change
- Uncertainty associated with scientific determinations, i.e. is the existing science sufficient to make policy decisions?
- Cost effective research and monitoring
- Identifying hotspots where increasing hypoxia occurs

Fish and Wildlife Manager

Economically valuable species of interest mentioned by West Coast fish and wildlife managers.

	ORGANISMS
Primary producers	Phytoplankton, algal blooms Coralline algae Macroalgae, kelp Estuaries, wetlands
Crustaceans	Dungeness crabs Spiny lobster
Molluscs	Oysters, larvae and adults Clams (cockles, gaper, butter, littleneck, geoduck) Squid Abalone
Echinoderms	Sea Urchin
Vertebrates	Sardines Rockfish Salmon

Impacts to Biology and Ecology

- The degree to which key species, fisheries, and ecosystem components will be stressed by OAH (see table at right)
- Ability to predict impacts to species, especially in major shellfish growing areas (e.g., Tomales Bay, Humboldt Bay)
- Species that may benefit from OAH, or species that are less sensitive
- Impacts to recruitment in key species
- Adaptive capacity in commercially and recreationally important species like oysters, Dungeness crab, and abalone
- Ability to select for resistance to acidification
- Impacts at multiple life history stages
- The potential trophic cascade effects on exploited fisheries on the Pacific West Coast

Natural Variation and Drivers of OA and Hypoxia

- Data on OAH conditions in the surf zone, sandy beaches, tidal flats, gravel beds, eelgrass beds, kelp beds, and shallow subtidal channels where native shellfish reside
- The biomechanics of OAH in porewater of gravel, sands, and mud inhabited by important commercial and recreational clam species
- Determining the applicability of scientific findings from commercial shellfish hatcheries to native shellfish populations and habitats
- Recommendations for the development, infrastructure, and operation of a coordinated network of OAH monitoring stations along the Pacific coastline
- Technological advancements that are needed to develop realistic forecasts of OAH impacts into the future

"What would be valuable to monitor beyond carbon dioxide?"

-Federal Environmental Protection Manager

Land Use and Park Managers

Impacts to Biology and Ecology

- Impacts to marine food webs
- Ability to predict shifts in community structure
- Impacts to important commercial and non-commercial species (e.g., Dungeness crab, clams, native and non-native oysters, rockfish, and salmon)

Natural Variation and Drivers of OA and Hypoxia

- Changes to chemical composition of waters in key fishing areas, salt mashes, estuaries, and eel grass communities
- Potential benefits to sea grasses or kelp beds that may buffer erosive wave action on beaches and coastlines
- Indirect effects of OAH to geological processes (e.g., erosion impacts beaches and coastlines)
- Areas that may be more prone to impacts from OAH, along with the spatial footprint
- The seasonal or episodic nature of OAH events
- Impacts of OAH to events like El Niño / La Niña, or the longer-term Pacific Decadal Ocillations

"Which key species, fisheries, and ecosystem components will be stressed and to what degree? Is there a predictability to all this?"

-State Fish and Wildlife Manager

Steve Lonhart / NOAA MBNMS

Conclusion

We are moving forward identify the appropriate format and timeline for addressing the science needs identified here. We seek opportunities to align potential Panel products with management and policy processes. All decision makers expressed the need for a product that presents the "state-of-the-knowledge," however they also recognized the need for that product to be dynamic. The products should not only bring together what is known, but provide a path forward to track ocean acidification and hypoxia into the future.

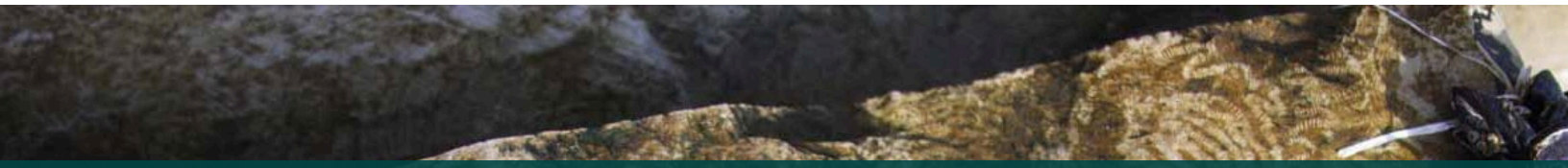
The Panel will:

- **Provide a snapshot of ocean acidification and hypoxia on the west coast** with an eye toward identifying information that is transferable to other regions across the U.S. and more broadly
- **Define research and monitoring priorities** that will address decision makers' needs
- **Strengthen partnerships between the academic community and decision makers**
- **Build a new body of scientific knowledge** from which decision-makers across state, regional, and federal levels may draw to develop more thoughtful management action

For more information on the Science Needs Assessment approach, visit here.
For additional snapshots of decision maker science needs, see also:

Ecosystem and Food Web Working Group

Ocean and Coastal Dynamics Working Group



About the West Coast Ocean Acidification and Hypoxia Panel

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