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Ocean Acidification: Setting Water Quality Goals

Sara Aminzadeh[1], Matt Armsby[2], Nina Bednarsek[3], Jonathan Bishop[4], Alexandria Boehm[5], Caren Braby[6], Francis Chan[7], Rob Dunbar[5], Richard Feely[8], Brian Gaylord[9], Libby Jewett[10], Christopher Krembs[11], Kristy Kroeker[12], Rochelle Labiosa[13], Thomas Maloney[14], Jenn Phillips[15], Brian Rappoli[16], Miyoko Sakashita[17], Deborah Sivas[18], George Somero[5], Martha Sutula[19], Dana Thomas[14], George Waldbusser[7], and Stephen Weisberg[19]

[1]California Coastkeeper Alliance, San Francisco, CA

[2]Resources Legacy Fund, Sacramento, CA

[3]Alfred-Wegener-Institute, Bremerhaven, Germany

[4]California State Water Resources Control Board, Sacramento, CA

[5]Stanford University, Stanford, CA

[6]Oregon Department of Fish and Wildlife, Salem, OR

[7]Oregon State University, Corvallis, OR

[8]Pacific Marine Environmental Laboratory, Seattle, WA

[9]University of California, Davis, Davis, CA

[10]NOAA Ocean Acidification Program, Silver Spring, MD

[11]Washington State Department of Ecology, Lacey, WA

[12]University of California, Santa Cruz, Santa Cruz, CA

[13]U.S. Environmental Protection Agency, San Francisco, CA

[14]California Ocean Science Trust, Oakland, CA

[15]California Ocean Protection Council, Sacramento, CA

[16]U.S. Environmental Protection Agency, Washington, DC

[17]Center for Biological Diversity, Oakland, CA

[18]Stanford Law School, Stanford, CA

[19]Southern California Costal Water Research Project, Costa Mesa, CA

EXECUTIVE SUMMARY

In response to the West Coast Ocean Acidification and Hypoxia Science Panel's Recommendation 3 (Revise water quality criteria), 25 experts were convened at Stanford University on October 17–18, 2016 to chart a path toward development of ocean acidification (OA) water quality goals. Participants were asked to help develop goals that in the short term could be used as management tools for defining monitoring needs and for interpreting modeling and monitoring output, and in the longer term could form the foundation for water quality criteria.

The workshop had three objectives: 1) Identify the chemical parameters and biological indicators that are most appropriate for assessing the status of ocean acidification; 2) Prioritize the research needed to advance the parameters and indicators toward use as water quality goals; and, 3) Pinpoint the biggest impediments to development of criteria from these goals and actions that can be taken to lessen those impediments.

Top parameters and indicators for developing ocean acidification water quality

Goals

Participants identified pH and carbonate saturation state as the two chemical parameters that are the strongest candidates for near-term adoption as water quality goals. They reached this conclusion because these parameters have been documented through both laboratory and field studies to affect biota, and their widespread use in ongoing monitoring programs provides some context for how these parameters vary naturally in the ocean environment.

Participants also identified four taxa whose biological condition could serve as a biological indicator for near term application: pteropods, mussels, oysters, and rockfish. Pteropod shell condition rose above other candidate biological indicators because pteropods are widely distributed, methods to measure their shell condition have been established, and shell condition has been linked to organism growth and survival. Importantly, pteropod shell condition has already been shown to reflect the acidification status of coastal waters, so this ecologically important group is already manifesting negative effects from OA. Pteropod population trends are also predictive of higher-level ecosystem trends and therefore shell condition represents a measurable early-warning indicator of ecosystem health.

Priority research needs

Participants recognized that the recommended chemical parameters and biological indicators are not yet sufficiently advanced (e.g., specific numerical values, threshold conditions) for use as defined management goals or as criteria, so they developed research recommendations that would enhance their application. The top research recommendations were similar for both chemical parameters and biological indicators:

1) Expand the linkage between chemical exposure and biological response. Establishing biologically-relevant water quality goals requires understanding the linkage between chemical exposure and biological response. Participants identified that this should be initiated through literature review and integration of studies conducted to date focusing on four major taxa (pteropod, mussels, oysters, rockfish) for which data are readily available.

2) Define natural variability in the parameters. Marine organisms have tolerances of pH and carbonate saturation state outside of their optimum range. Quantifying the frequency and duration of “natural” fluctuations in OA chemical parameters, without the influence of anthropogenic activities, is an important element of OA water quality goal setting.

3) Standardize and simplify operating procedures for measuring the parameters and indicators. Many existing procedures require complex research techniques. To quantify changes in ocean acidification for regulatory purposes, managers require chemical parameters or biological indicators that users with a wide range of experience can consistently measure.

4) Support co-located chemical and biological field measurements. Most threshold

development work is presently being conducted through laboratory exposure experiments. Appropriate field data are needed to not only validate laboratory observations, but capture the complex interplay among factors that are important in nature and cannot be replicated in the laboratory.

Impediments to new criteria

Workshop participants identified two primary impediments to developing new regulatory criteria. In addition to the research needs identified above, participants noted the following needs:

1) Clearly establish the management need for new criteria. Water quality managers indicated they are only interested in deploying the resources needed to develop OA water quality criteria if they are convinced that local nutrient and carbon inputs are a meaningful contributor to local acidification conditions and that local management actions would have a meaningful effect. Participants identified coupled physical-biogeochemical models that allow distinction of local and global emission effects as an appropriate means to assess the contribution of nutrients.

2) Generate the motivation and resources required to conduct the necessary science and administer the criteria implementation process. Participants noted that the suggested research and management activities will be expensive, and thus require broad public and legislative support. While achieving that is inherently a nonscientific activity, scientists can assist by better connecting acidification impacts to species and ecosystem services of public concern.

Full Text

http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/961_OceanAcidificationSettingWaterQualityGoals.pdf