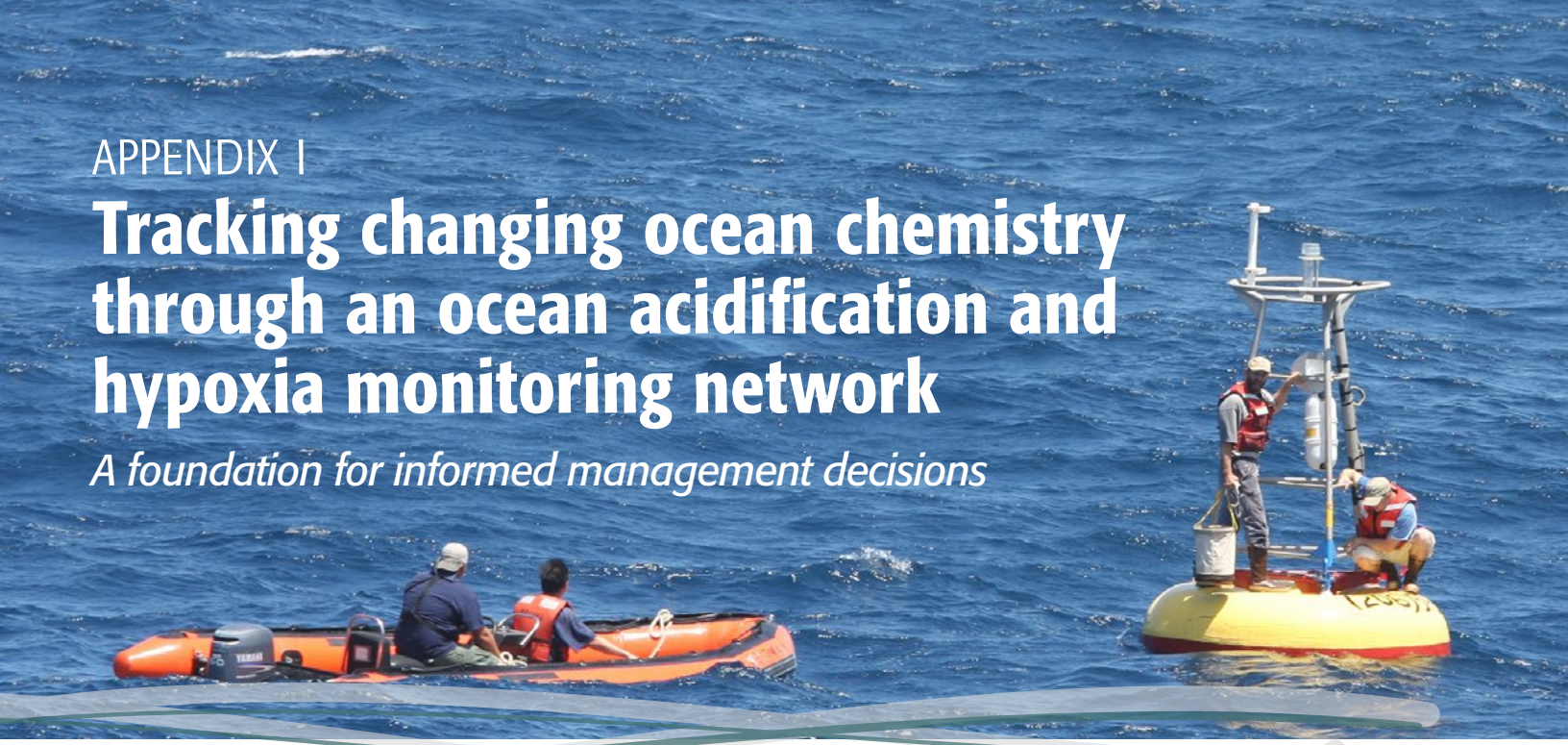

APPENDIX I

Tracking changing ocean chemistry through an ocean acidification and hypoxia monitoring network

A foundation for informed management decisions

Ocean acidification and hypoxia (OAH) monitoring programs dot the West Coast, as monitoring plays an invaluable role in scoping the severity of OAH-related problems, determining the trajectory of the problem (i.e., is it getting worse, and at what rate?), and assessing the effectiveness of past and planned management actions. Many monitoring programs were developed to address specific research or management needs. As a consequence, they do not adequately operate on the spatial and temporal scales over which OAH is occurring. Furthermore, traditional OAH monitoring focuses on measuring basic chemical parameters, such as pH and dissolved oxygen, rather than the full array of interrelated variables that collectively define OAH's impacts.

The Panel recommends establishment of a sustained, strategic and adaptive monitoring network that is founded on integration, coordination, and harmonization of existing efforts and their expansion in ways that will inform policy and management decisions. A regional OAH monitoring network will link decision-makers with a common pool of scientific data that will enable them to evaluate how, when, and where to act to serve the best interests of the region and society as a whole.

The monitoring network envisioned by the Panel explicitly includes physical, chemical, biological, and ecological monitoring to track change, understand impacts, and evaluate management actions. It leverages and enhances existing assets (e.g., observing systems, ecological time-series), technologies, protocols, partnerships, data systems and management frameworks (e.g., protected areas) to achieve a strategic, efficient network. The Panel's foundational requirements for a rigorous regional monitoring program are provided in a separate technical document entitled "*Ocean Acidification and Hypoxia Monitoring Network: Tracking the Impacts of Changing Ocean Chemistry to Inform Decisions*."

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Here we describe the key actions needed to achieve that desired monitoring network.

1. Define management needs from OAH monitoring.

Cultivate and enhance existing partnerships between monitoring practitioners, modelers, and decision-making users to better define OAH information needs across ecosystem types, and for diverse uses.

2. Assess how well existing monitoring efforts meet those management information needs.

Complete a comprehensive inventory of the geographic distribution, data quality, and operational status of existing monitoring programs that provide information relevant to OAH management. Use this inventory to address how well these monitoring assets are positioned to address management questions and support OAH forecast models. Use OAH model outputs to evaluate the information value of existing and proposed monitoring locations.

3. Evaluate and prioritize needs for new investment.

Enhance existing monitoring efforts to fully address management questions. Assess the feasibility of adding new measurements and analytical capacity to existing monitoring efforts. Establish regular communication and connections among managers, scientists, system operators, and end-users to iteratively assess the strength of alignment between monitoring activities and decision-making needs.

4. Enhance consistency among programs through training and quality assurance.

Many monitoring programs on the West Coast were established independently and thus have unique procedures for data procurement and management. Measurement techniques and data archiving should be harmonized among monitoring efforts. Staff involved in monitoring requires training in these procedures, and quality assurance activities should be performed to ensure reliability and comparability of data.

5. Develop a centralized portal for accessing OAH monitoring data.

Develop a simple means for accessing diverse monitoring data sets as well as OAH model output that inform OAH management. This will allow data to be catalogued, combined, compared, and shared, ensuring that monitoring data and model output are used effectively to inform further research, and ultimately management action. Establish community protocols for submitting new data into common data portals.

6. Develop and sustain intellectual capacity.

It is not enough to just make measurements and run models - it is also critical to maintain the intellectual capacity to interpret and communicate the findings. Investments in data analysis and data distribution are critical pieces of a monitoring network, as they will ensure the data are used to inform the management decisions the program was designed to support.

7. Communicate information widely.

Develop tools and technologies to promote greater two-way communication regarding observations and analyses, and data synthesis products. Incentivize regular information exchange activities that engage the broader user community.

Enhance existing monitoring efforts to fully address management questions.

This report was produced by the West Coast Ocean Acidification and Hypoxia Science Panel (the Panel), working in partnership with the California Ocean Science Trust. The Panel was convened by the Ocean Science Trust at the request of the California Ocean Protection Council in 2013, working in collaboration with ocean management counterparts in Oregon, Washington, and British Columbia. Ocean Science Trust and the Oregon Institute for Natural Resources served as the link between the Panel and government decision-makers. The information provided reflects the best scientific thinking of the Panel. More information on the Panel can be found at www.westcoastOAH.org. Cover image: Oregon State University / Creative Commons License; circle inset (Tessa Hill with instrument) - Hog Island Oyster Co.; circle inset (mooring) - Rachel Wold / University of Washington / NANOOS.