Item 4b

Staff Recommendation
June 15, 2021

# Enhancing California's ocean acidification and hypoxia monitoring network through existing long-term efforts

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**RECOMMENDED ACTION:** Staff recommends that OPC approve the disbursement of up to $1,680,786 to Scripps Institution of Oceanography, Southern California Coastal Water Research Project, and Central and Northern California Ocean Observing System to implement enhanced and standardized biological and chemical ocean acidification and hypoxia monitoring in the California Current across various ongoing monitoring programs.

**LOCATION:** Statewide

**STRATEGIC PLAN GOALS, OBJECTIVES, TARGETS and ACTIONS:**
Goal 1: Safeguard Coastal and Marine Ecosystems and Communities in the Face of Climate Change; Objective 1.2: Minimize Causes and Impacts of Ocean Acidification and Hypoxia; Target 1.2.1: By 2022, provide scientific guidance to the State Water Resources Control Board (SWRCB) to inform new nutrient loading standards that minimize biological and chemical impacts including ocean acidification, hypoxia, and harmful algal blooms; 1.2.4: Work with partners and make targeted investments to support the development of an ocean acidification and hypoxia monitoring and observation system optimized to deliver decision-relevant information that serves user needs by 2023; and advance the science on ocean acidification and hypoxia vulnerability and identify risks to California's biological resources, communities, and economies, within the context of other ongoing environmental changes. Goal 3: Enhance Coastal and Marine Biodiversity; Target 3.3.4: Develop adaptive management approaches to assess and effectively respond to climate-caused shifts in fish populations and fisheries by 2023; Target 3.6.1: Create an annual State of the Coast and Ocean Report starting in 2021 and a Report Card by 2025.

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**EXHIBITS:**

Exhibit A: Letters of Support
Exhibit C: *Biological and Chemical Monitoring Coordination: Recommendations to the Ocean Protection Council from the California Ocean Acidification and Hypoxia Expert Panel* (April 2021)

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## FINDINGS AND RESOLUTION:

Staff recommends that the Ocean Protection Council (OPC) adopt the following findings:

> "Based on the accompanying staff report and attached exhibit(s), OPC hereby finds that:
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> 1) The proposed project is consistent with the purposes of Division 26.5 of the Public Resources Code, the Ocean Protection Act;
> 2) The proposed projects are consistent with OPC's Proposition 84 grant program funding guidelines and environmental license plate funding guidelines (Interim Standards and Protocols, August 2013); and
> 3) The proposed project is not 'legal projects' that trigger the California Environmental Quality Act (CEQA) pursuant to Public Resources Code section, section 15378."

Staff further recommends that OPC adopt the following resolution pursuant to Sections 35500 *et seq.* of the Public Resources Code:

"OPC hereby approves the disbursement of up to $1,680,786 to the following grantees to implement standardized and coordinated biological and chemical OAH monitoring for the purposes of producing management-relevant information on biological sensitivity to OAH:

- $510,360 to the Scripps Institution of Oceanography"
- $618,000 to the Southern California Coastal Water Research Project"
- $552,426 to the Central and Northern California Ocean Observing System"

This authorization is subject to the condition that prior to disbursement of funds, grantees shall submit for the review and approval of the Executive Director of the OPC detailed work plans, schedules, staff requirements, budgets, and the names of any contractors or grantees intended to be used to complete the projects, as well as discrete deliverables that can be produced in intervals to ensure the projects are on target for successful completion. All projects will be developed under a shared understanding of process, management and delivery."

## EXECUTIVE SUMMARY:

This project will provide funding to expand and integrate biological measurements into ongoing ocean acidification and hypoxia (OAH) monitoring programs with a focus to develop protocols and best practices; adopt standardized pteropod and larval crab sampling and analysis; coordination of methodologies for collection of harmful algal blooms (HABs), and environmental DNA (eDNA) relevant to OAH; data management, aggregation, and curation; and coordination across programs on synthesis and interpretation to support management-relevant information. The coordination and integration of biological and chemical measurements has been identified as a key priority

to enhance California's OAH monitoring network and will be directly addressed by this project.

## PROJECT SUMMARY:

The California coast is vulnerable to OAH phenomena driven by global climate change. The intensification of OAH will increasingly put California's productive, rich, and commercially important marine life at risk. An OAH ocean observing network is key to understanding which species of marine life will be impacted, which habitats will be altered and which fisheries will be compromised. California does not currently have a state-wide ocean observing system that can provide early warnings of the biological impacts of OAH. Moreover, the lack of coordination limits ability for California (SWRCB) to develop ecosystem-relevant OAH water quality criteria, which are critical elements of the OPC's 2020-2025 Strategic Plan and Ocean Acidification Action Plan. Laboratory studies provide some of the necessary information, but criteria development may require additional field confirmation, which depends on having co-located chemical and biological measurements across a gradient of OAH exposure. However, California is home to a number of long-term seagoing research programs that if coordinated, can become the world's premier large-scale OAH ocean observing network.

Better connecting biological and chemical monitoring through coordination and standardization across ongoing monitoring programs was identified as the first recommendation in OPC's OAH Science Task Force monitoring gaps analysis report, *Enhancing California's Ocean Acidification and Hypoxia Monitoring Network; Recommendations to the Ocean Protection Council from the California Ocean Acidification and Hypoxia Science Task Force*. To provide further guidance and specificity on this recommendation, the Ocean Science Trust, on behalf of OPC, convened an Expert Panel of scientists. This Panel, composed of Jim Barry (Monterey Bay Aquarium Research Institute), Francis Chan (Oregon State University), Jan Newton (University of Washington), and Su Sponaugle (Oregon State University) provided additional recommendations on biological measurements that could be enhanced across ongoing monitoring programs (Exhibit C). The five monitoring programs evaluated are:

- **Applied California Current Ecosystem Studies (ACCESS)** is a private/public partnership that supports marine wildlife conservation and healthy marine ecosystems in north-central California by conducting ocean research to inform resource managers, and policy makers. ACCESS and its partners track ocean variability to examine seasonal patterns and assess how the ecosystem is responding to large, basin-scale climate shifts among years. Ongoing cruises started in 2004 and take place from April to October on the NOAA National Marine Sanctuary Research Vessel Fulmar. Fifty-one cruises have been completed to date.
- **California Cooperative Fisheries Investigation (CalCOFI)** consists of a partnership between the California Department of Fish and Wildlife, the NOAA Fisheries Service and the Scripps Institution of Oceanography. CalCOFI was formed in 1949 and focuses on the study of the marine environment off the coast of California, the management of its

living resources, and monitors the indicators of El Nino and climate change. CalCOFI conducts quarterly cruises off Southern and Central California, collecting a suite of hydrographic and biological data (at 75 stations in summer and fall, and 103 in winter and spring). In 2004, the CalCOFI surveys became part of the LTER (Long Term Ecological Research) ecological studies network as a site to understand the pelagic ecosystem of the California Current.

- **California Current Ecosystem Long-term Ecological Research (CCE LTER)** is an interdisciplinary group of scientists, students, and educators that is working to understand and communicate the effects of long-term climate variability on the California Current pelagic ecosystem. CCE LTER is based at the Scripps Institution of Oceanography but currently includes partners at four other institutions (Duke University, Georgia Institute of Technology, Point Reyes Bird Observatory Conservation Science, and the Southwest Fisheries Science Center/National Marine Fisheries Service). CCE LTER has a long-term partnership with CalCOFI, utilizing CalCOFI's cruise observations and deploying spray gliders along three CalCOFI cruise lines in Southern California.
- **The NOAA West Coast Ocean Acidification Regional Survey Cruises** span along the North American coastlines (Atlantic, Pacific, Gulf of Mexico, and Alaskan) and in the global open ocean and focus on mapping and monitoring the distribution of key indicators of ocean acidification including carbon dioxide, pH, and carbonate mineral saturation states.
- **Southern California Coastal Water Research Project Southern California Bight Regional Monitoring Program** is an ongoing marine monitoring collaboration that examines how human activities have affected the ecological health of more than 1,500 square miles of Southern California's coastal waters. Via this partnership, facilitated by SCCWRP, dozens of participating organizations pool their resources and expertise to investigate the condition of marine ecosystems across both time and space. Both regulated and regulatory agencies, as well as non-governmental and academic organizations, come together to design studies, interpret findings, and speak with a common voice about the ecological health of the Southern California Bight.

The Panel considered a variety of biological indicators that could be added to or coordinated more comprehensively among ongoing monitoring programs. Some of the indicators considered are currently measured by one or more of the five monitoring programs. Over thirty biological indicators were considered, ultimately grouped into seventeen activities evaluated for recommendation. Criteria used to rate their value for broader use across monitoring programs included: value to resource managers; link to attribution; scientific feasibility; likelihood of adoption by monitoring programs; time period required to observe OAH signal; and cost. Although all criteria were important, a primary goal of the recommended actions is to improve the California OAH monitoring program in a way that provides resource managers with information and tools useful in policy decisions. Therefore, among these criteria, the perceived value to managers was weighted heavily.

The Panel further emphasized that recommendations were strongly filtered by the leveraging potential of ongoing regional OAH monitoring programs. For example, detecting and tracking the impacts of OAH on adult fish and invertebrate populations that support California's key commercial and recreational fisheries is extremely important, but beyond the scope of what could be implemented easily by the programs under consideration. Likewise, efforts to monitor the impacts of hypoxia on benthic communities, a well-recognized concern for Southern California, warrants statewide prioritization but will require attention from programs that are better positioned to expand benthic studies.

With this process, the Panel recommended the following biological indicators for broader implementation across the five monitoring programs:

- Evaluate the extent of pteropod and crab shell dissolution and abundance.
- Measure the abundance and composition of microbial assemblages contributing to harmful algal blooms (HABs).
- Collect and analyze environmental DNA (eDNA) samples focusing on invertebrates, vertebrates, and HABs.
- Track the abundance and composition of zooplankton and ichthyoplankton.
- Track the abundance and composition of krill and forage fish assemblages.

In addition to recommendations for specific biological indicators to be added or expanded among monitoring programs, the Panel recommends several overarching programmatic practices to 1) promote the accuracy, accessibility, and comparability of observations across programs, 2) develop syntheses as status reports for biological conditions in relation to OAH, and 3) actively include policies and practices to promote diversity and inclusion (DEI) within California OAH monitoring programs.

Overall, recommendations are meant to catalyze a statewide monitoring coordination effort but recognizes that OPC does not have the funding capacity to sustain measurements long-term. Recommendations and projects were therefore targeted with the best chance of being absorbed into ongoing operations under current funding levels or to identify new ways to fund this critical effort into the future. The proposed projects directly implement multiple Panel recommendations; however, additional funding would be required to meet Panel recommendations in their entirety. The proposed projects will collectively and individually include tasks and outcomes:

**Project Tasks and Outcomes:**

**Task 1. Protocols/Best practices:** Best practices should be developed and used for chemical and biological measurements and observations. Projects will coordinate on development of standardized methodologies to maximize the comparability of observations among monitoring programs. Deliverables: Carbonate chemistry and pteropod/larval crab sampling standard operating procedures (SOPs).

**Task 2. Adopt standardized pteropod and larval crab sampling and analysis**: Calcifying organisms, such as pteropods and crabs, have tests (shells) of aragonite or calcite that are susceptible to ocean acidification if saturation states of these biominerals are below or in some cases close to one. Thus, shell dissolution is a useful and common indicator of ocean acidification status. Planktonic calcifiers such as pteropods and crab megalopae (larval crustaceans) are also prey items for higher trophic level species, including salmon and other fishes. While a direct linkage to hypoxia is not well known, the degree of shell dissolution is one of the more unambiguous indicators for ocean acidification. Deliverable: field collected, processed, and analyzed samples using coordinated SOPs.

**Task 3. Coordination and best practices for collection of HABs, and eDNA relevant to OAH:** Additional Panel recommendations will be explored as appropriate and to varying degrees across monitoring programs as capacity and expertise allows, with a focus on HABs and eDNA. Ultimately the goal is to coordinate and standardize collection, analysis, and interpretation across all recommendations. This project takes a first step in adding and enhancing pteropod and crab sampling, while supporting coordination and method consistency for other measurements. Deliverables: Various standard operating procedures (SOPs) and/or comparative analysis of methods and SOP recommendations.

**Task 4. Data management, aggregation, and curation:** Carbonate chemistry is currently funded and collected across all programs; however quality control and standardization of formatting and metadata is needed. Similarly, for biological measurements, data formats and metadata need to be coordinated and submitted in a standardized way. Central and Northern California Ocean Observing System will lead data management, aggregation, and curation across the monitoring programs to ensure data is interoperable and accessible. Visualization of time-series will also be explored to convey information in a public-friendly way and support future development of indicators. Deliverable: quality-controlled chemical and biological data in standardized formatting that is publicly accessible.

**Task 5. Coordination across programs on synthesis and interpretation to support management-relevant information:** Syntheses of existing data is a critical piece and ensures information is being communicated to appropriate stakeholders. Rather than stockpiling data for future analysis, new observations and archived data available across monitoring programs will be integrated and synthesized periodically as a checkpoint on the status and trends in biological indicators in relation to OAH conditions. Deliverable: coordinated synthesis and interpretation of data across programs to develop findings and products or integrate into existing products.

**About the Grantees:**

A department of UC San Diego, Scripps Institution of Oceanography is one of the oldest, largest, and most cutting-edge centers for global earth science research and education in the world. Scripps leads in research on climate change impacts and adaptation, resilience to hazards, conservation and biodiversity, oceans and human health, national security, and innovative technology to observe the planet.

The Southern California Coastal Water Research Project (SCCWRP) is a public research and development agency that develops and applies next-generation science to improve management of aquatic systems in Southern California and beyond. Since its founding in 1969, SCCWRP has been developing strategies, tools and technologies that the region's water-quality management community relies on to more effectively protect and enhance the ecological health of Southern California's coastal ocean and watersheds.

The Central and Northern California Ocean Observing System (CeNCOOS) is the U.S. IOOS Regional Association for the California/Oregon border south to Point Conception. It is housed at the Monterey Bay Aquarium Research Institute. The fundamental CeNCOOS approach is to develop long-term monitoring of environmental conditions such as water quality, productivity, and connectivity in support of marine protected area management in central and northern California.

**Project Timeline**

August 2021 – August 2024

## PROJECT FINANCING:

Staff recommends that the Ocean Protection Council authorize encumbrance of up to $1,680,786 to Scripps Institution of Oceanography, Southern California Coastal Water Research Project, and Central and Northern California Ocean Observing System to implement standardized and coordinated biological and chemical OAH monitoring for the purposes of producing management-relevant information on biological sensitivity to OAH.

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| Ocean Protection Council | $1,680,786 |
| Scripps Institute of Oceanography | $510,360 |
| Southern California Coastal Water Research Project | $618,000 |
| Central and Northern California Ocean Observing System | $552,426 |
| **TOTAL** | **$1,680,786** |

The anticipated source of funds will be from the Ocean Protection Council's Fiscal Year 2018/2019 appropriation of California Environmental License Plate Funds (ELPF). Using these funds to support this project is consistent with the California Ocean Protection Act, Section 35650(b), as well as OPC's Strategic Plan and Grant Program Funding Guidelines as discussed in more detail in the following section.

## CONSISTENCY WITH CALIFORNIA OCEAN PROTECTION ACT:

The proposed project is consistent with the Ocean Protection Act, Division 26.5 of the Public Resources Code, because it is consistent with trust-fund allowable projects, defined in Public Resources Code Section 35650(b)(2) as projects which:

- Improve management, conservation, and protection of coastal waters and ocean ecosystems
- Provide funding for adaptive management, planning coordination, monitoring, research, and other necessary activities to minimize the adverse impacts of climate change on California's ocean ecosystem

## CONSISTENCY WITH THE OPC'S STRATEGIC PLAN:

This project directly implements Objectives 1.2.1: By 2022, provide scientific guidance to the State Water Resources Control Board to inform new nutrient loading standards that minimize biological and chemical impacts including ocean acidification, hypoxia, and harmful algal blooms; and 1.2.4, Actions: Work with partners and make targeted investments to support the development of an ocean acidification and hypoxia monitoring and observation system optimized to deliver decision-relevant information that serves user needs by 2023; and advance the science on ocean acidification and hypoxia vulnerability and identify risks to California's biological resources, communities, and economies, within the context of other ongoing environmental changes.

## CONSISTENCY WITH THE OPC'S GRANT PROGRAM FUNDING GUIDELINES:

The proposed project is consistent with the OPC's Grant Program Funding Guidelines for Environmental License Plate Funds, in the following respects:

Required Criteria
1. Directly relate to the ocean, coast, associated estuaries, or coastal-draining watersheds: *The project directly investigates ocean and coastal processes to support best available science in decision-making and management.*
2. Support of the public: *See Exhibit B.*
3. Greater-than-local interest: *This project is statewide in scope with implications to the health and resilience of fisheries and ecosystems.*

Additional Criteria
4. Improvements to management approaches or techniques: *The findings from this project will provide scientific support and evidence so that the State Water Resources Control Board (SWRCB) may support new nutrient loading standards (regulatory loads) that minimize biological and chemical impacts from ocean acidification and hypoxia.*
6. Timeliness or Urgency: *The SWRCB's 2019 Ocean Plan Review identified "Ocean Acidification, Hypoxia, and Climate Change Impacts" as one its five highest-ranked issues. Further research is needed to evaluate how to develop water quality objectives and improve the resilience of the coastal environment. This project directly supports the priorities of the 2019 Ocean Plan Review.*
7. Coordination: *This project will compliment and coordinate with previously funded modeling effort to assess the effects of anthropogenic nutrients on ocean acidification and hypoxia. Coupled chemical and biological monitoring information is necessary to understand biological implications.*

## COMPLIANCE WITH THE CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA):

The proposed project is not a ‘legal project’ that triggers the California Environmental Quality Act pursuant to Public Resources Code section 21068 and Title 14 of the California Code of Regulations, section 15378.