Staff Recommendation
March 3, 2025

Item 6

Action Item:
Consideration and Adoption of a Resolution on Ocean Acidification and Hypoxia

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Recommended Action: Staff recommends that the Ocean Protection Council adopt the proposed Resolution on Ocean Acidification and Hypoxia.

Location: Statewide

Strategic Plan Goals and Objectives: Goal 1: Safeguard Coastal and Marine Ecosystems and Communities in the Face of Climate Change; Objective 1.2: Minimize causes and impacts of OAH; Target 1.2.1: Based on the latest scientific research, advance adoption of regulations, as needed, establishing water quality objectives for ocean acidification and hypoxia that include, but are not limited to, publicly owned treatment works, stormwater, and non-point source pollution, by 2025, with scientific analysis of the relationship between nutrient inputs and acidification hot spots completed by 2022.

Exhibits:

Exhibit A: Proposed Resolution on Ocean Acidification and Hypoxia

Findings and Resolution:

Staff recommend that the Ocean Protection Council (OPC) adopt the following findings: Based on the accompanying staff report and attached exhibit(s), OPC hereby finds that:

1. The proposed projects are consistent with the purposes of Division 26.5 of the Public Resources Code, the California Ocean Protection Act;

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

"OPC hereby approves the proposed Resolution on Ocean Acidification and Hypoxia."

Executive Summary:

Staff recommends that OPC adopt the proposed Resolution on Ocean Acidification and Hypoxia (OAH). The Resolution recognizes that OAH are worsening globally due to climate change and that the California coast is particularly vulnerable to OAH. OPC has prioritized research and monitoring to better understand sources and impacts that can inform OAH resilience and mitigation strategies statewide to address the impacts of all contributing sources. The Resolution also commits OPC to the following actions: invest in and advance monitoring and research; support development of water quality objectives(s) and program of implementation; advance and inform nutrient management approaches; and seek opportunities to advance multi-benefit infrastructure upgrades for water recycling. These actions elevate, consolidate, and reaffirm ongoing state priorities and commitments related to OAH, particularly considering recent modeling results and publications.

Background

Global climate change, which is driven by anthropogenic carbon dioxide emissions, is leading to OAH. The California coast is particularly vulnerable to OAH because wind-driven upwelling during spring and summer brings deep seawater that is low in pH and dissolved oxygen to the surface. To address OAH, OPC has prioritized monitoring and research to better understand the vulnerability and impacts to marine species and ecosystems as well as opportunities for building resilience and mitigation strategies.

Specifically, OPC has investigated whether the localized discharge of nitrogen from human sources could have an environmental effect on algal production and OAH, and if so, their biological consequences. To investigate this, OPC has previously invested substantial resources, with leveraged funding from the National Oceanic and Atmospheric Administration, to develop a coupled physical-biogeochemical OAH model for the entire West Coast with a focus on the Southern California Bight (Bight) and recently expanded this work on the San Francisco and Monterey coasts. The model is considered a state-of-the-art global example and has resulted in numerous peer-reviewed scientific publications. In the Bight, an open embayment located

between the Baja California Peninsula and Point Conception in the Southern California Current, this effort has demonstrated that coastal anthropogenic nutrients, primarily from wastewater treatment plant effluent, are having a significant impact on OAH in the region. While the magnitude of this contribution to OAH varies spatially and temporally in the Bight, during spring and summer, subsurface acidification and oxygen loss from local anthropogenic inputs can be comparable to, or greater than, those expected from global climate change.[1] [2] Additionally, these environmental changes are predicted to cause vertical compression of viable ocean habitat for fish and shelled organisms over a quarter of the Bight during 3 months of the year in late summer to early fall. One region of annually recurring habitat compression is located 30-90 kilometers from the coast, located near Santa Catalina Island.[3] The research has also demonstrated that these OAH chemistry and habitat declines decrease when dissolved inorganic nutrients are reduced from ocean outfalls.[4] Ongoing modeling efforts are expected to provide additional results in the next year related to better quantifying cross-border nutrient inputs from Mexico, and whether land-based nutrient inputs may exacerbate the magnitude and frequency of harmful algal blooms.

Human activities are particularly intense in the Bight, home to a population of more than 23 million people. There, point sources of treated wastewater are discharged to the ocean across 19 outfalls, which account for more than 92% of the total land-based nitrogen inputs in this region. Additional nonpoint source inputs contribute a minor fraction of this total. Model findings revealed that these land-based nutrient sources rival natural upwelling in magnitude, roughly doubling available nitrogen within a coastal band of a few tens of kilometers (during the period of 1997 – 2000).[1] Updated model findings for the more recent time period of 2012 – 2017 show the persistent contribution of these human nutrient inputs on OAH, despite a decline in coastal

[1] F. Kessouri, J.C. McWilliams, D. Bianchi, M. Sutula, L. Renault, C. Deutsch, R.A. Feely, K. McLaughlin, M. Ho, E.M. Howard, N. Bednaršek, P. Damien, J. Molemaker, S.B. Weisberg, Coastal eutrophication drives acidification, oxygen loss, and ecosystem change in a major oceanic upwelling system, Proc. Natl. Acad. Sci. U.S.A. https://doi.org/10.1073/pnas.2018856118 (2021).

[2] Kessouri, F., Sutula, M.A., Bianchi, D. *et al.* Cross-shore transport and eddies promote large scale response to urban eutrophication. *Sci Rep* 14, 7240 (2024).

[3] Frieder, Christina & Kessouri, Faycal & Ho, Minna & Sutula, Martha & Bianchi, Daniele & McWilliams, James & Deutsch, Curtis & Howard, Evan. (2024). Effects of urban eutrophication on pelagic habitat capacity in the Southern California Bight. Frontiers in Marine Science. 11. 10.3389/fmars.2024.1392671.

[4] Ho, M., Kessouri, F., Frieder, C.A. *et al.* Effect of ocean outfall discharge volume and dissolved inorganic nitrogen load on urban eutrophication outcomes in the Southern California Bight. *Sci Rep* 13, 22148 (2023).

nitrogen loads. These reductions in nutrient loads (14% Bightwide), occurring alongside volume reductions (33%), are largely due to upgrades that have occurred at several wastewater treatment plants to support water recycling. [1 5]

In 2023, stakeholders funded and convened an Independent Review Panel (IRP) to review the scientific integrity of the coupled physical-biogeochemical OAH model. The IRP found that the model is capturing fundamental physical and biogeochemical processes in the Southern California Bight that are associated with OAH and can be used to address basic management questions regarding ecosystem-level and region-scale impacts of the discharge of treated wastewater in the South California Bight region. The IRP also recommended investing in a series of actions to increase stakeholders' confidence in model results. OPC and other stakeholders are currently assessing these recommendations for potential future investments, recognizing that models require ongoing refinement and advancement over time, and to support the transition of the model to routine management applications. Through the IRP process, resource managers gained another layer of confidence in using the modeling tools' predictions as a basis for decision-making and taking action, including related to observational monitoring, as well as providing an important venue for collaboration across stakeholder groups.

OPC has additionally invested in ongoing projects to collect observational data of OAH off California's coast, including the enhancement of California's monitoring network by expanding biological measurements into existing OAH monitoring programs, developing best practices, and improving coordination and integration of biological and chemical measurements. A related project will develop a California OAH portal to support a centralized, user-friendly database of OAH data and products. Additional funding for projects that advance understanding of the impacts of OAH on marine species and ecosystems include work to understand how rockfish offspring respond to OAH based on the environmental and genetic history, and development of multi-stressor indices to evaluate marine calcifier (specifically, pteropods, Dungeness crab, and krill) habitat suitability. Results from these ongoing projects are expected over the next one to two years.

[5] Sutula, M. *et al.* A baseline of terrestrial freshwater and nitrogen fluxes to the Southern California Bight, USA. *Mar. Pollut. Bull.* 170, 112669 (2021).

Resolution Summary:

The Resolution highlights OPC priorities related to research and monitoring to better understand sources and impacts that can inform OAH resilience and mitigation strategies statewide to address the impacts of all contributing sources. The Resolution commits OPC to the following actions:

- **Invest in and advance monitoring and research:** Building upon previous investments, OPC will continue to fund projects that advance scientific understanding of OAH causes and impacts, identify and evaluate coastal pollutants contributing to OAH, and strengthen monitoring and observation systems statewide to further knowledge of current and future OAH conditions and inform nutrient management.
- **Support development of water quality objective(s) and program of implementation:** Based on the best available science, including observational monitoring and modeling data, and consistent with the precautionary principle, OPC supports the development of one or more water quality objectives and associated program of implementation by the State Water Resources Control Board to address OAH impacts to ensure the reasonable protection of California's coastal and ocean ecosystems and their beneficial uses. OPC supports and encourages a program of implementation that addresses the anthropogenic causes of OAH within the State Water Resources Control Board's regulatory authority, including nutrient management actions as appropriate, and considers water recycling needs and energy demands.
- **Advance and inform nutrient management approaches:** OPC will encourage state agencies to seek early collaboration and information sharing with external stakeholders to increase understanding of effective nutrient interventions, inform and support improved management of land-based nutrients, and carefully invest public funds and prioritize nutrient management in publicly owned treatment works and other specified land-based sources of nutrients in state programs. This includes, but is not limited to, requesting information regarding nutrient management approaches and feasibility when providing funding to non-state entities, to the extent permissible by law.
- **Seek opportunities to advance multi-benefit infrastructure upgrades for water recycling:** OPC will work with stakeholders and government partners to identify and leverage funding opportunities to inform and support infrastructure upgrades for water recycling at publicly owned treatment works that also reduce nutrient inputs on coastal and ocean ecosystems and resulting impacts on OAH. Infrastructure upgrades can provide additional co-benefits in support of other state water quality and water supply priorities, such as advancing *California's Water Supply Strategy: Adapting to a Hotter, Drier Future* and enhancing local water supply, through water recycling infrastructure that incorporates appropriate nutrient management. OPC supports a collaborative approach to advance infrastructure upgrades

and water recycling to ensure they are feasible, will meet water quality objectives, address aging infrastructure challenges, and advance OAH and nutrient remediation efforts to protect beneficial uses of California ocean waters that provide for California's coastal and ocean ecosystem.

This Resolution elevates, consolidates, and reaffirms ongoing state priorities and commitments to address OAH, particularly considering recent modeling results and publications.

Consistency with California Ocean Protection Act:

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

- Eliminate or reduce threats to coastal and ocean ecosystems, habitats, and species.
- Allow for increased public access to, and enjoyment of, ocean and coastal resources, consistent with sustainable, long-term protection and conservation of those resources.
- 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.