

A DECADE OF ACTION ON OCEAN ACIDIFICATION IN CALIFORNIA

A progress report to the Ocean Protection Council on state policy, management, and science to address changing ocean chemistry



CALIFORNIA IS ON A PATH TO ACHIEVING A 10-YEAR VISION

Waters off the coast of California are acidifying at twice the rate of the global average, driven by uptake of carbon dioxide released by the burning of fossil fuels and changing land uses. Devastating failure of oyster hatcheries in the Pacific Northwest signaled the first ocean acidification (OA) warning sign in the region. Corrosive waters are putting at risk our vibrant coastal and ocean ecosystems, and have recently been linked to dissolving shells in Dungeness crabs - one of California's most lucrative marine fisheries.

Given this looming threat, California has taken proactive steps during the last decade to increase our understanding of OA, invest in decision-relevant science, and develop the *State of California Ocean Acidification Action Plan (OA Action Plan) (2018)*. Armed with a 10-year vision and a suite of strategic actions that span the land-sea interface, the state is preparing to adapt and respond to the significant ocean chemistry changes ahead, as well as serve as an international leader to inspire other regions to tackle this shared challenge.

Here, we outline current progress to address OA in California, identify how existing Ocean Protection Council (OPC) investments advance the goals of the *OA Action Plan* and OPC strategic priorities, and share the State's near-term next steps to slow rates of acidification and prepare communities.



CALIFORNIA'S MAJOR ACHIEVEMENTS

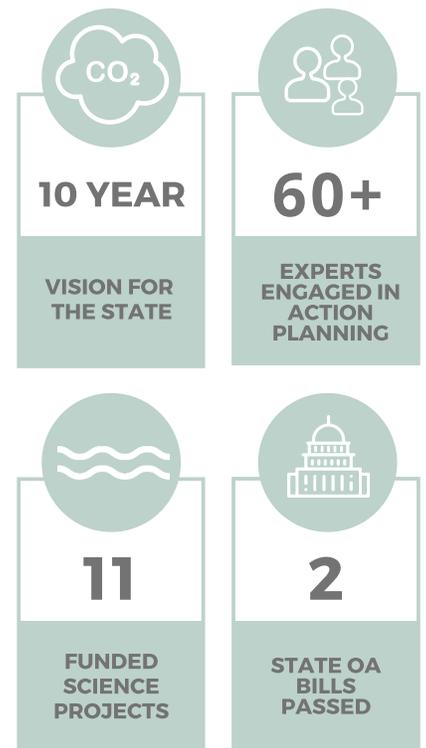
Over the last 10 years, California's major achievements to better understand, mitigate, and adapt to OA include the following milestones:

- **Developed one of the first state OA action plans**, engaging over 60 experts
- **Targeted investments in science** that advance strategies and objectives in the *OA Action Plan*
- **Served as a founding member of the International Alliance to Combat Ocean Acidification**, now including over 90 members, including government, tribal, and affiliate members
- **Developed a west coast-wide OA monitoring inventory**
- **Coordinated action and knowledge exchange across the west coast region** through the Pacific Coast Collaborative
- **Passed two OA bills** in the California State Legislature

NEXT STEPS

While progress has been made, these existing efforts are part of a much larger endeavor, particularly as OA acts in combination with other environmental stressors such as ocean warming and hypoxia. Priorities for the coming years, in alignment with OPC Strategic Plan targets, include continuing to:

- **advance models and the scientific analysis of the relationship between nutrient inputs and OA** impacts to inform water quality management that minimizes biological and chemical impacts.
- **support the development of an OA and hypoxia monitoring and observation system** optimized to deliver decision-relevant information that serves user needs.
- **advance the science on OA and hypoxia vulnerability and identify risks** to California's biological resources, communities, and economies, within the context of other ongoing environmental changes.
- **use our understanding of vulnerability and risk to educate and inform key stakeholders** on OA impacts and adaptive actions.
- **work with domestic and international partners to raise awareness of the threat of OA, and advocate for carbon emissions reductions** – the only long-term solution to avoid accelerating impacts from OA.



THE CALIFORNIA OA ACTION PLAN. In 2018, the Ocean Protection Council adopted the *OA Action Plan* as a roadmap to reduce and prepare for the impacts of OA.



BUILDING ON A HISTORY OF OA ACTION IN CALIFORNIA

California has identified OA as a priority issue for over 10 years. Devastating failure of oyster hatcheries in the Pacific Northwest between 2006 and 2009 led to the establishment of a Blue Ribbon Task Force and a landmark OA action plan for the State of Washington in 2012. Recognizing the need to harness the growing political attention on OA, California in collaboration with Oregon, Washington, and British Columbia, spearheaded the West Coast Ocean Acidification and Hypoxia Science Panel to synthesize the state of knowledge and identify management options.

Following release of the Panel's findings in 2016, the California State Legislature passed two related bills – Assembly Bill 2139 and Senate Bill 1363 – charging OPC to test potential OA mitigation methods and ensure the state continues to receive the best available scientific advice through establishment of a science task force (see below).

OPC has also made several strategic investments in OA-related science that are fundamental to taking effective action. In 2018, as a founding member of the International Alliance to Combat Ocean Acidification, OPC developed the *State of California OA Action Plan* as a roadmap to reduce and prepare for the impacts of OA.



ENGAGING BEYOND STATE BORDERS. State leaders have participated in international climate events to elevate the importance of OA inclusion in policy development and for the consideration of OA in international climate agreements. The Global Climate Action Summit in San Francisco (2018), New York Climate Week (2019), and COP25 in Madrid (2019) are just a few examples of how California is both sharing and learning from the experiences of other jurisdictions and geographies.

CONTINUED ADVISING: THE CALIFORNIA OA AND HYPOXIA SCIENCE TASK FORCE

In 2018, the Science Task Force was convened in response to AB 2139 (Williams, 2016) to serve as an advisory body to OPC to ensure further actions in California continue to be supported by the best available science. The Science Task Force is made up of eight leading scientific experts from California, Oregon, Washington, a non-governmental organization, and the federal government, charged with tracking investments in research and monitoring, connecting new findings with decision-makers, and providing recommendations to guide future action. Throughout their initial term, the Science Task Force played a crucial role in shaping the OA Action Plan, including developing a near-term science strategy to support its implementation.

The Science Task Force is now undertaking an analysis of gaps in the state's OA observing network and developing recommendations to inform investments to build an OA monitoring network to better understand trends and impacts, and to assess the effect of any regulatory and/or management actions.

For more information about the Science Task Force, visit www.westcoastoah.org.

EMERGING OCEAN ACIDIFICATION SCIENCE

California is already making progress on science necessary to support implementation of the *OA Action Plan* through a series of OPC funded initiatives to (a) understand where and when OA effects will most immediately manifest, and (b) identify local solutions for slowing OA's progression and building resilient ecosystems. Below, we highlight progress and insights gained from the state's investments and how efforts align with strategies in the *OA Action Plan*.

MODELING TO INFORM WATER QUALITY MANAGEMENT OPTIONS

Strategy 3: Reduce the pollution that causes OA

Coupled physical-biogeochemical models are helping us understand when and where local nutrient pollution from wastewater treatment plant discharges and agricultural runoff may contribute to coastal acidification and hypoxia in California. Researchers are starting to share initial model outputs which are informing discussions with the California State Water Resources Control Board about potential management options.



ASSESSING IMPACTS TO LIVING MARINE RESOURCES

Strategy 1: Prepare for a full range of OA risk and impacts; Strategy 5: Build resilience of affected communities, industries and interests

Efforts are underway to identify which California species are most threatened by changing chemistry, including crabs, urchins, oysters, and mussels. A recent synthesis highlights impacts to key commercial, recreational, and ecologically important species in California, and research is underway to identify the geography of stress along our coastline. These efforts are critical first steps to support actions of the California Department of Fish and Wildlife, and to advance resilience of coastal industries.



EXPLORING CARBON SERVICES OF AQUATIC HABITATS

Strategy 4: Deploy living systems to slow OA and store carbon

The state has invested in science to understand how to maximize carbon reduction ("blue carbon") through natural and constructed living systems. A recent working group explored the role of submerged aquatic vegetation as an OA management tool. In addition, monitoring efforts in eelgrass beds across the state are helping to inform when, where, and how much these habitats may reduce exposure to OA. Early findings suggest that these habitats can have a small, but measurable effect on local chemistry.



ENHANCING CALIFORNIA'S OA OBSERVING NETWORK

Touches on all OA Action Plan strategies

A comprehensive OA monitoring inventory was completed in 2018, including over 200 relevant field monitoring efforts along the coast from Alaska to Baja California. The Science Task Force is currently undertaking an analysis of California's monitoring gaps to assess how well existing data collection systems address key management decisions in the *OA Action Plan*, and will provide recommendations for expanding key decision-focused monitoring assets in summer 2020.

