CALIFORNIA OCEAN PROTECTION COUNCIL

STATE OF CALIFORNIA
COAST AND OCEAN ANNUAL REPORT
2022

Ocean Protection Council

Table of Contents

Acknowledgments

2022 Council Members

Wade Crowfoot, Secretary for Natural Resources, Council Chair

Betty T. Yee, State Controller

Ben Allen, State Senate

Mark Stone, State Assembly

Jared Blumenfeld / Yana Garcia, Secretary for Environmental Protection

Michael Brown, Public Member

Jordan Diamond, Public Member

Contributing Authors

Noah Ben-Aderet

Clarissa Anderson

Lindsay Bonito

David Caron

Alissa Deming

Jenn Eckerle

Michael Esgro

Christina Frieder

Luke Ginger

Elyse Goin

Mark Gold

Sreeja Gopal

Stacy Hayden

Alyssa Jain

Gloria Jin

Kaitlyn Kalua

Justine Kimball

Raphael Kudela

Thai Le

Jas Martin

Ella McDougall

Karen McLaughlin

Elizabeth Nguyen

Tenaya Norris

Maria Rodriguez

Jayme Smith

Yi-Hui Wang

Megan Williams

Steve Weisberg

Alison Wu

Emily Zhao

Meghan Zulian

Photos

Kellie Brown

Stacy Hayden

Getty Images

Jennifer Savage

California King Tides Project

California Department of Fish and Wildlife (CDFW)

National Oceanic and Atmospheric Administration (NOAA)

Introduction

In the Strategic Plan to Protect California's Coast and Ocean, the Ocean Protection Council (OPC) committed to reporting annually on implementation of our strategic priorities and providing an overview of critical issues impacting California's coast and ocean. Our 2021 Annual Coast and Ocean Report focused mainly on a retrospective of OPC activities and accomplishments. This year, our report includes a suite of preliminary indicators that provide a snapshot of ocean health in California, along with a summary of OPC's 2022 achievements in meeting its Strategic Plan goals.

The report is organized by the four goals in OPC's Strategic Plan. Under each goal is a set of **ocean health indicators**, followed by a **summary of achievements** towards meeting Strategic Plan objectives and targets for that specific goal.

Nine indicators across the four OPC Strategic Plan goals were developed:

- **Goal 1** (Safeguard Coastal and Marine Ecosystems and Communities in the Face of Climate Change): Sea-Level Rise, Sea-Level Rise Planning, Ocean Acidification, Water Recycling
- **Goal 2** (Advance Equity Across Ocean and Coastal Policies and Actions): Beach Water Quality
- **Goal 3** (Enhance Coastal and Marine Biodiversity): Kelp, Marine Mammals, Harmful Algal Blooms
- **Goal 4** (Support Ocean Health Through a Sustainable Blue Economy): Fisheries Landings

The indicators were developed by OPC staff and the 2022 Summer Interns in partnership with the West Coast Ocean Alliance (WCOA) and chosen based on data availability and the ability to leverage other efforts. Development of indicators requires high-quality monitoring data that is both spatially and temporally robust. A time-series of 10-20 years is typically required to be able to statistically assess trends. California is fortunate to have many long-term monitoring efforts, however these efforts might not be spatially designed to summarize trends at a regional or statewide scale. Developing scientifically sound indicators that can be assessed statewide and on an annual basis can therefore be a challenging effort.

As such, the indicators presented in this report represent a critical first step to understand important status and trends; however, they do not reflect final indicator development or selection for the purposes of the State of the Coast and Oceans Report Card due in 2025.

Over the next three years, OPC will build out the number and methodology of indicators, with the aim of completing a comprehensive, scientific indicator-based approach to grading ocean health in the2025 Report Card. WCOA is also pursuing the development of regional indicators to track and report on the health of the coast and ocean across the West Coast. OPC intends to continue its partnership with WCOA to ensure ongoing alignment between the efforts. The OPC Science Advisory Team will play an integral role in helping build out this comprehensive list of indicators.

2022 Achievements and Looking Ahead

OPC took significant and meaningful action to advance our strategic priorities in 2022. We invested over $25 million in science, restoration, and policy development that accelerated research and monitoring, biodiversity conservation, coastal resilience, and equity in partnership with California Native American tribes and local communities. We completed and began implementation of groundbreaking, first-ever policy efforts including the State Agency Sea-Level Rise Action Plan for California, OPC's Equity Plan, and the Statewide Microplastics Strategy. We invested $3.6 million to continue and expand the ocean and coastal stewardship work of the Tribal Marine Stewards Network and funded an acquisition to return land to the Wiyot tribe near Humboldt Bay.

For 2023, OPC is committed to ongoing efforts that advance equity with tribes and communities burdened by environmental and social injustice. Additionally, we will continue to prioritize actions that conserve coastal and marine biodiversity and build climate resilience. This includes investments in habitat conservation and restoration, addressing plastic pollution, implementation of 30x30 in coastal waters, ongoing management of California's marine protected areas, updating state sea-level-rise projections and funding adaptation plans and projects, and establishing a strategy to ensure fisheries and fishing communities are resilient in the face of climate change.

The severity of the threats facing California's coast and ocean require bold and swift action. With an unprecedented amount of funding, an ambitious roadmap, and dedicated state and external partners, OPC will continue taking critical steps to protect California's coastal ecosystems and communities in 2023.

Goal 1: Safeguard Coastal and Marine Ecosystems and Communities in the Face of Climate Change

Introduction

The world's oceans are significantly affected by climate change; they absorb ⅓ of annual carbon dioxide emitted by human activities, as well as over 90% of the anthropogenic warming since the 1970s. As a result, scientists have observed biological, chemical, and physical changes that include sea-level rise, coastal erosion, ocean acidification, warming seas, changing ocean currents, and shifting species distributions. Such impacts currently, and will continue to, threaten California's communities for decades to come.

It is critical to track key climate change impacts on our coast and ocean, so actions and decisions are informed by current trends. Each of the four indicators (Sea-Level Rise, Sea-Level Rise Planning, Ocean Acidification, and Water Recycling) were chosen based on data availability and ability to leverage similar efforts These selected indicators for this Goal reflect a subset of indicators planned for the 2025 Report Card.

OPC is committed to improving scientific understanding, increasing resilience, raising awareness, and integrating changing coastal and ocean conditions into California's state government policies, planning, and operations. Several key efforts towards accomplishing those goals are highlighted below.

Indicators

Overview

Selected indicators reflect the effects of climate change on our coast and ocean, as well as efforts to adapt to these ongoing and future changes. Sea-Level Rise and Ocean Acidification both track direct physical and chemical changes in the ocean and show a consistent trend of rising and more acidified ocean waters, as well as seasonal and inter-annual variability. To prepare for the inevitable impacts of sea-level, communities are starting to develop adaptation plans. However, most coastal communities still have not completed adaptation plans or have updated their Local Coastal Program (LCP) to include sea-level rise considerations. Coastal wastewater recycling provides one approach to manage nutrients and other land-based contaminants that exacerbate the impacts of climate change, including ocean acidification and hypoxia. Wastewater recycling additionally provides multiple benefits to increase climate resilience and water security for local California communities. Coastal wastewater recycling has incrementally increased between 2019-2021 with the highest rate of water recycling taking place in Southern California.

Indicator: Sea-Level Rise

Objective 1.1: Build Resiliency to Sea-Level Rise, Coastal Storms, Erosion, and Flooding

Description

Sea-level rise is primarily caused by thermal expansion of seawater and melting land ice driven by climate change. Sea-level rise can impact coastal ecosystems, damage infrastructure and development, increase the frequency and extent of tidal flooding, increase shoreline erosion rates, and increase seawater intrusion into coastal aquifers, rending them useless for domestic and agricultural use. Over 70% of California's residents live and work in coastal counties and are therefore vulnerable to these impacts. This indicator is based on the Sea-Level Rise indicator prepared for the "Indicators of Climate Change in California (Fourth Edition)"[1] developed by Patrick Barnard.

[1] Office of Environmental Health Hazard Assessment (OEHHA, 2022). Indicators of Climate Change in California, Fourth Edition, California Environmental Protection Agency, OEHHA

California is experiencing rising sea levels.

Trends

Sea levels have increased over the past century by about 8 inches across most of the California coastline. In some places on the far north coast of California, such as Crescent City, local sea level has dropped due to regional land uplift driven by the movement of Earth's tectonic plates. Relative Sea Level (RSL) includes vertical land motion due to subsidence and/or uplift in addition to rising sea levels, which results in variation across the state's water level recorders. RSL is measured at NOAA tide gauge stations along California's coast (Table 1 and Figure 1) and is increasing at every one of the state's NOAA tide gauges. station in California, except for Crescent City. On average, RSL in California is currently increasing on average 1.85 mm/year or 0.61 ft/century. Mean sea levels also show year-to-year variability linked to El Niño events.[2]

The general trend towards higher sea levels in California is consistent with global observations. Global mean sea levels based on hundreds of tide gauges have been rising at increasing rates: by 1.3 mm/year between 1901 and 1971; 1.9 mm/year (about 0.07 inch/year) between 1971 and 2006; and 3.7 mm/ year (about 0.1 inch/year) between 2006 and 2018. Satellite altimetry has documented average global sea-level rise of 3.54 mm/yr since 1991. The rate is increasing, however, averaging nearly 5mm/yr over the past decade (about 20 inches/century). Human influence on the climate was very likely the main driver of these increases since at least 1971.[2]

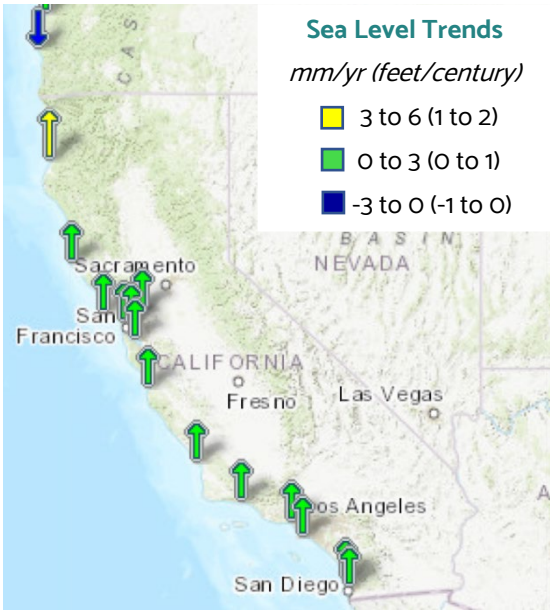


Figure 1. Sea Level Trends at California tide stations

[2] IPCC (2021). AR6 Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Masson-Delmotte V, Zhai P,Pirani A, Connors SL, Péan C, et al. (Eds.). Intergovernmental Panel on Climate Change. Geneva, Switzerland.

The impacts of sea-level rise will be amplified by storms, high tides, beach erosion and cliff retreat; flooding risks, in particular, will result from the combined effects of rising sea levels, heavy precipitation events, and shallower coastal groundwater.[1]

Sea Level Trends (stations listed from north to south)

Location	Period of record	Trend, mm/year (inches/year)
Crescent City	1933-2020	-0.79 (-0.03)
North Spit	1977-2020	+4.91 (+0.2)
Arena Cove	1978-2020	+0.89 (+0.04)
Port Chicago*	1976-2020	+2.03 (+0.08)
Point Reyes	1975-2020	+2.15 (+0.08)
Alameda*	1939-2020	+0.87 (+0.03)
San Francisco	1897-2020	+1.97 (+0.08)
Redwood City*	1974-2020	+2.54 (+0.1)
Monterey	1973-2020	+1.63 (+0.06)
Port San Luis	1945-2020	+0.96 (+0.04)
Santa Barbara	1973-2020	+1.08 (+0.04)
Rincon Island**	1962-2020	+3.22 (+0.1)
Santa Monica	1933-2020	+1.54 (+0.06)
Los Angeles	1923-2020	+1.03 (+0.04)
Newport Beach***	1955-1993	+2.22 (+0.09)
La Jolla	1924-2015	+2.13 (+0.08)
San Diego	1906-2020	+2.2 (+0.09)

* Gauge not along the outer coast

** Rincon Island is an artificial offshore island built for oil and gas production

*** Inactive

Figure 1 (previous page).and Table 1 Relative sea-level rise trends at NOAA tide gauges across California[1, 2]

Future Projections

Sea-Level Rise is projected to increase in coming decades.

The rate of RSL is projected to increase throughout the century. The most recent modeling projections indicate an additional 1.65 to 3.3 feet (Low/Intermediate to Intermediate scenarios, Southwest region) of sea-level rise is likely by the end of the century, with up to 6.6 feet possible, but less likely.[3]

Accelerating sea-level rise will have significant ecological, societal, and economic effects. Coastal infrastructure, ecosystems, and communities are all vulnerable to both increasing long-term sea levels and shorter-term high-tide flooding. Future work on this indicator will likely focus on the vulnerability of coastal habitats and critical infrastructure to sea-level rise, rather than a reporting of sea-level rise values and rates.

Indicator: Sea-Level Rise Planning

Objective 1.1: Build Resiliency to Sea-Level Rise, Coastal Storms, Erosion, and Flooding

Description

Sea-level rise adaptation planning is a community driven effort to evaluate vulnerabilities and prioritize approaches to manage or minimize the impacts of sea-level rise. Though it can be a lengthy and costly process, sea-level rise adaptation planning is a highly effective way for a community to understand and prepare for the impacts of coastal climate change. Early and frequent community outreach and engagement are critical to building local buy-in and consensus. Though sea-level rise adaptation plans are not required or mandated, the Coastal Act requires local

[3] Sweet, W.V., B.D. Hamlington, R.E. Kopp, C.P. Weaver, P.L. Barnard, D. Bekaert, W. Brooks, M. Craghan, G. Dusek, T. Frederikse, G. Garner, A.S. Genz, J.P. Krasting, E. Larour, D. Marcy, J.J. Marra, J. Obeysekera, M. Osler, M. Pendleton, D. Roman, L. Schmied, W. Veatch, K.D. White, and C. Zuzak, 2022: Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report NOS 01. National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD, 111 pp. https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

governments to complete an LCP, which delegates the authority to permit coastal development to the local jurisdiction. In the late 2000's, the California Coastal Commission began recommending local governments update their LCPs to include specific considerations for sea-level rise adaptation planning.

Trends

Most coastal jurisdictions have certified LCPs.

As of 2022, 83% of the 76 coastal jurisdictions (cities and counties) have completed and certified their LCPs (Figure 2).[4] LCP certifications began with the enactment of the Coastal Act in 1976. Since then, certifications continue to increase.

Most coastal jurisdictions have not completed sea-level rise adaptation plans or updated their LCPs to include specific sea-level rise considerations.

Although some LCPs include sea-level rise considerations, only 29% percent of LCP jurisdictions have completed specific sea-level rise adaptation plans, with four percent in progress (Figure 3).[4] Twelve percent of LCP jurisdictions have certified LCP Updates, which include sea-level rise considerations (Figure 4).[4]

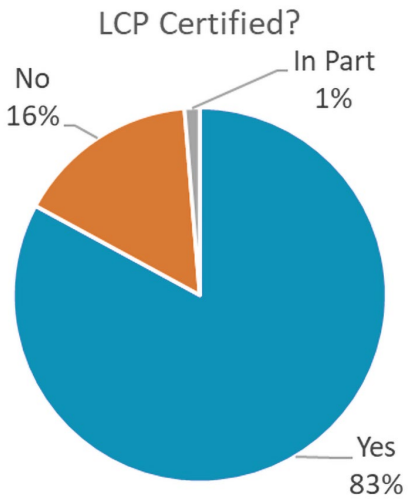


Figure 2. Percent of certified LCPs by LCP jurisdiction as of 2022.

[4] Lester, Charles. "California Coastal Adaptation Planning Inventory". Oct 4, 2022, storymaps.arcgis.com/stories/5c3ec4198b564750886cc75b95a8e492

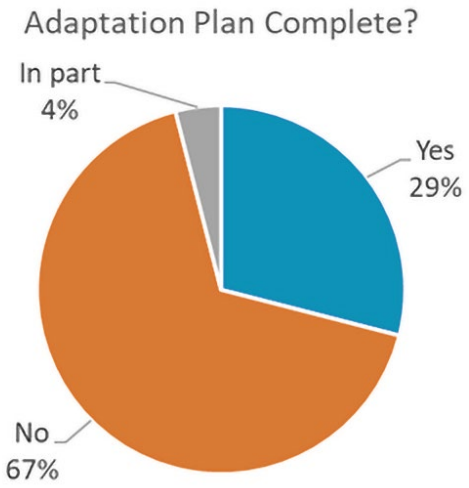


Figure 3. Percent of sea-level rise adaptation plans completed by LCP jurisdiction as of 2022.

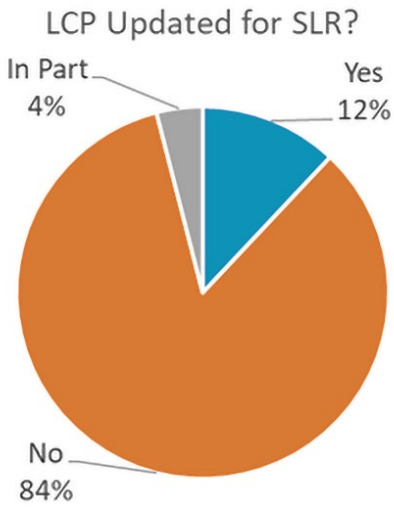


Figure 4. (above): Percent of LCPs updated for sea-level rise by LCP jurisdiction (cities and counties) as of 2022. Data from the California Coastal Adaptation Inventory (UCSB).

Future Projections

In 2020, the Coastal Commission released a report showing LCP certification date for all 126 LCP segments (within the 76 cities and counties).[5] General trends show more LCPs are funded for certification when local assistance grant funding is available. Therefore, with proper funding and support, full coverage of sea-level rise adaptation plans and LCP updates for the coast of California can be achieved, ideally by 2028. Funding and technical assistance is especially important for lower income and historically disadvantaged communities, which bear a greater burden of climate impacts. The creation of consistent guidelines and minimum standards across sea-level rise adaptation plans and LCP updates will help streamline efforts and produce consistent plans.

[5] "Summary of LCP Program Activity in FY 19-20", California Coastal Commission, Oct. 9, 2020, documents.coastal.ca.gov/assets/rflg/LCPStatusSummaryChart_October%202020.pdf

Indicator: Ocean Acidification

Objective 1.2: Minimize Causes and Impacts of Ocean Acidification and Hypoxia

Description

When CO_2 is absorbed by seawater, a series of chemical reactions occur that result in decreased pH, termed ocean acidification. With increasing acidification, fewer carbonate ions (CO_3^{2-}) become available for calcifying organisms to build and maintain their shells, skeletons, and other calcium carbonate structures. Aragonite is one form of calcium carbonate mineral used by many marine organisms. Aragonite saturation state is the measure of how easily aragonite will dissolve in seawater. If the availability of carbonate ions gets too low (i.e., when aragonite saturation state is less than 1), shells and skeletons will begin to dissolve.

Trends

Southern California coastal waters are acidifying.

Southern California is the best monitored portion of the State and coastal waters there are experiencing declines in aragonite saturation state. Surface waters, while declining, are not expected to fall below an aragonite saturation state of 1 in the foreseeable future. However, subsurface waters at 100 m depth are trending towards, and sometimes already exceeding, this corrosive threshold, where shells would be expected to dissolve.

The statewide trend appears to be largely driven by global atmospheric carbon emissions.

The long-term rate of change aligns with rates found globally and attributable to carbon emissions linked to use of fossil fuels. However, the role of local contributions to ocean acidification is an area of active statewide investigation.

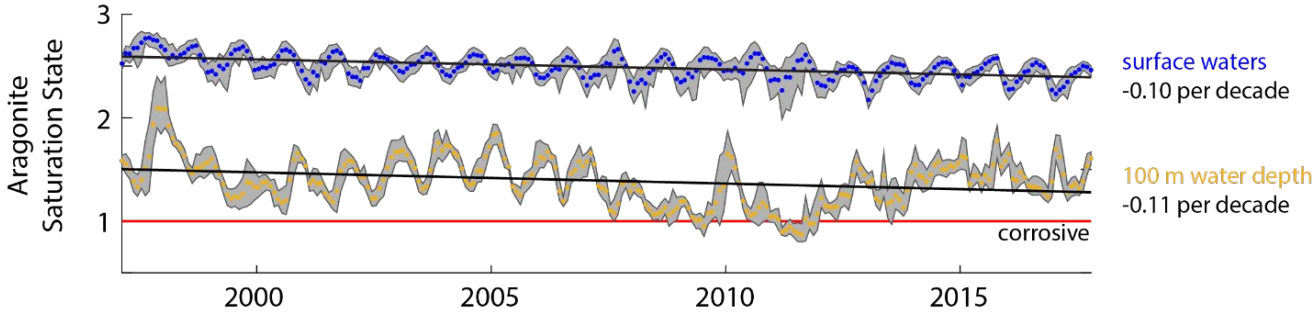


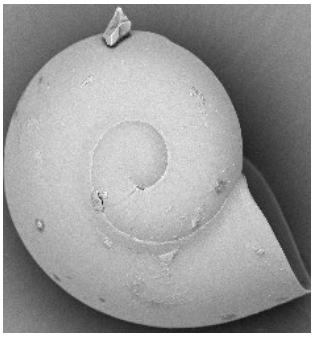
Figure 5. Time-series of aragonite saturation state at the surface (blue) and subsurface (100-m water depth; yellow) in Southern California state waters. Plotted is model output from a regional numerical ocean model with biogeochemical elemental cycling synthesized as monthly averages (circles) with10th and 90th percentiles of average conditions from across the region (grey shading). Significant long-term trends (solid black lines) and corrosive conditions with respect to aragonite (red line) indicated.

Future Projections

Ocean acidification trends are likely to continue through the end of the century, with the magnitude of change proportional to the amount of carbon dioxide emitted to the atmosphere.

The OPC has invested in expanding California's acidification monitoring programs in two ways. The first is geographical, to create greater data density in Central and Northern California. The second is to add a biological component to the monitoring programs to assess the extent to which biota are affected by acidification. The biological assessment is focused on examining shell degradation in crabs and in snails, known as pteropods, that are the base of marine food webs.

No Dissolution



Shell is intact with no signs of pitting

Moderate Dissolution

Shell is pocked with holes on the surface layer

Severe Dissolution

Shell has deep holes and cracks that penetrate multiple layers of shell

Figure 6. Stages of Pteropod Shell Dissolution

Indicator: Coastal Wastewater Recycling

Objective 1.2: Minimize Causes and Impacts of Ocean Acidification and Hypoxia

Description

California recognizes recycled water as an important resource for diversifying local supplies and improving water resilience. Coastal wastewater recycling provides multiple benefits to increase climate resilience and local water security; critically, wastewater recycling is one approach to manage nutrients and other land-based contaminants that exacerbate the impacts of climate change, including ocean acidification and hypoxia and the occurrence of harmful algal blooms. OPC's Strategic Plan aligns with the State Water Resources Control Board Water Quality Control Policy for Recycled Water (Recycled Water Policy) to increase the use of recycled water and minimize land-based stressors, such as nutrients, on ocean acidification and hypoxia. California's Water Supply Strategy: Adapting to a Hotter, Drier Future further calls for federal, state, and local investments in wastewater recycling to meet a target of recycling at least 800,000 acre-feet of water per year by 2030 and 1.8 million acre-feet by 2040, with most of that additional recycling involving direct wastewater discharges that are discharged into the ocean without environmental benefit.

Coastal wastewater recycling has incrementally increased between 2019-2021 with the highest rate of water recycling taking place in Southern California.

Statewide, approximately 728,000 acre-feet of recycled wastewater is produced each year with approximately 574,651 acre-feet supplied by coastal regions.[6] Coastal wastewater recycling has incrementally increased since volumetric reporting began in 2019 with 541,834 acre-feet of recycled water (25.7% of available coastal influent) produced and 574,651 acre-feet (32.5% of available coastal influent) produced in 2021.

Californians are conserving water, which has the potential to impact the amount of wastewater available for reuse.

As California residents are encouraged to conserve and reduce water use in their businesses and homes, and as water conservation rules and regulations continue to limit water use, wastewater systems are expected to observe decreases in the total amount of water available for reuse. Water conservation, which is a top priority for the state, impacts the volume of influent that enters a wastewater facility. Between 2019 and 2021, average indoor water use decreased from 55.0 to 39.4 gallons per person daily statewide, mirroring the observation in reporting that the total influent volume available for water recycling decreased from 2.876 million acre-feet in 2019 to approximately 2.65 million acre-feet in 2020 and 2021.[7]

[6] State Water Resources Control Board. 2022. Annual Volumetric Report of Wastewater and Recycled Water.

[7] State Water Resources Control Board, Division of Water Quality. 2022. August 2, 2022, Board Presentation.

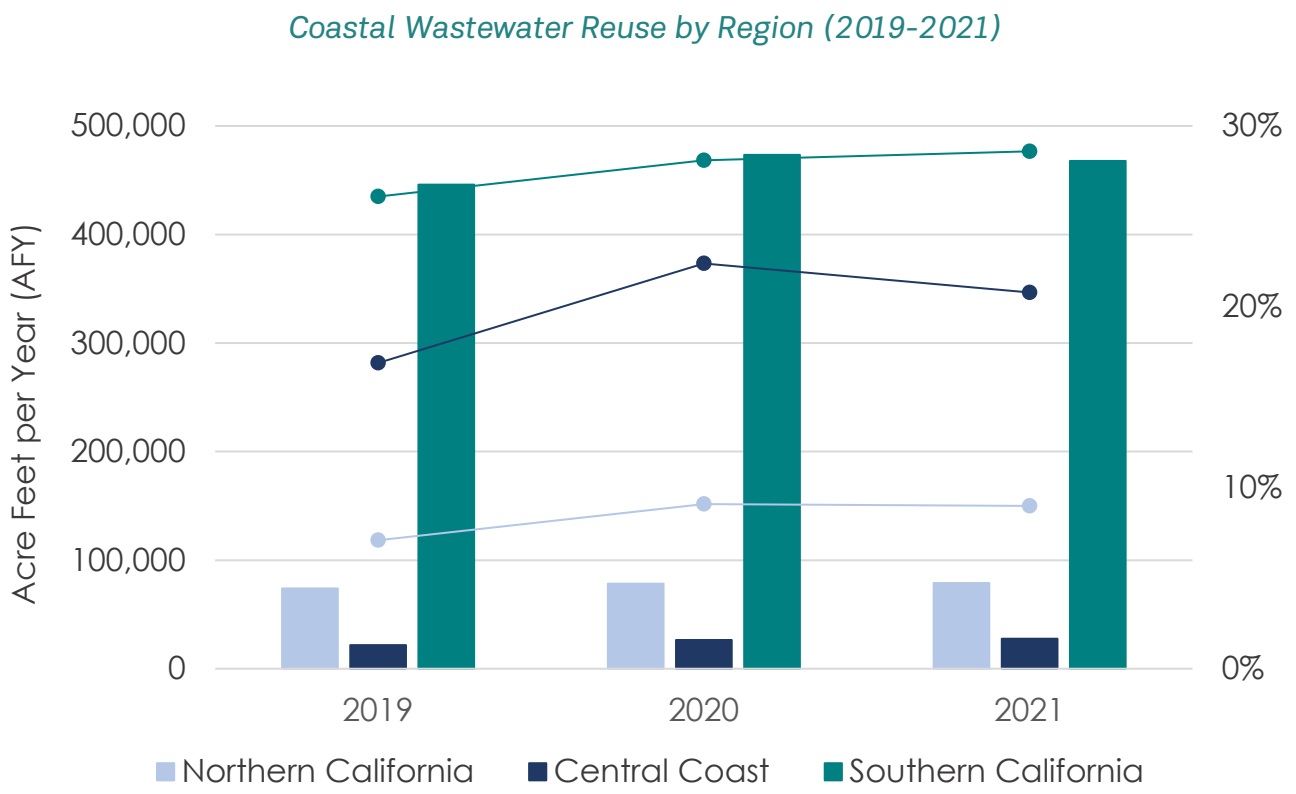


Figure 7. Annual Volume and Percent of Coastal Wastewater Recycling by Region. Beginning in 2019, approximately 750 wastewater and recycled water permittees statewide are required to submit volume data on influent, effluent, and recycled water use for the previous calendar year by April 30 annually. The data provided in this figure is limited to coastal wastewater recycling, and does not comprise all statewide data, to evaluate the ongoing status of the state's coastal wastewater recycling goals. This figure includes data from coastal Water Board regions: Regions 1 & 2 (Northern California), Region 3 (Central Coast), and Regions 4, 8, & 9 (Southern California). This includes all reported wastewater recycling within these regions and is not limited to direct ocean discharges.[6]

Future Projections

It is projected that over the next 20 years, California could lose 10 percent of its water supplies as the climate changes, resulting in average less snowfall, increased evaporation, and greater consumption of water by vegetation, soil, and the atmosphere itself.[8] State and local investments in

[8] State of California. 2022. California's Water Supply Strategy: Adapting to a Hotter, Drier Future.

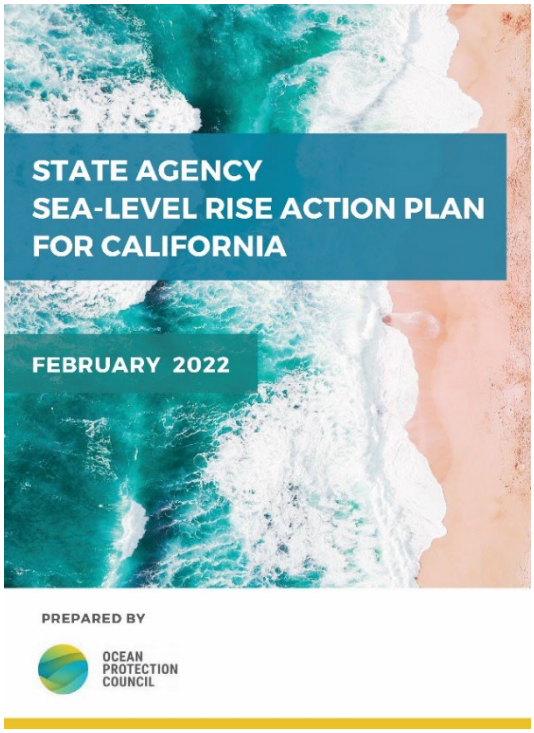
wastewater recycling infrastructure is anticipated to continue, with strategic investments needed to couple water conservation and to increase the scale of wastewater recycling statewide. It is anticipated that the rate of water recycling will continue to increase with coordinated state, local, and federal investments, and as the State Water Board establishes direct potable reuse regulations in 2023.

Accomplishments

Objective 1.1: Build Resiliency to Sea-Level Rise, Coast Storms, Erosion, and Flooding

Sea-Level Rise Action Plan

In August 2022, OPC publicly released the State Agency Sea-Level Rise Action Plan for California (Action Plan). The Action Plan is a first-of-its-kind effort to outline a roadmap toward coastal resiliency for the state of California with 80 agency-specific actions that are tied to outcomes and deadlines.



Structured around the Principles for Aligned State Action, the Action Plan is also dedicated to:

- improving equity and social justice in coastal resilience efforts.
- strengthening tribal relations.
- increasing support for communities entitled to environmental justice.

Developed through robust collaboration and partnership among the 17 state agencies that make up the State Sea-Level Rise Leadership Team, the Action Plan serves as a living document, with annual review and monitoring of progress, to guide the state in planning and implementing sea-level rise adaptation over the next five years.

Wetlands Inventory

In partnership with San Francisco Estuary Institute (SFEI), OPC completed an update to the California Aquatic Resource Inventory (CARI) to estimate baseline acreages of coastal habitats including wetlands, beaches, rocky intertidal and eelgrass habitats.

Coastal Habitat Type	Acres
Coastal wetlands	357,017
Beach	21,806
Dune	58,192
Rocky shore	6829
Eelgrass	17,248

Table 2. Acreages of coastal habitats from the most recent mapping available as of 2022.

To fill data gaps identified by the CARI database update, OPC is collaborating with SFEI and NASA Jet Propulsion Laboratory (JPL) on the incorporation of remote sensing datasets into the CARI database.

Sea-Level Rise Technical Guidance Update

In 2022, OPC approved funding to update the Sea-Level Rise Guidance report. The last technical guidance update in 2018 has been utilized by federal, state, and local partners to inform sea-level rise decision-making, planning, and projects. Since 2018, however, the science and application of sea-level rise projections has advanced with significant implications for adaptation and planning, such as greater confidence in projections over the next 30 years. Because of the rapidly evolving science on sea-level rise, OPC has committed to updating the technical guidance every five years to support thoughtful, consistent, and coordinated planning statewide. This update is being led by a 9-member expert Task Force and facilitated by the Ocean Science Trust. The updated guidance will include scenario based sea-level rise science based on the National 2022 Sea Level Rise Technical Report and considerations for localized impacts such as flooding and groundwater. Pragmatic guidance for end-users to apply and incorporate the science and projections in their local adaptation efforts will also be developed and ground-truthed through outreach and engagement. The guidance is expected to be completed in fall of 2023.

San Francisco Bay Regional Shoreline Adaptation Plan

OPC is working with the San Francisco Bay Conservation and Development Commission to implement the next phase of the Bay Adapt program through the development of a Regional Shoreline Adaptation Plan. This plan will include a Bay Area-wide snapshot of sea-level rise vulnerability and projections, as well as criteria and minimum standards for localized adaptation plans. Bay Area jurisdictions will be encouraged to adopt these minimum standards for their local planning efforts. These criteria and standards are expected to help standardize sea-level rise adaptation planning statewide.

Building Coastal Resilience to Sea-level Rise

In May 2022, OPC launched a competitive Proposition 68 solicitation for proposals that build resilience on the coast to prepare for and adapt to the impacts of sea-level rise. Upon approval at OPC's January 2023 meeting, selected research projects (totaling close to $6.5M) will study the effects of sea-level rise and flooding on coastal habitats, contaminated sites, and coastal recreation.

Selected implementation projects will work to provide on-the-ground resilience to sea-level rise over the next 50-100 years.

Objective 1.2: Minimize Causes and Impacts of Ocean Acidification and Hypoxia

Improving Understanding of Ocean Acidification and Hypoxia Vulnerability and Impacts

OPC approved a $2.7 million investment to fund projects that address ocean acidification and hypoxia research, monitoring, and synthesis priorities that will ultimately provide state resource management agencies and local jurisdictions with data necessary to protect marine biodiversity and water quality, advance coastal adaptation efforts, and support climate-ready fisheries. OPC and California Sea Grant selected projects through a coordinated investment effort to address the recommendations put forth by the California Ocean Acidification and Hypoxia Science Task Force.

These projects began in Spring of 2022 and will be completed over three years:

1. Advancing Ocean Acidification and Hypoxia Science off Northern California: A Critical Expansion of Monitoring and Research to Quantify Ocean Acidification and Hypoxia Exposure, Assess Ecosystem Impacts, and Support Model Development
2. Assessing the Potential for Rapid Adaptation to Climate Change in Rockfish
3. A California Ocean Acidification and Hypoxia Portal to Enable Synthesis and Understanding of State-wide Status and Trends
4. Multi-stressor Tools to Interpret Effects of Acidification, Hypoxia, and Warming on Southern California Current Marine Calcifiers.

Ocean Acidification and Hypoxia Monitoring Network

In 2021, OPC invested in a coordinated effort to better connect and standardize biological and chemical monitoring to create a statewide ocean acidification and hypoxia monitoring network. The five monitoring programs participating in this effort are:

- NOAA West Coast Ocean Acidification Regional Survey Cruises (WCOA Cruises)
- Southern California Coastal Water Research Project (SCCWRP) Southern California Bight Regional Monitoring Program (Bight Program)
- California Current Ecosystem Long-term Ecological Research (CCE LTER)
- California Cooperative Fisheries Investigation (CalCOFI)
- Applied California Current Ecosystem Studies (ACCESS) Program

During the summer of 2022, the collaboration between CalCOFI, ACCESS, and Bight partners kicked off. Their 2022 field season was successful in capturing information on seasonal variability in OA impacts on pteropods and larval crabs, and also helped to clarify differences in sample collection protocols on the types and relative abundances of organisms collected. Information from this research will help to generate a suite of best practices for sample collection and analysis for biological impacts of ocean acidification, as well as tools to assess the magnitude of impacts on these foundational organisms.

Goal 2: Advance Equity Across Ocean and Coastal Policies and Actions

Introduction

OPC recognizes the need to acknowledge historic and current injustices and take action to address inequity within our agency and as part of the policies and programs we carry out for the communities we serve.

Equity is a criterion for a sustainable and healthy ocean and coast, where humans play a role in safeguarding marine and coastal ecosystems, ocean resources, and ensures distribution of benefits is equitable among all. However, there is a growing need to better understand the social, economic, and cultural barriers, beyond the geographical constraints, that make it inequitable for many to access coastal and ocean resources and decision-making.

While 80% of California's 38 million residents live within 100km of shoreline access, the demographics of coastal residents is disproportionally wealthier, older, and less diverse than the general population of California.[9] Despite the fact that most Californians (89%) value the coast[10], data shows that access to coastal areas in California is inequitably distributed along income, age, and race. These disparities call for greater attention and assessment of equity considerations beyond aspects of physical proximity. To meaningfully assess coastal access, and properly assess barriers such as poor beach water quality, the future of these indicators must be informed by a range of information regarding visitation and use data, as well potential institutional, regulatory, financial, capacity, and social barriers that hinder the State's commitment to coastal access for all. The beach water quality indicator was chosen for this report due to data availability and its

[9] Reineman DR, Wedding LM, McEnery W, Reiblich J. Coastal Access Equity and the Implementation of the California Coastal Act. 2016;36:20.

[10] Probolsky Research. Coastal Conservancy - Statewide Survey - Presentation - Testimony - Narrative Versions. Coastal Conservancy. Published April 24, 2017. Accessed January 15, 2021.

potential impact on equal access. Indicator development for this Goal will be expanded and refined for the 2025 Report Card.

Equitable access also includes access to decision-making around management of our shared coast and ocean. OPC is collaborating with researchers, partner agencies, California communities, including California Native American tribes, to better understand the various aspects and challenges that affect equitable public access to ocean and coastal resources and policymaking. The strides we have made towards these efforts in 2022 are reflected in the highlighted accomplishments for this Goal. In the future, equity will be integrated and considered across all indicators to reflect the overall health and impacts of environmental stressors on both coastal and marine ecosystems, and people.

Indicators

Overview

Beach water quality is an important indicator that can influence the health of marine and human life. It serves as one example of assessing barriers to coastal access, as it may not impact beachgoers equitably, given a relatively small number of beaches comprise 50% of all observed bacteria contamination statewide. In the future, an assessment of beach visitation can inform the impacts of beach water quality on coastal access. Assessing the impacts of water quality on beach access requires not only evaluating the geographic proximity of relatively clean or contaminated beaches to underserved or disadvantaged communities but evaluating the use and visitation of California beaches to meaningfully assess who is impacted by poor beach water quality.

Given the coast holds recreational, cultural, and historical meaning to diverse groups of people, assessing the impacts of barriers to coastal access, such as beach water quality, requires a meaningful assessment of who visits and uses these coastal spaces, rather than solely evaluating the proximity of specific beaches to communities.

Indicator: Beach Water Quality

Objective 2.4: Enhance Healthy Human Use of the Coast and Ocean

Description

This indicator assesses the human health risk of water contact at California's ocean beaches. Pathogens contained in fecal pollution pose a potential health risk to the millions of people visiting California's beaches annually. Pathogens can also cause gastroenteritis when contaminated shellfish are consumed. In addition to health risks, fecal pollution can have impacts to tourism and local economies from beach closures and seafood contamination. Regular monitoring of fecal contamination is required to ensure public safety and to protect coastal economies. Microbial indicators are used to gauge the total pathogen concentration attributed to fecal contamination in coastal waters and shellfish with the bacterium *Enterococcus* being the most common. *Enterococcus* is not harmful to humans, but it indicates the presence of harmful pathogens commonly found in the intestines of vertebrates such as humans and birds. Beach water quality monitoring to effectively assess health risks and issue advisories, as well as strong pollution prevention measures, are critical for protecting the public from waterborne diseases.

Trends

California beach water quality is relatively good and remains unchanged during summer swimming seasons.

The average exceedance rates for approximately 600 beaches monitored in California did not change substantially since 2002 (Figure 8). Ocean beach bacteria levels exceed state water quality objectives on approximately 5% of the days during the summer swimming season. Winter exceedance rates also remain unchanged but are higher.

The average exceedance rates for California beaches during winter months did not change over the last 20 years. However, the average exceedance rates were more than twice as high as summer exceedance rates, and more variance in winter exceedance rates occurred from year-to-year (Figure 8). The fluctuations and higher exceedance rates during winter months can be attributed to rainfall which flushes fecal contamination into the ocean.

Most fecal contamination is concentrated in small geographic areas.

Roughly half of all California beaches have observed little to no bacteria exceedances (at rates of 0-2 percent) over the last 20 years. Meanwhile, California's beaches with the highest total exceedance rates (those within the lowest 10% for beach water quality) account for 50 percent of all bacteria exceedances statewide (Figure 9). The majority of high-exceedance beaches are located in Los Angeles, Orange, and San Diego counties, which are all impacted by land-based runoff.

Average Enterococcus Exceedance Rates in California 2002 to 2021

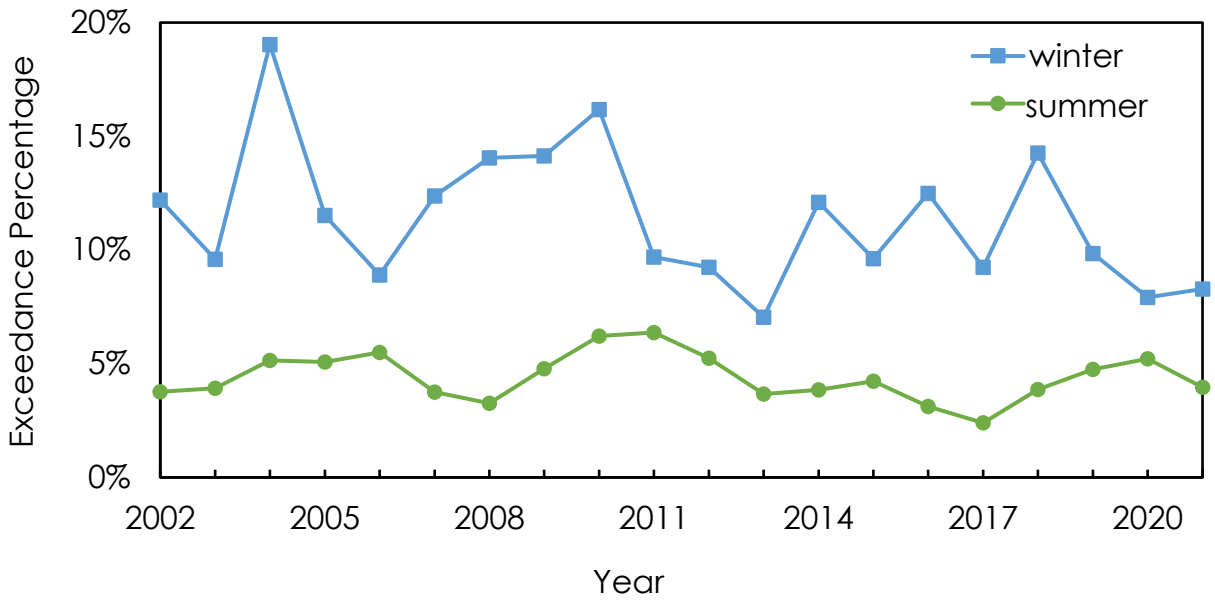


Figure 8. Average Enterococcus Exceedance Rates in California from 2002 to 2021. The exceedance rate for each beach is assessed based on the standards described in 2012 Recreational Water Quality Criteria by US EPA. The bacteria data came from all 17 coastal counties and 27 different monitoring agencies.

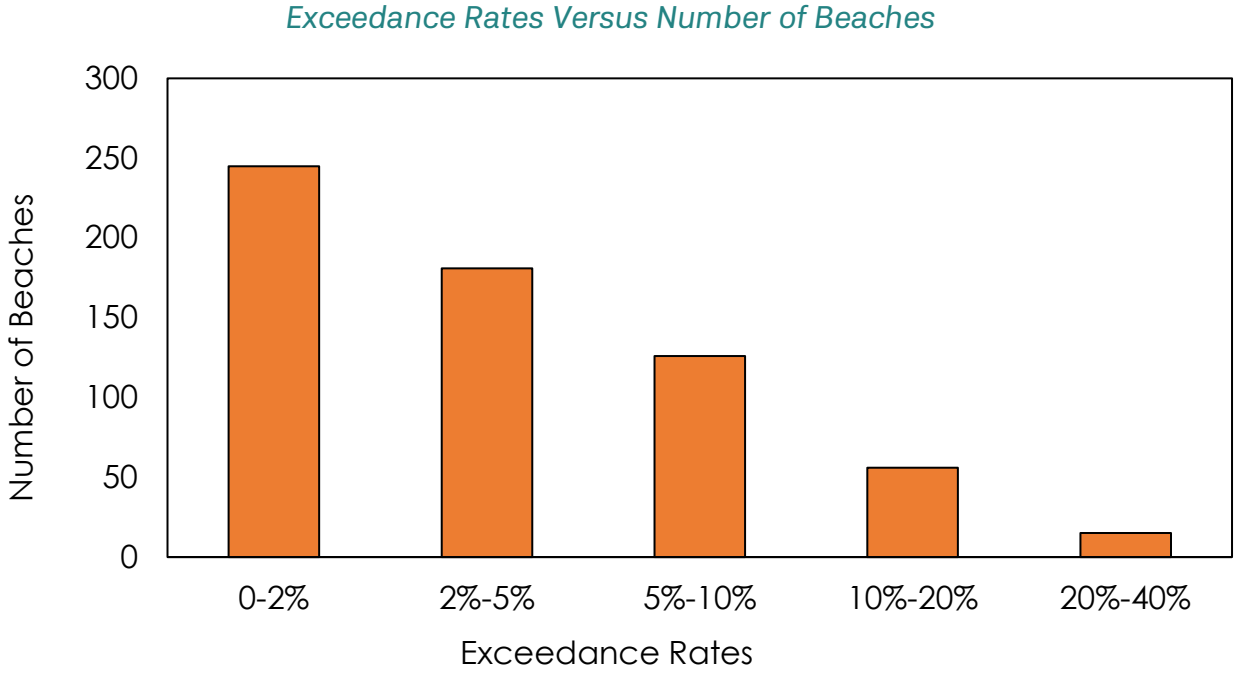


Figure 9: Distribution of exceedance rates for all California beaches. Exceedance rates were calculated using the method described under Figure 8. This figure reflects 10 years of bacteria data for beaches with more than 100 samples analyzed.

Future Projections

Rainfall affects coastal fecal contamination and rainfall patterns are projected to change across California due to climate change. More variation in fecal contamination is anticipated to be observed during winter months as rainfall patterns change. However, as California droughts continue to become longer and more severe, state and local investments in capturing, infiltrating, treating, and reusing urban runoff is anticipated to increase, which may result in less fecal pollution reaching the ocean and may lead to safer swimming conditions. Additionally, fecal pollution detection technologies are anticipated to shift to more sensitive and timely polymerase chain reaction (PCR)-based methods. This improvement in detection will help identify fecal pollution sources and subsequently improve mitigation efforts to improve beach water quality.

Accomplishments

Objective 2.1: Enhance Engagement with Tribes

Tribal Marine Stewards Network

In 2020, OPC invested $1 million to establish the Tribal Marine Stewards Network (TMSN) pilot program. Four partner tribes participated in the pilot: Tolowa Dee-ni' Nation, Resighini Rancheria, Kashia Band of Pomo Indians, and the Amah Mutsun Tribal Band. At its October 6 meeting, OPC invested an additional $3.6 million to continue and expand the TMSN's monitoring, outreach, and organizational development work, and to welcome a fifth tribe, the Santa Ynez Band of Chumash Indians, into the Network.

In the last two years, the TMSN has broken new ground in returning stewardship and management of ocean and coastal territories to California Native American tribes. Partner tribes have initiated:

- On-the-ground monitoring work that is helping both tribes and state agencies better understand the climate vulnerability of natural and cultural resources.
- New community engagement programs that are reconnecting tribal youth with traditional stewardship practices and enhancing tribal access to the coast and ocean.
- Strategic planning and organizational development that will make the Tribal Marine Stewards Network a sustainable and enduring program into the future.

The TMSN is a flagship example of how the state can support tribes in building ecological, community, and cultural resilience, an important step toward righting historic injustices.

Tribal Engagement Strategy

This year, OPC developed its first-ever Tribal Engagement Strategy, which will serve as a framework for enhanced communication and partnership between OPC and California Native American tribes on ocean and coastal issues. The Tribal Engagement Strategy was crafted in close collaboration with tribes, including early consultations and listening sessions held with tribes in Fall 2021, as well as further consultation and community roundtables on a draft Strategy held in Summer 2022.

The Tribal Engagement Strategy, which will be presented to the Council for consideration and possible adoption in January 2023, provides specific actions that OPC will undertake to enhance tribal engagement in all aspects of its work. These actions are based on feedback received from

tribes regarding their most significant priorities for coastal and ocean conservation and management.

Objective 2.2: Enhance Engagement with Underserved Communities

Equity Plan

In October 2022, the Council approved adoption of its first-ever Equity Plan. Through a collaborative partnership, OPC, and the Better World Group (BWG), developed the plan with guidance from an Environmental Justice Advisory Group (EJAG), and with extensive feedback from state agency partners and the public. The plan reflects objectives, strategies, and actions that advance equity and justice through overarching goals focused on four core areas:

- Equitable Engagement, Outreach, and Funding
- Building an Inclusive Workplace and Workforce for California's Coast and Ocean
- Designing Equitable Coastal and Ocean Policy Making
- Integrating Equity in Coastal and Ocean Science and Research

The Equity Plan represents a seminal step towards advancing equitable policymaking and research procedures that incorporate the knowledge, perspectives, needs, and desires of underrepresented groups across California to support the different values and priorities that communities, particularly California Native American tribes and environmental justice communities, bring to coastal and ocean science, policy, and resource management.

To kickstart the Plan's implementation, the Council also approved $1.3 million to establish OPC's Environmental Justice Small Grants Program. The pilot program will continue OPC's ongoing efforts to advance equity and environmental justice throughout the state by creating a dedicated funding path to prioritize investments for small and short-term projects across coastal regions that create positive impacts in California's environmental justice communities.

Wiyot Tribe Acquisition of Coastal Land

In August 2022, OPC and California Natural Resources Agency leadership joined the Wiyot Tribe and its partners, including Cal Poly Humboldt, in a ceremony to celebrate the Tribe's purchase of one of the last pieces of undeveloped coastal wetland and upland in their ancestral territory near the Humboldt Bay. The 46 acres, known as Mouralherwaqh or "wolf's house," will be preserved for its cultural significance to the Wiyot Tribe, and for ecocultural restoration, water quality protection and conservation purposes. The acquisition project was supported by OPC's Proposition 1 funding through a targeted coastal environmental justice solicitation.

Benefits from the project are likely to accrue for generations as the Wiyot Tribe ultimately envisions Mouralherwaqh as a culturally important gathering place for tribal members and as a vital ecosystem. By protecting and restoring the coastal uplands and wetlands in the area, improving water quality, and removing invasive species, this land return also supports the state's commitment to protect biodiversity and conserve 30% of its land and sea by 2030.

Goal 3: Enhance Coastal and Marine Biodiversity

Introduction

California's iconic coastal and marine habitats, including tidepools, sandy beaches, and kelp forests, host a diversity of species and provide food, cultural benefits, and recreational opportunities to millions of Californians. However, these ecosystems are increasingly threatened by human activity as well as the unprecedented impacts of global climate change. For example, from 2014-2019, more than 95% of the bull kelp off of California's north coast disappeared as a result of changing ocean conditions, and the loss of this foundational species had devastating impacts on biodiversity and local communities. Additionally, just this past year, San Francisco Bay witnessed the largest "red tide" event in recorded history, resulting in fish kills across the Bay Area.

Improving coastal and ocean water quality, protecting and restoring vulnerable kelp forests, and supporting both sustainable fisheries *and* thriving wildlife populations are key biodiversity objectives in OPC's Strategic Plan. The indicators for this Goal (HABs, Kelp, and Marine Mammals) were selected for relevance to these objectives, data availability, and how well changes in the indicators reflect overall coastal and ocean health. The accomplishments listed reflect the successful partnership efforts toward meeting those objectives in 2022.

Indicators

Overview

Selected indicators (harmful algal bloom incidence, kelp canopy cover, and marine mammal abundance) reflect the impact of human activity and changing ocean conditions on biodiversity. Harmful algal bloom incidence and kelp canopy cover are both highly variable across the state, with some areas showing little or no deviation from historical trends and some areas showing dramatic shifts. While marine mammal populations have been relatively stable in California waters, mortality events including ship strikes and entanglements have increased. Notably, changes in ocean conditions associated with the 2014-2016 marine heat wave impacted all three of these indicators, suggesting that California's coastal and marine biodiversity will likely be increasingly vulnerable in the future as climate change accelerates and disturbances such as heat waves become more frequent and more severe.

Indicator: Coastal Harmful Algal Blooms

Objectives 3.3 Support Sustainable Marine Fisheries and Thriving Fish and Wildlife Populations & 3.4 Improve Coastal and Ocean Water Quality

Description

Harmful algal blooms (HABs) pose a threat to California marine ecosystems. HAB events can be formed by numerous phytoplankton and cyanobacteria species that produce toxins that pose a threat to coastal and marine ecosystems.[11] These toxins impact both wildlife and humans, causing illness or death in exposed fish, marine mammals, and seabirds. Human consumption of seafood containing domoic acid, a neurotoxin made by *Pseudo-nitzschia,* can result in amnesic shellfish poisoning and domoic acid can accumulate in shellfish, such as mussels, oysters, clams, other filter-feeding organisms, and fish, including sardines and anchovies. Toxins from freshwater HABs that occur in inland lakes, rivers, and streams pose risks to pets, wildlife and humans through ingestion or water contact. Additionally, these freshwater-sourced toxins can be transported through

[11] Anderson, C.R., Moore, S.K., Tomlinson, M.C., Silke, J. and Cusack, C.K., 2015. Living with harmful algal blooms in a changing world: strategies for modeling and mitigating their effects in coastal marine ecosystems. Coastal and Marine Hazards, Risks, and Disasters. Elsevier BV, Amsterdam, pp. 495-561.

watersheds to the coast where they can accumulate in seafood, raising the possibility of exposure to multiple toxins. Other impacts of coastal HAB species include bloom-derived seafoam that can destroy the waterproofing of seabird feathers, fish kills caused by the physical clogging or laceration of fish gills, reduced light penetration, and lowered dissolved oxygen from algal decay, water discoloration, and economic impacts due to fisheries delays or closures.[12]

Trends

Occurrence and toxicity of coastal HAB species and associated toxins vary by season and by sub-region.

Toxin occurrence and concentration varies by HAB species on a local and sub-regional level statewide. Blooms of *Pseudo-nitzschia* have exhibited strong seasonality, with toxin appearing predominantly in the spring. Domoic acid has been detected in shellfish tissue in virtually all years from 2003 to 2016, although the magnitude and geographic extent of this toxin has considerable year-to-year variability. Santa Barbara, Ventura, and Central California counties have experienced the highest concentrations and most frequent occurrences of domoic acid shellfish contamination.[13] Meanwhile, data suggest *Alexandrium catenella* blooms occur more frequently in fall and in Monterey Bay than off the coast of Southern California. High density dinoflagellate HABs that discolor the water (also called "red tides") have been on the rise statewide since 2018.[14]

[12] Office of Environmental Health Hazard Assessment (OEHHA). 2022. Indicators of Climate Change in California, Fourth Edition, California Environmental Protection Agency, OEHHA.

[13] Smith, J., Connell, P., Evans, R.H., Gellene, A.G., Howard, M.D.A., Jones, B.H., Kaveggia, S., Palmer, L., Schnetzer, A., Seegers, B.N., Seubert, E.L., Tatters, A.O., Caron, D.A. 2018. A decade and a half of *Pseudo-nitzschia* spp. and domoic acid along the coast of southern California. doi 10.1016/j.hal.2018.07.007.

[14] California HABMAP. 2022. https://calhabmap.org.

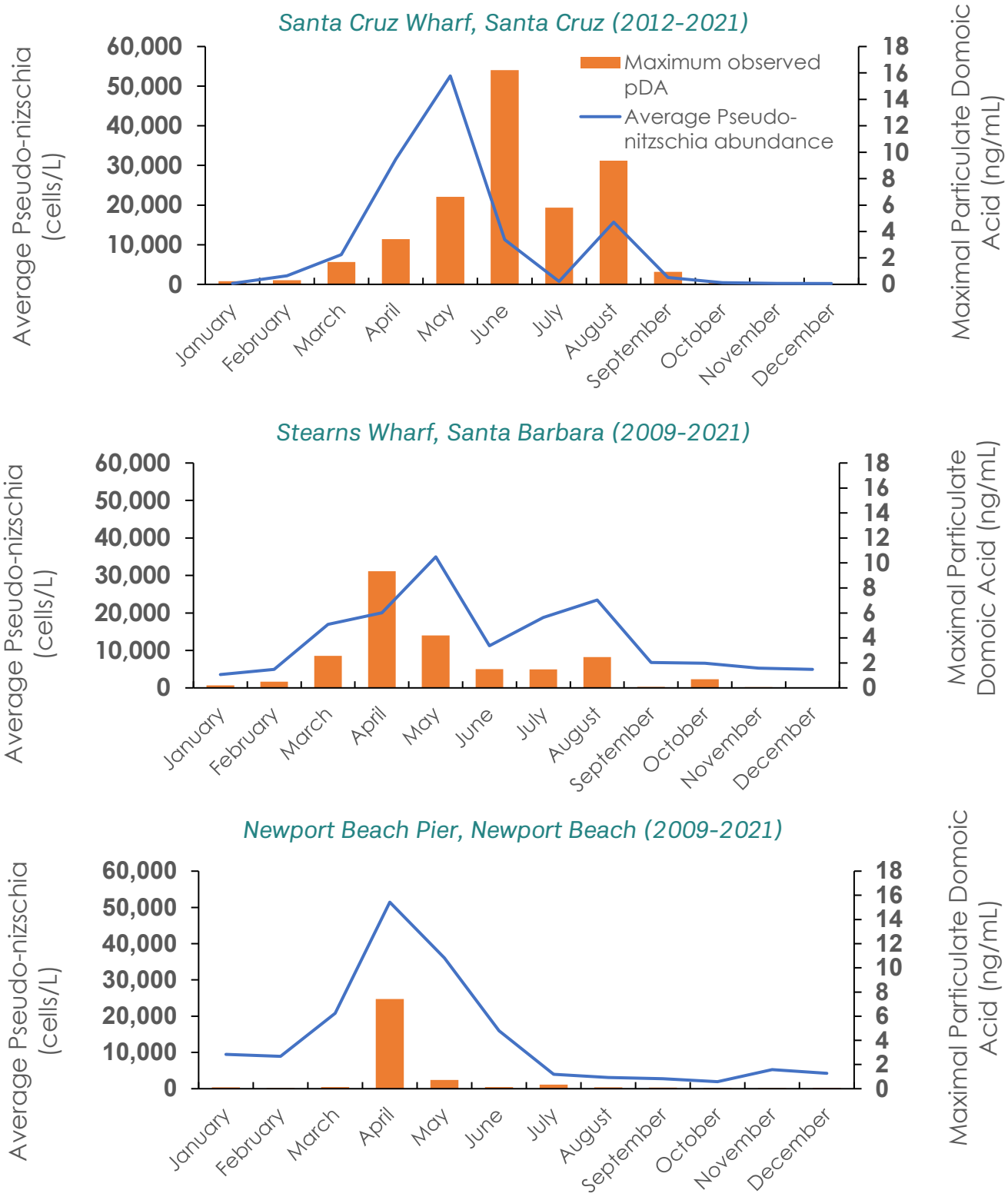


Figure 10 Relative abundance of Pseudo-nitzschia seriata and domoic acid occurrence at selected locations demonstrating seasonality and sub-regional variability. The data are from select sampling locations that comprise the Harmful Algal Bloom Monitoring Alert Program (HABMAP).

Pseudo-nitzschia habitat is migrating northward and a new sustained domoic acid hot spot has emerged following the 2014-2015 marine heat wave.

The 2014-2015 marine heatwave caused sustained, record-setting *Pseudo-nitzschia* HAB, which resulted in the northward expansion of this highly toxic taxa and higher concentrations of domoic acid in these regions. Samples collected in summer 2015 have shown the appearance of a domoic acid "hotspot" between Cape Mendocino, CaliforniaA and Cape Blanco, OR that was observed in the subsequent the summers of 2016–2018.[15]

Future Projections

Climatic variability and its effects on oceanographic conditions play a role in the year-to-year variability of coastal phytoplankton blooms.[16, 17] Future trends may vary by location with increased temperatures along the U.S. west coast (such as El Niño) likely to stimulate the growth of *Pseudo-nitzschia* in more northern regions but may reduce *Pseudo-nitzschia* populations and domoic acid occurrence in warmer southern California counties, as these waters may exceed the preferred temperature for toxin production.[18]

The California-Harmful Algae Risk Mapping (C-HARM) generates near-term (1-3 day) predictions of HAB conditions that can inform future long-term coastal modeling efforts to project the habitat range and occurrence of toxic HABs. California is well-positioned to monitor long-term trends of coastal HABs, since questions remain concerning how species will evolve and adapt to changing

[15] Vera L., Kudela R.M., Hunter M.V., Adams N.G., McCabe R.M. 2020. Climate Extreme Seeds a New Domoic Acid Hotspot on the US West Coast. doi 10.3389/fclim.2020.571836.

[16] Wells, M., et al. 2015. Harmful algal blooms and climate change: Learning from the past and present to forecast the future. doi 10.1016/j.hal.2015.07.009.

[17] Anderson, C.R., Moore, S.K., Tomlinson, M.C., Silke, J. and Cusack, C.K. 2015. Living with harmful algal blooms in a changing world: strategies for modeling and mitigating their effects in coastal marine ecosystems. Coastal and Marine Hazards, Risks, and Disasters. Elsevier BV, Amsterdam, pp. 495-561.

[18] California Ocean Science Trust. 2016. Framing the Science Around Harmful Algal Blooms and California Fisheries: Scientific Insights, Recommendations and Guidance for California.

ocean conditions, whether local upwelling will act as refugia for existing HAB species, and if new HAB species may become more common along the coast.

Indicator: Kelp

Objective 3.2: Restore and Protect Kelp Ecosystems

Description

Kelp forests are fundamental to California's marine biodiversity and its ocean economy. Kelp provides food and habitat to coastal species, supports fisheries, and offers opportunities for ocean recreation. Kelp forests also hold cultural significance for California Native American tribes. Because kelp is so important to California's marine ecosystems and coastal residents, its potential vulnerability to climate change is especially concerning. One way that scientists and resource managers assess kelp forest ecosystem health is by monitoring the extent of kelp canopy at the ocean's surface.

California's north coast experienced devastating kelp loss following a recent marine heat wave.

Kelp forests naturally fluctuate from year to year. Satellite imagery dating back to 1984 shows significant interannual variability, but a stable overall trend, in kelp canopy across the state up to 2014. However, on the north coast (California/Oregon border to San Francisco Bay) more than 95% of bull kelp canopy was lost from 2014-2019 due to a marine heat wave that brought with it a "perfect storm" of changing ocean conditions including warm, nutrient-poor waters, the decimation of sea stars due to Sea Star Wasting Syndrome, and an explosion in kelp-eating purple sea urchin populations[19]. Kelp resurged in some places on the north coast as ocean temperatures cooled in 2020-2021[20], but this recovery was limited overall, representing only about 20% of historical average, and in fall 2022, kelp canopy was observed to be declining again.

On California's central and south coasts, some areas are experiencing significant kelp declines, while in other areas, kelp is well within its historical range.

In contrast to the region-wide devastation observed on the north coast, patterns in kelp canopy on California's central coast (San Francisco Bay to Point Conception) and south coast (Point Conception to U.S./Mexico border) are more complex (Figure 11). At the local scale in both of these regions, there are kelp beds exhibiting both long-term increases and decreases.

[19] Rogers-Bennett, L., Catton, C.A. Marine heat wave and multiple stressors tip bull kelp forest to sea urchin barrens. Sci Rep 9, 15050 (2019). https://doi.org/10.1038/s41598-019-51114-y

[20] Satellite images show kelp forest has doubled in size on California's North Coast, after a dramatic collapse (San Francisco Chronicle, Nov 3 2021). https://www.sfchronicle.com/climate/article/Satellite-images-show-kelp-forest-has-doubled-in-16589392.php

Kelp Coverage from Southern, Central, and Northern California

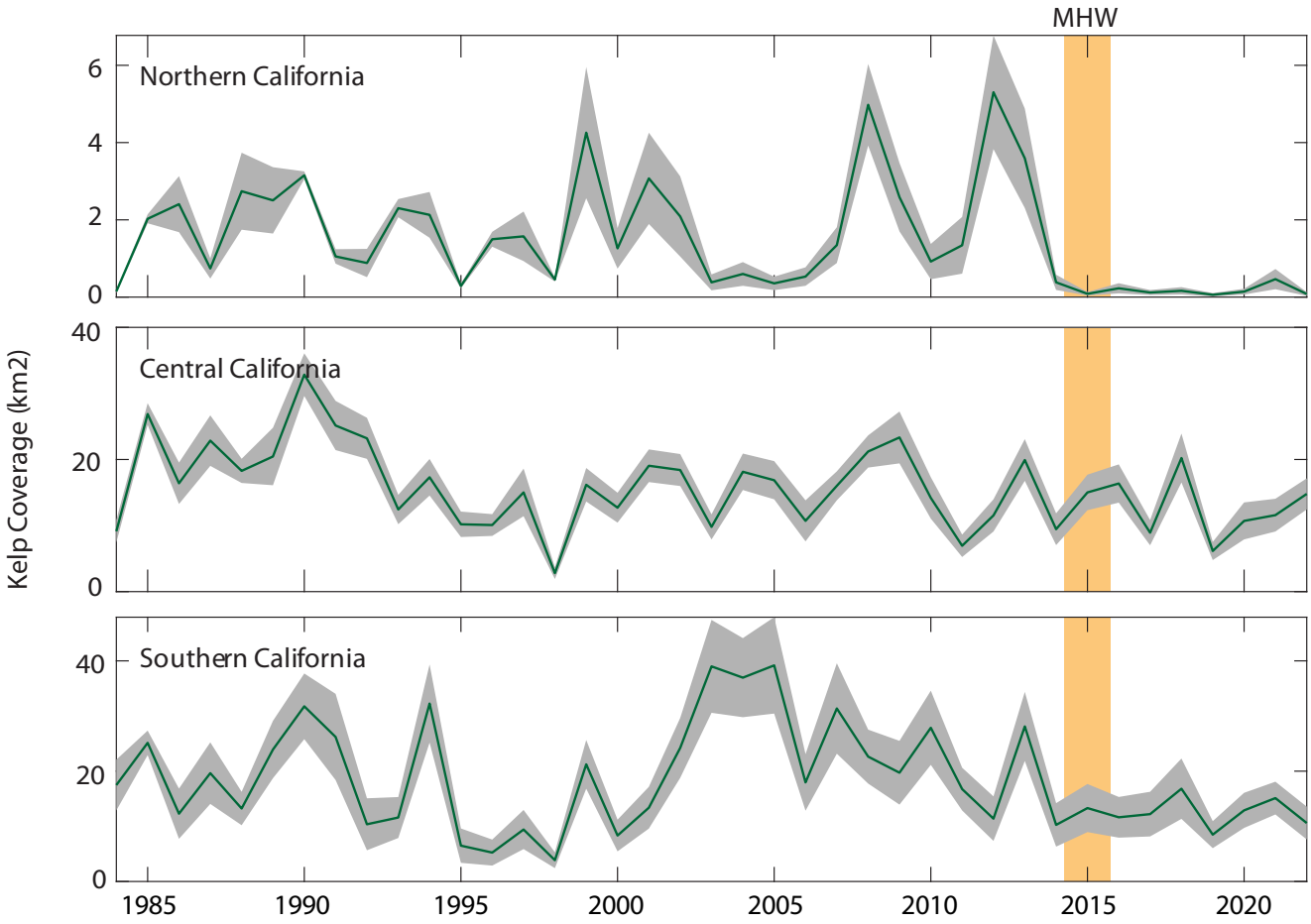


Figure 11. Time-series of kelp coverage from Southern, Central, and Northern California. Data of kelp coverage derived from satellite multispectral imaging from 1984 through quarter 3 of 2022, plotted as the maximum quarterly value from within a year for an individual pixel location (horizontal resolution is 30 m) and summed across the entire region. Shading represents the standard error of kelp coverage from within a quarter (assessed with multiple satellite overpasses). Yellow bar represents the 2014-2016 marine heat wave event. Data source: Santa Barbara Coastal LTER, T. Bell, K. Cavanaugh, and D. Siegel. 2022. SBC LTER: Time series of quarterly NetCDF files of kelp biomass in the canopy from Landsat 5, 7 and 8, since 1984 (ongoing) ver 18. Environmental Data Initiative. https://doi.org/10.6073/pasta/5fa36b985f30ee04d4771af2288aedd4 (Accessed 2022-11-21). Data analysis and visualization: Dr. Christina Frieder, Southern California Coastal Water Research Project.

Future Projections

Kelp may be increasingly vulnerable as climate change accelerates.

Marine heat waves and associated environmental and ecological changes are expected to increase in both frequency and severity with climate change. Additionally, the persistence of urchin barrens in some areas, especially on the north coast, may constrain kelp recovery even during periods of more favorable ocean conditions. While kelp loss has been most severe on the north coast to date, kelp in central and southern California may become similarly vulnerable as climate change accelerates. California's kelp therefore faces an uncertain future, highlighting the urgent need for more proactive, climate-ready strategies for kelp management and, in some cases, active intervention to prevent or reverse declines.

Indicator: Marine Mammals

Objective 3.3 Support Sustainable Marine Fisheries and Thriving Fish and Wildlife Populations

Description

Marine mammals are useful indicators of ocean health and are critical to maintaining balanced functional ecosystems. Researchers monitor marine mammal populations and generate abundance estimates, as far back as the 1970s for some species. When marine mammals strand on beaches and other coastal areas due to starvation, illness, injury or death, scientists can track these patterns in near real-time and monitor the impacts of various threats on marine mammals; stranding data is readily available from 2006 onward. Together, information on marine mammal population abundance and stranding numbers allows us to understand long-term and current trends of climate change, harmful algal blooms, human activity, infectious diseases and other threats.

Trends

Since implementation of the Marine Mammal Protection Act in 1972, many marine mammal populations that use California waters have been stable or increasing.

Stranding numbers have been stable since 2006, but there have been many acute, but significant, increases in the number of stranded marine mammals in California during this period associated with increased ocean temperatures and human interactions, among other causes.

Two commonly encountered marine mammal species that inhabit state waters were selected to illustrate these trends: California sea lions, which have been identified as a good indicator species for ecosystem assessments[21], and humpback whales, which are important for state ecotourism.

Both the California sea lion population and strandings of young sea lions (less than 2 years old) have been stable over the past decades (Figure 12, top panel). In years with intense, persistent and/or widespread ocean warming off the California coast (2009 and 2015), significantly more young sea lions stranded in California (Figure 12, bottom panel). Humpback whale abundance along the U.S. west coast increased significantly, especially between 2014 and 2018 (Figure 13, top panel). During this period, there also were increased numbers of injured or dead humpback whales due to entanglements in in fishing gear or marine debris, ship strikes or other human-related injuries in California, specifically in 2015, 2016 and 2018 (Figure 13, bottom panel).

Significant stranding events are defined as years where stranding numbers exceed a threshold value of what would be considered normal/expected for a species (dashed line in the bottom panels of each figure). The anomalous periods may be concerning for the health of a given population, especially if paired with other threats.

[21] Melin, Sharon R., et al. "California sea lions: an indicator for integrated ecosystem assessment of the California Current System." California Cooperative Oceanic Fisheries Investigations Reports 53 (2012): 140-152.

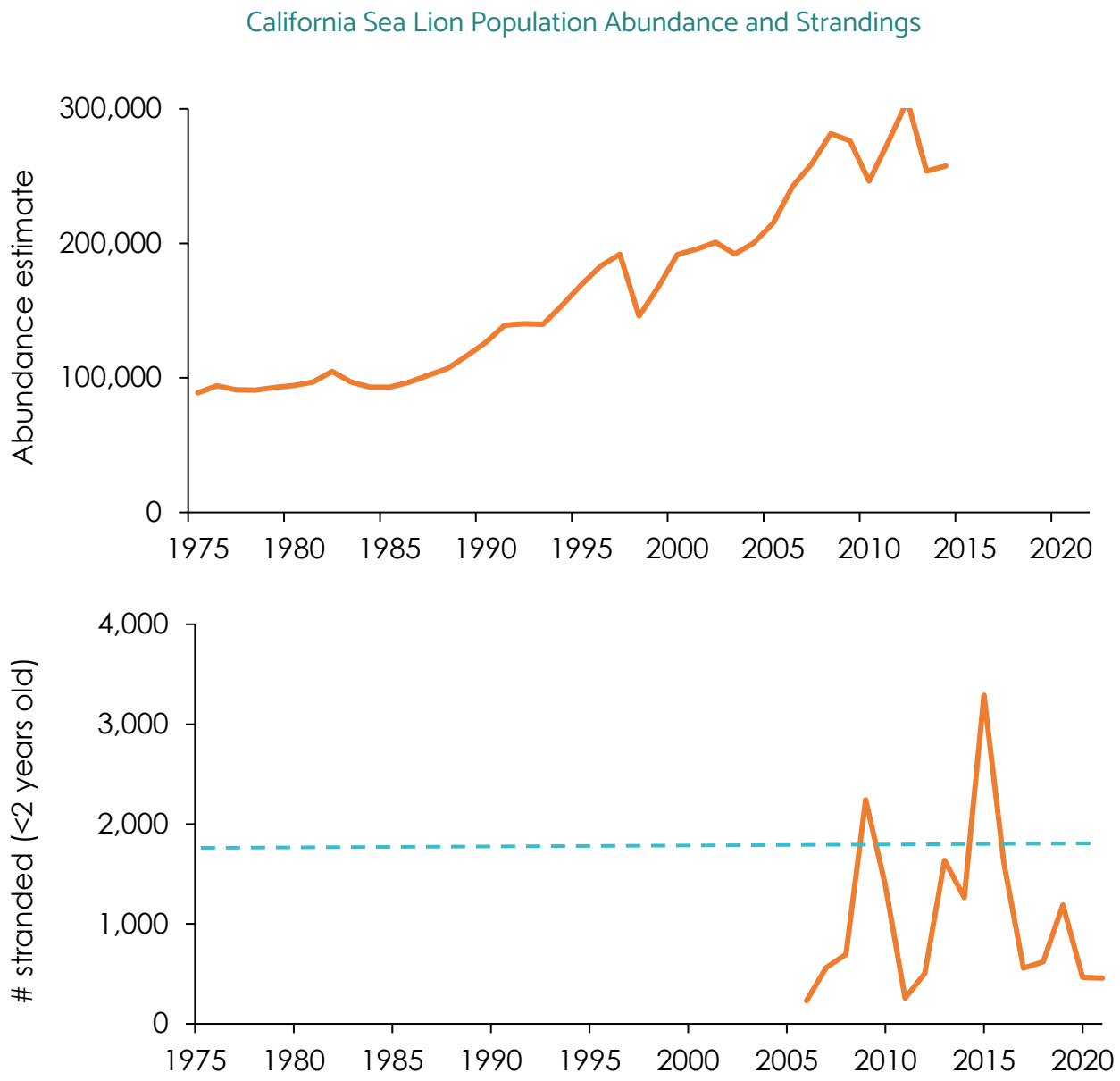


Figure 12. California sea lions. Top panel: Population abundance estimate from 1974-2014 (Laake et al. 2018). Bottom panel: Number of stranded California sea lions less than two years old in California, 2006-2021. [22] *The dashed line denotes where significant stranding events exceeded the threshold value of what would be considered normal/expected for the species.*

[22] Stranding data collected by the West Coast Marine Mammal Stranding Network and available via the Marine Mammal Health and Stranding Response National Database.

Humpback Whale Population Abundance and Human Related Injuries

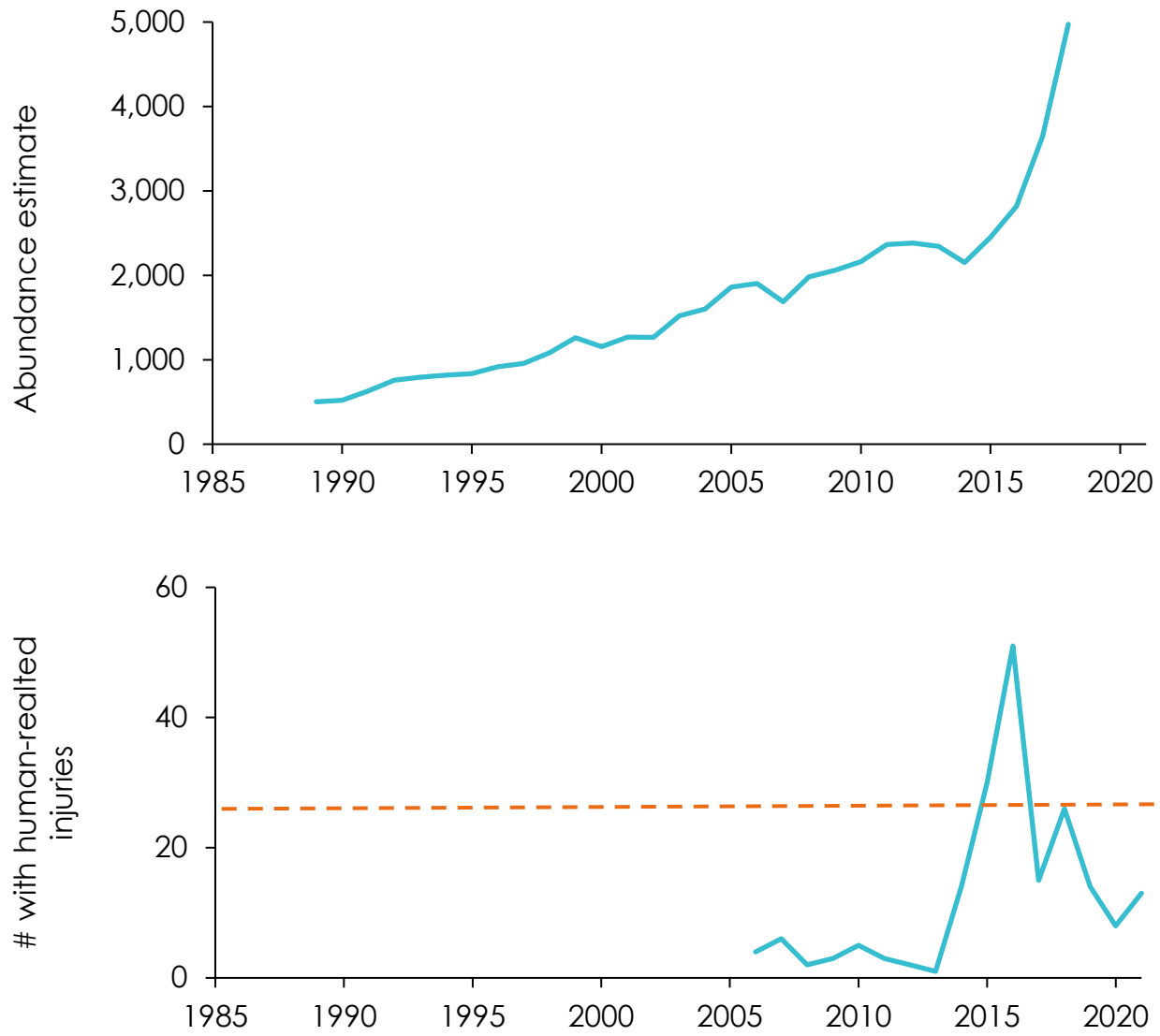


Figure 13. Humpback whales. Top panel: Population abundance estimates 1989-2018 (Calambokidis & Barlow 2020). Bottom panel: Number of humpback whales observed with human-related injuries in California, 2006-2021. [23] *The dashed line denotes where significant stranding events exceeded the threshold value of what would be considered normal/expected for the species.*

[23] Whale entanglement data, available via the Marine Mammal Health and Stranding Response National Database and reported separately to NOAA Fisheries by private citizens and other entities.

Future Projections

Periodic but significant increases in the number of stranded marine mammals will continue and may increase in duration, frequency, and severity, possibly impacting the long-term stability or health of marine mammal populations.

Marine climate events, such as the 2014-2016 marine heatwave, are expected to increase in frequency, duration, and intensity[24]. These extreme events are expected to continue to effect marine biota, with cascading effects throughout marine food webs, and likely will result in increased stranding events in the future that may disrupt marine mammal population stability or health.

In the future, the marine mammal indicator will expand its stranding component to include more species and demographic groups. These groups provide information on the causality of stranding events, which commonly include ocean warming, harmful algal blooms, human activity (boat strike, entanglement, gunshot, etc.) and infectious diseases.

[24] Spillman, Claire M., et al. "Onset and decline rates of marine heatwaves: Global trends, seasonal forecasts and marine management." Frontiers in Climate (2021): 182.

Accomplishments

Objective 3.1: Protect and Restore Coastal and Marine Ecosystems

Decadal Management Review of California's MPA Network

Over the past decade, the State has been preparing for the first retrospective review of the statewide network of 124 marine protected areas and its MPA Management Program. Released in early 2023, the Decadal Management Review (DMR) assesses progress toward the goals of the Marine Life Protection Act, identifies knowledge gaps, and recommends adaptive management actions. The DMR is structured around the "four pillars" of the Management Program, including key milestones over the past year:

- **Research & Monitoring:** OPC continued support for the long-term monitoring program by providing an additional $6.5 million for fieldwork in all key habitats: kelp forests, intertidal and mid-depth rocky reefs, and sandy beaches. To increase awareness about the science behind California's MPAs, a summer webinar series, "Ask a Researcher" hosted by OPC, was launched. The series highlights key findings from the long-term monitoring technical reports released in early 2022, summarizing ecological findings from the past decade.
- **Outreach & Education:** Continued partnership with CA State Parks led to more than 275,000 school age children receiving educational programming around MPAs during the past 3 years. Social media posts featuring MPA content received more than 3.6 million views.
- **Policy & Permitting:** The MPA Statewide Leadership Team released its FY 2021-2025 Work Plan, which identifies shared strategic priorities and key actions to promote cross-sector collaboration.
- **Enforcement & Compliance:** Multi-year projects came to a conclusion in 2022, resulting in 14 county-level trainings for enforcement partners statewide, training 470+ enforcement partners. A new signage inventory project was launched to track signage needs statewide.

MPA Investments

OPC has supported the MPA Management Program since its inception and made significant contributions to all pillars of the program in 2022:

MPAs and Climate Resilience

In response to the release of the OPC Science Advisory Team report, "Climate Resilience and California's Marine Protected Area Network," OPC launched a competitive solicitation for proposals that would deepen resource managers' understanding of the role of California's MPAs in mitigating climate impacts. Upon approval at OPC's January 2023 meeting, selected projects will provide much needed models and projections to predict impacts of climate change to key species and habitats and to understand the role of MPAs in providing resilience to these impacts.

MPA Small Grants Program

Since 2017, OPC has partnered with Coastal Quest to administer its MPA Small Grants Program to increase MPA outreach and education efforts statewide. Coastal Quest administered a call for proposals in 2018 and 2020, which has disbursed over $1.2 million directly to all 14 MPA Collaboratives and 12 community organizations to create locally relevant outreach content for a broad range of ocean users in multiple languages. In February, OPC approved a third round of funding for $1 million to support innovative outreach and education projects to conclude in 2024.

California Collaborative Fisheries Research Program (CCFRP)

An additional $1.5 million was provided to CCFRP this past October to support monitoring for the next three years and match a 3-year, $1.5 million appropriation in the FY 22/23 California State budget. CCFRP has provided the State with valuable information about MPA performance and effect of MPA protections on fish communities statewide, in addition to providing critical information to support stock assessments of various rockfish species and directly engaging angler communities in MPA monitoring.

California State Parks and Resources Legacy Fund

In October, OPC authorized a cumulative $4.3 million to CA State Parks and Resources Legacy Fund to expand MPA outreach and education within State Parks further enforcement and compliance efforts in the MPA Network through community partnerships. This funding builds on previous OPC investments to both entities to expand MPA messaging, interpretive programming, enforcement

trainings, and other compliance activities that further advance priorities of the state's MPA Management Program and the MPA Statewide Leadership Team Work Plan.

IUCN Green List

This year marked a turning point in California's effort to add the MPA network to the International Union for Conservation of Nature (IUCN) Green List of Protected and Conserved Areas, a global initiative that aims to promote effective, equitable, and successful protected areas worldwide. California represents the first MPA network to apply for the Green List, and over the past year, OPC has worked with IUCN to adapt Green List criteria for application to protected area networks – a major contribution to global conservation. In 2022, an expert assessment group representing California's diverse ocean communities determined that the MPA network all the adapted criteria necessary for Green Listing. In early next year, the group will conduct site visits to selected MPAs, with full Green Listing anticipated by spring of 2023.

Objective 3.2: Restore and Protect Kelp Forest Ecosystems

Accelerating Efforts to Restore And Protect California's Kelp Forests

In recent years, California's marine biodiversity and coastal communities have been devastated by climate-driven declines in kelp, especially on the north coast. In response, OPC invested more than $3.5 million from 2019-2022 in pilot research and restoration projects to monitor kelp forest health, improve understanding of kelp loss and resilience, and test kelp restoration methods. This year, an innovative partnership for kelp restoration between OPC, CDFW, and north coast commercial fishermen – who have experienced significant economic hardship due to kelp collapse – concluded, with fishermen removing over 50,000 pounds of kelp-eating purple sea urchins from two sites in Mendocino County. Encouragingly, scientific monitoring documented kelp recovery at one of these sites. A full report on this groundbreaking effort is available here: Restoration of Northern California Bull Kelp Forests: A Partnership-Based Approach. As the state works to develop a kelp restoration "toolkit," partnership with commercial fishermen will be prioritized as an effective restoration method that also brings economic benefit to communities impacted by climate change.

Building on pilot work to create a cohesive strategy for proactive, climate-ready kelp management, including regular monitoring of kelp forest health across the state, remains an urgent need. This year OPC invested $600,000 in enhanced kelp canopy monitoring using cutting-edge remote sensing techniques, as well as more than $1.2 million to support project management and science

integration for a statewide, ecosystem-based Kelp Restoration and Management Plan to be completed in 2026.

Objective 3.3: Support Sustainable Marine Fisheries and Thriving Fish and Wildlife Populations

Market Squid Fishery Management Plan Update

The market squid fishery is one of the state's largest and most valuable fisheries as well as a fishery that is facing some of the most immediate pressures from climate change. In June 2022, OPC approved a proposal to support CDFW in reviewing California's Market Squid Fishery Management Plan (FMP) to update management practices and increase the climate-resiliency of the fishery. The funding supports research to understand market squid's genomic landscape as well as facilitating a Squid Fishery Advisory Committee, the body responsible for reviewing and updating the Market Squid FMP. Updating the FMP is a necessary step to ensure long-term sustainability of the fishery in the face of changing ocean conditions that California is already beginning to experience.

Reducing Entanglement Risks

OPC continues to support the search for innovative solutions to reduce marine mammal and sea turtle entanglement risk in commercial fishing gear. These efforts include supporting and participating in CDFW's Risk Assessment and Mitigation Program (RAMP) for the California Dungeness crab fishery, as well as incentivizing the transition to or development of fishing gear that minimizes entanglement risks, and training skilled personnel to actively disentangle whales.

Supporting Innovation and Incentivizing Gear Transitions

As part of these efforts, OPC supported California's Drift Gillnet Transition program to incentivize the adoption of more sustainable fishing methods. The program helps commercial fishermen retire large-mesh drift gillnets and adopt gear that better protects sea turtles, whales, and other sensitive marine species. The program, implemented in partnership with CDFW, provides financial compensation to California fishermen who voluntarily turn in their nets and permits and switch to more selective fishing gear. To date, the program has successfully resulted in:

- 38 California state drift gillnet permit holders participating
- $2.7 million provided to these fishermen to incentivize switching to more selective fishing gear

- More than 50 miles and 54 tons of large-mesh drift gillnets surrendered and recycled into new products

On December 29, 2022, President Biden signed a bill that will prohibit all large mesh drift gillnets in federal waters by December 2027, completing an additional step to transition away from this harmful gear type.

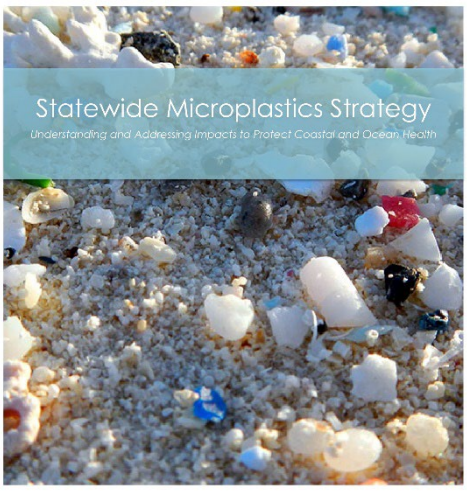
Besides working to reduce drift gillnet use, OPC continues to commit to reducing entanglement risk within California's commercial Dungeness crab fishery and supported the National Marine Sanctuary Foundation (NMFS) and CDFW in co-hosting the California Commercial Fishing Gear Innovations Workshop, held August 2022 in Sausalito. The workshop invited commercial fishermen, fishing gear manufacturers, and fishery managers to explore options and ideas for potential gear innovations to be used when the commercial Dungeness crab fishery is otherwise closed due to elevated entanglement risk.

Beyond Reducing Entanglement Risk – Actively Disentangling Whales

In addition to testing and promoting innovative fishing gear, OPC also invested in training personnel to actively disentangle large whales. In October and November 2022, OPC supported NMFS to conduct Large Whale Entanglement Response Trainings at both the Channel Islands and Monterey Bay National Marine Sanctuaries in partnership with NOAA Fisheries West Coast Region. These trainings included staff from various agencies and serve to build a network of trained professionals ready to deploy as needed to disentangle stricken whales.

Objective 3.4: Improve Coastal and Ocean Water Quality

Statewide Microplastics Strategy and Implementation



On February 2022, OPC adopted a first-of-its-kind Statewide Microplastics Strategy pursuant to Senate Bill 1263 (Portantino, 2018) that recommends early actions and research priorities to reduce microplastic pollution in California's marine environment. The Statewide Microplastics Strategy sets a multi-year roadmap for California to take a national and global leadership role in managing microplastics pollution, following a simultaneous two-track approach:

Track 1: Solutions

- **Pollution Prevention:** Eliminate plastic waste at the source (products or materials from which microplastics originate).
- **Pathway Interventions:** Intervene within specific pathways (ex: stormwater runoff, wastewater, aerial deposition) that mobilize microplastics into California waters.
- **Outreach & Education:** Engage and inform the public and industries of microplastic sources, impacts, and solutions.

Track 2: Science to Inform Future Action

- **Monitoring:** Understand and identify trends of microplastic pollution statewide.
- **Risk Thresholds & Assessment:** Improve understanding of impacts to aquatic life and human health.
- based on local data.
- **Evaluating New Solutions:** Develop and implement future solutions.

Critically, while trash and microplastics pollution and associated impacts are documented in California, the State lacks consistent monitoring and data collection statewide. OPC has continued to work with federal, state, and local partners to share information and identify priority investments, such as the development of a statewide plastics monitoring network to fill critical knowledge gaps and inform management action. OPC has also partnered with California Sea Grant to leverage federal funding opportunities and prepare a research solicitation to advance the research priorities outlined in the Statewide Microplastics Strategy and California Ocean Litter Strategy. These projects are scheduled to brought to the Council for consideration of funding in 2023.

SB 54 (Allen) enacts the Plastic Pollution Prevention and Packaging Producing Responsibility Act to establish phased statewide plastic source reduction, recycling, and composting requirements. The bill requires producers of covered materials to be part of a producer responsibility organization (PRO) with a producer responsibility plan approved by CalRecycle, or otherwise individually comply with source reduction targets and recycling or composting rates by January 1, 2023. The bill imposes various requirements on PROs, including contributing $500,000,000 annually between 2027 and 2037 into California Plastic Pollution Mitigation Fund created by the bill. (Ch. 75, Statutes 2022).

Modernizing Harmful Algal Bloom Notifications

In previous years, OPC invested in improving coastal harmful algal bloom (HAB) monitoring through the implementation of a statewide network to measure HAB species abundance and domoic acid occurrence with a consortia of universities and agencies located at nine stations along the coast. Through this program, Southern California Coastal Ocean Observing System (SCCOOS) and Central and Northern California Ocean Observing System (CeNCOOS) have provided information to the California Department of Public Health Marine Biotoxin Quarantines and Health Advisories that serve as warnings for recreational seafood harvests, as well as Health Advisories and Closures from the California Department of Fish and Wildlife, including support provided during the Santa Barbara

domoic acid event in the summer of 2022 that result in more than 400 marine animals killed or stranded, as well issuance of at least four warnings in Southern California.

Detecting and Managing Constituents of Emerging Concern

Beginning in 2019, OPC and State Water Resources Control Board reconvened the Constituents of Emerging Concern (CEC) Science Advisory Panel for Aquatic Ecosystems (Panel) facilitated by the Southern California Coastal Water Quality Project Authority (SCCWRP), to update the Panel's 2012 recommendations and assess the current state of scientific knowledge on the risks of CECs impacting human health and California freshwater, coastal, and marine ecosystems. In November 2022, the panel released the Draft Final Report, Monitoring Strategies for Constituents of Emerging Concern (CECs) in California's Aquatic Ecosystems, Recommendations of a Science Advisory Panel to guide the development of a statewide management strategy and monitoring recommendations for emerging contaminants. It is anticipated the final report will be publicly available in January 2023.

Conserving 30% of California's Coastal Waters by 2030

To protect biodiversity, advance equitable access to nature, and combat climate change, in 2022 the California Natural Resources Agency released a groundbreaking document – Pathways to 30x30: Accelerating Conservation of California's Nature – detailing strategies and opportunities to conserve 30% of California's lands and coastal waters by 2030. OPC is leading the state's effort to achieve 30x30 in coastal waters. 16% of coastal waters, the area covered by the state's MPA network, are already conserved based on the definition of conservation in the *Pathways* document. Conserving an additional half-million acres of coastal waters by 2030 will require bold action and new partnerships.

In 2022, OPC, which is a member of the 30x30 Partnership Coordinating Committee, attended the 30x30 Partnership kickoff event and hosted a virtual roundtable to hear perspectives from members of California's diverse coastal communities. Early next year, OPC will share additional opportunities for tribes, environmental justice organizations, conservation groups, fishermen, and others to get involved as we move forward with the strategies and opportunities detailed in the Pathways to 30x30 document. These opportunities include:

- **Adaptively managing our state's MPAs** to ensure they continue to provide strong protections for coastal and marine biodiversity, especially in the face of climate change.
- Working with federal partners to **strengthen biodiversity protections in California's National Marine Sanctuaries**.
- Partnering with California Native American tribes to establish **Indigenous Marine Stewardship Areas**, focused on supporting and enhancing tribal stewardship of coastal and marine ecosystems.
- **Collaborating with scientists and fishermen** to better understand the role of "other effective conservation measures," or OECMs – such as military closures, renewable energy installations, or areas established for the purposes of fisheries management – in protecting coastal and ocean biodiversity.

California's Engagement at the 2022 United Nations Biodiversity Conference (COP 15)

A group of California leaders, including Secretary Crowfoot and seven legislative members, as well as OPC leadership and staff, traveled to Montreal in December 2022 to showcase California's leadership at the United Nations Biodiversity Conference (COP 15) in Montreal. Through speaking engagements, panel discussions, and meetings with senior foreign officials, California highlighted its goal to conserve 30% of California's lands and coastal waters by 2030 and showed that protecting nature and fighting climate change are essential for economic security and prosperity. In December 2022, 196 nations adopted the Kunming-Montreal Global Biodiversity Framework, an ambitious ten-year deal that sets targets in 22 areas – including a commitment to conserve 30% of the planet's lands and seas by 2030, a target California adopted in 2020.

Goal 4: Support Ocean Health Through a Sustainable Blue Economy

Introduction

California's blue economy can create jobs, support livelihoods, build climate resilience, and allow for marine ecosystems to thrive. In 2022, offshore wind development accelerated in California, with Governor Newsom setting ambitious planning goals and the first lease sales of floating offshore wind energy areas in federal waters. Additionally, state agency partners made progress on an Aquaculture Action Plan to improve oversight and governance for sustainable aquaculture in state waters. These activities are essential to support clean energy and aquaculture in California, but require significant planning, monitoring, and outreach to minimize impacts to the environment, cultural resources, and fishing. OPC is playing a key role in advancing science, policy, and partnerships to inform these efforts.

Commercial and recreational fishing are also critical components of California's blue economy. However, in recent years, coastal communities have experienced significant hardship from fishing delays or closures caused by climate-driven events in the ocean. Ensuring climate-resiliency for fisheries and fishing communities is a top priority for OPC. The Fisheries Landing indicator for this Goal was chosen based on data availability and to spotlight the role of healthy fisheries on California's ocean economy. This indicator will be further refined for the purposes of the 2025 Report Card.

The accomplishments listed below summarize key policy efforts and OPC investments in critical research, monitoring and partnerships that support offshore wind development and sustainable aquaculture in California.

Indicators

Overview

The selected indicator provides a landscape view of fish/invertebrate landings and the economic value of those fisheries over the past four decades. It is important to note that landings and market values of California's top three commercial species are highly variable through time due to many factors including environmental changes, climate events, and management actions. Connectivity between landings and climate-driven events are evident, particularly during strong El Nino and marine heatwave events. However, climate impacts go beyond simply impacting fisheries landings and will affect California's fisheries in a variety of ways, with fish and invertebrate populations responding both positively and negatively to ocean warming. These responses include projected shifts in species' ranges and changes in habitat suitability; responses which will subsequently impact the distribution, species composition, and quantity of catches statewide.

Indicator: Fisheries Landings

Objective 4.1: Advance Sustainable Seafood and Thriving Fishing Communities

Description

Landing data, or catch data, is one component of tracking the status of fish populations and the economic health of each fishery. Reported landings provide basic catch records for amounts and values of various species taken by California's commercial fisheries. California's fishery statistics are based on data submitted by commercial fishermen, fish dealers, processors, and operators of sportfishing Commercial Passenger Fishing Vessels who submit copies of their landing records to the CDFW. Of California's commercial fisheries, Dungeness crab, market squid, and Chinook salmon are some of the most economically important and historically significant.

Trends

California's fisheries are highly dynamic, with catch levels varying greatly due to environmental variability, climactic events, changes in effort, and subsequent management action.

Market Squid, Dungeness Crab, and Chinook Salmon Landings

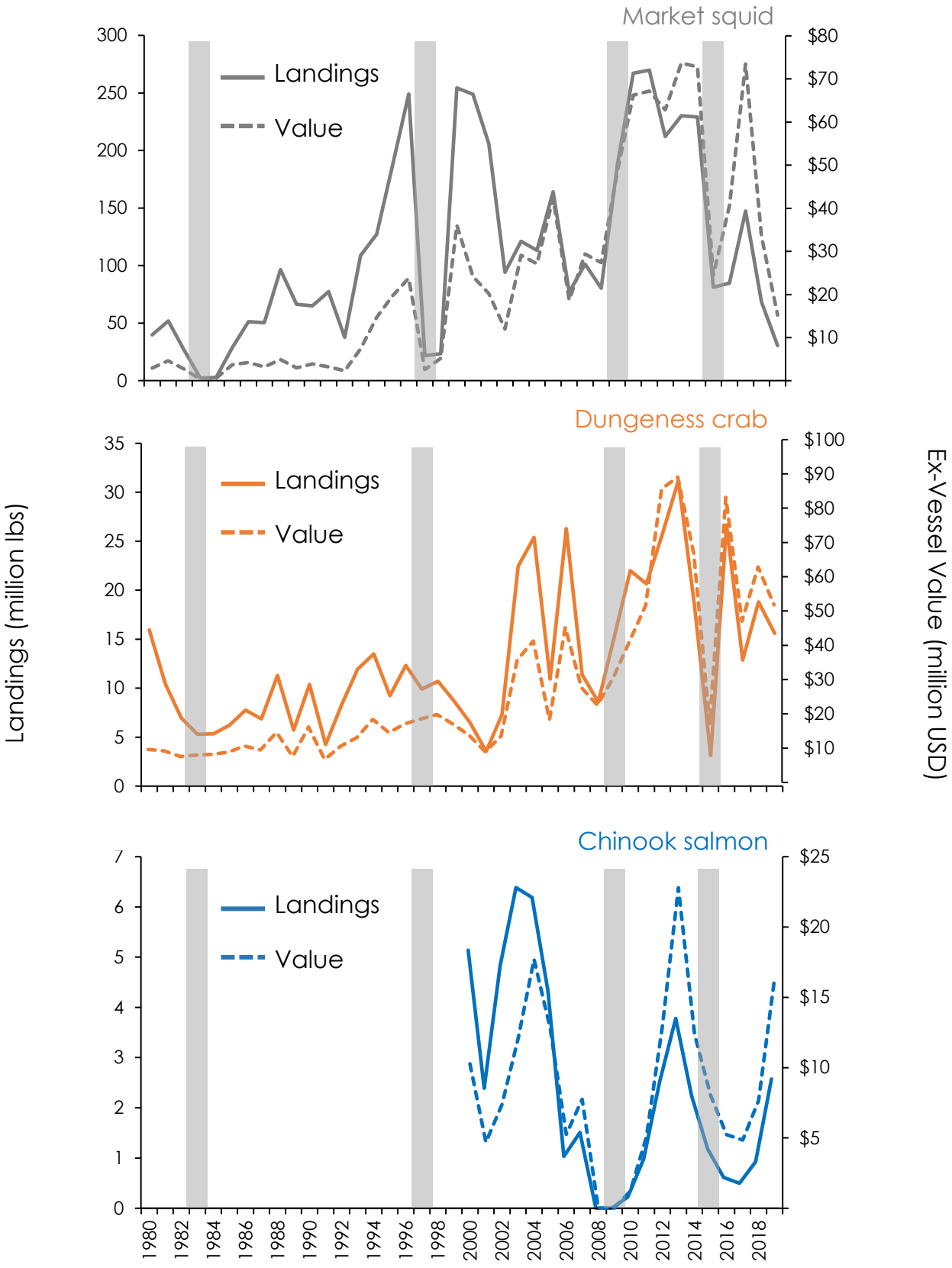


Figure 14. (Previous page) Landings data in pounds of market squid, Dungeness crab, and Chinook salmon from 1980 to 2019. Gray bars denote El Nino events along the West Coast

Over the past century, California's fisheries have seen a shift from majority finfish catch to a more diverse consortium of catch which includes high-value invertebrates like Dungeness crab, market squid, and sea urchin, often described as the "age of invertebrates"[25]. This shift is partly due to the decline and regulation of many finfish stocks in the latter part of the century[26]. However, declines in invertebrate catch due to climactic events, namely El Niño cycles and marine heatwaves, and subsequent management action, can be seen as well (Figure 14). Market squid, the state's largest fishery by volume, saw a sharp decline in total landings and value in 1998 in response to the 1997–1998 El Niño event[27].

[25] Miller, R. R., J. C. Field, J. A. Santora, M. H. Monk, R. Kosaka, and C. Thomson. 2017. Spatial valuation of California marine fisheries as an ecosystem service. Canadian Journal of Fisheries and Aquatic Sciences 74: 1732– 1748.

[26] Mason, J. 2004. Historical patterns from 74 years of commercial landings from California waters. Calif. Coop. Ocean. Fish. Investig. Rep. 45: 180–190.

[27] Zeidberg, L., Hammer, W., Nezlin, N., and Henry, A. 2006. The fishery for California market squid (*Loligo opalescens*) (Cephalopodia: Myopsida), from 1981 through 2003. Fish. Bull. 104: 46–59.

Changing climate is projected to shift species ranges and habitat suitability, affecting distribution of catch statewide.

Climate change will impact California's fisheries in a variety of ways, with fish populations responding both positively and negatively to ocean warming[28]. Models and empirical data also suggest shifts in ranges of species, offering new opportunities for fisheries expansion but likewise limiting catch in historical fishing grounds. A new study described a northern shift of the northern sardine stock fishery along the West Coast as the ocean warms, potentially resulting in a decline in landings by 20 to 50 percent over the next 60 years[29].

[28] Free, Christopher M., et al. "Impacts of historical warming on marine fisheries production." *Science* 363.6430 (2019): 979-983.

[29] Smith JA, Muhling B, Sweeney J, et al. The potential impact of a shifting Pacific sardine distribution on U.S. West Coast landings. Fish Oceanogr. 2021;30:437–454. https://doi.org/10.1111/fog.12529

Accomplishments

Objective 4.4: Guide Sustainable Renewable Energy Projects

Offshore Wind

As described above, the offshore wind development process in California moved forward rapidly in 2022. On the federal level, the first-ever lease sale for California and the west coast of the U.S. took place in December. The lease sale included five offshore wind lease areas – two offshore Humboldt Bay and three offshore Morro Bay. On the state level, the California Energy Commission adopted offshore wind goals of 2-5 GW by 2030 and 25 GW by 2045. To meet the requirements of the Assembly Bill 525 strategic plan, California Energy Commission hosted a series of webinars and outreach meetings to inform stakeholders and the public of the progress of working group efforts that would lay out a framework of sea space identification, a permitting roadmap, and economic assessment for future offshore wind projects.

In 2022, OPC continued to support projects to advance the understanding of impacts of offshore wind development to marine life, communities, fisheries, and tribes. To date, OPC has invested over $1.5 million in multiple offshore wind projects, including Conservation Biology Institute's modeling study that synthesizes a myriad of datasets to help inform decision makers of potential suitable areas for offshore wind development and a fishing ground mapping project that displays areas of different commercial fishing activities in the Central Coast. Additionally, OPC recently funded the California Fishermen's Resiliency Association to coordinate efforts of California commercial fisherman and serve as a point of contact to negotiate with developers on fishing community benefits. Finally, OPC has provided funding to California Energy Commission to work directly with northern and central California tribes to create inventories of tribal cultural resources that may be affected by offshore wind development. These projects, which include direct grants to tribes to support coordination and consultation with state agencies, are ongoing and will conclude in 2023.

Objective 4.2: Promote Sustainable Aquaculture

California's Aquaculture Action Plan

OPC continues to lead efforts to develop an Action Plan for sustainable commercial aquaculture in California that minimizes environmental impact and supports a robust blue economy. The Aquaculture Action Plan will focus on improving aquaculture governance (including the current

permitting, monitoring, and oversight landscape), as well as building a robust framework to sustainably expand aquaculture in California. OPC and California's Aquaculture Leadership Team are developing a draft of this Plan with completion expected in Summer 2023. A robust tribal consultation and public engagement process will follow.

OPC Science Advisory Team

In 2022, the OPC Science Advisory Team (OPC SAT), and the Ocean Science Trust (OST) advanced the scientific understanding of several ocean and coastal issues in California. Together, these activities and projects inform and ensure that OPC's policy decisions are aligned with the best available science.

New OPC SAT Engagement

In its role as Secretariat, OST implemented new strategies with the OPC SAT to provide rapid scientific guidance to OPC and align OPC's policy goals, priorities, and decisions with sound scientific understanding. Such strategies include, for example, the convening of subcommittees of select SAT members focused around advancing each of OPC's Strategic Plan goals. Additionally, OST has implemented expert panels to provide more in-depth and targeted scientific advice on near-term policy decisions. These activities have resulted in the development of a draft Restoration & Mitigation Policy for the state and the future development of ocean indicators for California's 2025 Oceans and Coasts Report Card.

Sea-Level Rise Task Force

As described above under Goal 1 accomplishments, OPC and OST recently convened a new Sea-Level Rise Task Force of scientific experts, and policymakers to update California's Sea-Level Rise Guidance. The Task Force is updating this guidance with the most current and best available science on sea-level rise and develop pragmatic and practical approaches for state and local decision-makers to understand and plan for future sea-level rise. This guidance is a critical tool for state and local sea-level rise adaptation planning and project implementation.

Summer Interns

In summer 2022, OPC hosted a cohort of six interns who helped advance OPC's strategic priorities while gaining meaningful professional experience within state government. Most notably, the interns provided vital contributions on the coast and ocean health indicators in this report.

Alyssa Jain, Gloria Jin, Thai Le, Jas Martin, and Elizabeth Nguyen were selected for the second year of OPC's ten-week paid summer internship program, which is focused on providing undergraduate college students with the opportunity to build a foundational background and robust overview of California's coastal and ocean science, policy, and management work. Emily Zhao joined OPC through a merit-based award from the Haas Center for Public Service's Undergraduate Fellowships Program at Stanford University, the fifth year of an ongoing partnership between OPC and Stanford.

www.opc.ca.gov