2025 Coast and Ocean Report Card Update

March 2025

CALIFORNIA
OCEAN SCIENCE TRUST

This report was prepared by Jill Harris on behalf of, and with input from, the Ocean Protection Council, California Ocean Science Trust, and the West Coast Ocean Alliance. For more information and to stay up to date on the progress of the California Coast and Ocean Report Card, visit opc.ca.gov/annual-reports.

The California Coast and Ocean Report Card uses a scientific, indicator-based approach to grade the health of California's coast and ocean. As called for in the 2020-2025 OPC Strategic Plan, the goal of the Report Card is to inform the public and decision-makers about the status of the coast and ocean and to highlight areas where the state can focus solutions.

Project Status as of March 2025

- Completed a round of public and tribal input
- Narrowed to a list of 13 indicators that are meaningful and feasible (i.e. available statewide data)
- Have a final score for kelp, vetted by a group of experts. Kelp status is Below Expectations and Trending Worse. For more information, please see Exhibit C (Kelp Indicator)
- For 8 indicators, plus Coastal Economy and Equity, have convened expert groups to review data, develop methodologies, and calculate scores
- For 4 indicators, have consulted experts to plan data analysis but have not convened formal working groups
- Have a concept design for the Report Card (p. 7)

Process, Collaborators, and Timeline

The Report Card is being developed through a partnership between OPC, California Ocean Science Trust (OST), and the West Coast Ocean Alliance (WCOA). WCOA is developing an Ocean Health Dashboard, which uses indicators to grade the ocean and coasts of California, Oregon, and Washington. OPC is the first WCOA member agency to apply a similar method of assessing ocean health to align with state-level goals, approaches, and investments. In some areas, such as equity, California's priorities are different, so OPC and OST are developing novel indicators that WCOA may adopt. In general, OPC, OST, and WCOA are working closely together to develop coordinated products that describe the status of the west coast ocean system.

The Report Card is based on the principles developed by the OPC Science Advisory Team in 2023 to provide recommendations for creating a Report Card (i.e., adapting existing approaches and aligning with ongoing West Coast efforts) and for the indicators themselves. We are closely following that recommended approach for developing the Report Card, and the list of potential indicators has served as a valuable starting point. See Appendix 1 for an overview of how the set of indicators has evolved over time.

A guiding principle for the Report Card is to align the data with existing monitoring programs so the scores are based on the best available data, the calculations reflect the most relevant expert knowledge, and we do not duplicate any analysis efforts. To that end, we are coordinating with relevant California state agencies and departments (e.g. with the Department of Fish and Wildlife regarding the indicators for kelp, fish, fisheries, and economy and the California Office of Environmental Health Hazard Assessment on their climate change indicators), and with other organizations that produce summary reports on marine ecosystems, such as the National Oceanic and Atmospheric Administration's Integrated Ecosystem Assessment (NOAA IEA), the National Marine Sanctuaries Condition Reports, and the Aquarium of the Pacific. Several NOAA IEA scientists are contributing to indicators for fish, ocean warming, and ocean acidification. The Aquarium of the Pacific released its marine species report card in February 2025, and members of their team are contributing to the fish and bird indicators for the California Report Card.

Expert working groups for each indicator (see list of indicators, p. 6) are charged with developing metrics and calculating scores for each indicator, including:

- deciding how to assign status and trends (i.e. timeframe for historical reference points);
- identifying data sources; and
- producing key deliverables, including calculated scores, key messages, a 2-pager, and a technical report.

Working group members come from more than 50 institutions, including UC and CSU campuses, state and federal agencies, and non-profit organizations. Group membership is designed to include diversity in expertise, sector, and geography, and we leverage the expertise of existing scientific groups wherever possible. Some working groups include knowledge holders from California Native American tribes and tribal communities.

The complete 2025 California Coast & Ocean Report Card will be delivered in December 2025. This will include a report card with final scores for all indicators, plus 2-page handouts for each indicator that provide more detail on the score and data (see Exhibit C for an example of the 2-page handouts). Additionally, each indicator will have a technical report of the methods and a public data repository.

Timeline

Timing	**Activities**	**Status**
2020	The OPC Strategic Plan sets a target of releasing a Report Card by 2025 that utilizes a scientific, indicator-based approach to grading the State of California's Coast and Ocean	Completed
2023	OPC Science Advisory Team convenes to generate recommendations for an ocean report card	Completed

Timing	Activities	Status
March 2024	OPC executes contract with OST to develop the Coast and Ocean Report Card	Completed
Summer - Fall 2024	Convene first set of working groups: kelp, HABs, mammals, fish, birds, economy, equity, coastal access, OA	Completed
Oct - Nov 2024	Public Input	Completed
Early 2025	Enact contracts for technical analyses	In Progress
March 2025	Present draft at Council Meeting Finalize Indicators	In Progress
March - Sept 2025	Continue working on indicators and analysis Convene remaining working groups (fisheries, beaches, sea level rise, coastal flooding, warming) Establish partnerships and processes for data and report card repeatability	In Progress
Summer 2025	Synthesis and Design	Future
Dec 2025	Final 2025 Report Card	Future

Public Input

In the fall of 2024, we launched a public outreach campaign targeting interested members of the public, including monitoring programs, community science groups, and frontline organizations, to receive 1) feedback on the draft set of indicators and 2) suggestions of datasets and subject matter experts. There were two parts to the public outreach: a web survey and a series of public webinars with time for Q&A. The survey was distributed to the OPC listserv and via OST networks.

We received 39 responses via survey and email from small and large NGOs, industry representatives (e.g. fishing, aquaculture, and marinas), and state and federal government agencies. Most suggestions were about indicators that should be added, while others were about eliminating, combining, or revising existing indicators. The top suggestions to add were:

- Fisheries
- Invertebrates
- Sandy beaches and/or dunes
- Aquaculture
- Cultural Resources

There were multiple comments and questions about how the indicators were organized and what the ultimate purpose of the report card was, i.e., if any specific actions would be taken based on the scores. For example (comments paraphrased):

- The biodiversity category was confusing because it included both organisms (e.g. kelp, fish, birds) and habitats (e.g. wetlands, rocky intertidal).
- Sea level rise appeared too many times. It was originally proposed to be separate indicators of the physical sea surface change, planning for that change, and impacts of that change on people. Comments recommended that it be a single comprehensive indicator.
- How often will the report card be updated? Will the data be publicly available?
- Is there any funding set aside for monitoring?
- A reminder to please ensure the north coast is included on equal standing with the more populated central and southern parts of the state.

Key changes to the Report Card as a result of public input:

- A separate Fisheries indicator was added; previously, fisheries were part of the Coastal Economy indicator.
- Aquaculture will be considered as part of the Coastal Economy indicator.
- We are pursuing a Beaches/Dunes indicator.
- The Biodiversity category has been renamed Ecosystems, indicating that it covers both organismal groups and habitats.
- The approach to sea level rise was refined to focus on sea level rise planning. Coastal flooding is added as an indicator.
- The Report Card will display a single statewide score for each indicator. Indicators may also include sub-scores by geographic region, if appropriate, to highlight important differences between the northern, central, and southern regions.

Tribal and Environmental Justice Advisory Board Input

Coordination with Tribal staff is guided by OPC Tribal Liaison Michael Esgro. We have connected with staff from environmental or natural resources departments of California Native American Tribes across the state. Multiple staff from different Tribal governments have provided input through written responses, informal meetings, and joining several expert working groups (e.g. fish, birds, economy). As the Report Card continues to develop, we will maintain communication with Tribes and actively seek input at key decision points.

We met twice with the Environmental Justice Advisory Board (EJAB), in August and in November 2024, to get advice on how to incorporate equity content in the Report Card. The EJAB acknowledged the challenges of scoring coastal equity, which is complex, multidimensional, and varies widely by community and geography. However, their overall resounding message was that, despite this challenge, equity should be clearly visible in Report Card, even if it is not scored. Since equity intersects with many of the Report Card indicators, EJAB members provided useful guidance in equity dimensions of other categories. That advice is reflected in the current approach to including equity in the Report Card, namely having equity dimensions woven through other indicators. EJAB members suggested data or case studies to include, and these suggestions will be incorporated in the final

product. Members of the EJAB also supported our efforts by sharing with their networks our request for public input and general information about the report card.

Indicators

There are 13 indicators in the 2025 Report Card:

1. Kelp
2. Mammals
3. Birds
4. Fish
5. Fisheries
6. Beaches
7. Coastal Access
8. Sea Level Rise (SLR) Planning
9. Beach Water Quality
10. Harmful Algal Blooms (HABs)
11. Ocean Acidification (OA)
12. Warming
13. Coastal Flooding

Additionally, information on Ocean Economy and Coastal Equity is evaluated and incorporated throughout the Report Card, but neither category is scored as a standalone indicator. Instead, these areas are treated as cross-cutting content that intersects with multiple other dimensions of the coastal and ocean system. Both topics are being developed by expert working groups using the best available data.

This list was developed through an iterative process of expert input, public input, and discussions among OPC and OST staff based on what is relevant, feasible given available data, and meaningful to the public and to decision-makers. This list does not represent a comprehensive or ideal list of indicators, but rather what is possible with available data. This list evolved from an initial list of 42 indicators suggested as possibilities by the OPC Science Advisory Team.[1]

Please see the Appendix for an accounting of how and why the list of indicators was revised (Table 1) and a summary of each indicator, including a description, approach for scoring, data sources, and working group members.

Report Card Design Concept

This is the first draft design concept for the Report Card. Examples of the 2-page handouts that will be produced for each indicator are available in Exhibit C. In the Report Card design

[1] Read the full report, *Establishing Science-based Indicators for California's Oceans and Coasts*, at https://opc.ca.gov/wp-content/uploads/2024/02/SAT-Indicators-Recommendations-Report-January-2024-508.pdf

concept, please note that **all colors shown for indicators are for illustrative purposes only and do not represent actual scores.** In the 2-page handouts for kelp and HABs, scores are final, though text is subject to revision.


DRAFT - Indicator Colors Shown for Design Purposes Only
2025 CALIFORNIA OCEAN & COAST REPORT CARD
ECOSYSTEMS
Aspects of ecosystem health tell us how the system is doing, where we need to take action, and whether management is effective.
Fish
1 sentence description
Birds
1 sentence description
Kelp
1 sentence description
Mammals
1 sentence description
Beaches
1 sentence description
COMMUNITIES
How people are using the ocean as a resource, ecosystem functions, and relevant equity considerations.
Fisheries
1 sentence description.
1 sentence equity consideration.
Coastal Access
1 sentence description.
1 sentence equity consideration.
Sea Level Rise Planning
1 sentence description.
1 sentence equity consideration.
DEMO ONLY


DRAFT - Indicator Colors Shown for Design Purposes Only
2025 CALIFORNIA OCEAN & COAST REPORT CARD
STRESSORS
Stressors help us understand what is driving change in the system and where we can intervene.
Coastal Flooding
1 sentence description
Warming
1 sentence description
Acidification
1 sentence description
Harmful Algal Blooms
1 sentence description
Beach Water Quality
1 sentence description
HOW TO READ THIS REPORT CARD
The color of each symbol indicates 2024 Status, which compares current conditions to the past 40 years. This information was assessed through distinct methods based on the indicator itself. To learn more about the science behind a specific indicator, please contact NAME at EMAIL.
2024 STATUS
Meeting Expectations
Below Expectations
Far Below Expectations
CALIFORNIA OCEAN SCIENCE TRUST
This report is part of the California Coast and Ocean Report Card, developed through a partnership between the Ocean Protection Council, the Ocean Science Trust, and the West Coast Ocean Alliance.
Learn more at URL
DEMO ONLY

Appendix: Indicator Information

Table 1. Evolution of the set of Report Card indicators.

Initial List from SAT (42)	**Revisions**	**Final List of Indicators** (13)
Kelp	*None*	1) Kelp
Marine Mammals	*None*	2) Mammals
Seabirds	*Change to "birds" to be more inclusive.*	3) Birds
Fish	*None*	4) Fish
Sandy Beaches	*None*	5) Beaches
Open Water	*Delete; lower priority; overlaps with other indicators*	
Rocky Intertidal	*Include in future report cards* *Insufficient data*	
Seagrass	*Include in future report cards* *Insufficient data*	
Wetlands & Estuaries	*Include in future report cards* *Insufficient data*	
Bays & Estuaries	*Information on bays and estuaries are included in other indicators*	
Benthic Fauna	*Delete; lower priority*	
Rocky Reefs	*Delete; lower priority; overlaps with other indicators*	
Soft Bottom	*Delete; lower priority*	
Inverts	*Delete; lower priority; overlaps with other indicators*	
Beach Water Quality	*Include in future report cards* *Insufficient data*	
Educational Activities	*Delete; insufficient data; lower priority; overlaps with other indicators*	
Cultural and Spiritual Activities	*Delete; insufficient data*	
Coastal Access	*None*	6) Coastal Access
Commercial Fisheries	*None*	7) Fisheries
Ocean Employment	*Incorporate in Ocean Economy*	8) Ocean Economy
Tourism	*Incorporate in Ocean Economy*	

Initial List from SAT (42)	**Revisions**	**Final List of Indicators** (13)
Rec Fisheries	*Incorporate in Ocean Economy*	
Aquaculture	*Incorporate in Ocean Economy*	
Ports	*Incorporate in Ocean Economy*	
Coastal Communities	*Incorporate in Ocean Economy*	
Energy	*Incorporate in Ocean Economy*	
Recreational Activities	*Incorporate in Ocean Economy*	
Scientific Research Investments	*Delete; insufficient data*	
HABs	*None*	9) HABs
Ocean Acidification + Hypoxia	*Insufficient data for hypoxia* *No revisions to OA indicator*	10) OA
Ocean Warming	*None*	11) Warming
Sea Level Rise (SLR) Planning	*None*	12) SLR Planning
SLR + SLR Impacts	*Information will be included with SLR Planning, not a separate indicator*	
Marine Debris	*Include in future report cards* *Insufficient data*	
Toxins	*Delete; lower priority*	
Invasive Species	*Include in future report cards* *Insufficient data*	
Wastewater Discharge	*Delete; overlaps with other indicators*	
Upwelling	*Delete; lower priority*	
Coastal Runoff	*Delete; overlaps with other indicators*	
Desalination	*Delete; lower priority*	
Coastal Cloudiness	*Delete; lower priority*	
Coastal Flooding	*None*	13) Coastal Flooding

Indicator Information

The following section describes the information used to score each indicator, including how the metric is defined and measured, data sources, and a list of subject matter experts involved.

1. Kelp

The kelp indicator assesses the amount of two canopy-forming kelp species, bull kelp and giant kelp. It relies on remotely sensed data of kelp canopy at the sea surface along California's coastline.

What is Kelp?

- Kelp is a large, brown seaweed that grows in shallow, nutrient-rich waters. Common characteristics of kelp are their structure, which includes a holdfast (root-like structure), a stipe (stem-like structure), and fronds (leaf-like blades).
- Kelp is known for its fast growth rate and can grow in dense mats or develop canopies that provide important habitats for marine life.
- Kelp forests support a wide variety of marine species, including fish, invertebrates, marine mammals, and birds.

Kelp status is based on the current canopy coverage, and is assessed relative to historical expectation. Historical expectation is defined as the median canopy coverage from all years for which data is available prior to 2014.

Kelp trends are assessed as the long-term linear trend in canopy coverage from the full extent of the available data, typically 40+ years.

Data Source

The indicator relies on satellite imagery from the Santa Barbara Coastal Long Term Ecological Research site (SBC LTER).[2] This dataset dates back to 1984.

Indicator Authorship

The first step in the development of the kelp indicator was a regional sub-group that met quarterly during 2022 to evaluate available datasets and recommend data types best suited for a coast-wide kelp indicator. The members of this group included Ed Parnell (Scripps Institution of Oceanography), Tom Bell (Woods Hole Oceanographic Institution), Jan Freiwald (Reef Check), Mark Hess (Ocean Imaging), Mike Lyons (MBC

[2] The time series of quarterly NetCDF files of kelp biomass in the canopy from Landsat 5, 7, and 8 is available at https://sbclter.msi.ucsb.edu/data/catalog/package/?package=knb-lter-sbc.74.

Aquatic), Ami Latker (City of San Diego), Shelly Walther (City of Los Angeles), and Christina Frieder (SCCWRP), and Steve Weisberg (SCCWRP).

In the summer of 2023, a broader expert group was formed to conceptualize the Kelp Indicator. The group met in person for a 3-day workshop in September 2023. Over the following year, the group continued to meet remotely quarterly to refine the methodology. The expert group reconvened in person for a 2-day workshop in October 2024 to finalize the Kelp Indicator. This group continues to meet remotely on a monthly basis to finalize products for the Report Card and the WCOA Dashboard.

Benjamin Grime, The Nature Conservancy
Christina Frieder, Southern California Coastal Water Research Project
Danielle Claar, Washington State Department of Natural Resources
Ed Parnell, Scripps Institution of Oceanography
Eric Nielsen, Portland State University
Helen Berry, Washington State Department of Natural Resources
Henry Houskeeper, Woods Hole Oceanographic Institution
Jan Freiwald, Reef Check Foundation
Kate Cavanaugh, University of California Los Angeles
Kyle Cavanaugh. University of California Los Angeles
McKenna Gray, Washington State Department of Natural Resources
Pike Spector, Ocean Protection Council
Sara Hamilton, Oregon Kelp Alliance
Scott Marion, Oregon Department of Fish and Wildlife Marine Resources Program
Tom Calvanese, Oregon Kelp Alliance
Tom W Bell, Woods Hole Oceanographic Institution
Tristin McHugh, The Nature Conservancy

2. Mammals

The marine mammals indicator assesses the populations of marine mammals in California waters.

Marine mammal status is a composite score based on marine mammal population assessments and stranding counts. The scores for populations and strandings are combined into a single score for status. There may be subscores to reflect variations in regions (north, central, southern) and species ranges.

Marine mammal trend calculation is under discussion with the workgroup.

What species are included?

- All marine mammal species that live in or pass through state waters (within 3 miles of shore) for which there are population assessments.
- *Included:* Pinnipeds, cetaceans, and sea otters

Important Points

- Marine mammals are sentinels of ocean health. Changes in mammal populations, or increases in stranding events, provide insights into ocean stressors such as climate change, pollution, harmful algal blooms, and wildlife diseases.
- There are more than 25 species/stocks of marine mammals in California. For some of these species, it is difficult to derive accurate population estimates, so these species/stocks may not be represented in the Report Card.

Data Sources

The data comes from multiple sources that are deemed reliable with good spatial and temporal coverage, including:

- NOAA Fisheries Marine Mammal Stock Assessment Data
- NOAA Fisheries Marine Mammal Stranding Report-Level A Data
- US Fish and Wildlife Service Stock Assessment Data

Working Group Members

Frances Gulland, Marine Mammal Commission
Sue Moore, Marine Mammal Commission
Sarah Wilkin National Marine Fisheries Service
Karin Forney, National Marine Fisheries Service
Alex Curtis National Marine Fisheries Service
Kerri Danil, National Marine Fisheries Service
Justin Greenman, National Marine Fisheries Service
Clarissa Anderson, Southern California Coastal Ocean Observing System
Henry Ruhl, Central and Northern California Coastal Ocean Observing System
Thomas Farrugia, Alaska Ocean Observing System
Terra Kelly, Eastern Pacific Marine One Health Coalition
Jacki Shaff, Eastern Pacific Marine One Health Coalition
Alissa Deming, Pacific Marine Mammal Center
Lian Hortensius, The Marine Mammal Center
Jessie Huggins, Cascadia Research Collective
Jim Rice, Oregon State University

3. Birds

The primary bird indicator assesses annual population variability for a suite of indicator species (20 or more) that represent the diversity of coastal and offshore seabirds in California.

What is a seabird?

- The Report Card uses the term “bird” because seabird refers specifically to species that are adapted to spend most, or all, of their lives on the ocean. Coastal birds and shorebirds are broader groups that live in or are dependent on the coastline, intertidal zone, and wetlands.
- The Bird indicator broadly includes all ocean-dependent species, including seabirds, coastal birds, and shorebirds.
- Migratory species, such as sooty shearwaters, are included if they rely on California ocean waters for part of their lives.

Bird status is based on change relative to the long-term mean value for each indicator species. Status is calculated from abundance or densities based on seasonal shipboard surveys of seabirds at sea (e.g., CalCOFI). Threshold of change is defined by standard deviations above and below mean values, where average scores are within 1 standard deviation of the mean value for each species.

Two secondary indicators support the interpretation of the primary indicator for both locally-breeding and migratory species:

- Productivity, based on long-term monitoring of breeding success (chicks fledged per female) at colonies (e.g. Channel Islands)
- Mortality, based on surveys of dead birds on beaches (e.g. COASST)

Bird trend is based on population change over 10-year and 20-year periods.

Which species are included? *subject to data availability

- Rhinoceros Auklet
- Cassin's Auklet; *Species of Special Concern*
- Marbled Murrelet
- Common Murre
- Pigeon Guillemot
- Western Gull
- California Gull
- Heerman's Gull
- California Least Tern
- Caspian Tern
- Elegant Tern
- Red-necked Phalaropes
- Red Phalarope
- Western Snowy Plover, *Species of Special Concern*
- Black Oystercatcher
- Brandt's Cormorant
- Pelagic Cormorant
- Double-crested Cormorant
- Brown Pelican
- Black-footed Albatross
- Sooty Shearwater
- Leach's Storm-Petrel, *Species of Special Concern*
- Ashy Storm-Petrel, *Species of Special Concern*
- Surf Scoter, *Species of Special Concern*
- Scaup
- Bufflehead
- Canvasback
- Redhead, *Species of Special Concern*
- Common Raven

Data Sources

These data come from multiple sources that are deemed reliable with good spatial and temporal coverage, including:

Density at Sea

- CalCOFI (Farallon Institute)
- RREAS (Farallon Institute)
- ACCESS (Point Blue)

Productivity

- Farallon Islands (Point Blue)
- Channel Islands (California Institute of Environmental Studies, CINP)
- Bolsa Chica (CDFW)

Mortality

- Beached Bird Surveys (CA Marine Protected Areas, COASST)

Working Group Members

Dan Robinette, Point Blue
Jaime Jahncke, Point Blue
Javier Silva, Sherwood Valley Band of Pomo Indians
Jeannette Zamon, NOAA
Josh Adams, USGS
Pete Warzybok, Point Blue
Pike Spector, OPC
Scott Shaffer, SJSU
William Sydeman, Farallon Institute

4. Fish

The fish indicator assesses the populations of all marine fish species living in California waters. The score is based on the proportion of species with high abundance and steady or increasing change over time. This is an ecological indicator of fish, not fisheries. The Report Card includes a separate fisheries indicator that addresses the human dimensions of fisheries.

Fish status is based on current relative abundance (high, medium, low, unknown/no data) and whether populations are consistent with management targets.

Fish trend is based on population changes over at least the last 10+ years and the last 20+ years where data are available. Species with increasing or stable trends receive higher scores; species with declining trends receive low scores.

What species are included? **subject to data availability*

- All marine fish that live in or pass through state waters (within 3 miles of shore)
- *Included*: pelagic species, such as tunas, that live mostly offshore but spend significant time in state waters

- *Included*: salmon and other anadromous fishes that spend part of their lives in the ocean and part in freshwater
- *Not included:* cryptic and rare species
- *Not included:* invertebrates such as crabs, lobsters, and market squid

Important Points

- There are over 600 species of marine fish in California. For many of these species, there are no reliable population data, so they will not be represented by the Report Card.
- There are subscores to reflect variations in regions (north, central, southern) and taxonomy.
- The fish section highlights the status and trends of species vulnerable to stressors such as climate change, habitat loss, and fishing pressure.

Data Sources

The data comes from multiple sources that are deemed reliable with good spatial (statewide or near statewide) and temporal coverage (>10 years of data), including:

- NOAA Stock Assessments
- MPA Monitoring Data (including programs that contribute, e.g., PISCO, CCFRP, etc.)
- CalCOFI
- Rockfish Recruitment and Ecosystem Assessment Survey (RREAS)

Other monitoring programs with smaller spatial coverage or fewer species will be used as needed to fill in gaps in statewide programs, e.g.

- NOAA Coastal Pelagic Surveys (CPS)
- NOAA Groundfish Bottom Trawl Survey (GBTS)
- NOAA Southern California Bight Rockfish Hook and Line Survey
- Los Angeles County Sanitation Districts Ocean Monitoring Survey

Working Group Members

Larry Allen, CSU Northridge
Lyall Bellquist, SIO
Katie Cieri, OPC
Jeremy Claisse, Cal Poly Pomona
John Field, NOAA / UC Santa Cruz
Chris Free, UC Santa Barbara
Scott Hamilton, SJSU
Andrew Leising, NOAA
Marisa McGrew, Wiyot Tribe
Erin Satterthwaite, CalCOFI & California Sea Grant, SIO, UCSD
Javier Silva, Sherwood Valley Band of Pomo Indians

5. Fisheries

The fisheries indicator describes how California's commercial fisheries are doing. The focus is on the human dimensions of the fisheries, because a separate fish indicator assesses the population status of many commercially important fish species.

Fisheries status is based on commercial landings and revenue and diversity of permits or landings.

Fisheries trend is based on how landings, revenue, and diversity have changed in the last 5 years.

Additional Information

- Market squid, Dungeness crab, salmon, and lobster dominate California's commercial fisheries by both weight and value of landings.
    - The state manages the fisheries for market squid, Dungeness crab, and lobster
    - Salmon fisheries are jointly managed by state (CDFW) and federal agencies (NOAA, Pacific Fishery Management Council)
- Around 11,3000 people are employed in the commercial fishing sector, but this figure is an underestimate because most commercial fishers are self-employed (i.e. not tracked in government employment numbers). Employment in commercial fisheries has been declining in recent years.
- Fishery closures and disaster declarations are meaningful measures of how a fishery is doing and whether commercial fishing provides a reliable source of income.

Data Sources

- Enhanced species reports for state-managed fisheries (CDFW)
- Stock assessments for federally managed fisheries (NOAA)
- Commercial fisheries data in the Marine Fisheries Data Explorer (CDFW)
- California Current Integrated Ecosystem Assessment (NOAA)

Experts involved in Indicator Development

Elliot Hazen, NOAA
Cyndi Dawson, CDFW
Jameal Samhouri, NOAA
Chris Free, UCSB

6. Beaches

The beaches indicator assesses the amount of sandy beaches and dunes along California's coast. **Status and trend** are scored based on changes over time in beach area.

- Beaches and dunes are valuable ecologically, culturally, and economically. More beach area provides space for tourism and recreation, shoreline protection from waves and storms, and habitat.
- Beach area naturally fluctuates due to erosion and accretion driven by winter storms and nearshore sand supply. Humans affect natural beach variability with beach management activities such as sand replenishment and building groins and jetties.

Potential Data Sources

- Coastal Dune Science Network inventory of coastal dunes
- Shoreline retreat rates monitored by satellite (USGS)
- Coastal cliff erosion rates (SIO Coastal Processes Group)

Experts Consulted in Indicator Development

Charles Lester, UCSB
Phil King, SFSU
Kiki Patsch, CSU Channel Islands

7. Coastal Access

The coastal access indicator assesses physical public access along the California coastline.

Coastal Access status is based on the percentage of shoreline miles within a quarter mile of a public access opportunity. One-quarter of a mile is generally considered walking distance to parks and other facilities.[3]

Coastal Access trend is based on the percent change in the number of additional public beach access points documented and promoted by the California Coastal Commission since its final paper publication in 2014 within each of the three major regions in California.

Important Points

- Thirty-nine percent of California's coastal shoreline is within ¼ mile of public access. Southern California has the highest percentage of accessible shoreline (61%), while Northern California has the lowest (25%). The shoreline mileage not open to the public due to military land ranged from 4.4% to 13.1% and is highest in Central California and lowest in Northern California.

[3] Wolch, J., *et al*. (2005). Parks and Park Funding in Los Angeles: An Equity-Mapping Analysis. *Urban Geography*, 26(1), 4–35. https://doi.org/10.2747/0272-3638.26.1.4; Boone, C. G., *et al*. (2009). Parks and People: An Environmental Justice Inquiry in Baltimore, Maryland. *Annals of the Association of American Geographers*, 99(4), 767–787. https://doi.org/10.1080/00045600903102949; Christensen, J., and King, P. (2017) Access for all: A new generation's challenge on the California coast. *Summary Statistics from Beach Intercept Surveys Conducted in Southern California in Summer 2016*. Institute of the Environment and Sustainability, UCLA. https://www.ioes.ucla.edu/project/coastal-access-california

- Thirty percent of California's shoreline is not open to the public and is suitable for more access infrastructure.
- This indicator measures only physical access. An additional and important consideration for equity is perceived or meaningful access to the coast, such as whether certain groups feel welcome in coastal spaces and whether people feel safe getting to the coast (e.g., safe and reliable transportation).

Additional Information

The shoreline was classified into one of three categories: (1) public beach access, (2) no public beach access due to lack of nearby access points or private property, or (3) not open to the public. The "not open to the public" category was divided into three sub-categories: inaccessible geomorphology (e.g., rocky cliffs or wave-cut platforms), military land use, and other land uses (e.g., reserves, research sites, storm damage, and access stewardship loss).

Data Sources

- California Coastal Access Inventory, California Coastal Commission
- California Coastal Trail, Beach or Shoreline Access, California Coastal Commission
- California State Park Entry Points, California Natural Resources Agency
- California State Park Parking Lots, California Natural Resources Agency
- Shoreline Length and Sediment Type, NOAA, Office for Coastal Management
- Military Airports, California Department of Transportation
- Military Bases, National Transportation Atlas Database
- Military Use Zones, California Military Land Use Compatibility Analyst

Current Collaborators; formal working group establishment is in progress

Laura Bliss (Lead), West Coast Ocean Data Portal
Linda Locklin, California Coastal Commission
Tanya Haddad, Oregon Coastal Management Program

8. Sea Level Rise Planning

The sea level rise planning indicator assesses California's progress in planning for sea level rise.

Sea level rise planning status is the percentage of land within each coastal district that is covered by an updated local coastal plan (LCP) and a sea level rise adaptation plan. The score can range from 0-100%.

Sea level rise planning trend is how the status has changed in the past five years.

The rate of sea level rise, and how this rate has changed, is included for context but is not part of the score.

9. Beach Water Quality

The beach water quality indicator assesses how frequently California's beaches meet water quality standards for swimming and other recreational use.

Beach water quality status is based on the number of beach days that meet water quality standards for recreational use.

About Beach Water Quality

When certain bacteria are present in sufficient concentrations, they pose a health hazard for swimming. Statewide, county health officers issue warnings when certain kinds of bacteria are found in the water at levels that exceed standards set by the Department of Health Services. Water that exceeds those standards poses health risks to beachgoers.

Data Sources

- Beach Watch (State Water Resources Control Board)
- Heal the Bay

10. Harmful Algal Blooms (HABs)

The harmful algal blooms (HABs) indicator assesses HAB impacts in California waters. This indicator considers HAB impacts in two ways. First, the indicator considers the impacts of HABs on bivalve shellfisheries by examining the proportion of available harvest days impacted by biotoxin advisories. Second, the indicator considers the impact of HABs on marine mammal populations by looking at stranding events linked to HAB toxin exposure.

HABs status is based on shellfish closures and marine mammal strandings within the last year. Individual scores are calculated as the number of coastal counties that experienced shellfish advisories or closures and the number of marine mammal strandings that exceed the historical baseline. The historical baseline year is 2009 for shellfish and 2006 for marine mammal stranding counts. The overall score is the average of the shellfish and stranding scores.

HABs trend is based on short-term (previous 5 years) and long-term (previous 15+ years) changes in the linear trend of shellfish harvest advisories/closures and marine mammal strandings. Increasing trends receive lower scores and declining trends receive higher scores.

What species are included?

- Bivalve shellfish that are monitored for HAB toxins including California mussels, razor clams, oysters
- Adult female California sea lions, adult female northern fur seals, adult female Guadalupe fur seals

- *Does not include* crabs, lobsters, or rock crab

Important Points

- HABs can occur naturally, so the baseline is not set at zero HABs occurring. Instead, changes are assessed relative to the historic record.
- There is concern about increased HAB frequency resulting from human activities. Increases in HAB events can harm the environment and coastal economy.
- Subscores may be reported to reflect variations in regions (north, central, southern) and taxonomy.

Data Sources

The data comes from multiple sources that are deemed reliable with good spatial and temporal coverage, including:

- Bivalve closure notices issued by the California Department of Public Health, California Department of Fish and Wildlife, and California Office of Health Hazard Assessment
- NOAA Fisheries Marine Mammal Stranding Report-Level A Data

Working Group Members

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Melissa Peacock, Salish Sea Research Center, Northwest Indian College

11. Ocean Acidification

The ocean acidification indicator assesses the volume of coastal ocean habitat that is unfavorable for calcification, using data from a combination of mooring buoys and models.

What is Ocean Acidification?

- Ocean acidification is the process by which ocean waters become more acidic due to increased levels of carbon dioxide (CO2) in the atmosphere.
- Acidification, or a reduction in pH, can have significant impacts on marine life, particularly organisms that rely on calcium carbonate to form shells or skeletons, such as mollusks, corals, and some plankton species.

Ocean acidification status is based on the percent of the seawater volume in coastal waters (over the continental shelf) that is unfavorable for calcification. Unfavorable

conditions are estimated from model outputs as the total seawater volume where aragonite saturation state is less than 1. An “average” or “meeting expectations” score is defined as the range of variability during the pre-industrial period. Current-day volumes of unfavorable conditions are scored as beyond or far beyond that expectation, depending on severity.

Ocean acidification trend is based on the change in saturation state compared to pre-industrial conditions. The data are from coastal time series moorings over decade-plus time periods.

Data sources
These data come from multiple sources that are deemed reliable with good spatial and/or temporal coverage, including:

Model outputs
- LiveOcean (UW)
- Regional Ocean Modeling System with Biogeochemical Elemental Cycling (UCLA, SCCWRP)

Ocean Carbon Buoys
- Cha’ba, La Push, WA
- CB-06, Cape Arago, OR
- CCE1, CA
- CCE2, CA

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12. Warming

The ocean warming indicator describes how much coastal ocean waters have warmed based on a combination of sea surface temperature and marine heatwaves. Marine heatwaves are sustained periods of unusually high ocean temperatures that are measured in terms of severity and frequency.

Status and trend are calculated compared to the pre-industrial period.

Data Sources

- California Current Integrated Ecosystem Assessment (NOAA)

- Marine Heatwave Trackers for the California Current and West Coast National Marine Sanctuaries (NOAA)
- Shore Stations Program (SIO)

13. Coastal Flooding

The coastal flooding indicator assesses the susceptibility of California's coastal areas to flooding based on observations of water levels above established flooding thresholds at tide stations across the state.

Coastal flooding status is the number of flooding days this year relative to the past 100 years.

Coastal flooding trend is how the number of flooding days has changed in the last 5 years.

Additional Information Coastal Flooding

- Flooding is exacerbated across daily to annual time scales by tidal extremes (e.g., high tides, spring tides, king tides), storms, and seasonal variability in ocean temperature and salinity, and over multi-annual to decadal time scales by climate variability (e.g., El Nino-Southern Oscillation, Pacific Decadal Oscillation), sea level rise, and long period lunar tides.
- This section may discuss coastal habitats at risk of type conversion due to flooding, such as tidal marshes being drowned and converted to mudflats
- This section may discuss critical infrastructure at risk of flooding, shallow and emerging groundwater, saltwater intrusion, and other SLR impacts, such as mobilizing pollutants from contaminated sites.
- Adapting to sea level rises poses significant costs to coastal communities, such as ensuring resilient infrastructure for working waterfronts, managing threats to public utilities (e.g., wastewater treatment facilities, gas and electric lines), economic losses from fisheries crises, restoring wetlands to protect habitats and communities, and implementing managed retreat for coastal infrastructure. For example, highways 1 and 101 are essential transportation and public access corridors for coastal California, and much of this iconic road is vulnerable to sea level rise.
- The costs of preparing for and responding to sea level rise come with equity considerations. Most of these costs will be borne by local governments, and many coastal municipalities are not wealthy.

Data Sources

- OEHHA Indicators of Climate Change
- U.S. Sea Level Change (USGS, NOAA, NASA, USEPA, USACE, DHS, FEMA, DOD)
- Sea Level Rise Viewer (National Ocean Service)

Experts Involved in Indicator Development

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Justine Kimball, OPC
Charles Lester, UC Santa Barbara
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Coastal Equity

The 2025 Report Card includes equity considerations for many of the other indicators, using distributional equity as an analytical framework.

What is coastal equity?

OPC defines equity as fairness of outcomes for all groups, where no one factor, such as race or gender, can be used to predict outcomes. *Coastal and ocean equity* grew out of the environmental justice movement and focus on the distribution of ocean-related benefits and harms. Coastal equity intersects with other dimensions of equity, including Indigenous rights and stewardship.

Coastal equity is a complex concept that usually includes three main aspects:

1) the recognition of everyone who benefits from the ocean or is impacted by our decisions about how to manage it
2) the establishment of processes and ways of making decisions that include those people
3) making sure that the benefits and costs of ocean management are distributed according to people's needs

Coastal Equity in the Report Card

The Report Card has a 1-sentence quantitative or qualitative statement about equity considerations for each of the following indicators. In addition, the 2-page handouts and technical reports include more detailed information.

- Fisheries: stock status of fish species targeted by subsistence fishers and for cultural uses
    - Cultural, social, and economic importance of subsistence fisheries, including fish, invertebrates, and seaweed.
- Coastal Access: distributional equity of the visitorshed, e.g. demographics of people who utilize coastal access points
    - Explanation of perceived and meaningful access vs. physical access
    - Discussion of intersection with Tribal Stewardship, such as a case study of the new Chumash Heritage National Marine Sanctuary, including the process to establish it, co-management policies, and implications for Tribal stewardship of other marine resources.
- Sea Level Rise Planning and Coastal Flooding: distributional equity, e.g., demographics of people in communities subject to coastal flooding
    - Examples of flooding impacts on disadvantaged communities.

    - Case study of the OPC-funded project for the Wiyot Tribe to integrate Western Science/GIS with Tribal Ecological Knowledge to develop a vulnerability assessment and adaption plan for protecting cultural resources from sea level rise.
    - Cost of SLR adaptation (including flooding, managed retreat, armoring) is mostly borne by local governments, and not all coastal counties are wealthy.
- Beach Water Quality: distributional equity of clean beaches, e.g. demographics of people who live near beaches with good and bad water quality.
    - Procedural equity of how people find out about water quality issues and who is involved in solutions.
    - Discussion of upstream sources and related drivers (e.g. upstream activities that affect beach water quality; past housing discrimination that drives where people live and therefore their exposure to pollution)
    - Case study of water and air quality problems at Imperial Beach
- Ocean Acidification: impacts on shellfish targeted by Tribal and subsistence fishers
- HABs: distributional equity of HABs, e.g. demographics of people living near HAB locations
    - Procedural equity related to how people find out about HAB events and who is involved in solutions
    - How HABs affect shellfish fisheries targeted for subsistence and cultural uses
- Coastal Economy: how income and GDP are distributed

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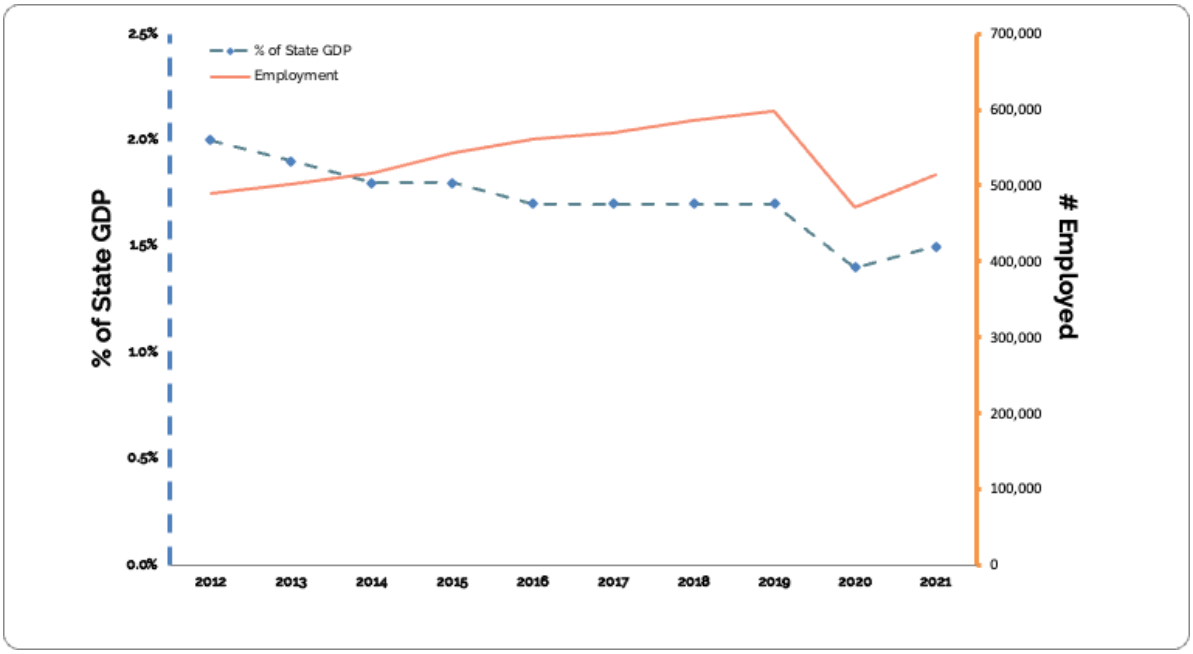
Ocean Economy

California's ocean and coastal resources are vital drivers of the state's economy, worth $51.3 billion and employing over 500,000 people.[4] This represents about 2% of the state's total GDP (Figure 1, below), which is larger than the agriculture sector and similar to national numbers. The ocean economy as a percent of the state's GDP has declined over time only because other parts of the economy are growing more rapidly; the ocean economy itself remains strong.

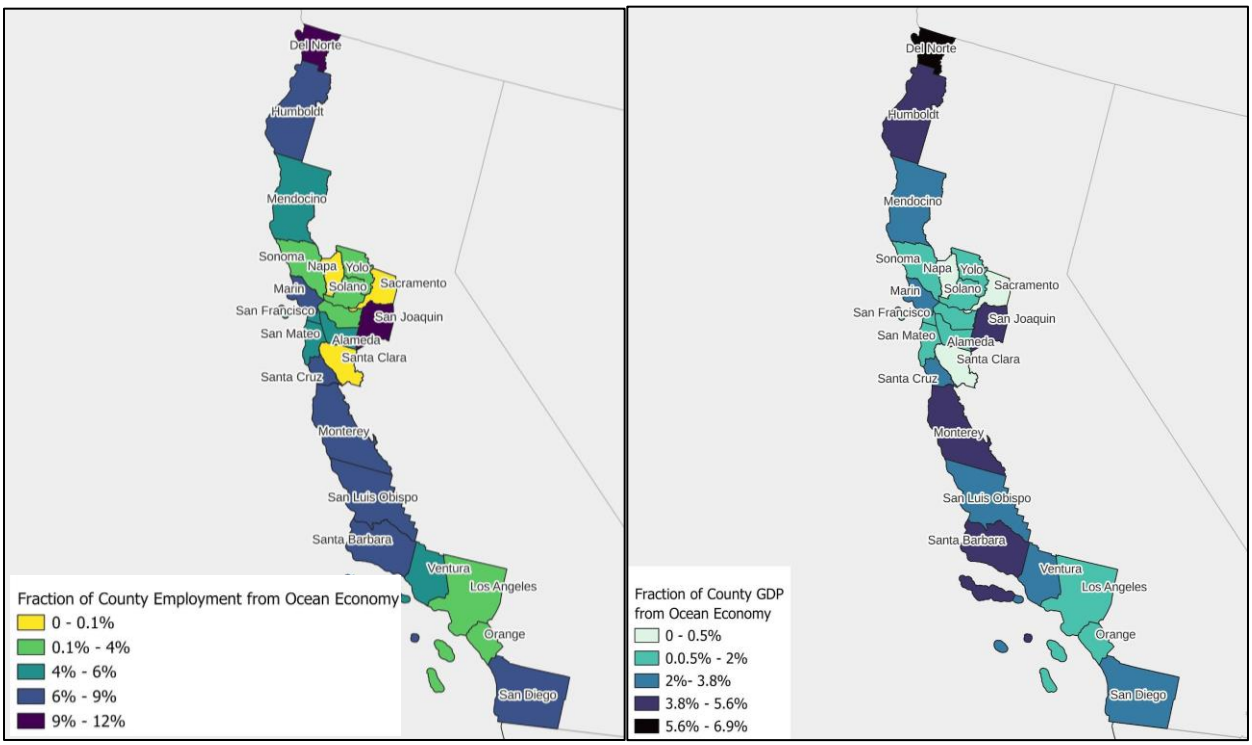
Employment in the ocean economy has grown steadily over the last decade: California gained about 100,800 jobs between 2010-2019, and employment in ocean industries has largely recovered from the significant dip during the COVID-19 pandemic. Most of these jobs are in the tourism and recreation sector, and there has been modest growth in the shipping sector.

[4] 2021 numbers

Notably, these employment figures do not include the fishing industry: most commercial fishers are self-employed, so employment figures are not recorded the same way as other industries. In 2023, there were around 3,000 registered commercial fishing vessels and 5,000 licenses.



The ocean economy is a small fraction of the state's total economy, but it plays an outsized role in more rural counties. In Del Norte and San Joaquin counties, around 10% of all jobs rely on the ocean. In Del Norte, Humboldt, San Joaquin, Monterey, and Santa Barbara counties, more than 5 % of the total GDP is from the ocean economy (Figures 2-3, below). Thus, the importance of the ocean economy varies by region.



The California Coast & Ocean Report Card defines the term ***ocean economy*** as economic activities that depend on the coast and ocean, comprising the following sectors:

1) Shipping and Marine Transportation
2) Tourism and Recreation
3) Fisheries and Living Marine Resources
4) Mineral Extraction
5) Marine Construction
6) Shipbuilding
7) Marine Research and Education
8) Electricity Generation
9) Local Government Spending on Coast and Ocean (infrastructure, parks, planning, etc.)

Just two of these sectors, **shipping and tourism, together account for 89% of the California's ocean economy**. Again, these figures underestimate the true value of the ocean to California's economy because they do not include categories such as real estate, where value is driven by proximity to the coast likely to be quite significant in some counties.

California's Blue Economy

In addition to supporting ocean-dependent industries, OPC is committed to supporting a thriving, sustainable ***blue economy***, which is the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs, all while protecting our state's marine biodiversity, fish, and wildlife. While the terms ocean economy and blue economy are sometimes used interchangeably, here we define the ocean economy to broadly include all

ocean-dependent activities and the blue economy to include only those economic activities that promote or protect ocean health.

The blue economy is a small and growing fraction of California's broader ocean economy and includes activities such as sustainable fishing, the shipping industry's efforts to reduce whale strikes and improve air quality around ports, the development of offshore wind energy to reduce reliance on fossil fuels, and the development of an aquaculture industry that is compatible with wild fisheries and causes minimal harm to the marine environment. There is debate about the sustainability of these industries, but they are part of the blue economy because they support economic growth while minimizing negative impacts and promoting environmental protection.

How Will Climate Change Impact the Ocean Economy?

California's ocean economy is expected to continue growing even as impacts from climate change continue. Variable impacts to sectors of the ocean and blue economies are anticipated with economic winners and losers. Impacts include changes in the intensity and frequency of storms (e.g., waterfront infrastructure damage and repair), sea level rise in some areas (e.g., coastal erosion and remediation), and shifts in the distribution of economically important fish stocks (e.g., which species are harvested and where they are landed).

California will lose beaches due to coastal flooding, shoreline change, and cliff retreat. Geologic beach loss does not translate directly to reduced recreational beach use, because people still go to shrinking beaches, but smaller beaches will eventually lead to a loss in tourism revenue for California's coastal communities and a diminishment of the nonmarket value of these beaches to the millions of Californians who go to our beaches to swim, surf, picnic, and be with family and friends.

Adapting to sea level rises poses significant costs to coastal communities, such as ensuring resilient infrastructure for working waterfronts, economic losses from fisheries crises, restoring wetlands to protect habitats and communities, and implementing managed retreat for coastal infrastructure. Highways 1 and 101 are essential transportation and public access corridors for much of coastal California, and much of this iconic road is vulnerable to sea level rise.

More About the Ocean Economy

Economists have developed other techniques to estimate the value of ocean resources. **Non-market value** is a way to measure the value of "free" resources such as California's beaches. For example, the non-market value of beaches includes the value that beaches provide for things like tourism, quality of life, and property value. The non-market value of all the beaches in San Diego County is over $1 billion per year, and could be more than $10 billion per year for the entire state.

Another approach is **natural capital accounting,** in which ecosystems and the services they provide are valued the same way that physical capital, like buildings, is valued. Investments in ecosystem protection and restoration can be evaluated in terms of returns on investment and contributions to economic growth.

Ocean Economy Working Group Members:

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