



University of Southern California Sea Grant

Strategic Plan

2018 – 2023

(Revised December 2020)

The Urban Ocean Program





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Malibu Lagoon during a king tide

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Redondo Beach Pier during a king tide

About USC Sea Grant

The United States Congress created Sea Grant in 1966 as a federal and state partnership to help fund and coordinate the intellectual capacity of the nation's universities to solve ocean, coastal, and Great Lakes problems. Today, Sea Grant is a national network comprised of 34 university-based programs in coastal and Great Lakes states. Sea Grant is administered and supported by the National Oceanic and Atmospheric Administration (NOAA). It is implemented by leading research universities and represents a unique partnership among states, the federal government, and academic institutions. Sea Grant programs provide scientific expertise and new discoveries that foster the wise use and conservation of the nation's coastal, marine and aquatic resources.

The Sea Grant Program at the University of Southern California (USC) in Los Angeles, California, is unique among the 34 programs in the national Sea Grant network. It is among the smallest, with an annual federal budget of approximately \$1 million. USC is one of the largest private universities in the United States and was one of the original participants in the National Sea Grant College Program, receiving some of the earliest funding in 1969 and officially establishing its Sea Grant program 48 years ago. USC has conducted marine science research and managed established marine laboratories in Southern California for over one hundred years. USC's marine facilities, research programs, marine faculty, and marine and environmental curricula make it one of the major research Universities in the Los Angeles region for ocean studies.

Despite a relatively small budget and staff compared to other Sea Grant programs, USC Sea Grant serves one of the largest (nearly 19 million) and diverse populations in three coastal counties of Southern California (Orange, Los Angeles, and Ventura) and two adjacent inland counties (San Bernardino and Riverside).

Los Angeles County is the most populous and diverse county in the United States, with 10 million residents speaking over 140 languages, making this a prime region to study the effects of urbanization on our coastlines and the impact of the ocean on the urbanized environment. This is especially true in the Southern California culture of "endless summer," which places such a unique value on its beaches and coastal ocean.

Recreational environmental amenities draw over 4 billion dollars in international tourism to the Los Angeles area each year. Los Angeles County is home to the busiest port complex in the United States; close to 45% of all oceanic freight entering the country comes ashore through the twin ports at Los Angeles and Long Beach. Together, these ports contribute more than 1 million jobs to a vibrant economy.

Over the years, USC Sea Grant has established a network of scientists, government agency personnel, private and public sector advisors, and science education leaders. Employing its extensive outreach to partners, collaborators, resource managers, and the public, USC Sea Grant can anticipate research needs and develop responses in a timely and responsive manner, leveraging its collaborations for broader impacts. Further, USC Sea Grant has worked closely with its networks to ensure that its research, communication tools, and education services reach broadly into the diverse Southern California community that it serves, with particular attention to underserved and underrepresented, priority communities.

Vision & Mission

USC Sea Grant contributes to solving the problems of the Urban Ocean while recognizing the opportunities for coastal commerce, recreation, and improving the quality of life in coastal regions such as Southern California. USC Sea Grant solicits and funds relevant, innovative research to help find solutions for pressing coastal management problems that demand science to help resolve issues of the greatest ecological and social importance. USC Sea Grant fosters the public's understanding of the science, so that it motivates better decisions and continues to bring decision-makers, scientists, and the public together to find solutions that are informed by the best available science, accessible and understood by all, and supported by diverse local communities.

Core Values

These core values reflect USC Sea Grant's core strengths and experience, and guide its management and decision-making:

- USC Sea Grant is dedicated to its role as a neutral broker of science that serves the people, wildlife, and ecosystems of such a diverse region.
- USC Sea Grant upholds the highest standards of scientific integrity.
- USC Sea Grant is dedicated to its role of building capacity and connections across people, resources, and knowledge to solve our most pressing problems.
- USC Sea Grant functions as a boundary organization that bridges the gap between science, stakeholders, and policy to support better decisions.
- USC Sea Grant leverages partnerships and collaborations with diverse stakeholders for broader impacts, engaging or collaborating within the minority, underserved, and underrepresented communities, including Native peoples and Tribal representatives, Black, Latinx, and other peoples of color.
- USC Sea Grant is a leader and regional resource for scientific, policy, and educational marine and coastal information.
- USC Sea Grant is responsive to local, regional, state, and national research needs and develops responses in a timely manner.
- USC Sea Grant is dedicated to the full inclusion and participation of individuals from a broad diversity of backgrounds, who bring a range of perspectives, values, knowledge, and tools to bear on major scientific problems.



Barnacle

Cross-Cutting Principles

USC Sea Grant aligns its cross-cutting principles with those of the National Sea Grant College Program. In the course of implementing the 2018-2023 National Strategic Plan, the National Sea Grant College Program will strive to address two specific areas to enhance the Program's capabilities in order to meet national needs:

- Cultivate partnerships by integrating the expertise and capabilities of partners from the international, federal, tribal, and state communities and from academia, non-governmental organizations, local, traditional knowledge, and industry.
- Enhance diversity, equity, and inclusion by seeking and welcoming diverse perspectives to enhance cultural understanding, and enable the network to pursue its vision and mission more innovatively, responsively, effectively, and efficiently.



Lechuza Beach in Malibu

Introduction

A journey down California's 1,100-mile coastline reveals rocky seashores, sandy beaches, and dramatic cliffs that are home to diverse plants, seabirds, and a wide variety of marine life. Offshore islands provide a lens into the history of the California coast and provide protected habitats for both terrestrial and marine species. One can also see superhighways, power plants, concrete river channels, trash, poor water quality, and two of the busiest ports in the United States. USC's location in the middle of Los Angeles has made the Sea Grant Program here an important regional resource, concentrating on issues arising out of the necessity of managing people and natural resources in an intensely populated and developed coastline. For this reason, in the 1980s, the USC Sea Grant program adopted as its programmatic focus the "Urban Ocean," a theme that continues to characterize our perspective on the needs of this region.



Santa Monica State Beach

USC Sea Grant's strategic plan goals for 2018-2023 reflect America's most urgent coastal and ocean needs, NOAA's national priorities, and the National Sea Grant Program's goals, while still addressing the specific needs and priorities of the region and the state. Under the larger umbrella of the urban ocean theme, our program's focus areas are congruent with the National Sea Grant College Program Strategic Plan for 2018-2023 (henceforth referred to as the National Plan) and include Healthy Coastal Ecosystems; Sustainable Fisheries and Aquaculture; Resilient Communities and Economies; and Environmental Literacy and Workforce Development.

50 Years of Progress in the Urban Ocean

The USC Sea Grant Program has grown throughout the years to provide expert guidance, funding, coordination, facilitation, training, education, neutral brokerage, and mediation - all under the common goal of elevating the best available science to support better decisions. For the last 50 years, our research investments, education programs, and extension efforts have supported achievements in several key areas of importance including water quality, harmful algal blooms, toxicology, aquatic invasive species, marine wildlife and ecosystems, ports, marine transportation, coastal management, coastal community resilience, sea level rise, and advances in "K-grey" marine science education. As we look towards the future, we are excited at the array of new ideas, research opportunities, and potential new partners who will help us build sustained, long-term, inclusive progress for our urban ocean and its residents.

The problems found in Southern California are not unique to the region, which is evident by the growing use of the term "urban" in titles for marine and coastal organizations and programs across the country. In addressing the range of issues found here, we will continue to provide information and models serving other urban coastal regions in California, such as the San Francisco Bay and San Diego regions, and other urban coastal environments in the United States and around the world. We consider Los Angeles a city of the future and treat it as an urban ocean laboratory. USC Sea Grant can pioneer solutions for the challenging issues associated with a culturally diverse range of perspectives including access and transportation, language and communications, and economic disparities that characterize urban coasts. These factors are of increasing importance along the steadily developing coastlines of the United States and the world.

Leadership

USC Sea Grant is administered within the USC Wrigley Institute for Environmental Studies (WIES). WIES is an “organized research unit” which administers the Wrigley Marine Science Center on Catalina Island, a world-class marine laboratory and conference facility. The laboratory hosts research and education programs in fisheries and aquaculture, aquaponics, geobiology, and climate change research, as well as leads innovative programs for “K-grey” marine science education and undergraduate and graduate programs in the marine sciences. The laboratory and conference center serve not only USC but are open to the broader marine and ocean science community. Sea Grant serves as a major research component of WIES; often Sea Grant-funded research is conducted at the Catalina facility. A graduate fellowship program is open to all applicants who have a need to conduct their research on Catalina Island and the fellows participate in lifelong learning and other educational and research programs.

WIES is part of the Dana and David Dornsife College of Letters, Arts and Sciences (Dornsife College). Dornsife College is the largest administrative unit at USC and the heart of teaching and research in the Natural Sciences, Humanities, and Social Sciences. The present reporting line from Sea Grant runs from Linda Duguay (Sea Grant Director and member of the WIES Senior Leadership Team (SLT)); to Dr. Joe Árvai, Director of WIES; to Dr. Amber D. Miller, Dean of the Dornsife College; to Dr. Charles F. Zukoski, Provost and Senior Vice President for Academic Affairs; to USC President Dr. Carol L. Folt

This location and reporting structure advantageous for USC Sea Grant for several reasons. First, it is housed in the same university revenue center as most of the academic departments and principal investigators likely to apply for USC Sea Grant support. Second, the close affiliation with WIES provides a symbiotic relationship, providing a solid focus for research, marine science, policy, and education and outreach programs. Furthermore, this close relationship easily allows for collaborative efforts with WIES, such as position sharing and joint research and education efforts.



Wrigley Institute on Catalina Island

In 2015, USC Sea Grant and the Wrigley Institute were co-located in new offices on the main USC University Park campus. In 2016, the Environmental Studies program was also located in the same building. The close proximity on campus of the marine environmental studies research and teaching programs allows for enhanced opportunities for collaboration and student participation.

The USC Sea Grant Program has a clear advantage in having its Director also play an important role in WIES leadership. Because USC Sea Grant is a major research arm of WIES, the Director helps to ensure that results from USC Sea Grant-funded research and outreach are well represented in WIES’ reports to its Advisory Board and supporters. Since its formation in 1996, the Wrigley Institute actively participates to recruit new faculty in various sub-disciplines of marine sciences, particularly in marine environmental biology, geobiology, environmental science, and earth sciences. In addition, the Wrigley Institute supports new fellowships for graduate students, runs a National Science Foundation-supported Research Experiences for Undergraduates (REU) program (a 10-week residential program on Catalina Island), and supports “K-grey” outreach and education programs. The growing cadre of marine scientists fostered by WIES - and a strong institutional commitment to marine sciences - allows USC Sea Grant to foster the work of an expanding group of excellent faculty researchers and students in the pursuit of solutions to local and regional urban ocean problems.

As part of a large research university, we recognize the need for information security going forward, in line with NOAA's Information Technology Security program. USC's information technology infrastructure is protected by an extensive range of cyber and information security protocols, and training is required for all USC faculty and students.

Sea Grant's small staff size allows close cohesion of the range of program elements and an invaluable cross-fertilization of ideas, plans and programming. Research administration, planning, extension, education, and communications efforts combine seamlessly to provide Southern California, state and national constituencies with information and services that are naturally interdisciplinary and coordinated.



Shark research at Catalina Island



Erosion in Malibu from winter storms

Strategic Plan Development

USC Sea Grant developed this Strategic Plan in 2016, with an update in 2020, relying on input from the range of interests and stakeholders at the national, regional, state, and local levels. We surveyed members of our Advisory Council, Academic Coordinators, and the California Natural Resources Agency Sea Grant Advisory Panel (RASGAP), as well as influential stakeholders in the region. Stakeholders included individuals from local and state governments, marine transportation and ports, K-12 and higher education professionals, coastal businesses, university researchers, Native peoples, commercial fisheries (including aquaculture), nonprofit environmental organizations, coastal residents, and communications professionals. Survey responses confirmed that USC Sea Grant's strategic focus areas, program areas, and research priorities are on point and valuable to the region. There was enthusiasm for expanding focus on the connections between freshwater systems, i.e. watersheds, aquifers, etc., and ocean and coastal waterways (see Healthy Coastal Ecosystems section). Survey responses also confirmed the interlinking benefits of USC Sea Grant's programs and outreach efforts across the region. 100% of respondents stated that they had increased knowledge or awareness of ocean and coastal issues as a result of Sea Grant outreach and education programs. A majority of respondents also stated that they gained useful contacts or new partnerships through working with USC Sea Grant, and had increased access to technical assistance, educational resources, and new scientific or management information and tools.

The USC Sea Grant Strategic Plan for 2018-2023 is broad in scope and vision, but with recognition of the constraints imposed by the modest character of our resources. We thus continue to prioritize the elements of our research, extension, and education portfolio in order to focus on the most pressing concerns of the greater urban Southern California region.

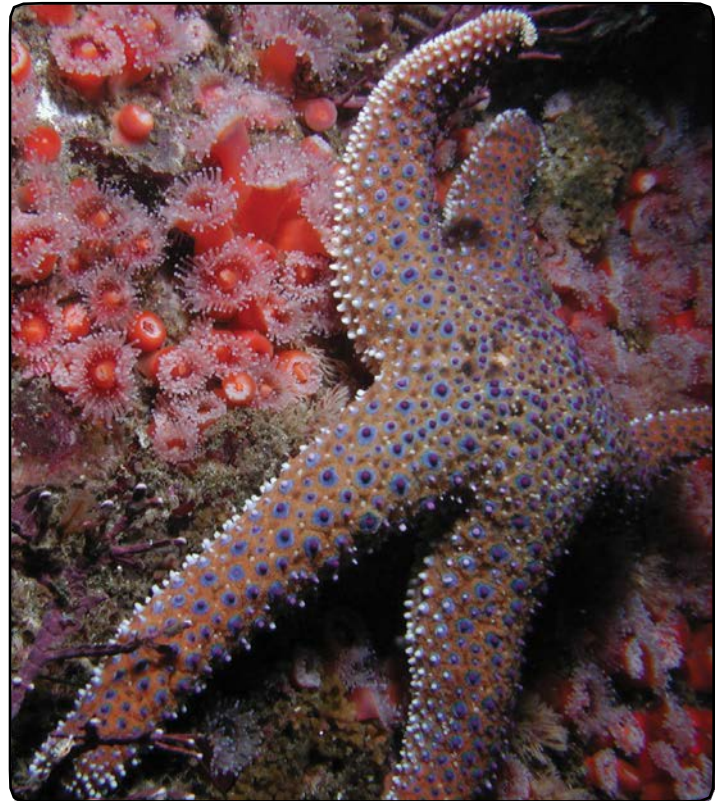
National Perspectives

The National Plan for 2018-2021 states as its mission “to provide integrated research, communication, education, extension and legal programs to coastal communities that lead to the responsible use of the nation’s ocean, coastal and Great Lakes resources through informed personal, policy and management decisions.” This follows closely upon the broad goal of the NOAA to “foster healthy and sustainable marine resources, habitats, and ecosystems through improved management and partnerships.” We intend to contribute to implementing the twin visions in the context of the Urban Ocean environment of Southern California.

The National Plan was developed with input from the state Sea Grant programs, national stakeholder groups, and representatives from NOAA programs, other federal agencies, and nonprofit environmental organizations. The National Plan thus provides the primary context for USC Sea Grant’s plan. For the suite of challenges presented in the Southern California urban coastal region, the USC Sea Grant plan refocuses those priorities, continuing our major emphasis on water quality, coastal ecosystem health, coastal community resilience, and a robust education effort. As part of our resilient communities and economies emphasis, we continue work on changing coastal communities, land use planning and marine transportation and ports, which are particularly important as economic drivers in the Southern California metropolitan region.

We have aligned USC Sea Grant’s major focus areas with the National Plan focus areas, including Healthy Coastal Ecosystems; Sustainable Fisheries and Aquacultures; Resilient Communities and Economies; and Environmental Literacy and Workforce Development. Our plan was developed based on input from the diverse constituencies with whom we work, along with formal input from our Advisory Council, Academic Coordinators, and the Resources Agency Sea Grant Advisory Panel (RASGAP).

Each focus area has goals, outcomes, and performance measures. The goals describe the desired long-term direction for each focus area. The outcomes are benchmarks from which USC Sea Grant can track progress toward achieving each goal. Performance measures are quantitative ways of measuring outcomes. Overall, USC Sea has aligned the goals, outcomes and performance measures for its 2018-2023 strategic plan with the goals, outcomes and performance measures of the National Plan.



Sea Star

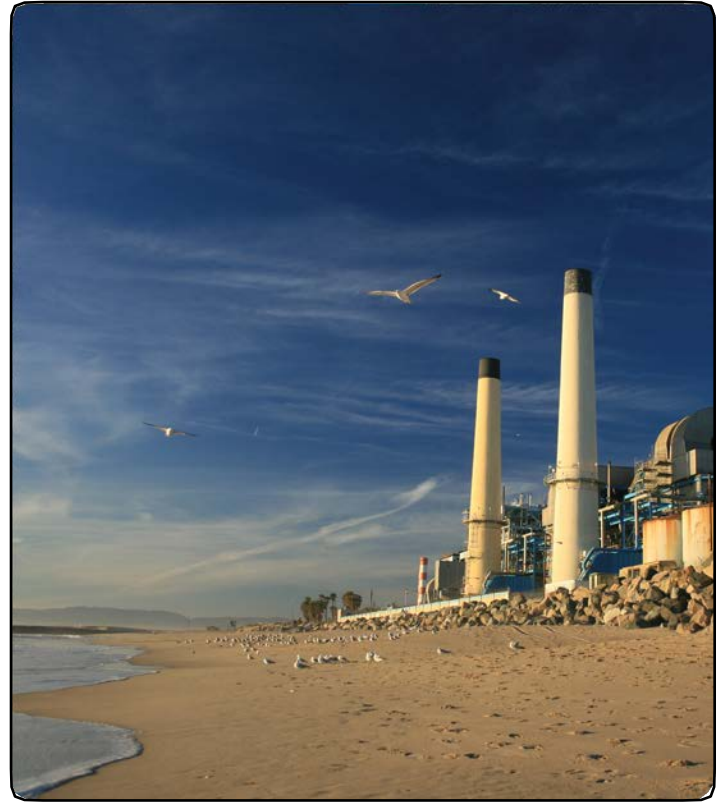
State and Local Perspectives

At the local level, several advisory bodies to Sea Grant are regularly consulted for guidance and strategic planning advice. These are councils on academic research, local, state, and regional research and outreach needs, and educational initiatives. All were consulted in the development of this Strategic Plan and regularly contribute ideas and insight to USC Sea Grant.

USC Sea Grant has an active, diverse, and engaged Advisory Council (Appendix I). Membership of the Council is composed of representatives of public and quasi-public agencies and non-governmental organizations (NGOs) with an interest or stake in Sea Grant’s research, outreach, or education programs. Advisors represent the City and County of Los Angeles, the California Water Resources Control Board, the California Coastal

Commission, the Bay Restoration Commission (part of the EPA National Estuary Program), the Southern California Coastal Water Research Project, public universities, private industry, and others. USC Sea Grant keeps the Council informed about research and outreach progress and consults with members formally on an annual basis. Advisory Council members advise planning and requests for proposal development and often review project proposals in their areas of expertise. Sea Grant staff call upon them informally for program advice on new and existing initiatives, maintaining an ongoing dialogue between the Council and staff year-long, not just through the annual in-person meeting.

Advisors formally reviewed and contributed to this Strategic Plan at its 2016 annual meeting and again in 2020. The dialogue and input from the Advisory Council are vital to the success and relevance of USC Sea Grant's work. The diverse composition of the Advisory Council is analogous to the diversity of the region USC Sea Grant serves. Purposefully, this positions USC Sea Grant's advisors to aid in balancing the focus of our work on issues that require the most immediate need and those that require long-term commitment.



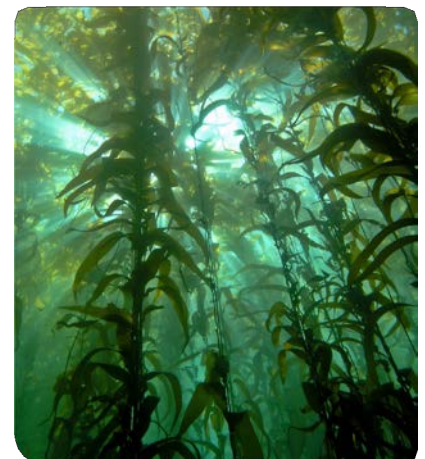
El Porto beach near the El Segundo power plant

USC Sea Grant's Academic Coordinators (Appendix II) come from several academic departments at USC and also includes a representative from the leadership of the California State University System (Vice President for Academic Affairs Emeritus), helping to ensure that a range of scientific disciplines is represented on this committee. The Academic Coordinating Committee contributes to the development of Sea Grant's Strategic Plan and research solicitations, reviews preliminary proposals, and provides input on external research opportunities and other programs.

A third advisory group, RASGAP, is a state panel comprised of representatives from the Departments and Programs within the California Natural Resources Agency, the state agency that provides state matching funds for the two Sea Grant programs in California (Appendix III). The RASGAP panel meets with Sea Grant Directors and Associate Directors twice a year during those years when proposals are being considered – first, for review and ranking of preliminary proposals, and second, after peer and technical reviews have been conducted – to help rank projects in the context of Agency information needs. In years when proposals are not being reviewed, Sea Grant consults members of RASGAP for guidance on emerging state priorities. This open dialogue and collaboration between key state partners and USC Sea Grant helps to calibrate research focus areas. As management needs shift gradually or events occur that require a rapid response, it is crucial to both state agencies and scientist to work cooperatively. In this capacity, USC Sea Grant leverages resources, such as staff time and professional networks, in an effort to support our key focus areas.

The California Ocean Protection Council (OPC) was created in 2004 to ensure that California maintains healthy, resilient, and productive ocean and coastal ecosystems for the benefit of current and future generations.

The Governor-appointed council is charged with providing leadership and coordinating the activities of ocean-related state agencies to better manage ocean resources. The OPC guides California's ocean policy initiatives and provides input for Sea Grant's solicitation of research proposals as well



Kelp forest, photo: Tom Ford

as occasional funding for Sea Grant projects. Sea Grant staff often attend meetings of the OPC in order to stay abreast of new policy directions and to obtain input on the research and outreach Sea Grant can contribute to state management programs. In the OPC's FY2020-2025 Strategic Plan, there are four areas of focus: climate change; coastal and marine biodiversity; equity (underserved communities, indigenous people, environmental justice, coastal access); and a sustainable blue economy (fisheries, aquaculture, sustainable energy, clean ports, eco-tourism). These focus areas overlap with USC Sea Grant's focus areas in this Strategic Plan. Additionally, OPC's Deputy Director oversees the administration of RASGAP, reinforcing active collaboration among USC Sea Grant and high-level State representatives.

USC Sea Grant also maintains close contact with the California Ocean Science Trust (OST), a nonprofit public benefit corporation established pursuant to the California Ocean Resources Stewardship Act of 2000. OST's mission is "to ensure that the best available science is applied to California's policies and ocean management to successfully maintain a healthy, resilient, and productive ocean and coast." OST provides scientific guidance and support for a number of California state agencies, including the OPC. USC Sea Grant has partnered with OST on projects in the past and will continue our collaboration to ensure research priorities are being met in the State.

Regional Perspectives

In 2006 the Governors of California, Oregon, and Washington initiated a collaboration to protect and manage ocean and coastal resources by creating the West Coast Governors' Alliance on Ocean Health (WCGA). USC Sea Grant's Director and Associate Director contributed to WCGA's action plans, which focused on marine debris, climate change, and ocean acidification. Subsequently, USC Sea Grant staff participated on WCGA action coordination teams, which focused on specific issue areas through the West Coast Regional Planning Body (RPB), which continued to work toward common goals to improve ocean and coastal health. In 2016, a new effort began to build upon lessons learned from the WCGA and RPB. The West Coast Ocean Partnership (WCOP) is a state, tribal, and federal body seeking to enhance dialogue and address regional ocean health priorities. The WCOP has identified three regional priorities: Climate Resilient Coastal Communities, Responding to Changing Ocean Conditions, and Improving Ocean Data and Coordination. As the WCOP gains momentum, USC Sea Grant continues to seek active involvement with the WCO.

Finally, USC Sea Grant's lifelong learning ("K-grey") marine education program focused on environmental literacy works closely with the National Marine Education Association, Sea Grant Educators Network, NOAA Office of Education, National Science Teachers Association, University of California Agriculture and Natural Resources (CANR) CA Naturalist Program, Southern California Informal Science Educators, local and county school districts, community-based organizations, informal science education partners, and the Consortium for Ocean Science Exploration and Engagement (COSEE) Education Foundation, an educational clearinghouse that emerged from the grant program funded through the National Science Foundation (originally Centers for Ocean Science Education Excellence now Consortium for Ocean Engagement and Exploration.)



New sea level rise models being shared with the community during an AdaptLA meeting, hosted by USC Sea Grant

A New Lens: Climate Resilience

California has long been a national and international leader in prioritizing research and action on our changing climate. USC Sea Grant will continue to advance scientific understanding of changing ocean conditions and potential impacts to coastal infrastructure and populations and help communities become resilient to storms, sea level rise, shoreline change, and coastal hazards. We will keep in mind that often the communities most at risk when faced with severe weather and climate extremes are those who are traditionally underrepresented in the sciences -- primarily Latinx, Black, Indigenous, and other people of color communities, and those from low socioeconomic communities, with limited resources to commit to adaptation strategies.

Additionally, we undertake work not only on the direct effects of changes to the ocean and coasts, but also on the role of climate as a significant driver of changes in ecosystems and habitats. In all of our focus areas, the changing climate is a lens through which we view the health of coastal ecosystems, the sustainability and resilience of coastal communities and those who work and reside in them, and the production of food resources, both by aquaculture and fishing. In science education, understanding the impacts of a changing climate is already an important dimension affecting all study areas in ocean science.

1 Focus Area: Healthy Coastal Ecosystems



Bioblitz at Pelican Cove MPA

The region known as the Southern California Bight, stretching from Point Conception in the north to south of Tijuana, Mexico, is highly developed – an urbanized coast characterized by nearly uninterrupted commercial and residential development. How do we balance ecological conservation and protection with intensive human uses of a public resource? These questions have always been central to USC Sea Grant’s funded research and outreach along the urban ocean coast. We work towards a healthier urban environment, reflected by cleaner coastal waters that afford better opportunities for recreation and commerce, and the protection of human and ecosystem health.

Looking forward, almost all of USC Sea Grant’s research and outreach on healthy coastal ecosystems will have to take into consideration sea level rise and other threats from a changing climate. It is a new lens through which scientists, managers, and policymakers must view the future; likewise, it is a lens through which USC Sea Grant will consider and implement future research and outreach. In fact, all the research and outreach areas in which USC Sea Grant works within this focus area – water quality, connections between freshwater and saltwater quantity and balance; harmful algal blooms; ecotoxicology and chemicals of emerging concern; aquatic invasive species; marine wildlife populations and health; and habitat restoration – will be affected by changing conditions in the coming decades. USC Sea Grant will support focused observations and studies of long-term trends and effects of oceanic events associated with a changing climate, such as more frequent or intense storms, warmer waters and sea surface warming, sea level rise, and changes in ocean chemistry, particularly ocean acidification.

It is difficult to tell the story of Los Angeles without talking about water, and it is impossible to tell the story of USC Sea Grant without talking about water quality. Indeed, USC Sea Grant has consistently maintained a research focus on water quality, and that will not change in the future. Ensuring that coastal waters are safe for people and marine life has always been a priority for the state and particularly for Southern California. However, the nature of water quality work has shifted over the decades from a focus on sewage and associated bacteria to a focus on stormwater runoff and viruses; the focus will continue to shift as the issues of drought, water conservation, and low impact development all affect coastal water quality. For example, as the region implements mandates to conserve and recycle wastewater, pollutant loads increase per unit volume of water, and the more concentrated flows may be even more damaging to both ecosystems and infrastructure. Issues connected to poor water quality from secondary treatment plants as well as stormwater systems, concentrations of pollutants, brine, and toxins continue to impact coastal waters.

Sea Grant has and will continue to support research aimed at improving the detection limits, tracking, testing-speed, and testing-costs for bacteria, viruses, or other water quality impairments, such as toxins, pharmaceuticals, and marine debris, especially macro- and microplastic pollution. The ubiquity of plastic in today's culture has contributed to it being one of the most serious ocean pollution issues of the 21st century. Eleven million metric tons of plastic enter the oceans every year, entangling wildlife and polluting habitats, particularly beaches, and the cleanup is costly to local communities. There is now plenty of evidence that microplastic debris is being ingested by wildlife, and likely humans who are at the top of the marine food chain, raising questions of long-term human health effects. Located in the largest, urban coastal community in the country, USC Sea Grant is perfectly poised to explore issues of ocean plastic pollution, including pathways, prevention strategies, effects on habitats and wildlife, and ecotoxicology.

Southern Californians have long been aware of the connection between inland contamination reaching coastal waters, but new work needs to focus on how the pathways, frequency, and concentration of contaminants may change with the changing climate's predicted effects on drought. Also, changes in the quantity and quality of freshwater as a result of changing climate may alter the balance and interaction between freshwater inputs and coastal water bodies (i.e. reservoirs, aquifers, groundwater, and estuaries). It is important to understand these changing hydrodynamics and their impacts on coastal water quality.

USC Sea Grant will continue to fund and manage projects that address ecotoxicological issues in order to determine responses of marine organisms to contaminants and pathogens and to develop effective bioindicators of contamination. Globally, wildlife and humans are exposed to increasing quantities and types of persistent industrial and pharmaceutical chemical contaminants and the effects of most of these chemicals on marine organisms (or humans) are unknown. A more scientifically-based understanding of the impacts of contaminants of emerging concern could help agencies and managers to develop water quality objectives in a more ecosystem-based manner by linking endocrine disruption and other important health effects directly to the anthropogenic contaminants causing the disruption. Better technology to detect endocrine disruption or other types of physical stress responses may also be able to help visualize the effects of stress caused by environmental conditions such as increasing temperature and ocean acidification, as well as other chemical and physical changes.

Key Themes

- Urban impacts on ecosystem health
- Beach erosion
- Harmful algal blooms
- Stormwater and wastewater
- Healthy ecosystems and MPAS
- Aquatic invasive species
- Coastal habitats at the land-sea interface (wetlands, estuaries)

Closely linked with pollution and coastal water quality is the growing issue of harmful algal blooms (HABs). Scientists still do not know all of the conditions that trigger a toxic algal species to bloom and produce toxins, but USC Sea Grant has and will continue to invest in projects investigating the biology and ecology of these species and the cascading effects of hypoxia, fish kills, and health threats to marine mammals and seafood resources. USC Sea Grant will support research to develop methods to establish indices of toxicity; to acquire a predictive understanding of massive algal accumulations; and to understand the impacts of HABs on the complex coastal oceanographic processes and changing ocean temperatures and chemistry. As the balance of interactions between fresh and saltwater may shift with a changing climate, it will also be important to examine interactions between freshwater algal blooms and the coastal ocean.

Research is only one piece of the complex HAB-management puzzle. Local informal science centers such as aquaria and museums are often bombarded by questions from the public during visible HAB events, and it is challenging for these institutions to address the complex issues and questions that arise. In response in 2011, USC Sea Grant, in partnership with scientists, informal science centers, and local classrooms, created the community HABWatch program. The program involves students and the general public in data gathering and involves the researchers in workshops and other forms of community education, thereby broadening the reach of USC Sea Grant's science into communities.



Citizen scientists during a bioblitz at Pelican Cove MPA

As we move forward with new ways to engage public interest in science and stewardship, USC Sea Grant aims to become a new hub for shared data and information on HABs, as well as a variety of other marine and coastal issues. In the near future, more citizen science and stewardship programs will use established and approved scientific protocols to gather data and enter it into databases, making that information easily available to students, scientists, and coastal managers, and allowing for broader participation in research science by diverse stakeholders.



Collecting water samples for HABWatch

USC Sea Grant has long focused on aquatic invasive species (AIS), forming national and international partnerships to study, monitor invasive species, investigate potential pathways of introduction, and, finally, develop policies and tools to prevent the introduction and spread of these organisms. Some scientists predict that the spread of AIS may increase with changing climate - research and outreach investigating new species or new threats to the urban ocean coastal ecosystem caused by invasive species will continue to be important. The development of tools such as AIS field guides is critical to building an effective citizen science community to help early detection of species introduction and ecosystem dynamics.

In 2012, a new network of marine protected areas (MPAs) went into effect along the Southern California coast. MPAs are considered to be an essential part of ecosystem-based management regimes and help to ensure robust habitat quality that is resilient to changing conditions. USC Sea Grant played a large role in the multi-year process to create these MPAs, ensure they were based on the best available science, and ensure that all stakeholders had a voice at the planning table. Adequate monitoring of these MPAs, developing science-based

adaptive management methods, and fostering public education will be critical for the future success of these protected areas in a changing climate. USC Sea Grant leads the Los Angeles regional MPA Collaborative, one of a statewide network of groups charged with fostering the State's implementation of education and enforcement programs and developing new outreach designs for the MPA network. Questions about resilience inside and outside of MPAs will be important aspects of MPA assessment, and useful as other jurisdictions around the US consider implementing MPA designs. USC Sea Grant will continue to work diligently with local, regional, state, and federal partners to ensure that the purpose of Southern California's MPAs is achieved, and that they are well understood and supported by the public of the Southern California region through partnering closely with diverse stakeholders from both coastal and inland communities, including Indigenous peoples.

In addition to the California network of MPAs, USC Sea Grant works closely with the National Marine Sanctuary Program and other federal entities with jurisdiction over marine protected areas. Specifically, Associate Director Phyllis Grifman is a long-time participant on, and Chair of, the Channel Islands National Marine Sanctuary Advisory Council, as well as chair of the program's Research Activities Panel. These roles include working closely with Sanctuary managers and stakeholders to foster public understanding of sanctuaries and MPAs, to encourage wise use, and to develop and help integrate research and management plans with other uses of the California offshore region.

Another impact on our offshore ecosystems has been the siting of oil and gas platforms. California's coast has a history of oil and natural gas production, dating back to the 19th century, and currently has 27 offshore oil and gas platforms in central and southern California. As these platforms reach the end of their economic viability they are decommissioned, and so it is of increasing importance to research how the decision of managing decommissioned platforms could impact offshore ecosystems. USC Sea Grant has funded research assessing the viability of oil platforms as artificial reefs in California's waters, investigating the role of oil platforms as habitat for fish and invertebrates; site fidelity of fishes on platforms; and the influence of platform structures on fish species composition, diversity, density, and reproductive output. As platforms continue to be decommissioned, USC Sea Grant will continue to support research that increases knowledge and understanding of artificial reef ecosystems and helps inform management plans moving forward.

Certain coastal habitats at the land-sea interface—estuaries, wetlands, sandy beaches, rocky intertidal— are particularly vulnerable to urbanization, development, sea level rise, and other shoreline changes. Many estuaries and wetlands (and their associated ecosystem services)—once prevalent along the Southern California coast—have been removed or heavily modified by development. According to the California Natural Resources Agency, less than 10% of historical distributions of wetlands remain intact in the State. These habitats are not only important for the organisms which depend on them, but they also provide ecosystem services to humans such as water filtration, physical barriers from storms and flooding, groundwater recharge, and nursery grounds for fisheries of economic importance. With added threats from rising sea levels, these coastal habitats will likely face additional impingement in the future. Understanding how estuaries, wetlands, beaches might change in the future will enable planners to make informed choices for their restoration, management, and sustainable development.



Checking for invasive species

Healthy Coastal Ecosystems Goals and Outcomes (HCE)

HCE GOAL 1: Habitat, ecosystems, and the services they provide are protected, enhanced, or restored.

- **Action 1:** Develop and share scientific understanding, decision-support tools, technologies, and approaches to protect and restore ecosystems.

Outcome 1: Scientific understanding and technological solutions inform and improve the management and conservation of natural resources.

Outcome 2: Ecosystem science and conservation priorities developed through stakeholder participation are addressed.

Outcome 3: Greater awareness and understanding of ecosystem functions and services they provide improves stewardship efforts.

- **Action 2:** Sustain the habitat, the biodiversity, and the abundance of coastal ecosystems, fish, wildlife, and plants.

Outcome 1: Biodiversity, habitats, and ecosystem functions and services are restored and sustained.

Outcome 2: Improved collaborative planning and decision-making leads to enhanced stewardship.

HCE GOAL 2: Land, water, and living resources are managed by applying sound science, tools, and services to sustain ecosystems.

- **Action 1:** Support a sound science - and management - driven framework that integrates observations, monitoring, research, and modeling to provide a scientific basis for informed decision-making.

Outcome 1: Collaborations with partners and stakeholders support planning, research, and technological solutions to address resource management needs.

Outcome 2: Community supported science initiatives are engaged and contribute to improving our knowledge with respect to coastal communities, economies, and ecosystems.

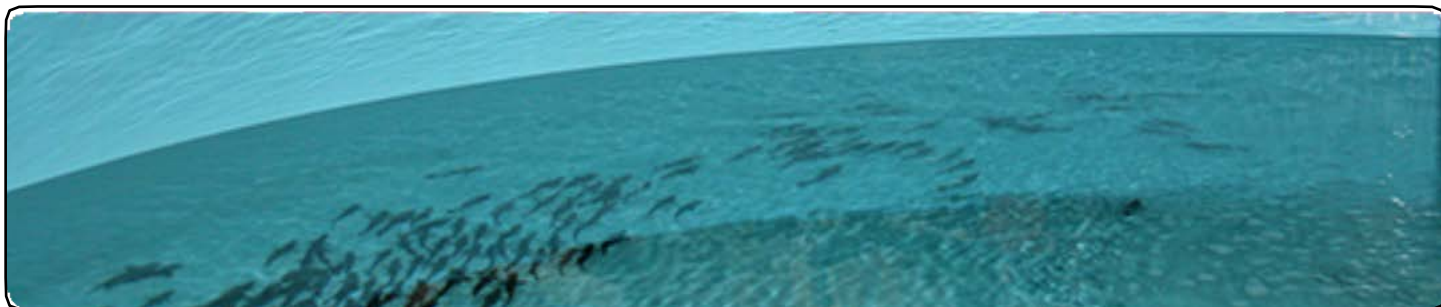
Outcome 3: Communities have access to sound science, data, tools, and the training to be effective in planning and decision-making processes.

Outcome 4: Resource managers understand the risks, options, tradeoffs, and impacts of their decisions.

- **Action 2:** Identify and promote case studies and strategies to enhance resilient ecosystems and watersheds in the context of changing conditions.

Outcome 1: Communities have access to information and understand projected changes within coastal ecosystems and how changes will impact coastal ecosystems.

Outcome 2: Communities can access case studies, training, and tools to improve their ability to plan, prepare, and adapt to future ecosystem conditions.



Juvenile white seabass in an aquaculture tank

It is USC Sea Grant's vision to have a safe, sustainable seafood supply and a public that understands how to make healthy and sustainable seafood choices. Like much of the world's oceans, Southern California has witnessed a decline in fisheries over the last half-century. Threats to fisheries off the Southern California coast include poor water quality; endocrine disruption from chemicals of emerging concern, coastal development and habitat destruction; increased activity of recreational fishing; and added threats from increasing temperatures and ocean acidification. Maintaining infrastructure for sustainable commercial fisheries present port and harbor managers with issues and opportunities for redevelopment of aging coastal assets.

Coastal development has always been an issue for fisheries for as long as USC Sea Grant has been working on the urban ocean coast. Research has shown that many species, including important game fish, use coastal wetlands and lagoons for breeding and nursery grounds. More work is needed to understand how the restoration of these sites could benefit fisheries, and how added threats from the ocean and a changing climate may affect these coastal fish habitats.

More research is needed to understand how new habitats have become important for fish recruitment and production in Southern California. Oil and gas platforms off the Southern California coast serve as artificial reefs and host a great diversity and abundance of marine life. We need to understand which physical characteristics and environmental conditions around these structures are associated with increased fish production. This work could have significant applications in the design and policy related to the deployment of new man-made structures in the marine environment (e.g., rocky reefs, renewable energy technologies) and in determining the potential biological impacts of platform decommissioning options.

Recreational fishing in particular is of great importance in Southern California. USC Sea Grant will continue to fund research, outreach, and education projects focused on recreational fisheries in Southern California, to foster innovative methods for improving game fish survival based on fish biology and ecology, and to foster understanding of California regulations meant to enhance sustainable and robust recreational opportunities.

Sustainable aquaculture is an important societal need that will continue to grow in the future. With collapsing fish stocks and an increasing national demand for seafood, it is clear that natural fish stocks, even with the help of marine protected areas (MPAs), will not be able to sustain fisheries markets. According to NOAA's Office of Aquaculture, 91 percent of seafood consumed in the U.S. is imported (and half of that is from aquaculture), leading to a seafood deficit of over \$11.2 billion per year. Domestic aquaculture will help the U.S. avoid larger foreign imports of seafood.

Key Themes

- Aquaculture and aquaponics in the classroom
- Coastal development and fisheries
- Fish recruitment and production
- Recreational fishing opportunities
- Seafood safety education

It is critical that any coastal or open ocean aquaculture program is conducted sustainably; therefore, soliciting and initiating research on sustainable practices and reducing the potential environmental impacts of aquaculture will be an important consideration moving forward. In addition, research reveals that increasing levels of ocean acidification can significantly impact fish stocks, particularly those with carbonate shells such as shellfish; fisheries research, and aquaculture based-studies to investigate ocean acidification threats and possible adaptations will be equally important.

USC Sea Grant, with research colleagues in USC's Department of Marine Environmental Biology, has begun exploring new directions supporting sustainable seaweed and shellfish farming, and forms of restorative aquaculture. Seaweed aquaculture holds promise as a sustainable source of myriad food and natural products, while providing multiple ecosystem services. Marine algae require no resource inputs (such as freshwater or fertilizers required for land-based agriculture) in order to grow. Farming seaweed can provide multiple ecological benefits such as improving water quality, potentially mitigating local ocean acidification, providing habitat, and helping to affect resilient coastal ecosystems as aquaculture is integrated into port and harbor infrastructure. Furthermore, growing seaweed together with shellfish in integrated multi-trophic aquaculture (IMTA) systems also offers promise as a sustainable way to grow protein while improving water quality and expanding the 'blue economy' and workforce. Supporting burgeoning seaweed and IMTA aquaculture efforts in California directly aligns with goals for a statewide sustainable aquaculture action plan as articulated in OPC's 2020-2025 Strategic Plan.

In order to support growing aquaculture and aquaponics industries, a trained, diverse workforce must be exposed to the subject in the classroom as well as in the field. High school students, for example, can learn first-hand about fish biology and husbandry, both to restock species and to run effective aquaculture systems. Coordinated research, outreach, and education in this area will be important to raise the next generation as informed consumers and a trained, diverse workforce.

Aquaculture education for the public is critical for the success of sustainable aquaculture growth in the U.S. because surveys show the overall public understanding of aquaculture is limited or negative. Greater public education and outreach is needed to inform the public about different types of aquaculture, best practices, and the value of eating safe, sustainable seafood. USC Sea Grant will continue to play a role at the intersection of science, communication, and education, partnering with formal and informal education centers like regional aquariums, NOAA's Coastal Ecosystems Learning Center Network, and museums to better inform and educate the public.



Demonstrating a non-lethal method for determining the sex of California halibut, photo: The Bay Foundation

Finally, seafood safety education will continue to be a priority for USC Sea Grant. Enlightened consumers make wiser choices about buying domestic products rather than imported ones that may not be harvested in sustainable ways. Moreover, those who understand the seafood markets and production practices will be better able to make healthy choices not only about the food they eat, but the manner in which it is produced, harvested, and processed. Consumers are better able to protect their families' health as they learn the safest methods for cooking seafood. Along the diverse and urban coast of the Los Angeles region, there are over 140 spoken languages and many different cultural practices when it comes to catching, preparing, and eating seafood. Partnerships are critical in making sure that our educational resources can be understood within the context of these rich and diverse cultures populating the Los Angeles region, including those traditionally underserved and underrepresented in the sciences and science communication.

Sustainable Fisheries and Aquaculture Goals and Outcomes (SFA)

SFA GOAL 1: Fisheries, aquaculture, and other coastal and freshwater natural resources supply food, jobs, and economic and cultural benefits.

- **Action 1:** Develop a trained workforce and enhance technology transfer in domestic aquaculture.
 - Outcome 1:** Increased understanding and technological solutions aid aquaculture management and production.
 - Outcome 2:** Partnerships enable the aquaculture industry to adapt and acquire innovative technologies.
- **Action 2:** Promote and support harvest and processing techniques that lead to safe, sustainable, and high-quality food, economic, and ecosystem benefits.
 - Outcome 1:** Coastal resource industries employ technologies and reinforce strategies to ensure safe and sustainable seafood and products.
 - Outcome 2:** Consumers understand the health benefits as well as the health risks of different types of seafood and purchase safe and sustainable products.
 - Outcome 3:** Coastal resource industries employ strategies that balance economic, community, and conservation goals.
 - Outcome 4:** Communication of best available science combined with indigenous and local knowledge that reflects sustainable practices in fisheries and aquaculture.

SFA GOAL 2: Natural resources are sustained to support fishing communities and industries, including commercial, recreational, and subsistence fisheries, and aquaculture.

- **Action 1:** Ensure sound science, services, and tools are available and accessible to resource managers, the fishing and aquaculture communities, and consumers.
 - Outcome 1:** Commercial and recreational fishermen and aquaculturists are knowledgeable about efficient, sustainable, and responsible tools, techniques, and uses of coastal and freshwater resources.
 - Outcome 2:** Resource managers and fishing and aquaculture communities have access to science and tools to increase their capability to adapt to future resource management needs.



Left: Students build and plant an aquaponics tank in their classroom

Right: Students weigh juvenile white seabass before putting them into the aquaculture tank





King tide at Venice Pier

California's coastal cities continue to face population growth and associated development pressures, placing demands on ecosystems, water supplies, and other vital resources. To compound the complexities of providing for a vibrant economy while protecting natural resources, Californians have the added challenge of prolonged drought and the imminent impacts of a changing climate. Sea level rise and shoreline change threaten coastal infrastructure, beaches, and wetlands, and increased storminess could lead to damaging floods and mudslides. USC Sea Grant's vision is to support a balance between the robust economic opportunities of the coast and ocean and the continued sustainability and biodiversity of marine ecosystems and resources. We will continue to play a major role in helping communities - including decision-makers, teachers, and students - understand current climate science and effectively integrate science into planning efforts, reducing risks and increasing resilience to natural and human-induced hazards.

Our goal is to share the best available science information and planning tools and provide technical assistance across Southern California to enable the region to prepare and adapt for a changing change now, thereby limiting future risks and economic losses. USC Sea Grant not only funds research and develops outreach products and educational tools to help understand the impacts of changing coastlines, but also works closely with local, regional, and state government to help coastal managers and communities understand and evaluate adaptation strategies to prepare for impacts from a changing climate.

Since 2010, USC Sea Grant's AdaptLA Program has developed and implemented a robust outreach, capacity building, and technical assistance program to coastal communities across Southern California. We conducted a statewide longitudinal survey to assess the state of adaptation in California, ensured the best available scientific modeling for sea level rise is available for local jurisdictions, assisted cities and L.A. County to assess vulnerabilities, and have trained thousands of coastal professionals on a variety of adaptation-related topics.

Over the next few years, we will continue to support the needs of the adaptation community of practice in Southern California and expand to new areas of focus. This work includes: supporting research aimed at evaluating the impacts of a changing climate on our coastal resources such as beaches, wetlands, aquifers, and rocky intertidal zones; evaluating the effectiveness and economic feasibility of potential adaptation strategies with an emphasis on natural and nature-based solutions, and providing guidance and assisting in monitoring innovative shoreline resilience approaches. For populations affected by potential changes to coastlines, including threats to infrastructure posed by changing shorelines and aging facilities, we will assist emergency managers

Key Themes

- Sea level rise and shoreline change
- Integrate science into planning efforts
- Scientific technical assistance
- Community outreach and engagement
- Partnerships and regional coalitions among governments, communities, and jurisdictions
- Nature-based solutions
- Maritime commerce and security
- Port development, air quality concerns, operational efficiency, and alternative fuels

and planners in integrating changing climate considerations into disaster and land use planning and engage communities in discussion of social vulnerability and potential opportunities to build community resilience. We will ensure that all communities, including those underserved and underrepresented, are engaged in informing the science research that is needed and has an opportunity to contribute to the science and understanding of change through community participatory science opportunities such as phenology projects in dunes and urban tides. We will also ensure they are included in the policy and management discussions. Finally, we continue to serve as a collaborator and convener for scientists and groups developing a watershed-level hydrological community of practice that includes all actors that manage and regulate local water resources.

In addition to being the largest urban center on the West Coast and the second largest in the nation, Los Angeles County is home to the ports of Los Angeles and Long Beach, constituting the busiest seaport complex in the country. Close to 45% of all marine freight entering the U.S. comes through these ports and international trade brings considerable economic benefits to the region as well as the nation. However, there are also notable environmental impacts on the coast and residents in the region, such as poor air quality, diminished water quality, and transportation congestion.



King tide in San Diego

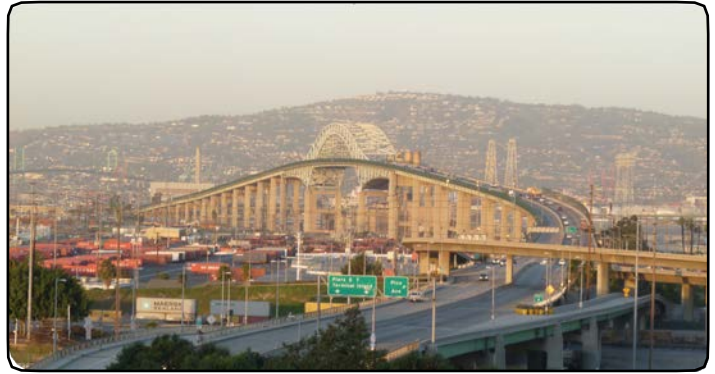
Looking ahead to 2025, we estimate there will be increases in maritime commerce that will impact the two Southern California ports, as well as the potential for emerging cyber risks to maritime transportation systems. Alterations in shipping patterns due to changes in international trading relationships, as well as evolution in vessel size is an issue of importance to commerce in Southern California that affects the economy as well as port infrastructure. Climate change has reduced some constraints to polar shipping lanes and as the busiest seaport complex on the West Coast, we anticipate being in a position to convene multidisciplinary discussions on the associated issues with our marine transportation stakeholders.

Additionally, we anticipate that changes in energy resources, specifically wind-generated electricity both offshore and nearshore, are issues of particular interest to the West. Sea Grant has a history of facilitating discussions of planning the use of ocean areas and we anticipate that we will expand our role in marine spatial planning as interest in offshore wind energy continues to develop. We will follow this as an emerging issue and will be prepared to facilitate public discourse.

USC Sea Grant's long-standing relationships with coastal communities and industries make it ideally suited to provide expert advice in port planning in conjunction with environmental management and protection and emerging issues. We will continue work to support analysis of development plans for a major marine laboratory and outreach center on the waterfront in the Port of Los Angeles; to provide widely available public education on the balance between economic development of seaports and environmental protection; to provide accurate and accessible scientific information to reduce conflicts over proposed multiple uses of coastal spaces; to consider the needs of residents of lower socioeconomic means who live close to port facilities; and to increase efficient land use practices. In addition, USC Sea Grant conducts research on the operational efficiency of seaports and the use of alternative maritime fuels.

Sustainable land use practices have significant effects on water quality in urban watersheds and along the coast. In addition to research and outreach on water quality issues in the nearshore ocean (addressed in the Healthy Coastal Ecosystems Focus Area) USC Sea Grant works with managers and stakeholders to ensure an improved understanding of how land-use practices and coastal policy intersect.

In coastal communities, new paradigms for sustaining resilient communities are being developed using information from economics, planning, landscape architecture, and the building industry. Low impact development is one tool being deployed to minimize runoff and conserve water, especially important in drought-prone Southern California. As coastal communities transform from fishing communities to combined residential, business, and recreation centers with innovative technologies including aquaculture, questions about size, scale, and open space puzzle planners and stakeholders alike. USC Sea Grant contributes to the development of tools for including multiple and diverse voices in the development of coastal and marine spatial planning.



Port of Long Beach

Resilient Communities and Economies Goals and Outcomes (RCE)

RCE GOAL 1: Coastal communities use their knowledge of changing conditions and risks to become resilient to extreme events, economic disruptions, and other threats to community well-being.

- **Action 1:** Use innovative tools to involve members of the public--including those from underserved and underrepresented communities--in contributory science to understand impacts through localized data collection and increase the public's awareness of changing conditions and the potential impacts their communities, economies, and ecosystems may encounter.

Outcome 1: Members of the community, including the underserved and underrepresented, are aware of and understand changing conditions and hazards and the implications to their communities, and are prepared to respond, and adapt.

Outcome 2: Existing and innovative training programs improve community leaders' understanding of changing conditions in their communities and implement adaptive strategies.

- **Action 2:** Utilize comprehensive planning and adaptive management strategies to enhance community resilience and adapt to hazards and changing environmental and socioeconomic conditions.

Outcome 1: Communities have access to information needed to understand the factors impacting ecosystems and participate in adaptive management planning.

Outcome 2: Communities are involved in developing adaptive management strategies that reflect both culturally relevant and localized community-supported science.

- **Action 3:** Increase the resilience of coastal communities through diversification, growth, and strengthening of coastal economic sectors.

Outcome 1: Members of the community, including the underserved, have access to information needed to understand how coastal economic activities and trends will impact environmental and community well-being.

Outcome 2: Communities have access to tools, services, and technologies to adapt and grow resilient economies.

Outcome 3: Leaders in coastal economic sectors understand how they can become more resilient through diversification and through the conservation of ecosystem resources and the services they provide.

RCE GOAL 2: Water resources are sustained and protected to meet existing and emerging needs of the communities, economies, and biodiverse ecosystems that depend on them.

- **Action 1:** Inform community members about how actions impact water quality and availability.

Outcome 1: Community members understand watershed functions and the services they provide that support communities and economies.

Outcome 2: Community members understand how actions will impact water quality and quantity and are able to make informed decisions.

Outcome 3: Community members are engaged in identifying current or historical actions that have positively impacted water quality and availability that inform understanding and approaches of how actions will impact water quality.

Outcome 4: Community members understand the importance of water resources to biodiversity within coastal ecosystems and the importance of that biodiversity to ecosystem resilience.

- **Action 2:** Collaborate with stakeholders to develop and share best management practices (BMPs) and measures to protect and manage water resources.

Outcome 1: Communities have access to sound science, data, tools, and services to understand and anticipate changes in water quality and quantity.

Outcome 2: Communities have diverse, sustainable economies and industries that support the existing and emerging water resource needs.

Outcome 3: Communities have access to science, tools, and technologies to protect and sustain water resources and make informed decisions.



Sharing coastal hazard maps during an AdaptLA meeting



Los Angeles Coastal California Naturalists

USC Sea Grant strengthens urban communities' connection with the ocean and coast through a suite of education initiatives. The broad range of programs, curricula, and place-based learning are provided in partnership with the community to ensure cultural relevance while striving to be inclusive in reaching diverse and underserved youth, educators, families, and life-long learners across Southern California. Where connections are made, learning takes place - across many environments, bridging generations, and resource gaps. Environmental literacy, especially Ocean science education, is not always available to students. USC Sea Grant strives to provide access for underserved and underrepresented groups, and early opportunities for exposure to sustainability, climate, and ocean concepts in science, technology, engineering, and math (STEM) fields, so students can develop their own ocean-related experiences. Students' interest in STEM careers is often sparked when they meet environmental and ocean scientists, learn about career opportunities in these fields and learn to apply science practices themselves. These experiences are further enhanced with internships and mentorships. USC Sea Grant recognizes that many individuals in Southern California are burdened with needing to learn English while also learning new concepts and financially not being able to take advantage of programs due to needing to support their families.

Ocean, climate, and environmental literacy are critical for individuals so that they can make informed and responsible decisions regarding the ocean and its resources. USC Sea Grant is a well-established educational resource bridging research and education stakeholders, providing the scientific and technical information to inform the development of classroom curricula, informal education programs (e.g., through aquaria, science centers, museums) and community-based organizations. USC Sea Grant will continue its work connecting ocean, climate, and environmental sciences and policy to on-the-ground formal and informal "K - grey" education, making sure that all people in Southern California, particularly all students, have exposure to environmental science, career opportunities, and the ocean itself.

Educators must be supported in order to develop creative methods that ensure learning opportunities for students of all ages and to support critical thinking and communication skills to foster wise decision making. USC Sea Grant plays a vital role in supporting the development of these skills by connecting students with community members, policymakers, and stakeholders. Engaging students in meaningful stewardship experiences that connect them with their communities is essential to building ocean and climate literacy; creating linkages that

Key Themes

- Place-based learning
- Intergenerational learning
- Community-based science programs
- Professional development for educators
- Next Generation Science Standards
- Bridging formal and informal education
- Meaningful stewardship experiences
- Diverse cultural connections to the ocean
- Undergraduate and graduate training

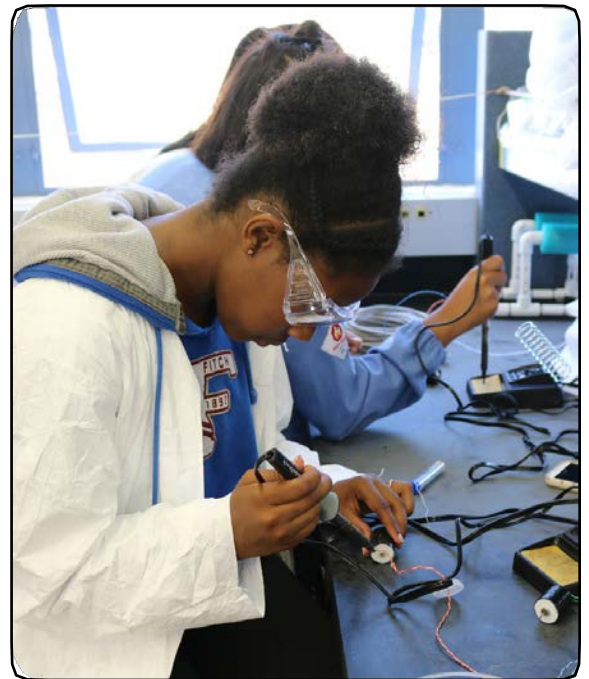
encourage connections between students and scientists provides formal and informal educators opportunities to use scientific data and technologies as educational tools.

USC Sea Grant is a leader in the national effort to develop principles for ocean literacy, approaching this through professional development and partnerships that enable teachers to create and implement standards based on marine science lessons that interweave ocean literacy principles and concepts. This helps develop marine and aquatic science education and ocean literacy strategies as prominent components of state, regional, and national education agendas. Updated ocean and climate literacy concepts and principles correlate well with the Next Generation Science Standards and Environmental Literacy Principles adopted by the State of California.

USC Sea Grant's education programs go beyond formal educational settings and curricula to make current marine science available and local scientific experts accessible to all people in the Los Angeles region, regardless of age, race, socioeconomics, primary language, or prior educational experience. It is important to provide a variety of methods to educators to help the public understand coastal and ocean science—including its applications—to help foster a sense of stewardship in our society. This is especially important in developing life-long learning habits; strong partnerships with informal science, technology, engineering, and math centers such as aquaria, museums, libraries, and afterschool programs to help achieve this goal

Enabling cross-generational learning and building connections among educators, children, and parents to ensure resources and knowledge are culturally relevant are keys to successful environmental education. It is important to recognize and value the diverse cultural connections to the ocean among the many unique voices, knowledge (including Native peoples), and communities represented throughout the greater Los Angeles area. These voices are essential in broadening our understanding of the connections to the ocean, and everyone benefits from the shared traditional knowledge and approaches to learning.

Building on our role in public education, USC Sea Grant fosters community-supported science programs that enrich data gathering and strengthen relationships between researchers and the public. These types of projects bring together scientists and community members to create opportunities for dialogue and new perspectives around some of our most pressing ocean and coastal issues. USC Sea Grant has helped fund, organize, and lead a number of community-supported science projects in the last five years, and these relationships seem to be quite symbiotic; scientists are benefitting from the expanded scope of data coming in from the public, and the public is benefitting from early understanding and support of these ongoing projects. Many of these efforts are utilized in the Los Angeles Coastal California Naturalist Program led by USC Sea Grant in partnership with the University of California. This effort specifically provides training for individuals from communities underrepresented in the field of interpretation including those who are Latinx, Black, Indigenous, and other peoples of color. This will continue to be an area of growth for USC Sea Grant in the coming years. Experiences in community-supported science programs lead to greater science literacy, engagement in local issues, and, in some cases, pursuing careers in ocean science and policy.



Summer High School Marine Lab

Coastal, ocean, climate, and sustainability science education is an investment in the future of healthy coastal ecosystems and resilient communities and economies. Our undergraduate teaching, graduate research investment, and fellowship opportunities help students prepare for careers in science, technology, engineering, mathematics, and other disciplines critical to local, regional, and national needs. While internships at pre-college levels build skills and provide training in both technical fields and application of learning prior to university, traineeships help train graduate students at both Master and Doctoral levels for careers in academia, government, and private enterprise, and fellowships (Knauss especially) place the very best graduates in positions that prepare our students to lead the nation in sustainable and forward-thinking environmental management. USC Sea Grant, in coordination with its partners, will continue to help identify and alleviate barriers to participation in Sea Grant fellowship and grant programs to ensure that students from diverse backgrounds, especially those in underserved and underrepresented communities, get access to Sea Grant's research, extension and education programs.



Teachers workshop on sea level rise



Urban Tides beach walk

Environmental Literacy and Workforce Development Goals and Outcomes (ELWD)

ELWD GOAL 1: An environmentally literate public that is informed by lifelong formal and informal opportunities that reflect the range of diversity of the Nation's coastal communities.

- **Action 1:** Enable the public to engage in community planning processes with respect to adaptive management to changing conditions by providing the best available information.

Outcome 1: Communities are knowledgeable and equipped with the best available science and technology in order to contribute to adaptive management planning processes.

- **Action 2:** Increase effective environmental literacy instruction for K-12 students and members of the community by formal and informal educators in partnership with community-based programs.

Outcome 1: Teachers and students are better informed in science, technology, engineering, and mathematics fields and can employ their knowledge to support sustainable practices within their communities and take an active role in increasing community resilience..

- **Action 3:** Increase effective environmental literacy communication to stakeholders, including how ecosystem change affects economic, social, and cultural values, as well as implications for conservation and management.

Outcome 1: Stakeholders develop a sense of awareness, understanding, and stewardship in order to sustain watershed, coastal, and marine ecosystems and resources.

Outcome 2: Communities implement sustainable strategies when managing natural resources and make decisions based on information acquired through informal science education.

ELWD GOAL 2: A diverse and skilled workforce is engaged and enabled to address critical local, regional, and national needs.

- **Action 1:** Grow awareness among the nation's diverse population of career paths that support the needs of the nation's coastal communities.

Outcome 1: All members of a community are enabled to explore and pursue the variety of occupations that are essential to sustain the nation's coastal communities, economies, and ecosystems.

- **Action 2:** Increase opportunities for undergraduate and graduate students to gain knowledge and experience in the science and management of watershed, coastal, and marine resources.

Outcome 1: High school and college-level courses and internships provide increased literacy, experience, and preparedness in areas of watershed, coastal, and marine ecosystems for all students including those from underrepresented groups.

Outcome 2: Undergraduate and graduate students, especially those from underrepresented groups, are supported and have access to formal and experiential learning, training, and research experiences.

- **Action 3:** Prepare a responsive and diverse workforce to advance and benefit from sectors that support the needs of the nation's coastal communities and ecosystems (e.g. industry, research, government, etc.), and to adapt and thrive in changing conditions.

Outcome 1: Employment in all sectors of the U.S. coastal resource enterprise expands and diversifies.

Outcome 2: The existing and future workforce is able to adapt and thrive in changing environmental, social, and economic conditions.



Giant kelp

Director, Linda E. Duguay, Ph.D.

In addition to serving as the Sea Grant Director, Dr. Duguay also serves on the Senior Leadership Team for the Wrigley Institute for Environmental Studies and is a Research Associate Professor in the Marine Environmental Biology section of the Department of Biological Sciences. This enables a close connection with research scientists and teaching programs at graduate and undergraduate levels. She also serves on USC's Women in Science and Engineering (WISE) advisory board. Linda has served as the President of the Association for the Sciences of Limnology and Oceanography (ASLO) 2016-2018; she served as past President 2018-2020 and President-Elect 2014-2016) in addition to serving on several state, regional, and national boards. Her work nationally helps to link USC marine programs with respected scientists around the U.S. and the world. Through her leadership and service, Linda ensures that USC Sea Grant remains at the advancing edge of ocean science and the emergence of new issues and innovations in science and education.

Associate Director, Phyllis Grifman, M.A.

As Associate Director, Ms. Grifman serves as Research Coordinator and oversees extension, outreach, and education programs. She is an active partner in numerous state and national activities, linking Sea Grant with research and information networks in such areas as national marine sanctuaries, state marine protected areas, ecosystem science, land use planning in both the public and non-profit sectors, and other local, regional and national endeavors. Ms. Grifman maintains close contact with current and former Sea Grant scientists, and develops Sea Grant's new research capabilities. She has served as Chair of the Advisory Council of the Channel Islands National Marine Sanctuary for several years, and has served on the Council for over a decade.

Marine Transportation & Seaport Specialist, Director of Extension, James Fawcett, Ph.D.

Dr. Fawcett is an Adjunct Professor in both the Dornsife College (Environmental Studies Program) and the Sol Price School of Public Policy, teaching marine environmental policy and coastal management. He is a well-known national and international expert in ports and maritime transportation, and serves as a liaison with the Ports of Long Beach and Los Angeles, the L.A. business community, and key Asian seaport researchers and managers. An urbanist by training, he focuses on the environmental impacts of the marine transportation industry and the decision regimes by which public goods are managed. He serves on the Marine Conservation Research Institute Board of Directors at the Long Beach Aquarium of the Pacific (AoP), extending his expertise through public lectures and advice on public projects.

Education Programs Manager, Linda Chilton, M.A.

Ms. Chilton is responsible for developing, implementing, and coordinating a broad range of educational programs for students, teachers, and families. Through her long participation in COSEE (now the COSEE Education Foundation), and numerous collaborations with science educators throughout California, she brings together scientists and educators to develop curriculum and field programs on current marine science topics. Ms. Chilton leads the development of the region-wide HAB (Harmful Algal Bloom) Watch Program, a citizen science initiative, and works with educators along the West Coast to reduce the introduction of aquatic invasive species. She manages USC Sea Grant's Island Explorers and Parent Child Education Programs, and works with local, regional, and national partners in addressing aquaculture education. Ms. Chilton dedicates much of her time engaging lifelong learners in community-supported science, connecting informal science experiences with current research and ocean issues, and creating partnerships to support underrepresented audiences in marine science education and career development. She co-leads the LA County CA Naturalist certification training that serves primarily participants reflective of those

underrepresented in naturalist and interpretive fields in the region. In 2014, she received the prestigious Marine Educators Award from the National Marine Educators Association, recognizing more than 25 years of leadership in marine science education.

Education Program Specialist, Maria Madrigal, M.S.

Ms. Madrigal works alongside the Education Programs Manager, Linda Chilton, to help identify needs and resources to support coastal based education programs, especially for field-based educators transitioning from in-person learning to virtual platforms and distance learning. Her role includes connecting with students, teachers, and families in formal education systems and after-school programming, and facilitating the collaboration of diverse network partners in order to identify common programmatic needs and adaptation strategies, all while ensuring equity and access for all students and educators. Previously, she served as the Program Manager for the USC Viterbi School of Engineering K-12 STEM Center where she oversaw three programs and swiftly identified successful virtual learning strategies for teachers at the onset of COVID-19. Prior to joining USC, she spent almost 20 years at the SEA Lab in Redondo Beach leading and managing education programs for both field-based and in-school presentations. As a program of the Los Angeles Conservation Corps, her priority was preparing young adults entering the workforce by providing education and job-training skills in the marine and environmental fields. In 2012, she was fortunate to participate in NOAA's Teacher at Sea program where she joined research teams aboard the Oscar Elton Sette in American Samoa conducting a comparative study of sampling methods to assess reef fish assemblages.

Science, Research and Policy Specialist, Melodie Grubbs, M.S.

As a coastal scientist, Ms. Grubbs is focused on helping managers, planners, and community members in Southern California prepare for and adapt to changing climate conditions, coastal hazards, and sea level rise. Ms. Grubbs specializes in physical coastal processes and dynamics, remote sensing, and geospatial analysis. Previously she served as the Director of Watershed Programs at The Bay Foundation where she developed, led, and implemented coastal habitat restoration and living shoreline projects. Ms. Grubbs also has experience at sea, serving as a scientist and chief mate on board an oceanographic research vessel. Ms. Grubbs holds a M.S. in Geographic Information Science and Technology from USC and a B.S. in Meteorology from the University of Hawaii at Manoa. At USC, her research focused on using remote sensing data to detect beach sediment changes associated with El Nino periods in Southern California.

Communications Manager, Leah Shore, M.S.

Leading the team's communications, Ms. Shore's work is centered around conveying the program's marine science research, extension, education, and outreach efforts across a broad range of audiences. Her work enhances the usability of the program's science findings through building resiliency, raising awareness, and increasing the capacity of research and issues surrounding our coastal communities. She manages the communication strategies and materials across projects and digital platforms, as well as serves as the primary science writer. Ms. Shore specializes in science communication, especially aimed at bridging the gap between science and application. Previously she worked as the Climate Assessment Specialist for the Southern Climate Impacts Planning Program, a NOAA Regional Integrated Sciences and Assessments team, focusing on the assessment of stakeholder risk and vulnerability to extreme weather and climate events, and aiding in decision-making and adaptation efforts across the South Central United States.

Science Writer, Charlotte Stevenson, M.S.

Ms. Stevenson contributes to writing and design of ongoing USC Sea Grant projects such as website copy, articles, newsletter communications, grant reporting, and strategic planning. She is the lead author of the recent publication *Apocalypse Cow*, as well as a retrospective celebrating the past 40 years of USC Sea Grant, *40 Years of Progress in the Urban Ocean*.

Contracts and Grant Coordinator, Ruth Dudas

Ms. Dudas has more than 25 years of administrative experience, working in the fields of printing and logistics as Executive Assistant and Office Manager before her tenure at USC Sea Grant. Since 2002, Ms. Dudas has served as USC Sea Grant's fiscal officer and budget coordinator, in addition to providing administrative support for Sea Grant staff. She ensures the efficient execution of daily office procedures and serves as liaison with USC contracts and grants operations and sponsored project administration.

Appendix I: USC Sea Grant Advisory Council (Revised 2020)

Name	Affiliation
Dr. Hee Seok Bang	College of Social Science, Chung Ang University
Mariela Paz Carpio-Obeso	Division of Drinking Water, State Water Resources Control Board
Candice Dickens-Russel	Director of Education for Sustainable Development, DoGoodery Social Impact Agency
Mas Dojiri	Assistant General Manager, City of Los Angeles Sanitation & Environment
John Dorsey	Professor of Civil Engineering & Environmental Science, Loyola Marymount University
Dr. Lesley Ewing	Senior Coastal Engineer, California Coastal Commission
Russell Galipeau	Superintendent (retired), Channel Islands National Park
Mark Gold	Executive Director, Ocean Protection Council
Dr. Robert Kanter	Managing Director (retired), Port of Long Beach
Dr. Charles D. Kopczak	Curator of Life Sciences, California Science Center
Jenny Krusoe	Executive Director, AltaSea at the Port of Los Angeles
CAPT J. Kipling Louttit	Executive Director, Marine Exchange of Southern California
Chris Mobley	Superintendent, Channel Islands National Marine Sanctuary
Craig Moyer	Partner, Manatt, Phelps & Phillips, LLP
Jeremy Potter	Pacific Studies Chief, Bureau of Ocean Energy Management
Dr. Jerry Schubel	President (retired), Aquarium of the Pacific
Rebecca Smyth	West Coast Regional Director, NOAA Office for Coastal Management
Dr. Guangyu Wang	Chief Administrative Director, Santa Monica Bay Restoration Commission
Dr. Stephen Weisberg	Executive Director, Southern California Coastal Water Research Project



Summer High School Marine Lab on Catalina Island

Appendix II: USC Sea Grant Academic Coordinators (Revised 2020)

Name	Affiliation
Dr. Karla Heidelberg	Associate Professor, USC Biological Sciences and Environmental Studies, Director of USC Environmental Studies Program
Dr. Kenneth Nealson	Professor, Wrigley Chair in Environmental Studies, USC Dana and David Dornsife College of Letters, Arts and Sciences, Department of Earth Sciences
Steven Murray	Interim Provost and Vice President for Academic Affairs and Professor of Biology Emeritus (retired), CSU Fullerton
Dr. Patrick Lynett	Professor, USC Department of Civil and Environmental Engineering
TBA	Social Science Faculty, USC

Appendix III: Resources Agency Sea Grant Advisory Panel (RASGAP)

Name	Affiliation
Debbie Aseltine-Neilson	California Department of Fish and Wildlife
Doug Capone	Private University/University of Southern California
Don Disraeli	Kanaloa Seafood
Jonathan Dolan	California State Water Resources Control Board
George Douglas	California Department of Parks and Recreation
Jenn Eckerle	California Ocean Protection Council
Mike Esgro	California Ocean Protection Council
Lesley Ewing	California Coastal Commission
Rebecca Fitzgerald	California State Water Resources Control Board
Ron Flick	Division of Boating and Waterways
Lauren Garske	California Coastal Commission
Mark Gold	Executive Director, Ocean Protection Council
Susan Hansch	California Coastal Commission
Jennifer Mattox	California State Lands Commission
Steven Murray	Interim Provost and Vice President for Academic Affairs and Professor of Biology Emeritus (retired), CSU Fullerton
Dirk Rosen	Marine Applied Research & Exploration
Wesley Smith	California Environmental Protection Agency, Office of Environmental Health Hazard Assessment
Michelle Succow	California State Parks
Katherine Walsh	California State Water Resources Control Board
Tom Weseloh	State Senate, Joint Committee on Fisheries and Aquaculture



The Urban Ocean Program

**University of Southern California Sea Grant
Strategic Plan
2018 - 2023**

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