



CALIFORNIA SEA GRANT EXTENSION

COASTAL SCIENCE SERVING CALIFORNIA
since 1973

California Sea Grant extension specialists are scientists and trusted advisors immersed in their communities.

They are uniquely positioned to find solutions and serve the research and outreach needs of California's coastal residents, visitors, and businesses. The strength of the California Sea Grant Extension Program lies in diverse scientific backgrounds, dedication to applied research, problem solving from the ground up, and enduring relationships with California's coastal communities.

The California Sea Grant Extension Program specializes in applied research designed to supply information to meet specific state information and management needs, as well as local needs. The program's work has helped strengthen California's fisheries, develop profitable new aquaculture sectors, restore and protect important coastal ecosystems, and help communities understand and prepare for the impacts of changes in weather and climate.

As California faces increased pressure to protect the coastal environment and coastal economy in the face of global change, there is a growing need for this combination of applied research and outreach, driven by community and state priorities. California Sea Grant is uniquely placed to help find solutions to real-world problems, in partnership with our strong and longstanding network of residents, industries, and agencies throughout the state.

CONNECTING COMMUNITIES WITH LOCAL FISHERIES

California Sea Grant has helped strengthen California's commercial fisheries through research, outreach, education, and training.

Californians love fresh, local food. We also love seafood. Yet in a country where 90% of seafood consumed is imported, consumers may be unaware of or unable to access the bounty of fresh, local seafood that is being responsibly sourced just off our coast.

Getting local seafood to consumers can be more difficult than it might seem. Regulations limit when, where, and how much can be caught, and the traditional long supply chain can make it difficult for consumers to understand where their seafood is coming from. Consumers may not be familiar with the variety of local California species like rock crab, opah, or rockfish, or are not sure how to handle or prepare fresh catch, and are instead in the habit of choosing better-known choices.

That's why California Sea Grant extension specialists are working with fishing communities to help build understanding and interest in California seafood.

Extension Specialists Carrie Pomeroy,Carolynn Culver, and Theresa Talley have worked with local governments and commercial fishermen around California to pass legislation that makes it easier to sell their catch at dockside fish markets, which now serve as models for other markets across the state. They have also worked closely with fishermen, chefs, and others in the food system to develop resources both for seafood enthusiasts to learn more about commercial fishing in California, and for fishermen interested in marketing their catch to local communities.

Their work is helping California communities learn about and access healthy and sustainable seafood caught by local fishermen.

A close-up photograph of several oysters, some open and some closed, showing their shells and the meat inside. The oysters are piled together, and the lighting is soft, highlighting the textures of the shells.

SUPPORTING CALIFORNIA'S AQUACULTURE FUTURE

California Sea Grant is bringing together agencies, non-governmental organizations, and the private sector to help develop the state's aquaculture industry in a sustainable, ecologically conscious manner.

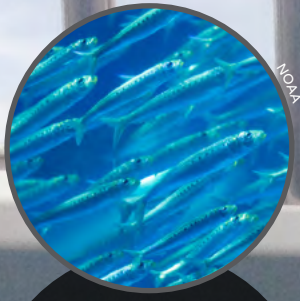
The U.S. currently imports 90% of the seafood we consume, and half of that comes from aquaculture. Meanwhile, global and domestic demand for seafood is on the rise, driven by population growth and rising incomes.

In California, the aquaculture industry has a major opportunity to help supply more domestically-produced seafood. But the industry faces an uphill battle. Some public perceptions of aquaculture in the state remain negative, and the regulatory environment is challenging to navigate, with uncertainty even in which agencies are responsible for permitting which aspects of the industry.

California Sea Grant Extension Specialist Paul Olin teamed up with the Aquarium of the Pacific and NOAA's National Centers for Coastal Ocean Science to help producers and regulators navigate these challenges by building partnerships and programs to fill the information gaps.

A recent workshop series brought together scientists, regulatory agencies, and industry practitioners to discuss all the challenges around aquaculture in the state, including siting, feeds, and disease, as well as potential environmental issues such as chemicals, drugs, nutrient enrichment, and invasive species. The group is using a sophisticated model that is capable of predicting environmental impacts of offshore aquaculture—and has built a community capable of responding and directing questions to the right players.

SUSTAINING SEAFOOD IN A CHANGING CLIMATE



California's commercial fishing heritage has been defined by species like sardine, lobster and Dungeness crab.

\$23B

California commercial and recreational fisheries generated \$23.4 billion in sales in 2015.

703K

In 2015, 703,000 California anglers went recreational fishing in the state.

California Sea Grant is working with fishermen and seafood growers to provide the latest science, and help industry and communities understand and adapt to change.

California's fishing industry is the second largest in the U.S., and a critical part of the economy. Yet California's fisheries and aquaculture producers face new challenges as the impacts of climate change become more pronounced. California fisheries already vary from year to year due to fluctuating environmental conditions. But future climate change is likely to bring new challenges such as increased variability, range shifts, and potentially dramatic changes in species and ecosystems.

California Sea Grant extension specialists work with fisheries participants, seafood growers, managers, and communities to help them plan and adapt in the face of uncertainty. Because Sea Grant extension specialists live in these communities and work side-by-side with local stakeholders, they are uniquely positioned to assess the connections among the environment, management, and economic and social systems, enabling them to provide an invaluable service to California's fishing and seafood-producing communities.

For example, California Sea Grant Extension Specialist Carrie Pomeroy contributed to a recent report that identified the potential effects of climate change on fisheries. The report describes seven strategies for management that could increase adaptability and resilience.

Pomeroy has also worked with state and local agencies to help managers and fishermen get the information they need to plan for and adapt to future changes.

Seafood producers such as oyster farmers will also face impacts from ocean acidification, a chemical change in the ocean that, like climate change, is driven by the increasing concentration of carbon dioxide in the atmosphere. Ocean acidification makes it more difficult for shellfish to build their shells. California Sea Grant Extension Specialist Joe Tyburczy is working with oyster growers in Humboldt Bay to monitor water quality and understand the extent to which eelgrass may counteract ocean acidification. This is especially important for shellfish hatcheries that produce the early life stages of bivalves, because they are particularly sensitive to ocean acidification. The production of these early life stages is fundamental to bivalve mariculture and is one of the key limitations to expansion of the industry.

Throughout the state, California Sea Grant extension specialists bring broad scientific expertise that can be applied at a local level to help fishing and seafood-producing communities survive and thrive.

California's ocean supports rich marine habitats and a vibrant fishing economy. However, climate change is impacting California fish stocks and communities that rely on fishing and aquaculture.



CONNECTING A NETWORK OF PARTNERS

54

ACADEMIC PARTNERS

including San Diego Unified School District and UC Cooperative Extension

85

GOVERNMENT PARTNERS

including U.S. Army Corps of Engineers and Pacific Fishery Management Council

70

INDUSTRY AND BUSINESS PARTNERS

including Monterey Abalone Company and Diablo Canyon Power Plant

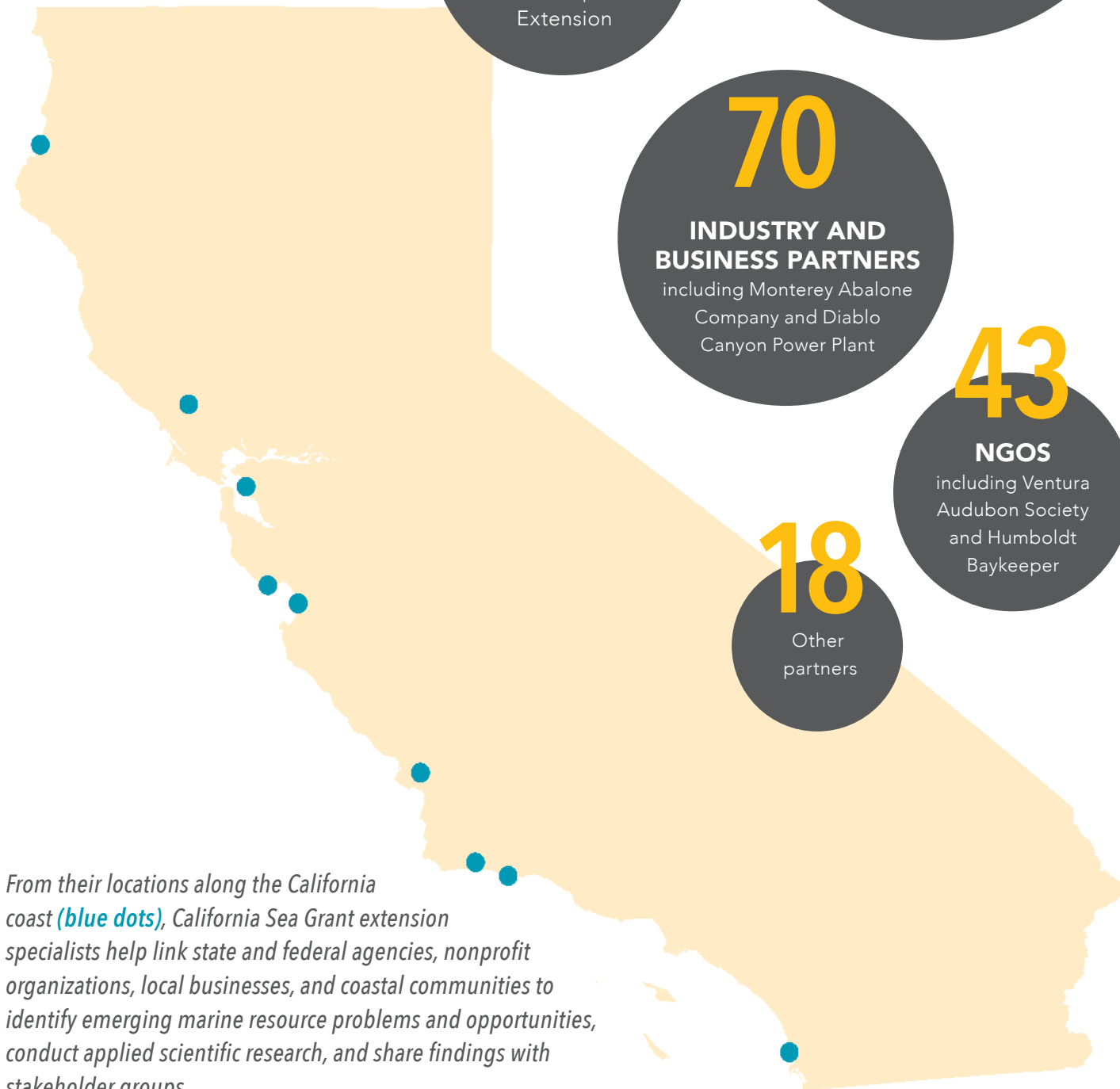
43

NGOS

including Ventura Audubon Society and Humboldt Baykeeper

18

Other partners



From their locations along the California coast (blue dots), California Sea Grant extension specialists help link state and federal agencies, nonprofit organizations, local businesses, and coastal communities to identify emerging marine resource problems and opportunities, conduct applied scientific research, and share findings with stakeholder groups.

INVESTING IN THE ENVIRONMENT AND ECONOMY

73,204

Number of acres of coastal habitat protected, enhanced, or restored as a result of California Sea Grant activities

\$72 MILLION

The programs and research funded by California Sea Grant had an estimated economic impact of \$72,802,118 to the state.

225

Undergrad, masters, and PhD students supported by California Sea Grant

23,380

People reached through California Sea Grant K-12 and informal education programs

643

Number of resource managers who use ecosystem-based management of land, water, and living resources as a result of California Sea Grant activities



26 MILLION

California tops the coastal populations chart with 26 million people living in coastal counties (NOAA 2014)

270

Partners from academic institutions, government, industry/business, NGOs, and other organizations

California has the nation's largest ocean economy, valued at more than

\$44 BILLION

/year

62,405

Estimated number of hours that citizens volunteered with California Sea Grant



All figures shown are for the time period of February 2014 to January 2018, unless otherwise noted.

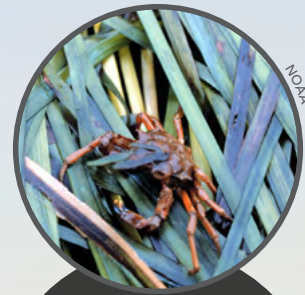
UNDERSTANDING AND PROTECTING CALIFORNIA'S EELGRASS

Eelgrass is an important habitat in California's bays—but it's in decline. California Sea Grant is bringing together scientists with local communities, federal agencies, and businesses to understand, protect, and restore these underwater meadows.

Seagrass beds were once common in California's bays. From Humboldt Bay in northern California to San Diego's Mission Bay, low tide would expose an expansive blanket of vibrant green ribbons. These underwater meadows have long been recognized as an important ecosystem, supporting fish populations, birds, and other species. People benefit too. Seagrass beds stabilize shorelines, filter water, and new research shows that they may even buffer the effects of ocean acidification.

Over recent decades, eelgrass has declined up and down the California coast. But while the problem is statewide, the causes were often locally specific. And each coastal community and ecosystem comes with a different context and different challenges in restoring the environment.

California Sea Grant and other agencies have sponsored a variety of research on eelgrass throughout California. Yet some of the most important insights have come from extension



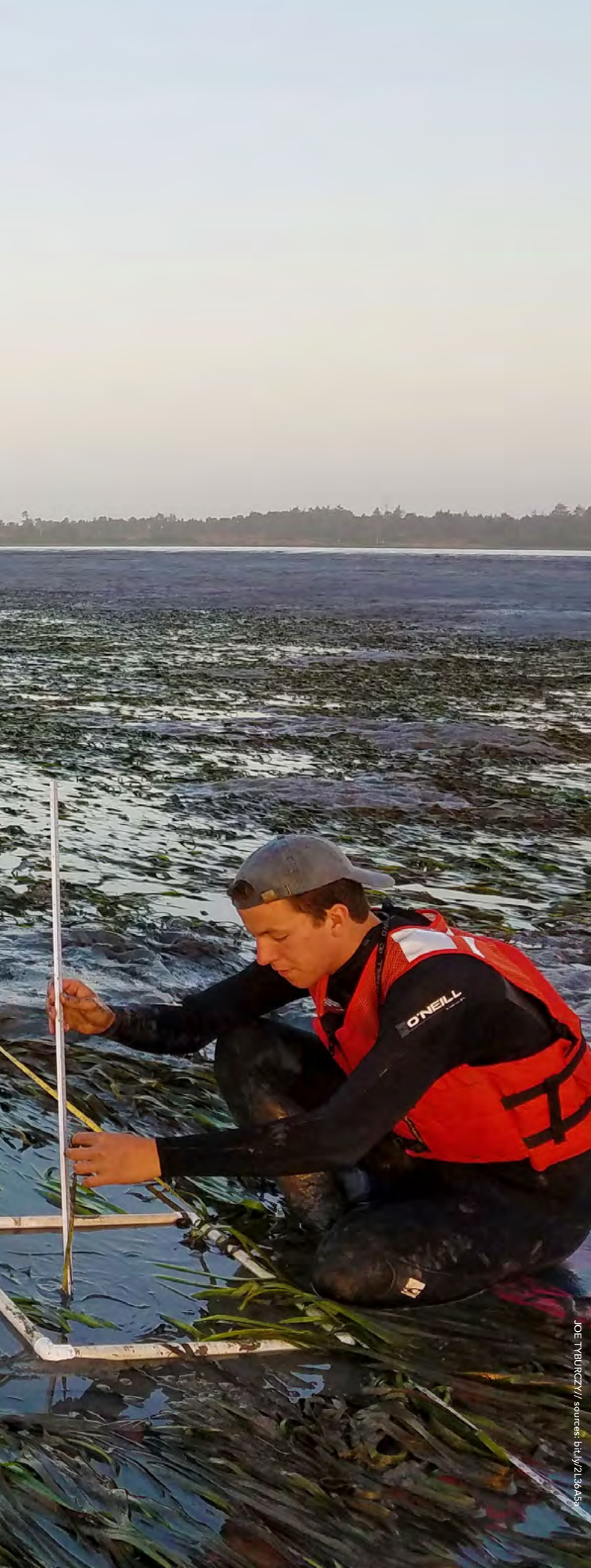
Eelgrass shelter and nurture sea life like juvenile fish and invertebrates.

97%

Eelgrass declined by 97% from 2007 to 2013 in Morro Bay.

500

In an annual survey, the number of brant geese in Morro Bay declined from 3,000 in 2006 to 500 in 2016.



JOE TYBURCZY // sources: btl/W/2136A5

specialists based in coastal communities, who have a unique view of the systems, both human and environmental, in which they work.

For example, in Morro Bay, in Central California, eelgrass declined by 97% from 2007 to 2013, but the cause was unknown. While local and federal groups began working to replant the eelgrass beds, later monitoring showed that little of the transplanted eelgrass survived.

In her role as a California Sea Grant extension specialist, Jennifer O'Leary was able to step in and connect local, state, and federal partners, including the Morro Bay National Estuary Program, with an interdisciplinary team of scientists at Cal Poly, San Luis Obispo to explore the problem. Through a series of experiments, the research team ruled out a number of the initial hypotheses. They now believe that the decline may be caused by sediment changes in the bay and changing water properties. A research project to understand and map sediment in the bay and its influence on eelgrass is underway. The project results are also being used to inform restoration efforts and identify areas of the bay where the grass is most likely to thrive.

Humboldt Bay, in contrast, still hosts a healthy eelgrass ecosystem—in fact, the northern California bay is home to roughly 40% of the remaining eelgrass habitat in California. California Sea Grant Extension Specialist Joe Tyburczy, based at Humboldt State University, is leading projects to monitor the eelgrass, as well as better understand its influence on ocean chemistry. Tyburczy works with researchers as well as local oyster farmers, for whom water quality is a top concern.



HELPING COMMUNITIES ADAPT TO CLIMATE CHANGE

By 2100, sea-level rise and flooding will threaten nearly \$100 billion worth of property along the California coast. California Sea Grant is helping communities prepare.

Sea-level rise is expected to alter the coast of California considerably over the next century. Beaches, coastal ecosystems, critical infrastructure, and property are all vulnerable to future flooding.

Local governments are working to develop sea-level rise adaptation plans to protect the coastline and minimize impacts.

Though the conventional approach to protecting coastlines has been to harden the shoreline with rip-rap or seawalls, these can lead to increased erosion in the long run. Increased interest is being paid to natural infrastructure solutions, a successful alternative that can restore beach ecosystems, improve recreation, and support beach-dependent industries.

California Sea Grant extension specialists are helping California communities with climate adaptation planning to protect their natural and built environments. For example, postdoctoral scholar Jenna Judge led a team of experts to develop five California-specific case studies that highlight nature-based approaches to sea-level rise adaptation and help familiarize coastal planners and local elected officials with these options.

Natural coastal habitats, including those that support rare and endangered species, are at risk if no adaptation actions are taken. California Sea Grant Extension Specialist Monique Myers led a team of scientists to develop guidance for Santa Barbara area decision makers for climate adaptation planning with a focus on coastal ecosystems and beach health. The City of Santa Barbara and City of Carpinteria are using the information to update their coastal land use plans and policies on climate adaptation.

SAVING SALMON THROUGH MONITORING AND OUTREACH

Coho salmon in the Russian River are critically endangered. California Sea Grant research is exploring the causes of the problem—and identifying solutions that work for fish and people alike.

Since 2004, California Sea Grant has run a monitoring program led by Extension Specialist Mariska Obedzinski for critically endangered coho and steelhead salmon in Sonoma County.

In 2017, California Sea Grant research led to remediation of a small dam on Mill Creek. Local groups used the data to seek funding to address the passage issue and salmon were seen spawning upriver of the dam's location immediately after.

Recent research by the team has shown which streams tend to go dry during droughts and how much water is needed for survival, allowing for the rescue of stranded fish as well as support for projects to increase streamflow even by modest amounts.

The number of returning coho has increased from less than 10 to an average of 400 to 500 per year in the last decade, but there is a long way to go to reach recovery targets (>10,000) and their recovery is not guaranteed. The California Sea Grant salmon monitoring program's success shows that sound science and solid partnerships with landowners and agencies at the local, state, and federal level can help pave the way.



WILL BOUCHER

Salmon serve as an indicator for the health of the whole watershed.

40%

Only 40% of the juvenile fish observed in high-priority areas live in streams that remain wet throughout the year.

533

The number of returning coho increased to an estimated 533 in 2017 from less than 10 in 2000.



BUILDING PARTNERSHIPS FOR A HEALTHY OCEAN

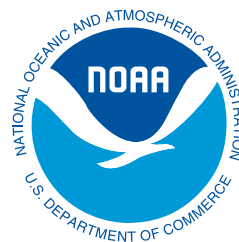
California Sea Grant brings together diverse partners to help address the problem of ocean litter and educate the public.

Plastic and other human pollution in the ocean is a problem around the world. But while the issue is most visible on beaches and in the sea, the solution starts on land—in communities, homes, and businesses.

California Sea Grant is conducting research, outreach, and facilitation to help address the problem, which has both economic and ecological impacts on the state. For example, California Sea Grant's Theresa Talley and Nina Venuti recently collaborated on a project with San Diego Canyonlands and the Ocean Discovery Institute to increase climate resiliency in a coastal watershed

that connects mid-city San Diego to the Pacific Ocean. Along with community volunteers, the project team removed trash, restored native plants, and tracked related weather data. Over the two-year project, 2,539 volunteers removed 12.6 metric tons—five school buses full—of trash from the canyon, while collecting data on the types and locations of trash found.

California Sea Grant also worked closely with the NOAA Marine Debris Program and the California Ocean Protection Council to develop their 2018 California Ocean Litter Strategy. California Sea Grant facilitated a stakeholder engagement process that gathered input from a broad swath of stakeholders, including industry representatives, in order to produce a strategy that would address the sources of ocean litter in California.



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