



CENTER FOR  
**OCEAN**  
SOLUTIONS

# 2012–2016 Strategic Plan

Center for Ocean Solutions. 2012.

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Front Cover Photo: Schooling Tuna (Danilo Cedrone, Courtesy of United Nations Food and Agriculture Organization)



Richard Wylie/Marine Photobank

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## Vision

Globally we, as a society, make decisions that lead to long-term ocean health. We understand the human-ocean connection and actively make choices to enhance the viability of the ocean—crucial to meeting the needs of people today and tomorrow. We value and steward vital linkages between the ocean, health, and climate resulting in thriving marine ecosystems and vibrant coastal communities.

## Mission

The Center for Ocean Solutions works to solve the major problems facing the ocean and prepares leaders to take on these challenges.

## Overarching Goals

- Probe for root causes of key threats to global ocean health and work in interdisciplinary teams to build enduring solutions.
- Crack open impenetrable problems and develop new ways to articulate and visualize them so they can be understood, quantified, modeled, and solved.
- Engineer solutions for real-world applications through active engagement with managers, decision-makers, and stakeholders.
- Help define and measure ocean health and develop resiliency metrics including thresholds and indicators to support ocean health.
- Link knowledge and technology to needs resulting in action by government, non-governmental organizations, foundations, and business.
- Equip decision-makers and emerging leaders with the knowledge and skills they need to make decisions that lead to long-term health of the ocean.

## WHO WE ARE

- A collaboration among the **Stanford Woods Institute for the Environment and Hopkins Marine Station of Stanford University, the Monterey Bay Aquarium, the Monterey Bay Aquarium Research Institute.**
- **Focusing on coastal and ocean ecosystems in the natural, physical, and social sciences.**
- **Drawing on a pool of more than 80 scholars and collaborating with other academic and governmental organizations as well as non-governmental organizations to tackle interdisciplinary and multisectoral problems.**
- **Located at Stanford University and in Monterey, California.**

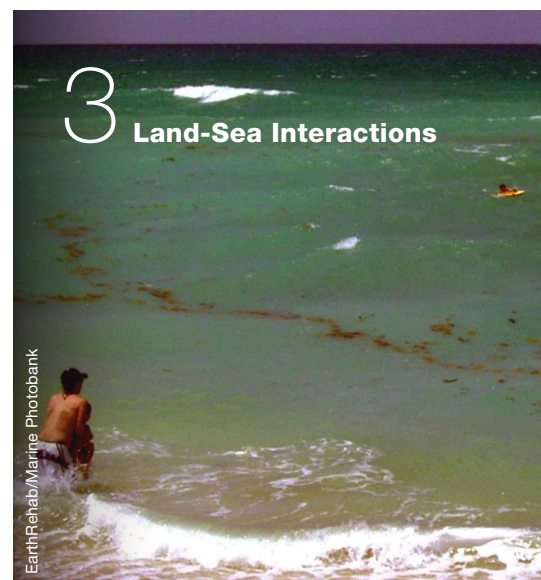
## WHO WE REACH

- **Community leaders**
- **Foundations**
- **Government leaders**
- **Graduate students and post-graduate scholars**
- **non-governmental organizations**
- **Peer organizations**
- **Resource managers**



COS Executive Director Meg Caldwell training future ocean leaders through the MARINE Ocean Policy Course.

# Focal Areas



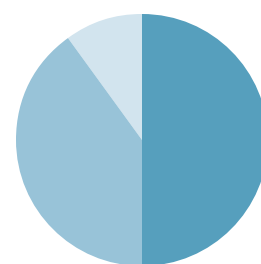
The focal areas we are using to categorize our work—ecosystem health, climate change, and land-sea interactions—are inextricably linked and our work in one area will inform and advance work in the other areas. The Center for Ocean Solutions (COS) uses the below filters as a guide for project selection.

## THE CENTER FOR OCEAN SOLUTIONS' PROJECT SELECTION FILTERS

COS proactively identifies issues and is responsive to the problems identified by managers and decision-makers. In order to be considered for COS engagement, proposed projects should:

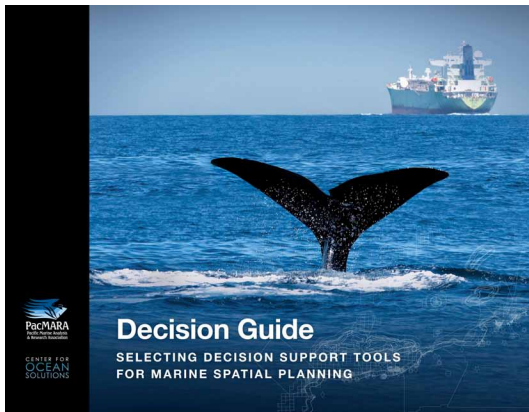
- Build on current research/activities of COS partners and use core competencies of COS.
- Present unique opportunities for COS to add value (where other institutions/organizations cannot).
- Present high likelihood of positive outcome within specified time period; be of suitable scope for COS to undertake given its human and budget resources.
- Maintain strongest possible integrity for COS as a credible broker of physical, biological, social science and policy knowledge, information, and problem-solving relevant to the ocean.
- Operate on issues reflecting a variety of time scales from long-term reframing and conceptualizing problems (policy impacts out 5–10 years), to intermediate identifying and solving emerging problems (3–5 years), to shorter-term solving existing problems (1–3 years), with an emphasis on short- to intermediate-term objectives (see “portfolio mix” chart to the right).

## COS PROJECT PORTFOLIO MIX AND PROJECT TIMESCALES



- Solving Existing Problems (1–3 years)
- Identifying & Solving Emerging Problems (3–5 years)
- Reframing & Conceptualizing Problems (5–10 years)

# Focal Area 1: Ecosystem Health



In 2011 COS convened coastal managers and decision makers together with decision support tool developers to enhance the utility of decision support tools in marine spatial planning. COS and colleagues at PacMARA then developed a guide book to aid practitioners in selecting appropriate tools for marine management.

Contemporaneous with the development of the nation's first federal ocean policy, COS shaped its Ecosystem Health Initiative around the most pressing questions framed by the national dialogue. Pressing questions include: What does it mean to implement ecosystem-based marine spatial planning? What are the governance options for collaborative, proactive decision-making? What is the role of the scientific community? Where can we learn from and apply best practices across disciplines such as the social sciences, economics, and political science? What can we learn from our experience with public lands multi-sector management?

In COS's pursuit to answer these questions, COS is tackling overarching, cross-cutting challenges, such as determining how to address multiple stressors in marine and coastal ecosystems while accommodating existing and emerging ocean uses. COS turns theory into practice and regularly works with practitioners who already want or need solutions to link knowledge to action that can be taken by them today.

COS is well positioned to take on the challenges associated with ecosystem health because of the depth of our legal and policy experience in understanding the existing regulatory structure and our expertise across the engineering and scientific fields to characterize and diagnose the sources of marine and coastal ecosystem stressors. We further understand the need to go deeper than the sources and probe to understand real root causes. Coupled with this expertise is our ability to communicate these complex problems in new ways.

## INFORMING AND INNOVATING FISHERIES MANAGEMENT

### Marine Spatial Planning in Action

The September 2011 West Coast Fisheries Forum Workshop held at Stanford focused on the role of Regional Fishery Management Councils in Multi-Sector Spatial Planning. COS's marine spatial planning experts worked directly with the Fisheries Forum team to develop both a comprehensive report on the existing tools and future opportunities for Regional Fishery Management Council engagement and led several discussions with Council members and their senior staff during the workshop.

### Looking Forward

The sustainability of fisheries is a natural and major focus for the Monterey Bay Aquarium. With a few exceptions, Stanford researchers have not historically focused on fisheries management, but this may actually be an advantage because conventional fisheries thinking has failed fisheries management in several important ways.

## Ecosystem Health Objectives and Strategies

### Objectives – What we are working to accomplish

- Improve governance of marine resources to ensure long-term sustainability of marine ecosystem services.
- Characterize cumulative impacts and develop a scientifically valid way of identifying and prioritizing stressors that need to be reduced. Create practical ways to reduce cumulative impacts.
- Apply emerging insights from theory and practice in coupled human-natural systems research to improve the sustainability of marine ecosystems.
- Provide marine managers with the guidance they need to develop appropriate ecosystem thresholds and performance standards for management of multiple human activities and indicators for tracking whether the thresholds and standards are being met in a given area.

### Strategies – Our way of getting there

- By synthesizing and translating the science of ecosystem-based management, we generate new methods to enhance governance and decision-making for coasts and the ocean.
- Through partnerships and problem solving with experts from multiple communities, (such as research scientists and marine and coastal managers) further develop ways for achieving ecosystem resiliency. This includes the development of practical measures of ecosystem health and identification of important thresholds.
- By convening and facilitating exchanges between agency decision-makers and scientists to share the current state of scientific understanding of cumulative impacts and existing practices, create breakthroughs for reducing cumulative impacts.
- Through courses and networking opportunities, provide leadership development for fisheries managers and policy makers.

**COS is actively evaluating the following innovative approaches to reducing commercial fisheries bycatch and improving the management of pelagic predators in the Pacific.**



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#### Bycatch

- **Produce a global map of “bycatch potential” based on available oceanographic and biological data. Publish a bycatch map and solicit feedback for ground-truthing our model.**
- **Solve policy, capacity, and legal issues impeding compensatory mitigation of sea turtle bycatch in Mexican gillnet fishery based on revenue from Hawaii-based longline fleet and facilitate implementation.**

#### Pacific Pelagics

- **Apply Tagging of Pacific Predators (TOPP) data to produce the next generation of spatially explicit stock assessments and management recommendations.**
- **Analyze governance of Pacific pelagic fisheries and identify opportunities for improving long-term sustainability of these fisheries. Develop recommendations for management, including enabling conditions for improved management.**

# Focal Area 2: Climate Change

## COMMUNICATING ABOUT CLIMATE CHANGE IMPACTS

Through a NOAA grant, COS is collaborating with Dr. Susanne Moser, a social scientist with UC Santa Cruz, to evaluate regional public attitudes, levels of understanding, and opinions about adapting to climate change impacts. The research will fill significant gaps in fundamental understanding of climate change communications including how lay audiences perceive, think, and feel about local impacts of climate change, what they think about various adaptation options, and what types of communication would be resonant and motivational to them to engage constructively on this topic.

### Applying our Communications Research

In 2011 COS and the Monterey Bay National Marine Sanctuary led the first Monterey Bay region-wide discussion on coastal climate change adaptation. Over 90 coastal decision makers from the region participated in the one-day workshop. The workshop design was informed by a survey of the local decision making community's perceptions of climate change, their understanding of how climate change will affect their work and region, and what they are doing, if anything, based on their understandings. COS included members of the target audience in the workshop advisory team as well as scientists, federal government experts and NGOs working on adaptation.

Through our Climate Change Initiative, COS is working with both research and decision making communities to advance our collective understanding of how climate change affects the dynamics in ocean and coastal systems. We are also working to communicate and translate these changes and to help coastal communities adapt effectively for long term sustainability. Climate change is an integrative challenge that will directly inform our strategies and approaches within the Ecosystem Health and Land-Sea Interaction focal areas.

### Climate Change Adaptation in Monterey Bay

One region in which COS is actively working to help decision makers adapt to the impacts of climate change is the Monterey Bay area. To minimize the economic and social losses associated with projected impacts of climate change, an increasing number of local governments in the Monterey Bay area are interested in incorporating actions to prepare for and adapt to these changes in their long-term plans. Making informed decisions requires effective communication of reliable information and systematic comparison of the advantages and drawbacks of both natural and engineered solutions. By strategically choosing alternatives that minimize costs and maximize a wide range of benefits and long-term options, government decisions can ensure the protection of people and property as well as the full suite of benefits natural habitats provide, including beach-going, ocean tourism, storm buffering and healthy fisheries.

Based on relevant expertise within COS as well as the physical location of COS partners in Monterey, the COS team is ideally positioned to collaborate with decision making communities in the Monterey Bay area to promote regional adaptation to climate change. The needs of decision makers highlight the value of a credible and easily accessible source of information on this topic.

### Corals and Climate Change

As sea levels increase, temperatures rise, and oceans acidify, the world's coral reefs face numerous threats. Added to these global problems are local issues such as polluted run-off from land, overfishing, and habitat destruction of mangrove forests and on reefs. Reef building corals provide critical ecosystem services: habitat for thousands of species including many that provide important fisheries resources, coastal protection from storms and waves, recreational opportunities for local people and tourists, species of medicinal use, and other benefits. As simple organisms with thin tissues spread over large surfaces, they are particularly sensitive to their environment.

COS scientists and researchers are among the leading experts internationally on coral reef ecosystems. Our strength will be combining this expertise with our ability to work within social and governance institutions to develop practical approaches to improve coral reef ecosystem resiliency in the face of climate change.

### Pacific Pelagics and Climate Change

Open ocean wildlife, including tuna, sharks, marine mammals, turtles, and seabirds have been extensively studied by COS researchers. To conserve these top predators, we need to understand and model their movements and aggregations. But we also need to understand how these relationships may change due to climate change. COS is working to integrate this emerging science with analysis of legal and policy frameworks to enhance protection of these highly valued species.



## Climate Change Objectives and Strategies

### Objectives – What we are working to accomplish

- Define what “successful adaptation” to climate change is in the coastal context.
- Catalyze research and actions in Pacific coastal communities that promote adaptation to climate change yielding resilient social, economic, and ecological systems.
- Deliver timely, relevant information about changes occurring in coastal and marine systems to help policy makers and managers make decisions for long-term viability of ecosystems including human communities.

### Strategies – Our way of getting there

- Through the engagement of both research and decision making communities, advance our collective understanding of the expected impacts on ocean and coastal systems that climate change will produce.
- Using social science research methodologies, we explore the efficacy of communications techniques around climate change.
- By convening the brightest minds across multiple disciplines (such as paleontologists, oceanographers, marine ecologists, social scientists), understand big shifts and discern the potential for natural systems to adapt in the face of climate change.
- Through the deployment of new technologies, measure and effectively report change in the nearshore coastal ocean.

## WHY OCEAN ACIDIFICATION MATTERS

Meg Caldwell



MBARI Senior Scientist Jim Barry.

Worldwide, the ocean has become about 30% more acidic since the Industrial Revolution as a result of the chemical byproducts of modern industrial activity.<sup>1</sup> Referred to as “ocean acidification,” this phenomenon will alter coastal and ocean ecosystems in ways we are just beginning to understand, and is likely to have adverse effects on many commercially important calcifying organisms like oysters, urchins and mussels.

COS staff collaborated with ocean acidification experts and managers on an article titled “Mitigating Local

Causes of Ocean Acidification with Existing Laws,” published in the journal *Science* in May 2011. The *Science* article and background reports prepared by COS provide a legal roadmap for tackling local ocean acidification hotspots at state and federal levels. COS presented this work with MBARI Senior Scientist James Barry at several conferences and meetings through the spring and fall of 2011, and jointly with COMPASS\* in Washington, DC, and Sacramento, CA. COS has brought this work into the MARINE\* program and will continue to work with representatives from the shellfish industry, water quality regulators, and the California Ocean Science Trust to build awareness among decision makers of both the problem and solutions. COS is also working with MBARI and the greater Monterey Bay community to host the international Oceans in a High CO<sub>2</sub> World Conference in 2012.

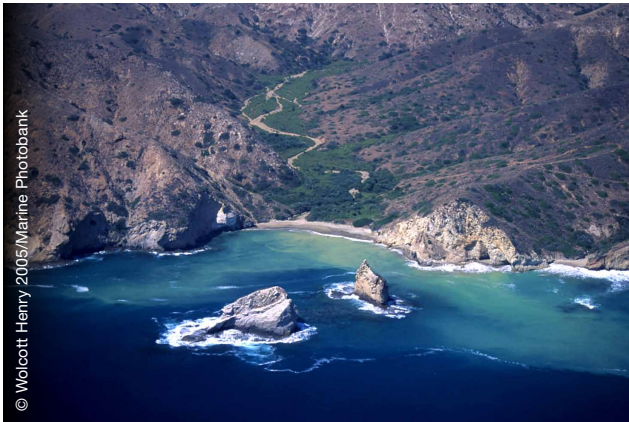
<sup>1</sup> S. Doney, The Growing Human Footprint on Coastal and Open-Ocean Biogeochemistry, 328 *Science* 1512 (2010).

\* COMPASS: Communication Partnership for Science and the Sea  
MARINE: Monterey Area Research Institutions' Network for Education

## ESTABLISHING A KELP FOREST RESEARCH PLATFORM IN MONTEREY BAY

COS and MBARI researchers are working with Hopkins Marine Station on developing a nearshore Marine Life Observatory aimed at providing data on climate change impacts to local ecosystems suitable for use by local and regional agencies. The objectives of this system are two-fold: (1) to provide a platform for cutting-edge climate change science in nearshore ecosystems, and (2) to identify critical data gaps and best practices for interpreting data into policy-relevant information. In addition to development, installation, and operations of the observatory, COS will host dialogs between the observatory researchers and local agency representatives. This interaction will help researchers incorporate needed instruments and develop data analysis, delivery and visualization techniques that will make data accessible, informative, and policy-relevant.

# Focal Area 3: Land-Sea Interactions



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The coastal ocean represents the major interface between humans and the marine environment, making coastal ecosystems those most heavily impacted by human activity. Due to the complexity of this topic, our Land-Sea Interactions initiative is still emerging. Initial exploratory projects include a coastal pathogens project focused on rapid detection methods and technologies and a hypoxia working group. COS's proposed cumulative impacts work also directly addresses multiple stressors from ocean and land-based activities and uses. COS is ideally suited to both unravel thorny land-sea problems and help decision makers identify and evaluate ways to solve these problems.

COS uses interdisciplinary collaborations to achieve practical understanding and to innovate enduring solutions for problems that arise at the land-sea interface. The problems are extraordinarily complex, especially from a human institutions standpoint. The Monterey Bay Aquarium brings deep knowledge of the life support systems required (either in captivity or in the wild) for keystone species, like the sea otter. MBARI brings far-reaching technology, engineering know-how, and coastal water quality experience. Stanford brings an extensive network of civil and environmental engineering coastal contaminant experts, coastal community public health innovators, and law and policy experts to the collaboration.

## Marine Pathogens

The Rapid Detection of Marine Pathogens Project aims to address human health issues related to coastal water quality by developing new analytical techniques and technologies for the timely, in-situ detection of human pathogens and fecal indicators in coastal waters. In pursuit of this goal, COS has partnered with MBARI to detect pathogens in seawater using MBARI's Environmental Sample Processor (ESP). Real-time results will provide accurate and timely microbial water quality information, which will in turn inform decisions to issue beach warnings and closures and thus improve public health protection. The detection of pathogens and pathogen indicators using this technology potentially has a wide range of applications, from water quality source tracking, to aquaculture siting, to homeland security.

## Hypoxia

Hypoxia is an escalating threat in the world's coastal waters, with severe consequences for marine life and ocean economies. Time series analyses have highlighted declines in dissolved oxygen concentration (DO) in the ocean over the last several decades. In addition to the global and regional trends of decreasing DO, recently documented hypoxic events in shallow, coastal locations are of special concern because they impact coastal species and ecosystems that support important economic sectors. In the California Current ecosystem, oceanographers have documented that the deep oxygen minimum zone is now shoaling. Nearshore oxygen levels are also declining, perhaps due to limited, but highly nutrient rich runoff from land. Climate models suggest that upwelling will intensify in the California Current providing increased cold, nutrient rich water that could enhance productivity. Unfortunately, the trends also indicate that upwelled water is likely to be oxygen poor and increasingly acidic.

## Land-Sea Objectives and Strategies

### Objectives – What we are working to accomplish

- Demonstrate the viability and affordability of new technology and analytical methods for rapid detection of coastal pathogens.
- Enable the delivery of timely information about coastal pathogens and other contaminants to public health officials and coastal resource managers.
- Foster the development and implementation of new water quality monitoring standards to better protect humans and wildlife.
- Understand the extent and frequency of hypoxic events in the coastal ocean.

### Strategies – Our way of getting there

- By working in parallel with federal and state laboratories, prove the viability of new technologies and methods.
- Through convening working groups, look at critical issues such as deepwater and anthropogenic coastal hypoxia.



Transporting ESP to Santa Cruz Wharf with MBARI ESP group (Scott Jensen, Douglas Pargett, COS Early Career Science and Engineering Fellow Kevan Yamahara, and Christina Preston).

## INTER-LAB CALIBRATION STUDY

A collaborative work plan with MBARI, NOAA\* Labs and SCCWRP\* for the next 12 months includes an inter-lab calibration study designed to understand the technical feasibility of using the Environmental Sample Processor (ESP) for regulatory water quality monitoring, by comparing the performance of the ESP against the performance of traditional laboratory equipment using an anticipated EPA method for evaluating water quality. The work plan also includes an experiment to compare the performance of ESP nucleic acid extraction methods to accepted laboratory methods. This experiment is technically and logistically complicated and requires significant effort from MBARI and several ESP units for testing.

\* NOAA: National Oceanic and Atmospheric Administration  
SCCWRP: Southern California Coastal Water Research Program

# Leadership Development and Education

For the vision of COS to be realized, it is critical to equip decision makers and emerging leaders with the skills they need to make decisions that lead to long-term health of the ocean. Leadership and education is an underpinning of our work and cuts across the three focal areas. Every COS strategy has a leadership development and education component. The COS Leadership Development and Education team and Communications staff work with each strategic initiative and individual project team to build strategic outreach and education facility into every project. In addition, COS collaborates on two core leadership development and education programs:

- **Fisheries Leadership and Sustainability Forum.**  
Our flagship decision maker outreach project.
- **MARINE.** This multi-educational institution program targets ocean-focused graduate students and post-doctoral scholars in the Monterey Bay area and Stanford's main campus. These scholars are emerging ocean leaders.



COS Science Director Larry Crowder briefs Fisheries Forum on coastal and marine spatial planning.

## The Fisheries Leadership and Sustainability Forum (Fisheries Forum)

The fishery management system in the U.S. is designed to put citizens and stakeholders in charge of policy. Federal law governing fisheries management requires that NOAA train new council members. The NOAA training provides an operational orientation to the council system, imparting basic information to help council members navigate the process and just briefly addresses some fundamental technical and scientific concepts. The Fisheries Forum serves as a complement to the NOAA

training and has the adaptability to address current topics and provide a wide range of skills to help council members be effective leaders in fisheries management and conservation.

The Fisheries Forum partners include: Stanford's Woods Institute for the Environment; Duke University's Nicholas Institute for Environmental Policy Solutions; the Center for Ocean Solutions; and Environmental Defense Fund, Incorporated.



The September 2011 West Coast Fisheries Forum Workshop.

## Monterey Area Research Institutions' Network for Education (MARINE)

MARINE is a COS-led collaboration to enhance graduate and post-graduate marine education around Monterey Bay that brings together graduate students, postdocs and faculty from seven regional academic institution campuses:

- CSU Monterey Bay
- Hopkins Marine Station
- Monterey Institute of International Studies
- Moss Landing Marine Laboratories
- Naval Postgraduate School
- Stanford University
- UC Santa Cruz

MARINE facilitates exchange among these institutions and provides an array of inter-institutional activities such as interactive and interdisciplinary courses, seminars, and workshops. These opportunities help graduate students and post-graduates apply their academic training to ocean challenges and engage in real world problem-solving.

The vision of MARINE is to equip Monterey Bay area graduate and postgraduate scholars with skills to be ocean leaders and communicators by:

- Training students to contribute to environmental decision-making and shaping the students' leadership and communications skills early in their careers.
- Exposing students to professional development and networking opportunities.
- Nurturing the growth of MARINE as a networked community of students, postdocs and faculty who focus on ocean and coastal science and policy.

MARINE short courses and workshops generally revolve around a common theme that may change annually or bi-annually. Land-Sea Interactions is the primary theme for MARINE over the 2012–2013 academic years. COS staff coordinate MARINE and are spearheading the effort to develop a course “passport” system for students to formally enroll in courses from any of the other six institutional campuses without bureaucratic hassle. Finally, COS is working with its faculty and student MARINE liaisons to develop a fellowship-style approach for the MARINE program so that “alumni” of the program are able to leverage their successful completion of MARINE short courses and workshops as well as draw on the MARINE network of graduate students and faculty as they progress through their careers.

### OCEAN POLICY COURSE

**This two-week, intensive in-residence course co-led with the Monterey Bay Aquarium, introduces graduate students in the natural and social sciences to ocean policy and governance and how science influences public policy decisions at the international, national and state levels. Students learn about pressing challenges to ocean health, and, together with leaders in ocean science and policy, examine how scientists can work with the policy-making process to address these challenges. The course uses urgent ocean policy issues, such as ocean acidification and fisheries management, to demonstrate the complexity of ocean-related decision-making. Students examine the roles of natural science, social science, and government institutions in ocean management. Students engage with experts in ocean science and policy and participate in field trips**



COMPASS Director of Science Policy Outreach, Chad English trains the course participants on science communication for policy makers.

**and group projects. Students also learn how to communicate with ocean policy makers and journalists through hands-on practical exercises and coaching.**



# Measures of Success

Konstantin Tkachenko/Marine Photobank

COS is developing detailed numeric targets, wherever possible, for the below metrics. We will revisit and refine these metrics over the life of the plan.

## MEASURES OF SUCCESS (1–3 YEAR METRICS)

- Build and secure strong relationships across disciplines, geographies, and decision-makers.
- Achieve recognition as a resource for trusted, non-partisan information and problem solving.
- Apply research-based approaches and methods for exploring problems, root causes, and collaborative problem-solving.
- Share findings and solutions and demonstrate their application with managers and decision-makers through white papers, articles, “how to” guides, presentations, professional and academic journals, and through direct engagement.
- Advance leadership skills for up-and-coming and established decision-makers.

## MEASURES OF SUCCESS (3+ YEAR METRICS)

- Sustained engagement by key partners including government, NGOs, foundations and business.
- Uptake of recommendations on how to apply ecological and social science advancements to current decision making.
- Test and implement the new approaches and methods for solving problems.
- Based on key learnings from COS engagements, approaches, etc., continue to develop and apply new ways to work and innovate.
- Apply new models for leadership development and incorporate successful existing models as integral components of COS projects.
- Advance policies that represent the vital linkages between ocean and human health and climate.

COS operates in a dynamic geopolitical and biophysical context and understands that we may need to adjust our priorities in light of changed or changing conditions in order to achieve long term goals.



Photo: Schooling fish. Richard Wylie/Marine Photobank.  
Back Cover Photo: Bigeye Trevally, *Caranx sexfasciatus*, spawning. Octavio Aburto-Oropeza/Marine Photobank.



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