



SCIENCE SERVING COASTAL COMMUNITIES

FY22-FY26

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U.S. DEPARTMENT OF COMMERCE | NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION |
NATIONAL OCEAN SERVICE | NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

LETTER FROM THE DIRECTOR

Curiosity. Creativity. Commitment. Innovation. Diversity of thought and perspective. Acceptance of a bit of risk. A dash of daring. Being willing to challenge the status quo. These are the hallmarks of both the scientific process and, to a large extent, the individuals that have been called to a career in the sciences. To this list I will add service, as we are a government agency that provides information and tools for the public good. We need to embrace each of these traits to be successful as individuals and as an organization. This strategic plan outlines how the National Centers for Coastal Ocean Science will foster that success and create an environment in which our scientific, business operations, and communication staff can thrive.

Science Serving Coastal Communities: FY2022–2026 articulates our six priorities for the next five years:

- Advancing Ecosystem Science for Conservation and Sustainable Use
- Developing and Implementing Advanced Observation Technologies and Ecological Forecasts
- Facilitating Resilience and Adaptation to Inundation and Climate Impacts
- Detecting, Monitoring, and Mitigating Impacts of Chemical and Biological Stressors
- Advancing Social, Economic, and Behavioral Approaches to Coastal Stewardship
- Investing in our People and Achieving Organizational Excellence

These will guide our investments in research, facilities, and our people. They will also be the basis for partnership development and inform how we strategically staff the organization, including efforts to diversify our workforce and foster an inclusive atmosphere.

Arguably, the demand for coastal science has never been greater. The human population living in coastal communities and the associated demands on coastal ecosystems are projected to increase. So too are ocean-based industries with economic activity along our coasts, including residential and commercial development, marine transportation, tourism, energy, and food production. A changing climate will continue to impact where and how citizens live and their quality of life, such as what they do for a living and how they choose to recreate. And, our nation's environmental legacy will be influenced by the thousands of decisions that are made on a daily basis. This is the context within which we conduct our science—one that is full of challenges, but also rich with opportunities to make scientific advances that meaningfully contribute to society.

With this background, I invite you to explore *Science Serving Coastal Communities: FY2022–2026* and learn what NCCOS seeks to achieve over the next five years!



Steve Thur, Ph.D.
Director
National Centers for Coastal Ocean Science



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NCCOS VISION: SCIENCE SERVING COASTAL COMMUNITIES

NCCOS MISSION:

The National Centers for Coastal Ocean Science delivers ecosystem science solutions for stewardship of the nation's ocean and coastal resources in direct support of National Ocean Service (NOS) priorities, offices, and customers to sustain thriving coastal communities and economies.

NCCOS VALUES

Value #1. We stand for scientific and professional integrity

- We conduct our business in accordance with the highest standard of professional behavior and ethics.
- We conduct our science in a manner that ensures objectivity, reproducibility, and accessibility of data and freedom of scientific expression.

Value #2. We serve the American people by making a difference in all we do

- We strive to contribute to a sustainable, healthy coastal environment that strengthens communities and ecosystems.
- We maintain a strong fiduciary responsibility and utilize our resources intelligently and with purpose.

Value #3. We value people and embrace diversity

- We appreciate the perspectives, attributes, and contributions of staff, colleagues, partners, and stakeholders.
- We treat everyone with respect, civility, and dignity and actively create an inclusive, supportive, and welcoming workplace.
- We support a healthy work-life balance.

INTRODUCTION

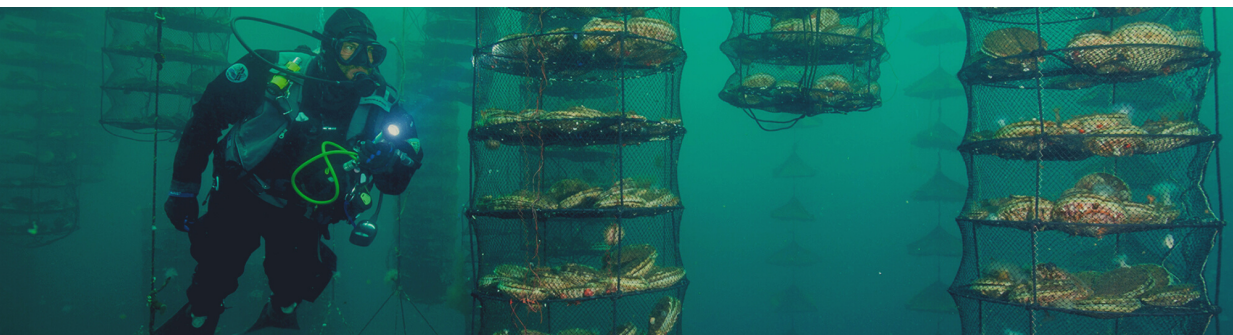
The complex challenges of sea level rise, coastal flooding, harmful algal blooms (HABs), and water pollution, among other hazards, pose increasing risks to coastal communities. In the five-year period spanning 2016–2020, weather and climate-related natural disasters cost the U.S. over \$616 billion. Losses of this magnitude are projected to become commonplace due to a changing and increasingly turbulent climate. The expected increases in the severity of coastal hazards will reshape our coastal ecosystems, and the coastal communities and economies that rely on them. The concentration of human activities on our coasts leads to additional pressure and inevitable competition over the use of our natural resources for commerce, food, energy, recreation, and conservation. With 40 percent of the U.S. population living in coastal counties and projected to increase, it is clear that a significant portion of the nation’s population, including some of the most disadvantaged communities, are increasingly vulnerable to these coastal hazards.

Providing evidence-based science products and tools that support informed decision-making is at the heart of NCCOS’s mission. Our stakeholders look to us to provide relevant, timely, and actionable products and tools they need to make informed decisions. We conduct nationwide, multidisciplinary research that integrates a broad spectrum of physical, biological, chemical, and social sciences to inform and guide resource and community managers, while seeking a balance among resource use, economic development, restoration, conservation, and human health. For example, our marine spatial planning products inform offshore aquaculture and wind energy placement, sanctuary site designations, and community vulnerability. By providing science products and tools, NCCOS helps communities plan for, adapt to, and reduce risks from the multiple challenges facing coastal communities. NCCOS’s mission has never been more important than it is today.

Over the next five years, the 2022–2026 Strategic Plan outlines our six science and organizational priorities that will guide our prioritization and the alignment of our internal and external science portfolios. Equally important, to provide flexibility in research plans and encourage innovation, these priorities will be used to develop NCCOS’s Priority Research Plans and support our Programmatic Approach to Funding each year. These priorities will also directly inform external funding opportunities during this time.

Solutions to the multi-faceted challenges of the 21st century require making strategic investments, organizational excellence, and innovative methods and approaches. As part of our strategic investments, NCCOS will focus on increasing the diversity of our staff and cultivating an inclusive culture that encourages different perspectives. We support NCCOS staff to be innovative in their area of expertise—both scientific and business operations—to achieve organizational excellence and advance scientific objectives.

Finally, NCCOS remains committed to the highest standards of scientific integrity to provide science products, tools, and information that are evidence-based, free of political influence, and produced by the best available science and data as described in the 2021 [Presidential Memorandum on Scientific Integrity](#).



NCCOS STRATEGIC PRIORITIES

NCCOS was formed in 1999 as the focal point for NOAA's coastal ocean science efforts. NCCOS helps NOAA meet its coastal stewardship and resource management responsibilities by working closely with coastal managers and other stakeholders to determine research needs and ensure the science and research products we are delivering are valuable to their decision-making and society. Our stakeholders are often engaged in our project planning and execution, and provide guidance throughout the research process to ensure our products meet their needs. NCCOS science is guided by NOAA's legislative mandates, executive orders, and NOS priorities, as well as stakeholder engagement. NCCOS's research integrates a broad spectrum of physical, biological, and social sciences to inform and guide resource managers seeking a balance between resource use, economic development, restoration, and conservation. Over the next five years NCCOS will focus on the following science priority areas. It is important to note that due to the dynamic nature of coastal ecosystems and management needs, sub-priorities may change over time.



NCCOS PRIORITY — ADVANCING ECOSYSTEM SCIENCE FOR CONSERVATION AND SUSTAINABLE USE

NCCOS is a nationally recognized leader in conducting management-driven ecosystem science in the nation's oceans, coasts, and Great Lakes, including coral reefs, estuaries, National Marine Sanctuaries, and National Estuarine Research Reserves. Ecosystem science is the study of interrelationships among living organisms, physical features, biogeochemical processes, natural phenomena, and human activities. Ecosystem-based management approaches are required to link natural and social-economic systems to support resource management. NCCOS will continue to advance ecosystem science by using innovative technologies and ecological modeling to develop products that support coastal managers.

The Ecosystem Science priority is broad due to the complex nature and geographic extent of coastal ecosystems and the myriad dynamic natural resource conservation issues. As a result, NCCOS has developed four sub-priority focal areas of importance to managers. These are

- Marine Spatial Planning (MSP),
- Habitat Mapping,
- Biogeographic/Ecological Assessments and Research, and
- Monitoring and Research in Coral Reef Ecosystems.

Coral ecosystems are called out given NCCOS's investments in corals and NCCOS's significant role in executing research supported by NOAA's Coral Reef Conservation (CRCP) and Deep Sea Coral Research and Technology Programs.

MSP is a process of analyzing and allocating the spatial and temporal distribution of human activities to balance ecological, economic, and social objectives for specific locations. The other three sub-priorities, and other parts of the NCCOS science portfolio, support the tenets of MSP and many other key aspects that inform ecosystem-based management. NCCOS's habitat mapping uses a suite of remote sensing technologies to acquire acoustic and optical data to develop digital species distributions and habitat maps. In addition, various technologies are used to assess and map ecosystem conditions, such as impacts of coastal pollution and location of marine debris. Defining the conditions of coastal environments and locations of human use activities, enables ocean industries (e.g., aquaculture, wind energy), regulators, and conservation planners to come together using common and authoritative data and information to make comprehensive MSP decisions.

Biogeographic assessments and research examine the spatial and temporal distributions of organisms, habitats, and the historical and biological factors that produce ecological patterns. Ecological assessments and research are more broad-based activities and range from defining the status of ecosystem components to determine baseline conditions to detecting change in those conditions over time. NCCOS's ecosystem science portfolio includes defining boundaries and evaluating the efficacy of marine protected areas (MPAs) (e.g., NOAA National Marine Sanctuaries) based on species home ranges and habitat use patterns (e.g., animal acoustic telemetry) and ecological connectivity research (e.g., larval transport and post-recruitment spillover, and marine mammal health assessments).

NCCOS is a major contributor to NOAA's CRCP's portfolio, serving the science needs of U.S. states and territories with corals. We conduct a suite of natural and social science investigations, including determining the impact of pollution and diseases on coral reef ecosystems, restoration science, and increasing our overall understanding of reef ecology. NCCOS continues to lead components of CRCP's National Coral Reef Monitoring Program, including monitoring of reef fishes, habitats, and understanding people's perceptions and uses of coral ecosystems. NCCOS is an active partner with the Deep Sea Coral Research and Technology Program through our scientific leadership of regional initiatives, participation in field expeditions, contributions



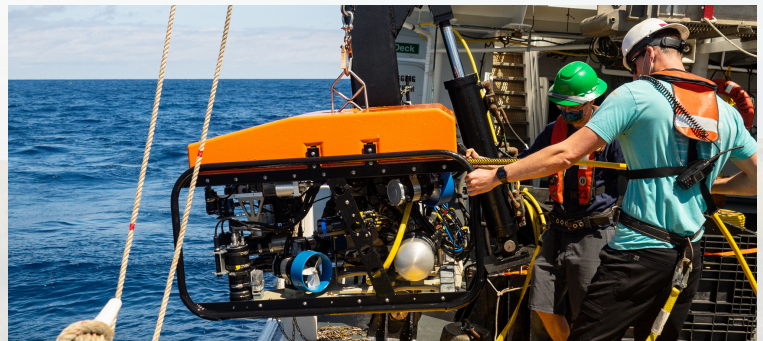
to research projects, and work in our laboratories to understand the biology and ecology of deep sea corals and their vulnerability to environmental stressors.

Given NCCOS's role to support the science needs of NOS, over the next five years, our research portfolio will include MPA assessments, coastal community and habitat vulnerability assessments, understanding habitat and ecosystem connectivity, mesophotic and deep coral research, predicting climate-related changes in species distributions and connectivity, and conducting science to support coastal resiliency and habitat restoration.

Habitat mapping products will continue to advance the use of machine learning techniques and artificial intelligence to increase the accuracy and efficiency in producing habitat maps. Many aspects of biogeographic and ecological assessments, research, and monitoring will continue to evolve, including advanced ecosystem models to forecast potential results of alternative management decisions. We will use new technologies for data collection to define the status and trends in conditions of coastal ecosystems. This will result in "big data" and analytics (e.g., imagery) requiring increased investments in data management. NCCOS will enhance our remote sensing capabilities through use of uncrewed systems (e.g., satellites, gliders, and drones) to monitor pelagic and benthic environments and evaluate habitat restoration activities. As part of NOAA's Natural Resource Damage Assessment (NRDA) response to the *Deepwater Horizon* oil spill, NCCOS has a significant role to map and restore mesophotic and deep benthic communities and support other science and restoration efforts associated with NRDA investigations.

ECOSYSTEM-BASED MANAGEMENT

NCCOS's Ecosystem Science portfolio supports the overall tenets of Ecosystem-Based Management (EBM) in the ocean across multiple spatial and temporal time scales. EBM is an integrated approach that recognizes a broad array of interactions within social-ecological systems (rather than considering single issues, species, sectors, or ecological services in isolation) and is guided by an adaptive management approach. The need to coordinate human uses of the ocean across sectors calls for ecosystem-based coastal and Marine Spatial Planning (MSP). MSP is a process of analyzing and allocating the spatial and temporal distribution of human activities to balance ecological, economic, and social objectives for specific locations. EBM requires MSP to empower decision makers to plan for increased investments in renewable energy, mitigate the impacts of climate change, support the blue economy, and increase conservation (e.g., marine protected areas). For example, NCCOS's MSP services recently provided data and maps that facilitated defining the location and designation of the Wisconsin Shipwreck Coast National Marine Sanctuary. NCCOS's MSP research and integrated ecosystem assessments advance the understanding of current and future human use patterns in coastal and marine waters and attempt to ensure high quality and relevant science is delivered in formats suitable for managers. NCCOS's Ecosystem Science activities will advance EBM through MSP, habitat mapping, and regional research, and will ensure data and information support management decisions to balance conservation and economic needs by minimizing resource use conflicts.



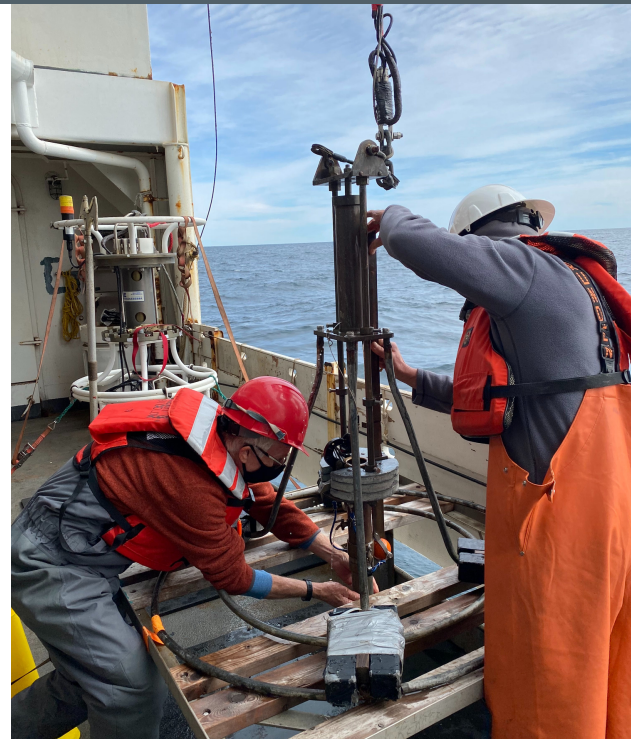
NCCOS PRIORITY — DEVELOPING AND IMPLEMENTING ADVANCED OBSERVATION TECHNOLOGIES AND ECOLOGICAL FORECASTS

Harmful algal blooms (HABs), hypoxia, and pathogens have major impacts on coastal and Great Lakes ecosystems and communities, and pose risks to economies, public health, and coastal resources, including protected wildlife. Climate change (e.g., sea level rise, warming oceans, extreme temperatures, changing precipitation patterns), coastal development and other environmental stressors, such as chemical contaminants, ocean acidification, and hypoxia, also drive coastal habitat and ecosystem changes that impact coastal communities. The delivery of timely, relevant, and actionable information and forecasts, allows coastal resource managers, public health officers, emergency officials, and the public to mitigate impacts to coastal ecosystems and communities.

Ecological forecasting is an interdisciplinary science capability that relies on observation technologies, the data they provide, and models to make predictions about ecological processes (i.e., the interrelationships among living organisms, physical features, biochemical processes, environmental drivers, natural phenomena, and human activities) and their impacts on people, economies, and communities. NCCOS is a leader in developing and providing ecological forecast products for HABs, hypoxia, pathogens, and coastal habitats to federal, state, tribal, local, and territorial authorities, as well as to the public, so that they can make decisions that protect and support thriving coastal economies, communities, and ecosystems.

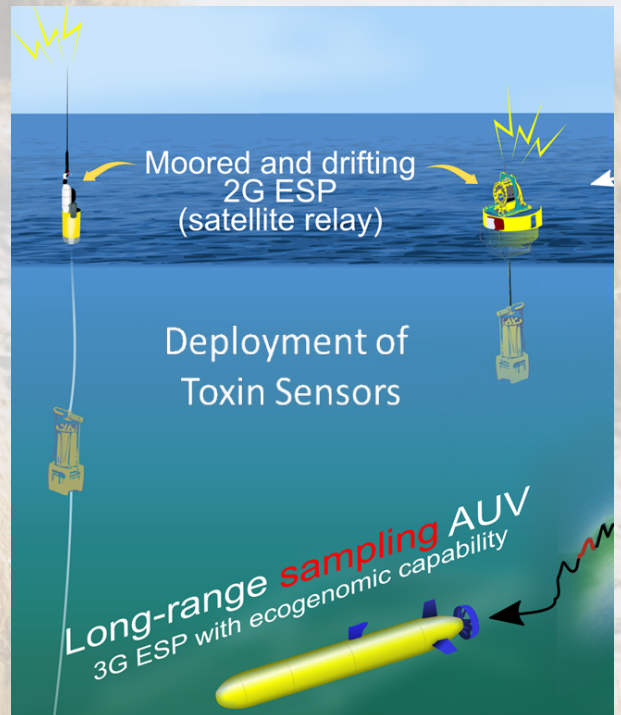
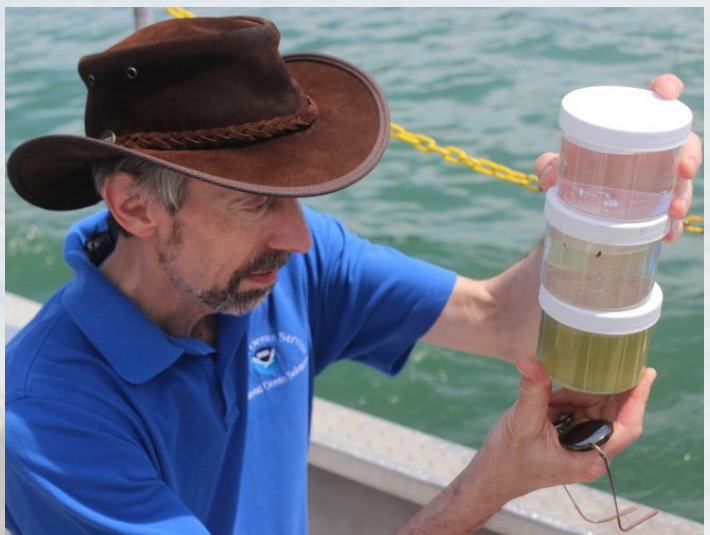
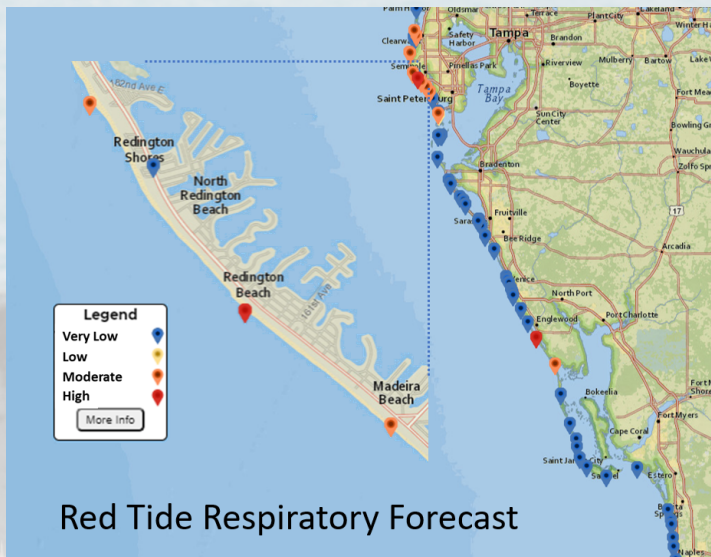
For FY22–FY26, NCCOS will strengthen its capability to predict *where, when, magnitude/severity, and socioeconomic impacts* of HABs, hypoxia, pathogens, and coastal habitat changes (which also determine the abundance and distribution of species) on coastal ecosystems, communities, and economies by investing in:

- Developing and using models that integrate a more diverse set of data (e.g., biological, physical, chemical, environmental, socioeconomic, spatial, temporal, etc.);
- Using advanced observation platforms such as satellites, uncrewed systems, and field-portable devices;
- Developing and deploying more capable and cost-effective passive and active sensors that deliver real-time data at finer spatial and temporal resolutions Reducing the time between data collection and processing to make data available for use in early warning systems and forecasts;
- Increasing the accuracy and extending the time period covered by forecasts;
- Expanding forecasting and observing capabilities to serve new regions and addressing emerging ecological concerns; and
- Integrating models (e.g., HAB, ocean acidification, hypoxia, pathogen, climate, biogeochemical, habitat, and socioeconomic models) that individually capture sub-components of coastal ecosystems and communities, but once linked and working together will deliver more comprehensive, powerful, and useful ecological forecasts.



HAB FORECAST AND OBSERVATION SENSOR TECHNOLOGY

Many coastal resources, communities, and economies are adversely affected by harmful algal blooms (HABs) to the tune of tens of millions of dollars annually. HABs occur in every coastal state, when algae proliferate, sometimes due to increased nutrient concentrations, warmer temperatures, and low water circulation. HABs produce toxins that can remain in freshwater and marine environments and accumulate throughout the food web, enter drinking water supply systems, and become aerosolized. These toxins: 1) endanger humans (with multiple forms of acute poisoning to longer term disease) and animals, including protected species, domestic animals, and pets; 2) foul public water supplies; and 3) reduce or block sunlight that is essential for the survival of many benthic marine flora and fauna. HAB forecasts integrate environmental, hydrographic, atmospheric, and biological data that are obtained using water and field sampling methods, and advanced observing/sensor technologies (e.g., satellites, uncrewed systems [aerial, surface, and sub-surface]), and artificial intelligence-assisted HAB identification technologies). Forecasts inform natural resource and water treatment facility managers, public health officials, aquaculture farmers, seafood harvesters, coastal communities, beachgoers, and the public on the size (i.e., spatial extent) and toxicity of HABs, where they are located and likely to go, and if they are likely to persist, or become more severe, so actions can be taken to minimize HAB impacts.



NCCOS PRIORITY — FACILITATING RESILIENCE AND ADAPTATION TO INUNDATION AND CLIMATE IMPACTS

Climate change alters coastal ecosystems and the services those ecosystems provide to coastal communities and economies. The increasing rate of sea level rise and frequency of extreme weather events means increasing damage to our coasts. Globally, natural disasters caused \$210 billion in damage in 2020, showing a growing cost of climate change. Losses of this magnitude are projected to become commonplace; 2020 was the 10th year in a row with eight or more weather events that each resulted in losses of \$1 billion or more in the U.S. A resilient community is able to prepare and plan for, absorb, recover from, and adapt to adverse events. NCCOS's research efforts inform resource management and policy decisions that support ecosystem services that improve a coastal community's resilience to the impacts of weather and changing climate conditions. NCCOS accomplishes this through timely and actionable scientific assessments, information, and tools to help coastal communities plan for and mitigate climate-related risks.

The NCCOS climate and resilience portfolio complements NOS capabilities and maintains partnerships within NOAA and with external stakeholders. NCCOS's science niche includes advancing understanding of ecosystem and community vulnerability to climate impacts and evaluating potential mitigation actions that include natural approaches. Projects regularly leverage water level observations and future water level scenarios delivered by NOS's Center for Operational Oceanographic Products and Services (CO-OPS) and collaborate with the Office for Coastal Management in stakeholder service delivery. Projects include coverage of National Estuarine Research Reserves and National Marine Sanctuaries, supporting management of NOAA's reserves and leveraging their regional networks.

Within this priority, NCCOS will focus on three sub-priorities:

- Ecosystem Change,
- Community and Ecosystem Vulnerability, and
- Restoration and Natural and Nature-based Features.

NCCOS will continue to support interdisciplinary research to advance our understanding of the vulnerability and value of wetlands, coral reefs, and other natural coastal infrastructure under varying sea level rise, storm, and adaptation scenarios. Quantifying the ability of natural and nature-based features to mitigate coastal inundation impacts and maximize protective value will be an increasing focal area. We will continue to expand our collaborations that support land management and engineering projects, translating science to inform action, particularly with the U.S. Army Corps of Engineers (USACE), Federal Emergency Management Agency (FEMA), and Department of Transportation. This research will emphasize the production of actionable science products, including models and tools, guidance documents, and visualizations.

In addition, we will evaluate climate impacts on ecosystems in combination with stressors identified in our other science priorities, such as the effects of increased ocean temperatures on harmful algal bloom distribution and changes in ecosystem system function. We will partner across NOAA to assess the compounding effects of climate change on other stressors such as acidification, hypoxia, and harmful algal blooms, particularly in already impaired systems and marine protected areas. Our research teams will continue to collaborate directly with state and local resource managers to ensure that our products meet their specific needs.



These efforts will build on and leverage the suite of science activities identified throughout this Strategic Plan. This will ensure that areas of emphasis, such as marine spatial planning and harmful algal blooms, are examined within the context of climate change to better facilitate adaptation to future conditions, impacts, and assess mitigation needs. A core component of this cross-priority integration will be incorporation of our human use, community vulnerability, and other social science with biological and physical science to provide coastal communities more holistic products to inform resilience and adaptation planning.

NATURAL SOLUTIONS FOR SEA LEVEL RISE MITIGATION

NCCOS ecosystem science capabilities include a focus on evaluating the response of coastal habitats to sea level rise and quantifying the ability of natural and nature-based features (NNBF) to mitigate the effects of sea level rise and inundation. NNBF are increasingly recognized as potential risk mitigation solutions that have the added benefit of providing a suite of additional ecosystem services. NCCOS is working to quantify the coastal protection and habitat benefits provided by NNBF relative to those of traditional shoreline protection approaches, like breakwaters and seawalls. Projects complement and leverage inundation data products and tools produced through other NOS offices, including: particular sea level rise scenarios, water level data, community engagement approaches, and installation or management of NNBF. This results in holistic NOS capacity that provides a suite of services that include a broad range of geographically representative habitats and communities, transferable capabilities and approaches to other relevant locations across the U.S., and the inclusion of co-benefits that provide a more holistic context to inform community decision-making.

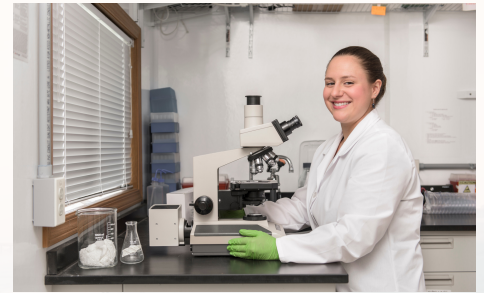




WHERE WE'RE LOCATED: NCCOS FACILITIES

NCCOS COOPERATIVE OXFORD LABORATORY

Centrally located in Chesapeake Bay on the Tred Avon River, the laboratory was established in 1960 primarily to investigate oyster diseases that devastated the fishery in the late 1950s. The facility became the Cooperative Oxford Laboratory in 1987 through an agreement between NOAA and the Maryland Department of Natural Resources to share the facility and cooperate in research. Partners include NOAA, (NCCOS and NOAA's Chesapeake Bay Office), Maryland Department of Natural Resources Fishing and Boating Services, and U.S. Coast Guard Station Oxford. The lab's assets include a 58-foot research vessel, a 500-foot pier, a designated oyster sanctuary for research, a seawater system, a challenge lab, BSL-2 labs, histopathology equipment (MD DNR), necropsy labs, and scuba capability.

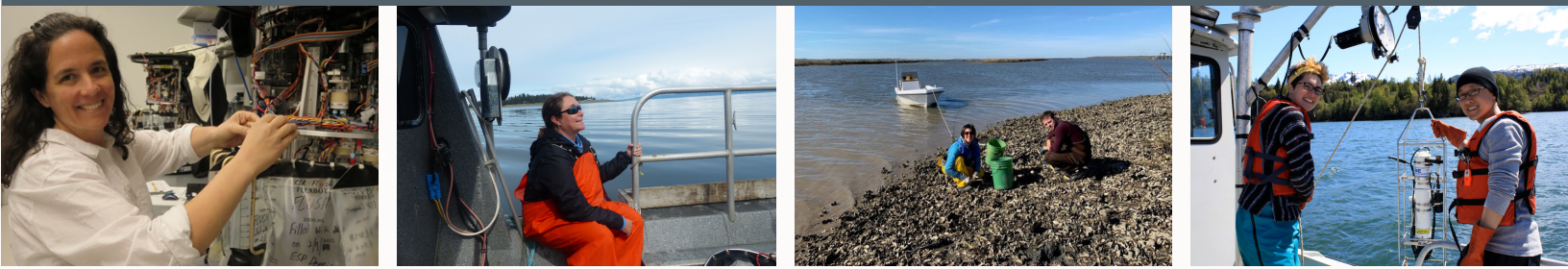


NCCOS HOLLINGS MARINE LABORATORY

HML is a NOAA-owned facility operated by NCCOS as a fully collaborative enterprise, governed by the five partner organizations through a Joint Project Agreement. HML partners consist of NOAA, the National Institute of Standards and Technology, the South Carolina Department of Natural Resources, the College of Charleston, and the Medical University of South Carolina. Scientists from all partner institutions work side-by-side in the laboratory, taking advantage of each other's special expertise.

HML was among the first to launch omics into the marine world emphasizing microbes, harmful algae, coral, aquaculture, and protected species. HML researchers move across omics domains of genomics (first time sequencing of more than twenty marine mammals and first microarrays for HAB species); transcriptomics (identifying transcriptome as the regulatory control for algal blooms), proteomics (protein markers for disease in humans and marine mammals and corals), and metabolomics (productivity analysis of multiple aquaculture species and temperature dependency of coral pathogens).





WHERE WE'RE LOCATED: NCCOS FACILITIES

NCCOS KASITSNA BAY LABORATORY

The Kasitsna Bay Laboratory has been the Alaska field station for both NCCOS and the National Marine Fisheries Service since the late 1950s. The University of Alaska Fairbanks helps NCCOS operate the lab. The facility includes a 1,400-square-foot, running seawater lab that hosts research on coastal impacts of climate change, ocean acidification, harmful algal blooms, and monitoring and change of nearshore biodiversity. The lab also serves as a testbed for underwater technology in high-latitude coastal ecosystems and under rugged conditions. This facility includes dormitory buildings with housing, kitchen, laundry, and internet for up to 48 people.



NCCOS BEAUFORT LABORATORY

The NOAA (NCCOS) Beaufort Laboratory, opened in 1899, is the second oldest federal marine laboratory and home to scientists from NOAA's National Marine Fisheries Service and National Ocean Service. Operated by NCCOS, this 60,000-square-foot lab on Pivers Island is recognized for a variety of research, including: harmful algal blooms, salt marsh ecology, coral reefs, seafloor mapping, and aquaculture planning. The lab also houses the North Carolina Coastal Reserve and National Estuarine Research Reserve, which serve as living labs for scientists and students to learn about coastal systems. The lab has a full SCUBA diving roster, small boats, seawater systems, high-tech labs for cell analysis, necropsy facilities, electronics workshops, a classroom, and a large auditorium.



NCCOS HEADQUARTERS SILVER SPRING

NCCOS leadership, scientists, and support staff are co-located with other NOAA offices in Silver Spring, Maryland. NCCOS employees plan, manage, and execute the budget; set information technology policy; and provide policy and communications support to NCCOS leadership in its internal and external partnerships and in its interactions with Congress. The program offices manage the Competitive Research Program and the NOAA RESTORE Science Program, and supervises or conducts science, research, and associated product development.



NCCOS PRIORITY — DETECTING, MONITORING, AND MITIGATING IMPACTS OF CHEMICAL AND BIOLOGICAL STRESSORS

Coastal ecosystems and communities are increasingly subjected to human-intensified stressors that degrade environmental quality and ecological integrity, and disrupt ecosystem benefits (e.g., food, water, economic, recreational, and cultural benefits) valued by the public. NCCOS conducts research and delivers scientific information and technologies to resource managers and public health officials for detecting, monitoring, and mitigating the impacts of chemical and biological stressors, including pathogens and harmful algal blooms (HABs) and their many toxins.

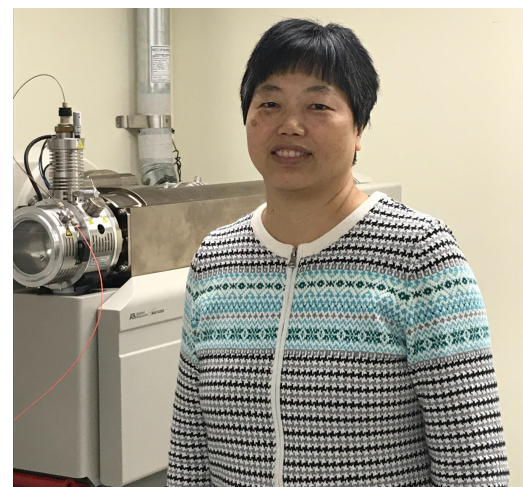
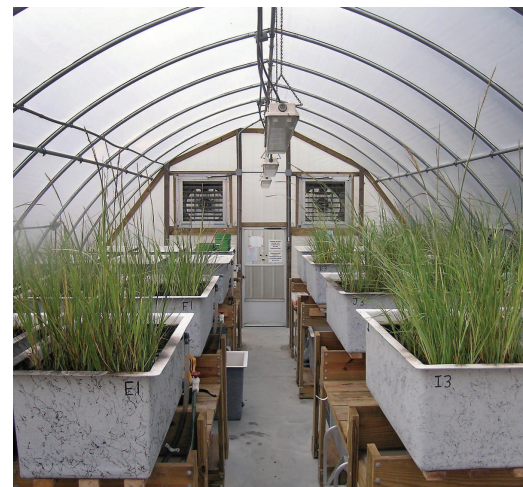
The detection, quantification, and monitoring of chemical contaminants and HAB toxins relies on NCCOS's advanced analytical capabilities (with biological, sediment, and aquatic samples), including bioassays and the development of validated methods and standards. These results are used to guide and validate ecological forecasts and are also entered into national and global reference databases. Test methods are transferred to local communities and resource managers to increase their capacity to monitor chemical contaminants and toxins in coastal ecosystems. In the case of the recreational and subsistence harvest of seafood in areas where HAB toxins (e.g., those responsible for paralytic shellfish poisoning) exist, accepted regulatory methods are provided to local authorities who determine if FDA food safety standards are being met.

NCCOS is a leader in determining toxicity thresholds and effects of chemicals on key coastal and estuarine species, corals, habitats, and the role of environmental factors (e.g., ultraviolet radiation, temperature, salinity) in exacerbating these effects. These efforts also support the evaluation and identification of chemical alternatives that have less of an impact on coastal ecosystems.

NCCOS develops technologies to prevent and control harmful algal blooms and adapt technologies and tools to restore water quality and coastal habitats impacted by oil spills. Research using marine species in their early life stages is also conducted to assess toxic and environmental threats present in ecological communities prior to the start of restoration activities.

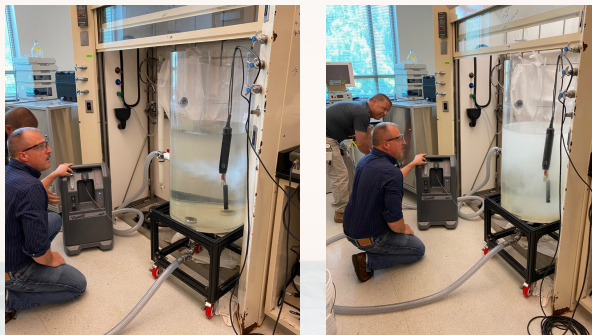
The following sub-priorities for FY22–FY26 will focus on the most pressing needs (including the identification of new and emerging threats) where NCCOS can have the most impact:

- Detecting, monitoring, quantifying, and assessing the impact of:
 - 1) priority chemicals (including crude oil, pesticides, personal care products, pharmaceuticals, flame retardants and microplastics, and their alternatives), ocean acidification, and hypoxia on coastal ecosystems;
 - 2) disease agents on corals; and
 - 3) the role of climate and environmental factors in exacerbating these impacts.
- Developing and validating HAB and toxin analytical methods and reference materials, advancing holistic approaches to understanding the causes and reducing the impacts of HABs and HAB toxins, ensuring community preparedness for HAB events, and supporting the transition of HAB control and prevention methods to application and commercialization.



NANOBUDDLE OZONE TECHNOLOGY (NBOT) COMBATS CHEMICAL AND MICROBIAL STRESSORS

Reducing chemical and microbial impacts where and when they are happening is one of the most challenging scientific requests from coastal communities. In response, NCCOS research has unleashed the unique biocidal power of ozone and placed it into a safe and targeted delivery mechanism of ultrafine microbubbles that is highly effective, but also ensures human and environmental safety. Through a Cooperative Research and Development Agreement, multiple companies are designing increasingly efficient and higher capacity NBOT components to test and demonstrate the best proprietary components that industry can engineer. Initially shown to be effective to eliminate harmful algal blooms with increasing scale of operation, NCCOS research has expanded NBOT application to a broad portfolio of chemical and microbial stressors, including pathogens and pollutants, to improve water quality, nutrients to prevent blooms from occurring, and elimination of invasive species in ballast water to protect biological diversity.

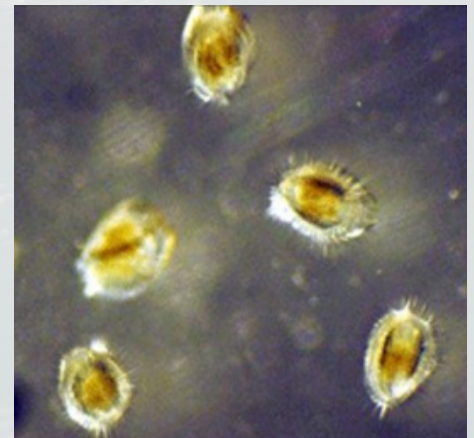


Nanobot 7.5 hp-60 treatment technology as installed at montreal pier facility. univ. wisconsin lsri/great waters research collaborative

Researchers scale up technology to reduce the introduction of algae, bacteria, and motile zooplankton invasive species in the Great Lakes (2021).

EVALUATING THE TOXICITY OF CHEMICAL ALTERNATIVES

Per- and polyfluoroalkyl substances (PFAS) are chemicals found in many commercial and industrial products and are known as “forever chemicals” based on their extreme persistence in the environment. Due to the harmful and persistent environmental impacts of these chemicals, there is a need to find PFAS-free chemical alternatives (e.g., PFAS-free fire-fighting foams). However, chemical alternatives, especially those that may occur in marine and coastal ecosystems, must be assessed for their toxicity to marine species. NCCOS assesses the toxicity of these chemicals, including quantifying bioaccumulation and establishing acute and chronic effects thresholds for fish, shrimp, oysters, and copepods. These toxicity data can inform decisions on the use of chemical alternatives and assist in the protection and conservation of coastal resources.



Oyster larvae in pfas toxicity tests

NCCOS PRIORITY — ADVANCING SOCIAL, ECONOMIC, AND BEHAVIORAL APPROACHES TO COASTAL STEWARDSHIP

Coastal ecosystems provide many benefits, known as ecosystem services, to coastal communities. These services can be categorized by the benefits they provide: cultural (e.g., recreation), regulating (e.g., nutrient removal), provisioning (e.g., food), and supporting (e.g., nutrient cycling). These ecosystems face many risks, including from climate change, and the interactions between humans and the ecosystems are becoming more complex. As an ecosystem's conditions degrade, its ability to provide these services is diminished, and dependent human populations become threatened. Coastal decision makers and the public need to understand and mitigate the risks and vulnerabilities not only to ecosystems, but also to the services they provide and the human communities that depend on them. Assigning a value—whether economic, social, or cultural—to the services provided by ecosystems allows managers to compare management options, such as whether to develop or conserve a natural area. It also makes communicating the value of ecosystems to policy makers and the general public easier. Additionally, communicating the risks through community engagement can yield a less vulnerable population.

NCCOS is uniquely positioned to apply social, economic, and behavioral approaches to support thriving and vibrant coastal communities, attending to their needs to support a diverse and flourishing economy, resilient infrastructure, secure food chains, social networks, and community well-being. As a leader in NOAA citizen science, establishing and engaging community networks, NCCOS continues to advance communities' understanding of the relationships between coastal ecosystems and human behaviors.

NCCOS research sub-priorities underpinning these science needs include:

- Ecosystem Service Valuation,
- Resilience and Vulnerability Assessments,
- Assessing Human Uses,

with a cross-cutting commitment to provide ecosystem solutions through highlighting and providing for the scientific needs of underserved communities.

The research priorities also include shared goals that include long-term monitoring of coastal community well-being (e.g., National Coral Reef Monitoring Program) and understanding the impacts of threats to ecosystem services and ways to mitigate those threats (e.g., integrated ecosystem assessments). NCCOS also develops tools and approaches to increase the capacity of coastal communities to adapt to changing coastal ecosystems, giving communities the information they need to assess climate-driven risks and tools to implement adaptation strategies. By engaging communities as stakeholders from the beginning, NCCOS ensures research goals will meet community needs. For example, NCCOS has an extensive stakeholder engagement strategy for climate vulnerability assessments to ensure the assessments meet community concerns and dovetail into local adaptation plans. Additionally, NCCOS is deploying harmful algal bloom toxin detection tools directly to communities that will help them address issues related to social, behavioral, and economic stewardship by providing safe access to marine foods and recreation waters.



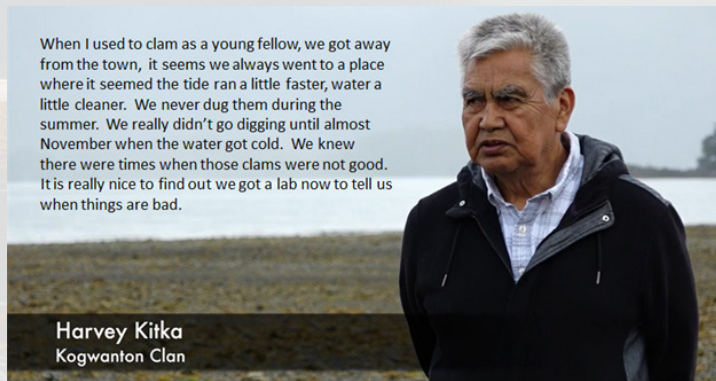
From FY22–FY26, NCCOS research efforts and priorities will continue to advance coupled social and natural sciences, emphasizing their interdependencies in light of changing climate and human needs, with a continued commitment to underserved communities and the unique economic and environmental challenges they face. NCCOS will continue to evaluate, measure, and map a wide suite of ecosystem services and vulnerabilities to meet the diverse ways in which communities value, depend on, and interact with coastal resources. Establishing and engaging community networks will advance the understanding of relationships between coastal ecosystems and human behaviors. Further, by providing training and technology transfer of tools and products, NCCOS will enhance access to the decision-making process and enable communities to consider a suite of risks in their mitigation and adaptation plans and consider new ones as they arise. These research efforts and priorities are tightly connected with NCCOS efforts to facilitate resilience and adaptation to inundation and climate impacts. By leveraging our ability to harness extramural expertise, NCCOS scientists will work collaboratively with partners and coastal managers to tailor research efforts to answer critical science needs.

SOCIAL SCIENCE IN SPECIAL PLACES

The NCCOS social science priorities support National Ocean Service special places, such as National Marine Sanctuaries, National Estuarine Research Reserves, and Habitat Focus Areas. These places are an opportunity for NCCOS scientists to understand how people use and interact with the coastal environment. They are living laboratories to measure values associated with a wide range of ecosystem services, such as recreational fishing along the Florida Keys Reef Tract and storm protection by coastal wetlands in the Northeast. In addition to special places, our work as a leader in NOAA citizen science and our community engagement also helps identify vulnerable and underserved communities to help address disparities in access to and use of the nation’s coastal spaces. Our vulnerability mapping project in Los Angeles identified communities that lack access to natural spaces and are at particular risk in the case of natural disasters, supporting local and regional managers in addressing these quality of life and health issues. NCCOS provides social science research—including, long-term monitoring, data synthesis, and primary data collections—for the assessments necessary for adaptive management of these places and supports management of the regions around them.



PARTNERING WITH TRIBAL COMMUNITIES



When I used to clam as a young fellow, we got away from the town, it seems we always went to a place where it seemed the tide ran a little faster, water a little cleaner. We never dug them during the summer. We really didn't go digging until almost November when the water got cold. We knew there were times when those clams were not good. It is really nice to find out we got a lab now to tell us when things are bad.

Harvey Kitka
Kogwanton Clan

"MY FAMILY HAS BEEN HERE FOR COUNTLESS GENERATIONS. SOME OF OUR EARLIEST STORIES GO BACK TO THIS: FOOD IS OUR LIFE. YOU TAKE WHAT'S THERE, YOU TAKE CARE OF IT, AND IT WILL TAKE CARE OF YOU. THAT'S OUR WHOLE PHILOSOPHY."

Harvey Kitka, Sitka Conservation Society "Voices of the Tongass." <https://www.seator.org/safe-shellfish/>

NCCOS is committed to inclusive, co-developed science that ensures tribal community ownership of products and services to meet local and regional needs. Understanding and incorporating local knowledge of natural areas and how non-marketed, traditional resources are used increases the social value of ecological research to the communities we serve. We support the development of community-led monitoring and forecasting capabilities for algal toxins in their subsistence, traditional, and recreational harvests. This includes facilitating phytoplankton identification trainings and workshops, expanding and validating toxin detection methods, and funding research that explores the transfer of HAB toxins within food webs. The Southeast Alaska Tribal Ocean Research (SEATOR) partnership is an example of a long-term outcome of these efforts. Since the SEATOR laboratory has been in operation, members of the 16 tribes have successfully avoided toxic shellfish beds with no human poisonings. Based on this success, regional programs have spread throughout Alaska tribal communities from the southeast to the Arctic, meeting specific tribal needs of aquaculture, dive fisheries, and place-based non-marketed traditional resources.

NCCOS PRIORITY — INVESTING IN OUR PEOPLE AND ACHIEVING ORGANIZATIONAL EXCELLENCE

Our commitment to our people and organizational excellence (i.e., standards, procedures, and practices for ensuring the effective use and management of our resources and assets and the motivation of staff to exceed expectations) ensures the successful delivery of scientific products and services of the highest quality. NCCOS applies innovative approaches to both research and science support functions and our staff, because their in-depth expertise and willingness to collaborate and contribute are sought after by a broad range of stakeholders and partners.

Our response to current and future environmental challenges, and our goal of supporting NOAA's mission and the U.S. economy, require strategic investments in our scientific portfolio in a holistic and systemic manner and the implementation of innovative recruitment strategies to meet diversity goals. With our commitment to training staff and modernizing our facilities and information technology (IT) infrastructure, we will ensure that we have staff, facilities (including research equipment), and an IT infrastructure with capabilities that will allow us to adapt and excel in meeting existing and emerging research and operational challenges. In the next five years, NCCOS will use its newly developed Strategic Workforce Plan to recruit and retain a workforce that reflects America's diverse population and cultivate an innovative culture in both the scientific and operational/business sides of NCCOS.

Resources include, but are not limited to, people, funding, facilities, and time. We will align and manage our resources with our scientific priorities through improved communication and a programmatic approach to funding research activities that are aligned with the NCCOS Strategic Plan. Investments in laboratories and facilities will be guided by a new Facilities Assessment Plan, and we will operate and manage our facilities as scientific assets in cooperation with co-located federal, state, and university partners. Safety, environmental stewardship, and security will be hallmarks of our facility operations.

We will expand our partnerships and strengthen our stakeholder engagement activities to improve our scientific capabilities and ensure that we are meeting the needs of coastal decision makers and the public. Increasing the diversity of the federal NCCOS workforce has begun with early career researchers through Special Hiring Authorities in the STEM disciplines. We will increase our ability to quickly and effectively respond to changing and emerging coastal environmental challenges by improving our business practices, in areas such as optimizing agreements with coastal managers and the extramural scientific research community, and by increasing resource sharing. NCCOS scientists and staff will provide support, guidance, and expertise to achieve cooperation and collaboration on scientific research with our partners.

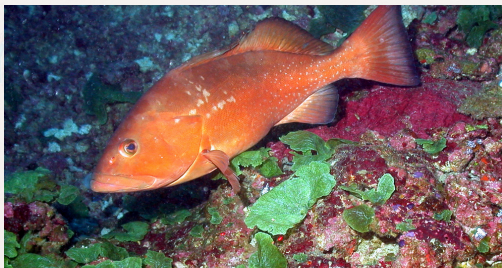
NCCOS is committed to communicating our science activities, findings, and products to the public, stakeholders, partners, NOAA leadership, and Congress. We will apply our expertise to inform coastal planning and management, federal policy and legislation, the scientific community, and the public (through social and traditional media). A cohesive communication effort is critical to develop consistent communication and outreach products for social and traditional media, web, internal and external information sharing as well as gathering input from public, stakeholders and partners to identify gaps in our efforts, identify opportunities, and ensure alignment with their ongoing or changing needs.



HOW WE DO OUR SCIENCE

INTERNAL AND EXTERNAL SCIENCE: A DUAL MODEL FOR SCIENCE DELIVERY

NCCOS uses a dual model for science delivery to coastal managers. Substantive internal science capacity is complemented by competitive external funding programs that use the expertise of scientists from across the country, including NCCOS scientists. NCCOS has over 200 active projects involving hundreds of internal and external scientists who actively engage with stakeholders to provide actionable coastal science products. While operated separately to maintain the competitiveness of external programs, these projects allow NCCOS science to cover a diverse portfolio in communities across every coastal state and territory. For example, NCCOS maintains a suite of capabilities that are available to assist state, local, and other partners in responding to harmful algal bloom events. These capabilities include direct funding support through the Event Response program, bloom forecast products, and analytical toxin detection services.



NOAA RESTORE SCIENCE PROGRAM

The NOAA RESTORE Science Program was authorized by the U.S. Congress in 2012 in the wake of the *Deepwater Horizon* oil spill to carry out research, observation, and monitoring to support the long-term sustainability of the Gulf of Mexico ecosystem, including its fisheries.

This cross-NOAA program administered by NCCOS offers an opportunity to improve our understanding of the Gulf of Mexico ecosystem and, simultaneously, use that knowledge to manage it sustainably. In practice, this means the program supports teams of resource managers and researchers who work together to produce science that helps answer the questions resource managers are facing.

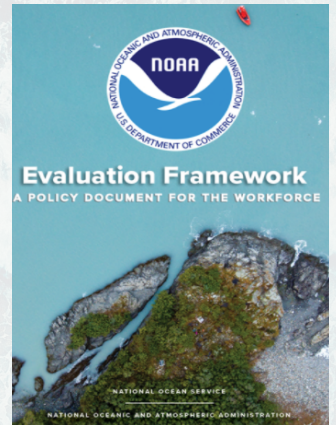
By investing in relationships, supporting actionable science, and promoting the practice of co-production over the next two decades, the Science Program is transforming over \$133 million of the penalties from the oil spill into applied ecosystem science in the Gulf of Mexico. In doing so, the program is building a community of resource managers and researchers committed to this type of work in the region.

The Science Program has led four funding competitions since 2012 and expects to run several more competitions over the next five years, including one on scientific synthesis in 2022.

To learn more about the program, please visit restoreactscienceprogram.noaa.gov.

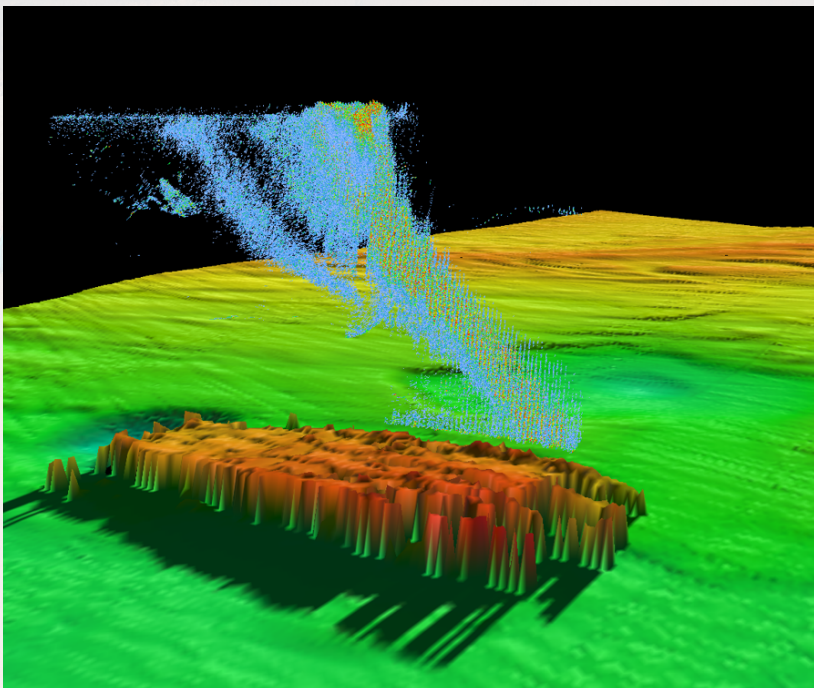
A CULTURE OF CONTINUOUS IMPROVEMENTS

NCCOS reviews and evaluates the quality, relevance, and performance of its programs to ensure that objectives are being met, and strengths and opportunities for improvement are identified based on feedback and insight from external experts and our partners. NCCOS adheres to NOAA's Administrative Order 216-115A for reviewing scientific and research programs and NOS's Evaluation Framework for reviewing business management practices and organizational structures. NCCOS is committed to a "culture of evaluation" to promote a cycle of continuous improvements.



A CULTURE OF TECHNOLOGICAL AND ORGANIZATIONAL INNOVATION

NCCOS recognizes the importance of innovation in the U.S. Government in each priority and all facets of our service. Within this framework we explicitly encourage technological and organizational innovation. We accept calculated risks that are often prerequisites for innovation, to more effectively and efficiently achieve our mission. Through our innovative culture, which we cultivate, we embrace and stimulate organizational innovation through dialogue, redefine success and failure, and reward innovative approaches to our work. In addition to building a culture of innovation through intentional communication on the subject and removing the disincentives that may have constrained innovation, NCCOS incentivizes creativity through two annual prizes: one each for technological and organizational innovation.



Innovation in acoustic technology: NCCOS scientists quantified oil and gas release at the MC20 site to originate from wells rather than from contaminated sediments. With this conclusion, containment and collection methods are now collecting approximately 30 barrels (1260 gallons) of oil per day.



NCCOS's investments in innovative approaches, such as cloud computing, have significantly increased our efficiency in running ecological and physical models, thus reducing the time needed to get products to coastal managers.

APPENDIX – STRATEGIC PLAN PRIORITY OUTLINE

1. Advancing Ecosystem Science for Conservation and Sustainable Use

- a. Marine Spatial Planning
- b. Habitat Mapping
- c. Biogeographic/Ecological Assessments and Research
- d. Monitoring and Research in Coral Reef Ecosystems

2. Developing and Implementing Advanced Observation Technologies and Ecological Forecasts

- a. HABs and Hypoxia
- b. Pathogens
- c. Coastal Habitat Changes
- d. Observation technologies

3. Facilitating Resilience and Adaptation to Inundation and Climate Impacts

- a. Ecosystem Change
- b. Community and Ecosystem Vulnerability
- c. Restoration and Natural and Nature-based Features

4. Detecting, Monitoring, and Mitigating Impacts of Chemical and Biological Stressors

- a. Priority Chemicals, Ocean Acidification, and Hypoxia
- b. Disease Agents on Corals
- c. Climate and Environmental Factors
- d. HAB and Toxin Analytical Methods and Reference Materials
- e. HAB Prevention and Control

5. Advancing Social, Economic, and Behavioral Approaches to Coastal Stewardship

- a. Ecosystem Service Valuation
- b. Resilience and Vulnerability Assessments
- c. Assessing Human Uses

6. Investing in our People and Achieving Organizational Excellence

- a. Cultivating Innovative Organizational Culture
- b. Aligning and Managing Resources Tied to our Scientific Priorities
- c. Leveraging Diversity and Inclusion for Mission Effectiveness
- d. Building and Strengthening Productive Partnerships and Engaging Stakeholders

COMMITTED TO COASTAL COMMUNITIES, COMMITTED TO THE FUTURE

