

Ocean Research Priorities Plan Synopsis

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The summary below highlights the main points of the ORPP and provides an explanation of the types of research that fit under each theme. Although it is based on the language of the plan, please be aware that the text is highly paraphrased: I have taken editorial liberties for the sake of brevity and in many cases I have rewritten or rearranged the material. This summary therefore reflects my personal bias, but I hope that it provides a useful overview of the ORPP. Please refer to the original document for more details or clarification (<http://ocean.ceq.gov/about/docs/orppfinal.pdf>).

Theme 1: Stewardship of Natural and Cultural Ocean Resources

The ocean is a source of food, minerals, and energy and is used for transportation, recreation, and tourism. It also preserves a record of the nation's cultural past. The ocean remains an unexplored realm with the capacity to provide new pharmaceuticals, industrial products, and energy sources. At the same time, its resources are subject to many pressures, such as overfishing, habitat destruction, and competition with invasive species. To unlock the full resource potential of the open ocean, coasts, coastal watersheds, and Great Lakes, society must improve understanding of these resources and balance their health and use.

Needed research in this area includes efforts involving sustainable resources, such as fisheries and alternative energy sources, and nonrenewable resources, such as fossil fuels and minerals

Research Priority 1: Assess the status and trends of resource abundance and distribution.

- monitor and map natural and cultural resources
- assess fish-stocks and status and health of protected resources
- monitor living resources (spanning multiple trophic levels)
- assess the spatial and temporal variability (both natural and use-induced) of resources (e.g., biota, energy, minerals, and pharmaceuticals)

Research Priority 2: Understand interspecies and habitat/species relationships.

- develop and validate ecosystem and species interaction models that incorporate feedback mechanisms among higher trophic levels;
- assess how environmental change (e.g., responses to climate drivers; rapid regime shifts; hydrodynamic circulation; watershed discharge) impacts resources
- evaluate the effects of natural resource policies on living resources and human communities

Research Priority 3: Understand human-use patterns that may influence resources.

- determine the "worth" of natural and cultural resources
- evaluate the socioeconomic trade-offs inherent in management efforts

Research Priority 4: Enhance the benefits of natural resources.

- develop sustainable approaches to aquaculture that consider implications for surrounding ecosystems, wild genetic resources, and impacts on coastal economies
- advance sustainable energy technologies, including efficient methods for power generation
- develop new generations of military subsurface detection systems that are less deleterious to species sensitive to acoustic emissions;
- develop bycatch-reduction technologies for fisheries and protected resources (e.g., seabirds)
- assess ecological and economic resources in the EEZ and the U.S. continental shelf

Theme 2: Increasing Resilience to Natural Hazards

Recent hurricanes and tsunamis have clearly demonstrated the potential for natural disasters to have economic, environmental, social, and public-health impacts on regional, national, and global scales. Although society cannot eliminate natural hazards, their impacts can be reduced. Investment in research and technology will provide the knowledge and information base needed to assess and reduce risk, save lives and property, ensure more rapid recovery and effective mitigation, and develop informed and effective responses to future hazard events.

Needed research in this area includes the causes and impacts of natural physical hazards, such as hurricanes and tsunamis, community and ecosystem vulnerability, and hazard mitigation.

Research Priority 5: Understand how hazard events initiate and evolve and improve forecasts of future hazard events.

- develop models of hazard generation (e.g., storms, submarine and coastal landslides, tsunamis, flooding) and evolution (e.g., tsunami propagation, storm and inundation modeling).
- assess effects of land subsidence and future climate change (e.g., changes in storm intensity or frequency, sea-level rise, landscape change) on hazard potential and vulnerability

Research Priority 6: Understand the response of coastal and marine systems to natural hazards and assess future vulnerability.

- understand and model landscape change (including the adjacent watershed) associated with coastal hazards, including direct alterations and secondary processes (e.g. slope failures, shoreline change, inlet formation, coastal erosion, sediment transport, flooding)
- determine structural and infrastructure resilience to hazards, and how it is affected by alterations (i.e., through physical destruction, sediment diversion, land use and restoration)
- assess vulnerability of coastal communities, public health, infrastructure, marine operations, and ecosystems to hazards

Research Priority 7: Develop multi-hazard risk assessments and support development of models, policies, and strategies for hazard mitigation.

- identify vulnerable ecosystem functions and infrastructure components, determine the potential for cascading component failure, and assess the efficacy of natural (e.g., barrier islands, coastal wetlands) and engineered systems (e.g., hurricane barriers, levees) in hazard mitigation.
- develop models and risk assessments that include economic, social and environmental costs associated with natural hazards
- integrate models and risk assessments into decision-support tools for public policy

Theme 3: Enabling Marine Operations

Marine operations are essential components of the global economy and national security. Marine operations require freedom of navigation in the global ocean and the use of U.S. ports, harbors, estuaries, and the Great Lakes. This includes the ability to conduct mapping and charting activities, gather tide and current information, and deal with issues such as bridge clearance, dredging, navigation aids, and ice coverage. Research, coupled with technological advances, will permit marine operations to meet challenging requirements for increased levels of transportation and commerce in the maritime domain and to address security concerns, while balancing sustainable use and protection of the environment.

Needed research in this area includes efforts to determine the impacts of marine operations, including transportation, energy exploration and development, and aquaculture, on the environment; and the impacts of the environment on marine operations.

Research Priority 8: Understand the interactions between marine operations and the environment.

- evaluate the release, dispersion, cycling, and ecological impacts of contaminants (i.e., oil spills, air emissions)
- evaluate interactions with marine life (e.g., bird migration, ship strikes, ocean sound)
- assess the impacts of aquaculture
- evaluate factors contributing to the introduction and persistence of invasive species (e.g., ballast water)
- assess effects of expanding transportation routes (e.g., Arctic routes)
- refine sediment transport models to enable rapid, efficient, and environmentally sustainable dredging and dredged-material management
- evaluate how climate change (e.g., sea-level rise, sea-ice abatement lake-level decreases) will affect marine operations (transportation routes, ports and harbors, energy-extraction platforms)

Research Priority 9: Characterize and predict conditions in the maritime domain.

- enhance environmental observation and forecasting of ocean conditions (e.g., currents, turbidity, surface waves, sea-ice extent, lake levels, biogeochemical conditions)
- increase precision in forecasting marine conditions (e.g., improved real-time, ocean-current models; storm-surge projections)
- develop technologies (e.g., robust sensors and infrastructure, autonomous vehicles) to support high-spatial-resolution and near-real-time forecasting

Research Priority 10: Use environmental information to enhance the marine transportation system.

- incorporate environmental impacts (e.g., benthic disturbance, contaminant releases, impacts from invasive species), social and economic drivers (e.g. human demographics, land use, income, and output) and operational needs (e.g. port and waterway depth and capacity) into marine operations planning and risk assessment

Theme 4: The Ocean's Role in Climate

The ocean plays a fundamental role in governing climate through its capacity to store and distribute heat and carbon. The challenge is to accurately assess the ocean's past and present state, processes, and phenomena influencing climate, and society's influence on them, and to improve predictions and projections of climate change. These predictions and projections will improve society's ability to respond to and reduce, where feasible, climate related hazards; to adapt to climate change and variations (e.g., sea-level rise, changing weather patterns); and to inform management and policy decisions addressing human and environmental impacts.

Needed research in this area includes efforts to examine regions of the ocean, including the Arctic and Southern Ocean, and their role in climate change and variability, changes and impacts to ecosystems, and efforts to predict ocean-climate processes and changes

Research Priority 11: Understand ocean-climate interactions.

evaluate the temporal and spatial extent of the interactions between ocean regions (e.g. tropical, polar, and deep sea) and climate change, including effects on ocean circulation, air-sea interactions, convection, and water-mass formation

Research Priority 12: Understand the impact of climate on biogeochemistry and implications for its ecosystems.

identify and quantify impacts of climate-induced changes in physical properties of the ocean (e.g., heat, freshwater and circulation), as well as biogeochemical properties (e.g., carbon, nitrogen, dust, trace elements, pollutants) on ecosystems.
determine fluxes and cycling of biogeochemical variables through sustained observations (e.g., observatories), process research (e.g., air-sea exchange, ecosystem interactions) and modeling

Research Priority 13: Project future climate changes and their impacts.

use expanded ocean observations, paleoceanographic data and assessments, and enhanced process research to develop coupled ocean-ice-atmosphere-land climate models that provide improved short-term (e.g., hurricane intensity) and long-term (e.g. sea-level rise) projections of the effects of climate change

Theme 5: Improving Ecosystem Health

Marine ecosystems provide a wealth of benefits to humankind. They are also vulnerable to misuse from human activity and impacts from natural events. Interdisciplinary research can provide the information needed to balance competing uses of the marine environment, to better predict the impacts of such use, to manage those impacts in a manner that ensures the long-term health and sustainability of marine ecosystems, and to help restore ecosystems damaged from past and current activities.

Needed research in this area includes examining natural and human-induced changes and impacts to ecosystems and developing methods to monitor impacts.

Research Priority 14: Understand and predict the impact of natural and anthropogenic processes on ecosystems.

- assess natural and anthropogenic changes in physical, biological, and chemical properties and their impacts on productivity and overall ecosystem health
- assess dispersal mechanisms for marine organisms
- develop trophic dynamics models that span multiple trophic levels
- assess impact (loss) and recovery responses to natural and anthropogenic stressors (e.g. impacts from El Niño/La Niña, increases in ocean temperature, ocean acidification, watershed activities, sediment/nutrient/contaminant flux, resource extraction)

Research Priority 15: Develop socioeconomic assessments and models to evaluate the impact of multiple human uses on ecosystems.

- assess social and economic factors (e.g., energy uses, coastal and watershed development, land use, water use, resource-use perception) that determine how society views and uses marine ecosystems
- develop new methods to evaluate non-consumptive use of ecosystem services and characterize the value society places on competing uses, including discounting procedures for adjusting cost-benefit analyses over time

Research Priority 16: Develop appropriate indicators and metrics for sustainable use and effective management of marine ecosystems.

- develop metrics and indicators that can be used to assess factors that stress and degrade ecosystems as well as to monitor restoration and recovery.
- use indicators to provide feedback on the efficacy of management practices

Theme 6: Enhancing Human Health

The ocean can be a source of health hazards from contaminated seafood, polluted waters, known and emerging disease-causing microbes, and harmful algal blooms (HABs). Efforts to enhance human health will focus on the cause, prevention, and treatment of disease. The ocean also holds abundant resources that convey a variety of health benefits to humans. Exploration of new habitats, combined with emerging biochemical and biotechnical techniques, will promote discovery and development of bioproducts that promote human health.

Needed research in this area includes efforts to identify and assess ocean-related risks to human health and identify and develop ocean products for human well-being.

Research Priority 17: Understand sources and processes contributing to ocean-related risks to human health.

- evaluate the sources (e.g., runoff, atmospheric deposition), cycling, and effects of current and emerging pathogens, toxins, and contaminants (e.g., mercury, flame retardants, endocrine disruptors, hydrocarbons)
- assess food webs to determine the fate of these compounds (e.g., bioaccumulation, biotransformation, biomagnification)
- provide information on human health risks, such as HAB onset, extent, and duration; infectious disease potential (including microbes that can cross from animal to humans); and the influence of climate change on water-borne diseases (e.g., cholera)

Research Priority 18: Understand human health risks associated with the ocean and the potential benefits of ocean resources to human health.

- characterize the benefits associated with consumption of seafood (e.g., improved cardiovascular health, cognition)
- quantify risks and impacts of exposure to health hazards (e.g., contaminants, pathogens, and toxins) and determine the incidence and severity of human illnesses.
- conduct epidemiological studies on at risk populations (children, pregnant women) and on diseases in ocean species that may serve as sentinels for new or ongoing threats

Research Priority 19: Understand how human use and valuation of ocean resources is affected by the relationship between human activities, health threats, and ocean resources.

- Evaluate the relationship between social and economic drivers (e.g., shoreline development, tourism, recreational and subsistence fishing) and human-health threats (e.g. contamination by pathogens, toxins, or pollutants)

Research Priority 20: Develop products and biological models to enhance human well-being.

- expand exploration, assessment, and development (e.g., biosynthesis) of ocean bioproducts (e.g., pharmaceuticals, nutrients, diagnostic tools, reagents, enzymes)
- assess utility of marine species as mechanistic models for the study of diseases, toxicology, and biochemical processes relevant to human health
- identify sentinel species and habitats that may serve as early-warning systems of potential ocean risks to humans