Physical Science for
Marine Resource Management

U.S. coastal regions, including the U.S. territories in the Pacific and Caribbean, host a rich diversity of marine resources spanning the warm tropical waters to Arctic sea ice covered waters. Marine resources and ecosystems are critical to commerce, human health and coastal tourism. For example, in 2016 commercial landings by U.S. fishermen exceeded 9.5 billion pounds valued at $5.3 billion, and approximately 371.6 million fish were caught by recreational fisherman. As pressures on marine resources continue to rise, there is a concomitant need for improved monitoring and prediction of weather, climate, and water conditions impacting the marine environment.

Legislative Drivers

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT Public Law 94-265, as amended through October 11, 1996 "to assure that the national fishery conservation and management program utilizes, and is based upon, the best scientific information available" (101-627, 104-297) Conservation and management measures shall be based upon the best scientific information available."

MARINE MAMMAL PROTECTION ACT, sec. 1371 "The Secretary, on the basis of the best scientific evidence available and in consultation with the Marine Mammal Commission, is authorized and directed from time to time, having due regard to the distribution, abundance, breeding habits, and times and lines of migratory movements of such marine mammals."

MARINE RESOURCES AND ENGINEERING DEVELOPMENT ACT of 1966 (Pub. L. 89-454) to "develop, encourage, and maintain a coordinated, comprehensive, and long-range national program in marine science for the benefit of mankind, to assist in protection of health and property, enhancement of

commerce, transportation, and national security, rehabilitation of our commercial fisheries, and increased utilization of these and other resources."

Physical Sciences Laboratory Capabilities

» Developing and evaluating sub-seasonal and seasonal forecast systems for the Arctic, coastal environments and ocean-bound rivers. PSL is an integral partner in projects developing end-to-end (physics => ecosystem => management) forecast systems.

» Developing empirical forecast methods (e.g., Linear Inverse Models) to predict and forecast environmental conditions impacting marine resources.

» Examining the effects of climate variability and change on environmental conditions impacting marine resources, for example, ENSO's effect on the U.S. coastal ocean, and the influence of changing ocean conditions (e.g., surface and bottom temperature, oxygen, pH, primary production).

» Investigating and explaining ocean extremes, such as ocean heat waves and rapid changes in sea ice.

» Supporting NMFS and NOS through the Integrated Ecosystem Assessment (IEA), Marine Tipping Point and other programs by providing observations and model output and guidance on how to best use it.

» Developing products, such as the climate change web portal, for use by NOAA and other government agencies, manager and stakeholders.

Research Partnerships

Marine Ecosystem-based Management (EBM)
Collaborative research integrating multiple factors, including

ocean temperatures, surface winds and other climatic variables to be considered when setting catch limits. Both NMFS and NOS, in conjunction with OAR are developing forecast models for the coastal zone and the adjacent ocean.

Habitat Blueprint

A collaborative research framework to think and act strategically across NOAA programs and with partner organizations to address the growing challenge of coastal and marine habitat loss and degradation. Increasing the effectiveness of efforts to focus expertise, resources, and actions to maximize benefits to marine resources, the primary goals of the Habitat Blueprint include sustainable and abundant fish populations, recovered threatened and endangered species, protection of coastal and marine habitats at risk, resilient coastal communities, and increased coastal/marine tourism, access and recreation.

Vulnerability Assessments

Vulnerability assessments provide a framework for evaluating climate impacts over a broad range of species with existing information. These methods combine the exposure of a species to one or multiple stressors (e.g. changes in climate) and the sensitivity of species to one or multiple stressors. These factors are then combined to estimate an overall vulnerability. Vulnerability assessments have been conducted for fish and invertebrates to climate change on the Northeast U.S. Continental Shelf and other U.S. regions.

What's Next for PSL

During the next five to ten years, PSL will support NOAA's priority to advance the Blue Economy through research to improve the observations, understanding and prediction of environmental conditions impacting marine resources. Specific activities will include:"

» Develop and improve ocean forecasts, especially in coastal and upwelling regions. Improve boundary conditions for high-resolution ocean models used to make S2S forecasts and long-term projections.

» Observation-based improvements in the parameterization of heat, momentum, and gas exchanges (O_2, CO_2, DMS) across the air-sea interface.

» Observations and modeling applications to better understand the influence of the physical environment on marine ecosystems; including patterns of variability, atmosphere-sea ice-ocean interactions, and upwelling and river-estuary-coastal ocean systems.

» Enhanced use of key terrestrial atmospheric, ship-based oceanography and biological measurements to monitor Arctic variability and resulting impacts on marine resources.

» Advance theories and simple models for ocean variability, e.g., understanding physical and biological regime shifts, extremes, multi-stressor impacts, tipping points, etc.

» Develop marine resources relevant products for use by the NOAA (and other) agencies, managers and stakeholders.

» Attribution and predictability assessments of extreme ocean, atmosphere and terrestrial conditions impacting marine resources.

Research is required to understand future changes in the Arctic environment, and to inform potential impacts on commerce and transportation. (Credit: U.S. Coast Guard)

An alewife, also called river herring, is an anadromous species of herring that spawns in fresh water and lives part of its life in saltwater. It is listed as a species of concern under the Endangered Species Act. (Credit: NOAA Fisheries)

PSL scientists are part of a broader NOAA effort to improve seasonal forecasts of ocean conditions along the U.S. west coast to reduce the bycatch of endangered species, such as loggerhead and leatherback turtles. (Credit: NOAA Fisheries)

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