



# NOAA's Undersea Research Program (NURP)

## FY 2004 SCIENCE GUIDANCE

*This document outlines NURP's Science Guidance to the NURP Centers for FY 2004.*

### INTRODUCTION

NOAA's Undersea Research Program (NURP) is a comprehensive underwater research program that supports NOAA's mission by placing scientists underwater to research issues of regional, national, and global importance. NURP provides access to advanced underwater technologies and methods, including mixed gas diving, manned submersibles, remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), sea floor observatories, and *Aquarius*, the world's only underwater laboratory. By using this *in situ* approach, NURP makes observations, collects samples, and conducts experiments that would otherwise be unobtainable.

NURP is primarily a grant program with about 90 percent of its funding going to the extramural (outside NOAA) research community. NURP-supported research quality is ensured by competitive and high standards of peer review patterned after that of the National Science Foundation. Highest priority is given to proposals for studies in the Great Lakes, territorial seas, adjacent waters of the United States, U.S. Territories, Freely-Associated States, and Puerto Rico. Responsibility for soliciting and supporting the research is assigned to regional NURP Centers in the North Atlantic and Great Lakes; Mid-Atlantic Bight; Southeastern U.S. and the Gulf of Mexico; Caribbean; West Coast and Polar Regions; and Hawaii and the Western Pacific. See Table 1 for NURP contacts, addresses, and phone numbers.

**Table 1. NOAA's Undersea Research Program Contacts**

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## STRATEGIES

NOAA is adopting a new strategic plan for FY 2003-2008, in response to the changing needs of society and the environment. The new plan responds to increasing changes in demographics, globalization, climate, economies, and stressors to the environment. NOAA's Strategic Plan for 2003-2008 is located at the web site for NOAA's Office of Strategic Planning, <http://www.osp.noaa.gov/>.

*NOAA's Mission:*

***To understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet the Nation's economic, social, and environmental needs.***

NURP responds to NOAA's mission by using its expertise in undersea *in situ* science and technology.

*NURP's Mission:*

***To increase knowledge essential for the wise use of oceanic, coastal, and large lake resources through advanced undersea research, sampling, observation, experimentation, and education.***

NURP's mission directly supports NOAA's mission, leading to understanding and predicting the undersea environment. From that standpoint, NURP will provide the scientific basis for NOAA and the Nation to align with the future so that a healthy and sustainable balance of the sea is reached.

To strive towards NURP's mission, five strategies have been defined:

- Promote healthy coasts and effective management with new scientific knowledge;
- Foster ocean stewardship through an improved understanding of ocean processes and ecosystems;
- Ecologically assessing our ocean frontiers;
- Develop new and novel underwater technologies; and
- Educate the nation about the oceans and the Great Lakes.

These strategies form the basis of NURP's scientific guidance for FY 2004.

## SCIENCE GUIDANCE

**1. Promote healthy coasts and effective management.** U.S. coasts are more densely populated than the rest of the country and continue to grow at faster rates. According to the Pew Oceans Commission, half the U.S. population currently lives in the one\_fifth of our land area

along the coasts; by 2025, demographers anticipate three-quarters of the U.S. population will reside in coastal regions. Much of the national economy is dependent upon a healthy and vibrant coastal zone consisting of recreational and commercial fishing, seafood processing, recreation and tourism, the boating industry, ports and harbors, marine shipping, offshore oil and gas, and marine equipment manufacturing. Aesthetic, cultural, and environmental aspects of the coastal zone significantly enhance its value. Clearly, economic growth and environmental protection are inextricably linked.

Driven by concern for the health and conservation of marine ecosystems and resources, certain marine and coastal zone areas are facing widespread degradation. For example, coral reefs are of particular concern. The National Marine Sanctuaries (NMS) Program and the National Estuarine Research Reserve System (NERRS) need to identify, designate, and manage areas of the marine environment of special national significance due to their conservation, recreational, ecological, historical, research, educational, or aesthetic qualities. Although the following research areas are not the only ones, they represent research needs that would be particularly relevant to NOAA's and NURP's mission. Accordingly, NURP will:

- 1.1 Perform research, monitoring, and comprehensive site characterizations (including assessment of patterns of biodiversity and the processes which maintain them) for key coastal habitats such as coral reefs and other critical habitats in NMS and NERRS sites to allow for more efficient management of protected resources.
- 1.2 Support sound decision-making for the management of toxic contaminants by providing reliable scientific analysis of trends, transport, fate, and effects for both point and non-point sources, and communicating these findings to policy makers.
- 1.3 Understand the effects of anthropogenic stressors on processes that affect specific life stages of marine organisms, particularly processes critical to population maintenance, such as reproduction (fertilization, metamorphosis, settlement, and recruitment). It is particularly important to understand what levels of exposure to stressors in the marine environment are acceptable, what limits ought to be targeted in monitoring programs, and what techniques are most appropriate to assess environmental exposure.
- 1.4 Identify and investigate the causes and consequences of eutrophication in coastal and estuarine waters and work with policy makers to identify cost-effective alternatives for their control, develop mitigation strategies, and promote integrated watershed management.
- 1.5 Seek a better understanding of the role that lake and ocean habitats play in maintaining the health of living marine and Great Lakes resources.

- 1.6 Use tools from engineering, biotechnology, ecology, and genetics to help identify aquatic nuisance species, their life cycles, ecological relationships, and disruption to coastal ecosystems.
- 1.7 Assess the physical and biological impacts of natural and anthropogenic-related disasters (e.g., hurricanes, tsunami, flood plumes, pollutant spills), and develop methods to evaluate the economic costs of destruction and recovery.
- 1.8 Evaluate the potential for the spread of waterborne diseases, alien and invasive species, particularly between Atlantic and Pacific coral reefs.

NOAA Fisheries also has interest in many of these areas because of responsibilities related to building sustainable fisheries and recovering protected species through, e.g., a better understanding of essential fish habitat (as defined in the Magnuson Fishery Conservation and Management Act). Success will be dependent on effective coordination of different programs, using the matrix management approach now required by the new NOAA Strategic Plan.

**2. Foster ocean stewardship.** According to NOAA Fisheries, over one-third of all fish stocks for which we have scientific population information are over-utilized, and nearly half are below optimal population levels. Additionally, habitat is degrading, posing an ever-increasing challenge to promote the recovery of protected species. The reasons are varied and complicated; some are natural and cyclical (e.g., hurricanes), while others are caused by humans (e.g., over-fishing). Fish are selective about where they live. With the advent of new fishing technologies, for example inexpensive satellite positioning, commercial and recreational fishermen have gotten better at finding and targeting fish habitats. Destructive fishing practices degrade these habitats, e.g., anchored gill nets are destroying fragile coral reefs. Trawls customized for “rock-hopping,” plow through rocky substrate, topple boulders, and bury the encrusting species that attract fish. Many commercial and recreational fishing activities relocate to deeper depths as shallow resources are depleted, and we know even less about the ecology and habitat of deep water species. Working with others, again with a matrix management approach, NURP will:

- 2.1 Improve stock assessments of mammals, fishes, and invertebrates by developing and employing advanced underwater technology, providing comparative data on populations, and improving and developing population and community models.
- 2.2 Identify and map essential fish habitat to determine habitat requirements for healthy populations, assess damage from mobile fishing gear, and provide research results that increase a manager’s ability to identify, protect, and restore essential fish habitat.
- 2.3 Conduct research on the life histories of marine organisms of commercial or ecological importance, including reproduction, feeding, behavior, age and growth, and distribution.
- 2.4 Conduct studies to assess the effectiveness of Marine Protected Areas (MPAs) and marine zoning for conserving fish stocks, essential fish habitat (including conservation of biological diversity), and for contributing new productivity to adjacent unprotected areas.

- 2.5 Improve the ability to accurately predict the effects of changes in environmental conditions by determining the relationships of oceanographic and climatic parameters to the abundance and diversity of fishery populations and communities.
- 2.6 Identify and quantify damage to fisheries resources and their habitat resulting from fishing gear impacts and contaminant input and spills, and determine rates of impact recovery.
- 2.7 Provide scientific information to assist NOAA Fisheries in developing the requirements for the siting of aquaculture operations in the U.S. exclusive economic zone.
- 2.8 Conduct studies of habitat preference, including adaptations of species to enhance stocks.
- 2.9 Determine the effectiveness of stock enhancement efforts, including replenishment of wild populations with hatchery-reared juveniles.
- 2.10 Assess the effectiveness of habitat enhancements designed to improve the success of stock enhancement efforts.

These objectives must be accomplished in cooperation with NOAA Fisheries to provide the research results to improve federal and state abilities to effectively manage and restore fisheries. NOAA's Ocean Service also has an interest in some of these areas (e.g., MPAs) because of responsibilities related to sustaining healthy coasts through such programs such as the NMS and the NERRS programs.

**3. Ecologically assessing our ocean frontiers.** A wealth of untapped living and non-living resources lie hidden at our ocean frontiers. In fact, the ocean floor constantly vents and seeps a wide array of chemicals and materials, at rates and amounts capable of affecting ocean chemistry on a regional scale. In turn, changing chemistry impacts how the oceans absorb (or release) greenhouse gases, process contaminants, give rise to new pharmaceuticals, and sustain life. NURP and NOAA's Office of Ocean Exploration (OE) are developing an effective partnership under this strategy. OE explores the ocean frontiers, while NURP's role is to understand (i.e., monitor, research, and assess) the importance of these ocean frontiers, including deep-sea vents, seeps, and volcanism. NURP will work with OE, NOAA line offices, and others to:

- 3.1 Expand the monitoring of deep-sea vents, seeps, and volcanism and the flux of materials emanating from them, and biological communities associated with them.
- 3.2 Seek out, recover, isolate, and culture novel organisms from unique, extreme environments such as deep-sea vent ecosystems.
- 3.3 Identify unique bioactive compounds with commercial potential associated with marine organisms.

- 3.4 Characterize deep-sea communities and the processes that regulate patterns of biological diversity to better understand effects of human exploitation (now and in the future).
- 3.5 Conduct basic and applied research to identify, explore, assess, and environmentally characterize gas hydrates.
- 3.6 Conduct basic and applied research on gas hydrate degassing and its role in the carbon cycle.
- 3.7 Conduct studies of past climates through paleoenvironmental methods, as a means of assessing present and predicting future climate regimes.

**4. Develop new and novel underwater technologies.** The changing and difficult study of the ocean realm requires new intellectual approaches and a national investment in a new mode of conducting marine investigations. With the exception an advanced synoptic remote sensing technologies over the last several decades, surface-ship expeditions have dominated ocean science since World War II. New approaches, such as advanced sea floor observatories and habitats (human occupied) greatly enhance traditional capabilities by providing invaluable long-term monitoring and continuity of observations. They are an example of the next generation in the development of technology for understanding the oceans.

Recent technological advancements in low-power miniaturized components enable development of ocean floor stations that feature a wide variety of *in situ* sampling tools and sensors. ROVs and AUVs use sea floor observatories as a home base to power-up and download acquired data, thereby extending the geographic range of these stations. Real-time data and imagery are routinely transmitted to land-based laboratories and the Internet via cables, radios, and satellite connections. Through sea floor observatories and habitats, scientists can control *in situ* experiments and equipment from their land-based laboratories. Through a matrix management approach, and partnerships with others, NURP will:

- 4.1 Develop new technologies that promote *in situ*, long-term research. This includes AUVs, underwater observatories and habitats, and chemical, physical and biological sensors that are needed to study critical elements and forcing factors in the marine environment.
- 4.2 Expand the monitoring of deep-sea vents, seeps, and volcanism and the flux of materials emanating from them, their effect on the ocean and atmosphere, and biological communities associated with them.

**5. Educate the nation about the oceans and the Great Lakes.** Education and outreach must be linked to NURP's research programs and innovative means must be developed to bring the excitement of ocean research to the general public. An additional way that NURP can engage in education and outreach programs is by supporting undersea research that involves more masters and doctoral candidates. NURP is intent on doing more to communicate the value of its research

to a larger audience. This strategy will be accomplished through a matrix management approach, encouraging corroborations with others to:

- 5.1 Contribute to educational outreach programs to enhance awareness and understanding of ocean and large lake processes, ecosystems and resources, and their study, management and conservation.
- 5.2 Hold periodic regional workshops regarding NURP research directions, necessary actions, NURP priorities, and the development of initiatives to provide a forum for all participants to listen, inform themselves, discuss, explain, and exchange views.
- 5.3 Promote formal and informal partnership agreements both inside and outside of NOAA.
- 5.4 Establish easily accessible communications links through Web pages, electronic bulletin boards, and printed material to provide current information to all our partners and customers regarding current research, future plans, and policy developments.
- 5.5 Encourage publication of articles in the popular press, including scientific outlets for laypersons, newsletters, newspapers, and publications of trade and hobby organizations with interests affected by NURP management and research. This is in addition to traditional technical articles in scientific journals,

## **CONCLUDING REMARKS**

The above five objectives constitute the NURP FY2004 Science Guidance. It is based upon the draft NOAA Strategic Plan for FY 2003-2008. Undoubtedly, additional objectives could be added. However, these objectives are meant to serve as an initial guide the NURP Centers in forming their approach to FY2004. The NURP Centers should continue to consider their individual capabilities, expertise, and unique regional priorities in developing their scientific and programmatic approaches.