UNDERSEA RESEARCH AND OCEAN EXPLORATION: H.R. 3835, THE NATIONAL OCEAN EXPLORATION PROGRAM ACT OF 2005 AND THE UNDERSEA RESEARCH PROGRAM ACT OF 2005

HEARING

BEFORE THE

SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS

COMMITTEE ON SCIENCE

HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

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UNDERSEA RESEARCH AND OCEAN EXPLORATION: H.R. 3835, THE NATIONAL OCEAN EXPLORATION PROGRAM ACT OF 2005 AND THE UNDERSEA RESEARCH PROGRAM ACT OF 2005

THURSDAY, JULY 27, 2006

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 2:10 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Vernon J. Ehlers [Chairman of the Subcommittee] presiding.

HEARING CHARTER

SUBCOMMITTEE ON ENVIRONMENT, TECHNOLOGY, AND STANDARDS

COMMITTEE ON SCIENCE

U.S. HOUSE OF REPRESENTATIVES

Undersea Research and Ocean Exploration: H.R. 3835, the National Ocean Exploration Program Act of 2005 and the Undersea Research Program Act of 2005

THURSDAY, JULY 27, 2006
2:00 P.M.—4:00 P.M.
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Purpose

On July 27, 2006 at 2:00 p.m., the Subcommittee on Environment, Technology, and Standards of the House Committee on Science will hold a hearing to examine the National Oceanic and Atmospheric Administration's (NOAA) National Undersea Research Program (NURP) and Ocean Exploration (OE) Program and to receive comments on H.R. 3835, the *National Ocean Exploration Program Act of 2005* and the *Undersea Research Program Act.* On July 1, 2005 the Senate passed S. 39, a bill largely identical to H.R. 3835 that would also authorize these programs. The Committee will examine the current programs, including their relationship to one another, in the context of pending legislation.

The Committee plans to explore these overarching questions:

1. What are the goals and missions of the Undersea Research and Ocean Exploration programs? How do these goals and missions relate to and complement other U.S. marine research programs?
2. Would a merger or consolidation of the NURP and OE programs still support the programs' activities and maintain the programs' role in national marine research?
3. Does H.R. 3835 provide sufficient guidance for the scope and direction of these programs and, if appropriate, for a merger?

Witnesses:

Panel 1

The Honorable Jim Saxton

The Honorable Robert Simmons

Panel 2

Dr. Richard Spinrad, Assistant Administrator of the National Oceanic and Atmospheric Administration (NOAA) Office of Oceanic and Atmospheric Research (OAR).

Mr. Andrew Shepard, Director, National Undersea Research Center, University of North Carolina-Wilmington.

Dr. Marcia McNutt, President and CEO, Monterey Bay Aquarium Research Institute.

Background on H.R. 3835:

H.R. 3835 was introduced by Mr. Saxton on September 20, 2005. The bill would authorize, for the first time in legislation, two existing programs within NOAA, the National Ocean Exploration Program (OE), which is the subject of Title I of the bill, and the NOAA Undersea Research Program (NURP), which is the subject of Title II (see Appendix II for a section-by-section summary of the bill).

The House Resources Subcommittee on Fisheries and Oceans held a hearing on H.R. 3835 on May 4, 2006. On July 1, 2006, the Senate companion to H.R. 3835, S.39 (sponsored by Senator Stevens), passed the Senate by unanimous consent, and was referred to the Committee on Science, and in addition to the Committee on Resources.

Background on NURP and OE:

NURP, which had its origins in the 1970s, funds applied research in areas such as ecology and fisheries management that can be of use to policy-makers, and generally focuses on areas that are relatively close to shore. NURP also funds the development of technology for undersea research, and education and outreach programs (such as the Aquarius underwater habitat, and JASON, which lets schools participate in undersea research).

NURP, housed in NOAA's Office of Oceanic and Atmospheric Research (OAR), operates through six regional centers at University of Connecticut (covering the North Atlantic and Great Lakes); Rutgers University (covering the Mid-Atlantic); University of North Carolina at Wilmington (covering the Southeastern United States and Gulf of Mexico); Perry Institute of Marine Science (covering the Caribbean)[1]; University of Hawaii (covering Hawaii and the Western Pacific); and University of Alaska at Fairbanks (covering the West Coast and Polar Regions). In addition to those six centers, the National Institute for Undersea Science and Technology (NIUST), established in 2002 by Congress, is based at the University of Mississippi and the University of Southern Mississippi. Each center manages its own operations and grant program, but research priorities and strategic direction are coordinated through the National Program Office at NOAA Headquarters.

The six centers use about 74 percent of their funding for competitively awarded research grants for scientists studying in their region. NURP support often includes the provision to scientists of equipment developed and owned by the centers, as well as technical support.

The OE program, also located in OAR, provides grants to researchers for expeditions to discover and document unknown or little know features of the oceans and Great Lakes. The program is run by NOAA Headquarters and focuses on a smaller pool of scientists who attempt to discover and record new and novel physical, biological or chemical aspects of the deep ocean far from the continental shelf, often deeper than 10,000 feet. The program supports development of new technologies and works with academic and industry partners to adapt commercial and experimental technologies to deep-water exploration activities. Education and outreach is a high priority, and OE uses its high-profile expeditions to engage students and the general public in the exploratory process and raise awareness of marine issues and their impacts on people's daily lives.

OE and NURP complement Office of Naval Research (ONR) and National Science Foundation (NSF) support for basic oceanographic research. OE expands the boundaries of the "known" marine environment, which can open up new lines of scientific inquiry, while NURP supports applied marine research that bridges the gap between basic marine science (funded by ONR and NSF) and the applied science and information needs of marine policy makers and resource managers.

Issues with NURP and OE:

Congressional Support for NURP

NURP has always received substantial Congressional direction in terms of the location of the regional centers and the allocation of funding for each center. Some of the regional NURP centers were established by Congressional direction rather than by a competitive process. This led to a perception among many academic scientists that some NURP centers operate within closed communities whose resources were not allocated in a transparent, competitive and rigorous way, and whose activities have been unresponsive to NOAA's science needs and strategic goals.

In the last decade, NOAA has attempted to bring NURP activities more in line with NOAA priorities and has formalized a centrally-coordinated and transparent grant program. While research grants are still awarded through the individual centers, there is now a uniform peer review process that is patterned after NSF's peer review process and coordinated with NOAA research priorities.

However, a new issue arose in the FY 2006 appropriations process. NURP funding was cut from approximately $17 million to $9 million and all NURP center funding was directed to the two centers on the West Coast. NOAA reprogrammed funding

[1] The Caribbean center will merge with the Gulf of Mexico and Southeast Atlantic center later this year.

to maintain minimal services at the East Coast centers but it is unclear how the centers will fare in FY 2007.

Measuring Program Success

Some scientists remain concerned about the clarity of NURP's and OE's missions and the metrics used to measure the programs' success. NURP's mission is largely to enable and support marine research by developing and supporting technology and technical knowledge. Many of the benefits that NURP provides to the marine research community (accrued expertise and regional knowledge, for example) can be difficult to define or quantify. OE's mission is to observe and survey little-known regions of the ocean. However, some scientists have criticized the OE program for not providing support or guidance for research beyond the initial observation of unexplored areas.

Merger of NURP and OE

In response to appropriations report language in 2004, which directed NOAA to consider realigning programs in OAR, NOAA has begun the process of merging NURP and the OE program, although it has not yet provided any details on how it will accomplish this. However, the current organization of the two programs is quite different. OE is a highly centralized program, run out of NOAA Headquarters, that manages and enables large-scale, deep water exploration of oceans around the world. In contrast, NURP is a regionally organized program that supports detailed study of marine resources and habitats within 200 miles of U.S. coasts and focuses its scientific support on operational and strategic priorities in line with NOAA's stewardship missions.

Scientists have expressed concern that the structures of the two programs are divergent and that a merger may result in the loss of significant and important benefits of one or both programs. Experts who are concerned with the vitality of the Nation's ocean exploration programs express concern that OE funding would be directed to operational and mission-oriented efforts rather than the deep water discovery that they see as the most critical. Marine researchers and managers who interact with the NURP program are concerned that if the merged program became more centralized the emphasis on regionally-important research would decrease. Proponents of both programs are concerned that combining the programs will result in a net decrease in funding for both efforts and an associated decline in the quality and quantity of marine research.

Administration of the Ocean Exploration Program

In 2003, the National Research Council of the National Academies released a study of ocean exploration programs that called for a dedicated national ocean exploration program. The report suggested the National Oceanographic Partnership Program (NOPP) would be the most appropriate place to form the program, rather than NOAA. (NOPP is a collaboration of 15 federal agencies that is supposed to coordinate all national ocean research.) Concerns over placing the program in NOAA stemmed from recurring problems in existing programs such as "slow grant processing and a lack of responsiveness to researchers" and NOAA's focus on internal NOAA agency topics that do not explicitly include exploration of the marine environment.

In contrast, in September 2004, the U.S. Commission on Ocean Policy, established by the *Oceans Act of 2000,* submitted a report entitled "An Ocean Blueprint for the 21st Century," in which the Commission recommended that NOAA and NSF lead an expanded national ocean exploration program with collaboration from the U.S. Geological Survey and the U.S. Navy's Office of Naval Research.

Funding History of NURP and OE:

From its inception in 1981 until the mid-1990s appropriations for NURP grew to approximately $20 million annually, then dropped to below $15 million. Between 1996 and 2005, NURP appropriations remained between $13 million and $18 million. Of that amount, approximately 70–75 percent was directed to NURP centers; each East Coast center received approximately $1–$1.5 million and each of the two West Coast centers received approximately $2.5 million. As depicted in the table below, in FY 2006, NURP funding was cut from approximately $17 million to $9 million and all NURP center funding was directed to the two centers on the West Coast.

The Office of Ocean Exploration was organized in 2001 with an appropriation of $4 million. The OE appropriation for 2002 was $14 million, and for 2003 was $15.1 million. FY 2006 funding for OE dropped from $29 million to $14 million.

	FY 2004 Enacted	FY 2005 Enacted	FY 2006 Req.	FY 2006 Enacted	FY 2007 Req.	FY 2007 House passed	FY2007 Senate mark	HR3835 FY2007 authori-zation
Ocean Exploration Program	$29.68	$28.60	$22.70	$14.10	$15.10		$27.0	$33.55
National Undersea Research Program	$16.80	$17.20	$10.50	$9.10	$9.20		$18.0	$19.25
TOTAL for NURP and OE	$46.48	$45.8	$33.2	$23.2	$24.3	$16.00	$45.0	$52.75

Background on Undersea Research and Ocean Exploration:

The Need for Ocean Exploration and Undersea Research

More than 70 percent of the Earth's surface is covered by oceans. The oceans and Great Lakes are a source of valuable living and non-living resources, provide enormous benefit to the transportation and recreation industries, impact development and human health around the country, contain vast quantities of mineral and fossil fuel deposits, and play a key role in Earth's climate system. The oceans also influence the economy. NOAA estimates that in 2003 commercial and recreational fishing contributed $43.5 billion to the national GDP. In addition, over 90 percent of the U.S. population is served by shipping on the oceans and Great Lakes.

Despite the present and future benefits that the oceans and Great Lakes provide, the world's oceans remain virtually unexplored and un-described. A few examples illustrate this:

- NOAA estimates that over 99 percent of the oceans' floors have yet to be explored, and maps of Earth's ocean bottoms have a resolution of seven miles. By comparison the Mars Global Surveyor has photographed the surface of Mars with a resolution as high as 1.6 feet.
- Pulley Ridge, a 60-mile-long reef off the coast of Florida, hosts a diverse and thriving ecosystem in water that is shallow enough to dive in, but was unknown until less than a decade ago.
- Discovered only within the last decade, deep-sea corals appear to offer critical habitat to many marine species including commercially important fish species.

Our incomplete understanding of the marine environment raises concern among many researchers and policy-makers that resource management and research priorities cannot be set to make the best possible use of research dollars and to most effectively support policy decisions. For example, because they were unknown, deep-sea corals were not being included in research, conservation and management efforts until very recently.

The Federal Role in Undersea Research and Ocean Exploration

One of NOAA's missions is to understand and predict changes in the oceans and Great Lakes to enable effective conservation and management of the Nation's marine resources. Developing the information and knowledge base to meet this mission requires thorough study of marine environments. However, the study of underwater environments is not as simple as equivalent studies on land. Aquatic environments pose significant technical challenges to the use of observing and recording technologies that land-based scientists take for granted, such as satellite observations, aerial photography, GPS, and simple human observation. To be able to spend time beneath the surface of lakes and oceans to perform marine research, humans require sophisticated technology such as SCUBA, submersibles, remotely operated and autonomous underwater vehicles, and in situ observation systems. Each of these technologies has taken years to develop and, in some cases, years to adapt to research use. These technologies are costly and require significant technical expertise to reduce the risk to researchers and equipment to acceptable levels. Few researchers have the time and resources to devote to acquiring and mastering these technologies and many marine science programs cannot afford the infrastructure and support staff needed to sustain such programs. By providing long-term funding and strategic direction for marine science, NURP and OE have become repositories of the equipment and expertise that scientists need to pursue underwater exploration and research. See Appendix II for a more detailed history of the two programs.

Witness Questions:

The witnesses were asked to address the following questions in their testimony:

1. What are the strengths and weaknesses of H.R. 3835? In particular:
   - Does the bill capitalize on the strengths of the programs, and effectively address their weaknesses? If not, what changes to the bill would you recommend?
   - Does the bill provide appropriate guidance for the scope and direction of these programs? If not, should the bill language be more or less prescriptive, and how?
   - What specific changes to the bill do you recommend to strengthen the legislation?
2. What are the strengths and weaknesses of the current National Undersea Research and Ocean Exploration Programs? What steps need to be taken to ensure the rigor of these programs and to encourage appropriate follow-on projects to meet their missions? Do you believe that these programs would be strengthened by a merger? If so, what form should a merger take? If not, why not?

Appendix I

SECTION BY SECTION SUMMARY OF H.R. 3835

Title I—National Ocean Exploration Program

Sec. 101—Short Title

Specifies that this title may be referred to as the "National Ocean Exploration Program Act."

Sec. 102—Establishment

Directs that the Secretary of Commerce, through the Administrator of the National Oceanic and Atmospheric Administration (NOAA), shall, in consultation with the National Science Foundation and other appropriate federal agencies, establish a coordinated national ocean exploration program within NOAA that promotes collaboration with existing programs, including NURP.

Sec. 103—Authorities

The Administrator of NOAA shall: conduct interdisciplinary exploration voyages or other scientific activities in conjunction with other federal agencies or academic institutions to survey little known areas of the marine environment, inventory, observe and assess living and non-living marine resources, and report such findings; give priority attention to deep ocean regions, with a focus on surveying deep water systems that hold potential for important scientific discoveries; conduct scientific voyages to locate, define, and document historic archaeological sites; in consultation with the National Science Foundation, develop a transparent process for peer review of proposals; enhance the technical capabilities of the United States marine science community; accept donations of property, data, and equipment for exploring the oceans or increasing knowledge of the oceans; and establish an ocean exploration forum to encourage partnerships and promote communications.

Sec. 104—Ocean Exploration Technology and Infrastructure Task Force

In coordination with the National Aeronautics and Space Administration, the U.S. Geological Survey, Office of Naval Research, and relevant governmental, non-governmental, academic and other experts, NOAA shall convene an ocean exploration technology and infrastructure task force to develop and implement a strategy to: facilitate the transfer of new technology to the ocean exploration program; improve the availability of communications infrastructure to the program; develop an integrated, workable, and comprehensive data management information processing system that will make information on unique and significant features obtained by the program available for research and management purposes; conduct public outreach in conjunction with relevant programs of NOAA, NSF and other agencies; and encourage cost-sharing partnerships that will assist in transferring exploration technology and expertise to the program.

Sec. 105—Interagency Financing

NOAA, NSF, and other involved federal agencies are authorized to participate in interagency financing.

Sec. 106—Application with Outer Continental Shelf Lands Act

Specifies that nothing in this title or in Title II shall supersede, or limit the authority of the Secretary of the Interior under the *Outer Continental Shelf Lands Act* (43 U.S.C. 1331 et seq.).

Sec. 107—Authorization of Appropriations

Authorizes appropriations to NOAA to carry out this title. Authorization levels begin at $30.5 million for FY 2006 and increase by approximately 10 percent each year to $71.92 million for FY 2015.

Title II—Undersea Research Program

Sec. 201—Short Title

Specifies that this title may be referred to as the "NOAA Undersea Research Program Act of 2005."

Sec. 202—Establishment

Specifies that the Administrator of NOAA shall establish and maintain an undersea research program and shall designate a Director of that program.

Sec. 203—Purpose

Specifies that the purpose of the program is to increase scientific knowledge essential for the informed management, use and preservation of oceanic, coastal, and large lake resources through undersea research, exploration, education, and technology development. Also specifies that the program shall be part of NOAA's undersea research, education and technology development efforts and shall make available the infrastructure and expertise to service the undersea science needs of the academic community.

Sec. 204—Program

Specifies that the program shall be conducted through a national headquarters, a network of regional undersea research centers, and a national technology institute. The Director shall provide overall direction with advice from a Council comprised of the directors of the regional centers and the national technology institute.

Sec. 205—Regional Centers and Technology Institute

Specifies that the regional centers and national technology institute shall provide: core research and exploration based on national and regional priorities; further advance undersea technology development to support NOAA's research mission and programs, including technology associated with seafloor observatories such as LEO–15 and the Aquarius habitat, remotely operated vehicles, autonomous underwater vehicles, and new sampling and sensing technologies; undersea science-based education and outreach programs to enrich ocean science education and public awareness of the oceans and Great Lakes; programs for the discovery, study, and development of natural products from ocean and aquatic systems.

Sec. 206—Competitiveness

Specifies that no more than 10 percent of the program budget may be set aside for discretionary spending on rapid response activities and NOAA-related service projects. Further specifies that all other external projects supported by the regional centers shall be managed using an open and competitive process to evaluate scientific merit, relevance to NOAA, regional and national research goals, and technical feasibility.

Sec. 207—Authorization of Appropriations

Authorizes appropriations to NOAA to carry out this title. Authorization levels begin at $12.5 million for the regional centers and $5 million for the national technology institute for FY 2006, and increase by approximately 10 percent each year to $29.47 million for the regional centers and $11.79 percent for the national technology institute in FY 2015. Stipulates in each fiscal year that 50 percent of the funds for the regional centers shall be for West Coast Regional Centers and 50 percent shall be for East Coast Regional Centers.

Appendix II

NURP and OE Program History

NOAA has been a center of technical marine expertise since it was established by executive order in 1970. The Manned Undersea Science and Technology (MUST) office, established in the early 1970s, supported NOAA SCUBA dive and undersea habitat operations around the world. The National Research Council examined the MUST program and related efforts in a 1980 report entitled, "The OceanLab Concept" which proposed a reorganization of MUST into a NOAA Dive Program and a regional undersea research and technology program designed to better integrate NOAA with academic and industry dive communities. The report supported the formation of a National Underwater Laboratory System which culminated in the formation of the National Undersea Research Program in 1981. During most of the following 15 years, NURP was a Congressionally-directed program for which the Administration did not request funding. Starting in 1995, NURP became a line item in NOAA's budget request. In 1997, NURP underwent "Reinvention" in which the program was realigned to match NOAA's strategic mission more closely, and a three to five year review process was implemented to periodically review each of the NURP centers.

By the late 1990s, NOAA exploration efforts were not an organized part of the agency's activities. In June 2000, the President commissioned the Secretary of Commerce to hold a panel on the state of ocean exploration. The final report was presented to the President in October of 2000 and outlined the need for a national ocean exploration program focused on the goal of discovery. The panel recommended the undertaking of multidisciplinary expeditions to include physical, geological, biological, chemical and archaeological oceanographic exploration and mapping, exploration of ocean dynamics and interactions, the development of new sensors and technologies to ensure that the United States remain at the forefront of ocean exploration, and an extensive campaign to utilize new methods to improve ocean literacy and information dissemination to research communities and the public. The report emphasized the need to revitalize a purely oceanic exploratory program to expand our general knowledge of the extent and content of marine environments around the world.

In response, NOAA established the Office of Ocean Exploration within OAR in 2001. OE was directed to study new ocean resources, research ocean acoustics, document American maritime heritage, explore ocean frontiers, and conduct a census of ocean life. In collaboration with other NOAA programs, academic institutions, and several non-governmental organizations, this Program has completed over 100 expeditions and has explored a wide variety of unique ecosystems from the deep waters in the Gulf of Mexico to Alaska's continental shelf, where more than 4,000 shipwrecks line the ocean bottom.

Chairman EHLERS. This hearing will come to order.

Good afternoon. I want to welcome everyone to this hearing on undersea research and ocean exploration, and I especially want to thank our witnesses for testifying. We have an excellent panel with us today to help us discuss how best to organize NOAA's marine research efforts.

The bill that we will discuss today authorizes two ocean programs at NOAA, the National Undersea Research Program, or NURP, and the Ocean Exploration Program, known as OE. These two programs provide critical tools and information that allow scientists and policy-makers to better understand and manage our nation's marine resources.

Unfortunately, not everyone appreciates, yet, just how important the oceans and the Great Lakes are to our daily lives. More than 70 percent of the Earth's surface is covered by oceans, seas, and the Great Lakes. Together, they are a source of valuable living and nonliving resources, are critical corridors for transportation and shipping, and provide some of the most popular recreation and vacation sites in the country.

Large quantities of mineral and fossil fuel wealth exist beneath the surface of the Earth's oceans, and novel new compounds with potential practical applications, are discovered on a regular basis. We could spend this entire hearing just talking about how important the oceans and Great Lakes are to all of us, but the most amazing fact about these incredible resources and the reason that we are here today is how little we know about them, and how much we have yet to learn.

I know our panel will make this point even more clearly, so I will give just a few brief illustrations of how much we don't know, and by the way, I think it is very important in science to know what you don't know, and so that you can ask the right questions.

NOAA estimates that over 95 percent of the world's oceans and over 99 percent of the ocean floor have yet to be explored. Today, maps of Earth's oceans' bottoms have a resolution of seven miles. This means that we can't even see features the size of the National Mall. By comparison, the Mars Global Surveyor has photographed the surface of Mars with a resolution as high as 1.6 feet. Amazingly, we have even been able to locate the Mars Rover, a device the size of an average office desk.

Pulley Ridge, a 60-mile long reef off the coast of Florida, hosts a diverse and thriving ecosystem, but was unknown until less than a decade ago. A good comment I heard over National Public Radio a few months ago pointed out that well over a thousand people have now climbed to the top of Mount Everest, several hundred astronauts have gone out into space, but only a few people have reached the bottom of the ocean to do exploration. One of our closest resources is yet largely unexplored.

Effective management of our marine resources requires a well organized, carefully thought out science program to both fill in the gaping holes in our knowledge, and give our managers and policy-makers the tools and information they need to do their jobs. We are here today to talk about two critical pieces of that science program.

Ocean exploration helps us define the scope and scale of marine environments, and gives us proper context within which to ask the

best scientific and policy questions. NURP gives scientists the specialized technical support they need to fill the gap between basic marine science and the more applied science and information needs of policy-makers and resource managers around the country.

There are two issues that I hope we will be able to address clearly today. The first has to do with clarifying the benefits that NURP and OE provide to the country. In the increasingly challenging budget environment, we cannot afford to squander resources on unfocused or poorly guided programs. I hope to learn from our witnesses whether the bill before us provides an appropriate structure for the two programs.

The second issue has to do with the proposed merger of the two programs. We need to be assured that this process has been carefully thought through, and includes adequate input from the broader marine science—pardon me—community. Without careful planning and the support of the community, a merger may do more harm than good. We need to decide if the bill provides appropriate guidance and flexibility to this process, so that whatever comes out in the end will strengthen, not weaken, our nation's marine science efforts.

I again want to thank our witnesses for being here today. I certainly look forward to your testimony and to an informative discussion.

I am now pleased to recognize Mr. Wu for his opening statement.

[The prepared statement of Chairman Ehlers follows:]

PREPARED STATEMENT OF CHAIRMAN VERNON J. EHLERS

Good afternoon! I want to welcome everyone to this hearing on undersea research and ocean exploration, and I especially want to thank our witnesses for testifying. We have an excellent panel to help us discuss how best to organize NOAA's marine research efforts. The bill that we will discuss today authorizes two oceans programs at NOAA: The National Undersea Research Program—or NURP—and the Ocean Exploration Program—known as OE. These two programs provide critical tools and information that allow scientists and policy-makers to better understand and manage our nation's marine resources.

Unfortunately, not everyone appreciates—yet—just how important the oceans and Great Lakes are to our daily lives. More than 70 percent of the Earth's surface is covered by oceans, seas, and the Great Lakes. Together they are a source of valuable living and non-living resources, are critical corridors for transportation and shipping, and provide some of the most popular recreation and vacation sites in the country. Large quantities of mineral and fossil fuel wealth exist beneath the surface of the oceans, and novel new compounds with potential practical applications are discovered on a regular basis. We could spend this entire hearing just talking about how important the oceans and Great Lakes are to all of us, but the most amazing fact about these incredible resources—and the reason that we are here today—is how *little* we know about them, and how much we have yet to learn. I know our panel will make this point even more clearly, so I will give just a few brief illustrations of how much we *don't* know:

- NOAA estimates that over 95 percent of the world's oceans and over 99 percent of the ocean floor have yet to be explored.
- Today, maps of Earth's ocean bottoms have a resolution of seven miles. This means that we can't even see features the size of the National Mall. By comparison the Mars Global Surveyor has photographed the surface of Mars with a resolution as high as 1.6 *feet.* Amazingly, we have even been able to locate the Mars Rover, a device the size of an average office desk.
- Pulley Ridge, a 60-mile-long reef off the coast of Florida, hosts a diverse and thriving ecosystem, but was unknown until less than a decade ago.

Effective management of our marine resources requires a well organized, carefully thought-out science program to both fill in the gaping holes in our knowledge and

give our managers and policy-makers the tools and information they need to do their jobs. We're here today to talk about two critical pieces of that science program. Ocean Exploration helps us define the scope and scale of marine environments and gives us proper context within which to ask the best scientific and policy questions. NURP gives scientists the specialized technical support they need to fill the gap between basic marine science and the more applied science and information needs of policy-makers and resource managers around the country.

There are two issues that I hope we will be able to address clearly today. The first has to do with clarifying the benefits that NURP and OE provide to the country. In the increasingly challenging budget environment, we cannot afford to squander resources on unfocused or poorly guided programs. I hope to learn from our witnesses whether the bill before us provides an appropriate structure for the two programs.

The second issue has to do with the proposed merger of the two programs. We need to be assured that this process has been carefully thought through and includes adequate input from the broader marine science community. Without careful planning and the support of the community, a merger may do more harm than good. We need to decide if the bill provides appropriate guidance and flexibility to this process so that whatever comes out in the end will, strengthen—not weaken—our nation's marine science efforts.

I again want to thank our witnesses for being here today—I look forward to your testimony and to an informative discussion.

I will now recognize our Ranking Member, Mr. Wu.

Mr. WU. Thank you, Mr. Chairman, and good afternoon, ladies and gentlemen.

Our nation has the fortunate advantage of vast coastal and oceanic resources, including those of the Great Lakes. Over half of our citizens live in coastal watersheds. Our ocean and coastal resources are the basis of billions of dollars of economic activities, including recreation, fisheries, oil and mineral extraction, and transportation.

Healthy oceans are critical to our future. Improved knowledge to manage ocean and coastal resources in a more sustainable fashion is essential if we are to continue to derive the full benefit of these valuable assets now and into the future.

We are coming upon the two year anniversary of the release of the report by the U.S. Ocean Commission. Sadly, few of its recommendations have moved forward.

The Commission's report notes the President's Panel on Ocean Exploration called for a robust national ocean exploration program in 2000. The panel's recommendation was to initiate multidisciplinary expeditions funded at a level of $75 million per year. Their recommendation led to the establishment of NOAA's Office of Exploration in 2001, with a budget of $4 million.

The Commission report indicates the small budget of NOAA's Office of Exploration and its agency-specific focus limit its effectiveness. They recommend that NOAA combine its efforts with those of the National Science Foundation to link NOAA's exploration activities to NSF's strong traditional oceanic research programs.

There is no shortage of enthusiasm for ocean exploration, and there are still vast, unexplored areas of the ocean, as the Chairman has noted. However, we are constrained by the budget available to fund all the expeditions we would like to undertake. H.R. 3835 authorizes additional funding for NOAA's programs in ocean exploration and undersea research, but without expanding NOAA's overall budget, I do not see how we will be able to act upon the recommendations of the U.S. Ocean Commission.

The Administration proposed combining NOAA's Ocean Exploration Program with the National Undersea Research Program.

H.R.3835 appears to maintain these programs as separate entities. I am very interested to hear the opinions of our panel about this—these differing proposals.

I would like to welcome all of you today and thank you for participating in this hearing. I look forward to hearing your testimony.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Wu follows:]

PREPARED STATEMENT OF REPRESENTATIVE DAVID WU

Good afternoon. Thank you, Mr. Chairman for holding this hearing on ocean exploration and research.

Our nation has the fortunate advantage of vast coastal and oceanic resources. Over half of our citizens live in coastal watersheds. Our ocean and coastal resources are the basis of billions of dollars of economic activities including recreation, fisheries, oil and mineral extraction, and transportation. Healthy oceans are critical to our future. Improved knowledge to manage ocean and coastal resources in a more sustainable fashion is essential if we are to continue to derive the full benefit of these valuable assets now and into the future.

We are coming upon the two-year anniversary of the release of the report by the U.S. Ocean Commission. Unfortunately, few of its recommendations have moved forward.

The Commission's report notes the President's Panel on Ocean Exploration called for a robust national ocean exploration program in 2000. The panel's recommendation was to initiate multidisciplinary expeditions funded at a level of seventy-five million dollars per year. Their recommendation led to the establishment of NOAA's Office of Exploration in 2001 with a budget of four million dollars.

The Commission report indicates the small budget of NOAA's Office of Exploration and its agency-specific focus, limit its effectiveness. They recommended NOAA combine its efforts with those of the National Science Foundation to link NOAA's exploration activities to NSF's strong traditional oceanic research programs.

There is no shortage of enthusiasm for ocean exploration and there are still vast unexplored areas of the ocean. However, we are constrained by the budget available to fund all the expeditions we would like to undertake. H.R. 3835 authorizes additional funding for NOAA's programs in ocean exploration and undersea research, but without expanding NOAA's overall budget I do not see how we will be able to act upon the recommendations of the U.S. Ocean Commission.

The Administration proposed combining NOAA's ocean exploration program with the National Undersea Research Program (NURP). H.R. 3835 appears to maintain these programs as separate entities. I am very interested to hear the opinions of our witnesses this afternoon about this proposal.

I would like to welcome our panel of witnesses today and thank you for participating in the hearing. I look forward to hearing your testimony.

Chairman EHLERS. Thank you, Mr. Wu.

If there are Members who wish to submit opening statements, their statements will be added to the record. Without objection, so ordered.

Just a word of explanation about procedure. We have two Members of Congress who are going to constitute Panel I, and this group is to be Panel II. The Honorable Jim Saxton of New Jersey and the Honorable Robert Simmons of Connecticut. Unfortunately, they are tied up in another committee meeting and cannot get away at this time. They will come when they are able to, and I apologize, but you will summarily be displaced while we take their testimony. It would not take long, because we normally don't question fellow Members of Congress, because we have immediate access to them at any time. So, it would be a brief probably 15-minute interlude, and then we would resume the hearing. If they don't show up by the time you are finished, you have nothing to fear. They may have something to fear, but you won't.

All right. At this time, I would like to introduce our first panel of witnesses. First, Dr. Richard Spinrad, Assistant Administrator of the National Oceanic and Atmospheric Administration Office of Oceanic and Atmospheric Research, better known as OAR.

Next, Mr. Andrew Shepard, Director of the National Undersea Research Center, University of North Carolina, Wilmington. If we have a lot more global warming, will your entire lab be undersea as well?

Okay. Next, we have Dr. Marcia McNutt, President and CEO of Monterey Bay Aquarium Research Institute, which is not only an outstanding research institute, but has the best view of any of them.

We are pleased to welcome all of you. I assume the witnesses have been informed that spoken testimony is limited to five minutes each. We have the little black box up there. Green means go, go, go. Yellow means you don't have much time left, wrap it up, and red means you are in trouble. So, you have five minutes each, and if your testimony is longer than that, it will certainly go into the record in total, but we will ask you to wrap up as soon as possible after five minutes.

So, we will start hearing the testimony of Dr. Spinrad.

STATEMENT OF DR. RICHARD W. SPINRAD, ASSISTANT ADMINISTRATOR, OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE

Dr. SPINRAD. Thank you, Mr. Chairman and Members of the subcommittee. I appreciate the opportunity to speak to you today about undersea research and ocean exploration. I am Dr. Richard Spinrad, the Assistant Administrator for NOAA's Office of Oceanic and Atmospheric Research.

My office is responsible for leading and conducting scientific research, environmental studies, and technology development for NOAA. Today, I will discuss the programs detailed in H.R. 3835, an Act to Establish a Coordinated National Exploration and Undersea Research Program in NOAA.

My written testimony addresses NOAA's technical comments on the bill. However, I want to emphasize today NOAA's strong support for the overall intent of H.R. 3835. In keeping with the Administration's commitment to ocean exploration, as described in the U.S. Ocean Action Plan, this piece of legislation elevates the importance of science-based ocean exploration and undersea technology development. The Act recognizes these activities as vital national missions, and strengthens federal efforts to pursue and support our understanding of the planet. We must remember that over 70 percent of the Earth's surface is covered by our oceans and remains vastly unexplored.

Our understanding of the ocean environment will be enhanced by our creation of a dedicated, integrated national program for exploration and advanced ocean technology development. In 2006, NOAA began a multiyear process to merge our National Undersea Research Program, or NURP, with the Office of Ocean Exploration, into a single Office of Ocean Exploration and Research. NOAA undertook this merger at the behest of Congress and NOAA's Science

Advisory Board to increase the synergies between the two programs, focus on undersea technology, and leverage the program's broad expertise in regional partnership networks.

Congress agreed to the merger in 2005, and in a spirit of transparency, we are currently conducting a series of workshops and discussions with our external partners to resolve the details. From my perspective, the merger is also about preserving research assets, which include our scientists and infrastructure in NOAA, and in our regional undersea research centers.

Unfortunately, however, recent Congressional support for the program has dwindled, as evidenced by the fiscal year 2006 appropriation and the 2007 House mark, which have been substantially below the President's request. The fiscal year 2007 President's budget request restores funding to our undersea research and ocean exploration programs at appropriate levels to meet the Nation's needs. Though NOAA has taken extraordinary steps to protect these assets, in the absence of sufficient funding, the effectiveness and future of the programs are at risk.

So, what is at stake? Let me describe a few capabilities that each of these programs brings to the table in this merger, and how each benefits our great Nation. Ocean exploration is an exciting adventure. It immediately captures the imagination. It is also serious, hardcore science. At its most fundamental, exploration improves our knowledge of living marine resources, their habitats, and ecosystems. Our knowledge in turn enhances fisheries and ocean stewardship, and benefits marine resource management. The economic and social benefits of exploration are significant. Wherever the program has looked, valuable new discoveries and information have been found.

For instance, our explorations have discovered deep sea organisms that have significant potential for new cancer drug treatments, pain inhibitors, and other pharmaceutical uses. Importantly, no other dedicated source of federal funding or logistics exists for pure exploratory-based ocean science. In 2007, we launch a new voyage of learning and discovery through ocean exploration when the Okeanos Explorer, a former Navy vessel, is converted to join the NOAA fleet as the Federal Government's only dedicated ocean exploration ship.

For over 25 years, NOAA's National Undersea Research Program has served the Nation by supporting research and providing cutting edge advanced technologies. NURP also provides the infrastructure necessary to support undersea operations for both the academic community and NOAA. The program has also played a strong role in developing next generation concepts for coastal observing systems.

NURP has also developed a series of autonomous or remotely operated undersea vehicles. These vehicles let us explore parts of the world never seen before. In fact, in May, one of these vehicles was used to observe lava actively erupting from an undersea volcano in the Pacific for the first time. These unique observations will help us learn more about the contribution of oceanic volcanoes to the Earth's climate and their effects on ocean ecosystems.

NURP's autonomous undersea vehicles and next generation chemical, physical, and biological sensor development will also help

us study critical elements in the marine environment. For example, deposits of methane hydrates in the Gulf of Mexico, which NURP helped discover, have potential benefits as an untapped domestic energy source, but also may contribute to climate change.

NOAA's Office of Ocean Exploration and Undersea Research will have the special technological expertise and equipment to contribute to this research. With the merger of the Office of Ocean Exploration and the National Undersea Research Program, we combine the search for new discoveries with the development of the advanced marine technologies to furthering our exploration of the oceans. This new ocean exploration and advanced technology development program will present a powerful new capability, and provide a sound foundation for the aggressive ocean exploration and undersea technology development that our nation needs.

Thank you for this opportunity to testify, and I look forward to your questions.

[The prepared statement of Dr. Spinrad follows:]

PREPARED STATEMENT OF RICHARD W. SPINRAD

Good morning, Mr. Chairman and Members of the Committee. I am Richard W. Spinrad, Assistant Administrator for Oceanic and Atmospheric Research at the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce. Thank you for inviting me to discuss H.R. 3835 and the role of the National Oceanic and Atmospheric Administration (NOAA) in ocean exploration and undersea research.

NOAA's vision is an informed society that uses a comprehensive understanding of the role of the oceans, coasts, and atmosphere in the global ecosystem to make the best social and economic decisions. NOAA's mission is to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our nation's economic, social, and environmental needs. NOAA's Office of Ocean Exploration and National Undersea Research Program (NURP) are contained within the Office of Oceanic and Atmospheric Research (OAR). In support of NOAA's mission, OAR conducts the scientific research, environmental studies, and technology development needed to improve our operations and broaden our understanding of the Earth's atmosphere and oceans. The Office of Ocean Exploration is devoted exclusively to the critical mission of exploring the still largely unknown ocean. The ocean exploration program focuses on discovery of new ocean resources for societal and economic benefits, serves as an effective means to promote ocean education and ocean literacy, and enables NOAA to become aware of ocean issues that may become the basis for future NOAA missions. NURP harnesses the academic community to focus on NOAA's undersea research needs. NURP currently supports NOAA's mission by providing undersea scientists inside and outside NOAA with advanced technologies, such as an underwater laboratory, submersibles and remotely operated vehicles, and the expertise needed to work in the undersea environment.

I am pleased to be here today to discuss H.R. 3835, an act to establish a coordinated national ocean exploration program within NOAA. NOAA supports the intent of this legislation. Title I of the bill addresses ocean exploration; Title II addresses NOAA's complementary program in undersea research. Together, these two programs provide a solid foundation for the aggressive ocean exploration and undersea technology program for our nation. Today, I will outline our current ocean exploration and undersea research programs, describe our planned merger of these programs, and explain why this legislation is important to NOAA.

In his preface to the President's Panel on Ocean Exploration report in 2000, former Secretary of Commerce Norman Mineta eloquently stated the importance of ocean exploration to our nation's interests and future:

> *"Our nation's history, from colonization and westward expansion to the deployment of the Hubble telescope, is testament to the fact that America is a country of explorers. Our pride as a nation is founded upon our yearning to make new discoveries and to seek out new knowledge. Exploration of the oceans responds to a growing national interest in our seas and an acknowledgement of their importance to our environment and quality of life.*

We are growing in the awareness that the ocean influences our daily lives in hundreds of ways. From providing fisheries resources or cures for disease, to unlocking the secrets of long-term climate variations, we are constantly reminded of the ocean's importance in sustaining life. Truly, our economic, environmental, and national security depends on our ability to understand the ocean frontier, as well as balancing the competing interests of conservation and economics."

Historical Perspective

In 2007, NOAA will celebrate 200 years of history of science and exploration, service, and stewardship of our nation's oceans, coasts, and Great Lakes. National interest in establishing a comprehensive ocean exploration program stretches back over 40 years, when, in the late 1960's, the Stratton Commission initiated the International Decade of Ocean Exploration. The resulting programs dramatically enhanced understanding of the global climate system, geochemical cycling, ocean circulation, plate geodynamics, and life in extreme environments. In 1971, NOAA established the Manned Undersea Science and Technology (MUST) program, which pioneered exploration from undersea habitats. MUST was transitioned in 1980 from a primarily headquarters program to the extramural NURP. Since then, NURP has continued to provide the scientific community with the undersea tools to conduct exploration and cutting edge research.

In 1983, an interagency effort to comprehensively map the U.S. exclusive economic zone (EEZ) was initiated. Our EEZ is the largest in the world spanning over 12,300 miles of coastline and contains 3.4 million square nautical miles of ocean—larger than the combined land mass of all 50 states. While the surface of the ocean has been studied via remote sensing for basic physical and biogeochemical properties, today less than 10 percent of the U.S. EEZ has been mapped with current multi-beam technology. Less than five percent of the EEZ has been mapped at a resolution required for accurately defining habitat. In addition to our nation's EEZ, approximately 95 percent of the world's oceans have not been visited or studied in situ. This includes the major features such as the 31,000 miles of mid-ocean ridge crest, 6,200 miles of deep sea trenches, over 30,000 sea mounts and the water-column of the ocean—which together are home to 99 percent of the Earth's living organisms. Because the scope of what remains unknown below the surface is enormous, we will continue to carefully prioritize the work we undertake.

Increasing national interest in ocean exploration, in large part stimulated by NURP-sponsored activity, culminated in 2000, when a Presidential Panel on Ocean Exploration convened by the Department of Commerce called for a robust national ocean exploration program propelled by the spirit of discovery. The panel proposed a strategy of interdisciplinary expeditions, new partnerships, and integrated federal programs to characterize the vast array of biological, physical, and chemical environments of the oceans and foster the development of technology. The panel's recommendations led to the establishment of the Office of Ocean Exploration within NOAA in 2001.

In 2003, a National Research Council report expressed support for a comprehensive national ocean exploration program strongly linked to traditional research, with broad international partnerships, and a commitment to educational opportunities. This report was followed in 2004, by the U.S. Commission on Ocean Policy recommendation to establish an expanded ocean exploration program. In response to the report of the U.S. Commission on Ocean Policy, the Administration developed the U.S. Ocean Action Plan. Ocean exploration will be addressed in the context of the Ocean Research Priorities Plan and Implementation Strategy, which was called for as part of the U.S. Ocean Action Plan. The National Science and Technology Council Joint Subcommittee on Ocean Science and Technology (JSOST) is currently developing this interagency planning document and implementation strategy on priorities for ocean science technology for the next five to 10 years. As one of the Co-chairs of the JSOST (along with the National Science Foundation and the Office of Science and Technology Policy) I am closely involved in this work, and can report that we continue to make progress. On April 4, 2006, we released our Ocean Priorities Framework for developing the Ocean Research Priorities Plan and Implementation Strategy; the detailed plan is due at the end of this calendar year.

The Office of Ocean Exploration

The recent sustained national interest in ocean exploration has resulted in an exciting, successful ocean exploration program within NOAA. The mission of this program is to conduct interdisciplinary ocean exploration expeditions and projects that provide scientific information as well as technical and educational leadership that contributes to NOAA's evolving environmental and economic missions. The program pursues this mission by focusing on four key goals:

Explore unknown and poorly known areas of the ocean: Exploration science expands our understanding of what resources and processes are in the oceans. The wealth of living and non-living resources yet to be discovered holds vast untapped economic potential and offers new opportunities for medical science. For example, microbial organisms that thrive in deep-sea environments produce novel enzymes and other compounds as a consequence of living in extremes of temperature and chemistry which have significant potential for creating bioproducts for use in pharmaceutical and industrial applications. Recent screenings show that these marine samples are 20 times more active than their terrestrial counterparts.

Ocean Mapping: Less than 10 percent of the U.S. EEZ has been mapped with current technology, and many resources, habitats, and features remain undiscovered. Our ability to manage ecosystems is dependent upon our ability to define the area these ecosystems cover. In conjunction with other NOAA mapping efforts, ocean exploration routinely maps ocean areas during expeditions to discover and record the physical, biological, geological, archaeological, and chemical nature of the oceans. This information is critical for both expanding our understanding of the U.S. EEZ, and supporting future establishment of the U.S. continental shelf, where potential resources such as mineral deposits, valued at $1.3 trillion, are estimated to exist.

New Technology: The Office of Ocean Exploration invests in new technologies to increase the pace, efficiency and scope of ocean discovery and to enhance the technical capability of the United States by promoting the development of improved oceanographic research, communication, navigation, and data collection systems, as well as underwater platforms and sensors. The program coordinates new technology needs and investments with other NOAA programs, other federal agencies, and through the National Oceanographic Partnership Program. The program also invests in projects that test and evaluate new and emerging technologies under live conditions. A merger of NOAA's ocean exploration program and undersea research program, which I will discuss later, will enhance NOAA's ability to support emerging technology in these areas.

Education and Outreach: The President's *Ocean Action Plan* calls for promoting lifelong ocean education as essential for fostering a strong economy, promoting healthy ecosystems and preparing a competitive workforce with the scientific understanding needed to balance the sustainable use and conservation of our natural resources. The ocean exploration program is a leader in this effort dedicating 10 percent of its budget to education and outreach to improve ocean literacy in the United States and to stimulate interest in ocean science. The program is uniquely positioned to use interdisciplinary expeditions as a catalyst to bring the excitement of ocean exploration to teachers and school children. The program's web site *(www.oceanexplorer.noaa.gov)* is rated in the top five worldwide in its category, by a major international science education authority. This web site, which includes teaching materials for educators, daily logs of expeditions, immediate reports of the discoveries, and live images of the seafloor, was visited by more than four million people last year. These efforts are inspiring a whole new generation to explore and work in the oceans which will help ensure that in the future the United States will have a competitive edge in the oceans and remain a global leader in ocean science and technology.

In less than five years, the Office of Ocean Exploration has been able to successfully leverage federal funding, equipment, and expertise to assemble interdisciplinary teams of scientist-explorers in support of more than 100 ocean expeditions and projects to unknown and poorly known areas of the ocean. These ocean expeditions have discovered many new marine ecosystems (including fish and coral habitats); new species of micro and macro-organisms; and chemical and geological processes that impact the oceans such as large quantities of carbon dioxide produced by underwater volcanoes. These expeditions have also mapped thousands of square miles of ocean floor that had never been mapped before, where they discovered new land forms, including large submarine volcanoes, sea mounts, and extensive areas of deep water coral reef and sponge habitats.

NOAA's partnerships with other federal agencies, academia, industry, ocean institutions and scientists from U.S. and international organizations are a vital component of NOAA's ocean exploration program. Together with our partners, NOAA increases our national understanding of ocean systems and processes by undertaking six to 10 major voyages of discovery per year and funding up to 25 additional missions and exploration-related projects per year. All expeditions are selected through a rigorous peer-reviewed process. The program spends approximately 70 percent of its funds outside of NOAA on science that benefits the Nation's understanding of the oceans and ecosystems.

Programs across NOAA benefit from new sources and scales of information generated by the Office of Ocean Exploration. These benefits include greater knowledge of living marine resources, their habitats, and ecosystems which enhance fisheries and ocean stewardship and comprehensive site surveys and inventories that inform management of NOAA's National Marine Sanctuaries. The program's characterization of the EEZ improves the management of habitat and marine resources, and by providing inventories of our nation's submerged cultural and historical resources, the Office of Ocean Exploration aids in the preservation of this heritage. The Office of Ocean Exploration also provides important governance and scientific investigation in support of the international Census of Marine Life, which is helping to identify important breeding areas and inform strategies for sustainable management.

The Office of Ocean Exploration's efforts are, in turn, supported by other programs within NOAA including the National Oceanographic Data Center, which provides vital data access, archive, and assessment support. NOAA has also assembled a team of data and information experts from its National Geophysical Data Center, the National Coastal Data Development Center, NURP, and the NOAA Library to ensure the broadest public access and use of the results from its ocean expeditions. This team has developed procedures for ensuring archival and public access to the variety of the data products generated on these expeditions including underwater video, which has become an important new source for quantitative data about the ocean environment, as well as for stimulating public interest and life-long learning.

We will see more opportunity for learning and discovery through ocean exploration when a new vessel dedicated to ocean exploration joins the NOAA fleet. After conversion, a former Navy vessel will be commissioned and named NOAA vessel *Okeanos Explorer.* The vessel will be available in 2008 to serve the Nation as a premier ocean research platform to conduct critical deep-sea missions including ocean floor mapping and biological and chemical oceanographic research. The vessel will also be equipped for "telepresence," a satellite-based communications technology that allows shore-side scientists, teachers, and students to connect in near real-time with scientists at sea and to view images from the ocean and seafloor using high-speed Internet. The near real-time data and images are transmitted to science command centers ashore where teams of scientists augment the work of scientists and explorers at sea. By bringing multiple high-quality video streams and sensor data from the remote seafloor to scientists, teachers, and students on shore, the potential exists to revolutionize oceanographic research and ocean education. "Telepresence" technology was successfully pioneered on a NOAA-sponsored expedition to the deep-sea hydrothermal vent field known as the "Lost City" on the Mid-Atlantic Ridge in July 2005.

The goals and missions of the current Ocean Exploration and Undersea Research Programs not only complement existing programs at NOAA, they also form the basis for growing partnerships with the National Science Foundation, and other federal agencies. For example, NOAA's Office of Ocean Exploration has initiated a pilot partnership with the National Science Foundation that has recently resulted in a highly successful, jointly funded exploration expedition to the Galapagos Ridge. This is a model for future, jointly funded cruises that support both OE's and NSF's interests in exploring unknown areas of the ocean.

NOAA's ocean exploration program is a national program that provides the opportunity of discovery to our partners in academia, federal and State agencies, and industry. No other federal dedicated source of funding or logistics exists for discovery-based ocean science. The economic and social benefits of discovery are significant and the promise of future discovery is clear; wherever the program has looked, new discoveries and information have been found.

The National Undersea Research Program

NURP has served NOAA and the Nation for over 25 years as an underwater research and technology program. NURP places scientists underwater using advanced technologies, either directly or remotely, and focuses its considerable expertise and connections to the academic community on NOAA's undersea research agenda. In recent years, the program has functioned through a network of six regional centers and an institute, hosted primarily by universities. Two centers are located on the West Coast in Hawaii and Alaska, and four are located on the East Coast in North Carolina, New Jersey, Connecticut, and Florida.

NURP has a proven record of providing the advanced technologies and infrastructure necessary to support undersea research and exploration operations for both the academic community and NOAA. Through regional competitive processes, the program sponsors cutting edge undersea research, which is applicable to NOAA's stewardship and management missions. The program also fosters innovative uses of existing technologies to meet undersea exploration and research challenges. Through

ownership or leasing, NURP has provided undersea systems that work from the coast to the deep sea. For example:

- NURP owns and operates the Aquarius, the world's only underwater science laboratory, located in the Florida Keys National Marine Sanctuary. Aquanauts live on and study sensitive coral reef ecosystems threatened by natural and human-caused impacts and are able to perform studies not possible through traditional diving techniques.
- NURP operates undersea remotely operated vehicles (ROVs) and autonomous undersea vehicles (AUVs) that increase the access of researchers to the depth and breadth of the oceans.
- NURP owns and operates the Pisces IV and V, human occupied submersibles that enable scientists to explore the deep ocean-depths down to 6,000 feet. In partnership with the Office of Ocean Exploration in the summer of 2005, the Pisces submersibles completed a historic expedition to the South Pacific where scientists examined more than 20 previously unexplored sub-sea volcanic ecosystems. The program also provides scientists with access to research submarines including the *Alvin, Johnson Sea-Link,* and *Delta* submersibles.
- NURP, as the lead office for fulfilling NOAA's statutory responsibility to improve the safety and performance of civilian divers, has supported advanced diving techniques, which enable researchers to explore and characterize little known habitats such as deep corals.
- NURP supports pioneering uses of technologies such as multi-beam sonar, advanced cameras, and sea bed observing instrumentation to address emerging ocean exploration and undersea ocean observing, sampling, monitoring and modeling issues for the National Ocean Service and the National Marine Fisheries Service within NOAA.

NOAA and the National Aeronautics and Space Administration (NASA) share the mission of exploration in remote and hostile ocean and space environments, respectively. Humans working both in space and under the ocean face similar challenges of lack of oxygen, weightlessness, extreme pressure differentials, and remote, cramped living quarters. Currently, the National Undersea Research Program and NASA conduct a uniquely successful partnership in which astronauts train and simulate Moon exploration at the Aquarius undersea laboratory. In addition to the operational benefits, this partnership provides a springboard for increased leveraging of exploration technology development between NOAA and NASA.

In FY 2006, Congress appropriated funds for NURP at a level significantly below the President's budget request. This reduction eliminated support for the four East Coast centers, and reduced funding at the West Coast and Polar Regions Center at the University of Alaska, Fairbanks, by one half. NOAA redirected a small amount of funds internally to enable NURP to maintain essential personnel and equipment at the four centers during restructuring efforts. NURP, as supported by the Administration's FY 2007 request, will include both an East and West Coast capability. Further details of the restructuring are currently under discussion in consonance with the merger of the program with NOAA's Office of Ocean Exploration.

Office of Ocean Exploration and NURP Merger

In FY 2007, NOAA will further address the need for ocean technology development by refocusing the priorities, direction, and partnerships of its National Undersea Research Program and merging it with the Office of Ocean Exploration (OE) (the Appropriations Committees concurred with this reorganization in 2005). Both NURP and OE strive to meet NOAA, national, and international needs for innovative undersea exploration and research. The merger of the two programs will help meet these needs and also effectively address NOAA's undersea technology requirements. Merging the two programs will more efficiently utilize our resources to focus on exploration and undersea technology challenges; expand the excitement of ocean exploration with a regional network of partnerships; and take advantage of efficiencies of time, personnel, and funding between both programs. The merged program will also allow NOAA to capitalize on the synergy between these programs to achieve the goal of expanding exploration into focused research, and then to finding operational or commercial applications for our discoveries. Together, these programs will provide a more robust program of ocean discovery.

This merger is also an opportunity for NOAA to increase its emphasis and effectiveness in utilizing and developing advanced undersea technology. Despite recent technological advances, the current pace of discovery and acquisition of new knowledge is slow and is limited by the present requirement of having to conduct nearly all ocean exploration from surface ships. Ships support a variety of advanced tech-

nologies for accessing the underwater environment, but information collection is limited to observations from humans in submersibles or remote observations from cameras carried by robots tethered to the ship. An increased focus on ocean technologies would complement ship-based explorations by advancing the development and use of new underwater exploration assets and sensors, especially including autonomous underwater vehicles and remote sensing. Autonomous robots with their expanded sensing capabilities could significantly increase the pace of exploration, discovery, and generation of new knowledge. Such technological advancements would benefit the entire marine science community by developing improved systems for oceanographic research, communication, navigation, and data collection.

The OE and NURP programs currently collaborate in a number of areas including expedition planning and execution, and data management. The full details of the merger are currently under discussion and will depend upon several factors including input from the regional undersea research centers and the extramural community, and program funding levels.

Support of the U.S. Ocean Action Plan

NOAA is lead or co-lead for roughly half of the assigned items from the President's *U.S. Ocean Action Plan,* and has made significant strides on several actions. The Office of Ocean Exploration and NURP provide unique capabilities to gather, synthesize, and apply information collected during expeditions of discovery to directly address many of the challenges described in the U.S. Commission on Ocean Policy report and the President's *Ocean Action Plan.* The Office of Ocean Exploration and NURP are supporting several of NOAA's *Ocean Action Plan* actions through activities including: conversion of the ship *Okeanos Explorer* for dedicated ocean exploration, providing advanced undersea technologies to support and integrate with the U.S. Integrated Ocean Observing System (IOOS), participating in the Joint Subcommittee on Ocean Science and Technology development of an Ocean Research Priorities Plan and Implementation Strategy, participating in Integrated Coastal and Ocean Mapping activities, and conducting and participating in a range of educational activities. In addition, NURP and OE support exploration and research projects which further conservation of deep corals, including deep corals within the Northwestern Hawaiian Islands Marine National Monument. An OE-sponsored expedition recently discovered extensive deep-water corals in the Olympic Coast National Marine Sanctuary. In direct response to the *Ocean Action Plan* recommendation to "Research, Survey, and Protect Deep-Sea Coral Communities," the Office of Ocean Exploration supported four expeditions with international partners in FY 2005 and is conducting additional activities in FY 2006 and FY 2007.

NOAA's Views on H.R. 3835

NOAA supports the intent of H.R. 3835 to establish a coordinated national ocean exploration program by building on the current capability within NOAA. This legislation would elevate the importance of science-based ocean exploration, and undersea technology development as a vital national activity and strengthen federal efforts to pursue and support it. H.R. 3835 recognizes the critical components of NOAA's current ocean exploration activities, including the development of new undersea technologies, outreach, and education. As part of its responsibilities NOAA supports the authorization of interdisciplinary exploration to expand our knowledge of the ocean's living and non-living resources.

H.R. 3835 advances undersea technology development and furthers support for undersea research and exploration by mandating that the program "make available the infrastructure and expertise to service the undersea science needs of the academic community." The legislation supports two of the most successful and unique aspects of NURP: (1) harnessing the Nation's extramural, academic expertise to provide solutions to NOAA's undersea challenges, and (2) conducting an open, competitive process for allocation of resources. It also supports the important program areas of undersea science-based education and outreach programs to enrich ocean science education and public awareness, and the discovery, study, and development of natural products from ocean and aquatic systems. The bill also provides a sufficient framework and guidance for ensuring that data generated by the programs will be made available to a broad spectrum of users, in essence supporting the approach that has already been developed within NOAA.

We do recommend that the following changes to the bill be considered. While NOAA agrees with the goal of Section 104, to promote coordination, such a statutory requirement is unnecessary and would duplicate existing efforts. NOAA currently coordinates with other federal agencies on ocean exploration activities and plans for the future. In addition, the coordination among federal agencies mentioned in the bill will increase under the auspices of the new National Science and Technology

Council's Joint Subcommittee on Ocean Science and Technology. The functions of the Joint Subcommittee on Ocean Science and Technology include identifying national ocean science and technology priorities and facilitating the coordination of interdisciplinary ocean research, ocean technology, and infrastructure development.

Section 107 authorizes appropriations to carry out the National Ocean Exploration Program described above in increasing amounts from $30,500,000 in fiscal year 2006 to $71,917,000 in fiscal year 2015, including $33,550,000 for fiscal year 2007. The Administration requests that the authorization levels in the bill be consistent with the President's FY 2007 Budget Request, which provides $15,128,000 for the Ocean Exploration Program.

In light of the NURP restructuring effort, the language of H.R. 3835 remains pertinent with few changes. The purpose of NURP remains consistent with Title II of the Act, to "increase scientific knowledge essential for the informed management, use and preservation of oceanic, coastal and large lake resources through undersea research, exploration, education and technology development." However, NOAA requests that particular named equipment not be enacted into law so that the program can best maintain the flexibility required to meet rapidly changing technological developments and needs.

Section 207 authorizes appropriations to carry out the Undersea Research Program described above in increasing amounts from $12,500,000 in fiscal year 2006 to $29,474,000 in fiscal year 2015, including $13,750,000 in fiscal year 2007. The Administration requests that the authorization levels in the bill be consistent with the President's FY 2007 Budget Request, which provides $9,152,000 for NURP in FY 2007. In addition, the bill includes authorization language and authorization for appropriations for the National Technology Institute. The Administration requests this language be removed to remain consistent with the President's Budget, which does not provide funding for the National Technology Institute.

NOAA also notes that in Section 207, all funding is directed to regional centers leaving no funding for administration of the program. Program administration should be provided, with a cap of 10 percent of appropriated amounts. NOAA supports an undersea research program that is national in scope. The Administration requests in the authorization of funding that no specific percentage of funding be authorized to either the West Coast or East Coast Regional Centers. This change would allow NOAA the flexibility to address research and technology needs from a national perspective covering our interests in the Atlantic, Pacific, Gulf of Mexico, and Great Lakes.

Conclusion

NOAA supports elevating the importance of ocean exploration based on sound scientific research as a vital national activity and endorses the strengthening of federal efforts to pursue and support it. H.R. 3835 recognizes the critical components of NOAA's current ocean exploration activities, including the development of new undersea technologies, and outreach and education programs. We are encouraged that the House of Representatives is considering this legislation to promote the importance of ocean exploration, and maintain and strengthen our ability to generate new ocean knowledge. The U.S.'s strength and leadership in the oceans depends on our nation's ability to generate and harness the latest in scientific and technological developments and to apply these developments to real world applications such as the management of our coastal and marine resources. A national ocean exploration and undersea technology development program is vital to sustaining the scientific advancement and innovation needed to maintain our nation's competitive edge in ocean science and technology, as well as to continue to meet the new emerging needs of NOAA's mission.

BIOGRAPHY FOR RICHARD W. SPINRAD

Dr. Spinrad is the Assistant Administrator of the National Oceanic and Atmospheric Administration (NOAA) in the Office of Oceanic and Atmospheric Research (OAR). He is a native of New York City, and a graduate of the Johns Hopkins University (B.A.), Dr. Spinrad has broad experience in marine science, technology, operations and policy. During his career he has worked in a wide range of positions in government, academia, industry and nongovernmental organizations. Spinrad earned an M.S. in physical oceanography and a Ph.D. in marine geology from Oregon State University. As a research scientist at Bigelow Laboratory for Ocean Sciences he developed and published concepts critical to our understanding of the relationship between water clarity and marine biological productivity. Spinrad served as President of Sea Tech, Incorporated during that company's development of several now-standard oceanographic sensors. He went on to manage oceano-

graphic research at the Office of Naval Research (including serving as the Navy's first manager of its ocean optics program), eventually becoming the Division Director for all of the Navy's basic and applied research in ocean, atmosphere and space modeling and prediction. In 1994 Dr. Spinrad became the Executive Director of the Consortium for Oceanographic Research and Education (CORE) where he led the development of the National Ocean Sciences Bowl for High School Students, and he co-authored, with Admiral James D. Watkins, *"Oceans 2000: Bridging the Millennia,"* which served as the guiding document for the establishment of the National Oceanographic Partnership Program (NOPP). In 1999 Spinrad became the Technical Director to the Oceanographer of the Navy. In this position he provided leadership and guidance for the development of the U.S. Navy's oceanographic and meteorological operational support to Naval forces. Currently, Spinrad serves as the United States permanent representative to the Intergovernmental Oceanographic Commission of UNESCO, and co-chairs the White House Joint Subcommittee on Ocean Science and Technology.

Rick Spinrad is the President-Elect of The Oceanography Society, and served as Editor-in-Chief of *Oceanography* magazine; he has served on numerous professional committees of organizations including the National Academy of Sciences and the American Meteorological Society. Spinrad also served on the faculties of the U.S. Naval Academy and George Mason University. He has spent over 300 days at sea conducting research, and has published more than 50 scientific articles. Spinrad is the editor of a textbook on ocean optics and several special issues of marine science journals.

In 2003 Spinrad was awarded the Department of Navy Distinguished Civilian Service Award, the highest civilian award that can be given by the Navy Department, and he has received a Presidential Rank Award. Dr. Spinrad lives in Falls Church, Virginia with his wife Alanna and two beagles.

Chairman EHLERS. Thank you very much. Mr. Shepard.

STATEMENT OF MR. ANDREW N. SHEPARD, DIRECTOR, SOUTHEASTERN U.S. AND GULF OF MEXICO, NATIONAL UNDERSEA RESEARCH CENTER, UNIVERSITY OF NORTH CAROLINA–WILMINGTON

Mr. SHEPARD. Mr. Chairman and Members of the Committee, thank you for the opportunity to address H.R. 3835. I have been working for NOAA for 28 years, the last 22 for the NOAA Undersea Research Program. In that time, the program has evolved to better serve the Nation, and now, we are on the verge of another major step in this evolution.

My written testimony provides some history of this change and accomplishments. Over the past two decades, the Undersea Research Program has supported more scientific diving than any other single federal program in the country, matching the number of dives performed by all the rest of NOAA combined per year. The program has stressed innovation, discovery, and capacity building, aiding NOAA in areas it needed our specialized help, such as ecosystems science and development of ocean observatories.

For two years, in 1999 and 2000, I commuted from my home in North Carolina to NOAA headquarters in Maryland. My major task was working with Barbara Moore, the NURP Director, the regional NURP centers, and others in NOAA to devise a new ocean exploration program. In 2001, with the guidance from the Presidential Panel coordinated by Ms. Moore, the Ocean Exploration Program was born.

We in NURP are gratified to see the Ocean Exploration Program mature and engage the world in the excitement of ocean frontiers. Their risky, discovery-driven science, wherein the investigator does not entirely know what they will find at the frontier, involves the

kind of uncertainty that often counts against exploratory work and NSF-style peer review processes, unless specifically encouraged.

Now, it is time to recognize the need for a coordinated full spectrum of undersea science applications, from the high risk and high reward expeditions and technology developments to how these discoveries benefit NOAA's mission. Authorization for NURP and OE together is a critical first step.

Does the bill capitalize on the strengths of the programs and address weaknesses? The bill addresses the major weakness of the programs, and that is funding, both underfunding and instability of funding. We strive to support the top scientists and technologists in the Nation conducting relevant, high quality science, using advanced technologies. Trying to accomplish this goal on a year-to-year uncertain funding cycle has been a major weakness. This is now how most federal programs that sponsor ocean science and technology support their grant projects. Stable funding will allow our science and technology developments to mature to useful results, and attract the very best experts.

Does the bill provide appropriate guidance for scope and direction? We are pleased with the bill's guidance, which recognizes, retains, and builds on the existing strengths of the programs. Scientific research, for example, is recognized as a critical component of the continuum from exploration to management needs, and a driver for technology developments. The regional centers and their local partners complement the global endeavors of ocean exploration by connecting discoveries to research and management done at regional ecosystem scales, the heart of NOAA's mission.

What steps are needed to ensure the rigor of these programs, and will the programs be strengthened by the merger? Programmatic rigor will be sustained through stable funding and business practices, such as credible peer review and outside, unbiased advisory panels, as prescribed in the bill. As Chair and spokesperson for the NURP Council Center Directors, we endorse the merger and its benefits for a stronger, more relevant national program.

How should this merger be accomplished? At the request of NOAA management, NURP and OE are now actively engaged in planning for a new merged program. The bill lays the groundwork for this planning. We especially look forward to the hiring of the merged program's director. This position is an opportunity to mold the merged program into a fully integrated team.

In closing, as stated by the President in 1970, in his address to Congress regarding NOAA's birth, and still relevant today: "We face a compelling need for exploration and development leading to the intelligent use of our marine resources." Meeting this challenge through authorization of these programs is long overdue.

Thank you for this opportunity to address you.

[The prepared statement of Mr. Shepard follows:]

PREPARED STATEMENT OF ANDREW N. SHEPARD

Mr. Chairman and Members of the Committee, I am pleased to appear before you concerning H.R. 3835 entitled the "National Exploration Program Act" in Title I, and the "NOAA Undersea Research Program Act of 2005" in Title II. I am grateful to the Committee for your recognition of the importance and need for enhanced support and integration of ocean exploration and undersea research. I have been working for NOAA since 1978, the last 22 years with the NOAA Undersea Research Pro-

gram. In that time, I have seen the program go through many evolutions to better serve the Nation—we are on the verge of another such evolution.

Why do we need specialized undersea research programs?

This a two part question: 1) why do we need to dive; and 2) why are dedicated programs needed? Mysteriously to me, we often must justify why we endure risk and spend time and money going underwater to study oceans. No one doubts the need to study forest ecology or demographics of a city by entering them! Oceanography has traditionally relied on surface ships, and in recent decades, remote sensing, largely as these approaches are traditional or accessible. We are entering a new age for ocean science: ecology is not a fringe discipline, but the core of the "ecosystem approach to management;" an electronic age when data and information can flow at unprecedented rates using robotics and sensors for a vast array of new ocean applications. The Undersea Research Program's technology developments and operations have changed the face of ocean science; the Long-term Ecological Observatory (LEO15) off New Jersey is a prototype coastal ocean observing system that early recognized the importance of quality dive support. Nitrox scuba diving is now supported by most dive shops and academic dive lockers in the country, spurred primarily by NURP development activities.

Why do we need dedicated programs? Simply stated, NOAA needs specialized undersea research programs as diving can be risky and complex. Most marine science programs cannot afford to sustain the technologies and expertise required to keep up evolving advanced diving techniques and technologies, which include robots, submarines, advanced scuba, and variety of related sampling tools.

Why have regional presences?

The practice of regionally located *"centers of expertise"* is common in many national programs, for example, Department of Energy's National Labs or National Institute of Health Centers of Excellence. Their proven success lies partly in economy of scale and common access to pools of specialized resources. NURP provides such specialized undersea assets on over 11,000 scientific dives per year, involving over 200 separate partnering institutes, including 27 U.S. states *(Attachment).* This mostly regional community functions as a vital research capacity needed to address many of NOAA's ocean science and management priorities. The concept of peer review-driven, regionally customized components of a national program encourages quality, relevance, productivity, and cost-effectiveness. The NURP refereed publication rate mirrors academia as a whole, which is ten times higher than government as a whole, at about 10 percent of the cost per publication, in part due to the invaluable contributions of teams of scientists, technologists, and students.

Regional presence enhances *public outreach and extension.* We actively participate in region-based management activities, such as the fishery management councils, state coastal management forums, and sanctuary and reserve advisory boards. It is not just a matter of saving money on travel; we offer local knowledge and expertise that is hard to sustain through a single national program. We want to sustain high-quality useful science, but we also need to make it available to managers and the people who live on the coasts.

Why are NURP, OE and NSF all supporting undersea science?

It is instructive to consider how these programs arose and their missions. NSF was established in 1950 as "the Federal Government's only agency dedicated to the support of education and fundamental research in all scientific and engineering disciplines. Its mission is "to ensure that the United States maintains leadership in scientific discovery and the development of new technologies" *(http://www.nsf.gov/about/history/).* By 1954, studies ranging from use of high speed computing for oceanography and deep sea bottom cores began. Since inception but especially in recent decades, NSF's peer review process heavily favors hypothesis-driven, fundamental research. While this culture meets the NSF mission, it does not necessarily encourage exploratory endeavors or applied research.

NOAA was established in 1970, pursuant to the Stratton Commission, essentially by combining the United States Coast and Geodetic Survey (formed in 1807), the Weather Bureau (formed in 1870), and the Bureau of Commercial Fisheries (formed in 1871) *(http://www.history.noaa.gov/noaa.html).* As stated by President Nixon in his address to Congress that accompanied the related Reorganization Plan (Number 4 of 1970), "We face a compelling need for exploration and development leading to the intelligent use of our marine resources. We must understand the nature of these resources, and assure their development without either contaminating the marine environment or upsetting its balance."

The first undersea science and technology program in NOAA, the Manned Undersea Science and Technology program, soon followed in 1971. In 1980, the National

Research Council endorsed the need for such a program in NOAA, but expanded it to become the **NURP** model with regional centers of expertise. For its first 20 years, NURP research spanned the spectrum of undersea science from deep exploration to shallow applied science, such as coral reef studies. However, as funding was cut drastically in 1996, more expensive exploration and new technology developments were compromised to sustain the applied scientific dive programs most needed by NOAA.

In 2000, with a mandate from a Presidential Executive Order, a special panel led by the NURP Director, Ms. Barbara Moore, produced a report, "Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration" *(http://explore.noaa.gov/about/pres_panel_report.pdf)* that led to creation of the NOAA Office of Ocean Exploration **(OE).**

NURP endorsed this new program and initially expected that it would be integrated with the existing NURP program. I believe that NOAA decided to keep the programs separate for a few reasons. At least initially, NOAA management wanted to control the types of projects supported, as opposed to allowing open peer-review to dictate the program direction. NOAA management was also concerned that the exploration-based objectives remain distinct from NURP's strategic (mission-related) research focus.

Should NURP and OE be merged?

Times have changed and now **NURP and OE should be authorized and merged.** HR 3835, as presented in Title I and Title II, lays out the focus and strengths of each program, and provides a foundation upon which NOAA can build a new, coordinated program. OE has established a solid community of users, reputation, and need for exploration science, and operates in global waters. The program encourages quests and queries that might not survive an NSF peer review competition, but often are led by NSF-sponsored investigators seeking to venture into poorly understood science and regions. However, as a NOAA program, it cannot afford to end its investigations by only asking questions. NURP's regional Centers conduct research and technology development to support NOAA's mission, particularly in the area of ecosystem-based management. The Centers have relationships at the regional level, with NOAA field offices, academic institutions, managers, and other State- and regional-level entities. The Centers also have expertise in undersea technologies needed in their regions, and in some cases provide those technologies themselves. A closer working partnership between OE and NURP will allow the regional programs to follow up on the OE explorations with more focused research that will serve NOAA's mandate to both understand and manage ocean resources.

Closing Remarks:

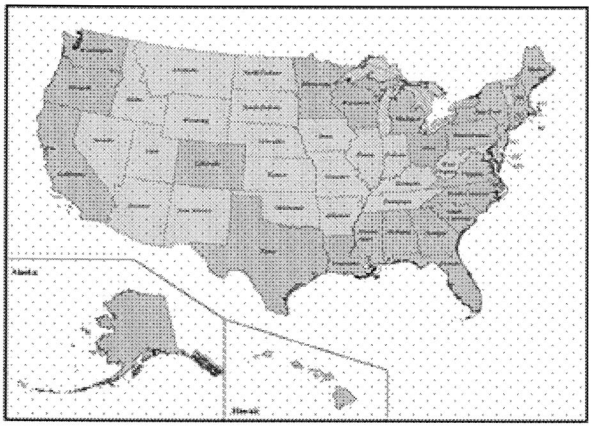
In closing, this authorization is long overdue. The Bill addresses the major weakness of the programs—under-funding and instability of funding. We seek to support cutting edge science projects using advanced technologies, wielded by the top scientists and technologists in the Nation. Trying to accomplish this goal on a year-to-year uncertain funding cycle has been our major weakness. This is not how NIH, ONR, NSF or NASA, for example, support their research grant projects. With stable funding we can allow the science and technology development projects to mature to useful results, and attract the very best experts.

Previous attempts to authorize have been thwarted by political concerns more than need for the programs. H.R. 3835 lays the groundwork for a credible, long-lasting, and flexible national program of science, technology development, and ocean literacy. With your help and guidance, Mr. Chairman and Committee Members, we can clear the final hurdles to authorizing these important national programs.

Thank you for the opportunity to participate in the Committee's deliberations.

ATTACHMENT: National Undersea Research Program-- Science Dive Activities FY 2003-2005

Research Center/Program	FY	Occupied Submersibles	Robotic Vehicles	Nitrox SCUBA	Participants	Institutes	Projects
Northeast U.S. and Great Lakes Center – *University of Connecticut*	05	4	81	0	87	40	17
	04	0	126	15	184	69	15
	03	7	99	100	212	78	17
Mid-Atlantic Bight Center – *Rutgers University*	05	0	9	143	110	16	10
	04	0	17	134	58	14	6
	03	0	18	140	62	12	8
Southeast U.S. and Gulf of Mexico Center – *University of North Carolina at Wilmington*	05	0	144	6481	344	90	43
	04	0	120	7503	333	104	41
	03	33	153	8984	287	28	41
Caribbean Marine Research Center – *Perry Institute of Marine Science*	05	11	0	3377	100	28	32
	04	0	0	4544	90	17	11
	03	0	0	3807	67	25	19
West Coast & Polar Region Center – *University of Alaska Fairbanks*	05	18	15	1588	69	27	9
	04	24	45	1195	181	44	17
	03	23	33	1230	91	32	15
Hawaii and Western Pacific Center -- *University of Hawaii*	05	71	19	0	68	29	12
	04	60	24	0	52	27	11
	03	81	68	0	32	14	9
TOTALS		**332**	**971**	**39241**	**2427**	**694**	**333**



States with NURP affiliations (projects led by resident investigators), 2001-2005.

BIOGRAPHY FOR ANDREW N. SHEPARD

CAREER GOAL AND RESEARCH INTERESTS

Utilize technical, academic and research background to conduct scientific undersea research, and generate funds for marine research and education. Areas of scientific interest and expertise include: benthic ecology of off-shore reef ecosystems, fishing gear technology; impacts of fishing gear on seafloor habitats; applications of Information Technology for organizing and presenting research results.

EXPERIENCE HIGHLIGHTS

Director, NURC at UNCW (1988–Present). Previous positions as Center Science Director (1988–1999), Center Associate Director (2000–2004). Program objectives: provide advanced undersea research systems to regional scientists for investigations in support of NOAA's mission—health of ocean resources and environments. Primarily responsible for: 1) administration, 2) program development and 3) oceanographic research: Supervisor: Dr. Dan Baden Director, UNCW Center for Marine Science (910–962–2308, *baden@uncw.edu*).

Other relevant positions related to career goal:

- *Program Development Coordinator—Coastal Ocean Monitoring and Research Program (2001–2002):* Ocean observing system and research program off North and South Carolina coasts. Responsibilities included development of data management system, development of co-funding opportunities, creation of program progress reports.
- *Program Officer—National Undersea Research Program (1999–2001):* Headquarters for National Undersea Research Centers; 18-month contract, on leave of absence from UNCW; responsibilities included grants and contracts management, development of NURP management information system and web site, development of future funding initiatives, and strategic planning.
- *Deputy Science Director—NURP regional center for New England and the Great Lakes (1984–1988):* Responsibilities included direction of Center's Fishing Gear Evaluation Program, administrative and technical support (computers and LAN management), center progress reports; diving support (e.g., ROV pilot, scuba) for field center research projects.
- *NOAA Commissioned Officer, Lieutenant (Navy rank) (1978–1984):* Assignments included: Manned Undersea Research and Technology Program, Woods Hole, MA; Field Operations Officer, NOAA ship Mt. Mitchell overseeing hydrographic (bathymetric charting) and oceanographic research missions.

EDUCATION

1975–1977: University of Massachusetts, Amherst, MA; Master of Science Degree in Marine Science

1971–1975: Bates College, Lewiston, ME; Bachelor of Science Degree in Biology

SPECIALIZED TRAINING, CERTIFICATIONS AND SKILLS

- Navigation: Visual, Celestial, Electronic (SatNav, Loran, GPS)
- Surveying: Triangulation, Geodesy, Horizontal Leveling
- Diving: Surface Supplied, divemaster, decompression, saturation, mixed gas technical (to 70 meters), Nitrox, dry suit; submersible pilot (DeepWorker 2000); ROV pilot (DOE Phantoms, Benthos Minirover), Diver Medical Technician (EMT plus Recompression Chamber Operation, Diving Medicine, and Accident Management, Oxygen Administration)
- Statistics: ANOVA, COANOVA, Non-parametrics, Graphical Interpretation; SAS, SPSS, Minitab
- Computers: C++ Programming, HTML/Active Server Pages/Web Page creation, Relational Database Management, Geographic Information System (ArcView 3.3)

CURRENT ORGANIZATIONS & COMMITTEES

- Governor appointee, Advisory Council, North Carolina Museum of Natural Science (2004–present)
- Co-Chair, Executive Board of Advisors, NSF Center for Ocean Science Education Excellence-Southeast Region COSEE–SE (2002–present)
- South Atlantic Fishery Management Council, Coral Advisory Panel (2005–present)
- NOAA Deep Sea Coral Planning Team (2002–present)
- Dive Safety Control Board, UNCW

RECENT PUBLICATIONS

Shepard, A.N. and A.J. McCurdy. 2003. The Link Project: Partnerships to Promote Sea and Space Exploration and Technology Development. *Sea Technology* 44(7):47–52.

Koenig, C.C., A.N. Shepard, J.K. Reed, F.C. Coleman, S.D. Brooke, J. Brusher, and K.M. Scanlon. 2005. Habitat and fish populations in the deep-sea Oculina coral Ecosystem of the western Atlantic. *American Fisheries Society Symposium* 41:795–805.

Reed, J.K., A. Shepard, C. Koenig, K. Scanlon, and G. Gilmore. 2005. Mapping, habitat characterization, and fish surveys of the deep-water Oculina coral reef Marine Protected Area: a review of historical and current research. Proceedings of Second International Symposium on Deep Sea Corals, Sept. 9–12, 2003, Erlangen, Germany. Springer-Verlag.

Harter, S. and A.N. Shepard. In press. Deep sea coral ecosystem monitoring: case study of the Oculina Bank marine reserve. *Bull. Mar. Sci.*

Reed, J.K., C.C. Koenig, and A.N. Shepard. In press. Effects of Bottom Trawling on a Deep-Water Oculina Coral Ecosystem. *Bull. Mar. Sci.*

Chairman EHLERS. And Dr. McNutt.

STATEMENT OF DR. MARCIA K. MCNUTT, PRESIDENT AND CHIEF EXECUTIVE OFFICER, MONTEREY BAY AQUARIUM RESEARCH INSTITUTE

Dr. MCNUTT. Good afternoon, Chairman Ehlers and distinguished Members of the Subcommittee. I am Marcia McNutt, Director of MBARI, a small, private, nonprofit research institute that was founded and funded by David Packard to be a technology incubator for the ocean research community.

I also chaired the 32-member President's Panel, which in just 60 days, convened, deliberated, and completed a succinct report laying

out the motivation, objectives, priorities, and essential elements of a comprehensive national program in ocean exploration. This report led to the establishment of NOAA's OE program, and continues to guide it to this day.

Let me briefly explain the importance of NOAA's OE program to the Nation, and also to NOAA. With a healthy and vigorous ocean exploration program, the Nation benefits from policy-makers, such as yourselves, and citizens so inspired by the wonders and mysteries of the ocean that they insist on the acquisition and application of state of the art knowledge and understanding of the ocean that enriches us both economically and spiritually.

Ocean exploration supports NOAA's mission by making new and unexpected discoveries that overthrow reigning paradigms, leading to new management strategies that actually work. Ocean exploration is distinguished from research by the fact that exploration leads to questions, research leads to answers. Often, novel discoveries are made accidentally in the process of performing hypothesis-driven research, but with a purposeful exploration program, those discoveries are more likely to be appreciate for what they are documented, and followed-up.

For example, one of the greatest surprises in oceanography in the 20th century was the discovery of the hot-vent communities, the deep sea oases that thrive in seawater geothermally heated to several hundred degrees centigrade. This entire new ecosystem led to huge new possibilities for how life might be sustained elsewhere in the universe. This discovery led to new questions. What is their energy source? How do proteins fold at such high temperatures? We would not even know enough to have asked these questions had this discovery not been made, and in fact, it almost wasn't.

The shipboard party involved was entirely geologists and geophysicists. There wasn't a single biologist on board that ship to witness what was to become the most important discovery made in marine biology ever. The shipboard party lacked such basic biological supplies that the geophysicists had to sacrifice all of their vodka to preserve the novel specimens they collected.

Such discoveries don't need to be rare, accidental, or potentially unappreciated, with a strong, vigorous, and systematic ocean exploration program. This graphic that is up here shows how NOAA's OE program might ideally relate to the broader ocean research agenda and to the NURP program.

New discoveries are made by either looking in new places, the left side of the upper box, or by deploying new tools, the right side of the box, which see the ocean in new dimensions. Now, the strength of a federal organization like NOAA undertaking this program is that they can be systematic about going to new places, the left side of the box. NOAA's weakness in this undertaking is the right side of the box. They are not known for their prowess in technology development. That is a strength of H.R. 3835, in that it creates this interagency taskforce, which brings in ONR, NASA, and other agencies, which can help contribute new technology to ocean exploration.

The discoveries lead to new questions, the white arrow going down, and some of these questions will be relevant to NOAA's mission. Others will be relevant to the missions of other agencies.

Again, the interagency taskforce in H.R. 3835 will facilitate the sharing of discoveries with other parties that are more likely to follow up on them. The National Science Foundation should be added explicitly to that taskforce, as it is mostly likely that NSF will support the early research resulting from exploration discoveries, until such time as their relevance to other agency missions or commercial organizations is clear.

For those discoveries deemed relevant to NOAA's mission, the NURP program can serve as something of a halfway house, serving as a bridge between OE's discoveries and the eventual incorporation and application of that knowledge and understanding within NOAA's line agencies.

Currently, I see two challenges to NOAA's OE program, and the first isn't money. The first is that ocean exploration is not part of NOAA's mission. Exploration is part of NASA's mission. NASA is our space agency. Why isn't it part of NOAA's mission, if NOAA is our oceans agency? I would like to see, under section 103, that the NOAA Administrator be advised to add exploration to NOAA's mission.

I do see that this bill goes in the right direction, in terms of bringing critical funding to OE's budget, but just in comparison, my own institution spends $30 million a year exploring Monterey Bay. It is a big ocean out there, and we need more money for ocean exploration.

I would also like to comment on the potential merger. Strengths of the merger would be in facilitating the transfer of ocean exploration discoveries to followup within NOAA through the NURP program, but I also see challenges. An ideal OE program undertakes multi-disciplinary voyages of discovery for the benefit of all ocean sciences. NURP is intended to be more targeted to serve NOAA's line agencies in their basic science needs.

OE's explorers will not necessarily be the same people who benefit from the discoveries, whereas NURP investigators fully expect to be the ones who reap the scientific rewards. OE must be systematic in its program, whereas NURP has traditionally supported a portfolio of disconnected projects. OE will be most successful if it has strong central management to ensure common standards, professional data management, and extensive research, whereas NURP has employed a very distributed management system.

I think that this merger could be successful, but in the arrangement that I show here, where NURP acts to follow up on OE discoveries, and that also benefits OE by allowing OE to shed the burden of capitalizing on its discoveries deemed relevant to NOAA's line agencies, such that OE can remain true to its focus on pure exploration for the benefit of all ocean sciences.

Thank you for this opportunity to comment. I hope my views are of some help. Thank you.

[The prepared statement of Dr. McNutt follows:]

PREPARED STATEMENT OF MARCIA K. MCNUTT

Good afternoon, Chairman Ehlers, and distinguished Members of the Subcommittee on Environment, Technology, and Standards. I am Marcia McNutt, director of the Monterey Bay Aquarium Research Institute (MBARI) in California. MBARI is a small, private, non-profit research laboratory founded by David Packard to serve as a technology incubator for the ocean research community. I am pleased

to be here today to provide my views on two of the National Ocean and Atmospheric Administration's (NOAA's) programs, Ocean Exploration (OE) and the National Undersea Research Program (NURP), and more specifically on pending legislation H.R. 3835.

First, allow me to preface my remarks with the statement that I have nothing to gain personally from this legislation. My own research is not now and never has been funded by NOAA, and only an insignificant amount of my institution's entire budget is derived from NOAA programs. My motivation in addressing you today is simply to do what is right for the Nation and for the oceans.

Next, I will explain my involvement with the Ocean Exploration and NURP programs. I chaired the 32-member President's Panel on Ocean Exploration which, in just 60 days, convened, deliberated, and completed a succinct report laying out the motivation, objectives, priorities, and essential elements of a comprehensive national program. This report led to the establishment of the NOAA exploration program and continues to guide it to this day. In addition, my institution has had a long-standing agreement with the West Coast office of NURP whereby NURP-funded investigators get access to my institution's unique ships and remotely operated vehicles for undersea research, neither of which are ordinarily available to outside users. This arrangement not only provides access to state-of-the-art capabilities for academic and NOAA researchers, but also provides greater external visibility and demand for MBARI's technology and marine assets. The NURP program, while having hardly any impact on MBARI's budget, is an important factor in our technology transfer strategy.

Let me briefly explain the importance of NOAA's Ocean Exploration program to the Nation and to NOAA. With a healthy and vigorous Ocean Exploration program, the Nation benefits from policy makers, such as yourselves, and citizens so inspired by the wonders and mysteries of the ocean that they insist on the acquisition and application of state of the art knowledge and understanding of the oceans for informed ocean management. Ocean Exploration supports NOAA's mission by exploring the ocean in all dimensions to make new and unexpected discoveries that overthrow reigning paradigms.

Ocean exploration is distinguished from research by the fact that exploration leads to questions, while research leads to answers. When one undertakes exploration, it is without any preconceived notion of what one might find or who might benefit from the discoveries. Research, on the other hand, is undertaken to test a certain hypothesis, with the clear understanding of the benefits of either supporting or refuting the hypothesis under consideration. Often novel discoveries are made accidentally in the process of performing hypothesis-driven research, but with a purposeful exploration program, those discoveries are more likely to be appreciated for what they are, properly documented, and followed-up.

Here is a concrete example. One of the greatest surprises in oceanography in the 20th century was the discovery of the hot-vent communities, deep-sea oases that thrive in sea water geothermally heated to several hundred degrees centigrade. These animals form an entire ecosystem completely independent of the sun's energy, and their existence opens up huge new possibilities for how life might be sustained elsewhere in the universe. This discovery led to a host of new research questions. What is the energy source for this new style of community? How do proteins fold at such high temperatures? By what reproductive strategy do deep-sea vent organisms manage to find and colonize new, isolated vent systems as the old ones die? These are important questions, but ones that we would not know enough to even ask had the discovery not happened. And it almost didn't. The shipboard party involved was entirely geologists and geophysicists. There wasn't a single biologist on board to appreciate the significance of what was to become the most important discovery in marine biology. Ever. Lacking basic biological supplies, the geophysicists had to sacrifice all of their vodka to preserve the novel specimens they collected.

Such discoveries don't need to be rare, accidental, or potentially unappreciated with a strong, vigorous, and systematic ocean exploration program. I created a graphic (Figure 1) to show how NOAA's OE program might ideally relate to the broader ocean research agenda and to the NURP program.

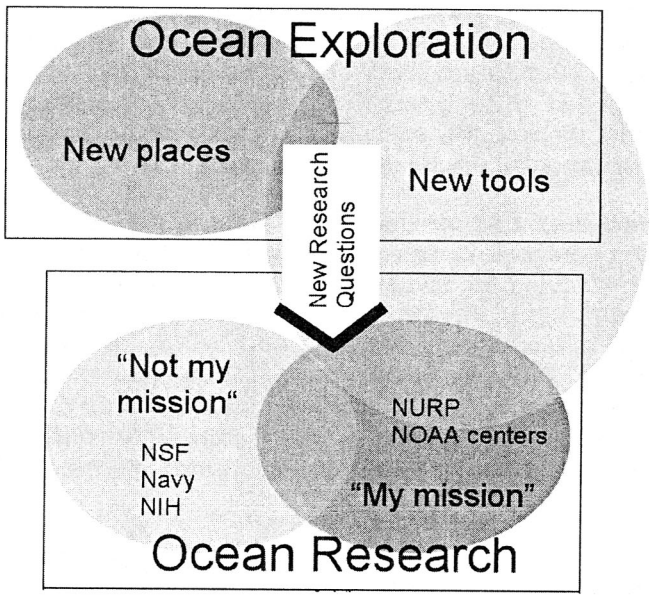


Figure 1. Conceptual diagram showing how the flow of new research questions from ocean exploration provides fertile ideas for new research directions. However, there is no guarantee at the time that the exploration is undertaken that the organization undertaking the exploration will be the organization to benefit from the discoveries.

The upper box is meant to represent NOAA's Ocean Exploration program. New discoveries are made by exploring new places, and/or by deploying new tools which "see" the ocean in new dimensions. With roughly 95 percent of the ocean still unexplored, and new tools that image the physics, chemistry, biology, and geology of the ocean at all scales being developed constantly, the opportunities for discovery are virtually limitless. The greatest strength of having a federal organization such as NOAA leading this effort is the fact that it can undertake a systematic, multi-disciplinary exploration of the ocean. However, if I had to identify NOAA's weakness in terms of being the lead agency for this effort, it is the fact that NOAA is not widely known for its prowess in developing new technology. For this reason, I support the provision in H.R. 3835 that establishes an interagency task force which includes NASA and ONR to facilitate the transfer of new exploration technology to the program.

Those discoveries lead to new research questions. In the case of a NOAA Ocean Exploration program, some of the research questions will be quite relevant to NOAA's mission, while others will need to be pursued by other agencies, such as the National Science Foundation, Navy, or the National Institutes of Health. Again, the interagency task force established in H.R. 3835 will facilitate the sharing of discoveries with other parties who would be more likely to follow them up. Definitely the National Science Foundation should be added explicitly to this list, as it is most likely that NSF will support the early research resulting from exploration discoveries until such time as their relevance to other agency missions or commercial organizations is clear.

For those discoveries that are deemed relevant to NOAA's mission, the NURP program provides an excellent mechanism for research follow-up. The NURP program is peer reviewed, so that only the most exciting hypotheses proposed by the top researchers are pursued, and it provides access to the necessary deep-sea assets, such

as manned submarine, remotely operated vehicles, and autonomous underwater vehicles. The NURP program can be considered something of a half-way house, serving as a bridge between OE's discoveries and eventual incorporation and application of the scientific knowledge and understanding within NOAA's line agencies.

NOAA's OE program is the only ocean exploration, sensu stricto, accomplished with federal funds. The only other organizations that undertake ocean exploration for the sake of unfettered discovery are my own institution, using funds we receive from the David and Lucile Packard Foundation, and Bob Ballard's Institute for Exploration. The NOAA OE program, thanks to some inspired and dedicated leadership within NOAA, is trying to build a first-class program. But they face two challenges. One is that, to date, exploration is not specifically in NOAA's mission statement. Exploration is part of NASA's mission, and NASA is the Nation's space agency. Why shouldn't exploration be part of NOAA's mission, if NOAA is our oceans agency? It certainly isn't because we have already found everything that needs to be discovered! In the most recently released NOAA Strategic Plan, the words "ocean exploration" did not appear even once. I believe it would very much help the situation if under Section 103 in H.R. 3835, the NOAA Administrator was advised to add exploration to NOAA's mission. A second problem is the lack of sufficient funding for the program. The amount of funds appropriate for OE is equivalent to the round-off error in NASA's budget. My own institution spends about $30 M/year, twice OE's budget, exploring just Monterey Bay. It is a big ocean out there, and H.R. 3835 does a credible job at ramping up the OE budget authorization.

I was also asked to specifically comment on a potential merger of OE and NURP. Strengths of a merger would be in facilitating the transfer of exploration discoveries to research follow-up, as diagramed in Figure 1 above, and in turn making deep sea assets available to the Ocean Exploration program through mechanisms already in place with NURP. However, I also see many challenges. An ideal OE program undertakes multi-disciplinary voyages of discovery for the benefit of all of ocean sciences. NURP is intended to be more targeted in the projects it undertakes so as to serve the needs of NOAA's line agencies for basic scientific understanding. OE's "explorers" will not necessarily be the same people who will benefit from the discoveries. NURP investigators fully expect to be the ones who reap the scientific rewards from their efforts. OE must be systematic in its program in order to make any progress, whereas NURP has traditionally supported a portfolio of disconnected projects. OE will be most successful if there is strong central management to ensure common standards, professional data management, and extensive outreach, whereas NURP has employed a very distributed management system. If OE is managed like NURP or as a component of NURP, it would be a disaster. However, I believe that a relationship as I identified above in Figure 1 could be successful: NURP acting to follow up with OE discoveries. In that arrangement, OE sheds the burden of capitalizing on its discoveries deemed relevant to the missions of NOAA's line agencies, and can remain true to its focus on pure exploration for the benefit of all ocean sciences.

Thank you for this opportunity to comment, and I hope my views are of some help in your deliberations.

BIOGRAPHY FOR MARCIA K. MCNUTT

2/19/52 Born, Minneapolis, Minnesota

6/70 Graduated from high school, Northrop Collegiate School, Minneapolis, Minnesota.

5/73 B.A. in Physics from Colorado College, Colorado Springs, Colorado.

1/78 Ph.D. in Earth Sciences from Scripps Institution of Oceanography, La Jolla, California. Dissertation title: Continental and Oceanic Isostasy.

Awards and Fellowships

1970—Class valedictorian, recipient of awards for mathematics, science and French.

1970–1971—National Merit Scholarship

1973—Phi Beta Kappa, summa cum laude

1973–1976—National Science Foundation Graduate Fellowship

1977–1978—University of California Dissertation Fellowship

1984, 1993—*Journal of Geophysical Research* Editor's Citation for Excellence in Refereeing

1985—Graduate Student Council Award for Teaching

1985–1986—Mary Ingraham Bunting Fellow, Radcliffe College

1988—Macelwane Award, American Geophysical Union

1988—Fellowship, American Geophysical Union

1988—Doctor of Science, *honoris causa,* Colorado College

1989–1990—NSF Visiting Professorship for Women, Lamont-Doherty Geological Observatory of Columbia University

1991–1997—Griswold Professor of Geophysics

1993—Outstanding Alumni Award, The Blake Schools, Minneapolis

1995—Capital Science Lecturer, Carnegie Institution

1996–1997—Phi Beta Kappa Visiting Scholar

1996—MIT School of Science Graduate Teaching Prize

1998—Fellowship, Geological Society of America

1997—Science and Technology Fellow, CSU Monterey Bay

1998—Fellowship, American Association for the Advancement of Science

1999—Member, American Academy of Arts and Sciences

1998—Sanctuary Reflections Award, Special Recognition Category, Monterey Bay National Marine Sanctuary

2002—Elected member American Philosophical Society

2003—ARCS Scientist of the Year

2004—National Associate, National Academy of Science

2004—Alumna of the Year, University of California, San Diego

2004—Doctor of Science, *honoris causa,* University of Minnesota

2005—Elected member, National Academy of Sciences

Post-graduate Employment

1/78–6/78—Postdoctoral Research Associate, Scripps Institution of Oceanography.

6/78–7/79—Visiting Assistant Professor, University of Minnesota, Minneapolis.

6/79–6/82—Geophysicist, Branch of Tectonophysics, Office of Earthquake Studies, U.S. Geological Survey, Menlo Park, California.

7/82–7/86—Assistant Professor of Geophysics, Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology.

7/86—Associate Professor of Geophysics, EAPS, MIT.

7/89–3/98—Professor of Geophysics, EAPS, MIT.

7/93–7/95—Associate Director, MIT SeaGrant College Program.

7/95–8/97—Director, MIT/WHOI Joint Program in Oceanography and Applied Ocean Science and Engineering.

9/97–present—President/CEO Monterey Bay Aquarium Research Institute.

6/98–present—Professor, Department of Earth Science, UC–Santa Cruz (on leave).

10/98–present—Professor of Geophysics, Stanford University.

Special Training

8/74—Completed U.S. Navy UDT and Seal Team training course in underwater demolition and explosives handling. Also, NAUI certified SCUBA diver and Red Cross Water Safety Instructor.

Sea Experience

Participant on 14 oceanographic expeditions on ships from Scripps, Woods Hole, Oregon State University, and Columbia University.

Co-chief scientist on Crossgrain 2 marine geophysical expedition to the Marquesas Islands, April 1987.

Co-chief scientist on the R/V Maurice Ewing EW9103 multi-channel seismic expedition to French Polynesia, May, 1991.

Chief scientist on the R/V Maurice Ewing EW9106 marine geophysical survey of the Marquesas Fracture Zone, September-October, 1991.

Chief scientist on the R/V Maurice Ewing EW9204 ocean bottom seismometer experiment in the Marquesas Islands, May, 1992.

Co-chief scientist on BARGE, a multi-channel seismic survey on Lake Mead of the Colorado Plateau—Basin and Range breakaway zone, March, 1994.

Chief scientist on R/V Maurice Ewing EW9602, multi-channel seismic survey of the Austral Islands, March-May, 1996.

Chief scientist on R/V Roger Revelle expedition to measure hydrothermal heat flux in the Hawaiian Islands, August-September, 1997.

Professional Societies

American Geophysical Union (Fellow)

American Association for the Advancement of Science (Fellow)

Geological Society of America (Fellow)

Other Activities

Past

Journal of Geophysical Research Associate Editor, 1980–1983

Journal of Geophysical Research guest editor, 1983

Pure and Applied Geophysics, editorial board, 1987–1988

Member, IUGG special studies group on density and stress differences within the Earth, 1980–1983

Member, IUGG special studies group on geodynamics of mountain belts, 1983–1987

Member, NSF panel for graduate fellowships in Earth Sciences, 1985, 1986, 1987 (Chairman 1988, 1989, 1990)

NSF Ocean Sciences, Panelist, 1986–1988, 1990

NSF Science and Technology Centers Panelist, 1989

Member NASA science steering group for the Geopotential Research Mission 1978–1988.

Chairman, Science Working Group, NASA Gradiometer Study Team, 1987

Panel Co-Chairman, NASA Coolfont Workshop, 1989

Member, Committee on Geodesy, National Research Council, 1982–1984

Member, Geodynamics Committee, National Research Council, 1984–1987

Member, Earth Science Committee, National Research Council, 1987–1989

Member, AGU Tectonophysics nominating committee, 1983, 1985

Member, AGU Budget and Finance Committee, 1986–1988

Chairman, AGU Journals Board, 1988–1990

Chairman, Tectonophysics Fellows Committee, AGU, 1990, 1992

Chairman, AGU Publications Committee, 1990–1992

Member, *Tectonics* editor search committee, 1983

Member, Lithosphere Panel, Ocean Drilling Program, 1986–1988

Member, National Earthquake Hazard Reduction Program Advisory Committee, 1991

Chairman, AGU Publications Committee, 1990–1992

Chairman, Joint Committee for Marine Geology and Geophysics, MIT/WHOI Joint Program, 1984–1988, 1991–1995

President, special study group "Transmission of Stress and Geodynamic Implication," International Association of Geodesy, 1987–1991

Tectonophysics editorial board, 1982–1991

Member, Atolls and Guyots Detailed Planning Group, Ocean Drilling Program, 1991

Member, Performance Evaluation Committee, Ocean Drilling Program, 1991

Member, Organizing Committee for the Frontiers of Science Symposium, National Academy of Sciences, 1991–1992, 1994

Chairman, Visiting Committee, Geological Sciences Department, U of Arizona, 1992

Member, Advisory Committee for Earth Sciences, National Science Foundation, 1990–1993

Member, NASA Earth Science and Applications Division Advisory Subcommittee, 1990–1993

Member, Advisory Structure Review Committee, Ocean Drilling Program, 1992–1993

Chairman, Organizing Committee for the Frontiers of Science Symposium, National Academy of Sciences, 1993

Chairman, Visiting Committee, Scripps Institution of Oceanography, 1993

SEI (Study of the Earth's Interior) Committee, American Geophysical Union, 1992–1994

Audit and Legal Affaris Committee, American Geophysical Union, 1992–1994

Nominating Committee, American Geophysical Union, 1992–1994

Member, Board on Earth Sciences and Resources, National Research Council, 1994

Member, Committee on Geophysical and Environmental Data, National Research Council, 1994

Member, National Academy of Sciences Television Advisory Committee, 1994

Member, Committee to Study the Criteria for Federal Support for Research and Development (Press Committee), 1995

President, Tectonophysics section, American Geophysical Union, 1992–1994

Chair, Audit and Legal Affaris Committee, American Geophysical Union, 1994–1996

Member, Organizing Committee for the German-American Frontiers of Science Symposium, 1995, 1996

Chair, External Review Committee, Department of Geological Sciences, UC Santa Barbara, 1997

Member, External Review Committee, Department of Geology and Geophysics, U of Minnesota, 1997

Member, Lincoln Lab Advisory Board, 1994–1997

Member, National Medal of Science Committee, 1995–1997

Member, New England Aquarium Advisory Board, 1995–1997

Co-Chair, NSF-OCE Workshop on the Future of Marine Geosciences, 1995–1998

Vice-Chair, Advisory Committee for Geosciences, National Science Foundation, 1996–1998

Chair, Macelwane Award Committee, American Geophysical Union, 1996–1998

Co-Chair, Chinese-American Frontiers of Science Symposium, August, 1998

Member, Government-University-Industry-Research-Roundtable committee on Stress in Universities, 1995–1998

Member, NRC committee on the Science of Earthquakes, 1996–1999

Member, NRC Committee on 50 Years of Ocean Sciences at NSF, 1998

Member, ODP Executive Committee for Drilling Opportunities in the 21st Century, 1998–1999

Member, German-American Academic Council, 1994–1999

Member, Ocean Research Advisory Panel, National Ocean Partnership Program, 2000–2001

Member, Ocean Science Synthesis Committee, NSF, 1998–2001

Chair, NOAA Exploration Panel, 2000–2001

President, American Geophysical Union, 2000–2002

Member, Exploration of the Seas Committee, National Research Council, 2001–2004

Member, Review Committee for the Division on Earth and Life Sciences, National Academy of Sciences, 2003–2004

Member, Jackson School Vision Committee, University of Texas at Austin, 2003–2004

Past President, American Geophysical Union, 2002–2004

Member, Visiting Committee, Department of Ocean Engineering, MIT, 1999–2004

Chair, Ocean Research Advisory Panel, National Ocean Partnership Program, 2001–2005

Present

Member, Visiting Committee, Department of Mechanical Engineering, MIT, 2005–present

Whale Conservation Fund Advisory Council, 2004–present

Member, Visiting Committee, School of Earth Sciences, Stanford University, 1999–present

Chair, Visiting Committee, Department of Earth and Planetary Science, Harvard University, 2002–present

Member, External Review Committee for Marine Science Institute, University of California at Santa Barbara, 2006

Member, Advisory Board, Winchell School of Earth Sciences, University of Minnesota, 2005–present

Member, Board of Directors, Monterey Bay Aquarium, 1998–present

Member, Schlumberger Technical Advisory Committee, 2000–present

Member, Editorial Advisory Committee, *Science* magazine, 2001–present

Chair, Monterey Bay Crescent Ocean Research Consortium, 2000–2006

Chair-elect, Board of Directors, Joint Oceanographic Institutions

Member, Ocean Council, joint task force for Joint Oceanographic Institutions and the Consortium for Ocean Research and Education

Member, Class membership committee, National Academy of Sciences

Reviewer for *JGR, GJRAS, Tectonophysics, Nature, Tectonics, Journal of Geophysics, EPSL, PEPI, GRL, RGSP, PAGEOPH,* NSF, NASA, LPRI, NERC

Invited Lectures

Caltech (1978, 1980, 1997), U. of Minnesota (1978, 1996, 125th Anniversary Lecturer, 1999, IT Distinguished Woman Lecturer, 2003, 2005), Harvard (1978, 1984), U.C. Santa Barbara (1978, 1981), Cornell University (1978, 1983), U. of Michigan (1979, 1989, 1994), Dalhousie (1979), Lamont-Doherty (1980, 1985, 1986, 1989, 1995; 50th Anniversary Lecture 1999), Stanford (1980, 1984, 1998, 2003), Sandia Labs (1981), MIT (1981; Wallace Lecture: 1998, 2005), Woods Hole (1981, 1985, 1987, 1989), UC Berkeley (1982; 1989; 1995; 1998), UCLA (1982, 1989), Society of Engineering Science (1982), Washington University at St. Louis (1982), Brown (1983, 1989, 1994), Yale (1983, 1985, 1995), Scripps Institution of Oceanography (80th Anniversary Lecturer: 1983; 1995, 2002), 27th International Geological Congress, Moscow (1984), Institute of Physics of the Earth, Moscow (1984, 1987), U. of Wyoming (1985, Dedication of Geosciences Building: 1998), Colorado College (1985, 1988, 2003), SUNY Stony Brook (1985), IUGG Workshop in Zurich (1985), U. Lowell (1986), University of Rhode Island (1986, 1994), Radcliffe Summer Science Program (1986, 1987), WHOI College Teachers Workshop (1987), Geological Society of Washington (1988, 2005), IGPP Los Alamos (1989), IPG, Paris (1989, 1996), Institute of Computational Geophysics, Moscow (1989), Institute of Petroleum Research, Tel Aviv (1989), York University (1990), University of North Carolina, Chapel Hill (1990), Northwestern (1990), Penn State (1990), University of New Mexico (1991), University of Texas at Austin (1991), Boston University (1992), Duke University (1992), UMass, Amherst (1992, 1996), U of Washington (1993), Princeton University (1993), National Academy of Sciences (1994), Keystone *Scientist to Scientist* Colloquium (1994), Berlin Symposium on Issues Facing the German-American Academic Council (1994), U of Toronto (1994; J. Tuzo Wilson Lecture, 2004), MacMaster University (1994), University of Maine (1995), Workshop on Science Education, University of Iowa (1995, 1996), Amherst College (1996), Smith College (1996), University of Brest, France (1996), Western Maryland College (1996), Hiram College (1997), Carnegie-Mellon University (1997), St. Lawrence University (1997), Birmingham-Southern College (1997), University of Wisconsin at Milwaukee (1997), Ripon College (1997), College of St. Catherine (1997), University of Hawaii (1998), UC Santa Cruz (1998), Augsburg College (Sverdrup Lectures: 1998), Arizona State Univeristy (1998), AAAS (1998, 1999), Library of Congress (1999), U.S. Geological Survey (2000), Purdue University (Crough Lecture, 2000), White House Millenium Matinee (2000), Trinity University (2000), University of Utah (2001), ACM1 Computer Conference (Keynote Speaker, 2001), Revelle Lecture (NAS, 2001), American Academy of Arts and Sciences (2001), Oceans 2001 (Keynote lecture, 2001), University of South Carolina (Convocation Speaker, 2002), Ocean's Symposium, Anchorage, AL (2002); JAMESTEC 30th Anniversary Symposium (2002), Oregon State University (Condon Lecture: 2002, 2005), University of California, San Diego (2002), Illinois Math and Science Academy (2003), ARCS Foundation (2003), Women in Science and Engineering, UCSD (2003), Nuclear and Space Radiation Effects keynote speaker (2003), Division of Planetary Sciences, American Astronomical Society plenary speaker (2003), Barrow Arctic Science Consortium public lecture (2003), Portuguese-American Foundation Annual Lecture in Marine Sciences, Lisbon (2004), 9th Circuit Court Judicial Conference (2004); Marin County Women Lawyers (2004), MIT–ME dept (2005), Santa Fe Institute (2005), Naval Postgraduate School (2005), PopTech (2005), Space Mission Challenges (2006).

PEER REVIEWED PUBLICATIONS

1. McNutt, M.K. and R.L. Parker, Isostasy in Australia and the evolution of the compensation mechanism, *Science* 199, 773–775, 1978.
2. McNutt, M.K. and H.W. Menard, Lithospheric flexure and uplifted atolls, *J. Geophys. Res.* 83, 1206–1212, 1978.
3. Shih, J.S.F., T. Atwater, and M.K. McNutt, A near-bottom geophysical traverse of the Reykjanes Ridge, *Earth Planet. Sci. Lett.* 39, 75–83, 1978.
4. McNutt, M.K., Continental and Oceanic Isostasy, Ph.D. thesis, University of California, San Diego, California, 1978.
5. McNutt, M.K. and H.W. Menard, Reply to comments on 'Lithospheric flexure and uplifted atolls' by R.D. Jarrard and D.L. Turner, *J. Geophys. Res.* 84, 5695–5697, 1979.
6. McNutt, M.K., Compensation of oceanic topography: An application of the response function technique to the Surveyor area, *J. Geophys. Res.* 84, 7589–7598, 1979.
7. McNutt, M.K. and H.W. Menard, Reply to comments on 'Lithospheric flexure and uplifted atolls' by H.T. Stearns, *J. Geophys. Res.* 84, 7698, 1979.
8. Parker, R.L. and M.K. McNutt, Statistics for the one-norm misfit measure, *J. Geophys. Res.* 85, 4429–4430, 1980.
9. McNutt, M.K., Implications of regional gravity for state of stress in the Earth's crust and upper mantle, *J. Geophys. Res.* 85, 6377–6397, 1980.
10. McNutt, M.K. and Thomas Heaton, An evaluation of the seismic window theory for earthquake prediction, *California Geology* 34, 12–16, 1981.
11. McNutt, M.K. and Rodey Batiza, Paleomagnetism of Northern Cocos seamounts: Constraints on absolute plate motion, *Geology* 9, 148–154, 1981.
12. Rundle, John and M.K. McNutt, Southern California uplift: Is it or isn't it? *EOS, Trans. Amer. Geophys. Union* 62, 97–98, 1981 (refereed journal article).
13. Chase, C.G. and M.K. McNutt, The geoid: effect of compensated topography and uncompensated trenches, *Geophys. Res. Lett.* 9, 29–32, 1982.
14. McNutt, M.K. and H.W. Menard, Constraints on yield strength in the oceanic lithosphere derived from observations of flexure, *Geophys. J. Roy. Astr. Soc.* 71, 363–395, 1982.
15. Menard, H.W. and M.K. McNutt, Evidence for and consequences of thermal rejuvenation of the lithosphere, *J. Geophys. Res.* 87, 8570–8580, 1982.
16. Dixon, T.H., M. Naraghi, M.K. McNutt and S.M. Smith, Bathymetric prediction from SEASAT altimeter data, *J. Geophys. Res.* 88, 1563–1571, 1983.
17. McNutt, M.K., Influence of plate subduction on isostatic compensation in northern California, *Tectonics* 2, 399–415, 1983.
18. McNutt, M.K., Reply to comments on "Nasal surgery and airflow," *Plastic and Reconstructive Surgery* 73, 700–701, 1984.
19. McNutt, M.K., Lithospheric flexure and thermal anomalies, *J. Geophys. Res.* 89, 11, 180–11, 194, 1984.
20. Committee on Geodesy, *Geodesy: A Look to the Future,* National Academy Press, Washington, D.C., 1985.
21. McNutt, M.K., Nonuniform magnetization of seamounts: a least-squares approach, *J. Geophys. Res.* 91, 3686–3700, 1986.
22. Sheffels, B. and M.K. McNutt, The role of subsurface loads and regional compensation in the isostatic balance of the Transverse Ranges, California: Evidence for intracontinental subduction, *J. Geophys. Res.* 91, 6419–6431, 1986.
23. McNutt, M.K. and L. Shure, Estimating the compensation depth of the Hawaiian swell with linear filters, *J. Geophys. Res.* 91, 13915–13923, 1986.
24. Fischer, K., M.K. McNutt, and L. Shure, Thermal and mechanical constraints on the lithosphere beneath the Marquesas swell, *Nature* 322, 733–736, 1986.
25. McNutt, M.K. and L. Royden, Extremal bounds on geotherms in eroding mountain belts from metamorphic pressure-temperature conditions, *Geophys. J. Roy. Astr. Soc.* 88, 81–95, 1987.
26. Kogan, M.G. and M.K. McNutt, Isostasy in the USSR I: Admittance data, in *The Composition, Structure, and Dynamics of the Lithosphere-Asthenosphere System,* K. Fuchs and C. Froidevaux, eds., Geodynamics Series, AGU, vol. 16, 1987.
27. McNutt, M.K. and M.G. Kogan, Isostasy in the USSR II: Interpretation of admittance data, in *The Composition, Structure, and Dynamics of the Lithosphere-*

Asthenosphere System, K. Fuchs and C. Froidevaux, eds., Geodynamics Series, AGU, vol. 16, 1987.

28. McNutt, M.K., Lithospheric stress and deformation, *Rev. Geophys.* 25, 1245–1253, 1987.
29. McNutt, M.K. and K.M. Fisher, The South Pacific superswell, in *Seamounts, Islands, and Atolls,* B. Keating, P. Fryer, R. Batiza, and G.W. Boehlert, eds., Geophysical Monograph #43, American Geophysical Union, Washington, D.C., 1987.
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31. McNutt, M.K., Thermal and mechanical properties of the Cape Verde Rise, *J. Geophys. Res.* 93, 2784–2794, 1988.
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Chairman EHLERS. Thank you very much, and thank you to all the witnesses. As I announced earlier, we would stop the proceedings as soon as the sponsor of the bill arrived, and Congressman Saxton is here. Mr. Spinrad, would you be kind enough to just step aside for a moment, and Mr. Saxton, you can take that seat.

Mr. Saxton is the author and principal sponsor of H.R. 3835, which is the subject of the hearing today. He has a number of eminent cosponsors as well, and we are very pleased to welcome you, Jim. I have explained that you had scheduling problems, so we will fit you in whenever you get here, and we will not bother you with questions, because we can always question you later.

But we would appreciate your testimony on this issue. Thank you for being here. I think your mike is not on.

STATEMENT OF HON. JIM SAXTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW JERSEY

Mr. SAXTON. Okay, thank you. Chairman Ehlers, thank you very much, and Ranking Member Wu, and Members of the Committee. Thank you for giving me the opportunity to testify, and particu-

larly, thank you for your consideration of the National Ocean Undersea Research Program, and for considering this bill today.

Our dependence on healthy marine ecosystems continue to grow. Mr. Gilchrest and I work on these issues almost all day every day, and so, we are very eager to have this bill enacted into law. Ocean exploration and undersea research remain a relatively minor component of the U.S. ocean science, and is a missing link in our national strategy to better understand the Earth's environment.

When I walked into the room, I saw the Tennyson quote on the wall, which I find quite fascinating, and fits right into today's hearing: "For I dipped into the future, far as human eyes could see; Saw the vision of the world, and all the wonder that would be." These programs are intended to give us that vision beneath the Earth's—beneath the ocean's surface, and therefore, become an extremely important component in our understanding of earth sciences.

Consequently, the report of the U.S. Commission on Ocean Policy recommended the National Oceanic and Atmospheric Administration and the National Science Foundation should lead an expanded National Ocean Exploration Program. I am proud to be the sponsor of the National Ocean Exploration Program Act to promote implementation of the Commission's recommendation.

The bill authorizes two important ocean programs, the Ocean Exploration Program and the National Undersea Research Program. The National Ocean Exploration Program Act would create better coordinated—better coordination between NOAA and the National Science Foundation. Among the purposes of the Act are to expand ocean exploration, to discover the new marine substances, which would potentially have therapeutic benefits; and to study unique marine ecosystems, organisms, and the geology of the world's oceans. As the federal agency responsible for managing living marine and coastal resources, NOAA requires a presence beneath the sea and Great Lakes to better understand the systems under its management. The Undersea Research Program provides NOAA with the unique ability to access the undersea environment, either directly, with submersibles and technical diving, or virtually, by using robots and seafloor observatories.

Both of these programs authorized by the legislation are core to the mission of NOAA. This past year, several weather events, hazardous material spills, the increasing occurrence of harmful red tide events, and the continued decline of the coastal resources and habitats demonstrated the need for timely, accurate environmental information that can inform decision-making to reduce loss of life, property, and coastal infrastructure, and to improve management of marine and coastal resources. A primary focus of NOAA's Undersea Research Program is to help provide the information to meet these very needs.

As Members of this committee will recall, I have a long history of Undersea Research Program interest, which was established by NOAA shortly before I came to Congress. As a matter of fact, with the Mid-Atlantic Bight Undersea Research Center, which is based in my district, I am very familiar with the work conducted through this regional center.

As an example, in mid-1996, the Mid-Atlantic Bight Center established the world's first long-term ecosystem observatory, commonly referred to, Mr. Chairman, as Leo XV. Situated on the continental shelf off New Jersey, Leo XV provides a real-time interface with advanced samplers and sensors, enabling investigators to plug in instruments, conduct and modify experiments remotely, and access data via the Internet. This has been a very interesting part of the 3rd District of new Jersey.

Critical research on the fate and effects of deep sea waste disposal that redefine our national waste management strategy; a few more examples include: development of new samplers and sensors for ocean observing systems, via the Leo XV underwater observatory; novel applications of autonomous undersea vehicles, and emerging acoustic technologies to track and monitor fish, their migration, and habitat use; major studies on the effects of trawling on the bottom continues to have informed fisheries' managements' efforts; development of the REMUS autonomous undersea vehicle that enables investigators to conduct detailed transects of the coastal ocean processes and features; and finally, the creation of acclaimed education and outreach programs that capitalize on real-time data systems to enrich science education, teaching of basic skills, and enhancement of ocean literacy among the young people of our country.

H.R. 3835 is co-sponsored by our colleagues who host regional NURP centers in their districts, as well as others who recognize the strengths and benefits of the program, a regionally based structure that leverages the Nation's best talent to address NOAA's undersea research and technology requirements, mechanisms to transfer science-based information to the management, education, and science communities, and an unparalleled record of safe field operations in the ocean.

Mr. Chairman and Members of the Committee, I have a longer statement I would like to submit for the record, but this is, in effect, a summary of my feelings on this matter, and I thank you once again for giving me the opportunity to come here and say these things.

[The prepared statement of Mr. Saxton follows:]

PREPARED STATEMENT OF REPRESENTATIVE JIM SAXTON

Talking Points on H.R. 3835

Thank you for the opportunity to testify on behalf of H.R. 3835, which will authorize the Ocean Exploration and NOAA Undersea Research Programs.

Although our dependence on healthy marine ecosystems continues to grow, ocean exploration and undersea research remain a relatively minor component of U.S. ocean science and is a missing link in our national strategy to better understand the Earth's environment.

Consequently, the report of the U.S. Commission on Ocean Policy recommended the National Oceanic and Atmospheric Administration and the National Science Foundation should lead an expanded national ocean exploration program. I am proud to be the sponsor of the National Ocean Exploration Program Act to promote implementation of the Commission's recommendation.

This bill authorizes two important ocean programs—the Ocean Exploration Program and the National Undersea Research Program.

The National Ocean Exploration Program Act will create better coordination between NOAA and the National Science Foundation. Among the purposes of the Act are to expand ocean exploration to discover new marine substances that potentially

have therapeutic benefits; to study unique marine ecosystems, organisms and the geology of the world's oceans.

As the federal agency responsible for managing living marine and coastal resources, NOAA requires a presence beneath the sea and Great Lakes to better understand the systems under its management. The Undersea Research Program provides NOAA with the unique ability to access the undersea environment either directly with submersibles and technical diving, or virtually using robots and seafloor observatories. Both of the programs authorized by this legislation are core to the mission of NOAA.

This past year, severe weather events, hazardous material spills, the increasing occurrence of harmful red tide events, and the continued decline of coastal resources and habitats demonstrated the need for timely, accurate environmental information that can inform decision-making to reduce loss of life, property and coastal infrastructure, and to improve management of marine and coastal resources. A primary focus of NOAA's Undersea Research Program is to help provide the information to meet these needs.

As Members of this committee will recall, I have a long history with Undersea Research Program, which was established by NOAA shortly before I came to Congress. With the Mid-Atlantic Bight Undersea Research Center based in my district, I am very familiar with the work conducted through this regional center. A few examples include:

- In 1996, the Mid-Atlantic Bight Center established the world's first Long-term Ecosystem Observatory, commonly referred to as LEO–15. Situated on the continental shelf off New Jersey, LEO–15 provides a real-time interface with advanced samplers and sensors enabling investigators to plug in instruments, conduct and modify experiments remotely, and access data via the Internet.
- Critical research on the fate and effects of deep sea waste disposal that redefined our national waste management strategy.
- Development of new samplers and sensors for ocean observing systems via the LEO-15 underwater observatory, novel applications of autonomous undersea vehicles, and emerging acoustic technologies to track and monitor fish behavior, migration, and habitat use.
- Major studies on the effects of trawling on bottom communities that have informed fisheries management efforts.
- Development of the REMUS autonomous undersea vehicle that enables investigators to conduct detailed transects of coastal ocean processes and features, and
- Creation of acclaimed education and outreach programs that capitalize on real-time data streams to enrich science education, teaching of basic skills, and enhancement of ocean literacy among our youth.

H.R. 3835 is co-sponsored by our colleagues who host regional NURP centers in their districts, as well as others who also recognize the strengths and benefits of the program:

- A regionally-based structure that leverages the Nation's best talent to address NOAA's undersea research and technology requirements,
- Mechanisms to transfer science-based information to the management, education and science communities, and
- An unparalleled record of safe field operations in the ocean.

Mr. Chairman, I have a longer statement I would like to submit for the record that elaborates on each of these key elements—elements that I am hopeful will be preserved in H.R. 3835, as well as in the ongoing merger of the Ocean Exploration and Undersea Research Programs in NOAA.

Thank you again for holding this hearing today and for the opportunity to testify. I look forward to working with the Committee to move the bill forward.

Addendum to Mr. Saxton's oral testimony:

1) Regional Structure

NOAA has a long history of partnering with academic institutions to leverage regional benefits on behalf of agency science, management and education programs. This is evident in programs such as Sea Grant and the National Estuarine Research Reserve System. The benefits of the NURP partnership with university-based regional Centers are many:

- Access to a broad talent pool of researchers, engineers and educators

- Ready access to regional and local management agencies
- Enhanced ability to leverage partnerships and resources
- Efficient mechanism to disseminate information to stakeholders at regional and local levels
- Regional-scale programs are required to enable ecosystem approaches to management
- Development and experienced, safe operation of advanced undersea technology.

With respect to the last point, I want to point out that despite a relatively modest budget, the NURP program has contributed greatly to development of advanced undersea technology. Most notable for me is the establishment of LEO–15, an undersea observatory that serves as the model for the Nation's emerging ocean observing system. This platform was recently renovated with the latest software and hardware to enable it to continue to serve as a testbed for development of samplers and sensors. In addition, NURP has developed a broad suite of samplers and sensors for undersea vehicles. Support for this and other technology development should continue to be provided by NOAA and is recognized as a distinct part of this bill under authorization of appropriations.

I'm aware that, due to funding constraints, efforts are underway to consolidate the four existing regional centers on the east coast. This is an effort that I've been tracking closely. I want to ensure that the benefits provided by the regional construct are not lost in this consolidation, or in the merger process. Ideally, there should be at least two centers on the east coast with one of these centers serving the needs of the northeast. I'm well aware, and my colleague from Connecticut is well aware that the respective center directors for the Mid-Atlantic and Northeast regions have been working on a joint or consolidated center to serve the Mid-Atlantic, New England and Great Lakes regions. I believe that H.R. 3835 codifies the regional NURP structure, and I urge NOAA to ensure that a northeast regional presence be maintained to capitalize on the expertise resident in the existing Mid-Atlantic and Northeast Undersea Centers.

2) Transfer of Science-Based Information

In collaboration with partners leveraged via the regional centers, NURP has excelled in the delivery of science-based information to user groups such as fishery managers, coastal managers, educators, students and the general public. This has been accomplished largely with external sources of funding and is a good example of a benefit of the regional center construct. For example, the NURP Centers on the east coast worked with the Office of Ocean Exploration to produce the at-sea education program for the Deep East expedition in 2001, an expedition that featured submersible dives to unexplored parts of the Hudson Submarine Canyon. In addition, the Mid-Atlantic Center works in partnership with the Mid-Atlantic center for Ocean Sciences education Excellence to deliver real world science to students throughout the region, an effort that is now being expanded throughout the country. The NURP Centers possess strong capabilities in education and outreach, an element that is recognized in H.R. 3835 and must be preserved in the merger between OE and NURP.

3) Safety

For more than 30 years, the NURP program has conducted undersea research activities without mishap. This is a tribute to the knowledge, expertise and capabilities of the science and operations staff at the regional centers. This is yet another example of the benefit of the existing regional centers. If this capability were lost, either through consolidation or the merger, it would be extremely difficult to reestablish. As I noted earlier, great care must be taken to ensure that strengths of the NURP program be codified in H.R. 3835 and maintained in the merger process. Center personnel and infrastructure represent key strengths that must be preserved in the regions.

Merging NURP and OE

NOAA has begun a process to merge NURP and OE. This process is expected to take about 12 to 18 months. During this time, I will ask NOAA to provide regular progress reports to the House Fisheries and Oceans Subcommittee. In addition, I strongly urge NOAA to continue active engagement of the NURP Center directors in the merger process. The merger should preserve the strengths of the NURP program as I outlined earlier. In addition, the merger should provide a clear role for the NURP Center Directors in the leadership, direction, and decision-making of the NURP/OE program.

Recommendations:

1) In an effort to remain as similar as possible to the other chamber's bill, H.R. 3835 retained the same title as S. 39—to establish a coordinated national ocean exploration program within the National Oceanic and Atmospheric Administration. I now recommend changing the short title to recognize the importance of the NOAA Undersea Research Program.
2) Instruct NOAA to preserve the regional center structure and its associated benefits in the merger between NURP and OE.
3) Ensure that the NURP regional centers are adequately represented in the leadership and decision-making of the merged NURP/OE program.
4) At the Fisheries and Oceans Subcommittee hearing on the bill in the Resources Committee, it became apparent that there were questions regarding how the two programs, NURP and OE, would be merged and coordinated. This largely stems from the fact that the bill establishes similar authorities for both ocean exploration and undersea research. For example, both programs are authorized to develop technology, administer proposal-driven programs, and conduct education and outreach activities. A mechanism to ensure coordination of effort among these programs is recommended.

Chairman EHLERS. Thank you very much, and without objection, your longer statement will be entered into the record, as well as a copy of the letter we have received from, it was addressed to Vice Admiral Conrad Lautenbacher of the National Oceanic and Atmospheric Administration, from J. Val Klump of the University of Wisconsin in Milwaukee.

So, thank you very much for being here, Mr. Saxton. And I do want to mention, I am sure you are aware that I have been working for six years on the NOAA Organic Act. We are finally making considerable progress. It passed this committee long ago. I hope to get it passed into law before the end of the year, and I hope it will mesh well with your bill.

Thank you very much.

DISCUSSION

Thank you for the quick switch back and forth, and we will get into the questions. I did want to mention Dr. McNutt, your point about exploration not being explicitly part of NOAA's mission. As part of the NOAA Organic Act, which I just mentioned, we have put it in the bill, as one of their duties is "conducting and supporting research and development of technology for exploration of the oceans." That is probably not as direct and clear as you would like, but we may be able to clear that up, as it goes through the process, but I think your point is very well taken. That should be clearly stated as part of NOAA's mission.

SUPPORT FOR H.R. 3835

At this time, we open up our first round of questions. The Chair recognizes himself for five minutes, and first of all, Mr. Shepard, I just wanted to check with you on one point. We just heard from Mr. Saxton about the H.R. 3835, *National Ocean Exploration Program Act of 2005,* and the *Undersea Research Program Act of 2005.* Dr. McNutt, you have already stated your support of that.

If you are familiar with the bills, Mr. Shepard, are you in support of them as well?

Mr. SHEPARD. Yes.

SUPPORT FOR INTERAGENCY COORDINATION

Chairman EHLERS. Thank you. I appreciate your support for that. The—Dr. McNutt, do you explicitly endorse the idea of interagency coordination, as provided in the bill? Dr. Spinrad, do you explicitly oppose it?

Can you each comment on the other's position, as fairly and temperately as you can. Mr. Shepard, we will ask you for your thoughts too, as well.

So, Dr. Spinrad, first.

Dr. SPINRAD. Thank you, Mr. Chair. I would like to clarify. There is absolutely no objection to interagency coordination. In fact, we support it strongly, and if I may point out, one of the positions I hold is, as Co-chair of the White House Joint Subcommittee on Ocean Science and Technology, with my colleague from the National Science Foundation, Dr. Margaret Leinen, and in fact, that is precisely the reason why we feel we have a structure in place, in fact, codified in the Administration's U.S. Ocean Action Plan, through the Committee on Ocean Policy and its subordinate committees, to accommodate the kind of interagency activity we talked about here, that being the Joint Subcommittee on Ocean Science and Technology.

I would that, in fact, through that structure, we bring in a much more diverse and vast collection of agencies than we might otherwise, and in fact, in complete support of the comment made by Dr. McNutt, we would have NSF as a co-chair of that by definition, using an existing structure. That body, in fact, right now is tasked with putting out the first ever statement of our national ocean research priorities, which will be delivered 31 December, and in there, will be specific identification of ocean exploration.

So, I think we are well on the way to using that particular structure, and that is the basis of our comment with respect to that technical feature of the bill.

Chairman EHLERS. Well, thank you, and we will look into that in more depth, because if we take up the Saxton bill, and there may not be time this year, but we could take a good look at what you are doing now, look at what he proposes, maybe we can come up with a very good plan to handle that.

Dr. SPINRAD. Thank you.

Chairman EHLERS. Mr. Shepard, do you have any comment on that issue?

Mr. SHEPARD. Yes, thank you.

As I pointed out in the testimony, first of all, we are strongly in support of the advisory boards. The taskforce, we are uncertain of the nature of the taskforce, but in an advisory capacity, fully support that.

We understand that our activities need to be merged with the other federal agencies that are doing work in the oceans, and we want to make sure that whatever we do complements both ocean exploration and the other federal agencies. So, we don't have any objections to working—we also would suggest that we would like to see a NOAA, a strong NOAA advisory component as well, of the various line offices in NOAA.

Chairman EHLERS. Thank you very much.

Another question for—did you want to add some further comments, Dr. McNutt?

Dr. MCNUTT. Just to state one.

I understand what Dr. Spinrad means about these other mechanisms in place for interagency coordination, and I think those would be fine, if ocean exploration were a top priority for any of those groups meeting around the table.

Unfortunately, I am afraid right now it is not a top priority, and therefore, I like this provision in H.R. 3835, because it instructs them specifically to make sure, in meeting in those—it could be in those same fora, that ocean exploration is part of the discussion.

Chairman EHLERS. Thank you for clarifying that.

MERGER OF NURP AND OE

I appreciate that. Mr. Shepard and Dr. McNutt, the Committee, this committee has many options, as it considered H.R. 3835, in light of NOAA's planned merger of NURP and OE. So, we could, for example, add language to allow or prohibit the merger, or add additional requirements about the merger process.

Is your suggestion that we include something along this line in the bill, or do you have any other suggestions? And this time, I will start from the other end, Dr. McNutt.

Dr. MCNUTT. Well, I think my view of this is that the less prescriptive that this bill is on it, perhaps the better. I think that there are a lot of nuances as to how this merger comes together, and frankly, I think the success of it may actually boil down to who is chosen to lead the charge within NOAA, and therefore, I could imagine ways that it could be prescribed in the language that might be harmful or supportive, and perhaps, it is best to be nonprescriptive.

Chairman EHLERS. Mr. Shepard, any comment?

Mr. SHEPARD. Yes, thank you. As we pointed out, again, in the testimony, we are very comfortable with the wording as it is in the bill, because what it does is it takes the strengths of these two programs, and lays them out. And NOAA is working hard now to, and the two programs involved are working hard to come up with a plan that can then be vetted with our partners. So, I think there is action already on the way, and we should give it time to work. Thank you.

Chairman EHLERS. Thank you. My time is expired. I am pleased next to recognize an eminent Member of this committee, who is extremely interested in these issues, Mr. Gilchrest from Maryland.

Mr. GILCHREST. Thank you, Mr. Chairman.

I like the idea that—I think one of the issues that brought NASA to the forefront of the consciousness of Americans, besides Sputnik, was that they were going to explore, to go where no man has gone before, that was an intriguing natural inherited quality of most human beings. If they can't get out there and explore themselves, they want somebody else to do it. So, I think if we use that as a provision in NOAA, in a few years, it would be nice if we could bring NOAA up to the same level of funding as NASA, which I think should be a priority of this committee and the other committees in Congress.

I guess the issue, and you have clarified it quite well, merge or not to merge. The issue is, though, coordination, unimpeded exchanges of information, so that people can collaborate with that information, become more competent, and work together, in that sense, to begin to understand, at this stage in our nation's history and world history, what are the priorities, as far as the Earth and the oceans are concerned.

PRIORITIES FOR OCEAN EXPLORATION AND RESEARCH

So, the question that I would have is how do you set priorities for the various programs, whether it is research or exploration? Number two, is ocean chemistry, in light of CO_2 sink for the ocean, one of your priorities? And the consequences over the next few decades of that to ocean life.

Do you have as a priority, as a result of the thermohaline system with global warming, understanding, new understanding of ocean circulation, the conveyor belt phenomenon in the North Atlantic?

And then one thing that Mr. Saxton raised was what is the understanding, or the nexus between global warming, hurricanes, sea surface temperature, and the consequences, pretty direct, to coastal communities?

So, I guess if you got all of that, I am not sure if I could remember all that myself, but just a brief comment from each person would be appreciated.

Dr. MCNUTT. Okay. I will start by making a stab at this. First of all, the last question first, connection between hurricanes, global warming, et cetera. From what we know now of the genesis of hurricanes, they live off an energy transfer from the thermocline up into the atmosphere, and to the extent that we are increasing the strength of that, there is a definite concern about increasing frequency, and in fact, there has been some new studies published in Science magazine that shows that even the historical record is starting to show the increased pace of destructive hurricanes.

In terms of whether chemistry is involved in ocean exploration, exactly. In the President's Panel report, where we lay out the priorities of the program, mapping the ocean in all of its dimensions is a very high priority. The beauty of exploration is if you do it in a systematic way, that mapping can be multidimensional, such that at the same time you are looking at the thermohaline circulation, you are also looking at the changing chemistry of the ocean, and you are also looking at the changing biology. And when we talk about mapping, it is four dimensional. We have to map in time too, and there is the beautiful connection to the National Science Foundation's Ocean Observing Program, and to NOAA's IOOS, the Integrated Ocean Observing System.

And so all of these programs need to be brought together, and that is why, in my diagram, I tried to show the importance of this interagency cooperation and collaboration. When you talk about the fact that NASA has definitely captured the imagination of the public, and wouldn't we like to have NOAA on that same pedestal, I think to too many Americans, NOAA is viewed as a bunch of lawyers who deal with lawsuits when their data is used incorrectly and fisheries collapse. Wouldn't we love it if NOAA was viewed as explorers who are adding to our basic understanding of this planet?

Just in, rewriting, Mr. Saxton brought up Tennyson's. I think that should be changed to: "I dipped into the ocean further than human eyes could see. Saw the vision of this water world, and all the wonder that would be."

Mr. GILCHREST. Mr. Spinrad, do you have a comment?

Dr. SPINRAD. First, Mr. Gilchrest, let me take this opportunity, and thank you for your strong support for these activities. This, as your set of questions indicates, is an extraordinarily diverse, and also, extraordinarily exciting portfolio of opportunities.

I would like to address my comments to your focus on prioritization, how do we move towards priorities? As a mission agency, NOAA has specific mission goals, in climate, in ecosystems, in weather, in commerce and transportation. So, the initial answer to your question, as we look at our priorities within those mission goals, and then, working, this is where that interagency collaboration is critical, we have to work with the Office of Naval Research, who has a national security mission. We have to work with NIH, who has a health mission, all the way down the line. We have to work with Energy.

All of these issues, the research associated with them will be driven by the particular questions we need to answer, and the fascinating part about some of what you are hearing among this panel is that one of the best ways to identify those questions is through exploration and discovery, especially in an environment where we have such a great unknown, whether it is 95 percent or 70 percent, we have a large percentage of unknown with regard to processes, parameters, features, and the oceans.

So, my perspective on us is that the value of the ocean exploration program is it helps us define those particular questions which we can take into a multi-mission, that is to say interagency venue, and determine who has got what responsibility for addressing these particular questions in climate, in human health, in natural hazards.

The other point I will make, and your questions with respect to CO_2, ocean acidification climate, those questions beg the vibrant nature of the collaboration between mission agency scientists, that is to say, our own scientists at our laboratories at NOAA, and at the Naval Research Lab and other labs, with the academic research community, which is why the kinds of capabilities that the NURP program brings to the table, in terms of established academic, Federal Government relationships, are so critical to addressing the kinds of questions which would be defined through exploration addressing agency missions.

Mr. GILCHREST. Mr. Shepard, do you wish to add anything?

Mr. SHEPARD. Yes, thank you. I just want to segue directly from the last thing Rick said. I think that is right on the mark, in that what we are saying, the strength of this bill is, is the question between ocean exploration and the regional presence that the NURP centers bring, all the issues that you mentioned now have a direct impact on coastal oceans and the coastal communities.

Coral reefs, hurricanes, the impacts on coastal communities as far as shoreline erosion, sea level rise, those are all things that the regional coastal ocean observing system is connected to, and attempting to build the system that we need to detect these things

and understand their impact. These regional ocean—regional undersea research centers are actively engaged at the regional level, with the regional associations. They are called that for a reason. They are set up that way for a reason, and having the regional presence gives you a direct conduit from ocean exploration directly into the management community. So, I think we really can add quite a bit to this partnership. Thank you.

Chairman EHLERS. Thank you all. The gentleman's time expired. Next, I am pleased——

Mr. GILCHREST. If the Chairman will indulge for nine and a half seconds.

Chairman EHLERS. One, two, three.

Mr. GILCHREST. The—at the expense of sounding too philosophical, bringing in another quote from Norman Cousins, editor of the *Saturday Review* some decades ago, which in essence is, I think, the mission of NOAA. Norman Cousins said: "Knowledge is the solvent for danger."

And there is potential problems out there, but it is the collaboration of that information, and then, the dissemination of that knowledge to us, the policy-makers, that can resolve some of those future problems.

Thank you. Thank you, Mr. Chairman.

Chairman EHLERS. I am pleased to recognize Dr. Schwarz for five minutes.

Mr. SCHWARZ. Thank you, Mr. Chairman. As a fellow Michigander, I am going to—I am just going to throw a couple of things out here, numbers of them.

DUPLICATION, COOPERATION, AND THE GREAT LAKES

Mr. Spinrad, you dealt with, as I wrote my questions down, Mr. Gilchrest asked his, and you covered some of mine, so, I am going to probably ask you to free associate with some of these again, if you don't mind.

For all three of you, are there any good private analogues to NURP and OE, and are we doing anything that is duplicative here that doesn't need to be duplicative, or is duplicativeness a good thing in this sense? Cooperation with the U.S. Navy, which you mentioned the Navy Research Labs. Are there others, areas where the Navy and yourselves can and should cooperate?

Strategic missions, which would have the Navy involved, or other strategic missions that the new combined agency or office might deal with, and with whom would you cooperate, if there were some strategic mission that you were involved in, or strategic information you were tasked to assemble?

And finally, tell me how you feel that the new agency would deal with issues having to do with the Great Lakes?

Dr. SPINRAD. I would be glad to walk through each of those, sir.

Let me start by saying, and I am going to interpret your question with respect to the private analogues to mean the private corporate sector, because clearly, there are private research sectors——

Mr. SCHWARZ. 501(c)(3)s, universities, and flat out private.

Dr. SPINRAD. Okay. The—in terms of the specificity we are talking about with the NURP and the OE program, I am not aware of specific analogues, and in fact, I would argue that one of the goals

here, speaking as a representative of the Department of Commerce, one of our objectives, of course, is to stimulate competition, stimulate new economic sectors, and I firmly believe that with the kinds of activities we are talking about, for example, I could look you in the eye and say that we will spur the development of new technologies for underwater vehicles, for sensors, that sort of thing, and I think that is where the strength of the private sector intersection is with this activity.

One of my favorite subjects, you raised cooperation with Navy. Most of my career in Washington was with the Navy, with the Office of Naval Research, and with the Oceanographer of the Navy. I feel comfortable in saying that we have got very good connections with both the operational and research sides of the Navy. Your specific question about where those intersections might be, I would identify four areas. One is in technology development. Navy has strong activities with respect to development of sensors and platforms and systems. Another is in mapping, and in fact, one of the things we are looking at is an integrated ocean and coastal mapping capability, where basically, everything we are doing in our OE and NURP programs is coordinated with Navy's hydrographic survey capabilities. Data management. Navy has extraordinary capabilities down in Mississippi for archiving and managing data. And then, observations. Dr. McNutt alluded to the Integrated Ocean Observing System. We look forward to working with Navy on that, and many of the concepts embedded in OE and NURP would be part of the IOOS' development.

With regard to whom we would work with in the Navy, it is three sectors. It is the research sector, through the Office of Naval Research. It is the policy sector, through the Oceanographer of the Navy, and it is the fleet, so all three of those would be groups we would work with.

And very succinctly, everything we have talked about here is intimately connected with NOAA mission objectives in the Great Lakes, whether it is sanctuaries, whether it is transportation, whether it is invasives. All of those issues are central to what we are talking about in ocean exploration and NURP, and I would foresee using the existing Great Lakes resources of the Sea Grant institutions, as well as our own Great Lakes Environmental Research Lab being central to activities.

Mr. SCHWARZ. And let us put invasives in italics.

Dr. SPINRAD. Understood.

Mr. SCHWARZ. Thank you, Mr. Chairman.

Chairman EHLERS. The gentleman yields back.

We have a series of votes called. It will probably take a half-hour or more, and I don't want to detain you that long. So, I have just one quick question, and the remainder of questions that we wish answers to, we will simply put in the mail to you rather than keep you here an extra hour.

PROPOSED APPROPRIATIONS IN H.R. 3835

The quick question is the bill that is under discussion, H.R. 3835, and this is just for Mr. Shepard and Dr. McNutt, because I think I know what Dr. Spinrad's question would be. The authorization numbers in there, in other words, the amount of money authorized,

which is a maximum that could be appropriated. Do you believe they are appropriate in the two bills? Mr. Shepard, is that enough money?

Mr. SHEPARD. Yes. We have thought about it a long time. We understand the realities that face the Federal Government at this time, and we think those numbers will allow us growth.

Chairman EHLERS. Okay. Dr. McNutt.

Dr. MCNUTT. For ocean exploration, given the realities of the other demands on the federal budget, I think these are very appropriate numbers, and if appropriated to those levels, would lead to a very vigorous and successful program.

Chairman EHLERS. Okay. And then one other quick question. Do you think the funding in the bill for the NURP centers should be split between the East and West Coast centers, or provided in one large pot, as recommended by Dr. Spinrad, so that NOAA would decide how to split it? Mr. Shepard.

Mr. SHEPARD. I have a conflict of interest. I am on the East Coast. I think I had better stay out of it.

Chairman EHLERS. You both have a conflict of interest. Dr. McNutt, are you going to bite the bullet, or——

Dr. MCNUTT. I will declare the same conflict.

Chairman EHLERS. All right. Thank you for your help on that one.

So, thank you all very, very much for being here. It has been most helpful to me. I have a great love for NOAA. I have a great love for the research they do. I would certainly love to see it expanded. That, of course, is from the perspective of a scientist and someone on the Science Committee. But I certainly hope we can get the NOAA Organic Act passed, which would help everyone in the field, and we can perhaps incorporate the important elements of this in that, or take this part up early next year and deal with it.

So thank you very, very much for being here. You have been most helpful to us, and I deeply appreciate it.

If there is no objection, the record will remain open for additional statements from the Members, and for answers to any followup questions the Committee may ask of the witnesses. Without objection, so ordered.

The hearing is now adjourned. Thank you very much.

[Whereupon, at 3:10 p.m., the Subcommittee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Richard W. Spinrad, Assistant Administrator, Office of Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Questions submitted by Chairman Vernon J. Ehlers

Q1. With regard to the process of the proposed merger of OE and NURP, the merger has been planned since 2005, but there is still no clear picture of how NOAA will plan and conduct the merger. You also mentioned that you want the merger process to be inclusive. Can you please explain in detail (1) how you expect the planning process to unfold, and (2) how you plan to solicit and incorporate extramural input? For example, will you use informal meetings, Federal Register *notices, or other means to reach out to the community, and will extramural input be included as you define the "essential functions" of the merged program?*

A1. The details of an Office of Ocean Exploration (OE) and National Undersea Research Program (NURP) merger are being finalized in an integrative process that involves a core team comprised of the leadership of the existing OE and NURP programs, including the extramural directors of the regional NURP centers, and six program teams. The program teams are each focused on one of six functional areas—science, data management, technology development, education & outreach, administration, and operations. The program teams are comprised of OE and NURP staff, and personnel from the regional NURP centers. The regional center participants are encouraged to bring input from their external research partners to the process. The program teams are compiling recommendations as to the scope, procedures, and structure of their functional area. These recommendations will be used by the core leadership team to draft business and strategic plans, as well as an abstract which describes the essential function and anticipated structure of the new program, by early 2008. NOAA will solicit recommendations from the core and program teams on procedures to further engage the external community.

NOAA values the involvement of the external research community in discussions of the merger. Accordingly, NOAA held meetings in March 2005 and June 2006 involving external partners to characterize the merged program structure, short-term goals and long-term areas for potential collaborations. One of the outcomes from these meetings was the creation of the six program teams described earlier whose recommendation will form the basis for the draft business and strategic plans.

Once internal planning has matured, external review will be sought from the broader undersea research and ocean exploration community and will be incorporated, as appropriate, into the final business and strategic plans. The mechanism for soliciting this review will be determined by NOAA before the abstract is presented to the external community and may include expansion of the purview of NOAA's external Science Advisory Board Ocean Exploration Advisory Working Group to include the new merged enterprise. External review may also include collaboration with the Consortium for Ocean Research and Education or other preeminent professional societies such as the American Geophysical Union, the Oceanographic Society, and the Marine Technology Society.

Q2. With regard to the substantive outcome of the proposed merger of OE and NURP, prominent members of the OE community continue to express concern about possible downsides of a merger, particularly from the perspective of OE missions. For example, exploration advocates worry that resources will be directed away from pure exploration into mission-oriented survey work, diluting the goals of the program. Are you aware of these concerns? If so, how do you plan to address them?

A2. NOAA has been made aware of these concerns both during the hearing, by Dr. Marcia McNutt, and during its Ocean Exploration Advisory Working Group meeting in April 2006. The Ocean Exploration Advisory Working Group is comprised of 11 members of the extramural community and is a standing committee of the NOAA Science Advisory Board. NOAA will give concerns of the Ocean Exploration Advisory Working Group and the ocean exploration community full consideration as the merger progresses.

Maintaining a robust ocean exploration program is important to NOAA. The merging of the Office of Ocean Exploration and the National Undersea Research Program will allow NOAA to bring additional nationwide capabilities to bear on ocean exploration. The scientific discoveries from ocean exploration expeditions as well as the technical and educational leadership demonstrated during these expedi-

tions are critical to NOAA being able to meet its evolving environmental and economic missions. Involvement of NURP's expertise, capabilities and regional presence in NOAA's ocean exploration enterprise will strengthen the ability of the ocean exploration program to bring the results of discoveries to bear on NOAA's ecosystem and environmental prediction challenges.

Appendix 2:

Additional Material for the Record

UNIVERSITY of WISCONSIN
UWMILWAUKEE

Great Lakes WATER Institute
Wisconsin Aquatic Technology & Environmental Research

29 November 2005

Vice Admiral Conrad C. Lautenbacher
National Oceanic and Atmospheric Administration

Dear Admiral Lautenbacher:

This letter is to affirm to you and to NOAA the value of the National Undersea Research Program to the Laurentian Great Lakes. I understand that recent budgetary plans have called for the elimination of NURP centers serving the Great Lakes, and I urge NOAA to seek the means to keep this extremely valuable program afloat.

As you are aware, the Great Lakes are inland seas, not mere lakes. The Great Lakes contain over 10,000 miles of coastline and 6 quadrillion gallons of water – enough to cover the continental U.S. to a depth of 9.5 feet. Some of the world's largest sea going ships sail these waters, and the fury of their storms is legendary. History lines the lakes' bottoms with one of the highest densities of shipwrecks in the world, and they claim victims even today.

However, despite their sheer volume, we are not without our water problems. In 1993, more than 400,000 of Milwaukee's citizens suffered illness as a result of the contamination of the water supply by the intestinal parasite, *Cryptosporidium* – the largest single water borne disease outbreak in the history of the U.S. The most severely affected were the poor and minority communities. The U.S.- Canadian International Joint Commission (IJC) has identified 43 "Areas of Concern" around the Great Lakes – environments in which pollution currently is severe enough to run a substantial risk to human and wildlife health. The cost of clean-up represents a major regional problem running to billions of dollars that augurs to stifle urban revitalization, resource stewardship, and industrial growth. At the same time the relative risks associated with alternative remediation strategies are poorly quantified due principally to a lack of science.

Despite their physical power and size, these lakes are surprisingly fragile systems. Climate change models predict large scale alterations in global meteorological patterns, particularly in temperate and high latitudes where shifts in the timing and magnitude of precipitation of 20 percent are possible. Such changes could have significant impacts on agriculture and food production in the U.S. Corn Belt and on the Great Lakes, which are particularly sensitive to alterations in heat and precipitation fluxes. Exotic species invasions into this evolutionarily young system have a long history of disrupting ecosystems, altering biological diversity, and changing the key pathways in important biogeochemical cycles. These changes have had major resource management consequences, with concomitant economic losses in the billions of dollars and deteriorations in ecosystem health.

600 East Greenfield Avenue, Milwaukee, WI 53204-2944 414-382-1700 *voice* 414-382-1705 *fax* www.glwi.uwm.edu

The Great Lakes are, essentially, "closed systems", i.e. whatever we pump, toss, leak or wash into these lakes from our homes, farms and industries remains within the basin indefinitely. The retention time for water in Lake Michigan is ~100 years, in Lake Superior nearly 200 years. Consequently, the major sink for materials and persistent contaminants is the continuously accumulating sediments which blanket the lakes' floors -- a highly dynamic region known as the benthic boundary layer (BBL). The extent to which these sediments and the overlying waters couple at the BBL to sequester and bury or to recycle and release nutrients which fuel the food chain, or toxic substances which may contaminate it, is critical in controlling the concentrations, fate and impact of these substances.

NURP supported research has been out in front in understanding processes at the BBL -- the realm of the lake floor where much of the ledger for the lakes elemental economy is kept. Prior to 1985 virtually no active scientist in the world had ever had a first hand look at this environment. In that year, the National Undersea Research Program, in a major new initiative brought state-of-the-art undersea research technology to the Great Lakes. Scientists, many of whom had spent a lifetime of research hanging sampling gear on a wire, saw, literally for the first time, the environment they were studying.

These observations challenged not only the paradigms of the past, but spawned an entire of series of new in situ science investigations: critical fish habitat and niche heterogeneity, predator-prey interactions, the biological and geochemical consequences of vertical migration behavior, the physical dynamics of the bottom boundary and the elucidation of the importance of "nephaloid layer" -- a flocculent soup of highly active bugs and mud extending a few meters off the bottom.

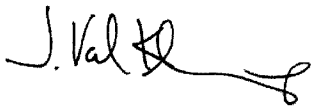
Since those first manned submersible dives in Lake Superior in 1985, NURP has supported 1000's of dives, by over 100 scientists (and scientists in training) at over 30 institutions in both the US and Canada. The development of new technology and the education in its use which NURP stimulated through an active grant and funding initiative in the 1980's and early 90's, has led directly to the use advanced underwater technological "tools-of-choice" in major research and sampling efforts now underway in the Great Lakes and other marine and freshwater systems funded by NSF, NOAA COP, NOAA Sea Grant and others.

The impact the National Undersea Research Program had in the Great Lakes in the late 80's and early 90's was immense. It stimulated a period of major, broad spectrum field research on an oceanographic scale. In an era when fewer and fewer U.S. and Canadian scientists were engaging in field research on the lakes, NURP provided an invaluable boost in activity and focus. The program also captured the attention and imagination of the public. Countless articles, news stories, magazine pieces, and TV specials hit the streets. The positive impact of this cannot be overemphasized. Surprisingly few people appreciate the majesty and magnitude of these inland seas. NURP turned their eyes seaward -- "... how deep, how long, how much, what did you see, were you scared, what did you learn ... " the questions poured in from everywhere -- from kids in schools, from cities' mayors, from the fisherman on the dock. The people liked what they saw and heard, they liked the fact that a little known government agency with a funny sounding acronym was paying attention to their lakes. Water is important to the Great Lakes public. They understand the need to understand. The potential to build on this interest, via expanding partnerships with the public and private sectors has not been tapped, but it is there. Educators are crying out for new ways to expose school kids to the lakes -- their physics, their biology, their chemistry, their history and cultural importance, their value to the future. The Great Lakes NURP Aquanaut program, launched in 1999 on a shoestring, and still in its infancy, resonates loudly with these educators and students and could fill a crying need.

The National Undersea Research Program has had an impact far greater than its relatively modest budget would presuppose. Now, more than ever, as freshwater resources come under increasing stress and demands, the need for research which will arm today's decision-makers and prepare tomorrow's leaders in bringing to the process of decision-making the best possible scientific understanding has never been greater. NURP has shown that it can play a unique role in creating this new understanding. No other program, agency or foundation combines the creative inquiry with 21st century technology in the same way. The result is unique. The result is better science. The result is better scientists. But most of all the result is a better understanding of this resource.

I urge you to use your influence to help keep the National Undersea Research Program viable and healthy. I believe it is a small but critical piece of the research enterprise of the United States and of the Great Lakes region. If there is anything I can do to assist and support, please do not hesitate to contact me.

Sincerely yours,



J. Val Klump, J.D., Ph.D.
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STATEMENT OF U.S. REPRESENTATIVE ROB SIMMONS (CT–2)
CO-CHAIRMAN, CONGRESSIONAL LONG ISLAND SOUND CAUCUS
CO-SPONSOR, H.R. 3835, THE *Ocean Exploration and Undersea Research Act*

Thank you, Mr. Chairman, for inviting me to appear before your Committee on legislation important to me and to my district.

As a co-sponsor of the bill, I would like to add my support for passage of H.R. 3835 that would formally incorporate the relatively young Office of Ocean Exploration and long-running Undersea Research Program within the National Oceanic and Atmospheric Administration (NOAA).

As you may know, the University of Connecticut, located in my district, is host to the National Undersea Research Center for the North Atlantic and Great Lakes. For the past 20 years, the regional NURC center at UConn has been at the forefront of supporting research to meet NOAA's needs, developing and applying new technologies, and supporting innovative hands-on teacher professional development programs.

The National Undersea Research Program already promotes working side by side with NOAA programs such as the National Marine Fisheries Service. Together they have provided support for research—directly aiding the New England Fishery Management Council in developing management actions to conserve deep water coral habitats on Georges Bank and better defining the role that seafloor habitats play in the survival and production of juvenile lobsters.

Before coming to Congress, I served in the Connecticut General Assembly where I worked to provide $40 million in state investment in marine sciences. Much of this investment—including a 137,000 square foot marine science building, a state-of-the-art 77" coastal research vessel, dock facility and infrastructure—directly allows the NOAA programs, NURC and Sea Grant to better meet NOAA's mission. By supporting regional centers, H.R. 3835 will continue to promote such fruitful partnerships.

As you know, my district borders the Long Island Sound, a unique estuary with economic and ecological importance to the region and to the Nation. The Sound contributes approximately $6 billion annually to the regional economy and is a cherished resource for the 28 million people living within 50 miles of its shores. The Sound is heavily used for recreation and for commerce by residents of Connecticut and New York as well as numerous visitors each year. This treasure, along with all of our waters, deserves our utmost support.

H.R. 3835 provides the building blocks upon which NOAA can build a coordinated ocean exploration and research program, ideally one with sustained funding levels. Our nation must maintain all the tools to study the complex ecosystems that lie beneath our oceans and Great Lakes. By authorizing H.R. 3835, we ensure that our nation maintains the capacity to explore, understand and promote the Earth's waters.

I am pleased that you will have the opportunity today to hear from so many individuals that have committed their lives to working on and studying our waters. Again, I thank you and the witness panels for your time and consideration of H.R. 3835.

STATEMENT OF MR. ROBERT I. WICKLUND,
DIRECTOR—FEDERAL PROGRAMS, UNCW

AND

DR. DANIEL G. BADEN,
DIRECTOR—CENTER FOR MARINE SCIENCE, UNCW

Mr. Chairman and Members of the Committee, we are pleased to submit this statement in the discussion of H.R. 3835 entitled the *"National Ocean Exploration Program Act"* in Title I, and the "NOAA Undersea Research Program Act of 2005" in Title II. We first want to commend the Committee for recognizing the importance of ocean exploration and undersea research to this nation. The National Ocean Exploration Program contained in Title I and the Undersea Research Program contained in Title II of the bill complement each other in many ways and they belong together in this legislation.

We never expected to be submitting testimony to this august body in 2006 for the passage of legislation that would give authorization to programs dedicated to the understanding of the undersea environment. Three decades ago the Senate, with a keen interest in how the Nation could benefit from underwater exploration and research, introduced S. 2285 the *"Manned Undersea Science and Technology Act."* Much of this old bill is similar to the legislation that we are considering here today, and other bills and drafted amendments have been attempted on both sides of the aisle since 1977. After almost thirty years, we are still trying to pass a bill to legitimize the need and enhance our ability to understand the environment that covers most of the planet. Our hope is that through this legislation Congress has finally come to recognize the enormous importance of providing the means to explore and study the oceans in every way possible.

Having said that, and after much effort by this and the Resources Committee to move this bill, we want to add that we and our colleagues are dismayed by the recent actions of the House Appropriations Committee to virtually gut FY 2007 ocean funding for NOAA. Over a half billion dollars was cut from last year's funding level, almost all coming from the ocean side of the Agency. The programs that your legislation addresses in this hearing are also part of that cut. The Appropriations Committee provided only $16 million dollars for the two programs combined. This is less than half of funds that would be authorized in H.R. 3835. There is a disconnect here that makes little sense. We collectively recognize the importance of the oceans and their resources to the Nation's strategic and economic base in terms of climate, fisheries, transportation, human safety and health, tourism and general well being. We also recognize, as did the U.S. Commission on Ocean Policy, that the oceans are under siege. Coral reefs are dying off at record levels, killed by disease, rising temperatures, or crushed by destructive fishing practices. Fish population decline and habitat destruction are rampant. Coastal water quality is degrading. Coastal hazards to human life and property is on the increase due to hurricanes and other storm systems. These are all critical issues that are tied directly to the oceans. If we do not put the energy and funds into increasing our knowledge of the oceans, then we cannot manage their resources wisely nor mitigate the hazards. We find it inconceivable that just two years ago the Commission's Report *"An Ocean Blueprint for the 21st Century"* set forth a bold course to make understanding, protection, use and management of the oceans the highest of priorities. Now and over the past few years the trend seems to be to reduce our commitment to ocean issues. What is the reasoning, the complacency, the downright lack of commitment and caring for our oceans that is demonstrated by this nation?

We should not, therefore, allow this important legislation, that will do much to address some of these concerns, slip away. We urge you, Mr. Chairman, in the strongest terms, to do what it takes to see that the Committee, the full House and the Senate pass the provisions H.R. 3835 into law.

We believe that it would help your committee if we gave you a quick history of the government's involvement in undersea research and how it led to where we are today. First, undersea research in NOAA began when the Agency was created by the Stratton Commission around 1970 as the Manned Undersea Science and Technology Program (MUST). One year later the Hydro-Lab Undersea Laboratory Program and others were launched, giving scientists first-hand working experience living in an undersea laboratory and using lock-out submersibles. It was immediately obvious to us that there was great potential to advance our knowledge of the ocean by placing humans directly into the sea. By 1980, based upon a report from the National Research Council, Congress worked with NOAA to change the program to a

regional system with a stronger scientific and technical base in academia and industry. This was named the National Undersea Research Program (NURP). Also about this time, the Aquarius Undersea Laboratory was built and is still operating today as the only remaining seafloor lab in the world.

As of 2006, the program consists of six regional Centers covering all coasts of the U.S. and Caribbean and a National Institute of Undersea Science and Technology.

NURP has continued to operate for the past twenty-six years making discoveries and improving the management of our coastal, ocean and Great Lakes resources, placing thousands of scientists in all forms of diving equipment, undersea laboratories and research submersibles as well as using remotely operated vehicles.

But, here again is another ocean program under siege. NURP's funding decreased from a high of a little over $18 million dollars ten years ago to about $4.5 million dollars last year. Around six years ago the Ocean Exploration Program was started to increase our ability to go even further to places never before seen by man. Although the two programs complemented each other in many ways, they continued to operate as separate entities.

As we realized that a change was needed back in 1980 to make the program in undersea research more effective, it appears that it is time, once again, to reassess how we can make it work better and to bring the two programs- Ocean Exploration and Undersea Research—together. NOAA has been working on a plan, over the past year or so, to restructure the two programs and merge them. The legislation you are considering today provides the building blocks for this new merged program.

MERGING THE OCEAN EXPLORATION AND UNDERSEA RESEARCH PROGRAMS

NOAA is faced with a great challenge in its role as the Nation's steward of our oceans, coasts and Great Lakes—underwater ecosystems that are largely unknown, yet exploited and highly impacted. Continued failures of traditional assessment and management methods to sustain resources suggest new approaches are needed, such as ecosystem-based management. NOAA needs an expanded, integrated program of undersea exploration, strategic research, and technology development, which will result in:

- new discoveries, resources and promotion of our blue planet
- knowledge and new perspectives needed for Ecosystem-Based Management
- Cutting-edge, innovative technical solutions for science, engineering, and commercial applications.

Together, these elements provide synergy, capacity and knowledge needed to meet the great ocean challenge.

We maintain that this synergy must continue to include strong ties to regional partners who promote:

- Closer cooperation with local stakeholders, such as fishery management councils and water quality agencies
- Increased participation in regional ocean science, management, and education planning activities
- Enhanced scientific and operational capacity through extramural partners in other federal programs, states, academia, and industry
- Involvement of a broader community of scientists, managers, educators, and students in NOAA's mission
- Better outreach through access and proximity to the public, and
- Dedicated support for ecosystem approach to management through coordinated team of NOAA, academic and industry partners.

Lastly, at a time when support for the oceans is most threatened, we need to increase efforts to reveal the importance of this work to the world and what will be lost to future generations. Ocean education and literacy breeds public support. These two programs together have already demonstrated their ability to reach students and public groups across the globe to convey the need and excitement of ocean exploration and research. On-going "K through gray" activities include:

- Virtual ocean programs that bring the sea into classrooms and living rooms through tele-presence and live events
- Interactive, at-sea learning that enhances ocean literacy, enriches science education, and promotes environmental stewardship
- Innovative ocean observation programs that promote development of science and math skills, and problem-solving approaches to learning, and

- Informal science center partnerships that expose millions of visitors each year to the oceans through exhibits and hands-on activities.

Mr. Chairman, we endorse this legislation wholeheartedly, with one recommendation. We believe that the funding levels in the bill for the undersea research program are too small to accomplish the many tasks it will be conducting in the future. The costs of developing new technologies to explore and study the oceans are high and we recommend a fifty percent increase in the authorizing numbers in Title II of H.R. 3835.

We appreciate your attention to our remarks and the opportunity to submit testimony on behalf of this most important legislation.

Thank you.