Committee on Resources,

Subcommittee on Fisheries Conservation, Wildlife & Oceans

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U.S. House of Representatives, Washington, D.C. 20515-6232 - - (202) 226-0200

Witness Statement

Testimony of

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Before the
Resources Subcommittee on Fisheries Conversation, Wildlife and Oceans and the
Science Subcommittees on Research and Environment, Technology and Standards
Oversight hearing on
Ocean exploration and the development
and implementation of coastal and ocean observing systems

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Good afternoon Chairman Gilchrest, Chairman Ehlers, Chairman Smith, members of Congress. Members of the subcommittees and staff, ladies and gentleman, *Aloha*.

I am Alexander Malahoff, Professor of Oceanography, director of the Hawaii Undersea Research

Laboratory and director of the Marine Bioproducts Engineering Center, University of Hawaii at Manoa, Honolulu, Hawaii.

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The United States of America is surrounded by the oceans. Our country has the world's largest exclusive economic zone. We have the largest Navy, the largest research fleet, and yet, the smallest merchant marine. The oceans are an essential resource to us in our fisheries, oil resources and coastal resources. Yet, this vast environment of the oceans is also our frontline defense against any adversary. Today, the oceans are much more to us than the traditional area of interest that I have just described. The oceans are the source of our weather and climate. The oceans are the habitats for a spectacular spectrum of life ranging in size and complexity from microorganisms to whales. The oceans are the homes for coral reefs, soft corals, and other complex sessile organisms inhabiting the ocean floor. Submarine volcanoes and mid-ocean ridges form the habitats for exotic life assemblages around hydrothermal vents and homes for microorganisms known as extremophiles. These environments on the ocean floor or lying just below the sea-surface represent sites where life began and then grew into the complex diverse system we know of today. This is a complex interlocking system of life, ranging from the ocean floor and the water above, to the atmosphere above that.

The oceans will continue providing us with food and energy and with the resources for a range of entirely new industries, specializing in marine bioproducts, pharmaceuticals and nutraceuticals derived from exotic micro-organisms, such as extremophiles living around hydrothermal vents on the ocean floor. We are a great and resourceful nation and our future rests upon our competitive advantage in the world based upon our out-of-the-box thinking.

In order to have a meaningful knowledge of this complex system and its potential role in the future well being of the United States and its people, a meaningful plan that has a global perspective of this earth system needed to be put in place. The plan would include a full survey and assessment of the ocean life systems, the effect of ocean chemistry and climate on these systems, and the vast array of habitats on the ocean floor, all viewed from an integrated perspective.

The plan designed to achieve our meaningful knowledge of the oceans came to us in the form of the report issued under the direction of the President entitled, "Discovering the Earth's Final Frontier: A U.S. Strategy for Ocean Exploration". The recommendations stemming from the report focus around ocean exploration -- exploration with clearly identified goals, objectives and potential benefits. This is an exciting interdisciplinary, inter-cultural, inter-agency program. It lays the groundwork for understanding the whole diverse ocean system and our intimate relationship to this system. In this program, we will look at this system from human habitation on the coasts and islands of the oceans to the hydrothermal vents on the ocean floor. In order to accomplish this, we must systematically map the complete environment. We must establish multi-sensor observatories that will read all environmental data from the coastline to the deep ocean floor. This includes the biology, geology, physical oceanography, and water chemistry of the oceans. We must understand the role, history and impact of humans upon the ocean from pollution to historic wrecks and structures on the ocean floor. We must make this information readily available to educators and environmental, political, industrial and research leaders, so that effective plans for new aquaculture, new ocean industries, and new ocean conservation initiatives can be laid.

These challenges in our Ocean Exploration Program open up wide, avenues for advancement to all sectors of our society with interest and investment in the oceans. First of all, it invigorates the vision of a new presence for the American society in the oceans. Secondly, the program offers an opportunity for a different

presence in the oceans for America. With new tools, systems, observatories, vehicles, and sensors applied to these programs, new industries will flourish and a new ocean systems industrial niche will develop. Our paucity in the international maritime transportation industry will be balanced by our leadership in the ocean exploration industry. The exciting aspect of the Ocean Exploration Initiative will be the challenge of partnerships that would envelope the diverse interests described.

The National Oceanic and Atmospheric Administration has taken an effective lead by creating the Office of Ocean Exploration. This has been a bold move towards this new interdisciplinary, inter-cultural and inter-agency arena. This is a fresh start and a catalyst that will enable our nation to take a lead in the wholistic understanding of our oceans. This is a critical step for our nation to take and everyone should be behind it.

It is and exciting step because it challenges us to think along a broad intellectual front, yet focus on frontier problems. These could be the survival of coral reefs, or the range in the diversity of microorganisms, or the challenge of open ocean pelagic fishery aquaculture, or the extraction of new pharmaceuticals from organisms living in the hydrothermal vents, or the impact of human presence on our coastlines. This broad thinking will lead to a revival of global expeditions with airplanes, ships, submersibles, satellites, robotic miniaturized underwater vehicles, autonomous observatories, and *in situ* robotic laboratories. This U.S.-led Ocean Exploration Program will also attract international partners with a dazzling array of ocean observational systems spanning the globe.

Ladies and gentlemen, America must take the bold, necessary step to regain the U.S. lead on all fronts of maritime technology. The challenge of this new Ocean Exploration is monumental. In our own Hawaiian Island chain, stretching the length of over 1,200 miles, a home for most of America's tropical coral mass, very little is known about the nature and life of the ocean floor north of the inhabited windward islands. The Hawaiian Islands are strategically located in the middle of the Pacific Ocean, a physical and cultural presence of the United States in the middle of the world's largest ocean.

How do we begin this task in our Hawaii? Much of the work to date has been accomplished in Hawaii through the use of submersibles operated by the Hawaii Undersea Research Laboratory, one of six Centers of NOAA's National Undersea Research Program (NURP). NURP is a is a comprehensive underwater research program that places scientists underwater, directly through the use of submersibles, underwater laboratories, and wet diving, or indirectly by using remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), and observatories.

NURP is primarily a grant program with most of its funding going to the research community, primarily academia. In this program, research quality is ensured by competitive and high standards of peer review. Highest priority is given to proposals for studies in the large lakes, territorial seas, and adjacent waters of the United States. Responsibility for soliciting and supporting the research is assigned to regional Centers: North Atlantic and Great Lakes; Mid-Atlantic; Southeastern U.S. and Gulf of Mexico; Caribbean; West Coast and Polar; and Hawaii and Western Pacific.

The National Undersea Research Program is one that has made a significant difference towards understanding of the oceans and its resources. The undersea research has laid the foundation for the United States to fully explore of the undersea environment. NURP sets an example in working through partnerships. For instance, the Hawaii Undersea Research Laboratory conducted a workshop of our constituents and Pacific partners in 1997. The Hawaii and American Flag Pacific Islands Coastal Zone and Fisheries Workshop was a resounding success because it effectively addressed the key concerns of the this large region related to: 1) coral reefs, coastal habitats and water quality, 2) coastal hazards and mitigation,

and 3) fisheries. In the area of fisheries, for example, it helped HURL to understand the needs of fisheries managers (e.g., NOAA's National Marine Fisheries Service) and it aided in the development of partnerships and the leveraging of funding sources to solve such problems as:

- Examine of the effectiveness of 'no-take' marine protected areas.
- Evaluate the extent and status of exploited fish resources and the discovery of new resources.
- Understand the functional role of habitat in survivorship, growth, and reproduction of managed marine species.
- Quantify rates of recovery for habitats impacted by chronic and pulsed fishing activities.
- Map and characterize the habitat and biological integrity of benthic communities and reefs at selected continental shelf sites (e.g., marine protected areas) that are inaccessible to usual diving techniques (deeper than 50 meters).

Because of the infrastructure and presence of unique equipment, such as the 220-foot mothership, the R/V *Ka'imikai-o-Kanaloa* and the 6,800-foot depth capable *Pisces IV and Pisces V* and ROVs at the Hawaii Undersea Research Laboratory, discoveries of unique and diverse populations of extremophiles in hydrothermal vents of the pit craters of the submarine volcano, Loihi, were made possible. The extremophiles discovered barely 20 years ago in vents and seeps surrounded by mineral deposits and unique life that exists without sunlight and oxygen, have revolutionized modern scientific theory about the origin and sustenance of life on Earth. Extremophiles are known for their ability to flourish in the world's most harsh environments. These are the organisms whose unique biology holds great potential in biomedical and commercial applications.

We will need a larger number of ROVs, with better sensor capability, that are suited for a variety of tasks, from the small ones that can explore smaller crevices to large ones that better equipped to do larger tasks and that have the payload capacity to return a variety of samples to the scientists operating from the surface. However, as with the exploration of the farther reaches of space, a greater dependence will begin to be put on AUVs and fixed seafloor observatories. AUVs need to become more reliable, capable of doing a variety of tasks, and capable of larger range. Fixed, or multi-deployable, seafloor observatories of the *Aquarius* and LEO-15 type also need to be expanded in capability and number to examine, *in situ*, the processes of such phenomena as deep-sea processes. Such processes include the volcanic evolution of new islands, e.g., Loihi in the Hawaiian-chain, or the dynamics of spreading ridges. These result in the injection of mass and energy into the ocean, and the evolution of new species and resources.

There is an immediate need for an expansion of our present capabilities -- manned submersibles, ROVs, AUVs, and seafloor observatories. The key to this expansion will be the development of a new generation of submersibles, such as those capable of going efficiently and safely to the depths of the ocean. No new deep ocean submersibles have been built in the United States during the past 30 years. With new metallurgy, new propulsion and greater sensor capability, the development of better and smaller electrical, acoustical, and optical sensors, and a new generation of deep ocean exploration vehicles should be developed by the United States. Twenty million dollars per vehicle would provide the U.S. with leadership in this field.

The new Ocean Exploration Initiative is an exciting and challenging program for the United States. It will build new industries, educate the citizenry, preserve the environment and open new collaborative partnerships.

In the technology arena, partnerships between academia, the U.S. Navy, NASA, NOAA, EPA and industry will be forged. A new ocean knowledge base will be established, providing critical ocean information to the

U.S. government for defense, resource management, environmental protection and policy and law. The ocean knowledge base will also provide information to coastal developers, states and municipalities, fisheries, oil and ocean mineral industries, and provide the knowledge base for oceanographers and educators.

It is essential that this new venture be fully supported by Congress, that the fledgling Office of Ocean Exploration be fully funded, and that a fleet of new age submersibles be constructed for the exploration of the Pacific, Atlantic and Arctic oceans, and the Gulf of Mexico.

Core programs essential to accomplishing the objectives of Ocean Exploration, such as NOAA's NURP should be fully funded and ocean exploration programs in the Defense Department, the National Science Foundation, the Environmental Protection Agency be supported. States bordering and surrounded by the oceans should be encouraged to join the partnership and U.S. industry should be encourages by government to take a lead in the development and manufacture of instruments, vehicles, systems, observatories, data processing and information technology. This way, Ocean Exploration will be a cornucopia for a new wave of American knowledge and industry.

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