

NATIONAL ASSOCIATION OF MARINE LABORATORIES

FY 2016 PUBLIC POLICY AGENDA

The National Association of Marine Laboratories (NAML) is a nonprofit organization representing the ocean, coastal and Great Lakes interests of member laboratories that employ thousands of scientists, engineers and professionals nationwide. NAML labs conduct high quality research and education in the natural and social sciences and translate that science to improve decision-making on important issues facing our country

NAML's priorities are drawn from and strongly support two important reports from the National Academy of Sciences. They are: ***Sea Change: 2015-2025 Decadal Survey of Ocean Sciences (DSOS)***; and ***Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century***. Specific priorities germane to NAML labs are:

- Enhance science, education and public engagement at marine labs by supporting the continued development of their unique assets and qualities that allow them to prepare the next generation of scientists, expand opportunities for active learning and collaborative research, and explore a wide range of approaches to engage the public. This includes strong sustained support for competitive merit-based ocean, coastal, and Great Lakes research provided by relevant federal agencies to address the research priorities identified in *DSOS*;
- Promote a network for discovery and innovation via Federal and non-Federal support to build and maintain a modern infrastructure for research, education, and networking including advanced internet connectivity and cyber infrastructure;
- Pursue financial sustainability by developing business plans that foster the unique value of marine labs, creating mechanisms to establish reliable based funding, and diversifying approaches to obtain supplemental support – such as a national partnership program to co-locate federal scientists and infrastructure at NAML facilities; and
- Develop metrics for demonstrating the impact of marine labs in research, education, and public engagement.

The Role of Marine Laboratories in the Nation's Research and Education Enterprise

"Field stations are national assets formed by the unique merger of natural capital, intellectual capital, social fabric, and infrastructure that leads to the important scientific endeavors required if we are to understand our rapidly changing natural world." ***Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century***.

Ocean, coastal and Great Lakes marine laboratories are vital, place-based "windows on the sea." They connect communities with cutting edge science, while providing students and citizens with meaningful learning experiences. The members of NAML work together to improve the quality and relevance of ocean, coastal and Great Lakes research, education and outreach. NAML seeks support for the following activities:

- The conduct of basic and applied research of the highest quality, making use of the unique capabilities of coastal laboratories in conducting education, outreach and public service;
- Balanced support of research with infrastructure with particular emphasis on cost-effective networking of capabilities;
- Encouragement of effective management and conservation of marine and coastal habitats and resources using ecosystem-based management approaches that restore ecosystem health;
- Observing systems that collect data needed to improve predictions of natural and human caused disasters and support the management of marine resources for the benefit of environmental and human health needs; and
- Education and training.

Oceans, Coasts and Great Lakes are Vital for Economic Growth and the Well-being of the Nation

More than half of the United States population lives in coastal counties that generate 58% (\$8.3 trillion) of the Nation's gross domestic product (GDP). In 2011, Americans, on average, ate 15 pounds of fish and shellfish per person – 4.7 billion pounds all together – making the U.S. second in the world in total seafood consumption. Offshore oil production in the U. S. Exclusive Economic Zone accounts for 24% of the total U.S. crude oil production. If American coastal watershed counties collectively comprised a single country, that country would have a GDP higher than that of China. The United States has jurisdiction over 3.4 million square miles of oceans – an expanse greater than the land area of all 50 states combined. This is a dynamic area that offers a mosaic of biologically diverse habitats that provide a wealth of environmental resources and economic opportunities, while at the same exposing human and biological communities to hazards such as damaging tsunamis and hurricanes, industrial accidents and outbreaks of water borne pathogens. The 2010 Gulf of Mexico *Deepwater Horizon* oil spill and Sandy in 2012 are vivid reminders that the depth of our understanding of our oceans and coastal areas, and our ability to protect them, is far from complete. Developing sufficient capabilities to sustain ocean-based economies and protect our coasts and coastal communities from natural and man-made hazards requires a sustained, balanced investment in research, infrastructure, education, and training.

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Investing in Research

NAML believes America is driven by innovation — advances in ideas, products and processes that transform existing economies, create new industries and jobs, and contribute to our nation’s ecological and economic health and security. It is essential that the nation reaffirms and revitalizes the unique partnership that has existed between the Federal Government, the states, business and the nation’s research and education enterprise. Investing in the nation’s research enterprise has contributed significantly to our long-term prosperity and technological pre-eminence through research spanning a landscape of disciplines, from physics to geology, chemistry to biology, engineering to social sciences, and observing to modeling.

NAML believes that research and education programs at the major federal science agencies with ocean and coastal responsibilities should be viewed as priority investments in the future health and well being of the Nation. Much attention has been focused justifiably on the need for our Nation to continue its support of premier basic research programs. It is also important to maintain strong support for mission-oriented ocean, coastal and Great Lakes research that includes long term observing programs. Research programs that enhance agency missions and support the extramural community in competitive, merit-based research provide highly cost-effective returns on investment and distribute economic and societal benefits over a broad array of communities. Further, NAML believes that developing exchange programs between federal agencies and marine laboratories will further strengthen the communication and capacity of both for the benefit of the ocean science and management enterprise.

Investing in Research Infrastructure

NAML believes that a comprehensive range of ocean and coastal research infrastructure is essential to meet growing demands for scientific information and to ensure that we restore and maintain ecosystem health to support safe, efficient, and environmentally sustainable use of our ocean, coastal and Great Lakes resources. Most marine laboratories operate independently of one another. Greater networking with other marine laboratories, field stations, and other research centers would leverage resources to facilitate discovery and spark innovation. Networking would also allow institutions to share best practices, protocols, and platforms for data archiving and retrieval. Such networking has the potential to open new arenas of scientific inquiry, education, and outreach. It can capture social and intellectual capital to tackle major questions and seize opportunities as no single marine laboratory can, and it enhances creativity and innovation by attracting a wide range of scientists and promoting multidisciplinary collaboration. The most successful and sustainable networks start small and are self-defining; they encourage reciprocity among network members. Networking can facilitate the development and diffusion of knowledge and technology in a way that encourages innovations. It is also important to appreciate that marine laboratories vary in scope, size, infrastructure requirements, and purpose; each contributes to the global portfolio in distinct ways. Internet connectivity and cyberinfrastructure are two neglected and underdeveloped elements of infrastructure. One common element, however, in need of attention is internet connectivity and cyberinfrastructure, which would facilitate data sharing and analysis. Installation of new cyberinfrastructure requires data-management and data-sharing plans and conformity of data with widely used metadata standards. Such infrastructure also requires a long-term funding commitment for repair, upgrades, and technical support.

Investing in Science, Technology, Engineering and Mathematics (STEM) Education

NAML’s education mission is two-fold. First, it is to enhance ocean STEM education to ensure that all citizens recognize the reciprocal effects of the oceans, coasts and Great Lakes on their own lives and the impacts citizens have on these environments. Second, it is to provide formal research and training opportunities at K-12, college, and post-graduate levels to ensure a scientifically savvy, technically qualified, and ethnically diverse workforce capable of solving problems and answering questions related to the protection, restoration and management of coastal and ocean ecosystems, climate variability, and societal needs. An informed and engaged public is essential for the nation to address complex ocean- and coastal-related issues, balance the use and conservation of marine resources, and maximize future benefits from the ocean. Public understanding of human impacts on the marine environment should be balanced with recognition of the benefits to be derived from well-managed ocean resources. Ocean-related education is by its nature interdisciplinary, involving many of the natural sciences and the human connection to natural resources. It can increase overall science literacy and enhance the nation’s health, standing, safety and security. NAML laboratories seek to expand the engagement of individuals from groups that have been historically under-represented in ocean research, education and outreach. This is particularly important in fulfilling the goal of achieving a diversified STEM pipeline to meet future science and ocean workforce needs.

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National Science Foundation

Although many other federal agencies contribute to ocean science and technology, the Division of Ocean Sciences at NSF (OCE) provides the broadest base of support for the field, including funding for research in physical, biological, and chemical oceanography and marine geology and geophysics, and the development, implementation, and operational support for ocean research infrastructure. NSF funds vital basic research that enhances the public understanding of the Nation's oceans, coasts and Great Lakes. NSF also supports science, engineering and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well being. Research in this area as well as in other ocean and coastal areas is supported via a highly competitive, merit-based process through a variety of modes of support at NAML laboratories involving individual investigators, small interdisciplinary teams of researchers and students, and large collaborative efforts integrating several laboratories.

Research emphases in NSF should reflect the eight priority science questions contained in *DSOS*. These include: What are the rates, mechanisms, impacts, and geographic variability of sea level change? How are the coastal and estuarine ocean and their ecosystems influenced by the global hydrologic cycle, land use, and upwelling from the deep ocean? How have ocean biogeochemical and physical processes contributed to today's climate and its variability, and how will this system change over the next century? What is the role of biodiversity in the resilience of marine ecosystems and how will it be affected by natural and anthropogenic changes? How different will marine food webs be at mid-century? In the next 100 years? What are the processes that control the formation and evolution of ocean basins? How can risk be better characterized and the ability to forecast geohazards like mega-earthquakes, tsunamis, undersea landslides, and volcanic eruptions be improved? What is the geophysical, chemical, and biological character of the seafloor environment and how does it affect global elemental cycles and understanding of the origin and evolution of life?

NSF's support for ocean research infrastructure should be realigned with these research priorities. NAML is particularly supportive of the creation of new research networks that connect NAML laboratories and terrestrial field stations in ways that would enhance other ecosystem networks supported by NSF. NAML embraces this and other recommendations, which stem, in part, from *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*.

NAML notes the increasing share of support for facilities and infrastructure, which now approaches 50% of the total. This is up substantially from the historical 40% share. Advanced infrastructure, while expensive, is essential for the field to move forward. However, the support for infrastructure must be balanced with the need to support individual investigators – particularly young investigators – with the resources needed for high quality research activities. The *DSOS* considers marine laboratories and field stations **critical** for the research priorities related to coastal and estuarine oceans, biodiversity and marine ecosystems, and marine food webs. NAML endorses the recommendations of *DSOS*, although NAML also expects NSF to implement those recommendations with consideration to NAML's priorities in this document. NAML particularly calls out the following *DSOS* recommendations:

- In order to sustain a robust ocean science community, holistic fiscal planning is necessary to maintain a balance of investments between core research programs and infrastructure. To maintain a resolute focus on sustaining core research programs during flat or declining budgets, infrastructure expenses should not be allowed to escalate at the further expense of core research programs.
- NSF Ocean Sciences (OCE) should strive to reduce the O&M costs of its major infrastructure and restore funding to core science programs within the next five years. If budgets remain flat, OCE should adjust its major infrastructure programs (OOI, IODP, and the academic fleet) to comprise no more than 40-50% of the total annual program budget.
- OCE should implement an immediate 10% reduction in the major infrastructure costs with the smallest reduction to the academic research fleet.
- NSF should reconsider whether the current regional class research vessels (RCRV) design is aligned with scientific needs and is cost effective in terms of long-term O&M pressures, and after doing so, should act accordingly.
- OCE should initiate a high level standing committee to evaluate the entire portfolio of OCE-supported infrastructure and facilities in a comprehensive and balanced way and to recommend proposed changes that should include the entire life cycle of construction, O&M, decommissioning, and recapitalization.
- OCE should expand its partnership capabilities with other federal agencies and international partners.

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National Oceanic and Atmospheric Administration

One of NOAA's stated key overarching priorities for FY 2016 is providing information and services to make communities more resilient. America's coastal communities and shorelines are facing escalating risks from changes in storm intensity, precipitation, flooding, changing sea levels, and changes in ocean ecology that can result in dramatic economic losses. Increasing population density along the coast will further intensify pressures on ecologically and economically important areas, and put more people in the path of coastal storms. Increasing sea level can further escalate the costs and risks of inundation events. NOAA's National Climatic Data Center recorded 14 U.S. weather and climate-related disasters in 2011 with over \$1 billion each in damages, the highest number on record for a single year. A 2011 report by the New York State Energy Research and Development Authority warned that the combination of sea level rise and coastal surge that can accompany a powerful storm could flood much of New York City's major infrastructure, and estimated that the economic losses from a 100-year storm could range from \$58 billion to \$84 billion. The estimated \$65 billion in damages from Sandy, which overwhelmed the city in October 2012, falls directly within that range and the Federal government has invested almost \$10 billion in aid to individuals, and state, local and tribal governments as well as \$450 million in hazard mitigation grants. A 2005 study by the National Institute of Building Sciences on Federal hazard mitigation grants estimated that \$1 spent on hazard mitigation potentially leads to avoidance of \$4 in disaster relief costs and lost Federal tax revenue. Smartly investing in resilience will reduce the economic impacts of these hazards and improve national economic security.

Improved resiliency is not limited to the Nation's ocean coastal areas. The Great Lakes region boasts a massive geographic footprint, and is a major driver of the North American economy. With economic output of \$4.7 trillion in 2011, the region accounts for 28% of combined Canadian and U.S. economic activity. By comparison, the region's output ranks ahead of Germany, France, Brazil and the U.K., and it would rank as the fourth largest economy in the world if it were a country, behind only the U.S., China and Japan. The Great Lakes are responsible for nearly 1 million manufacturing jobs; 217,000 jobs in tourism and recreation; over 100,000 in shipping; over 110,000 in agriculture, fishing and food production and about 10,000 related to mining. Understanding the complexity of the Great Lakes is vital for the future health and well being of this region of the country.

NAML envisions invigorated coastal communities and economies, with increased resiliency and productivity. Indeed, resiliency is the basis of high productivity. Comprehensive planning will help protect coastal communities and resources from the effects of hazards and land-based pollution to vulnerable ecosystems by addressing competing uses, improving water quality and fostering integrated management for sustainable uses. Geospatial services will support communities, navigation and economic efficiency with accurate, useful characterizations, charts and maps, and assessment tools and methods. Coastal decision makers will have the capacity to adaptively manage coastal communities and ecosystems with the best natural and social science available. Resilient coastal communities and economies cannot be achieved without strong partnerships. NOAA should increase its outreach to and usage of NAML laboratories by increasing support of *existing programs* such as the National Sea Grant College Program, cooperative institutes, a strong extramural ocean acidification research effort, the National Estuarine Research Reserve System, the Integrated Ocean Observing Systems program, etc. to help it achieve the coastal resiliency goals in its strategic plan. NOAA should also join with NIH and NSF to revitalize its support for the Oceans and Human Health research program.

NAML strongly supports recommendations made by the NOAA Science Advisory Board (SAB) that calls for priority support for NOAA extramural programs. This recommendation comes on the heels of a significant decline in NOAA extramural research expenditures. For example, according to data provided by NOAA to the SAB's R&D Portfolio Review Task Force, extramural support has declined since 2005 by over \$60M. As a percent of the total NOAA Research budget, extramural support has dropped significantly since 2005. At that time extramural support represented 50.2% of the OAR portfolio. In 2011 the percentage had declined to 34%. NAML also continues to express concern with prior NOAA proposals contained in appropriation language requests that would enable NOAA to compete with non-federal and private entities for private sector support. NOAA should adhere to its public-private partnership policy, which recognizes the distinct, yet cooperative, roles of the public and private sectors as it relates to environmental information.

Extramural research enables NOAA to leverage its R&D and operational investments with the resources of the nation's leading university scientists resulting in greater and faster scientific advances at lower costs. A predictable and reliable partnership with the extramural research community is critical to NOAA's long-term success. As available resources become scarcer and major program reorganizations may be considered, NOAA should enhance its partnership with the extramural research community in creative and innovative ways. For example, NOAA should expand its efforts to co-locate agency research staff and infrastructure at non-Federal marine laboratories. Such actions will not only result in significant cost savings, but also will achieve a greater return for its investment and increase scientific collaborations and productivity. A robust NOAA budget directly coupled with solid support for extramural partnerships is essential for NOAA to serve national needs.

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National Aeronautics and Space Administration

Part of NASA's mission is to develop an understanding of the total Earth system and the effects of natural and human-induced changes on the global environment. Oceans play a major role in influencing changes in the world's climate and weather. Long-term ocean data from satellites make it possible to employ modeling techniques for global mapping of seasonal changes in ocean surface topography, currents, waves, winds, phytoplankton content, sea-ice extent, rainfall, sunlight reaching the sea, and sea surface temperature. Studying these patterns at a global scale can help forecast and mitigate the effects of floods and drought. Ocean observing satellite images tell us about the most fundamental climate changes. Satellite data have improved forecasting model capabilities to predict events such as El Niño and other global and regional climate cycles. Expanding NASA extramural support will further develop the ability to better predict ocean phenomena.

Environmental Protection Agency

EPA is an important source of support for marine laboratories, and EPA's own laboratories are a critical part of the marine science community. EPA's Office of Research and Development and Office of Water provide essential resources to marine laboratories nationwide, fund research grants in various environmental science and engineering disciplines, and engage the Nation's best scientists and engineers in targeted research complementary to EPA and other federal research activities. Unfortunately, support for research has declined dramatically over the past several years within EPA, and the EPA's Science Advisory Board has called for renewed investments. Enhanced support for extramural research programs at EPA, such as BEACHES, Science to Achieve Results and the National Estuary Program, are essential in helping to mitigate and adapt to environmental change.

Department of Interior

DOI is an important federal player with respect to the ocean and coastal community through the research and other activities supported and conducted by the Bureau of Ocean Energy Management (BOEM), the U.S. Geological Survey (USGS) via the Coastal and Marine Geology program and the National Biological Service, and the U.S. Fish and Wildlife Service (FWS). Greater partnership with NAML laboratories would provide BOEM, USGS, and FWS with improved access to marine science information to support their role in the management of ocean and coastal resources.

FWS' Landscape Conservation Cooperatives (LCCs) are applied conservation science partnerships with two main functions. The first is to provide the science and technical expertise needed to support conservation planning at landscape scales – beyond the reach or resources of any one organization. Through the efforts of in-house staff and science-oriented partners – such as NAML laboratories – LCCs generate the tools, methods and data that managers need to design and deliver conservation using the Strategic Habitat Conservation approach. The second function of LCCs is to promote collaboration among their members in defining shared conservation goals. With these goals in mind, partners can identify where and how they will take action, within their own authorities and organizational priorities, to best contribute to the larger conservation effort. LCCs assist partners to see how their activities can merge with those of other partners to achieve a bigger and more lasting impact. Many LCCs link watershed activities with coastal and Great Lakes water quality issues. NAML encourages the continued engagement of the LCCs with NAML laboratories to help achieve mutual interests.

National Institutes of Health – National Institute of Environmental Health Sciences (NIEHS)

NIEHS Centers for Oceans and Human Health fund research on marine-related health issues, such as developing techniques for more accurate and earlier detection of harmful algal blooms with the goal of preventing or reducing exposure, and studying the health effects of eating seafood that harbors toxins produced by harmful algae. NIEHS grantees examine the health effects of consuming seafood containing pollutants such as PCBs and mercury; identify indicators of recreational water contamination and illness, and explore compounds from marine organisms that hold promise as therapies for neurodegenerative disorders, cardiovascular and infectious diseases, certain cancers and other conditions. NIEHS is conducting research on the effects of the *Deepwater Horizon* oil spill on coastal communities—social and human health effects. NAML encourages NIH to reinvigorate its support for the Oceans and Human Health research program, in cooperation with NSF and NOAA.

Department of Energy

DOE's Energy Efficiency and Renewable Energy division has initiated significant efforts to understand and develop sources of renewable marine energy from tidal, wave and current sources. Environmental effects and conflicts with existing ocean uses must be evaluated as U.S. coastal energy sources are developed. The Nation's marine laboratories are uniquely distributed and serve as ideal locations for much of the research needed to rationally develop these energy sources. Opportunities to partner with DOE in these areas are strongly encouraged.

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Education, Diversity and an Ocean Literate America

The U.S. continues to be at risk with respect to student achievement in science, technology, engineering and math among industrialized nations, as well as, emerging industrializing nations. As reported in the National Science Board’s *Science and Engineering Indicators 2014* report:

- In mathematics, the percentage of U.S. students reaching the proficient level remained well below half in 2011: 40% of fourth graders and 35% of eighth graders performed at or above this level.
- In science, only 32% of eighth graders performed at or above the proficient level for their grade in 2011.

In comparison with other nations, the U.S. average score on the 2011 Trends in International Mathematics and Science Study (TIMSS) mathematics assessment was substantially lower at grade 4 than those of seven other countries/jurisdictions and those of six countries/jurisdictions at grade 8. The top performing nations each scored at least 50 points higher than the U.S. at grade 4 and at least 77 points higher than the U.S. at grade 8.

NAML continues to believe it is critically important that we improve ocean literacy and workforce development among all sectors of our nation. Marine laboratories play an important role in formal and informal education and workforce development by providing citizens of all ages a place for experiential ocean education. Marine laboratories serve as primary training grounds for students and are committed to enhancing diversity within the field of ocean, coastal and Great Lakes research and education. By fostering relationships with community colleges and minority-serving institutions, marine laboratories provide distinctive learning opportunities for underrepresented groups. Marine laboratories are key to achieving a greater understanding of ocean and coastal ecosystems and promoting stewardship of these ecosystem resources.

NAML laboratories believe the mission agencies have a role in helping to educate and train the workforce they will need in the future to carry out their missions. Therefore NAML strongly supports the continuation of STEM education programs in NOAA, NASA, NIH and other mission agencies. NAML also continues to strongly support partnerships with Federal agencies to address the ocean education needs of the Nation. These include the NSF’s Louis Stokes Alliance for Minority Participation, Centers for Ocean Science Education Excellence, Research Experiences for Undergraduates and Research on Learning in Formal and Informal Settings programs; NOAA’s Expanding Partnerships Program in the NOAA Education Office and Sea Grant’s fellowships and K-12 STEM education programs; and EPA’s Science to Achieve Results (STAR) Fellowship Program. The importance of marine laboratories in support of coastal states’ Environmental Literacy Plans is essential in developing a literate public. Investment is needed today in coastal, ocean and Great Lakes education programs at NAML laboratories that support formal and informal learning at all age levels, in all disciplines and for all Americans.

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