



MEMORANDUM FOR 45TH PRESIDENT OF THE UNITED STATES

Date: July 2016

From: The National Association of Marine Laboratories

Re: Ocean, Coastal & Great Lakes Research and Education Fuels the Nation's ~~Ocean and Coastal~~ Economy

The National Association of Marine Laboratories (NAML), first established in 1985 with nearly a dozen separate marine laboratories, has grown into a network of over 100 institutions operated by universities, non-profit organizations, and local, state, and federal governments that focus on the oceans, coasts and Great Lakes. According to the National Academy of Sciences' report *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences* (p.92), **marine laboratories are one of the most cost effective and highly relevant** components of the ocean, coastal, and Great Lakes research and education enterprise.

NAML labs are national assets formed by the unique merger of natural, intellectual, social, and infrastructural capital that leads to important scientific endeavors required to understand our rapidly changing natural world. They are repositories of long-term observations and datasets. These facilities are distributed throughout our nation's coastlines and provide diverse and unique settings for research, access to vital research infrastructure, and opportunities for education and outreach, while employing thousands of scientists, engineers, students, and educators. Scientists at NAML laboratories provide critical, actionable findings that inform policy and improve decision-making on important issues such as food safety, water quality, coastal resiliency, and natural resource management. Students and citizens that visit NAML labs engage in experiential learning that enhances science literacy and improves knowledge of our ocean and coastal environments.

The ocean, coastal and Great Lakes communities are significant drivers of the nation's economy – in coastal and inland communities. Ocean, coastal, and Great Lakes research and education, much of which is conducted within the network of NAML laboratories, is a vital part of the nation's research and education enterprise, and is a critical component of the economic and environmental health of the nation. The nation is faced with a widening gap between the actual level of federal funding for research and education and the required investment to sustain the U.S. as the world's leader in innovation.

Therefore, NAML strongly recommends:

- **The nation increase its investment in research and education to develop the knowledge, people, and technologies that power the ocean and coastal economies, create jobs, improve health, strengthen our national security, and support the U.S. as a global leader;**
- **This effort should include ocean observations, data integration, and related cyber and physical infrastructure; monitoring, research, and response to changing environmental conditions (such as sea level rise, ocean temperature increases, and ocean acidification); and**
- **Renew the commitment to improve the quality of STEM education and re-energize efforts to attract, recruit, support, and retain women, minorities and others not currently well represented in the science and technology workforce.**



The Value of the Nation's Coastal and Ocean Economy

For centuries, the sea has sustained lives and livelihoods, divulged ancient and unforeseen treasures, and stirred our dreams of remarkable new discoveries. But never in history have we had the immense opportunities now beckoning from the sea. On the horizon is a new blue economy, an exciting oceanic frontier that offers great promise for making our nation safer, healthier, and more prosperous. The new blue economy is a knowledge-based economy, looking to the sea not for extraction of material goods but for data and information to address societal challenges and inspire their solutions. This economy is entrepreneurial and environmentally responsible, collaborative and competitive.¹

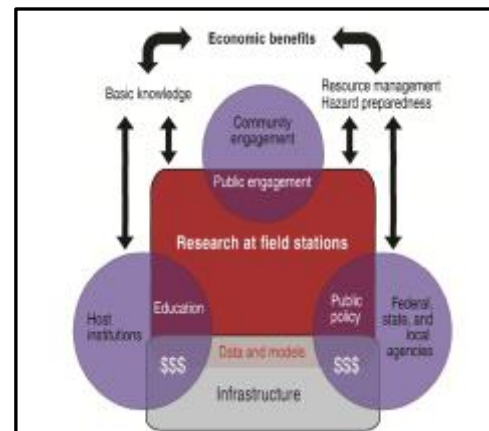
A recent report from the Center for the Blue Economy reported that the ocean economy² generated a larger share of U.S. economic activity than farming, food products, oil and gas extraction, and forest products. Employment supported by the ocean economy is almost as large as the employment of all of these industries combined. The Great Lakes alone generate nearly \$5 trillion in economic activity or about 30% of combined U.S. and Canadian economic output. Finally, the U.S. marine transportation system is an essential driver of the U.S. economy and its impact is felt well beyond the coast and reaches into the heartland of the nation. America's seaports are crucial generators of economic development and well-paying jobs, both regionally and nationally, that is felt throughout all supply chains that use the ports.

The ocean and our coasts are invaluable for humanitarian, environmental, and health reasons. The oceans are a primary source of food for over one billion people, a globally significant regulator of the earth's climate, the basic source of water for the hydrologic cycle, a cleaning agent that absorbs carbon dioxide and generates oxygen, and home to thousands of flora and fauna, many with pharmaceutical value. The ocean has been a source of new drugs to treat certain cancers. Blue-green algae, commonly found in Caribbean mangroves, are used to treat small-cell lung cancer and certain sponges produce chemical substances that can be used to treat cancer and manage pain. A wide gulf often separates science from the people who need research results to protect and support them. However, the new blue economy puts science and predictive capabilities to work in a way that can fill critical, fast-rising needs across sectors.³

The network of the Nation's marine laboratories is cost effective, highly relevant, and the vehicle that brings science to those who depend on research results to protect lives and support livelihoods.

Examples of ocean, coastal and Great Lakes research impacting coastal economies

Oysters: The Pacific Northwest is home to the largest hatchery based oyster industry in the US. Research conducted at Oregon State University found that losses of \$110 million dollars to the hatchery industries of Oregon and Washington State were due to ocean acidification, which impedes shell formation in the early stages of oyster development. Based on OSU's research findings, the hatcheries in the Pacific Northwest have adapted by "buffering" their hatchery and nursery waters, the equivalent to using "Tums" to buffer an acidic stomach. Although buffering can be done in a controlled hatchery to a limited extent, it is not practical to buffer the entire ocean. Further research is focused on finding more acid-tolerant oyster strains for providing brood stock to the hatcheries.



Source: *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*, National Academy of Sciences. 2014



Great Lakes Restoration: Muskegon Lake is part of the Great Lakes coastal wetlands ecosystem, which is a critical source of food and habitat for fish and wildlife within the Great Lakes. Approximately 65% of the shoreline had been hardened with seawalls and concrete or rock riprap. Additionally, broken concrete, foundry slag, sheet metal, slab wood, saw dust and other materials in shallow water areas posed hazards to recreation and degrade habitat. The Muskegon Lake Habitat Restoration Project was initiated, to restore hardened shoreline areas, create or restore emergent and open-water wetlands, and remove unnatural fill on the south shore of Muskegon Lake. Scientists at the Annis Water Resources Institute at Grand Valley State University used both biological and socioeconomic research to improve the design and impact measurement of the restoration activity. The economic impact of the restoration returned \$66 million to the region for the \$10 million expended.

Lobsters -- In the Gulf of Maine, since 1980 the temperatures have been rising on average at the rate of one degree Celsius every 40 years. But in the last decade the temperatures are increasing at a rate of one degree about every four years. As the temperatures rise, so do the incidences of shell disease in lobsters. Scientists at the University of Maine, describe the latter as a "nasty looking disease" with dramatic effects on the lobster's exoskeleton. It is a bacterial infection that dissolves the shell, pitting it and rendering the lobster unpalatable for sale. In its most severe forms, the disease can cause blindness, prevent the lobster from molting - when it sheds its exoskeleton - and interfere with its hormonal system. In the latter case, an egg-bearing female lobster might suddenly cast off its skeleton, taking the eggs with it. The disease is now present in some 30 per cent of the harvestable size lobster caught in southern New England. With knowledge of the temperature link to this disease, scientists are working to devise mitigation strategies to address this issue.

Maintaining a Vibrant Ocean, Coastal, and Great Lakes Research and Education Enterprise is Important for the Economic and Environmental Health of the Nation

Research conducted by people educated and trained, in part, at the nation's network of marine laboratories has uncovered the linkage between changes in ocean temperature and its impact on the lobster industry; the role science can play to maximize the return on shoreline restoration; and the impact of ocean acidification on the oyster industry. Training and research centered in the nation's network of marine laboratories should:

- develop vital, lifesaving adaptive and mitigation strategies to enhance coastal resiliency with forthcoming environmental challenges facing the Nation;
- develop a deeper fundamental understanding of earth system science so that we can more accurately predict and respond to severe weather and climate changes on local, regional, national, and global scales;
- develop techniques and technologies that will increase the competitiveness of the U.S. aquaculture industry, and contribute to sound fishery management practices, thereby enhancing food security by increasing society's access to safe, affordable, sustainable, and healthy seafood; and
- lead to the discovery of new marine biological agents that may prove valuable in the treatment of diseases and other ailments.

To develop the knowledge and technologies needed to meet these and other challenges in the ocean, coastal, and Great Lakes environment, it will take the continued education and training of people in science, technology, engineering, and mathematics (STEM). This argues for a renewed commitment to improve the quality of STEM education provided at the pre-K levels and continuing on through the undergraduate and graduate levels of education and for a meaningful and sustained effort to attract, recruit, support, and retain women, minorities, and others not currently well represented in our scientific and technical workforce.

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 local, state, regional, national and international entities.



The U.S. Research and Education Enterprise is Essential for the Long Term Health of the Nation

NAML lab directors are concerned about the long-term health of the nation's research and education enterprise and its ability to contribute to the nation's ocean and coastal economy. Increased funding for research, development, and education is critical to the economic enterprise. However, the U.S. is failing to keep pace with our competitors' investments in R&D. For example, China's research investments are rapidly growing by an average of 8% per year, in pursuit of the goal of investment equal to 3% of GDP. By contrast, U.S. investments have not been growing at an influential pace. At this rate, China will surpass the U.S. in R&D intensity in about eight years.

Re-gaining our Nation's competitive edge will require federally funded research and education to become a higher priority than has been the case in over two decades. The Nation needs an enriched workforce of trained, science savvy, entrepreneurs. Basic research is often where the breakthroughs occur that change existing theories and revolutionize technologies. During the 18 years from 1975 to 1992, the federal investment in basic research grew at an average annual inflation-adjusted rate of over 4%, despite serious challenges including the 1973 oil embargo, the Great Inflation of 1979-1982, and the final years of the Cold War. Leaders in both parties, in the White House and Congress, were able then to agree that investments in research should be a high priority for federal support.

Additionally, scientific and technological advances allow us to better understand our world. Building our knowledge allows us to respond more appropriately to new challenges, adapt to changing conditions, and take advantage of emerging opportunities for the benefit of our Nation. Strong science, technology, and engineering capabilities and informed people and communities are the foundation for improving our understanding of the marine environment—from the coasts to the deep sea—and informing our decisions about how best to manage the activities that affect the valuable and multiple resources the marine environment provides. Sustained scientific research and innovative technologies give us the high-quality information we need to maintain or restore ocean resources, guide development and investment opportunities, safeguard lives and property from marine hazards, enhance national security, prepare for and respond to the impacts of climate change and ocean acidification, improve public health, and protect ocean resources. Advancing our scientific, technological, and engineering capabilities also increases the Nation's competitiveness and helps spur the innovation that drives our economy and improves our quality of life. Ultimately, success in improving the ways we use and manage ocean resources depends on building broad public understanding and recognition of the importance of the ocean, coasts, and Great Lakes to our daily lives and the long-term welfare of our Nation.

For the United States to continue to be a global leader in understanding and acting on the connections between our well-being and the health of the natural environment, we need to continue exploring and expanding our knowledge of the ocean, our coasts, and the Great Lakes. Management and policy decisions must be based in the context sound science provides, through the integration of natural and social science data, information, and knowledge. The next Administration must support actions that will contribute to high quality science and ensure that information based on that science is made available to guide decisions and actions. Insight gained from scientific research, advances in observations, and innovative technologies will further enable evaluation of trade-offs between alternative management scenarios, enhance our ability to balance competing demands on ecosystems, and strengthen our Nation's economic and scientific competitiveness. At the same time, increasing understanding of the ocean, coasts, and Great Lakes among our people and communities will empower better-informed public stewardship of ocean resources.

NAML lab directors believe the challenges confronting this Nation and the world with respect to sea level rise and its impact on national security, domestic unrest in developing countries, expanding diseases, flooding, severe weather, and coastal community economic resiliency will all rely on the natural and social sciences, engineering, and technological developments to provide the information and people needed to deal with these challenges. Continuing changes to the ocean and coastal environment, such as ocean and coastal acidification and rising ocean temperatures, will have impacts on marine life (both plant and animal life) that we do not

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fully understand, but yet will surely complicate issues related to food security, commercial fishing, and seafood production and marketing. This country must accelerate the discovery of new scientific knowledge and the education and training of its technical workforce to meet these and many other challenges facing us in the 21st century.

Investments in research and education are essential for maintaining technological innovations and advancements that will help our society and a global population survive in rapidly changing times. NAML urges stronger investment into the research and education enterprise of the United States, to reverse the trend of the last 24 years that has left the United States trailing our international competitors. Every research dollar invested returns economic prosperity many times over. If the U.S. is to meet the environmental and economic challenges facing this country, we must make the necessary investments in our research and education enterprise. Nowhere is this need greater than for our ocean, coastal and Great Lakes communities – which serve the economy of our entire nation. Failure to act now may put us in a position from which we cannot recover.

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July 2016

ⁱ Spinrad, R. W. (2016), *The new blue economy: A vast oceanic frontier*, *Eos*, 97, doi:10.1029/2016EO053793. Published on 08 June 2016.

ⁱⁱ *State of the U.S. Ocean and Coastal Economies – 2016 Update*, Center for the Blue Economy, Middlebury Institute of International Studies at Monterey.