On behalf of the Consortium for Ocean Leadership (COL), I appreciate the opportunity to share our funding priorities for the Fiscal Year (FY) 2019 Defense Appropriations Act. COL represents the nation’s leading ocean science, technology, and education institutions, with the mission to shape the future of ocean science. Ocean science strengthens our national security, supports a safe and efficient marine transportation system, underpins our economy, and furthers understanding of complex ocean and coastal processes important to our everyday lives – today and tomorrow.

Aligning with like-minded security science organizations and coalitions\(^1\), we respectfully request the subcommittee provide the Department of Defense (DOD) no less than $2.4 billion for the Defense basic research program elements, $14.5 billion for the Defense Science & Technology program, and to support the administration’s request for the Defense Advanced Research Projects Agency (DARPA). To ensure our nation can maintain maritime superiority in an increasingly unstable world, COL respectfully requests the subcommittee oppose the cuts in funding proposed in the president’s FY 2019 budget request and provide the Navy with no less than the science and technology funding levels appropriated in the FY 2018 omnibus spending bill, which were $622 million for basic research (6.1), $994 million for applied research (6.2), and $817 million for advanced technology development (6.3).

DOD leaders have testified that competitor nation states are meeting and beating the U.S. in innovative and strategic capabilities;\(^2\) DOD has conceded to the attrition of our competitive military advantage in air, land, sea, space, and cyberspace;\(^3\) and the Navy acknowledges the U.S. competitive advantage in ocean sciences and understanding and exploiting the ocean environment has eroded.\(^4\) Action must be taken – not only to address today’s threats but also to preserve our ability to efficiently and effectively respond to tomorrow’s threats. DOD’s science and technology program does just this, balancing basic research to respond to future threats through emerging science and technologies with applied research to enable successful transition of scientific and technological capabilities to maintain our warfighting advantage over potential adversaries. To maintain our nation’s national security, we also must prioritize science and technology investments in concert with our national security and national defense strategies.

It is paramount that the U.S. Navy maintains its strategic advantage in the undersea domain against strategic competitors (e.g., China, Russia) and rogue regimes (e.g., Iran, North Korea) who threaten our maritime security and superiority. Ensuring robust and sustained funding for Navy science and technology programs and partnerships (which represent a small fraction of the overall Navy budget) is key to ensuring the culture of innovation and initiative that DOD has prioritized (internally as well as with its non-federal research partners) is mirrored through the Navy. Federal investment is required to meet the endstate goals of the U.S. Navy’s Task Force Ocean:

\(^{1}\) https://www.amacad.org/pdfs/InnovationAmericanImperativeCalltoAction.pdf
Navy-relevant ocean science infrastructure in the U.S. remains measurably ahead of our competitors

The U.S. Navy’s capability and capacity to understand and exploit the ocean environment remain measurably ahead of our competitors

The U.S. Navy’s capability and capacity to exploit the full range of science and technology development in the U.S. advance through increased permeability between the Navy and government, academia, and the private sector

To achieve enhanced performance in the undersea battlespace, testing and demonstration of science and technology concepts is required, including studies and new approaches to real-time characterizations conducted by integrated programs that may include seagoing oceanography, acoustics, signal processing, unmanned systems, and data analytics. The president’s FY 2019 budget request for Navy’s basic research funding is $25 million below the FY 2018 omnibus level, with the Navy’s University Research Initiative falling 17 percent. Navy’s applied research funding sees a $103 million hit in the request, with significant decreases to Power Projection Applied Research (-38 percent), Ocean Warfighting Environment Applied Research (-43 percent), and Undersea Warfare Applied Research (-5 percent). Technology development fares no better with its $66 million difference between the request and the FY 2018 omnibus. Reductions such as these could mean critical research projects do not receive funding, effectively limiting the Navy’s ability to “exploit the full range of science and technology development” occurring through partnerships with academia. Additional to losses in critical research areas like observations and modelling; unmanned vehicles; power generation; propulsion hydromechanics; bioinspired autonomous and surveillance systems; environmental quality; and casualty care, management, and prevention, the Navy may be forced to reduce its science, technology, engineering, and math (STEM) activities. Whether decreasing support for the Young Investigator Program or sponsoring fewer graduate fellowships at historically black colleges and universities (HBCU) and Hispanic serving institutions (HSI), this is a major loss to the human capital and tactical workforce development identified as a key issue by Navy’s Task Force Ocean.

Ocean Science – Vital to the Nation’s Security

Ocean science and technology have provided our nation with a knowledge advantage against myriad maritime threats. Basic ocean research forms the critical foundation to ensure continuity of our ocean knowledge advantage, which in turn generates warfare advantage and deters aggression. However, as noted, the Navy’s competitive advantage over key military competitors in understanding and exploiting the ocean environment has diminished and can only be re-established through investments in science and technology research across all ocean agencies. Asian and European ocean education and research enterprises have, in many cases, matched or exceeded those in our nation. Admiral James Watkins, former Chief of Naval Operations, often remarked that oceanography was a key determinant in the U.S. Cold War “victory,” due to the knowledge advantage provided to our forward deployed maritime forces, especially our submarines. We are firmly convinced that ocean science and technology today can and must provide us with the same knowledge advantage against the maritime threats we face today and tomorrow.

The academic research community has enjoyed a long and productive partnership with the U.S. Navy in helping to ensure maritime military readiness, domain awareness, and warfighting advantage. This success has its foundation in sustained investment in science and technology programs implemented through the 6.1, 6.2, and 6.3 programs. Investments in science and technology now are crucial to ensuring future capabilities, which take time and sustained funding to nurture through the research and development process and to integrate into the operational
battlespace. A good example of this is the continued acceleration of autonomous undersea vehicles (AUV) and other ground-breaking undersea technology by the Navy and DOD. The impact of the ocean environment on these systems is even more pronounced than it was for the manned and tethered systems of the past. Acoustic advantage; endurance and energy consumption; autonomy; and effective command, control, and communications for AUVs (to include artificial intelligence capabilities) are heavily influenced by ocean conditions. These must be measured, modeled, and accurately predicted to ensure undersea warfare advantage is maintained against a global undersea threat that is ever-growing in complexity and proliferation.

Given the critical importance of ocean knowledge in both the warfighting arena and in threat awareness, the ocean science community greatly appreciates the subcommittee’s backing of the Navy’s science and technology enterprise, including collaborations and partnerships. COL strongly supports inclusion of adequate funds in the 6.2 account to implement Task Force Ocean at-sea research priorities (Ocean Warfighting Environment Applied Research). Primary goals include increasing connection between ocean enterprise and Navy’s challenges; improving transition of research into operation for warfighter efficiency; capitalizing existing science and technology strengths and supporting new technology development; and training tomorrow’s workforce with the proper skillset to meet future needs. Naval forces also require precise knowledge of how the environment will impact operations to gain tactical advantage against adversaries who are intimately familiar with their home environments. The request for increased funds will allow the Navy to contract with University-National Oceanographic Laboratory System (UNOLS) ships for needed research sea time and seagoing technical capabilities to progress at-sea research.

Ocean research and marine technology development provide the critical foundation to ensure continuity of our undersea knowledge superiority that generates warfare advantage. Simply put, our undersea forces must be able to win every “away game,” and we therefore must be able to exploit the ocean environment to ensure “home field advantage” at those “away games.”

Navigating Threats from Changing Ocean Conditions – Critical Sensing and Observing

Monitoring, understanding, and predicting ocean changes enables us to plan strategically for impacts to global and regional stability and to plan effectively to counter threats that are catalyzed by decaying stability. Stability, comprised of food, water, energy, and economic security, must be understood, predicted, and mitigated through increased ocean knowledge. The Navy and DOD have a distinguished history of fostering the science and technology that have been responsible for U.S. military success and superiority under, on, and above the sea. There is growing concern that this superiority is being challenged by a significant increase in investment by our rivals, while funding support for science and technology within DOD and the Navy has languished. This is particularly apparent in the proposed reduction in the Navy 6.2 and 6.3 funding included in the president’s FY 2019 budget request, which would result in an approximately 10-20 percent decrease in research and technology development resources.

With the ocean providing 20 percent of the animal protein in the human diet and 24 percent of global land degrading (25 percent rangeland, 20 percent cropland), it is understandable that illegal, unreported, and unregulated (IUU) fishing and desertification are not only food security issues but ultimately ones of national security. Changes in ocean conditions directly associated with access in the Arctic lead to expanded navigation and commerce in the region (e.g., shipping,

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http://www.education.noaa.gov/Ocean_and_Coasts/
fishing, oil and gas exploration, bioprospecting, mining) and could result in disputes amongst nations or accidents requiring search and rescue or other response.

Whether considering ocean conditions to better understand drought forecasts or to model changes in fish distributions, data and information from the sea strengthen the Navy’s awareness of conflict catalysts. However, these data and information must be gathered. Ocean observation platforms and sensor technology advancement allow for real-time characterization of ocean conditions as well as necessary data to assess trends. The basic and applied research lines, robust partnerships and collaborations with ocean science and technology institutions, and in-house surveying capabilities all support the increase of ocean knowledge for our nation’s security advantage.

**Long-term Commitment to People, Platforms, and Partnerships – Human Capital and Tactical Workforce**

It is hard to overemphasize the significant advantages that have resulted from Navy support for basic research, including highly trained people, cutting-edge technology, and innovative ideas. The advantage and benefits that have accrued to DOD and the Navy cannot be attributed solely to the amount of investment – equally important is the Office of Naval Research’s culture that understood the importance of providing sustained support for technology development and the cultivation of researchers (internally and among its academic partners), including early career and established scientists. The cultivation of people and technology in support of national security priorities is well beyond the mission and role of other federal agencies supporting ocean science, such as the National Science Foundation and the National Oceanic and Atmospheric Administration. For example, the U.S. Navy’s competitive advantage in undersea warfare research relies on the ability to execute unique data collection systems and sea-going expertise. The backbone for these programs is comprised of partnering scientists, expert engineers, and technicians with decades of experience in executing research at sea.

It is also important to recognize the critical role science and technology funding plays in the development of new technology (e.g., sensors, platforms, models, data analytics) that are essential to helping the Navy meet its mission requirements. Much of the oceanographic equipment in use today, for defense and non-defense research, observations, and modeling, has resulted from Navy investment in its development, as well as its integration to defense and non-defense at-sea platforms and in research labs through the Defense University Research Instrumentation Program. Unfortunately, the level of investment in technology development has seriously declined in recent years, with greater focus being placed on the transition of applied technology into operations. The negative impacts of this shift in emphasis and support has been realized as the flow of new technologies and their application to Navy mission requirements slows, just as the increased investments by rivals begin to bear fruit. Task Force Ocean specifically targets ocean-related technology development through and with the Navy, academia, and the private sector.

Additional to the technology shortfalls, there is a human capital issue. Forty-seven percent of American geoscientists in the private sector and 43 percent in the federal government are over the age of 55, making them likely to retire in the next 10 years. The Workforce Research team at the American Geosciences Institute calculated that there will be a shortfall of 135,000 geoscientists in the U.S. workforce over the next decade. Specifically Navy-focused, the Navy oceanography enterprise has lost more than half of its physicists and geophysicists and 12 percent

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7 Distribution of Geoscientists, Fedscope, March 2015, [https://www.fedscope.opm.gov/ibmcognos/cgi-bin/cognosisapi.dll](https://www.fedscope.opm.gov/ibmcognos/cgi-bin/cognosisapi.dll)
of its physical scientists and oceanographers in the last decade alone. In the last 20 years, the Naval Research Laboratory has lost approximately 50 percent of its acousticians and 13 percent of its oceanographers. We can ill afford to have a shortage of these workers, both military and civilian, who are vital to the national security community.

**Conclusion**

Ocean science and geosciences *writ large* impact every American every day. Across the nation, across science disciplines, and across the federal family, it is clear that robust and sustained federal investments in ocean and geosciences are key to addressing global and national challenges; underpinning new and growing economies while maintaining and supporting existing ones; and improving technologies that preserve lives, livelihoods, persons, and property. As the subcommittee drafts the FY 2019 spending bill, we hope you reflect on the Navy’s concern with the erosion of competitive advantage in the ocean science and technology arena and the fact that the bulk of the intellectual capacity regarding the ocean resides within the academic research community. Peer-reviewed extramural research is the most efficient and effective vehicle for providing our policymakers and our commercial partners with the expertise, information, and data necessary to address the emerging challenges facing our nation.

To maintain global stability, it is critically important the nation understand the factors of conflict catalysts. To successfully navigate a changing physical, chemical, and biological ocean while maintaining geopolitical establishments, the Navy must regain their competitive advantage in knowing the ocean and coastal baseline conditions, changing conditions, forecasted conditions, vulnerabilities of undersea and coastal infrastructure, and the threatened human population. The changing climate and ocean systems are altering when and where our military may be called to duty but also *how* the military can respond. Rising sea levels affect amphibious landing opportunities and extreme weather could impact deployment, intelligence, surveillance, and reconnaissance capabilities. It is through the robust federal support of the Navy’s basic and applied research, maintaining superiority in technology development and integration, and through collaborative partnerships with ocean science and technology institutions that this will happen.

Madam Chairman, Ranking Member, and members of the subcommittee, the ocean science and technology community appreciates the support the subcommittee provided for oceanographic research and technology advancement, and we hope you will continue to prioritize science investments to ensure the U.S. can maintain its superiority at sea. The ocean research community is well positioned to assist the Navy in meeting national security challenges in the maritime battlespace. We greatly appreciate your consideration of our recommendations and look forward to working with you to support science and technology innovation that underpins our military’s superiority and our nation’s security.

Below is a list of institutions that are represented by the Consortium for Ocean Leadership:
Alabama
Dauphin Island Sea Lab

Alaska
Alaska Ocean Observing System
Alaska SeaLife Center
Arctic Research Consortium of the United States (ARCUS)
North Pacific Research Board
University of Alaska Fairbanks

California
Aquarium of the Pacific
Bodega Marine Laboratory
Esi
Estuary & Ocean Science Center, San Francisco State University
Gordon and Betty Moore Foundation
L-3 Communications MariPro, Inc.
Liquid Robotics, Inc.
Monterey Bay Aquarium Research Institute
Moss Landing Marine Laboratories
Stanford University
Teledyne RD Instruments
U.S. Naval Postgraduate School
University of California, San Diego Scripps Institution of Oceanography
University of California, Santa Barbara
University of California, Santa Cruz
University of Southern California

Colorado
Cooperative Institute for Research in Environmental Sciences (CIRES)

Connecticut
Mystic Aquarium & Institute for Research

Delaware
Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS)
University of Delaware

Florida
Earth2Ocean
Florida Institute of Oceanography
Harbor Branch Oceanographic Institute of Florida Atlantic University
Mote Marine Laboratory
Nova Southeastern University
University of Florida
University of Miami
University of South Florida

Georgia
Savannah State University
Skidaway Institute of Oceanography of the University of Georgia

Hawaii
University of Hawaii

Illinois
John G. Shedd Aquarium

Louisiana
ASV Global, LLC
Louisiana State University
Louisiana Universities Marine Consortium

Maine
Bigelow Laboratory for Ocean Sciences
The IOOS Association
University of Maine

Maryland
Johns Hopkins University Applied Physics Lab
National Aquarium
Severn Marine Technologies, LLC
University of Maryland Center for Environmental Science

Massachusetts
Massachusetts Institute of Technology
University of Massachusetts, Dartmouth
Woods Hole Oceanographic Institution

Mississippi
University of Mississippi
University of Southern Mississippi

New Hampshire
University of New Hampshire

New Jersey
Monmouth University Urban Coast Institute
Rutgers University

New York
Columbia University Lamont-Doherty Earth Observatory
IEEE Oceanic Engineering Society
Stony Brook University

North Carolina
Duke University
East Carolina University
North Carolina State University
University of North Carolina, Chapel Hill
University of North Carolina, Wilmington

Oregon
Oregon State University

Pennsylvania
Pennsylvania State University

Rhode Island
University of Rhode Island

South Carolina
South Carolina Sea Grant Consortium
University of South Carolina

Tennessee
Eastman Chemical Company

Texas
Harte Research Institute for Gulf of Mexico Studies
Shell Exploration & Production Company
Sonardyne, Inc.
Texas A&M University
University of Texas at Austin

Virginia
College of William & Mary Virginia Institute of Marine Science
Institute for Global Environmental Strategies (IGES)
Old Dominion University
Teledyne CARIS
U.S. Arctic Research Commission

Washington
Sea-Bird Scientific
University of Washington
Vulcan, Incorporated

Washington, D.C.
National Ocean Industries Association (NOIA)
Southeastern Universities Research Association (SURA)
Marine Technology Society (MTS)

Wisconsin
University of Wisconsin, Milwaukee School of Freshwater Sciences

Australia
Institute for Marine and Antarctic Studies (IMAS)

Bermuda
Bermuda Institute of Ocean Sciences

Canada
Dalhousie University
University of Victoria Ocean Networks Canada