U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON ENVIRONMENT
HEARING CHARTER

Defining a National 'Oceanshot': Accelerating Ocean and Great Lakes Science and Technology

Monday, June 7, 2021
11:00 am ET
Zoom

PURPOSE

The purpose of this hearing is to discuss the importance of ocean, coastal, and Great Lakes research in the U.S., the science that needs to be done most urgently, and how we can point Federal investments in that direction. This hearing will be an opportunity to hear from experts on innovative ideas for advancing ocean, coastal, and Great Lakes science and technology (S&T) and defining a national "oceanshot" as part of the U.S.'s participation and leadership in the UN Decade of Ocean Science for Sustainable Development (2021-2030). The hearing will also discuss the importance of building a more diverse, equitable, and inclusive ocean, coastal, and Great Lakes science enterprise to underpin more creative and collaborative solutions. This hearing is timed to celebrate World Ocean Month in June and World Ocean Day on June 8.

WITNESSES

- **Mr. Craig McLean**, Assistant Administrator for Oceanic and Atmospheric Research and Acting Chief Scientist, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
- **Dr. Margaret Leinen**, Vice Chancellor, Marine Sciences, Director, Scripps Institution of Oceanography
- **Dr. Michael P. Crosby**, President & CEO, Mote Marine Laboratory
- **Dr. Robert D. Ballard**, President, Ocean Exploration Trust, Explorer-at-Large, National Geographic Society

KEY QUESTIONS

- What are the major gaps in our understanding of ocean, coastal, and Great Lakes science, what data are needed most urgently, and how can we address these gaps?
- What is our national vision, or "oceanshot," for advancing ocean, coastal, and Great Lakes S&T in the next decade?
- What are the potential applications of ocean, coastal, and Great Lakes S&T to help transform American society and the economy and contribute to resilience?
- Which stakeholders and underrepresented groups need to be engaged, and how do we engage them, in advancing ocean, coastal, and Great Lakes S&T?
- How can we strengthen dialogues between different communities working across the ocean science-policy interface, to foster interdisciplinary research, connect research to applications and decision-making, and involve innovators in the development of applied ocean technology?
- How can partnerships be leveraged to advance ocean, coastal, and Great Lakes S&T?

- What are strategies for addressing diversity gaps in ocean, coastal, and Great Lakes S&T and creating a more diverse, equitable, and inclusive enterprise?
- How can the Science Committee support ocean, coastal, and Great Lakes S&T progress in the short-term and over the next decade?

BACKGROUND

The oceans are ecologically and economically significant to United States, supplying an important source of food and protein to Americans, providing recreation and cultural value, producing over 50 percent of the oxygen we breathe, and regulating the weather and climate system. In addition, the ocean is important for our national security. A June 2020 estimate by NOAA and the U.S. Economic Bureau estimated the goods and services provided by our oceans, coasts, and Great Lakes, called the "Blue Economy," contribute $373 billion per year to U.S. Gross Domestic Product. The Blue Economy is growing faster than the nation's economy as a whole,[1] and supports millions of jobs.

However, ocean, coastal, and Great Lakes health is declining due to climate change, multiple stressors, and growing coastal populations. Ocean warming, overfishing, ocean acidification, deoxygenation, biodiversity loss, plastic and other pollution, nutrient runoff, and destructive tourism are among the growing anthropogenic threats facing our oceans today. The Subcommittee held a hearing on February 27, 2019 called "Sea Change: Impacts of Climate Change on Our Oceans and Coasts" that discusses changes occurring in the oceans due to climate change and ocean acidification and resulting impacts to human society.[2]

While the oceans are critical to sustaining life on Earth and our success as an "ocean nation," the U.S. spends relatively little of our GDP on ocean science.[3] In 2011, 0.34% of the total Federal budget was allocated to ocean and coastal support.[4] At the U.S.'s premier federal ocean science agency, NOAA, ocean, coastal, and Great Lakes research was funded at $231.5 million in Fiscal Year 2021, out of total nondefense R&D spending of $84.69 billion.[5] The 2020 Global Ocean Science Report found that ocean science accounts for only 1.7 percent of total R&D expenditures worldwide, on average.[6] Ocean science is critical for understanding and predicting weather and climate, and can support businesses such as the shipping industry, tourism, fisheries, and aquaculture, as well as conservation and management activities. Ocean science also helps support the resilience of coastal communities by predicting coastal hazards like storm surge, sea level rise, and tsunamis.

Recognizing the importance of the oceans to the U.S., President Biden signed a Proclamation on National Ocean Month on June 1, 2021, highlighting the value of the oceans to the U.S. and calling upon Americans to protect, conserve, and restore our oceans and coasts.[7] A healthy ocean will help us mitigate and adapt to climate change, feed the world's population through sustainable fisheries, and create new jobs.

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[1] https://www.noaa.gov/media-release/marine-economy-in-2018-grew-faster-than-us-overall

[2] https://science.house.gov/hearings/sea-change-impacts-of-climate-change-on-our-oceans-and-coasts

[3] Ocean science is a broad field that includes multiple disciplines, and falls into at least one of five categories: biological, physical, geological/geophysical, chemical, and socioeconomic.

[4] https://www.oceaneconomics.org/FedExpend/

[5] https://www.aaas.org/news/rd-fy-2021-omnibus-review-and-estimates

[6] https://unesdoc.unesco.org/ark:/48223/pf0000375147

[7] https://www.whitehouse.gov/briefing-room/presidential-actions/2021/06/01/a-proclamation-on-national-ocean-month-2021/?fbclid=IwAR1JgIpNR6PtUDGJ53uVCokkSUzHCyEDoimt0S7-E_3VMta4j07Er5n9OcQ

The "Ocean Decade"

2021 marks the inaugural year of the UN Decade of Ocean Science for Sustainable Development (2021-2030, also called the "Ocean Decade"). According to the Intergovernmental Oceanographic Commission, the Ocean Decade will focus on initiatives across the globe to drive the science needed to ensure sustainable use of ocean resources and long-term ocean health.[8]

This next decade provides an opportunity for the U.S. to clarify, define, prioritize, and accelerate ocean, coastal, and Great Lakes S&T goals to strengthen our Blue Economy and improve the health and resilience of our ocean, coasts, and Great Lakes. In order for the U.S. to advance our domestic ocean S&T and be a world leader this decade, it will require extensive public-private partnerships, coordination and collaboration across the scientific enterprise, and participation from diverse stakeholders and underrepresented groups.

The National Academies of Sciences, Engineering, and Medicine established the U.S. National Committee for the Ocean Decade (National Committee), which will serve as the communications hub and engage and encourage participation of the U.S. ocean science community in the Ocean Decade. The National Committee held a 2-day virtual meeting on February 3-4, 2021 to launch U.S. efforts for the Ocean Decade.[9] The National Committee solicited proposals for an "oceanshot" from the scientific community, or "bold and transformative" concepts that draw from multiple disciplines and fundamentally advance ocean science for sustainable development.

The Ocean Data Revolution

Ocean data is becoming more abundant and more complex as new, inexpensive, and autonomous ocean sensors and instruments become widely adopted. Some of these newer ocean technologies were discussed in the Subcommittee's hearing on "Ocean Exploration: Diving to New Depths and Discoveries" from June 5, 2019.[10] A recent study found that these systems are already "transmitting as much data in one year as has been acquired in the past century."[11] A comprehensive May 2021 report by Ocean Conservancy and the Center for Open Data Enterprise[12] on ocean data discusses the challenges and opportunities facing our current "ocean data revolution."[13] The report describes inadequate federal funding, growing issues around data access and usability, and rising concerns around privacy.

The U.S.'s current network architecture and data management capabilities are insufficient to accommodate the increase in real-time data. For example, at NOAA's largest environmental data archives, the National Centers for Environmental Information, data storage demands are expected to grow exponentially from approximately 40 petabytes[14] in 2020 to 250 petabytes by 2030.

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[8] https://www.oceandecade.org/

[9] Upcoming announcements and events related to the U.S.'s involvement in the Decade can be found here: https://www.nationalacademies.org/our-work/us-national-committee-on-ocean-science-for-sustainable-development-2021-2030#:~:text=From%202021%2D2030%2C%20the%20UN,and%20long%2Dterm%20ocean%20health.

[10] https://science.house.gov/hearings/ocean-exploration-diving-to-new-depths-and-discoveries

[11] https://www.frontiersin.org/articles/10.3389/fmars.2019.00440/full

[12] The report was informed in part by a roundtable hosted by NOAA, Amazon, Microsoft, Esri, Ocean Conservancy, and CODE

[13] Trice, A., Robbins C., Philip, N. and Rumsey, M. Challenges and Opportunities for Ocean Data to Advance Conservation and Management, Ocean Conservancy, Washington D.C., 2021.

[14] One petabyte is equal to 1 million gigabytes.

The report recommends sustained federal investment and engagement with stakeholders and communities to transform ocean data into decisions for conservation, Blue Economy, and climate solutions. It also recommends actions to increase data transparency through the adoption of FAIR (findable, accessible, interoperable, reusable) data principles to ensure data access is open, freely available, discoverable, and comparable.

Research Gaps and Foundational Challenges

There is much more to understand and discover about the oceans. Because the oceans are so vast, they are also historically difficult to access and expensive to study, leading to gaps in our understanding. In fact, we know more about the surface of the moon and Mars than the ocean floor. According to NOAA, more than 80 percent of the ocean remains unmapped, unobserved, and unexplored, including in the U.S. The U.S. has the largest ocean property, or Exclusive Economic Zone (EEZ), in the world, covering 11,351,000 square kilometers,[15] and is larger than the U.S.'s land mass. Given that more of the nation is below water than above water, it is important to understand and characterize what is in the U.S. EEZ in order to better manage and conserve our natural resources. Ocean exploration and research can help us gain new insights into marine ecosystems, biodiversity, and ways the ocean can sequester and store carbon.

To advance ocean exploration, the National Ocean Mapping, Exploration, and Characterization (NOMEC) Council was established in the White House in June 2020 to coordinate Federal agencies and support partnerships to advance ocean mapping, exploration, and characterization. The NOMEC Council published a National Strategy and Implementation Plan, outlining federal priorities and actions.[16]

In addition to exploration, ocean observing and monitoring systems are essential to understanding hazards, ecosystems, and processes including climate change. More observations will improve modeling and predictive capabilities to help communities adapt to future conditions. The engagement of Blue Economy industries such as offshore energy and shipping, coastal communities, and local experts would increase the use and support for observing systems. Furthermore, other ocean observing challenges include meeting power requirements for data collection and transmission as well as overcoming institutional silos.[17]

In addition to remaining research gaps, the National Committee identified major foundational challenges to the ocean science community: ocean literacy; connecting science to applications through engaging stakeholders in identifying scientific needs and translating scientific findings into actionable information; partnerships across sectors, disciplines, and nations, to include international organizations and industries; data management, including the integration and standardization of data that can be widely shared and utilized; the need to increase the diversity of the ocean science community to better represent and speak to the communities who require this scientific information; and the overarching need for greater and more effective communications across cultures, disciplines (in particular social sciences and behavioral sciences), sectors, and organizations.[18]

[15] NOAA Ocean Exploration Review Panel's report, "Ocean Exploration's Second Decade." 2012. https://oceanexplorer.noaa.gov/about/what-we-do/program-review/2012-oe-review-report.pdf
[16] https://iocm.noaa.gov/about/documents/strategic-plans/210107-FINALNOMECImplementationPlan-Clean.pdf
[17] Identified by participants in the Ocean Decade U.S. Launch Meeting, Feb 3-4 2021.
[18] "Ocean Decade: U.S. Launch Meeting Synopsis"

Diversity, Equity, and Inclusion in Ocean Science

Ocean sciences, and geosciences overall (including Earth and atmospheric sciences), are the least diverse of all STEM fields. While the past several decades have seen significant progress in gender balance among PhD recipients, ethnic and racial diversity at the doctoral level in these fields is lagging. In 2016, only six percent of graduates in the geosciences, including ocean science, were from underrepresented groups,[19] and among them, Black students made up less than two percent of graduates.[20] Ocean science has seen stagnation in the percentage of underrepresented minority degree attainment where other STEM fields have seen modest gains.

Diversity within the federal ocean science workforce is lacking as well. According to a March 2021 House Science Committee Majority Staff report on the federal scientific workforce, less than four percent of NOAA scientists are Black, and only 1.3 percent are Black women.[21] Studies suggest that increasing diversity in STEM fields, including ocean sciences, will help strengthen scientific collaborations.[22] Initiatives on many scales and aimed at various educational levels, especially grade school and undergraduate, are needed to understand and make ocean sciences more attractive and accessible to underrepresented groups.

Early career ocean professionals are actively engaged in the Ocean Decade process and officially recognized by the UN as an informal working group. This working group is engaged to ensure transformative change in ocean science and solutions by encouraging inclusive approaches for innovative and effective ocean solutions and working to improve community understanding and connection to the ocean.[23]

Partnerships for the Future

Partnerships between different sectors and stakeholders are increasingly becoming a tool to support ocean science and technology. The primary federal interagency mechanism for supporting ocean S&T has been the National Oceanographic Partnership Program (NOPP, P.L. 104-201, 10 USC 7901-7903),[24] which was reauthorized in the FY21 NDAA. Since 1997, NOPP has leveraged resources across agencies, academia, and industry to "invest in priorities that fall between agency missions or that are too large for any single agency to support." NOPP has funded projects across broad oceanographic topics, including environmental monitoring, ocean exploration, technology development, marine resource management, and led to the creation of the Integrated Ocean Observing System.

Public-private partnerships are also an important tool to help support ocean technology development, exploration activities, and data sharing. For example, NOAA and the offshore wind development company Orsted Wind Power North America LLC recently signed a first of its kind memorandum of agreement to make some of Orsted's ocean mapping and observing data available to the public.[25] This paves the way for future data sharing agreements with Blue Economy industries to increase the transparency and usability of ocean data to the public.

[19] https://www.nature.com/articles/s41561-018-0116-6
[20] https://tos.org/oceanography/article/strategies-for-increasing-diversity-in-the-ocean-science-workforce-through
[21] https://science.house.gov/staff-reports/scientific-brain-drain-quantifying-the-decline-of-the-federal-scientific-workforce
[22] Ibid.
[23] https://theconversation.com/a-new-generation-of-ocean-leaders-158321
[24] https://www.nopp.org/
[25] https://www.noaa.gov/media-release/noaa-signs-data-share-agreement-with-offshore-wind-energy-company