FY23 NOAA Ocean Exploration Competitive Grant Program Fiscal Report

Authors: Adrienne Copeland, Mashkoor Malik, Logan Kline, Nina Pruzinsky, and Patrick Cooper

September 2024

Introduction

NOAA Ocean Exploration is dedicated to exploring the unknown ocean, unlocking its potential through scientific discovery, technological advancements, and data delivery. By working closely with partners across public, private, and academic sectors, we are filling gaps in our basic understanding of the marine environment. This allows us, collectively, to protect ocean health, sustainably manage our marine resources, accelerate our national economy, better understand our changing environment, and enhance appreciation of the importance of the ocean in our everyday lives.

With priority placed on exploration of deep waters and the waters of the U.S. Exclusive Economic Zone, NOAA Ocean Exploration applies the latest tools and technologies to explore previously unknown areas of the ocean, making discoveries of scientific, economic, and cultural value. These mechanisms range from NOAA Ship *Okeanos Explorer*, competitive grants, investments in cooperative institutes, and collaboration with various federal, state, academic, philanthropic, and private-sector entities.

Through the annual ocean exploration competitive funding opportunity (program authority 33 USC 3403(a)), NOAA Ocean Exploration solicits and funds projects that advance ocean exploration, technology, and maritime heritage. These funding opportunities have supported more than 282 lab-based and/or expedition-based projects since the grant program's inception in 2001. Throughout its history, NOAA Ocean Exploration's competitive grant program has supported over 668 entities and 226 principal investigators (PIs).

This report highlights NOAA Ocean Exploration's Fiscal Year 2023 (FY23) funding opportunity and provides select summary data for prior funding years (FY19-23) to demonstrate trends.

FY23 Year in Review

Overview and Summary Metrics

For the FY23 funding opportunity, NOAA Ocean Exploration priorities included interdisciplinary baseline characterizations of unknown or poorly known deep-ocean areas, processes, and resources; technological innovation or novel application to advance deep-ocean exploration objectives; and discovery and initial characterization of maritime heritage. Further information can be found in funding opportunity number NOAA-OAR-OER-2023-2007237.

In FY23, NOAA Ocean Exploration:

- Received 62 pre-proposals ($34,408,634), encouraged 25 full proposals ($15,134,975), received 25 full proposals ($15,083,919), and recommended 9 proposals for funding ($4,838,601), each between $121,607 and $750,000, totaling $4,838,601 (see **Figure 1**). The number of pre-proposals received showed an increasing trend in both number of submissions and requested funds from FY19 to FY21 with a drop in numbers in FY22. However, another increasing trend occurred from FY22 to FY23 (see **Figure 2**).
- Funded 4 general ocean exploration proposals, 4 technology proposals, and 1 maritime heritage proposal.
- Funded 30 ship/submersible days at sea.
- Funded 9 principal investigators from:
    - Academia (4)
    - Federal government, NOAA (1)
    - Federal government, other than NOAA (1)
    - Nongovernmental organization (2)
    - Private sector (1)
- Directly supported 3 graduate students and 1 undergraduate student.
- Funded 20 entities across 7 U.S. states.
- Leveraged about $2.4 million in external support secured by funded PIs as shared costs, in-kind contributions, etc.
- Supported 39 individuals for a cumulative total of 76.2 personnel months.
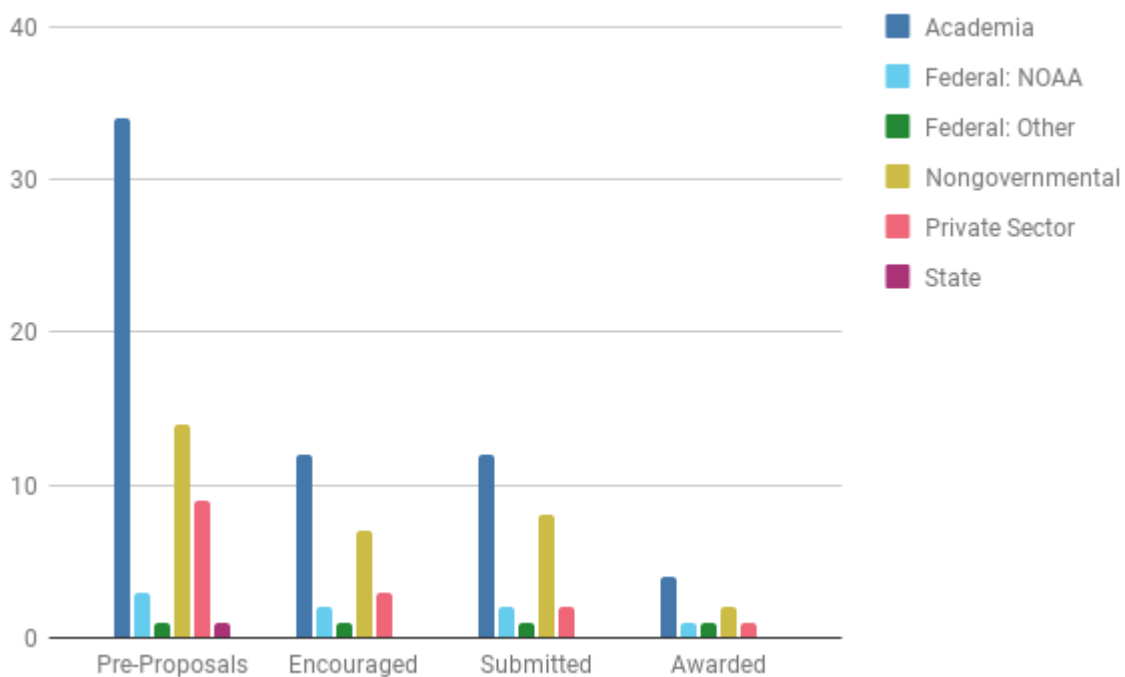
Figure 1. Distribution of FY23 NOAA Ocean Exploration funding opportunity pre-proposals received, pre-proposals encouraged to submit as full proposals, full proposals received, and proposals awarded funding across different sectors of ocean exploration, including academic, federal (NOAA and other), nongovernmental (e.g., philanthropic), private sector, and state entities.
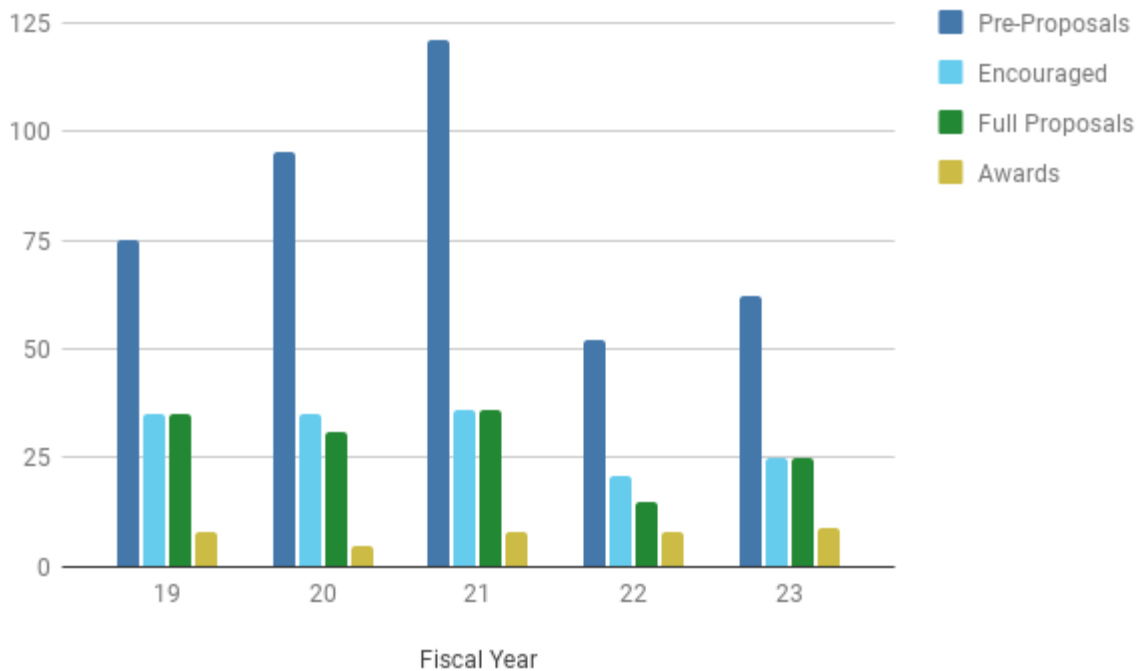
Figure 2. Distribution of NOAA Ocean Exploration funding opportunity pre-proposals received, pre-proposals encouraged to submit as full proposals, full proposals received, and projects awarded funding, FY19-23.

The 9 projects funded through the Ocean Exploration Fiscal Year 2023 Funding Opportunity are noted in **Table 1**. More details about each project are in **Appendix A.**

Table 1. Funded projects for the Ocean Exploration Fiscal Year 2023 Funding Opportunity (arranged alphabetically by project title).

| Project Title	PI, Entity	Theme	Expected Close Out
Autonomous Deep-Ocean Exploration of Diverse Habitats Along the Aleutian Margin	Shank, Timothy Woods Hole Oceanographic Institution	Exploration	06/2025
Autonomous, Directional Acoustic Profiling Float for Soundscape Characterization	Raghukumar, Kaustubha Integral Consulting Inc.	Technology	06/2025

Autonomous Localization of Seafloor Fluid Flow Sources	Xu, Guangyu University of Washington	Technology	06/2025
Deployable Artificial Intelligence for Exploration and Discovery in the Deep Sea	Katija, Kakani Monterey Bay Aquarium Research Institute	Technology	07/2025
Diversity and Biopharmaceutical Assessments of Deep-Sea, Mineral-Rich Biomes off Southern California	Jensen, Paul Scripps Institution of Oceanography	Exploration	08/2024
Early Encounters on a Western Frontier: The Search for Svyatoy Nikolai (1807-1808)	Roth, Madeline & Wrubel, Katie NOAA Office of National Marine Sanctuaries	Maritime Heritage	06/2024
Exploration of Deepwater Habitats off Puerto Rico and the U.S. Virgin Islands for Biotechnology Potential	Guzman, Esther Harbor Branch Oceanographic Institute	Exploration	06/2025
Software Tools to Enable Automated Detection of Submerged Archaeological Sites From Multibeam Sonar	Skinner, Katharine University of Michigan	Technology	06/2024
Integrated Exploration of Biodiversity at Priority Benthic Habitats	Morrison, Cheryl U.S. Geological Survey	Exploration	06/2025

Each year, NOAA Ocean Exploration attempts to balance the distribution of funds across the three themes (ocean exploration, technology, and maritime heritage). Final allocation of funds is based on the number of project proposals received in each of the three focus areas. Both the theme ranking and overall competition rank are evaluated. **Figure 3** shows the distribution of awards by theme for FY19-23.
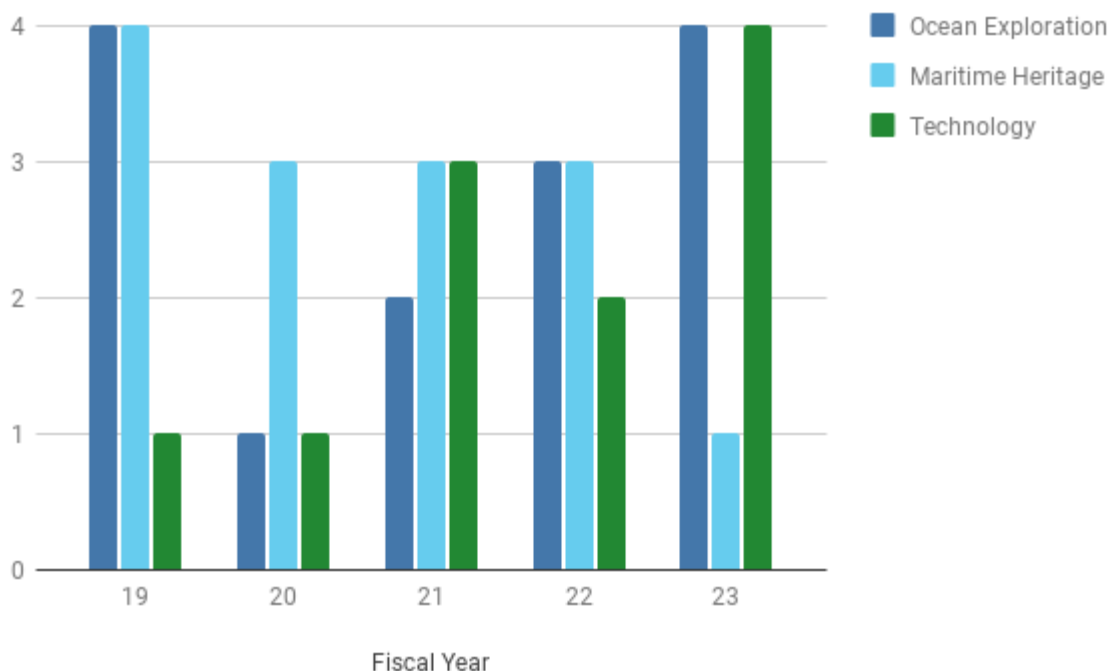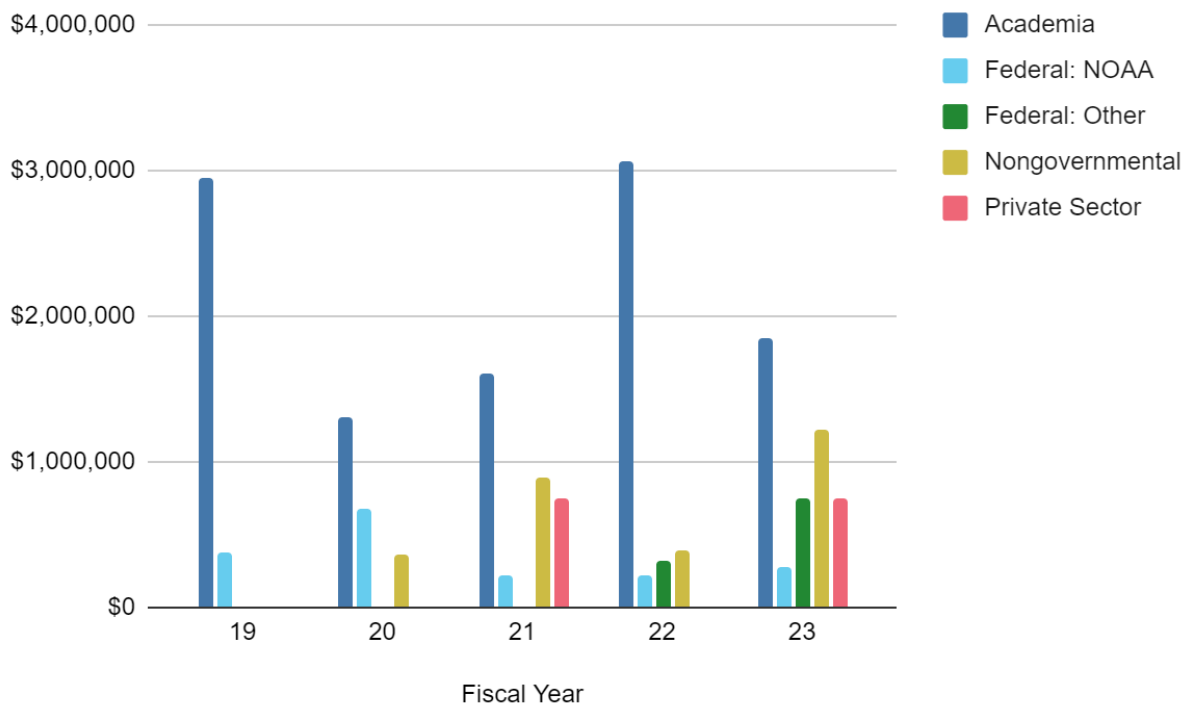

Figure 3. Distribution of NOAA Ocean Exploration funding opportunity awards by theme, FY19-23. Applicants before FY20 were able to select multiple themes, so some projects may be represented in multiple categories.

Between FY19 and FY23, NOAA Ocean Exploration funded proposals received from academia, federal agencies, nongovernmental organizations, and the private sector. Overwhelmingly, academia has received the most funds (see **Figure 4** and **Figure 5** for distribution of awards and funds). Reasons for disproportionate funding may include academics' reliance on grant funding as their primary funding source. NOAA Ocean Exploration recognizes that nongovernmental and private-sector entities have an increasing role in ocean exploration, maritime heritage, and technology development, and NOAA Ocean Exploration continues to consider opportunities to engage these entities.
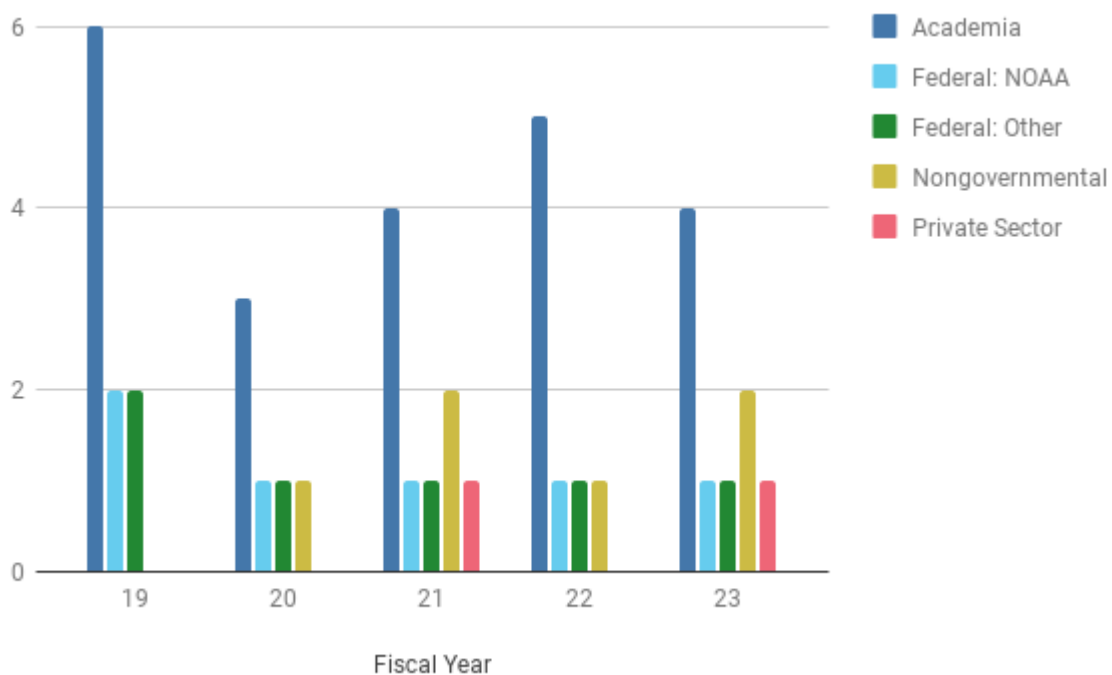
Figure 4. Distribution of NOAA Ocean Exploration funding opportunity awards by sector, FY19-23.

In support of these opportunities, NOAA Ocean Exploration encourages interdisciplinary exploration that can be accomplished through partnerships between academia, government agencies, nongovernmental organizations, the private sector, and state entities. In this way, the NOAA Ocean Exploration funding opportunity supports collaboration networks across the entire ocean exploration community.

Figure 5. Distribution of NOAA Ocean Exploration funding opportunity funds by sector, FY19-23.

Funded proposals often leverage additional support in the form of cost-sharing, ship time, in-kind contributions, and other services, resources, and personnel time not covered by NOAA Ocean Exploration funding. Funded projects leveraged over $10.2 million in additional support between FY19 and FY23 (see **Figure 6**). In FY23, leveraged support included ship time, platform assets, and salary funding. Leveraged support (both technical and monetary) is opportunistic and is controlled by factors external to NOAA Ocean Exploration. Sometimes this support includes funding from other agencies or entities. Leveraged support and outside funding are not required to receive funding via the NOAA Ocean Exploration funding opportunity.
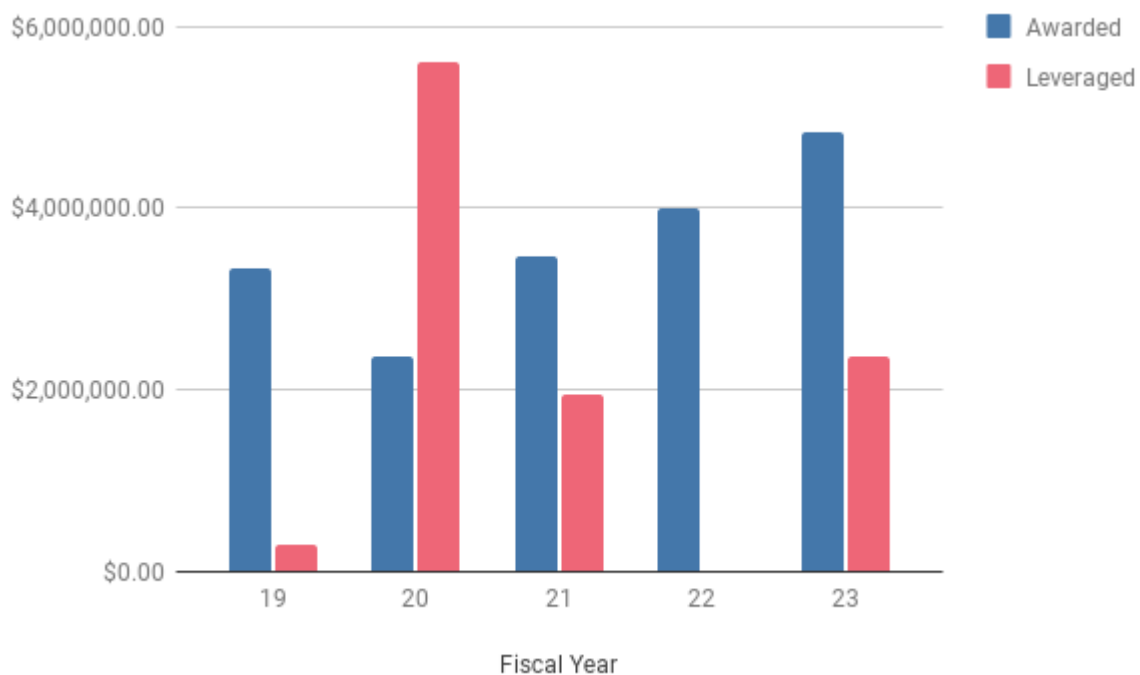
Figure 6. Funding awarded via the NOAA Ocean Exploration funding opportunity and support leveraged, FY19-23.

PIs, co-PIs, and other significant contributors funded by NOAA Ocean Exploration between FY19 and FY23 represent a variety of entities both domestically and internationally. **Figure 7** is a visual representation of the collaborative nature of NOAA Ocean Exploration-funded projects and shows the wide reach of NOAA Ocean Exploration's funding opportunity beyond the nine principal investigators who were directly funded. The directionality of the arrows in **Figure 7** indicates the direction of collaboration from awarded entities to collaborating entities. Each point in the network represents one entity and may represent multiple projects if awards were given to multiple principal investigators from an entity between FY19 and FY23. This institutional network depicts 89 relationships between 96 unique entities. These collaborations have resulted in the inclusion of sectors that did not directly receive NOAA Ocean Exploration funding between FY19 and FY23, specifically state and foreign entities.
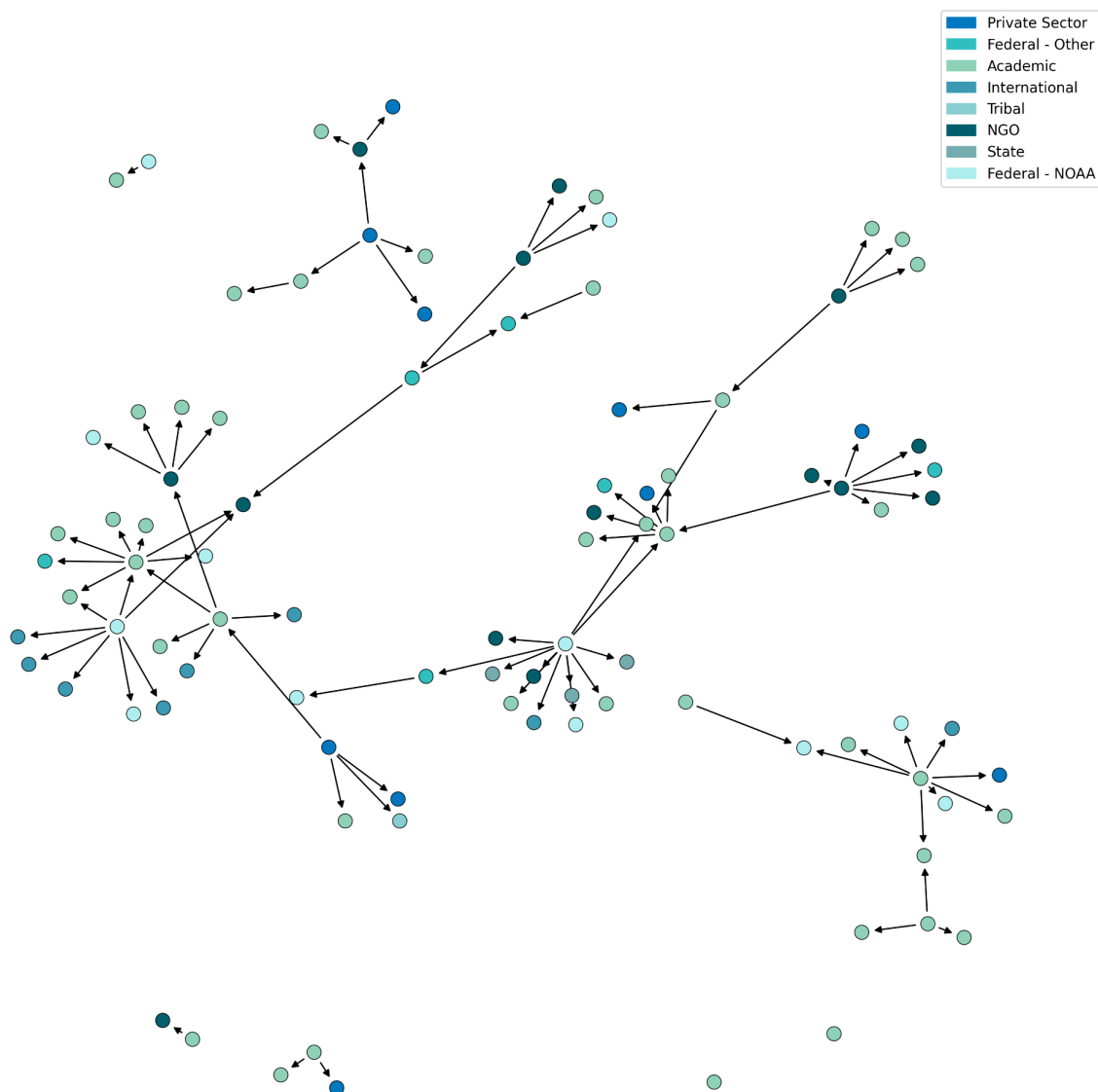
Figure 7. Collaboration network of principal investigators, co-principal investigators, and other significant contributors funded via the NOAA Ocean Exploration FY19-23 funding opportunities.

Grants Closeout During FY23

Five grants were closed out during FY23. The final reports and publications for these projects will be archived with the NOAA Institutional Repository once available.

Acknowledgments

Sources for Additional Information

Searchable online table for past NOAA Ocean Exploration funding opportunity projects from FY14 through present: https://oceanexplorer.noaa.gov/about/funding-opps/ffo-recipients.html

NOAA Ocean Exploration Library Guide: https://libguides.library.noaa.gov/oceanexplorationbib

More information about NOAA Ocean Exploration's competitive grant program and contacts: https://oceanexplorer.noaa.gov/about/funding-opps/welcome.html

Appendix A: Abstracts of FY23 Funded Projects

Title: Autonomous Deep-Ocean Exploration of Diverse Habitats Along the Aleutian Margin
Principal Investigator: Timothy Shank, Woods Hole Oceanographic Institution
Theme: Exploration
Abstract: The seafloor of the Aleutian margin hosts exotic ecosystems, including methane seeps and deepwater corals, and may also hold critical minerals. Given the importance of these natural resources, the U.S. government identified the U.S. Exclusive Economic Zone around Alaska's Aleutian Islands as a priority for exploration and characterization. Little is known about the diverse ecosystems in these waters, so the potential for scientific discoveries is high, and the need for science to support knowledge-based policies is pressing. To further our understanding of this important region, this team will use cutting-edge tools and approaches, including two autonomous underwater vehicles with imaging and sampling capabilities (including a newly developed deep-sea methane sensor) to geologically, chemically, and biologically map the water column and seafloor along the eastern Aleutian margin. They anticipate discovering new seeps; chemosynthetic, coral, and sponge communities; seafloor minerals; and more. These findings will advance knowledge of the fundamental geological and biological features of the Aleutian margin, direct and inspire further exploration and research, and inform decision-making at the regional and national levels.

Title: Autonomous, Directional Acoustic Profiling Float for Soundscape Characterization
Principal Investigator: Kaustubha Raghukumar, Integral Consulting Inc.
Theme: Technology
Abstract: Sound is a crucial component of ocean science and stewardship. Deepwater soundscapes can provide insight into marine mammal distributions, seismic and volcanic activity, illegal fishing activity, other human activities, and more. Yet, collecting acoustic data in the deepest and most remote parts of our ocean has historically been difficult, largely due to the challenges of deploying and recovering traditional acoustic sensing equipment in these hard-to-reach places. To advance deepwater soundscape exploration, this research team will develop and demonstrate the first ever first autonomous, near-real-time, directional acoustic profiling float powered by marine renewable energy (ocean thermal energy conversion, OTEC). They will also develop soundscape analysis tools to provide insights into acoustic events of interest recorded by the float. The portable and low-cost float will enable sustained exploration of poorly understood deepwater soundscapes, eventually increasing the amount of global soundscape data — data that will expand the breadth of our deep-ocean knowledge, support biological and hazards monitoring, and inform management and mitigation of ocean noise to eliminate or reduce impacts on marine life.

Title: Autonomous Localization of Seafloor Fluid Flow Sources
Principal Investigator: Guangyu Xu, University of Washington
Theme: Technology
Abstract: Some of Earth's most unique habitats exist on the seafloor at sources of fluid discharge such as hydrothermal vents and cold seeps. The importance of these systems has been recognized for decades, and improvements have been made in the tools we use to search for them, such as autonomous underwater vehicles (AUVs). Nevertheless, the methods used for such exploration remain crude, and the reliance on human supervision hinders discovery. To streamline the process of locating seafloor fluid flow sites, this research team will develop a fully autonomous algorithm to enable AUVs to trace biogeochemistry signatures in the water column that are indicative of vents and seeps using real-time data recorded by onboard sensors, independent of human operators. After robust testing, they will demonstrate their approach at an active hydrothermal vent site off the Oregon/Washington coast. This new approach will improve the efficiency of AUV-based exploration and enhance the ability of scientists to conduct other operations at the same time while at sea. Ultimately, it has the potential to improve our knowledge about seafloor vents and seeps and the marine life they support.

Title: Deployable Artificial Intelligence for Exploration and Discovery in the Deep Sea
Principal Investigator: Kakani Katija, Monterey Bay Aquarium Research Institute
Theme: Technology
Abstract: We still have much to learn about our ocean and the animals that live within it. Modern robotics, low-cost observation platforms, and other emerging exploration tools are making underwater imaging easier and more accessible. However, processing all this visual data, particularly data with complex scenes and animals that require expert classifications, is quite resource intensive. This research team will use artificial intelligence (AI) to address this significant obstacle to discovery. Specifically, they will develop software for remotely operated and autonomous underwater vehicles to detect, track, and classify seafloor and water column animals in underwater video in real time. They will train this "deployable AI" using FathomNet, a publicly available underwater image training set, which they will expand and augment as part of this project, and test it in the waters of Monterey Bay National Marine Sanctuary. By automating the collection and real-time analysis of large volumes of underwater visual data by uncrewed underwater vehicles and making the imagery available in a global database, this project will enable scientists, policymakers, and the public to better, and more rapidly, understand the life that inhabits our ocean.

Title: Diversity and Biopharmaceutical Assessments of Deep-Sea, Mineral-Rich Biomes off

Southern California

Principal Investigator: Paul Jensen, University of California, San Diego - Scripps Institution of Oceanography

Theme: Exploration

Abstract: Deep-ocean invertebrates and microbes hold undetermined biopharmaceutical potential that could drive innovations in biotechnology and advances for human health. Some of these organisms live on or around critical minerals that are increasingly important to modern society. To help us understand the tradeoffs associated with extraction of these minerals, this research team will assess the biodiversity and biopharmaceutical potential of benthic invertebrates and microbes at mineral-rich, deep-ocean sites within the Southern California Borderland (SCB). They will base their assessment on samples (sponges, soft corals, sediment cores, mineral rocks, and water) along with high-resolution video and still photographs collected from the SCB. Their work will establish biotic baselines for invertebrates and microbes in the SCB before any mineral extraction occurs, demonstrate the importance of biodiversity to biopharmaceutical potential, and encourage further academic and industrial biopharmaceutical research in the deep ocean. In addition, it will inform policy decisions regarding management of the SCB's deep-ocean seafloor resources and mitigation of potential impacts and raise awareness of the potential value of deep-ocean habitats for human health.

Title: Early Encounters on a Western Frontier: The Search for *Svyatoy Nikolai* (1807-1808)

Principal Investigator: Madeline Roth & Katie Wrubel, NOAA NOS - Office of National Marine Sanctuaries

Theme: Archaeology

Abstract: The *Svyatoy Nikolai*, a survey vessel for the Russian American Company, was lost at the turn of the 19th century in the waters of today's Olympic Coast National Marine Sanctuary (OCNMS). In 1808, the ship and crew (composed of men and women; Russian, English, and Aleut) departed Alaska to map the Pacific coastline and identify potential locations for an Oregon-based colony. The ship was driven ashore and abandoned off the coast of Washington. The stories of the crew and their subsequent interactions with Indigenous communities of the Hoh, Makah, Quinault, and Quileute tribes provide valuable insight into maritime history in the era of colonization. To better understand the region's maritime heritage, this research team will search for the remains of *Svyatoy Nikolai* and other shipwrecks in OCNMS through remote sensing and targeted, noninvasive archaeological surveys. This project will result in baseline data to support monitoring and management of historic sites; develop and strengthen relationships among federal, state, and tribal heritage partners and other stakeholders; and enhance our understanding about the first interactions between Indigenous communities and settlers in the Pacific Northwest.

Title: Exploration of Deepwater Habitats off Puerto Rico and the U.S. Virgin Islands for Biotechnology Potential

Principal Investigator: Esther Guzman, Florida Atlantic University - Harbor Branch Oceanographic Institute

Theme: Exploration

Abstract: Natural products produced by animals, plants, and microbes on land have long been used as sources of drugs and treatments for human illnesses and diseases. Marine natural products are also potential sources for such drugs and treatments. And now, they are having a growing impact in the field of biotechnology, and biopharmaceuticals in particular. While the potential of marine natural products may be great, access to them for preclinical and clinical investigations is not. This research team will explore and document marine habitats in deepwater areas around Puerto Rico and the U.S. Virgin Islands with the goal of collecting marine organisms (e.g., sponges, corals, and microorganisms) that may contain natural products that can be developed into useful pharmaceutical products. Collected samples and subsamples will be stored in and shared via a suite of long-term repositories that will enable future biopharmaceutical research and development. Knowledge gained during and as a result of this work will contribute to the treatment and prevention of existing and emerging illnesses and diseases.

Title: Software Tools to Enable Automated Detection of Submerged Archaeological Sites From Multibeam Sonar

Principal Investigator: Katherine Skinner, University of Michigan

Theme: Technology

Abstract: Recent advances in sensor technology and marine robotic systems have resulted in massive amounts of multibeam sonar data. However, finding submerged objects, like shipwrecks, within these data is time consuming and typically requires expert knowledge. This research team will address these challenges by developing a machine learning tool to automate detection and enable discovery of archaeological sites, limiting the need for human input. They will use existing data from Thunder Bay National Marine Sanctuary (TBNMS), deeper water data collected by NOAA Ocean Exploration on NOAA Ship Okeanos Explorer, and known shipwrecks to train and validate their tool. This tool will be integrated into an open-source, GIS-based toolkit. This project will reduce the time and cost required to detect archaeological sites from multibeam sonar data across the maritime heritage community — from the Great Lakes to the deep ocean — enabling discoveries to be made and shared with the scientific community and the public. TBNMS plans to use this tool to search for shipwrecks and other archaeological sites in the sanctuary, where more than 100 known wrecks have yet to be found.

Title: Integrated Exploration of Biodiversity at Priority Benthic Habitats

Principal Investigator: Cheryl Morrison, U.S. Department of the Interior - U.S. Geological Survey

Theme: Exploration

Abstract: The Aleutian Arc is a volcanic arc that includes a chain of islands extending west from the Alaska Peninsula to international waters. The waters surrounding the Aleutian Islands are vast, and the biological and geological resources within them are ecologically and economically important. But, as of January 2023, only 34% of Alaska's seafloor has been mapped, and even less has been explored. Much of the deep Aleutian Arc is virtually unknown. To advance our scientific knowledge about this region, where the potential for new discoveries is high, this research team will explore and provide initial characterization of high-priority sites in the central and western Aleutian Islands during a ship- and submersible-based expedition. Research targets for exploration and characterization include coral and sponge communities, volcanoes and other seafloor hazards, gas seeps, hydrothermal vents, and critical mineral deposits. Primary operations will include data collection (e.g., video and biological, geological, and water samples) during submersible dives and seafloor mapping. Results from this expedition will inform natural resource management, protection, and stewardship and hazard assessments, benefitting both Alaskan and national economies as well as human health and safety.