



2021 Annual Report

ACCELERATING OCEAN SCIENCE FOR THE GLOBAL GOOD



WOODS HOLE
OCEANOGRAPHIC
INSTITUTION

**OUR OCEAN.
OUR PLANET.
OUR FUTURE.**





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Cover: WHOI collaborated with the artist collective Superflex to bring the video installation *Vertical Migration* to the facade of the United Nations Secretariat Building September 21–24, 2021. Photo courtesy of Eskinder Debebe, United Nations.

This page: Through the lens of the remotely operated vehicle *Jason*, sea anemones and shrimp cluster around a hydrothermal vent along a site called the Piccard Field, 5,000 meters (16,404 feet) deep on the Caribbean seafloor, during a 2012 expedition. Photo courtesy of Chris German, NASA/ROV *Jason* Team, © Woods Hole Oceanographic Institution

A Message from the Board Chair and the President

TWO THOUSAND TWENTY-ONE WAS A YEAR OF EXTRAORDINARY ENERGY AND transition at the Oceanographic. WHOI developed best-in-class protocols to keep our staff safe on land and at sea as we emerged from the pandemic. Most offices and labs saw staff return, and research and travel began to go back to normal, largely because of WHOI's commitment to safety, a culture our staff embodies to its core.

Starting in 2021, WHOI embarked on a journey to define its vision for the future and its vital role in the health of our planet. Our scientific and technical staff, administration, board, and corporation provided their ideas and perspectives through a series of virtual town halls and smaller meetings facilitated by external consultants. Together, we laid out a plan to invest in inclusive excellence, lead innovation, and engage the world through a deep commitment to fundamental science and discovery coupled with world-class engineering. In the end, Vision 2030 affirmed our community's commitment to applying WHOI's distinctive capabilities to advancing ocean science for the global good, at a pace commensurate with the urgency of the challenges ahead.

Our timing could not have been better, as the United Nations Decade of Ocean Science for Sustainable Development (2021–2030) initiated a global movement to unleash ocean science for a better and more sustainable world. At the same time, private-sector interest in the ocean is growing. National science funding and professional organizations are emphasizing the need for interdisciplinary, use-inspired science to accelerate innovation and the search for solutions. New technologies and methods are enabling faster and lower-cost approaches to studying and understanding the oceans. And amid this growing interest, philanthropists are seeking to make a difference through partnerships with trusted organizations like WHOI.

We completed our first new building in almost a decade, the 54,000-square-foot George and Wendy David Center for Ocean Innovation. The Center is home to a “collision space” where scientists and engineers can come together to collaborate on critical research and technology projects. We also launched the Francis E. Fowler IV Center for Ocean and Climate, which seeks new knowledge and solutions at the intersection of oceanography and climate science. And we were selected to lead a new National

Everything WHOI accomplished this year was a tribute to the generosity of our supporters and the growing community of people committed to our ocean, our planet, and our future.

Science Foundation Science and Technology Center focused on deeper understanding of the chemicals and chemical processes that underpin ocean ecosystems and the global carbon cycle. Together, these and other new initiatives position WHOI for even greater leadership in the years to come.

The generosity that created these centers was part of a record-breaking year in advancement. We raised more than \$40.3 million in new commitments, including 12 seven-figure donations. In addition to success at the high-dollar end of the spectrum, we also increased the total number of donors significantly, chiefly through a sophisticated direct-mail program. A total of 6,963 people gave to WHOI in 2021—47 percent more than in 2020. This helped our overall financial picture by increasing total revenues to \$295.3 million.

On the communications side, we saw momentum continue to build on all platforms. Our Ocean Communications Initiative played an instrumental role in raising awareness of WHOI and ocean issues to unprecedented levels. We created new kinds of content and reached new audiences on the web and on social media, resulting in a twofold increase in content views across all our channels. “Keep It Weird,” WHOI’s largest-ever marketing awareness campaign around the ocean’s twilight zone, garnered close to 22 million views and increased awareness of the zone by 49 percent among survey respondents. New designs created for the project, along with new growth strategies for online sales and cause-marketing campaigns, helped to double sales of WHOI merchandise compared with 2020.

We also renewed our commitment to diversity in 2021—a key part of ensuring WHOI’s excellence in a highly competitive labor market. In July, we announced the appointment of Dr. Natalie Nevárez as our first chief diversity, equity, and inclusion officer. This appointment is part of a comprehensive plan to increase representation of all racial, ethnic, and socioeconomic groups across the ranks in WHOI’s ocean research community, and to foster an inclusive and welcoming environment for everyone who would like to contribute their talents and energy to our mission of advancing the frontiers of ocean science.

The discoveries and decisions we make in the next decade will determine what the ocean—and our planet—will look like for centuries to come. WHOI is at the forefront of this effort, even as we carry on the important tradition of educating new generations of ocean scientists and engineers. We thank our supporters, scientists, engineers, and staff for persevering with us during a second year of uncertainty due to the pandemic, and we hope you enjoy reading about our achievements in the pages that follow, knowing that everything WHOI accomplished this year was a tribute to the generosity of the growing community of people committed to our ocean, our planet, and our future.

Onward!



David Scully
Board Chair



Peter de Menocal
President and Director



RESEARCH HIGHLIGHTS

WHOI scientists and engineers spanned the globe in 2021, revealing crucial knowledge about the ocean's influence on our climate, the health of marine and human life, and the impacts of marine pollution using innovative tools of our own creation. COVID-19 presented challenges, but with careful protocols, WHOI scientists, engineers, and mariners prevailed. Through their perseverance, WHOI continued to break new ground in the name of our ocean, our planet, and our future. Here are some of their findings.



WHOI TO CREATE A DIGITAL LIVING REEF TO AID SUSTAINABILITY

The National Science Foundation (NSF) selected WHOI to collaborate on the first phase of its two-part Convergence Accelerator Program, a \$21 million investment to address national-scale societal challenges with use-inspired solutions. WHOI was one of 16 teams across the United States chosen to participate in the program's Networked Blue Economy track, which aims to create a smart, connected, open ecosystem for ocean innovation, exploration, and sustainable utilization. The project will develop a three-dimensional "digital twin" of a living coral reef at the Palmyra Atoll, about 1,000 miles south of Hawaii. The virtual replica can be accessed from any laptop or smartphone to get real-time information—updated through sensors, robotics, and satellites—about safely harvesting reef resources.

Also participating in the project are the National Oceanic and Atmospheric Administration (NOAA), the Marshall Islands Conservation Society, the University of Guam, Stanford University, Johns Hopkins University, the Caribbean United Nations Development Programme, and the University of California, Irvine.



STUDY: EMPEROR PENGUINS INCREASINGLY THREATENED BY MELTING SEA ICE

If climate goals set out by the 2015 Paris Agreement are not met, emperor penguins will be pushed toward extinction by the turn of the next century as the sea ice they need for molting, feeding, and reproducing disappears, according to a study led by Woods Hole and co-authored by an international team of policy experts, ecologists, and climatologists. Funded by NSF and NASA, the research was used by the U.S. Fish and Wildlife Service to propose that the birds be listed as threatened under the Endangered Species Act.

Scientists projected the dynamics of all known emperor penguin colonies under various scenarios using a climate-dependent meta-population model. For the first time, the model included the effects of extreme climate events based on the satellite record. It found that at current rates, these iconic birds, which are endemic to Antarctica and reach a height of four feet, will diminish slowly in number until 2040 and then begin a steep decline resulting in their virtual disappearance within the next 60 years.

The research has important implications for assessing climate change risks to other species as well, and reinforces the need for legal recognition and enhanced precautionary management.

If climate goals set out by the 2015 Paris Agreement are not met, emperor penguins will be pushed toward extinction by the turn of the next century as the sea ice they need for molting, feeding, and reproducing disappears. Photo by Peter Kimball, © Woods Hole Oceanographic Institution



WHOI scientist Don Anderson (center) gently guides a multi-corer as it is lowered to the ocean bottom. The instrument takes eight individual sediment core samples from the bottom, which scientists use to look for the presence of seedlike cysts released by harmful algae. Photo by Nicole D'Entremont, © Woods Hole Oceanographic Institution

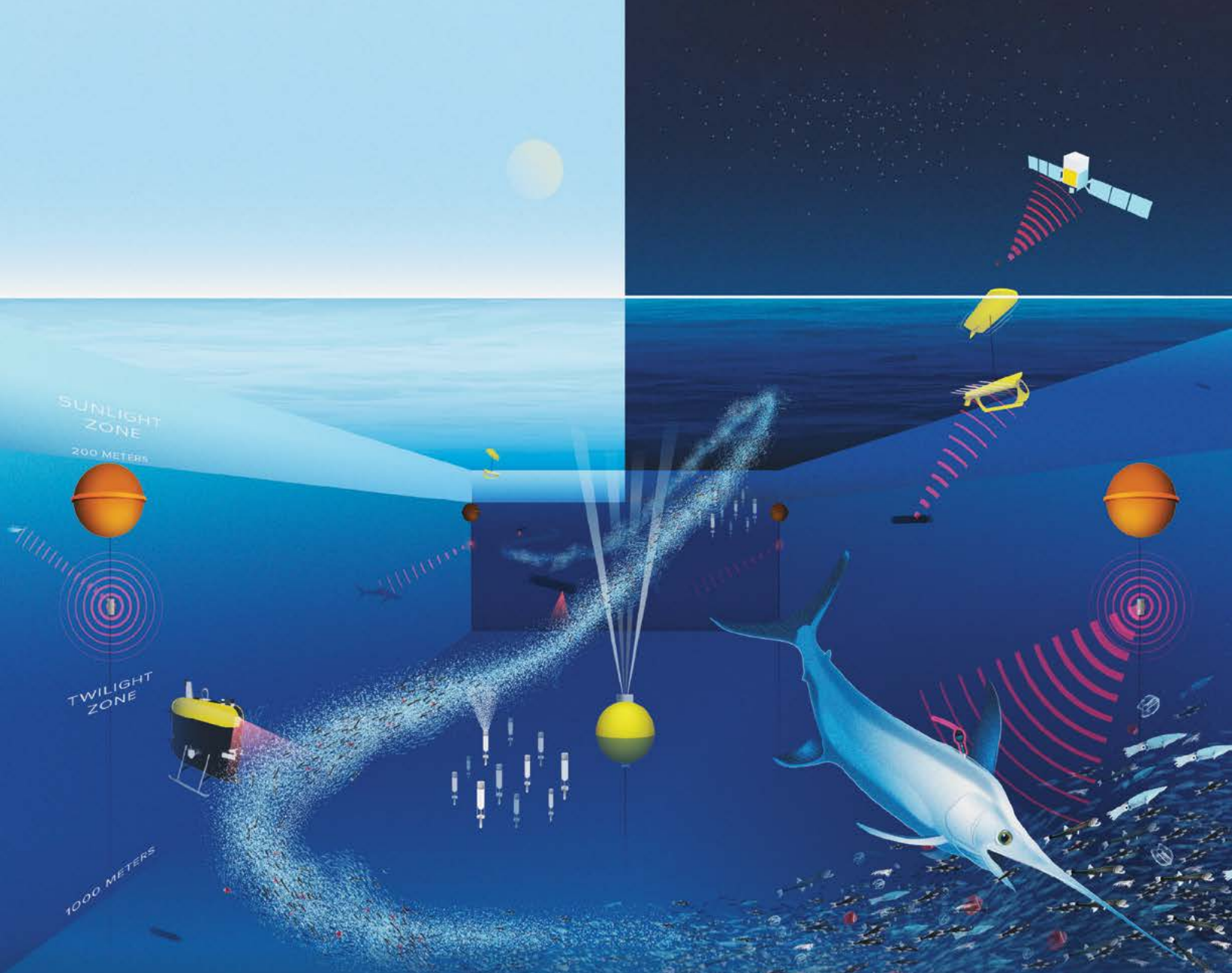
TOXIC ALGAE STUDY FINDS A GROWING THREAT IN ALASKAN ARCTIC

Changes in the Arctic Ocean suggest a previously rare phenomenon—widespread blooms of toxic algae—could become more commonplace, potentially threatening a wide range of marine wildlife and the people who rely on it for food and much of their economy. That is the conclusion of a study led by WHOI scientists and their colleagues in the United States, Japan, and China. Although microscopic ocean algae are usually beneficial and serve as the base of the marine food web, some species produce potent neurotoxins that can directly and indirectly affect humans and wildlife, causing illness and even death. The study, published in the *Proceedings of the National Academy of Sciences*, found that the rapid warming of the waters around western and northern Alaska has had a dual effect on the toxic algae *Alexandrium catenella*: It's melting the sea ice, which brings the organisms the sunlight that helps them grow, and it's raising the water's temperature enough to favor germination from the usually dormant cyst stage. What the authors call an “unprecedented regime shift” in the Arctic ecosystem is complicated by other ecosystem stresses already present. The researchers warn that navigating the new conditions will take a great deal of targeted research going forward.

OBSERVATION NETWORK OFFERS UNPRECEDENTED VIEW OF LIFE IN THE OCEAN'S TWILIGHT ZONE

The twilight zone, a dimly lit region roughly 200 to 1,000 meters below the surface of the ocean, contains the largest biomass of fish on Earth, but remains largely unexplored by scientists. WHOI is developing a new observation network that will offer a peek into about 155,000 square miles of twilight zone in the northwest Atlantic through round-the-clock data collection over months or even years.

While most ocean research is conducted in small areas over limited timeframes, the innovative network will use new technologies, including moored buoys equipped with acoustic survey systems, a swarm of optical and geochemical sensors, and new fish-tracking tags that will continuously record the position of major predators such as sharks and tuna. It is hoped that these components, connected by a satellite link at the surface, will improve estimates of fish and invertebrate density and distribution, reveal new insights about species' interactions and migrations throughout the water column, provide carbon cycling and global climate data, and help fuel new strategies for conservation and policymaking. A generous gift from the Happel Foundation in Lucerne, Switzerland, is making the network possible.



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Although there are gigatons of fish in the ocean's twilight zone, surprisingly little is known about them. With a generous gift from the Happel Foundation, WHOI scientists are building the first long-term observation network that will provide a 24/7 view of life in the twilight zone.

Illustration by Natalie Renier, WHOI Creative, © Woods Hole Oceanographic Institution



WHOI ADVANCES SEAWEED SOLUTIONS BY DEVELOPING MORE USEFUL STRAINS

For more than half a century, humans have been increasing their use of seaweed in livestock feed, cosmetics, pharmaceuticals, industry, and foods from sushi to seasonings. Global seaweed cultivation has grown from about 35,000 tons in 1950 to more than 35 million tons today, and demand is expected to continue to soar—particularly as more and more uses are discovered for the sustainable, nutritious plants, which, when farmed, also help to diversify ocean life and boost local economies.

The environmental NGO World Wildlife Fund (WWF) has awarded WHOI a grant to identify and develop sugar kelp strains for commercial uses, focusing on meeting targeted needs such as flavor and texture. The research, begun in 2021 and conducted at farms along the Northeast coast over two breeding and harvesting seasons, will examine genetic and environmental influences on various strains, compare the strains by traits such as color, taste, and shelf life, and train hatchery operators on how to grow “seed” year-round. The project is expected to help seaweed farmers advance their productivity, leading to strong partnerships for greater environmental and societal gains.

NSF AWARDS WHOI A NEW OCEAN CHEMISTRY CENTER TO STUDY CARBON FLUX

A new center at Woods Hole will conduct transformative research, along with education and outreach, to promote a deeper understanding and appreciation of the chemicals and chemical processes that underpin ocean ecosystems.

For decades, the NSF’s Science and Technology Centers have been supporting ambitious, complex research in fields ranging from mechanobiology to particle physics to climate change. Now the agency has made a five- to 10-year commitment to a new site at WHOI, in partnership with the University of Georgia. The Center for Chemical Currencies of a Microbial Planet (C-CoMP), will work to understand the ocean’s part in the global carbon cycle using recent advances in data science and analytics, ocean-sampling technologies, biology, chemistry, modeling, and informatics.

NSF’s centers in ocean sciences have been beacons of scientific understanding and technological leadership, and have led to some of our deepest understandings of the role the ocean plays in sustaining our planet. The resulting open-science framework of the new site can engage educators and policymakers by linking the physiology and function of microbes to improved predictions on the ways the ocean works.



Global seaweed cultivation has grown from about 35,000 tons in 1950 to more than 35 million tons today.

This kelp, at an offshore aquaculture farm, will be harvested to help WHOI researchers develop techniques to expand kelp cultivation, which has the potential to provide low-impact nutrition, renewable energy, and carbon storage. Photo by Paul Caiger, © Woods Hole Oceanographic Institution

HOPE FOR CORAL REEFS: STUDY FINDS SOME ARE BECOMING MORE HEAT-TOLERANT

A series of underwater El Niño–induced heatwaves in the central Pacific’s Phoenix Islands Protected Area (PIPA) over the past two decades provided the perfect natural conditions for WHOI scientists to study the effects of ocean warming on coral reefs, where about a quarter of the ocean’s fish feed, reproduce, and rear their young. After a 2002–2003 heat-wave devastated coral communities in the PIPA, the reefs recovered and experienced minimal losses during a similar event in 2009–2010. Then, in 2015–2016, a massive heat-wave put twice as much stress on the corals, yet the die-off was much less severe than expected, according to a study published in *Geophysical Research Letters*. Using satellite data and temperature loggers to examine each impact, the researchers ruled out 11 environmental factors—such as greater cloud cover—that might explain the higher-than-expected survival rates in the 154,440-square-mile reserve. The team also hypothesized that heat-tolerant offspring from the corals that survived each successive event are repopulating the reefs, allowing the community to keep pace with warming seas—at least for now. The study could help reef managers identify the coral communities most likely to survive a warming ocean, improving conservation and restoration outcomes.

RIGHT WHALE HEALTH ASSESSMENT RECOMMENDS MANAGEMENT ACTIONS

Listed as endangered since 1972, an estimated 336 North Atlantic right whales remain on the planet. While the playful, gentle mammals are no longer under threat from the whaling industry—which gave them their name because they moved slowly, stayed close to shore, and would float after being killed, making them the *right* whale to hunt—they continue to experience considerable trauma from changing ocean conditions, underwater noise pollution, collisions with ships, infections, fishing-gear entanglement, and other human-caused threats. A paper published jointly by WHOI and NOAA in the journal *Diseases of Aquatic Organisms* looked at a variety of data sources, including necropsy results, photogrammetry showing growth rates and body conditions, metabolic assessments, and prey dynamics, to recommend additional research and necessary management actions to enhance the health of individual right whales. These include placing a greater emphasis on slowing vessels and changing their tracks where a risk of collision exists; reducing entanglement by closing more high-risk areas to fixed fishing gear; and lowering fishing gear density and strength in other areas.



TED AUDACIOUS PROJECT

Kid-oriented website and book teach about the twilight zone

TED—Technology, Entertainment, Design—is more than just its famous “talks.” Its Audacious Project, started in 2018, helps fund “big, bold ideas for global change,” among them WHOI’s Keep It Weird campaign, designed to engage children, tweens, and everyone, really, in learning about the ocean’s mesopelagic layer, or twilight zone.

One way to create awareness, according to Samuel Harp, WHOI’s chief marketing officer and vice president for advancement, is to help people relate to the weird and wonderful characteristics of the creatures that live in the twilight zone, like the bioluminescent strawberry squid, which has one eye that looks up and one that looks down, and the spherical, translucent giant ostracod, which, despite its name, is only an inch long.

Researchers believe the twilight zone is home to more life than all the world’s fisheries combined, and that public awareness is a key to protecting it. The campaign’s focus on the otherworldly aspect of the twilight zone has garnered it nearly 22 million views, increased awareness by 49 percent among survey respondents, and helped boost sales of WHOI merchandise to nearly double the numbers for 2020.

“All of us know what it feels like when someone calls us weird. We want to show that weird is what drives innovation and creativity and is something that should be celebrated,” said Heidi Sosik, science lead of the project. “We see the weird creatures of ocean twilight as perfect examples of what makes weird wonderful in all of us.”

The jewel squid (*Histioteuthis reversa*), sometimes also known as the strawberry squid, is a member of the cockeyed squid group because it has two mismatched eyes. The larger eye looks up into the dim light filtering down from above, while the smaller one points down to look for flashes of bioluminescence that might indicate a potential meal. It is just one of countless animals that many of the ocean’s large apex predators—such as sperm whales and Risso’s dolphins—target as they dive down into the twilight zone to feed. Photo by Paul Caiger, © Woods Hole Oceanographic Institution

GRANT TO DIGITIZE WHALING LOGBOOKS GIVES RESEARCHERS A TREASURE TROVE OF HISTORICAL DATA

Thousands of whaling ship logbooks dating back to the late 1700s are helping WHOI scientists compare centuries-old weather data—including air temperature, rain, shifting wind and pressure patterns, severe storm events, and sea-ice conditions—with modern readings, providing invaluable information in the study of climate change. An ongoing collaborative effort by WHOI, the University of Massachusetts Dartmouth, and the Providence Public Library, the project recently received a three-year, \$450,000 grant from FM Global, an insurance company headquartered in Rhode Island that focuses on science-based property-risk mitigation. Nearly 40 percent of the award will go to WHOI for its climate-research contribution to the project. Understanding historical weather patterns is useful for modern ocean navigation, commerce, supply-chain planning, coastal management, national defense, and helping vulnerable communities plan for future extreme weather disasters.

LOW-CARBON MISSION BOOSTS GLOBAL DATA-COLLECTION NETWORK

In 2021 WHOI was part of an innovative international collaboration between the intergovernmental, public, and private sectors to undertake one of the largest low-carbon-footprint missions ever in support of ocean research. It used the 82-foot sailing vessel *Iris* to deploy 100 new floats among the almost 4,000 already dotting the globe's seas collecting weather and climate data for the Argo Project, which monitors the temperature, salinity, and pressure of the upper 1.2 miles of ocean. By the end of the nearly 100-day voyage, the floats—some replacing those at the end of their service, others going to undermeasured regions—spanned the Atlantic from Brest, France, to Woods Hole before veering south toward the coast of Namibia. Over the past two decades, Argo has had a profound impact on scientists' understanding of changes in our oceans. WHOI is one of the original Argo member institutions and maintains about 10 percent of the global float array.

Thousands of whaling ship logbooks dating back to the late 1700s are helping WHOI scientists compare centuries-old weather data—including air temperature, rain, shifting wind and pressure patterns, severe storm events, and sea-ice conditions—with modern readings, providing invaluable information in the study of climate change. Photo by Jayne Doucette, © Woods Hole Oceanographic Institution



EDUCATION HIGHLIGHTS

WHO's educational programs continue to be impacted by the pandemic, but in 2021 students and postdoctoral researchers began to return to in-person activities, including lab work, fieldwork, and classes. Remote learning and research did have some positive effects, including increased familiarity with virtual communication platforms, convenience in working with collaborators, and increased attendance thanks to hybrid work models. Additionally, we have had continued success in increasing the diversity in WHO's educational programs as a pathway to broadening participation in the ocean sciences and engineering.

THE MIT-WHOI JOINT PROGRAM (JP) IN OCEANOGRAPHY/APPLIED OCEAN SCIENCE AND ENGINEERING

PROGRAM DESCRIPTION: A five-year doctoral degree program, or, for U.S. Navy officers, a 27-month master's degree program, that combines the strengths of WHOI and MIT to provide research and education opportunities in ocean science and engineering disciplines.

As MIT-WHOI JP students increasingly returned in person to their labs and classes in 2021, they also participated in field-based research that ranged from traversing the Juneau Icefield to joining cruises in Atlantic, Pacific, and Arctic Oceans. They used submersibles, autonomous vehicles, and scuba gear to observe and sample ecosystems ranging from deep-sea hydrothermal vents to tropical coral reefs. As in prior years, current and incoming JP students were recognized with competitive fellowships from agencies including the National Science Foundation, the Department of Defense, and the Natural Sciences and Engineering Research Council of Canada.

WHOI held a virtual celebration for the 2021 JP graduates on June 2. The celebration included cameos from Marcia McNutt, a geophysicist and the 22nd president of the National Academy of Sciences; Sunita Williams, an astronaut and U.S. Navy officer; and Dawn Wright, a geographer, an oceanographer, and the chief scientist at the Environmental Systems Research Institute in Redlands,

California. As part of the 2021 MIT commencement, MIT-WHOI JP student Daniel Lowenstein introduced Rafael Reif, president of MIT, and sent congratulations from Palmer Station, Antarctica, with seals and penguins chiming in behind him.

THE 2021 WHOI SUMMER STUDENT FELLOWSHIP (SSF) PROGRAM

PROGRAM DESCRIPTION: A 10- to 12-week ocean science and engineering research experience for a diverse group of rising college seniors majoring in science, technology, engineering, or mathematics.

The 2021 SSF program was primarily remote but with a weeklong visit in early August to WHOI. We recognized the need for cohort-building and arranged for a team of three MIT-WHOI JP graduate students to meet regularly with the SSFs over Zoom and Slack and have regular online social activities, so by the time the students arrived at WHOI they had already established relationships with one another that were then enhanced by the visit. They met mentors and advisers, had a field trip to a salt marsh, spent a day on the research vessel *Tioga*, and enjoyed lab and facilities tours, cookouts, and social events. During the entire summer—to their credit more than ours—it was clear that the SSFs had learned over the previous year how to get the most out of remote learning, and despite the unprecedented circumstances, they gained valuable research



MIT-WHOI Joint Program student Kalina Grabb uses a diver-operated submersible chemiluminescent sensor (DISCO), to measure superoxide, a chemical indicator of coral health. Photo by Dan Mele, © Woods Hole Oceanographic Institution

experience. All 31 students completed reports and gave excellent poster presentations, and they gained valuable mentors in the course of their study. About half of the SSFs presented results of their research at national meetings in the fall and winter, either virtually or in-person.

THE GEOPHYSICAL FLUID DYNAMICS (GFD) PROGRAM

PROGRAM DESCRIPTION: Initiated in 1959, the GFD Program introduces geophysical fluid dynamics to physical-sciences graduate students and promotes an exchange of ideas among the many fields that share a common interest in the nonlinear dynamics of rotating, stratified fluids.

GFD ran a summer lecture series in 2021, but owing to COVID-19 uncertainties, did not award fellowships or have a formal program.

POSTDOCTORAL RESEARCHERS

Thirty postdoctoral scholars, 14 postdoctoral fellows, and 62 postdoctoral investigators engaged in WHOI research for some portion of the year.*

WHOI postdoctoral researchers adapted to a fully hybrid model for 2021, with significant behind-the-scenes work to provide flexibility and accommodate travel and visa restrictions. They were back in labs and able to participate in research cruises and fieldwork

while following necessary but ever-changing quarantine protocols. Despite the loss of significant in-person networking opportunities, these postdocs have had success in finding their next positions.

**Scholarships were awarded competitively and funded through the endowment and other sources; fellows were funded through competitive awards from external agencies, foundations, and foreign countries; and investigators were funded with grants from external sources that are part of each department's research base.*

CONTINUED RECRUITMENT AND DIVERSITY SUCCESS

Efforts to broaden diversity in all education programs continued during 2021, with significant help from Dr. Natalie Nevárez, WHOI's new chief diversity, equity, and inclusion (DEI) officer, the Committee for DEI—including a number of JP students and postdocs—and the two Doherty Chair DEI faculty advisers, Lauren Mullineaux and Adam Subhas. In October, WHOI staffed a virtual booth at the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science National Diversity in STEM Conference.

In 2021, 55 percent of the undergraduate Summer Student Fellows and 27.5 percent of the 153 graduate students in the MIT-WHOI Joint Program's five disciplines—biological oceanography, chemical oceanography, marine geology and geophysics, physical oceanography, and applied ocean science and engineering—were from groups that are underrepresented in the ocean sciences.

IN MEMORIAM

Sadly, WHOI lost too many beloved friends, leaders, and supporters in 2020. They are deeply missed. Please join us in remembering them fondly for their extraordinary generosity and their service to WHOI and the ocean.



ARTHUR ZEIKEL

Trustee, Life Trustee

Philanthropic focus:

Supporting innovative technology development
“As a young analyst Art quickly learned that good decisions require good data. He was drawn to WHOI because its researchers are the experts on getting the data right, ensuring we make great decisions about our oceans to secure our future on this planet. His heart was in Cape Cod, where he spent so much time over the years. He loved a good adventure, and his involvement with WHOI meant he was never far from one.”

—Jon Stavis, Trustee and son-in-law



BOB JAMES

Trustee, Life Trustee

Philanthropic focus:

Alvin Phased Replacement Fund, unrestricted support
“Bob’s passion for the ocean and for WHOI’s role in understanding how it works was unsurpassed. Bob served for many years as a Trustee and executive committee member, and I remember how he smiled and had so much energy in his voice when he talked about WHOI’s contributions to ocean science and technology. He just loved the place.”

—Bob Gagosian, former WHOI president and director



GERALD BLAKELEY JR.

Trustee, Life Trustee

Philanthropic focus:

Unrestricted support
“My father loved the water, his family, and the country. He was a lifelong sailor who felt his best ideas came to him at sea. He accomplished a lot in his 100 years of life and worked with some amazing groups and organizations, but WHOI was always at the top of his list, because he knew how vital its work was to the health of the planet and the oceans he held so dear.”

—Jerry Blakeley III



JOHN “JACK” WISE

Trustee, Life Trustee

Philanthropic focus:

Ocean and Climate Change Institute
“Like many chemical engineers of his generation, Jack devoted not only his career but also his personal time to advancing research, and to supporting others whose research made a difference in the world. He was on the U.N.’s Intergovernmental Panel on Climate Change, and he put his money where his mouth was by supporting WHOI’s climate change research. WHOI is lucky to have had a man like Jack on its side.”

—Alec Sargent, Trustee



LOUIS W. CABOT

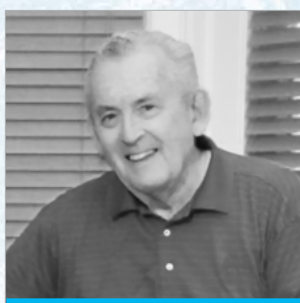
Trustee, Life Trustee

Philanthropic focus:

Director's Discretionary Cabot Fund, MV Coastal Observatory, Right Whale Initiative

"What a pleasure it was to have had the opportunity to work with Louis over the years we served together as Trustees of WHOI. An always positive force and source of wise counsel, particularly when it came time to define the role of Life Trustees in framing the governance structure, Louis always managed to bring everyone together, no matter what the issue at hand, and did so with a sense of humor and good cheer."

—Newt Merrill, former chair of the Trustees



JAMES ORR JR.

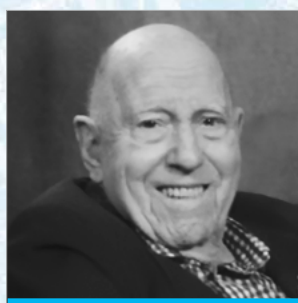
Corporation Member

Philanthropic focus:

Access to the Sea Fund, Project Odyssey

"Jim and his wife, Jane, helped us set up a sensor system on the Mississippi in New Orleans and supported the research of some of my postdocs, Joint Program students, and summer and guest students visiting WHOI, particularly those with research projects on North American rivers. Jim was an expert ship-model builder—his beautiful scale model of the *Tioga* is on exhibit in the Fenno House lobby."

—Bernhard Peucker-Ehrenbrink, department chair, marine chemistry and geochemistry



DENMAN "DENNY" MCNEAR

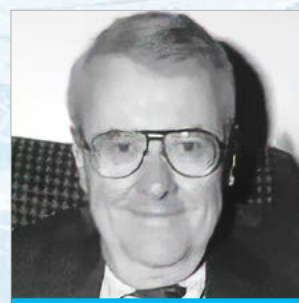
Corporation Member

Philanthropic focus:

Unrestricted support

"Throughout his life, my dad was a strong supporter of many environmental and historical organizations, including WHOI. With his second wife, Babs, he enjoyed attending events and engaging with other members and various speakers. As native Californians and part-time residents of Cape Cod, he and Babs spent countless hours at the beach, enjoying the sun and surf and exploring the treasures that washed up onshore."

—Den McNear



GORHAM L. "JERRY" CROSS JR.

Corporation Member

Philanthropic focus:

Penzance Endowed Science staff support, unrestricted support

Like so many of our local Corporation Members, Jerry had a lifetime commitment to the ocean and the Institution. He and his wife, Joan, spent their summers in Woods Hole, right next door to our Quissett campus. This gave Jerry a front-row seat to the ocean science that went on at WHOI right in his own backyard.

—Steven Hoch, chair of the Corporation

THE POWER OF GIVING

PRIVATE PHILANTHROPY IS WHAT KEEPS WHOI ON THE LEADING EDGE OF SOLUTIONS-BASED SCIENCE AND INNOVATION AT A TIME WHEN OCEAN PROBLEMS ARE AFFECTING ALL OF HUMANITY.

WHOI relies on gifts from individuals and foundations that support high-risk, high-reward science that pushes ocean science boundaries. In 2021, as the pandemic wound down but its effects were still being felt, this support made a major impact. Meet some of these generous and visionary supporters.

FRANCIS E. FOWLER IV

Gift launches new WHOI center for ocean and climate research

Francis Fowler has loved the ocean since the first time he saw it, at age 5, in La Jolla, California. “I was so excited,” he said. “I’d never seen anything so beautiful, and from that day on I wanted to learn as much about it as I could.” Since then, Fowler, a businessman and entrepreneur, has spent as much time as possible in and around the water, swimming, boating, fishing, water skiing, scuba diving, flying seaplanes, and sailing his 85-foot custom ketch around the world.

And now he has given a lasting gift to the seas that have given him so much throughout his life. After an initial donation of \$3 million for the immediate establishment of the Francis E. Fowler IV Center for Ocean and Climate at WHOI, Fowler has bequeathed his entire \$25 million estate to running the center in perpetuity. “If we want to turn climate change around, we need to look at the ocean,” he said. “It covers more than 70 percent of the Earth’s surface, and it’s our planetary life-support system. If we don’t understand and take care of it, the future of our planet could be compromised.”

The center will focus on exploring ocean-based solutions to climate change and will engage policymakers and the public through collaborative, multidisciplinary efforts to conserve coastlines, reduce the footprint of fishing and aquaculture, lower barriers to ocean-based renewable energy, and more. The world’s oceans have the potential to provide as much as a fifth of the cuts in greenhouse gas emissions needed to keep the global temperature rise below 1.5 degrees Celsius, but to do that, said Fowler, “It is imperative that we act now.”

Peter de Menocal, WHOI’s president and director, called Fowler’s gift “extraordinary.”

“This center will propel critical work that is needed to understand and elucidate the interplay between climate, ocean, and society,” de Menocal said. “And it will further cement WHOI’s position as a leader in climate research at a time when the world urgently needs scientific leadership in this area.”





In May, WHOI President and Director Peter de Menocal, Massachusetts State Senator Susan Moran, and Board Chair David Scully watch as Wendy David cuts the ribbon on the 54,000-square-foot innovation center she and her husband, George, CEO of United Technologies, helped make possible. Photo by Jason Goldstein © Woods Hole Oceanographic Institution

GEORGE AND WENDY DAVID

David Center for Ocean Innovation promotes ocean health and climate resilience

This year saw the opening of the George and Wendy David Center for Ocean Innovation, a first-of-its-kind collaboration hub occupying the newest building on WHOI's Quissett campus. The center represents a significant investment in advancing WHOI's capabilities in ocean technology, fundamental and applied ocean science, and innovation to address societal problems. The center is named for George David, the former chairman and CEO of United Technologies Corporation, a Connecticut-based multinational conglomerate, and his wife, Wendy David. The Davids are committed to developing the facility and advancing communications and education programs for future leaders in ocean science and technology.

The 54,000-square-foot facility is intended to bring ideas into action at a pace commensurate with global problems affecting the ocean, including plastic waste, environmental degradation, and climate change. The facility is also home to WHOI's AVAST (Autonomous Vehicles and Sensor Technologies) program, which fosters collaboration across disciplines and among global, state, and regional actors within industry, government agencies, and private philanthropies.

"The oceans are profoundly important to our planet's well-being and future," said George David. "We have not been kind to these oceans, especially in the last century, and technologies and innovations offer us opportunities to reduce the impacts and even turn them back. This center should lead the way. Wendy and I are delighted to be a part of it."

“We have not been kind to these oceans, especially in the last century, and technologies and innovations offer us opportunities to reduce the impacts and even turn them back. This center should lead the way. Wendy and I are delighted to be a part of it.” —George David



“WHOI provides an opportunity to put my money where my mouth is in terms of supporting and caring about the world’s oceans, which is absolutely necessary at this time. I think everybody should be doing it.”

—Ron McCormick

RON MCCORMICK

Annual Fund provides assistance “wherever WHOI needs it”

For the past few years, New Jersey attorney Ron McCormick, his wife, Alexis van der Sterre, a lawyer, and their two children have been summering on Cape Cod. On one of their first trips to the Cape the family happened to tour WHOI’s facilities. “Prior to that I was unaware of the organization and the rich history behind it,” McCormick said. “I’ve had a long-standing concern about the state of the environment in general and of course the oceans were a big part of that. Once we toured the campus and I became aware of some of the funding issues, I wanted to do whatever small part I could to support the organization.”

That “small part” grew into an ongoing relationship between the McCormick–van der Sterres and the Institution that has resulted not only in several generous gifts to the Annual Fund but also in McCormick’s election this year as a member of the WHOI Corporation.

Growing up in Brooklyn, McCormick always had an interest in animals that later led him to a love of science and eventually an enthusiasm for gardening. “My research into soil conservation naturally extended to other things,” he said, “and for the past decade or so climate change is such a huge part of the public discourse that it’s impossible to not think about it. Conservation is not just one avenue.”

McCormick said he and van der Sterre give to the Annual Fund because it fills the gaps left by earmarked funding sources. “The money is used wherever WHOI needs it,” he said. He pointed out that exploration of outer space has overshadowed ocean science in recent years, creating an imbalance. “National support of NASA is huge, and while looking outward is a laudable goal, our understanding of what’s going on here on our planet is of paramount importance,” he said. “WHOI provides an opportunity to put my money where my mouth is in terms of supporting and caring about the world’s oceans, which is absolutely necessary at this time. I think everybody should be doing it.”

ANALOG DEVICES, INC.

WHOI-based consortium will advance knowledge of ocean’s role in climate change

Because there’s no such thing as knowing too much about the role of the world’s oceans in climate change, another major gift this year is focused on that topic as well. Analog Devices, Inc. (ADI), a multinational

semiconductor company headquartered in Wilmington, Massachusetts, has given \$3 million over three years to fund the new Ocean and Climate Innovation Accelerator (OCIA), a highly scalable collaboration that will leverage the unique resources and capabilities of partner organizations from business, academia, and the nonprofit sector. The consortium will focus on the development of a networked ocean, where undersea sensors will continuously monitor important metrics to enable evidence-based ocean-health stewardship and drive more accurate climate and weather predictions.

Designed to act as an engine for continuous innovation from some of the world's leading minds and businesses, the WHOI and ADI-led consortium will also establish educational and research initiatives, including the Climate Challenge Grant Program; award seed funding to small projects that foster new avenues of research and engineering; and engage novel ideas and technologies.

Oceans are among our most important defenses against a warming planet, said Vincent Roche, CEO of ADI. "Through OCIA, we have committed to engaging ADI's engineers and technologies to advancing knowledge of the oceans," he said. "By doing so, we hope to drive meaningful impact on the global fight against climate change."

JESSICA AND ANDREW SIEJA

Super Reefs initiative kickstarts reef resilience

Jessica Sieja first went scuba diving in high school, because her father wanted her to feel the wonder he felt as a kid diving in his native Indonesia. He took her to Australia's

Great Barrier Reef, and later to his home country. Today, Sieja would like to pass on that kind of experience to her own children.

"Those beautiful, thriving reefs are something you don't forget," she said. "Now, 20 years later, I'm thinking about what the future holds for my kids, and what I would give for them to be able to experience that biodiversity."

That personal connection to coral reefs, combined with her growing alarm over the climate crisis, prompted Sieja and her husband, Andrew, to make a major gift to WHOI's Super Reefs initiative. The project—a partnership between WHOI, Stanford University, and the Nature Conservancy—seeks to identify and protect reefs and aid their recovery in areas that have shown resiliency despite increasing marine temperatures and pollution. Working with the governments and scientists of Pacific Island nations, the project's first goal is to limit the impacts of pollution and fishing by expanding these countries' marine protected areas. Divers and underwater robots will search for additional "super reefs" and create maps and models of where coral larvae travel. In alliance with local scientists, Super Reefs researchers will conduct tests and initiate recovery efforts through community engagement and establishing coral nurseries.

"I wanted to donate to something strategic, where we can see the impact," said Sieja. "Not a lot of philanthropy goes to climate change projects. But as a mother, it's something I think about every day. Climate change is a core pillar of our philanthropy because it's the number one threat to human existence."

“Through OCIA, we have committed to engaging ADI’s engineers and technologies to advancing knowledge of the oceans. By doing so, we hope to drive meaningful impact on the global fight against climate change.” —Vincent Roche, CEO, Analog Devices, Inc.

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RV *Neil Armstrong* passes by a large iceberg off Southeast Greenland. This 238-foot ship is uniquely equipped to reveal new details about this critical part of the global oceans, meeting the range, endurance, and technical requirements to support advanced oceanographic research around the world. Photo by Croy Carlin, © Woods Hole Oceanographic Institution

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Least tern (*Sternula antillarum*) parents feeding their day-old chicks at South Cape Beach State Park on Cape Cod. MIT-WHOI graduate student Ruijiao Sun took this picture in June, when areas of the beach are roped off to protect the terns during nesting season. Least tern populations are declining, as the birds prefer to nest in open sandy areas, which makes them vulnerable to predators and human activities. Photo by Ruijiao Sun, © Woods Hole Oceanographic Institution

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WHOI scientist and photographer Simon Thorrold encountered this group of slender pinjalo (*Pinjalo lewis*) hovering above a coral sea mount in Kimbe Bay, Papua New Guinea. Thorrold is part of a team developing the world's first coral reef digital twin, a four-dimensional virtual replica of the physics, chemistry, and biology that make up a living reef system. The Digital Reefs project will be accessible to stakeholders around the world who are making critical decisions every day to manage and protect these valuable ocean ecosystems. Photo by Simon Thorrold © Woods Hole Oceanographic Institution

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WHOI biologists Maria Pachiadaki and Ginny Edgcomb, and engineers Fred Thwaites and Steven Faluotico, move components from a microbial sampler submersible incubation device, which preserves microbes in conditions that mimic the deep ocean, to a new frame. Photo by Daniel Cojanu, ©Woods Hole Oceanographic Institution

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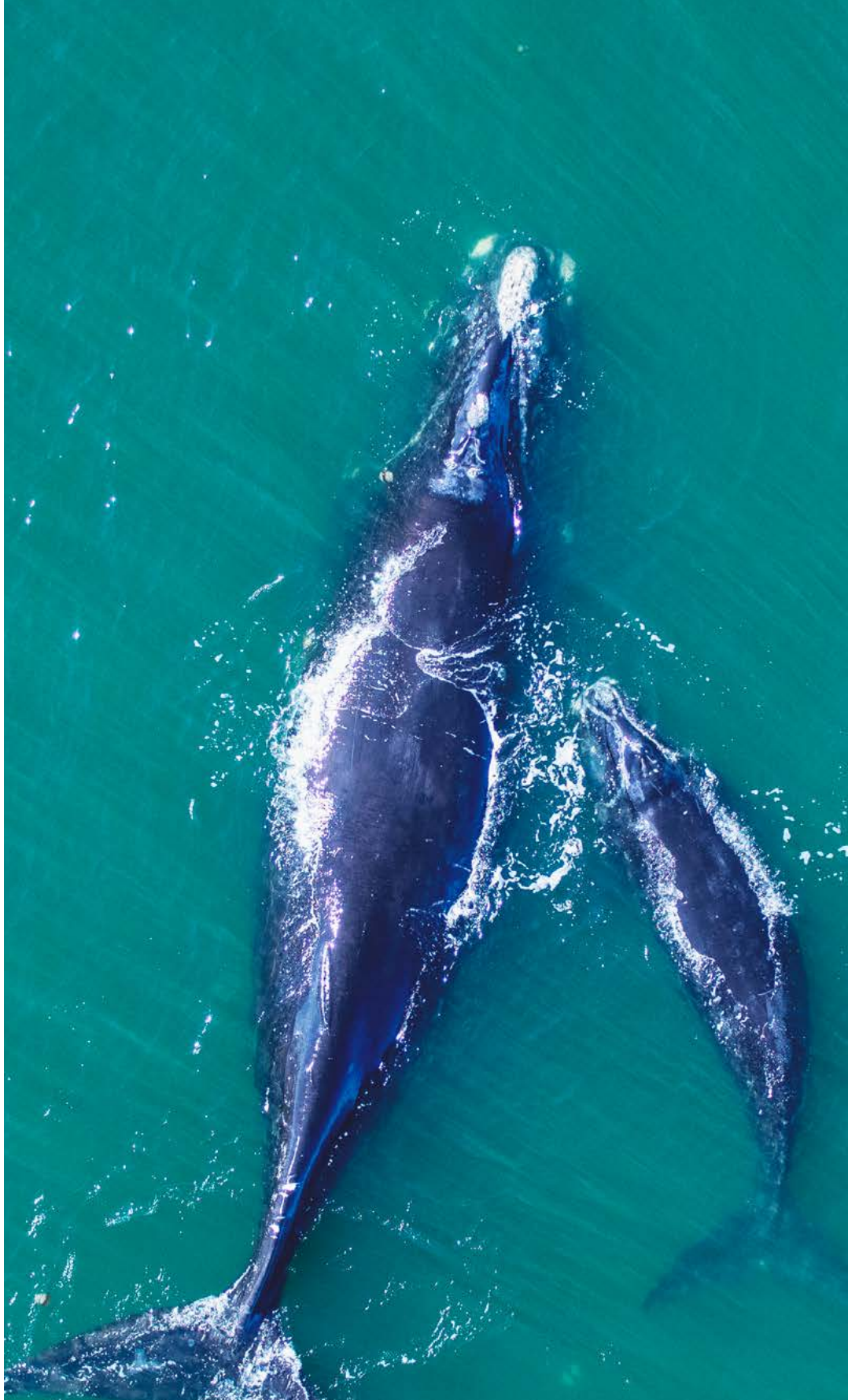
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North Atlantic right whales (*Eubalaena glacialis*)—here, a mother and calf—are critically endangered, with fewer than 400 remaining. These creatures can weigh up to 70 tons and grow longer than a school bus; they're often found on the continental shelf off the U.S. East Coast, making them vulnerable to human activities. WHOI scientists and their partners are working to prevent entanglement and ship strikes and to reduce marine noise pollution in the areas where these whales live. © Woods Hole Oceanographic Institution, NOAA Permit #17355

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Pelagic gooseneck barnacles (*Lepas anatifera*) will grow on almost any hard surface they find, including on this Ocean Observatories Initiative mooring retrieved from the South Atlantic Ocean. The initiative has five active locations across the globe and has transformed ocean research by establishing a network of sensors that make real-time ocean observations, which are freely available to anyone with an internet connection. These data are helping scientists study the ocean's role in the global carbon cycle, extreme weather conditions, and how the physics, chemistry, and biology of the water column may be changing. Photo by Lance Wills, © Woods Hole Oceanographic Institution



2021 FINANCIAL STATEMENTS

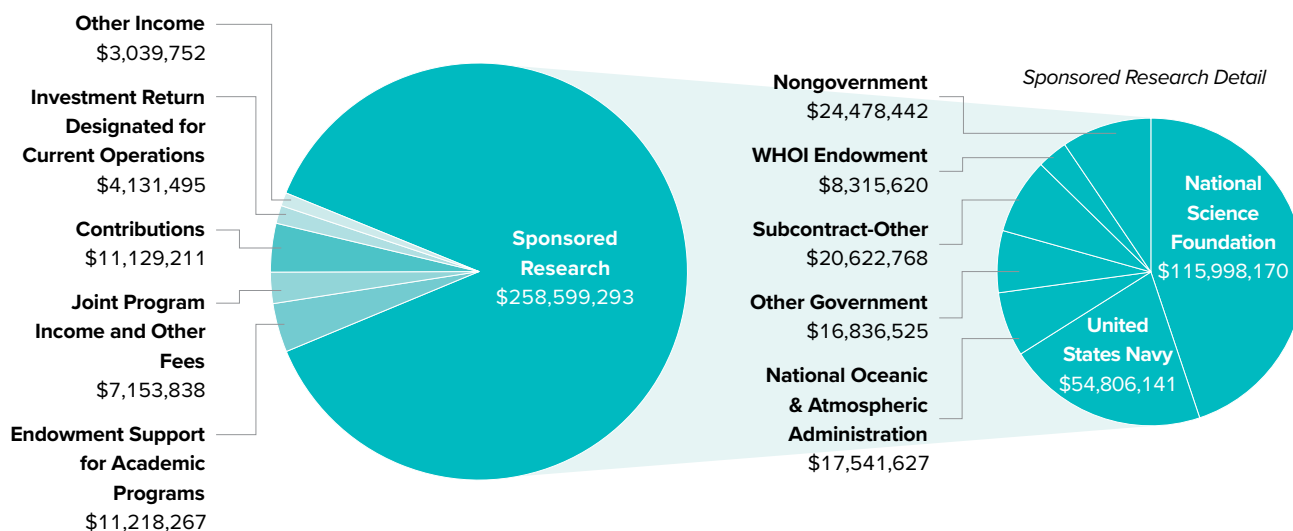
WE ARE PLEASED TO PRESENT THE 2021 AUDITED FINANCIAL STATEMENTS OF THE WOODS HOLE OCEANOGRAPHIC INSTITUTION (WHOI). WE ARE GRATEFUL TO OUR MANY FUNDERS, BOTH PRIVATE AND PUBLIC, FOR THEIR SUPPORT OF WHOI'S MISSION OF OCEAN RESEARCH, EXPLORATION, AND EDUCATION.

The Institution continued to weather the unprecedented headwinds of the pandemic in 2021 with remarkable resilience. Our scientists, engineers, and technical and support staff remained fully employed and productive, resulting in an increase of 14.6 percent to our total funded sponsored research portfolio. Funding from the National Science Foundation and the United States Navy were key drivers of this increase. We continued to make significant investments in our fundraising activities and finished the year with a surplus of unrestricted funds. We completed our

new research facility, the George and Wendy David Center for Ocean Innovation, on time and on budget in July 2021, based on the original funding source with additional plans to complete the second and third floor. The midlife refit of the *Atlantis* also advanced on schedule and on budget. The *Atlantis* returned to full operation in August 2021. Our endowment realized strong returns, ending 2021 with a market value of \$513.0 million. We are grateful to our trustees for their generosity and fiduciary guidance.

REVENUES

Total: \$295,271,856



STATEMENT OF FINANCIAL POSITION

As of December 31, 2021, WHOI's total assets were \$738.0 million, total liabilities were \$236.6 million, and total net assets were \$501.4 million. Net assets represent the accumulated financial strength of a not-for-profit organization and are an important gauge of its ability to carry out its mission. As noted in our 2021 report, the Institution issued \$75.5 million in MassDevelopment Fixed Rate Revenue Bonds Series 2018, during 2018.

The Institution received net proceeds of \$85.7 million; of this amount \$50.7 million was used to retire the Series 2008 Bonds, with the remaining used to build the new research facility and for renovations and maintenance projects throughout the Institution. The federal government allows interest and depreciation for real property and equipment in the Institution's indirect cost rates for reimbursement. Principal payments on the Series 2018 Bonds began in 2019. The endowment, \$513.0 million, represents 70 percent of the total assets as of December 31, 2021.

STATEMENT OF ACTIVITIES

WHOI's total revenues without donor restrictions increased by \$31.6 million; from \$263.6 million in 2020 to just under \$295.3 million in 2021; and the Institution's change in net assets from operating activities was \$1.3

million. Our \$20.9 million of endowment income and appreciation was distributed to operations as follows:

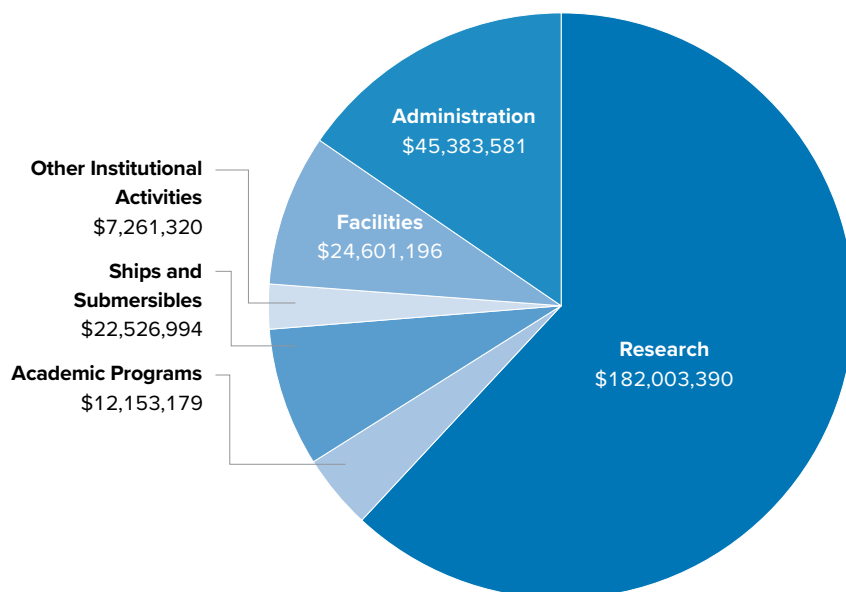
- Education: \$9.2 million
- Research: \$7.5 million
- Unrestricted: \$4.2 million

The Institution had facilities and administration costs of \$70.0 million, and approximately 84 percent of that amount, \$58.7 million, was recovered from government and nongovernment research. This included \$2.0 million of interest associated with the Series 2018 Bonds. The remainder was institutional expenses.

Philanthropy continues to play a large role in meeting both research and educational programming obligations. Current-use giving and endowment income accounted for 19.8 percent of the Institution's revenue in 2021. In total, 6,963 supporters invested in high-impact ocean science at WHOI in fiscal year 2021. The continued expansion of the donor base at all levels remains an essential growth strategy for coming years.

EXPENSES

Total: \$293,929,660





WOODS HOLE
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INSTITUTION

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