



WELCOME
to
Woods Hole

A world center for marine,
biomedical, and environmental
scientific exploration

Welcome to Woods Hole

A History of the Scientific Community

The village of Woods Hole was settled more than 300 years ago and for two centuries remained primarily a farming and fishing community. Then in 1871 the United States Commission of Fish and Fisheries (precursor of the National Marine Fisheries Service) was established, and its first director, Spencer Fullerton Baird, set up a seasonal collecting station in Woods Hole to study marine animals. Attracted by the abundance of fauna and unpolluted waters, he established a permanent laboratory in the village in 1875. Soon, visiting scientists were studying local marine plants and animals, and a hatchery was organized to stock rivers with shad, salmon, and other fish.

In 1888, a second institution, the Marine Biological Laboratory (MBL), was established across the street. Its founders believed that some of the essential processes of life, such as cell division, nerve and muscle activity, and development, might be studied more easily in simple marine forms than in higher animals. Consequently, both teaching and research were begun in cellular biology, embryology, and biomedical fields as well as in marine biology in general.

Woods Hole Oceanographic Institution (WHOI), a private nonprofit research organization originally funded by the Rockefeller Foundation, was incorporated in 1930 to study all branches of oceanography. During World War II, WHOI gathered oceanographic information for anti-submarine warfare, amphibious landings, and other operations. Since then, WHOI has continued to work with the government, with 80% of its annual budget supported by federal grants and contracts, primarily the National Science Foundation.

In the 1960s, a fourth institution, the U.S. Geological Survey, headquartered its new branch of Atlantic Marine Geology here to investigate the geology and geophysics of the Atlantic, Gulf of Mexico, and Caribbean. The Sea Education Association joined the community in 1975, and Woods Hole Research Center in 1985.



NFESC Photo Archives

Water Street, early 1900s. Candle House at right dates to Woods Hole's whaling days (1828–1864). Fisheries building is at left in background.

Map of Woods Hole



Map by Jayne Doucette, WHOI Graphic Services



National Marine Fisheries Service (NMFS) is the federal agency with stewardship responsibility for our nation's living marine resources. The agency's Woods Hole Laboratory conducts research on fisheries resources and the fishermen who harvest them, and on marine mammals and other protected resources in the Northwest Atlantic Ocean. Information derived from this research is primarily used by those who make management decisions about these resources and their habitats.

The laboratory is the nation's first and oldest facility specifically dedicated to marine fisheries research. It became a year-round institution in 1875, and is currently part of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Laboratory scientists are primarily interested in three broad areas of research—resource assessment, ecosystem monitoring, and socioeconomics. Resource assessment scientists determine the distribution, size, and productivity of marine fish, shellfish, and marine mammal populations, as well as the effects of fishing and other human activities on those populations. Ecosystem monitoring scientists investigate the role that natural or nonhuman factors (such as climate

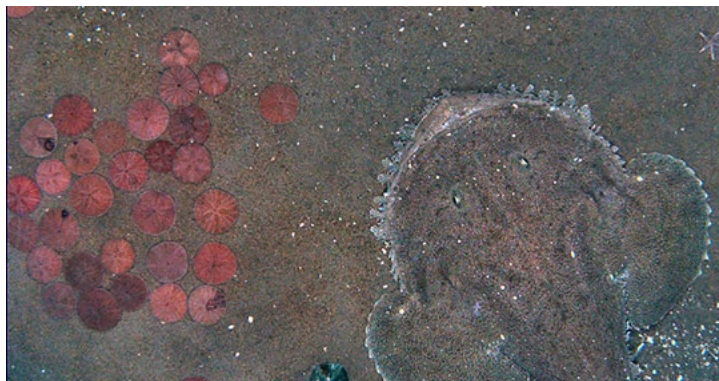
change and food web dynamics) play in marine populations and the overall ecosystem. Socioeconomic scientists study the social, economic, and cultural effects of fisheries and marine mammal management on coastal communities in the New England and Mid-Atlantic states. Fieldwork by laboratory scientists is supported by the 209-foot *Henry B. Bigelow*.

The Laboratory employs about 175 natural and social scientists, technicians, and administrators. It also houses the Woods Hole Science Aquarium, which annually receives more than 80,000 visitors, including several thousand students on science field trips.

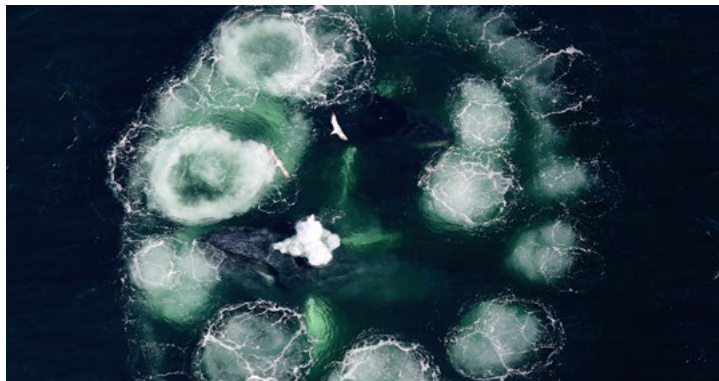
The Laboratory further serves as headquarters for NMFS's Northeast Fisheries Science Center, which coordinates research not only at the Woods Hole Laboratory, but also at four other laboratories in the Northeast (Narragansett, RI; Milford, CT; Highlands, NJ; and Orono, ME). Scientists at these other locations conduct research on ecosystem health, aquaculture, habitat conservation, and endangered or protected marine life in the waters of the Northeast continental shelf.



Left: Lu-Seal, Woods Hole Science Aquarium's resident marine mammal. See back cover for hours and location.



Top right: A monkfish and sea scallops on the ocean's bottom. Image taken by a towed camera during a research cruise.



Below right: Two humpback whales make a net of bubbles to trap prey, photographed during a NOAA Fisheries whale research flight. Image taken under MMPA research permit#17355.

Photos courtesy of National Marine Fisheries Service

Marine Biological Laboratory

www.mbl.edu



Founded 1888

Since its founding in 1888, the Marine Biological Laboratory (MBL) has played a pivotal role in fundamental biological discovery. More than 55 MBL-affiliated scientists have been recognized with Nobel Prizes.

The MBL's oldest and most singular strength is its convening power, attracting the world's leading scientists and students to Woods Hole to accomplish some of their most creative and far-reaching work. Each year, more than 1,000 scientists and students utilize the laboratory's unique resources and environment, with a strategic focus on the oceans and marine life, the inner workings of cellular life, and the science and impact of climate change. Their research centers around four key areas:

- new discoveries emerging from the study of novel marine organisms, encompassing research in regenerative biology, neuroscience, sensory physiology, and comparative evolution and genomics;
- the study of microbiomes and microbial diversity and ecology in a variety of ocean and terrestrial habitats to uncover how microbial systems orchestrate major biogeochemical cycles that sustain life on Earth.
- development of novel optical technologies and computation applications to discover invisible worlds that no one knew existed—from the rich diversity of

ocean and coastal marshes to the molecular details of intracellular life in a variety of organisms.

- research at the nexus of the biological and geophysical sciences, evolution, and ecology—shaping our understanding of the causes and impact of climate change, species dynamics, and the diversity of ocean life.

Central to the MBL's identity are its advanced courses, which attract more than 550 of the best and brightest students in the world, from more than 300 institutions and over 30 countries. Students learn from internationally renowned scientists and are immersed in the laboratory, learning cutting-edge approaches while investigating contemporary research problems.

The MBL offers scientific workshops and conferences throughout the year, as well as courses and internships for undergraduate and graduate students. The public is invited to visit the Pierce Exhibit Center (see back cover), book a summertime tour, or attend one of the many free lectures open to the community.

The MBL is a private, nonprofit institution. In 2013, the laboratory formed an affiliation with the University of Chicago.



MBL Collection



Tom Klein/dinst



MBL Collection

Left: The MBL has a long history of research in ecosystems science and global change, and carries out studies on ecological change and its impact in a number of locations, from coastal oceans to the Arctic.

Top right: Marine organisms, with their many unique characteristics and traits, represent the next frontier of basic biological discovery.

Bottom right: MBL scientists investigate diverse areas of fundamental biology to explore the origins, diversity, and nature of life on a changing planet, and to inform the human condition.



The Woods Hole Oceanographic Institution (WHOI) is synonymous with exploration of the unknown. Since 1930, WHOI researchers have ventured to the furthest reaches of Earth and brought back discoveries that have saved lives, provided invaluable benefit to society, and transformed our understanding of the planet we live on.

In World War II, WHOI chemists and biologists developed anti-fouling paint for the U.S. Navy that saved money and improved ship performance. They also made fundamental discoveries about sound in the ocean that enabled U.S. submarines to escape detection, while allowing the U.S. to more effectively track enemy subs.

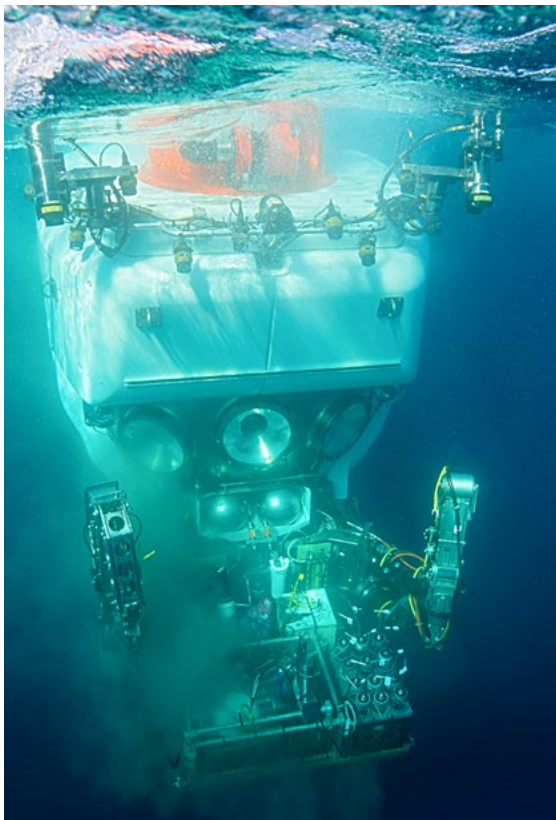
WHOI scientists have revealed the fundamental chemical and physical workings of the oceans that regulate Earth's climate. At the same time, they have discovered how changes to these systems, some human-induced, often have far-reaching impacts.

WHOI engineers have pioneered many undersea technologies, including the human-occupied submersible *Alvin*, that have enabled researchers to blaze new trails into the deep. In 1977, scientists discovered lush communities of life around hydrothermal vents on the seafloor, revolutionizing our understanding of how life can exist without sunlight here on Earth and where it

might one day be found elsewhere in the solar system. In 1985, WHOI-led teams located the wreckage of RMS *Titanic* and, in 2011, the wreckage of Air France flight 447. WHOI scientists also helped assess the impacts of the 2010 Deepwater Horizon oil spill and continue to monitor the spread of radiation from the Japanese nuclear power plant in Fukushima across the Pacific.

Today, WHOI is the world's largest private nonprofit oceanographic research institution, attracting scientists across a broad spectrum of scientific fields to its labs in Woods Hole. The world-renowned graduate program it operates with the Massachusetts Institute of Technology trains students from around the world to become future leaders in ocean science and engineering.

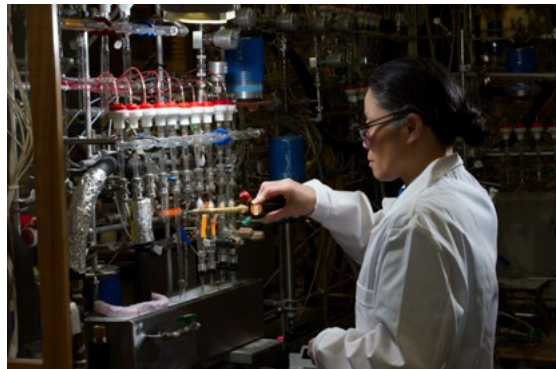
In labs and classrooms, ships and field sites, WHOI scientists, engineers, technicians, and students work side-by-side in often harsh and unpredictable conditions for a single purpose: to better understand the oceans that sustain us and make our planet livable.



Chris Linder, WHOI



Bay Aerial, WHOI



Tom Kleindinst, WHOI

Left: Human Occupied Vehicle (HOV) *Alvin* enables in-situ data collection and observation by two scientists to depths reaching 4,500 meters.

Top right: In 2015, WHOI's newest research vessel the R/V *Neil Armstrong* makes its inaugural voyage.

Bottom right: A research assistant working in the National Ocean Sciences Accelerator Mass Spectrometry Facility (NOSAMS). NOSAMS provides analyses of carbon 14 to determine the age of carbon-bearing materials up to about 60,000 years old.



**Woods Hole
Science Center
Established 1962**

Earth scientists at the U.S. Geological Survey's Woods Hole Coastal and Marine Science Center explore and study the geology, chemistry, and physics of marine and fresh water environments in the United States and around the world. Established in 1962, the field office has grown from a handful of researchers exploring the offshore continental margin to a team of about 100, studying many of society's pressing issues, such as climate change, coastal erosion, marine pollution, resource extraction, and habitat degradation. The USGS research facility is located on the Quissett Campus of the Woods Hole Oceanographic Institution.

The Woods Hole team's research focuses on five general themes: coastal and shelf geology, sediment transport, environmental geoscience, energy and tectonics, and information science. A long-term goal is to develop predictive capabilities for geologic processes and to provide the basic geologic framework of U.S. coastal and offshore areas. The results of these studies are released to the public as reports, maps, journal articles, books, atlases, websites, and seminar contributions. Much of the data and information are accessible online through the USGS Web site.

The USGS Woods Hole Coastal and Marine Science Center has specialized capabilities in

oceanographic research, including sediment transport instrumentation, an integrated seafloor mapping facility, geochemistry laboratory facilities, the coastal and lake research vessel *Rafael*, a gas-hydrates testing laboratory, and an advanced autonomous surface vehicle for shallow-water geophysical studies (IRIS).

USGS research is used to increase basic understanding of earth processes, to help develop government policy, and to aid managers in their stewardship and regulatory functions. The USGS in Woods Hole collaborates with other research institutions within the Woods Hole scientific community, the nation, and the world. USGS marine research also involves collaboration with states and other government agencies such as the Environmental Protection Agency, the Army Corps of Engineers, the departments of Commerce, Energy, Defense, and State, and other bureaus within the Department of the Interior.

Publications by the Woods Hole team provide scientific information of national and international importance to the research community, federal and state agencies, as well as the general public. Additional information is available via the USGS Web site at www.usgs.gov.



Top left: Onshore and offshore groundwater sampling. Geochemists study the flux of groundwater and nutrients across the land-sea interface.

Top middle: The autonomous surface vessel IRIS.

Top right: Gas hydrate researchers sampling a deep-sea sediment core from the Gulf of Mexico. Gas hydrates are being studied for their potential as a methane resource in both permafrost and deepwater marine settings.



Bottom: USGS Woods Hole Coastal and Marine Science Center, Quissett Campus.

Clockwise from top left: Sandy Baldwin, USGS; Tom O'Brien, USGS; Bill Winters, USGS; Dann Blackwood, USGS

SEA Semester®



Relocated to
Woods Hole
in 1975

Sea Education Association (SEA) is an internationally recognized leader in undergraduate ocean education. Since 1971, they have equipped students with the tools to become environmentally literate leaders prepared to address the defining issue of the twenty-first century: the human impact on the environment.

SEA has educated over 8,000 ocean scholars, stewards and leaders through its flagship accredited study abroad program, SEA Semester. SEA Semester is the sailing adventure of a lifetime grounded in academic purpose. The program combines classroom study on the SEA campus in Woods Hole with a sailing research expedition in the Atlantic, Pacific, or Caribbean. This unique shore-to-sea approach allows students to take what they have learned in the classroom and test it against their observations in the field, sailing as scientists and crew aboard one of SEA's two custom-equipped tall ship research vessels.

The SSV *Corwith Cramer* and the SSV *Robert C. Seamans* are both inspected and certified by the U.S. Coast Guard as Sailing School Vessels (SSV). They are maintained and staffed to the highest standards, and meet or exceed the Coast Guard safety requirements for their class.

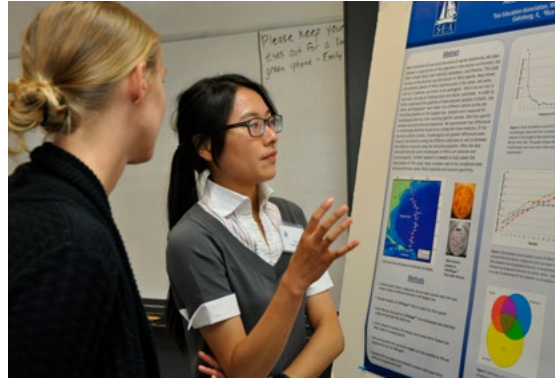
SEA's other educational offerings include summer high school programs, partnership in the graduate MIT/

WHOI Joint Program, and collaborative programs with institutions including Harvard University, Stanford University, and the Wharton School at the University of Pennsylvania, among many others.

In 2016, the National Science Board – the advisory body for the National Science Foundation – named SEA the recipient of its 2016 Public Service Award. This annual prize honors individuals and groups that have made substantial contributions to increasing public understanding of science and engineering in the United States.

SEA campus entrance





Top left: Shipboard lab

Top right: Student poster presentations.

Bottom right: Class on the quarterdeck

Bottom left: SSV *Robert C. Seamans*, SEA's Pacific sailing research vessel





WOODS HOLE
RESEARCH CENTER

Founded 1985

Woods Hole Research Center (WHRC) has been studying climate change causes, impacts, and solutions since 1985. With research projects spanning the globe, from Cape Cod to Siberia, WHRC scientists focus on forests, soils, rivers, and land use change. The Center was named the world's number one climate change think tank for three years in a row, from 2014-2016.

WHRC holds an important place in the history of the environmental movement. In 1979, WHRC founder George M. Woodwell was one of the first scientists to testify before the US Congress about the dangers of climate change. In 1992, WHRC was instrumental in launching the United Nations Framework Convention on Climate Change, the body which ever since has negotiated major climate treaties, culminating in the landmark 2015 Paris Agreement. WHRC scientist Richard A. Houghton was recognized for his contributions to the Intergovernmental Panel on Climate Change when it was awarded the 2007 Nobel Peace Prize. In 2009, then-WHRC President John P. Holdren was hired by President Barack Obama to become the White House science adviser. Dr. Holdren went on to serve in that role longer than anyone in US history.

WHRC has long-running projects monitoring forests in the Brazilian Amazon, assessing permafrost thaw and boreal forest vulnerability in the Arctic, analyzing climate impacts on rivers and their watersheds, and educating the next generation of scientists. Using a combination of field work and satellite remote sensing, WHRC scientists map and model their findings, publish results in peer-reviewed scientific journals, and work with governments to incorporate science into policy.

Originally located in the village of Woods Hole, the institution moved in 2003 to its Gilman Ordway Campus, which encompasses two energy efficient buildings on 8 acres of land on the Quissett ridge. Because of the Center's focus on the effects of greenhouse gas emissions, the George M. Woodwell Building (2003) and the Carriage House (2010) were specifically designed to use sustainable materials and renewable energy systems. The institution's energy need is supplied in large part by solar panels and a 100kW wind turbine. Seventy percent of WHRC's approximately 50 employees are scientific researchers.



Top left: WHRC Gilman Ordway Campus: George M. Woodwell Building.

Top right: Researchers at Tanguro Ranch field station, Brazil.

Bottom: Scientists study effects of fire at Yukon Delta National Wildlife Refuge.



© Chris Linder

Woods Hole at a Glance

The Woods Hole Science Aquarium at NOAA Fisheries, Marine Biological Laboratory's Robert W. Pierce Visitors Center, and Woods Hole Oceanographic Institution's Ocean Science Exhibit Center and Information Office are open to the public.

Marine Biological Laboratory

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National Marine Fisheries Service

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