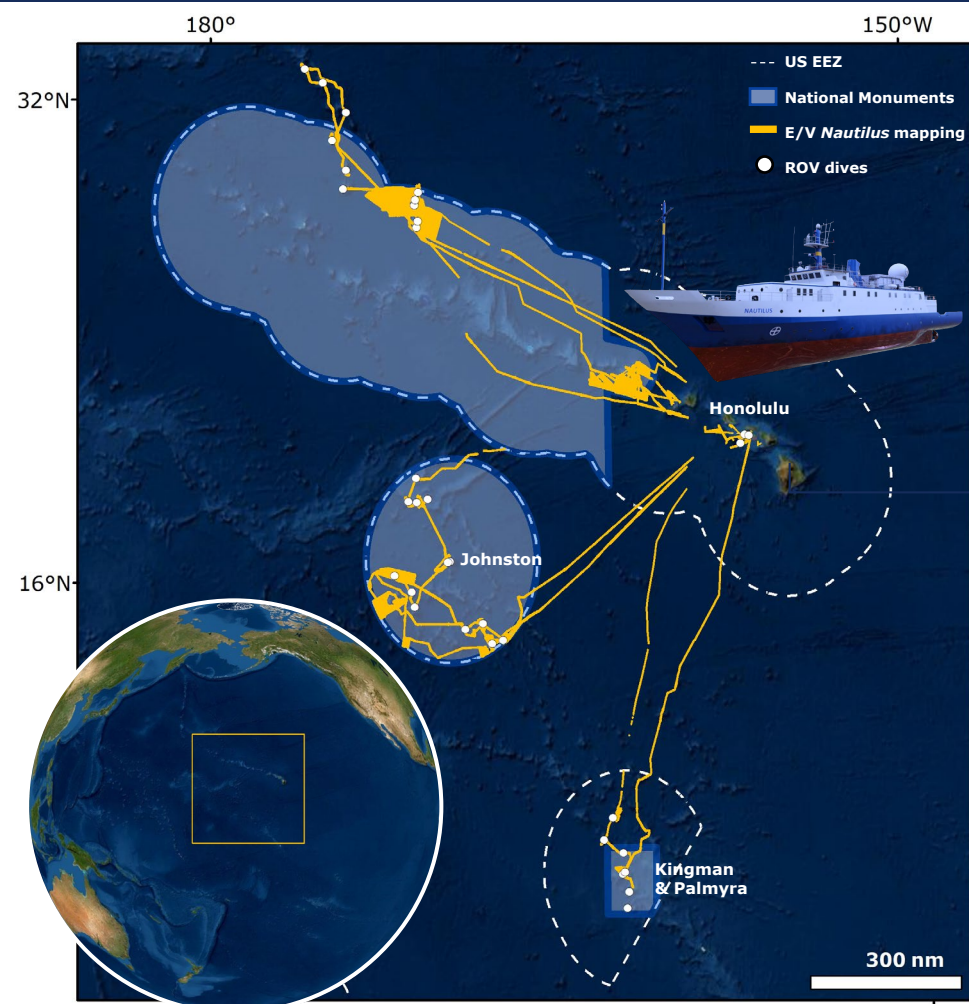
















E/V *Nautilus*

2022 Season Summary



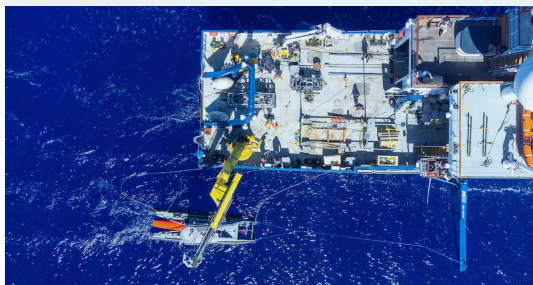
-  **11** expeditions
-  **202** days at sea
-  **162,172** km² of seafloor mapped
-  **34** successful ROV dives
-  **534** hours of seafloor exploration
-  **562** samples collected
-  **36** students at sea
-  **21** educators at sea
-  **111** scientists participated remotely
-  **1,180** media stories
-  **569** live ship-to-shore interactions
-  **>72,000** ship-to-shore participants
-  **>1,800,000** live stream views
-  **>6,500,000** highlight video views

OVERVIEW

In 2022, E/V *Nautilus* successfully completed an 8-month field season consisting of 11 expeditions that explored the Central Pacific for a total of 202 days at sea. E/V *Nautilus* began its season with a shakedown expedition in the Main Hawaiian Islands, and then conducted a series of expeditions focused on seafloor mapping and ROV explorations, testing and integrating emerging exploration technologies, and a brand-new partnership with the National Geographic Society focused on shallow-water surveys. Collectively, 2022 expeditions mapped over 162,000 km² of seafloor, and surveyed a wide diversity of habitats and geological features ranging from coral reefs just a few meters below the surface to abyssal depths approaching 4,000 meters.

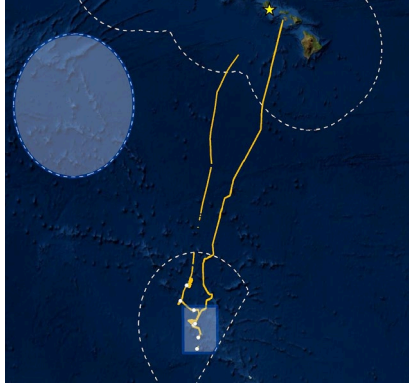
SHAKEDOWN

Between March 1-10, E/V *Nautilus* conducted a shakedown expedition to complete engineering tests in preparation for the 2022 season. This 9-day expedition included routine shakedown operations of the ship's mapping systems and ROVs, as well as the first-time integration of University of New Hampshire's uncrewed surface vehicle (USV) *DriX* onto E/V *Nautilus*. This included integrating the vehicle with the ship's infrastructure, fine tuning the deck operations with launches and recoveries, as well as training the team in emergency scenarios and operating USV *DriX*. Many lessons were learned during the mission, which were pivotal to the success of two cruises later in the season that also included USV *DriX*.



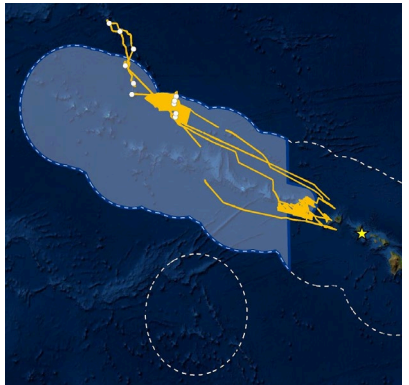
KINGMAN & PALMYRA

Between March 14-April 5, E/V *Nautilus* conducted a [22-day expedition](#) to explore the deep-sea habitats in the US EEZ surrounding Kingman Reef and Palmyra Atoll. Despite weather challenges, the expedition completed eight successful ROV dives, six of which within the current boundaries of the Monument, and two in an area that may be considered for Monument expansion in the near future. During one of the dives, the ROVs documented an enigmatic sedimentary deposit, which may represent turbidites deposited after a slump failure, a phenomenon that has not been recorded in this region. In addition to ROV dives, the expedition mapped over 19,507 km² of previously unmapped seafloor, including 3,450 km² within the Pacific Remote Islands Marine National Monument.



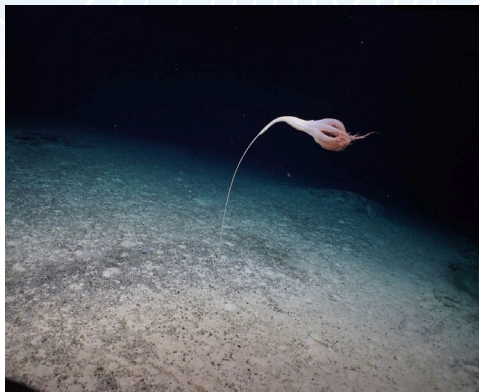
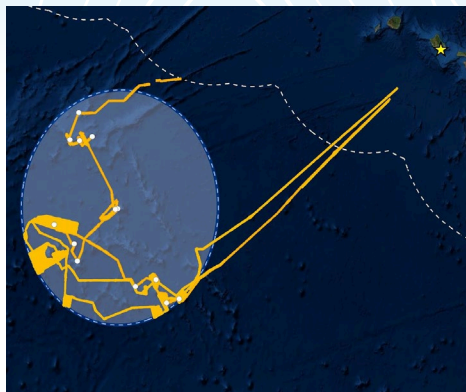
PAPAHĀNAUMOKUĀKEA MARINE NATIONAL MONUMENT

Between April 7-September 13, E/V *Nautilus* conducted three expeditions for a combined 72 days at sea in and around the Papahānaumokuākea Marine National Monument. The [first of these](#) included ROV explorations, and the other two were dedicated to seafloor mapping. Noteworthy ROV observations included a “[yellow brick road](#)” documented at 1,029 meters, a geological formation that likely represents the fractured crust of a hyaloclastite deposit where the fractures intersected at right angles. While this formation is a result of completely natural causes, its resemblance to a human-made structure resulted in the story obtaining close to 1.5 billion in press reach. The three expeditions mapped a combined area of 89,330 km², including 72,118 km² inside the Monument. Mapping operations on these missions built on previous mapping efforts inside the Monument by the E/V *Nautilus* and other programs. Collectively, over half of the seafloor inside the Monument has now been mapped at a high resolution, providing an important foundation for follow-on exploration, research, and management activities.



JOHNSTON

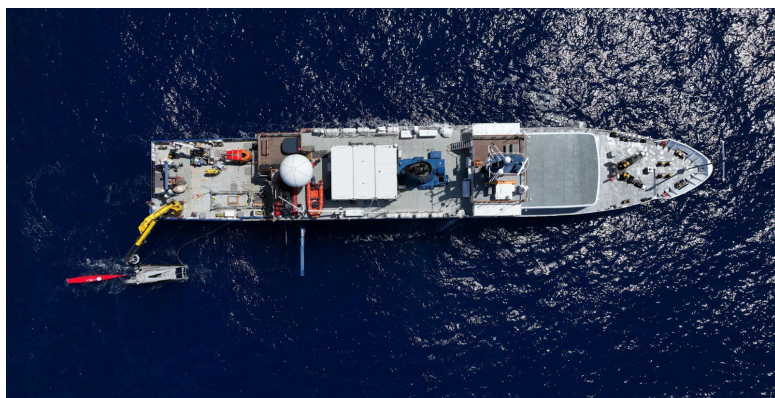
Between May 25-July 13, 2022, E/V *Nautilus* conducted two back-to-back expeditions for a combined 47 days at sea that explored the deep-water geology and biology inside the Johnston Unit of the Pacific Remote Islands Marine National Monument. The expeditions mapped over 55,275 km² of seafloor, including 42,493 km² inside the Monument where several seamounts and larger ridge features were mapped for the first time. This mapping data was key to the successful execution of 13 ROV dives during the [second expedition](#), which explored a wide diversity of habitats and geological features, including the deeper flanks of Johnston Atoll, as well as those of offshore seamounts and guyots. Noteworthy ROV observations included recording basalt atop most guyots with basalt morphologies overlying limestones. This suggests that many guyots in this region experienced multiple phases of volcanism. Other noteworthy observations included the discovery of a [fossilized Megalodon tooth](#), [fossilized whale bones](#), and the first record of the seapen genus [Solumbellula from the Pacific](#). A total of 278 samples were collected, a record for the E/V *Nautilus*, which will support future studies on the deep-sea biodiversity, geological age, and volcanic history of the region.



TECHNOLOGY CHALLENGE & DUAL-TECHNOLOGY MAPPING

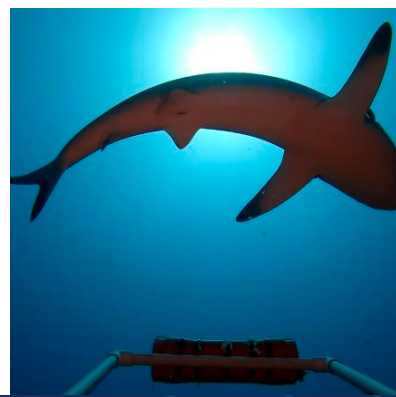
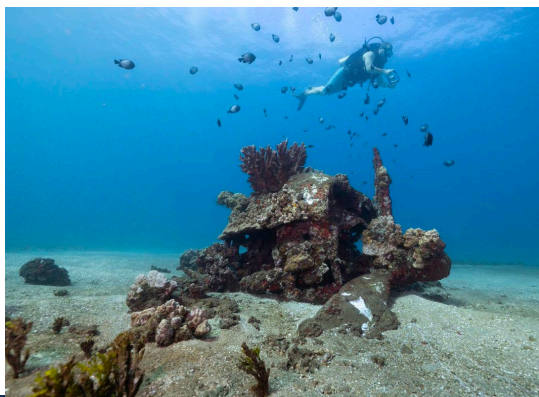
Between May 6-22, E/V *Nautilus* supported an [expedition](#) that combined various [exploration technologies](#), including USV *DriX* from the University of New Hampshire, as well as the autonomous underwater vehicle *Mesobot* and hybrid vehicle *Nereid Under Ice* from Woods Hole Oceanographic Institution. Over the course of this 16-day expedition, the team successfully demonstrated the complimentary capabilities of these technologies, including communications between the three vehicles while they were simultaneously deployed, the vehicles being re-tasked based on information gained from a partner vehicle, and remotely operating the vehicles by personnel back on shore.

Between July 16–August 8, E/V *Nautilus* conducted [an expedition](#) that mapped seafloor around the Northwestern Hawaiian Islands using [sonars of both the ship and USV *DriX*](#). Over the course of six USV *DriX* deployments, the shallow-water mapping capabilities of USV *DriX* were progressively integrated into simultaneous mapping operations with the deep-water sonars of E/V *Nautilus*. In addition to developing important new protocols for multi-vehicle exploration, the expedition also demonstrated inter-institutional collaboration, with the mission being co-funded by NOAA Ocean Exploration via the Ocean Exploration Cooperative Institute, and NOAA Office of Coast Survey via the Center for Coastal and Ocean Mapping/Joint Hydrographic Center.



FROM SHORE TO THE ABYSS

Between September 15-October 24, E/V *Nautilus* conducted [three back-to-back expeditions](#) in support of the new From Shore to the Abyss program, with funding from the National Geographic Society. The team quickly adapted to this new shallow-water focus, a first for E/V *Nautilus*, and supported the deployment of divers, snorkelers and sampling equipment in nearshore waters around the islands of Maui, Lānaʻi and Hawaiʻi. These expeditions focused on field surveys to support studies on [marine mammal communication](#), [shark communities](#), [maritime heritage](#), and [microplastic pollution](#). In total, 116 SCUBA and 40 small boat surveys were conducted over the course of these expeditions.



DATA ACCESS

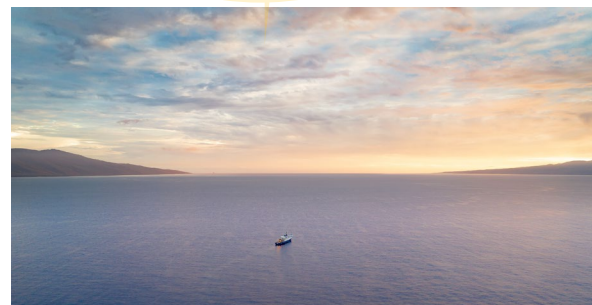
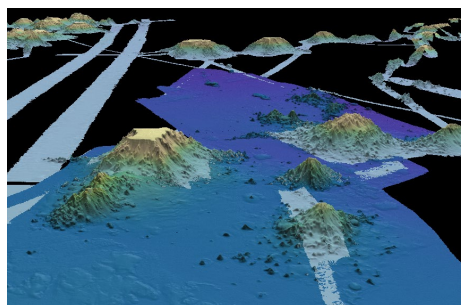
Making our data publicly available continues to be a priority. To this end, data and samples collected during 2022 expeditions, including video and environmental data collected on every ROV dive, physical samples, mapping and oceanographic data, have been sent to publicly-available repositories for archiving, links to which are provided below. In the interim, data is also available [upon request](#).

DATA TYPES	ARCHIVES
Expedition websites (Background information, highlight photos, videos, and educational materials)	NautilusLive.org
Expedition documentation (daily reports, event logs, chat logs)	Marine Geoscience Data System
ROV documentation and observations (dive reports, event logs, chat logs)	Marine Geoscience Data System
ROV video (full dive videos)	YouTube and Marine Geoscience Data System
Geological samples (rocks and push cores)	Marine Geological Samples Lab at the University of Rhode Island
Biological samples (whole specimens and tissue)	Harvard University's Museum of Comparative Zoology
Ship seafloor mapping (multibeam, backscatter, and sub-bottom)	Rolling Deck to Repository and Marine Geoscience Data System
Ship navigation (latitude, longitude, heading)	Rolling Deck to Repository and Marine Geoscience Data System
Ship-sensor environmental data (CTD, O2, air temperature, sea surface temperature)	Rolling Deck to Repository and Marine Geoscience Data System

BROADER IMPACTS

E/V *Nautilus* expeditions in 2022 surveyed some of the remote areas in the US Pacific, as well as successfully integrated various emerging exploration technologies. Expeditions were planned and executed around US government priorities to close knowledge gaps. Mapping and ROV operations were all conducted in unexplored areas, thus contributing directly to the National Strategy for Mapping, Exploring, and Characterizing the United States Exclusive Economic Zone, Seabed 2030, and the UN Decade of Ocean Science for Sustainable Development. The successful integration of several autonomous vehicles onto E/V *Nautilus* demonstrated that the use of multiple robotic vehicles is a powerful force multiplier in collecting ocean data.

Expedition activities also advanced NOAA mission priorities, particularly in terms of understanding ocean changes, sharing that knowledge with others, and conserving marine ecosystems. This work also helped advance priorities on education, diversity, and inclusion by providing opportunities for underrepresented minority groups to participate in expeditions. Finally, the data collected on these missions is an essential precursor to future explorations throughout the region, which will undoubtedly lead to many more discoveries. To this end, data and samples collected on these missions have been deposited in publicly available repositories in order to enable follow-on science and management activities.



ACKNOWLEDGMENTS

Thanks to the captain and crew of E/V *Nautilus*, the Nautilus Corps of Exploration, the Ocean Exploration Trust, and all that supported the expeditions from shore. 2022 expeditions were funded by NOAA Ocean Exploration via the Ocean Exploration Cooperative Institute, NOAA Office of Coast Survey via the Center for Coastal and Ocean Mapping/Joint Hydrographic Center, and the National Geographic Society.