



DEEP-SEA TALES FROM A HAWAIIAN MARINE PROTECTED AREA

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YOUNG REVIEWERS:



CELINE
AGE: 14



KEVIN
AGE: 15



ERIC
AGE: 10

The deepest portions of the world's oceans remain mostly unexplored, although recent expeditions onboard the exploration vessel called Nautilus added many new insights to our ocean knowledge. In this article we unveil some details from a previously unexplored area of the Pacific Ocean. The Papahānaumokuākea Marine National Monument, off the Hawaii Archipelago, is an incredible place. Here, undersea mountains, deep-ocean coral forests, and habitats created by volcanoes are common, but their details remain mysterious. Our recent expedition relied on the contributions of indigenous people, who interacted directly with ocean scientists. The indigenous collaborators shared tales from their ancient cultural traditions, and their information was useful for shaping the scientific exploration. The collaboration made the exploration even more enriching for the scientists, deepening their relationship with the beloved ocean!

REMOTELY OPERATED VEHICLE (ROV)

A free-swimming submersible craft controlled remotely by scientist hosted on a research vessel and used to perform tasks such as exploration of the deep ocean.

TWILIGHT ZONE

The area between 200 m and 1,000 m below the ocean surface. This zone is still largely unexplored and includes sharp changes in temperature, salinity (saltiness) and water density.

Figure 1

The Hercules ROV exploring the deep-sea environment during the 2024 Nautilus expedition.

MARINE PROTECTED AREAS

Ocean zones with special rules to protect sea life. They help keep marine ecosystems healthy, support biodiversity, and ensure people can benefit from ocean resources.

HAVE YOU HEARD ABOUT REMOTELY OPERATED VEHICLES?

Remotely operated vehicles (ROVs) are deep sea exploration devices, tethered to the main ship through a long cable. They are unmanned and controlled remotely from scientist remaining onboard the ship E/V Nautilus. The first ROV was called Poodle and it was designed in 1953. Hercules ([Figure 1](#)) is a U.S.-designed ROV owned by the Ocean Exploration Trust, under the direction of Robert Ballard—the researcher known for finding the wrecks of the Titanic and the German battleship Bismarck. The advanced instruments and technologies on Hercules opened scientists' curious eyes thousands of meters below the ocean surface, in what is called the **twilight zone** and beyond. Specifically, we explored the darkness of an underwater mountain called King George Seamount, located within the Papahānaumokuākea Marine Natural Monument. What we saw in these deep underwater zones was incredible!

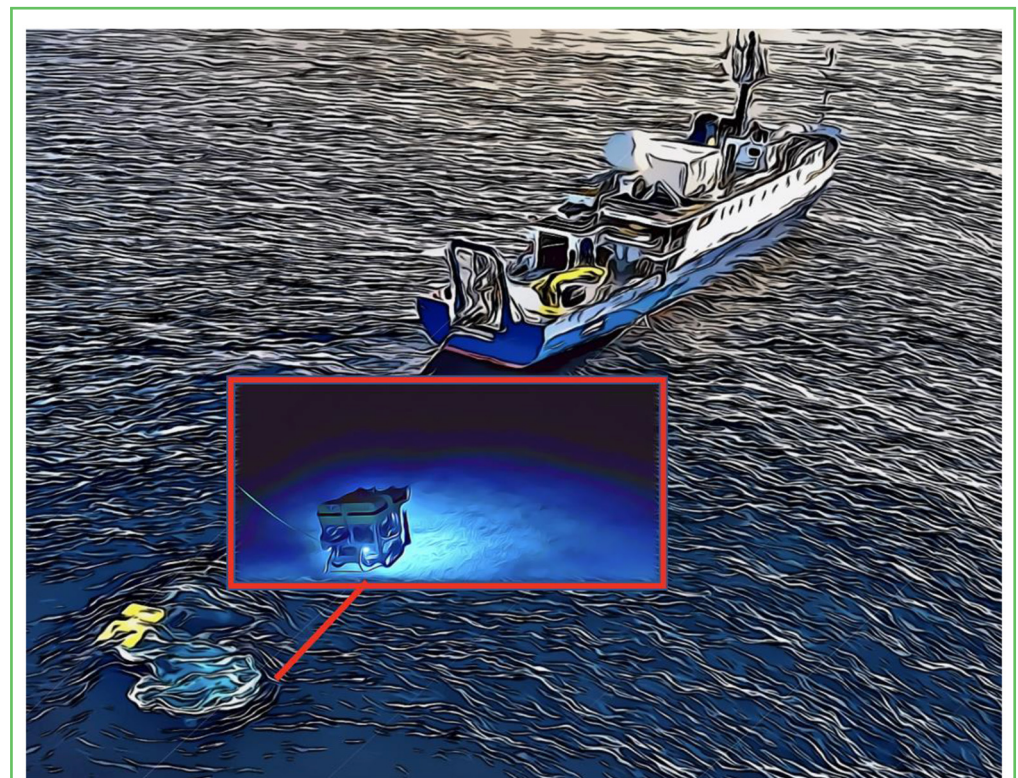


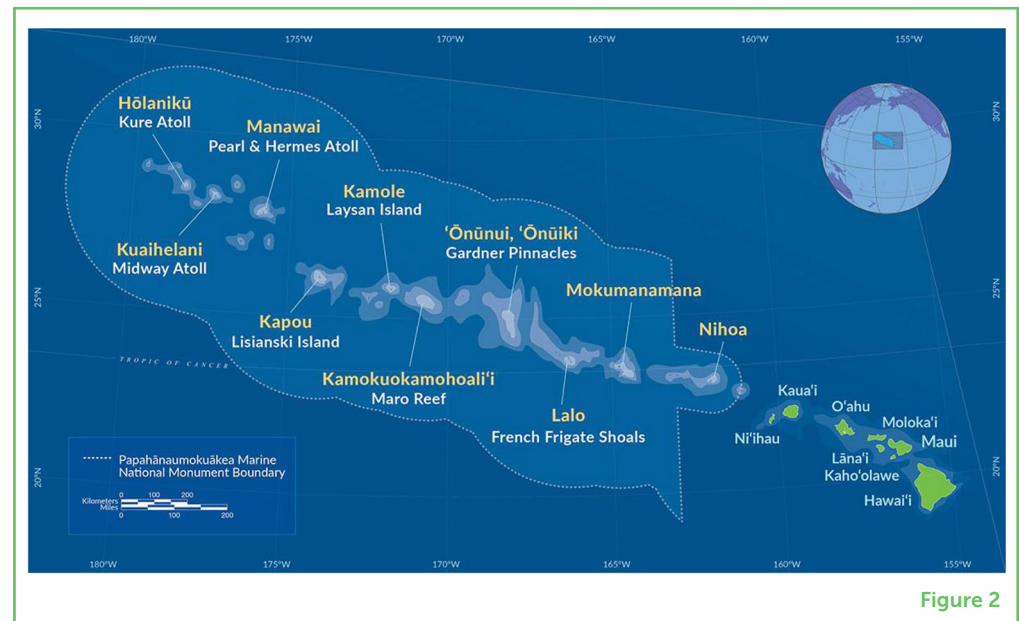
Figure 1

AN EXTRAORDINARY PLACE FOR NEW DISCOVERIES

The Papahānaumokuākea Marine National Monument is one of the largest **marine protected areas** in the world ([Figure 2](#)). Marine protected areas are established worldwide mainly to preserve local biodiversity and to keep ecosystems healthy, but these areas also aim

Figure 2

A map of the Papahānaumokuākea Marine National Monument, highlighting the large number of islets and islands included in this marine protected area. The white dotted line indicates the protected area boundaries.

**Figure 2**

to conserve the cultural heritage and traditions of local inhabitants. Much of the monument consists of open-sea and deep-water habitats, with typical features such as outcropping or shoals, extensive coral reefs, and lagoons. These underwater structures look similar to structures found on land in this region, confirming that both regions are interconnected.

In 2010, the Papahānaumokuākea Marine National Monument area was declared an **underwater heritage site**, in part due to its traditional significance for the **indigenous** Hawaiian culture. This area is considered a sacred ancestral natural environment, embodying the Hawaiian concept of man's belonging to the natural world, and as a place where life is believed to begin and to return after death—reminding people of the strong connection between human wellbeing and natural ecosystems.

Then, in 2016, it was included in the global list of underwater cultural heritage sites [1]. Just like we would protect a historical building on land, the ecosystem and marine species populating this underground monument need and deserve to be protected. In short, the Papahānaumokuākea Marine National Monument is a special area where science and outreach to indigenous communities can come together.

The Papahānaumokuākea Marine National Monument currently includes many small islands. The Nautilus expedition in 2023 contributed to extensively mapping the area within the protected zone, and it also uncovered unexpected new insights about this key **biodiversity hotspot**.

INDIGENOUS

This term describes any group of people native to a specific region, inhabiting or existing in a land from the earliest times or from before the arrival of colonists.

BIODIVERSITY HOTSPOT

A place with much more plant and animal life than nearby areas.

TURNING ON THE LIGHTS DEEP BELOW THE SEA SURFACE

Imagine riding in a car in the deep darkness. You suddenly turn on the headlights and see a colorful, populated world. This is what happened when our ROV was launched in the waters and dove more than 3,000 m into the sea and through the wide screens located onboard in the observation area of E/V Nautilus scientists onboard saw an endless field covered by pink, branched colonies of hard-skeleton corals. This was the same type of marine animal forest also seen nearby in the ancient Johnston Atoll, which has been considered sacred for centuries by the local indigenous people. How did the ancestors of these people know that there was something they must protect deep down in the ocean? This is one of the important mysteries scientists seek to understand using local ecological knowledge.

Have a look at [this video](#) summarizing many of the fascinating things our ROV Hercules helped us to uncover, including the pink coral forest and bamboo corals [2]. Once you watch it, you will never think of the deep ocean as a remote, desert-looking environment again! The video also shows a curious-looking deep-sea fish spotted on Lō'ihi Seamount, which uses a modified dorsal fin on the top of its head as a lure to attract unsuspecting prey into its open mouth! Life in the deep ocean can be hectic, as organisms can sometimes be spotted fighting for survival. We also found a strange sponge during our explorations (Figure 3A). It seems to be looking at us, with its holes resembling two big eyes. This alien-looking friend filters water and serves as a habitat for other, smaller species that live among its holes. Its presence on

Figure 3

An example of images detected from the ROV camera. (A) A deep seamount how it looks like from the ROV camera whilst approaching the seafloor. (B) Some residuals of ghost nets among a deepsea coral branches and an aluminum can discovered on the sea bottom beyond –3,000 m. (C) A dumbo octopus predated from some deepsea squat lobsters. (D) A goosefish from Lophiidae family, among the basalt rocks whilst sampling rocks and benthic organisms with the ROV arm in the deep-sea forest of pink bubblegum corals.

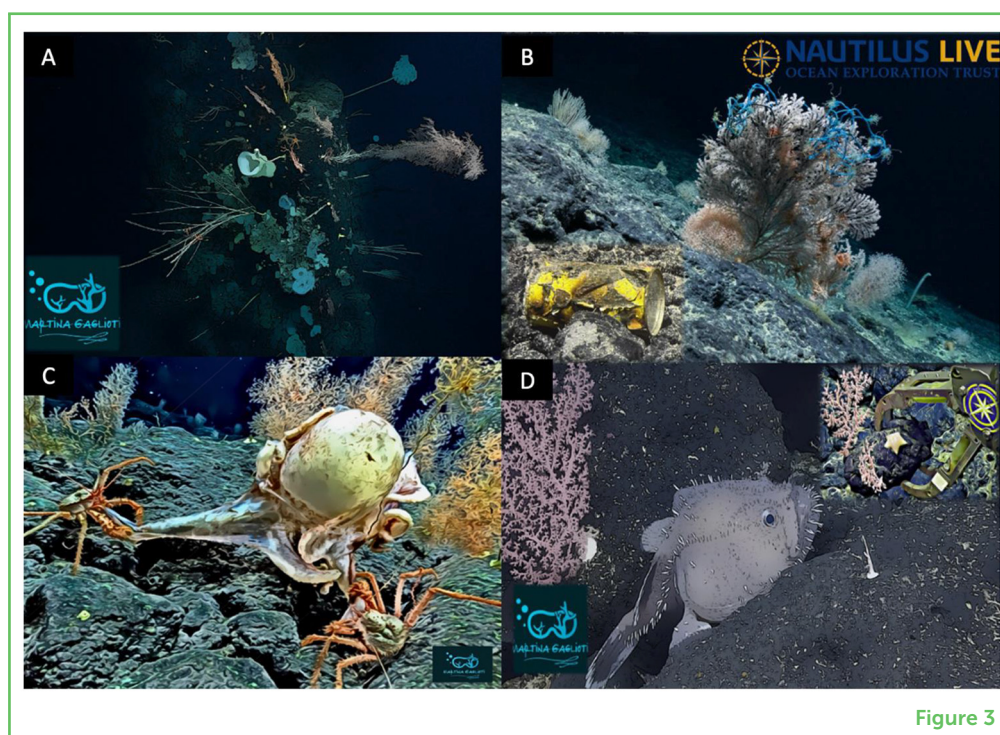


Figure 3

the sea bottom regulates populations of both microfauna (organisms not visible to the naked eye, <0.2 mm in diameter) and macrofauna (organisms >2 mm in diameter) in the region. The base of the sponge is securely anchored to the seafloor by a structure that looks like the stem of a flower, allowing the sponge's body to reach a higher zone in the water column where the environment is richer in nutrients [3]. To catch as many food particles as possible, the sponge's body is normally oriented toward the main current [4]. This is a very clear evolutionary development that helps organisms survive in an environment where nutrients are scarce [5].

MORE THAN DARKNESS AND COLD WATER...

Unfortunately, in addition to the fascinating natural life that we uncovered during our exploration, we also found traces of human impacts in these deep waters far away from the coastline. We found pieces of fishing nets and other debris such as plastic fragments, a yellow aluminum can, and the remnants of other fishing gear amongst the dark granitic stones and the branches of a hard coral colony (Figure 3B). Debris like fishing nets can damage life on the seafloor if it is not removed promptly. Other researchers have also detected similar man-made items at many different deep-sea locations across the world, from the Atlantic to the Indian Ocean [6, 7]. These findings highlight how our actions on land can have long-lasting effects on marine life, even in far-away and remote areas, due to ocean currents and surface winds. This should make us more aware of our daily habits and encourage us to adopt more sustainable practices, such as reducing the amount of waste we produce and recycling as much as possible.

WHEN BIODIVERSITY AND NATURAL WONDERS MIX WITH LOCAL CULTURE

In addition to equipment and technologies that help us explore the depths of the ocean, relying on local knowledge of the ocean environment can also advance our understanding. Combining the knowledge of indigenous people with insights gained using modern technologies is extremely powerful. The intersection between local knowledge and scientific study can be particularly useful when **habitat restoration** actions are needed, for instance to preserve particularly valuable sites or to rehabilitate marine habitats damaged by human activities or other environmental issues. Indigenous people contributed to the expedition since its planning phase, sharing information about local tradition and extant knowledge related to the expedition area, or simply translating some words from local idioms to English helping also in local cartography interpretation. This approach helped the scientific crew to prioritize the exploration areas accordingly. Also, some indigenous people representatives joined

HABITAT RESTORATION

Repairing damaged ecosystems to help plants and animals thrive again. It involves providing the right food, water, space, and shelter for species to survive.

the expedition as integral part of the crew onboard, their presence enhanced a lot the scientific studies adding also an ethical value to the expedition itself.

LOOKING FOR A BRIGHTER FUTURE

Over the past century, humans have explored almost every space on planet Earth. The downside of this exploration is that there is no part of the planet that is free from negative human impacts. Combining scientific skills with traditional knowledge in a respectful way can help us to preserve the rich biodiversity that exists in remote areas like the twilight zone. For example, deep-sea expeditions are normally planned around scientific priorities, but instead, during the planning phase of our 2023 expedition, we integrated indigenous traditional knowledge into our planning phases by asking about local traditions, tales on the explored areas, knowledge gaps such as missing biodiversity information on specific areas, rituals around some places or origin behind some local toponyms.

This approach toward shared knowledge positively affected the outcomes of our joint efforts. For instance, respecting mother nature is a value that indigenous communities pass on through the generations, and we can use this as an example to change our habits and reduce the extensive negative impacts we have had on our planet so far. As hard as we work to improve, there is still more to do—the ocean is *huge* and our knowledge is still so small in comparison. There is still space for many generations of curious new scientists who wish to learn more about ocean ecosystems to better understand and protect our changing planet!

ACKNOWLEDGMENTS

I wish to thank the NOAA colleagues for their warm welcome and the Nautilus Explorer crew who allowed me to join this expedition as Scientist Ashore. The images provided in this contribution are a cartoonized version of some pictures taken from the ROV images archive shared with all the participants at the end of the exploration experience. I sincerely appreciate also the young reviewers efforts to make this contribution more suitable for young readers. Original photo credits: Ocean Exploration Trust, NOAA, Oregon State University, Thurber. This expedition was financed by NOAA and Ocean Exploration Trust.

ORIGINAL SOURCE ARTICLE

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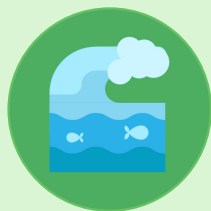
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YOUNG REVIEWERS

CELINE, AGE: 14

Hi, my name is Celine and I am a high school student from Vancouver BC. I really enjoy studying chemistry and biology on my own time. Also, I like to play sports outside with my friends for fun. My other hobbies are reading, drawing, and scrolling on the internet.



KEVIN, AGE: 15

I am a STEM enthusiast with a keen interest in technology and transportation. In my free time, I love observing how things move, whether it is cars on the road or appliances in action. I find joy in helping to fix them, all while marveling at their mechanics. This curiosity extends to my school life, where I actively participate in the Robotics Club and excel in science and math. My dream is to pursue a career in engineering, where I can immerse myself in the world of machines and contribute to innovations that enhance our everyday lives. I thrive on hands-on activities and am excited to explore the endless possibilities in the field!



ERIC, AGE: 10

My favorite series is Harry Potter. I like writing. I also like animals and hope to be a zookeeper when I grow up. So far, I have had 54 pets that have died and are still alive, including mammals, fish, and rodents.



AUTHORS

MARTINA GAGLIOTI

I am a marine biologist, GIS analyst, outreach, and scientific communicator. I am a diver since I was 9, fortunately even well before turning all this into a job! My daily effort is to fill the gap between the scientific world and the wider society. I am currently leading several projects and grassroots initiatives with this rationale both in Med Sea and beyond the EU boundaries. I served as an individual consultant for IOC-UNESCO within the Ocean Literacy team, the Italian National Decade Committee and I am currently serving as an expert for some IUCN Commissions and SER task forces and chapters. I coordinated some Blue school initiatives in Italy and introduced the Blue School concept in Latina Province since 2022. I focused my research on waste management and sustainable recycling, leading to some key investigations on this debated topic even in some key UNESCO sites. My expertise is mainly in marine ecology, but I have a great interest for nature in general so I like to learn also from other ecosystems to shape my research questions and develop investigation ideas. I am currently one of the two Co-chairs of the Decade Gender Expert Working Group and I have served within the EU Blue Parks community since 2023. *mart.gaglioti@gmail.com

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