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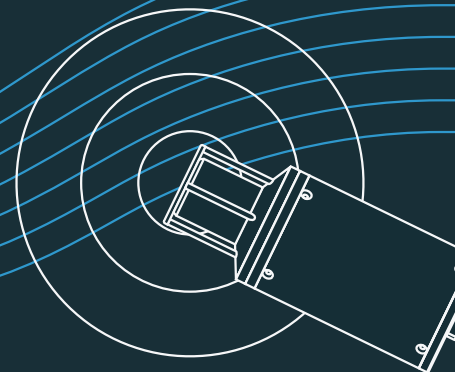
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FEATURING:

Biomedical Research

Deep-Sea Mining Oversight

Q&A: Deepwater Diver Richard Kohler



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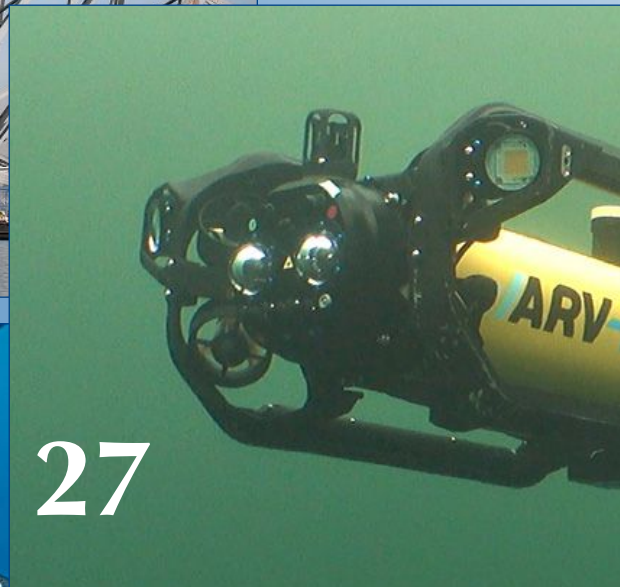
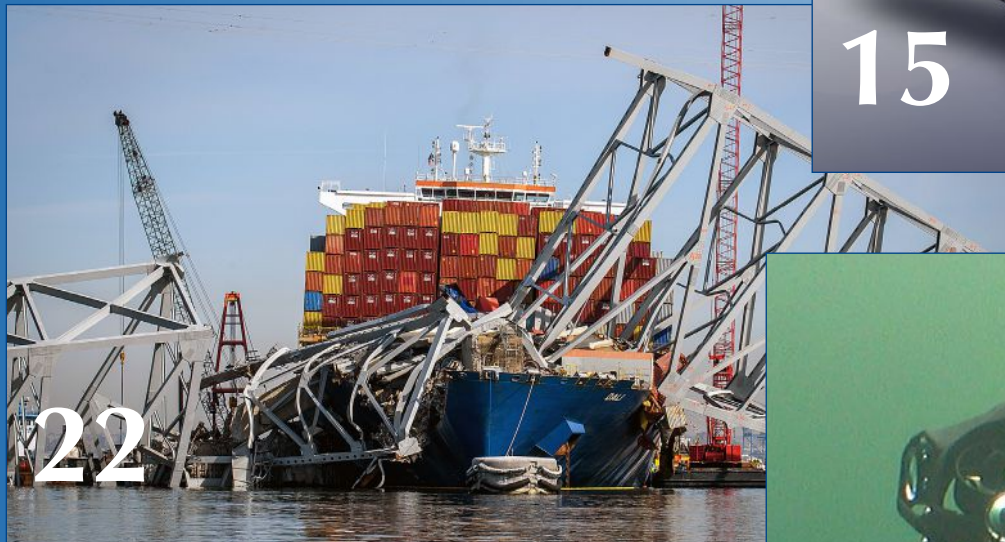
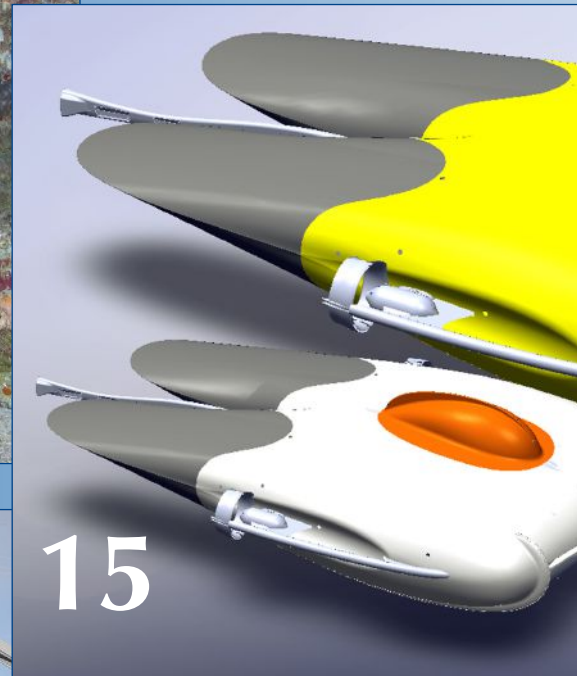


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Richard Kohler has been a part of exploring the *Britannic*, a sister ship of the *Titanic* that was used as a floating hospital during WWI. The wreck rests at 400 ft. in the Aegean Sea. See Q&A on page 31.

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)) NOIA ESG Excellence Award Winner. The National Ocean Industries Association (NOIA) has named SEACOR Marine as the winner of the third annual NOIA Environmental, Social & Governance (ESG) Excellence Award. The NOIA ESG Excellence Award highlights and recognizes those who, by their actions, design or influence, are contributing to the advancement of the ideals embodied by the NOIA ESG principles. SEACOR Marine is recognized for its comprehensive commitment to ESG performance across nearly every operational aspect of the company. Its entry highlighted a diverse array of initiatives, including ocean protection through extensive pollution and waste prevention measures, and enhancing employee well-being with robust safety and mental health programs. Furthermore, SEACOR Marine is at the forefront of the industry's transition to digitization and automation, leveraging advanced technologies to boost efficiency and reduce emissions, including the global deployment of hybrid platform supply vessels. The award-winning entry from SEACOR Marine was evaluated by an independent panel of experts from Pickering Energy Partners, Cornerstone Government Affairs and an independent industry expert.

)) Wind Propulsion Tech Report. Bureau Veritas Marine & Offshore (BV) has published its Wind Propulsion Technology Report, which details the technology systems that are available, their viability, as well as the various challenges that inhibit the adoption of wind propulsion systems at scale: <https://marine-offshore.bureauveritas.com/newsroom/wind-propulsion-report>. The report underscores the significant growth potential within the sector and the important role that wind propulsion technologies will play in the shipping industry's decarbonization transition. Safety measures are a concern for widespread adoption of the technology, and BV addresses this challenge by developing rules and notations for wind propulsion. Also, joint industry projects, such as WiSP 3, are developing standardization of performance predictions to provide assurance to shipowners and operators that wind propulsion systems won't negatively impact vessel performance. As owners and operators seek alternatives to reduce their carbon emissions and comply with current regulations, the report emphasizes the need for international regulatory bodies to recognize and support wind propulsion as a credible means of reducing carbon emissions. However, the International Maritime Organization has yet to define specific regulations or guidelines on the use of wind propulsion systems on ships. Installation and operation of wind propulsion systems remains subject to the same rules and regulations as engine-based propulsion systems, so there is a lack of clarity surrounding wind propulsion technologies' contribution to reducing carbon emissions on ships. This is a significant barrier to integrating wind propulsion technology at scale, as owners and operators are not provided with the clarity or assurance that investment in such systems will contribute to their compliance efforts. The report outlines the growth potential of wind propulsion as a viable contributor to a ship's energy balance by highlighting wind propulsion's role in a broader range of technologies aimed at advancing the shipping industry's decarbonization efforts.

)) Guide to Ethical Geoengineering. As interest grows in geoengineering as a strategy for tackling global warming, the American Geophysical Union (AGU), the world's largest association of Earth and space scientists, has launched an ethical framework as a guide to responsible decision making and inclusive dialogue. Climate interventions, also known as geoengineering or climate engineering, are deliberate, large-scale attempts to alter the climate system in a way that halts, slows down or reverses global warming. The report, facilitated by and advised by a global panel of experts, says any research into large-scale interventions in Earth's climate system must be grounded in sound ethical principles so society can make informed choices about whether to deploy them. It warns that the unintended consequences of large-scale deployment are largely unknown. The report, Ethical Framework Principles for Climate Intervention Research, seeks to establish a set of globally recognized ethical principles to guide research, funding and policy proposals, drawing on precedents developed to guide research around other emerging fields with unknown consequences, such as ethical practices for biomedical research and genetic engineering.



)) ST's John Sabo Passes. It is with great sorrow that *Sea Technology* announces the passing of John J. Sabo (1952-2024), who was a sales representative for *ST* magazine for decades. He died after a long struggle with Alzheimer's. Sabo was hired by Compass Publications' founder, Charles Bussmann, in December 1977. By January 1978, he was working alongside Amos Bussmann, the current publisher of *ST*, with whom he worked for more than 40 years. Sabo represented many publications over his career, but his favorite was *Sea Technology*. With his easy manner and ability to make people laugh, Sabo developed enduring relationships with the *ST* team and his customers throughout the country. He is survived by his wife, Barbara, and his sons, Alex and Greg. **ST**

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Carbon-Based Batteries Can Power Maritime ESS

The marine industry has long sought more sustainable and efficient energy storage systems (ESS), especially with the transition to greener technologies. Traditionally, lithium-ion (Li-ion) batteries have dominated energy storage markets due to their high energy density and relatively light weight. However, in recent years, carbon-based batteries have emerged as a strong alternative, especially in marine applications, ranging from sensors to underwater drones to vessels small and large (<https://digitalbattery.co.uk>).

Li-ion batteries come with safety concerns, such as thermal runaway, which can lead to fires or explosions, particularly when exposed to physical damage, temperature fluctuations or water. This poses a significant risk in marine settings where exposure to extreme weather, saltwater and physical stress is common.

Carbon-based batteries, on the other hand, are more stable and safe. They are not prone to overheating and, thus, do not pose a fire hazard and are more resilient to temperature changes.

Saltwater and humidity create corrosive conditions in marine environments. Li-ion batteries are sensitive to moisture and need careful sealing and insulation to prevent degradation, which can increase maintenance costs and complexity.

Carbon-based batteries, particularly those made with advanced carbon materials, such as graphene or carbon nanotubes, offer superior resistance to corrosion. Their inherent durability makes them better suited to handle the challenging conditions at sea, reducing the frequency of maintenance and extending battery life.

Carbon-based batteries excel in energy efficiency and charging speed compared to Li-ion. Many carbon batteries, especially supercapacitors and hybrid designs, have faster charge and discharge rates than Li-ion batteries. This is particularly useful in marine applications where quick energy recovery is necessary, such as in electric boats or submarines. Fast charging times can also reduce downtime during port stays or in emergencies. The high cycle life of carbon-based batteries (tens of thousands of cycles in some cases) ensures they remain efficient and operational over long periods. They can handle frequent charge-discharge cycles without significant degradation.

As the marine industry moves toward sustainability, reducing its environmental footprint is becoming increasingly important. Li-ion batteries rely on lithium, cobalt and nickel, which come from resource-intensive mining processes. Additionally, the disposal of lithium-ion batteries can be problematic and expensive due to the presence of hazardous materials.

Carbon-based batteries are more eco-friendly. Carbon is abundant and can be sourced sustainably. In addition, carbon-based batteries often do not contain toxic materials, making end-of-life management easier.

Carbon-based batteries are more easily scalable without compromising safety or efficiency. They are also modular, so they can be tailored to the specific energy needs of an application. Carbon-based batteries have 98.6 percent energy availability at low discharge rates, resulting in high reliability.

While Li-ion batteries have dominated the market, carbon-based batteries are emerging as a better option for marine environments. Their safety, durability, energy efficiency and environmental benefits make them well-suited to the challenges of the sea. As the marine industry continues to prioritize sustainability and cost-efficiency, carbon-based batteries are positioned to play a crucial role in powering the future of marine energy storage systems. **ST**

SEA TECHNOLOGY® 2025

JANUARY

Annual Review & Forecast

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

***Undersea Defense Technology (UDT), March 25-27, Oslo, Norway*

MARCH

Electronic Charting/Vessel Management/
Ports & Harbors/Dredging/Homeland Security

***Ocean Business, April 8-10, Southampton, U.K.*

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

***MAST AUKUS (USA), May (dates TBD), Waikiki, Hawaii*

MAY

Communications, Telemetry, Data Processing

***OCEANS 2025 Brest, June 16-19, Brest, France*

JUNE

Seafloor Mapping/Sonar Systems/Vessels

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BONUS INFORMATION

- | | | |
|----------------------------|---------------------|-----------------------|
| • Capital Report | • Marine Renewables | • Ocean Engineering |
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Editorial Calendar

ADVERTISING CLOSES ON THE 15TH OF THE MONTH PRECEDING ISSUE DATE

JULY

Deck Gear, Cable, Connectors, Power Systems & Salvage

****IMAGE 2025**, August 24-29, Houston, Texas

AUGUST

Ocean Resources Development & Coastal Zone Management

****MAST AUKUS (UK)**, September (dates TBD), Glasgow, U.K.

****OCEANS 2025 Great Lakes**, September 29-October 2,
Navy Pier, Chicago, Illinois

SEPTEMBER

Geophysical Exploration/Seafloor Engineering

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

****CLEAN GULF**, November 18-20, Houston, TX, New Orleans, Louisiana

****Offshore Energy**, November 25-26, Amsterdam, The Netherlands

NOVEMBER

Undersea Defense/Antisubmarine Warfare

DECEMBER

Diving, Underwater Vehicles & Imaging

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Marine Drug Discovery

Mohawk ROV Collects Samples for Biomedical Research

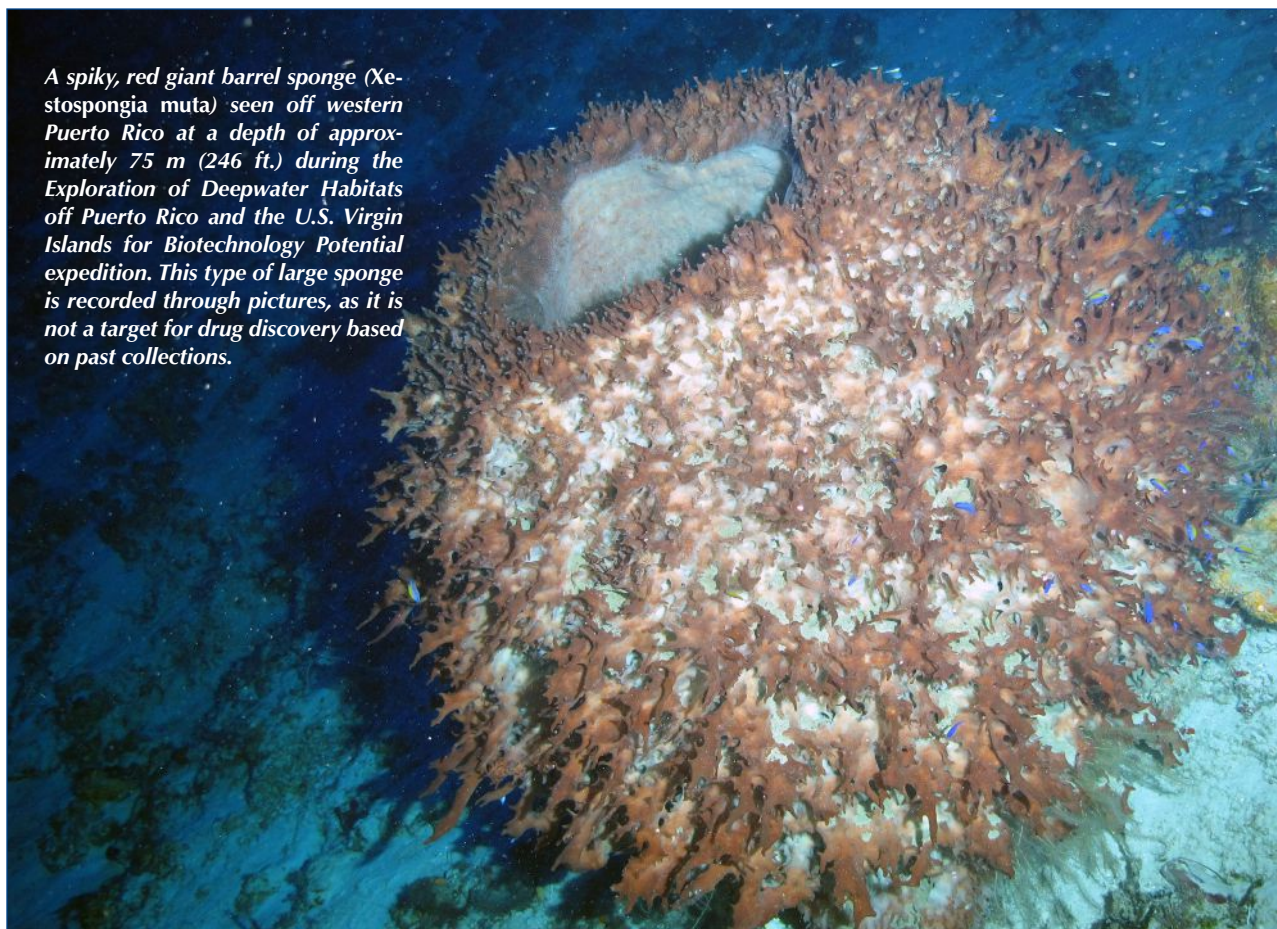
By Dr. Esther Guzmán • Samantha Flounders

Sixty-two percent of current medicines have their origin in natural products. Natural products are small molecules made by a living organism. Since the oceans cover over 70 percent of the Earth's surface and contain a wealth of biological diversity, it is logical to expect that many discoveries can come from the ocean. Many marine organisms have genes that are similar to those in

humans, although they are used for different functions. Similarly, certain processes are shared between humans and marine organisms.

Drugs from the sea are slowly turning into a reality: Ara-C or cytarabine has been approved since 1969 to treat leukemia; Halaven is the synthetic version of eribulin mesylate, a natural product obtained from a marine

A spiky, red giant barrel sponge (Xestospongia muta) seen off western Puerto Rico at a depth of approximately 75 m (246 ft.) during the Exploration of Deepwater Habitats off Puerto Rico and the U.S. Virgin Islands for Biotechnology Potential expedition. This type of large sponge is recorded through pictures, as it is not a target for drug discovery based on past collections.





*(Top) A mustard yellow sponge seen off western Puerto Rico at a depth of approximately 75 m (246 ft.) during the Exploration of Deepwater Habitats off Puerto Rico and the U.S. Virgin Islands for Biotechnology Potential expedition. (Bottom) A white sponge seen off northwestern Puerto Rico at a depth of approximately 111 m (364 ft.). The green and red lasers are from two different cameras, and the distance between them measures 10 cm. This allows scientists to determine the size of a sample for collection. The large tubular sponge is an *Aplysina*, and this class of sponge is known to have compounds with anti-cancer activity, including activity against triple-negative breast cancers.*



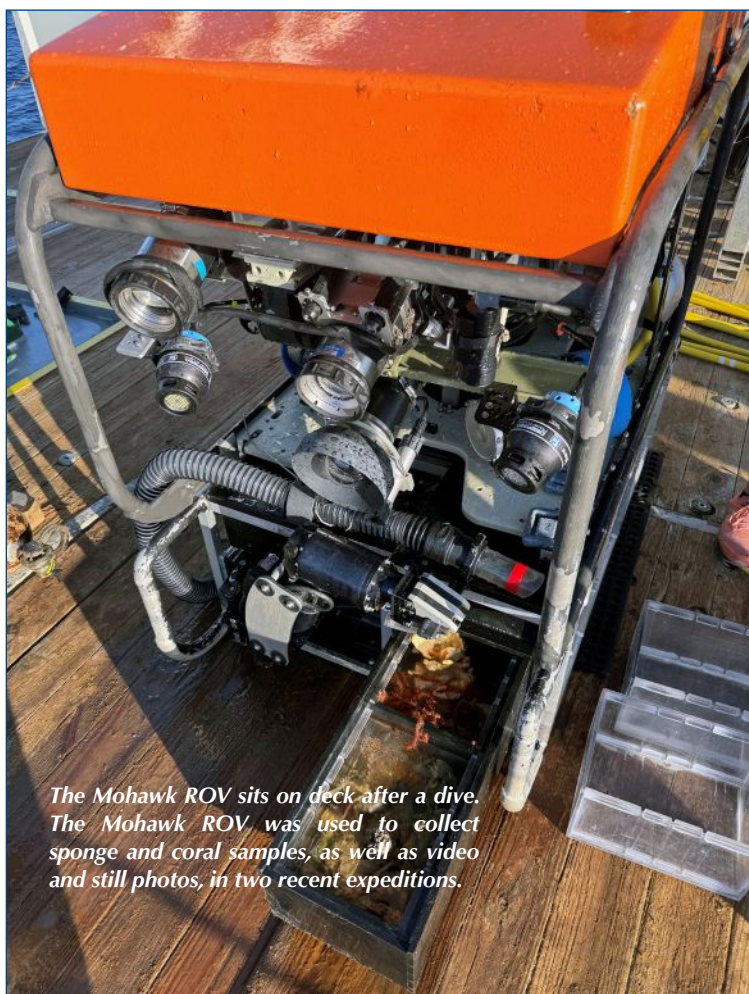
sponge that was approved in 2010 to treat metastatic breast cancer; Yondelis is the semi-synthetic version of the natural product from a tunicate and was approved in 2015 to treat soft tissue sarcoma and ovarian cancer.

More recently, antibody-drug conjugates (ADC) are seeing clinical success. ADCs combine a natural product that kills cancer cells with an antibody to guide it to the tumor. Polivy, approved in 2019 to treat lymphomas; PADCEV, approved in 2019 to treat metastatic urothelial cancers; and TIVDAK, approved in 2021 to treat metastatic cervical cancer, use monomethyl auristatin E

(MMAE), a synthetic version of the natural product made by a cyanobacteria, to kill the cancer cells.

HBOI and UNCW UVP Partnership

The Marine Biomedical and Biotechnology Research Program at Harbor Branch Oceanographic Institute (HBOI; a part of Florida Atlantic University since 2007) has been doing drug discovery from marine organisms since 1984, as an added value to the ocean exploration conducted with the Johnson-Sea-Link (JSL) manned submersible. This submersible had outstanding collecting



The Mohawk ROV sits on deck after a dive. The Mohawk ROV was used to collect sponge and coral samples, as well as video and still photos, in two recent expeditions.

capabilities, the ability to hover, and reached depths to 1,000 m. Ocean exploration with the JSL led to a collection of about 30,000 invertebrates and about 19,000 microorganisms related to drug discovery work.

The selling of the institute's ships in 2010 and the retirement of the submersible in 2011 hampered how the group combined ocean exploration with drug discovery. The need to recollect organisms that contain compounds of interest and the desire to continue the exploration of the oceans for medicinal purposes led to looking at alternative forms of collecting. The solution was found in the Mohawk ROV, a sophisticated, versatile vehicle with high reliability and mobility. The ROV has a working depth of 1,000 m and is maintained and operated by the University of North Carolina Wilmington (UNCW) Undersea Vehicles Program (UVP), which comprises three ROV pilots and technicians. The small, dedicated team operates the Mohawk ROV from vessels of opportunity, and this can support a wide variety of research missions.

Mohawk ROV

The Mohawk ROV is outfitted with a custom designed, science-specific tool skid developed by HBOI and modeled after the JSL manned submersible. The skid powers scientific instruments, such as the Sea-Bird SBE 49 Fast-CAT, a CTD sensor, and the PyroScience AquapHOx-LX O₂ and pH sensor, an oxygen long-term logger. Addi-

tional scientific sensors may be added, depending on the scientists' data collection objectives.

The Mohawk's science skid is also equipped with an ECA Hytec Micro 5E, a five-function all-electric manipulator arm. Samples can be picked up, snipped or suctioned. The manipulator and suction sampler provide the ability to collect a wide variety of sample sizes, textures, and consistencies. All samples are georeferenced so that the ROV can return to the exact spot in the future if necessary.

The Mohawk ROV captures high-definition (HD) video throughout the entirety of the dive with an Insite Pacific Mini Zeus Mark II color video camera with 10:1 zoom, auto/manual iris, auto/manual focus and 2.38 million effective pixels. This high-definition video with extreme zoom capabilities provides the science party with a clear, detailed, real-time view of the underwater environment.

The Mohawk's compact frame and agile mobility allows for the pilots to fly the vehicle right up to prospective samples for a closer look. Digital still photography is controlled by the science party and captured by a Kongsberg Maritime OE14-408 10-mp digital still camera with 5x zoom. Digital still photos are paired with an OE11-442 strobe with evaluative through-the-lens (E-TTL) auto flash metering, which calculates how much light the flash needs to emit for appropriate brightness. The video camera, stills camera and strobe are mounted to a powered tilt platform, which allows for proper framing of

an image.

It is of the utmost importance to capture and record the samples in situ. Once the science party decides they would like to acquire a sample, a digital still photograph is properly framed and zoomed as desired. Every photo and all video are laser-scaled at 10 cm by dual lasers mounted to the digital still camera and video camera. This provides a quick size reference via two laser dots when looking at sample photos. Underwater imaging provides the visual record of how the samples truly existed in their natural environment. Once they are brought to the surface, they can look very different. Some organisms release substances (such as mucus and inks) that can change their appearance when sub-sampled.

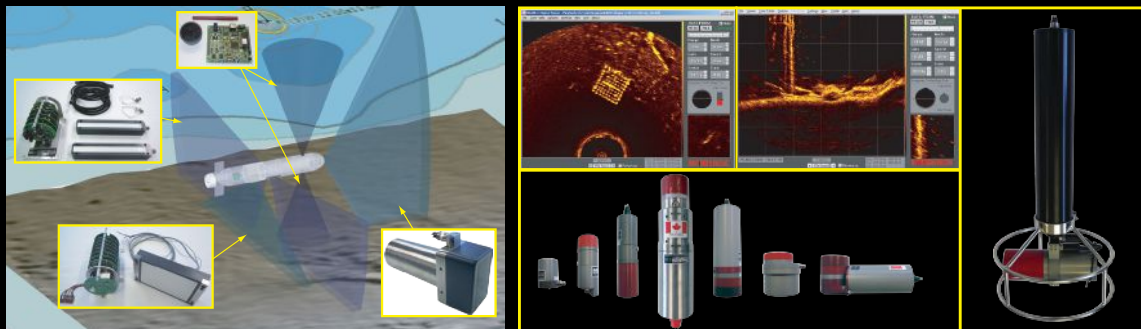
Furthermore, underwater imagery provides a visual timeline for monitoring reef health and documenting changes over time. Habitat characterization over time is of critical importance for understanding the health of our oceans.

Many times, no sample is necessary, and the agile maneuvering of the Mohawk ROV allows for the pilots to fly and land in densely populated areas for a high-definition look and take framed, scaled, and zoomed photos.

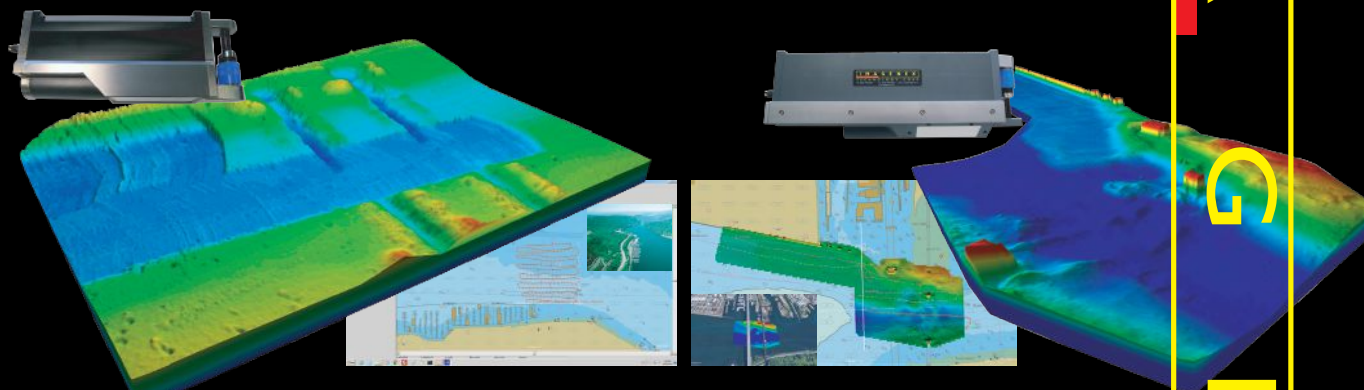
Flower Banks Expedition

An expedition to the Flower Garden Banks National Marine Sanctuary (FGBNMS) in 2022 funded by NOAA

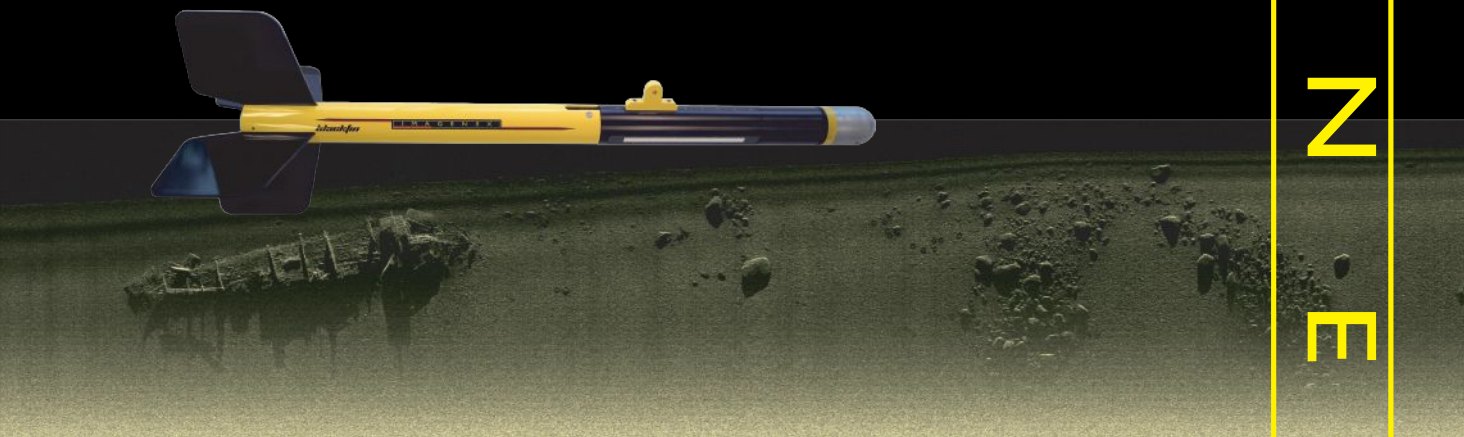
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A closeup of the arm of the Mohawk ROV, operated by skilled pilots to collect samples. The biobox is full of precious samples for the scientists, who will start processing them as soon as the boxes are emptied.

Ocean Exploration (OER) led to the discovery and documentation of rich biodiversity outside of the sanctuary's protected areas. The Mohawk ROV was the ideal vehicle for the mission, collecting more than 175 samples in just nine days. The pilots and manipulator operators of the Mohawk are known for their capability to fill up the collection skid repeatedly on multiple bounce dives in a day. While only a few samples have been tested for their therapeutic potential, there are already some leads.

The process of extraction is similar to making coffee. Whenever you make coffee, you extract the chemicals in the coffee beans using hot water, which include about a thousand chemicals that give coffee its taste and smell. Instead of extraction via hot water, marine organisms are extracted using alcohol, then separated into mixtures of four to five compounds that are used to screen for activity.

Some forms of pancreatic, lung, breast, skin and colon cancers have mutations that activate unusual pathways to obtain nutrients that allow these cancers to grow. About 575 samples from organisms collected during the FGBNMS cruise were screened for their potential to inhibit these unusual pathways from obtaining nutrients, with 99 samples corresponding to 37 organisms shown to have this activity. These compounds could help in the treatment of the cancers mentioned.

Triple-negative breast cancer receives its name because it lacks the estrogen, progesterone and epidermal growth factor 2 receptors on its surface. This lack of receptors makes these cancers difficult to treat. Although they only represent about 12 percent of all breast cancers, they tend to be aggressive. About 234 samples corresponding to 10 organisms collected during the FGBNMS expedition have been tested for their potential to

selectively kill triple-negative breast cancer cells when grown as spheroids, or little tumors, with 52 samples exhibiting this activity. We are very excited about these samples because their mode of action may be different from known drugs, adding potential new ways to treat this disease.

Extracts from bacterial samples obtained from the samples collected during this expedition were also tested for their ability to be novel antibiotics. About 313 samples were tested for their potential to inhibit the growth of multidrug-resistant *Staphylococcus aureus* (MRSA), an infection that is prevalent in many hospitals; 79 samples exhibited this activity. Two-hundred twenty-four samples were tested for their potential to inhibit the growth of the yeast *Candida albicans*, with 21 exhibiting this activity.

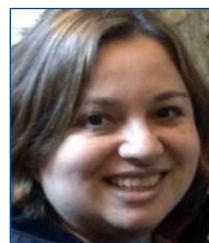
Ongoing and Future Work

The activities highlighted above were the ones found in-house using our current assays from a limited number of organisms. More samples will be added to the library to make them available for broader screening, increasing the chance for more leads.

In the past, samples from our collection have been tested against other diseases, such as Alzheimer's, and cancers through collaborations with other universities. Moreover, as new assays become available in-house, samples from the library are tested in these, resulting in finding new activities from compounds that were already known. (HBOI collections are also studied to support taxonomic, ecological, evolutionary and climatological research conducted by scientists worldwide through collaborations.)

Earlier this year, in a NOAA OER-funded expedition, HBOI used the Mohawk ROV to explore the deepwater habitats off Puerto Rico. The Mohawk effectively and efficiently collected 136 samples for biotechnology studies. All of us are eager to see what activity against dreaded diseases these samples may possess. HBOI is enthusiastic to use the Mohawk's new 1,000-m system in the future to expand the range of our biomedical treasure hunt. **ST**

Dr. Esther Guzmán received her Ph.D. in biomedical sciences, immunology, from the University of Texas MD Anderson Cancer Center. She is a research professor at the Harbor Branch Oceanographic Institute of Florida Atlantic University, focused on finding marine natural products that can be novel therapeutics against cancer.



Samantha Flounders is an ROV pilot and technician with the UNCW Undersea Vehicles Program. She has piloted more than 300 dives and been on 14 ROV missions. She is a former NOAA Corps officer with a degree in marine biology from the University of Hawaii at Manoa.



Mobile Monitoring

AUVs for Environmental Oversight of Deep-Sea Mining

By Maria Pleskach



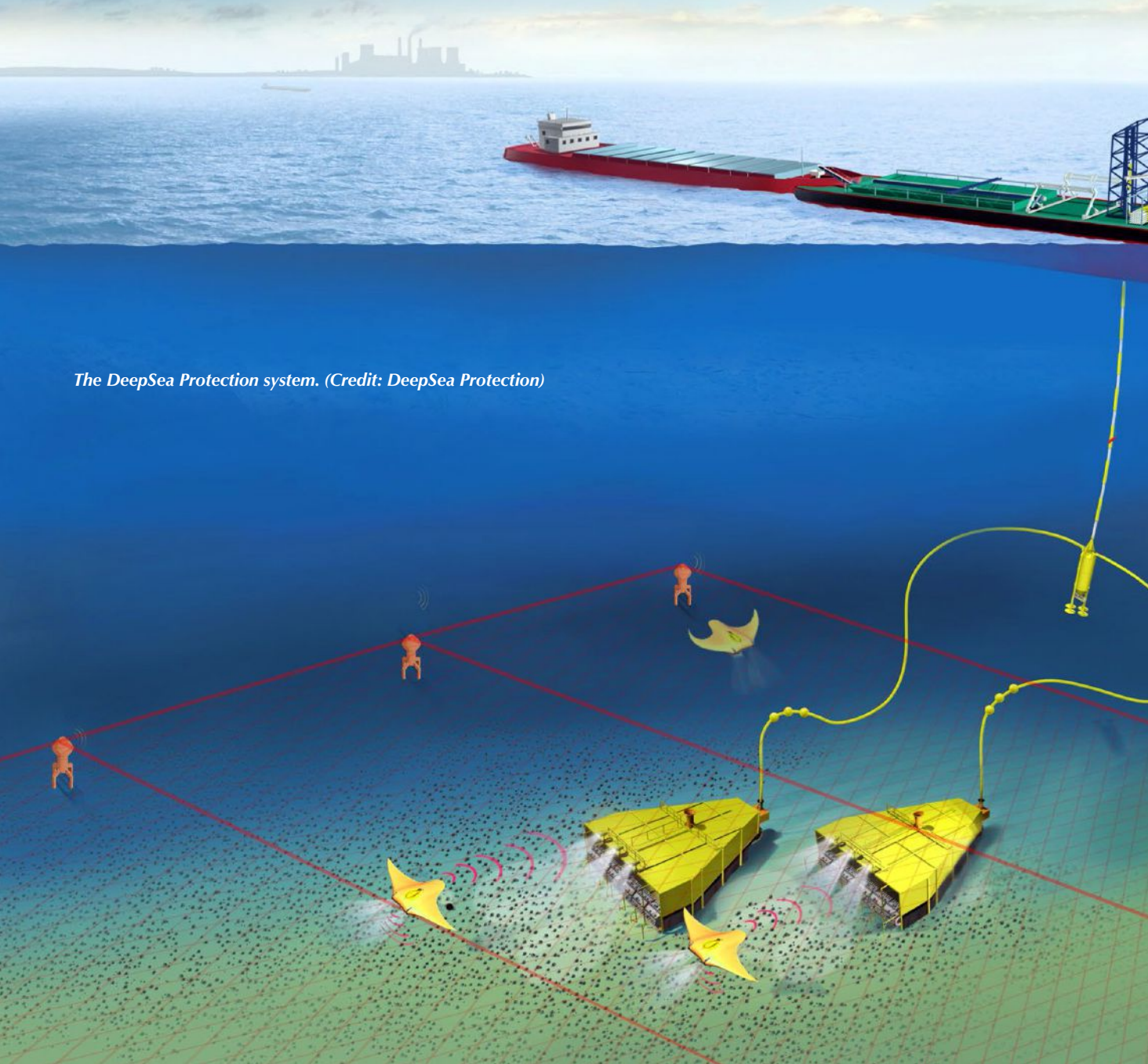
A polymetallic nodule collected from the ocean floor. (Credit: EvoLogics)

Although the deep sea remains primarily unexplored, deep-sea mining for critical minerals is an industry in the making. It targets critical minerals such as nickel, copper, cobalt and manganese, essential for various industrial applications and modern consumer electronics. These are found in three types of marine deposits in extreme deep-sea environments: polymetallic nodules spread along the abyssal plains, polymetallic sulphides formed around hydrothermal vents, and cobalt-rich ferromanganese crusts covering seamounts.

With exploration efforts ongoing since the 1960s, commercial-scale mining has yet to commence, despite

increasing interest. As several mining enterprises race to obtain production licenses, an open debate between governments, environmental organizations and other mining stakeholders questions whether deep-sea mining should even go ahead at all. Amidst a regulatory limbo, deep-sea mining faces strong environmental concerns due to the potential ecological impacts on the affected ecosystems (*Sea Technology*, October 2024).

All existing and proposed regulations for deep-sea mining emphasize the requirements for comprehensive monitoring of the marine environment during any exploration and future extraction activities.



The DeepSea Protection system. (Credit: DeepSea Protection)

In an effort to step up marine research, Germany's state-funded DeepSea Protection project targets the gaps in existing stationary monitoring technologies with the development of a mobile robotic deep-sea multi-sensor network for data collection and real-time assessment.

Legal Status of Deep-Sea Mining

The International Seabed Authority (ISA) is an autonomous organization established in 1982 under the United Nations Convention on the Law of the Sea (UNCLOS) and its subsequent 1994 Agreement on Implementation. ISA is responsible for managing the seabed, ocean floor and subsoil beyond the exclusive economic zones (EEZs) of sovereign nations: commonly referred to as the "Area."

As of the writing of this article, the ISA is an intergovernmental body of 169 member states and the European Union, with the U.S. being a notable absence since the

country never ratified the Law of the Sea. The ISA's dual mandate is to administer seabed mineral-related operations and ensure the effective protection of the Area's marine environment. The ISA first prioritized developing comprehensive rules, regulations, and procedures for prospecting and exploration of mineral resources in the seabed Area. The ISA adopted exploration regulations for polymetallic nodules in 2000 (revised in 2013), polymetallic sulphides in 2010, and cobalt-rich ferromanganese crusts in 2012. These include guidelines to assess the environmental impacts of marine mineral exploration, including requirements for environmental impact assessments, baseline studies, monitoring and reporting.

So far, the ISA has issued 31 15-year exploration contracts in the deep seabed with 22 contractors. Despite years of exploration efforts for deep-sea minerals, commercial-scale seabed mining still lacks official regulation.



Since 2014, ISA has been working on rules for the exploitation phase in the Area, including standards and guidelines. The ISA Assembly meeting in July 2024 yielded no final decision on deep-sea mining, with more than 30 member states calling for a moratorium, so the debate continues.

Within the EEZs, deep-sea mining is governed by the corresponding nation's state legislation. Several countries have enacted or proposed laws to allow these activities.

In 2022, the Cook Islands issued permits for exploration within its EEZ, which has significant and relatively well-studied cobalt deposits but has yet to permit extraction.

In January 2024, the Norwegian parliament approved exploratory deep-sea mining in a large part of the EEZ area between Jan Mayen Island and the Svalbard archipelago, opening a pathway for mining companies to ap-

ply for exploitation permits. The Norwegian parliament intends to grant these on a case-by-case basis. This decision opens a significant area of Norwegian waters to exploratory mining, pending further environmental research before commercial licenses are issued.

In June 2024, after a detailed survey earlier this spring, Japan's Nippon Foundation and the University of Tokyo announced the discovery of over 200 million metric tons of manganese nodules on the seabed near Minamitorishima, an isolated Japanese coral atoll in the northwestern Pacific. Plans are made for a trial collection of the manganese nodules from the site as early as 2025, with a view toward commercialization.

It is crucial to note a growing number of nations opposing deep-sea mining activities. For example, France has enforced a ban, while Canada, New Zealand, Switzerland, Mexico, Peru and the United Kingdom have implemented moratoriums. An alliance of Palau, Fiji, Samoa and the Federated States of Micronesia advocates for a complete moratorium due to environmental concerns. Many other nations, including Germany, Spain, Brazil, Costa Rica and Chile, have chosen a precautionary pause approach, stressing the necessity for additional research and caution before permitting deep-sea mining activities. This growing consensus reflects apprehensions over environmental impacts and insufficient scientific understanding to ensure the safe exploitation of deep-sea resources.

For both opponents and supporters of deep-sea mining, environmental impact is a major consideration for any decision making on seabed activities.

Current Mining and Monitoring Equipment

In modern mining techniques, manganese nodules are collected by crawlers that scrape them from the seabed. These nodules are then transported to a production support vessel through a pump system connected to a pipe string, the so-called riser. On board the vessel, the nodules are separated from water and sediments and then transferred to transport ships for processing onshore. The mining of massive sulphides employs a similar system but requires crawlers not only to pick up material but also to break up seabed rock. This calls for grinding machines like those used in tunnel construction.

Recent years have seen significant advancements in the crawler-and-riser method. Modern trials of such equipment tend to have a scale of offshore drilling operations, so there is overlap between deep-sea mining and offshore oil and gas industry practices. Big offshore players such as Allseas and Transocean have entered the deep-sea mining sector, and the latest production support vessels, e.g., the Allseas *Hidden Gem* and Transocean's *Olympia*, are converted from offshore drillships.

A recent example of exploratory crawler-and-riser nodule mining is the 2021 technical trials of the Patania II pre-prototype nodule collector vehicle in the GSR (Belgian-sponsored) and BGR (German-sponsored) contract areas of the Clarion-Clipperton Zone (CCZ) by Global Sea Mineral Resources (GSR), a subsidiary of DEME. Patania II was successfully operated at commercial driving speeds and nodule pickup rates.

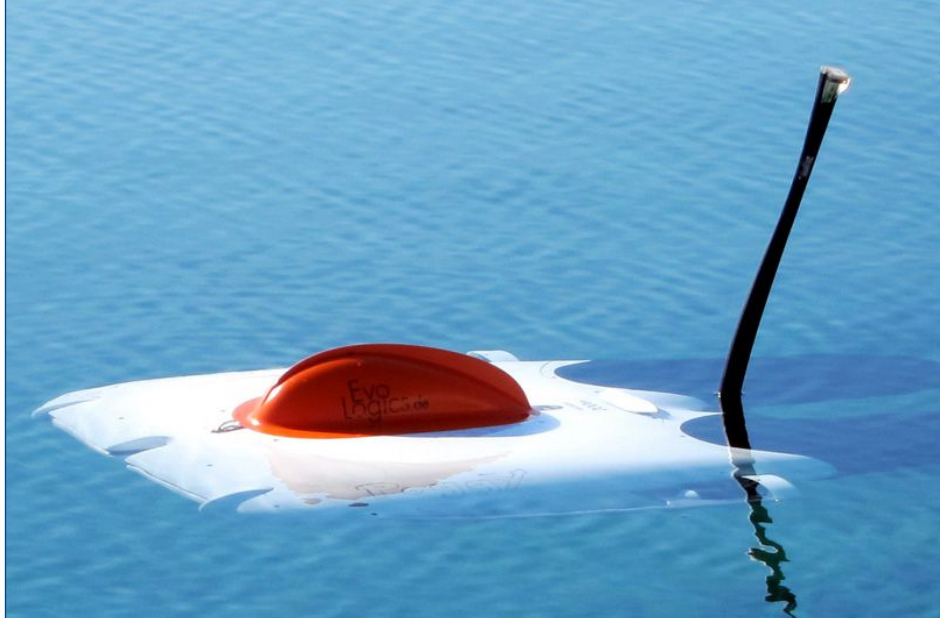
In 2022, NORI, a subsidiary of The Metals Company (TMC), and Allseas concluded a large-scale, two-month deepwater pilot collection in the NORI-D area of the CCZ. Engineers drove the pilot collector vehicle over 80 km across the seafloor, collecting approximately 4,500 tonnes of seafloor polymetallic nodules and lifting over 3,000 tonnes of nodules up a 4.3-km riser system to the surface production vessel, the *Hidden Gem*.

It's worth noting that autonomous harvester vehicle technology for hovering over the seafloor as opposed to tethered crawlers is also being developed, with U.S.-based Impossible Metals announcing a successful test of its Eureka II harvester AUV at a 1-mi. depth in May 2024, with plans for testing a production-scale Eureka III in 2025.

The much-needed monitoring of the environmental impact during deep-sea mining operations involves using advanced technologies to assess and mitigate potential damage to the marine ecosystem. Technological challenges are immense, given the extreme conditions of the deep ocean, including high pressure, low temperatures and total darkness.

For its 2021 trials, GSR collaborated with independent scientists aboard the chartered vessel *Normand Energy* to monitor the test mining. These trials were also independently monitored from the MV *Island Pride* by scientists from 29 European research institutes of the JPI-O MiningImpact consortium, invited by Germany's Federal Institute for Geosciences and Natural Resources (BGR). The expedition members performed a series of experiments to advance the current understanding of both the extent of suspended sediment plumes and the ecological responses to nodule collection. An extensive array of environmental monitoring equipment was deployed, ranging from commercially available instrumentation to custom prototype sensors designed for these nodule collection trials. In total, around 200 individual monitoring instruments were hosted on 43 separate platforms, the majority of them being landers and moorings.

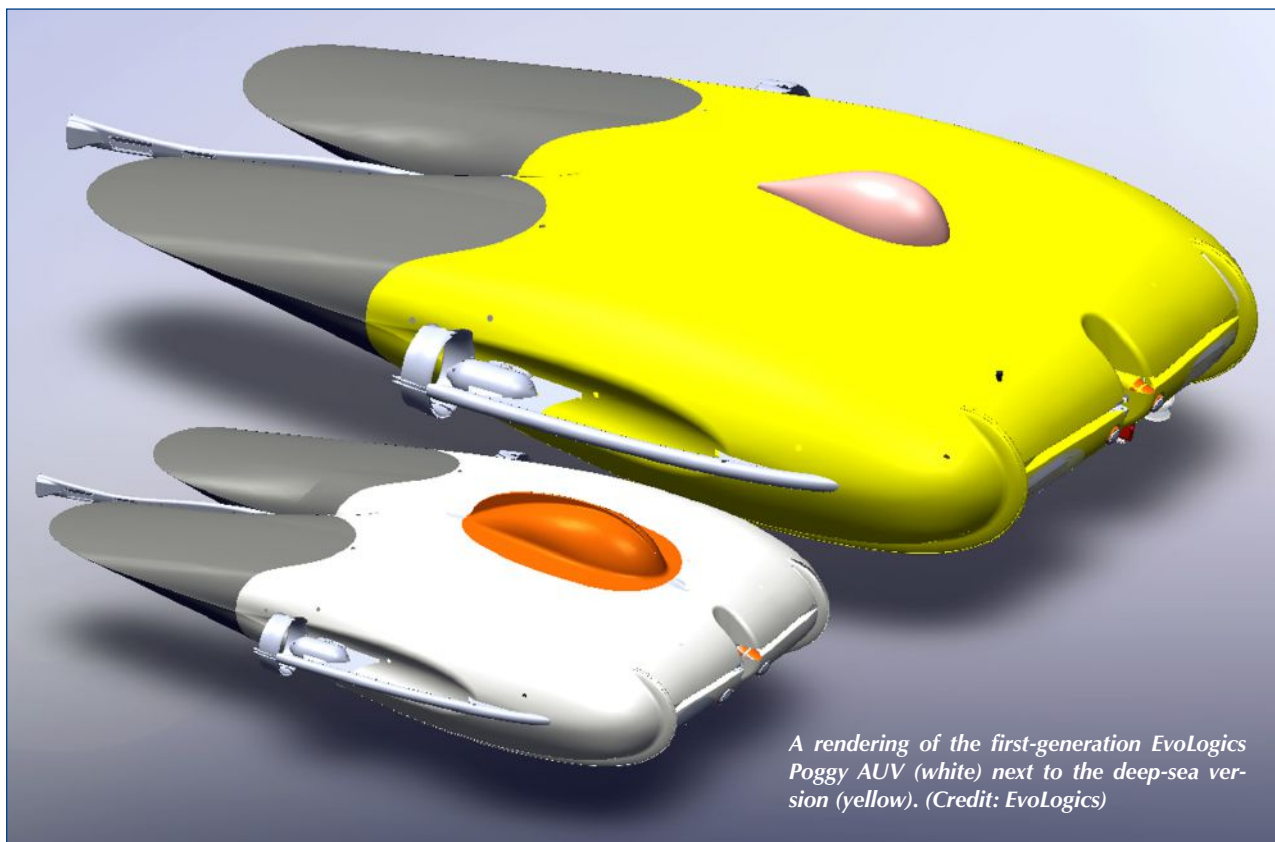
During its 2022 nodule collection trials, NORI worked with DHI Water & Environment, experts on sedimentation modeling, to implement a plume monitoring study. Over 50 assets and marine sensors were deployed to the test field to collect data on all aspects of plume dynamics, concentration, and dispersal. In 2023, NORI conducted additional research at the NORI-D trial site and reported gathering further environmental data. Sci-



EvoLogics Poggy AUV. (Credit: EvoLogics)

entists used an ROV, several seafloor sampling devices, and lander systems to assess impacts to biota, seafloor geochemistry, and ecosystem recovery on the seafloor.

Landers and moorings are the classic scientific tools for deep seafloor data collection, operating autonomously and hosting various sensors to measure environmental parameters over extended periods. Landers provide comprehensive data on physical, chemical and biological aspects of the seafloor, while moorings offer vertical



A rendering of the first-generation EvoLogics Pogy AUV (white) next to the deep-sea version (yellow). (Credit: EvoLogics)

profiles of the water column and continuous monitoring at fixed locations. Both are designed for long-term data collection, enabling the study of temporal changes and the impacts of human activities.

Modern trends in the blue economy include the increasing use of mobile robotic equipment for autonomous underwater exploration, enabling efficient mapping and monitoring of marine environments. Uncrewed underwater vehicles with advanced sensors and AI capabilities allow for real-time data collection and analysis. In addition, the deployment of mobile robotic systems enhances maritime safety and reduces operational costs by minimizing the need for human intervention. The dimensions of newly developed solutions are moving toward the extremes, with systems becoming either very large or increasingly smaller and smarter.

Deep-sea AUVs and ROVs have been adopted for mapping, surveying and monitoring seabed mining sites, while seabed landers and moorings are still a mostly stationary technology often lacking real-time data retrieval, and they require resurfacing to download the collected data and reposition the instruments.

The DeepSea Protection System

One of the ongoing research and development efforts for environmental monitoring during deep-sea mining activities is DeepSea Protection, a German consortium working on a mobile sensor system with flexible profiling and repositioning capabilities.

Funded by the Federal Ministry for Economic Affairs and Climate Action (BMWK), the DeepSea Protection project runs until 2025, and the consortium comprises

nine academic and industry partners: EvoLogics GmbH, Technical University of Berlin (TU Berlin) - Department of Design and Operation of Maritime Systems, Sea & Sun Technology GmbH, Sensorik-Bayern GmbH, PlascoTec GmbH, Plasma Parylene Systems GmbH, the Fraunhofer Institute for Reliability and Microintegration (IZM), the Fraunhofer Institute for Computer Graphics Research (IGD), and Aalen University - Laboratory for electric drives and power electronics.

The EEZ and ISA-licensed mining areas offer potential extraction opportunities for several decades. This implies that once a sub-area is harvested, the collectors move over to the next field, and the environmental monitoring system must follow along. The DeepSea Protection system will be fully mobile, following the collectors with relocatable ground stations and a swarm of autonomous UUVs—without the need to resurface.

The research objectives of the project include the development of the entire hardware and software of the system, rated for 4,000 to 6,000 m, including its communication, navigation and coordination, as well as data processing and visualization. To ensure the robustness required for deep-sea deployment, project partners are working on pressure-neutral motors for seafloor stations and underwater vehicles; custom application-specific sensors; miniaturized embedded power, control and evaluation electronics; and surface coatings for long-term protection against seawater.

Project partners aim to construct a demonstration setup comprising four seafloor stations and three UUVs, and to test and optimize their coordinated operation during a subsequent trial phase.

“The novelty of the DeepSea Protection system is a network of repositionable seafloor and mobile benthic units, acting in a coordinated formation.”

Repositionable Seafloor Stations

Commonly used lander and mooring systems are stationary and do not have a propulsion system. The few relocatable seafloor landers developed over recent years are not suitable for applications in deep-sea mining. They either lack functionality and depth rating, or have a size and weight calling for significant deployment, control and recovery efforts. Monitoring systems such as gliders and Argo floats do have a buoyancy system that enables moving up and down the water column, but these are not fit for precise positioning and repositioning due to their gliding/drifting design.

The novelty of the DeepSea Protection system is a network of repositionable seafloor and mobile benthic units, acting in a coordinated formation.

The seafloor units of the DeepSea Protection network are conceived as compact multifunctional stations positioned around the exploration/extraction area to be monitored. These units, dubbed the deep-sea “Kalmars” (German for “squids”), aim to combine the capabilities of landers, moorings, and acoustic network and positioning nodes for the mobile units of the monitoring system.

The Kalmars are developed at TU Berlin, with EvoLogics and Sea & Sun Technologies supporting the conceptual and component development, system integration, and open-water trials.

When anchored on the seafloor, the battery-powered Kalmar units with built-in EvoLogics acoustic modems serve as stationary nodes of the telemetry and positioning network, as well as sensor platforms for monitoring environmental parameters. Placed around the perimeter of the operations area, the Kalmars exchange acoustic signals to determine their positions relative to each other, thus establishing a local coordinate frame. Sent to the surface support vessel with a USBL transceiver and GNSS antenna, these positions are georeferenced and transferred back to the seafloor units, so the network can perform georeferenced LBL positioning of the mobile assets within the perimeter.

To sample environmental data, the engineers integrate a compact winch to periodically collect vertical profiles with a multiparameter probe, unwinding and rewinding it like a yo-yo.

The Kalmars are designed with a propulsion system and buoyancy control to move both vertically and horizontally within the water column, enabling autonomous deployment, repositioning, and resurfacing.

Mobile Units: Deep-Sea Poggy AUV

The mobile nodes of the DeepSea Protection system are the deepwater-rated evolution of the EvoLogics Poggy AUV, a biomimetic AUV initially developed as part of the Bonus Seamount project (2017 to 2020), aimed at study-

ing submarine groundwater discharges in the Baltic.

Poggy’s distinctive design features dual propulsion thrusters and two flexible “tails.” Originating from EvoLogics’ Manta Ray AUV, Poggy’s “wingless” design is simplified and optimized to enhance maneuverability and reduce drag. The two mechatronic tails enable unique maneuvers and act like adjustable hydroplanes for precise control over roll and depth. With a payload capacity for multiple instruments, Poggy can demonstrate dynamic climbs and dives and glide very steadily at lower speeds to collect sensor data.

The tails are straight and symmetrical when propelling forward, and adjusting their geometry alters the drag profile and enables very accurate control of pitching and rolling. Poggy’s design also uses less energy than other methods because of less water disturbance. It is immune to the problem of clogging that can affect subsea thrusters near the seabed, which is important for surveys related to deep-sea mining where a steady, slow glide along the seafloor is required.

To adapt the Poggy design from coastal to deep-sea applications, EvoLogics collaborates with IZM on developing integrated pressure-neutral components and connectors to eliminate pressurized housings inside the vehicle’s hull. The vehicle is sized up from 1.3 m to approximately 2 m to increase the instrument payload.

For the next-generation depth-rated Poggy platform, EvoLogics is integrating a multiparameter probe, a CTD, side scan sonar, an underwater camera and a novel turbidity sensor developed by Sea & Sun Technology within the project framework. Poggy AUV’s measurement systems will supplement the Kalmars’ vertical profilers to form a 4D sensor network for collecting environmental data around the deep-sea sites.

Conclusion

Deep-sea mining for critical minerals is a disputed activity with strong opposition from environmental organizations worldwide. While an international “mining code” does not currently exist, several companies are trialling production-scale equipment. How and when to move forward must be supported by strong data on the environmental impacts of deep-sea mining.

Advancing existing technologies for comprehensive environmental monitoring is crucial to establish strict environmental regulations to minimize potential ecological disruption. Effective monitoring systems, such as DeepSea Protection, are key to balance resource extraction with conservation. **ST**

Maria Pleskach manages technical writing and communications for EvoLogics GmbH.

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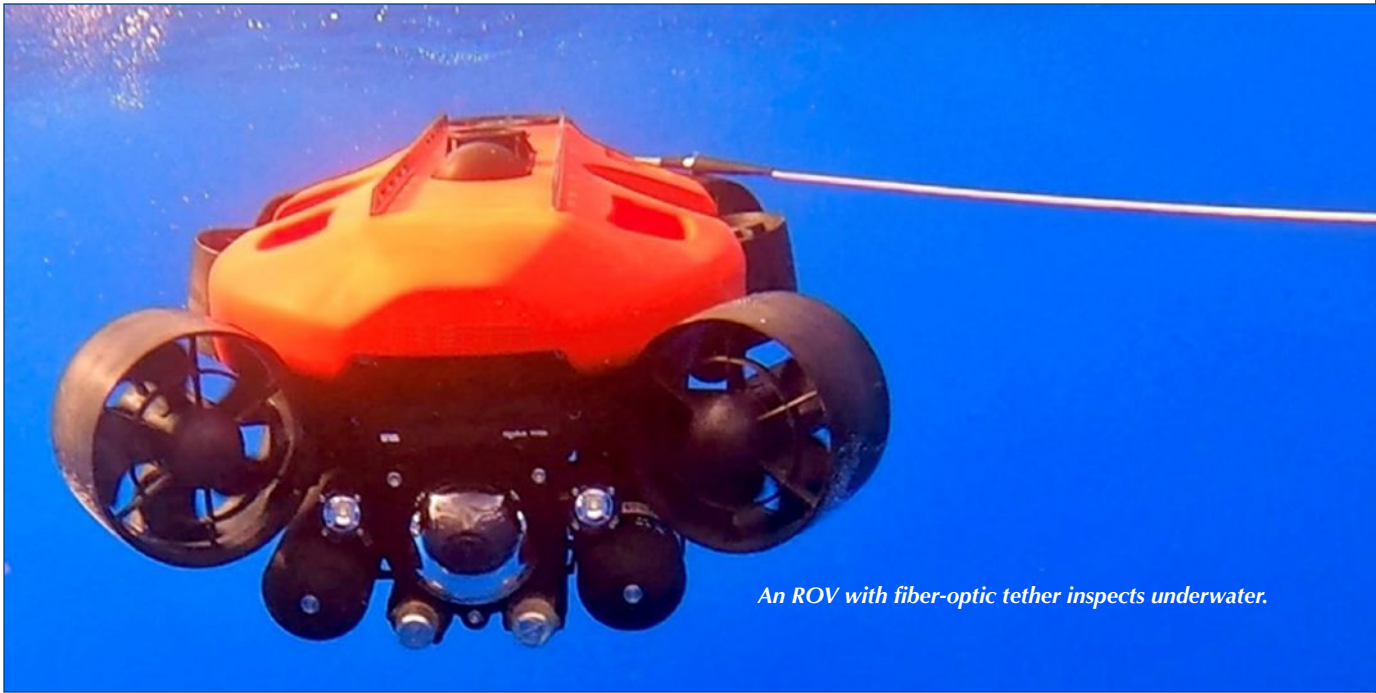
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Inspecting Infrastructure

The Critical Role of ROVs and Fiber-Optic Tethers

By Stephen O'Riorden



An ROV with fiber-optic tether inspects underwater.

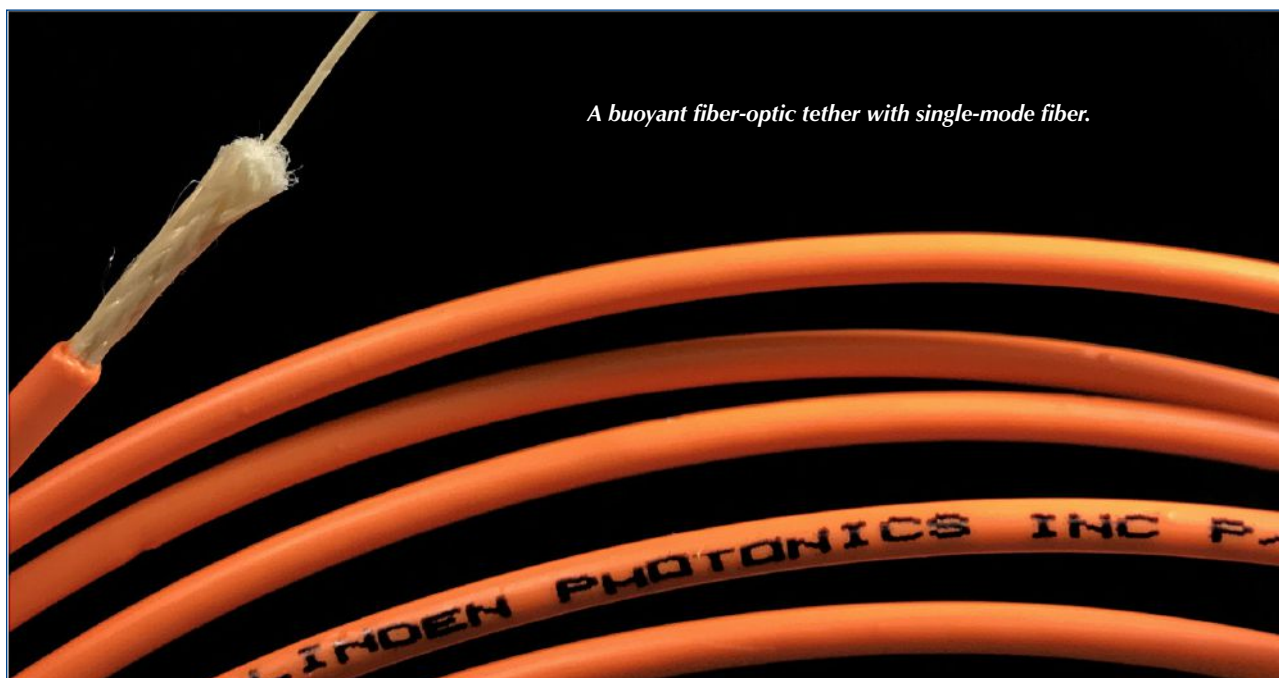
With much of the world's critical infrastructure aging, regular inspection is essential for ensuring the safety, integrity and longevity of these structures. Bridges, tunnels, dams, pipelines, and underwater structures all need thorough and regular inspections. When human divers face limitations due to depth, visibility or hazardous conditions, ROVs become necessary (*Sea Technology*, November 2024). These underwater robots have become the go-to solution for detailed, safe and efficient infrastructure inspections.

ROVs enable operators to inspect structures in deep, murky waters; monitor hard-to-reach areas; and collect data that would otherwise be difficult and dangerous to obtain. A crucial component of these ROV systems

is their communication link with the operators on the surface.

The solution to maintaining strong, real-time control over ROVs in challenging underwater environments is the use of fiber-optic tethers. These cables provide a reliable, high-bandwidth connection, enabling real-time data transfer, video streaming and precise control of the vehicle.

Fiber-optic cables are central to the functionality of many underwater ROVs. Unlike wireless communication, which is limited in underwater environments due to signal attenuation, fiber optics offer a reliable, high-bandwidth communication link between the ROV and its surface operators. Linden Photonics specializes in



A buoyant fiber-optic tether with single-mode fiber.

the development of durable fiber-optic cables designed for harsh environments, making products particularly suitable for underwater applications.

Key Applications of ROVs in Infrastructure Inspection

Bridge Piers and Supports. Many bridges span bodies of water, meaning their supports and foundations are submerged. These critical components must be inspected for corrosion, cracking or scour (the erosion of soil around bridge foundations). ROVs are used to navigate around these submerged structures and visually inspect them or use sonar to detect damage that is not visible to the naked eye.

Dams and Reservoirs. Dams, which control water flow and generate hydroelectric power, have large underwater foundations and intakes that need regular inspection to prevent failures. ROVs can access these areas to detect sediment buildup, erosion or cracks in the concrete. They also monitor the condition of floodgates and intake pipes.

Offshore Structures. Oil rigs, wind farms and offshore platforms are often located in deepwater, where human divers cannot operate for long periods. ROVs can perform inspections of these structures to ensure their stability and monitor the condition of pipelines and subsea equipment.

Underwater Tunnels. Tunnels constructed under rivers or oceans, used for transport or water conveyance, need regular checks for leaks, structural integrity and obstructions. ROVs can easily navigate through these confined spaces, taking video footage and using sonar for a comprehensive assessment.

Pipelines. Subsea pipelines, which transport oil, gas or water, stretch for hundreds of miles underwater. ROVs can conduct detailed inspections to detect any signs of corrosion, cracks or leaks that could lead to environmental disasters.

Fuel Tanks. Inspecting fuel tanks with ROVs is a safer and more efficient method than manual inspections. ROVs can navigate confined spaces and assess the integrity of tank walls, detect corrosion and check for contaminants without draining or disrupting operations. However, the caustic nature of certain fuels can be highly damaging to the fiber-optic tether used to control the ROV. Exposure to chemicals and corrosive substances can degrade the tether's jacketing, leading to potential loss of signal transmission or even complete operational failure. To mitigate this, the tether must be made from materials resistant to chemical exposure, ensuring safe and reliable inspections. Regular maintenance and inspection of the tether itself are also crucial for sustaining performance over time.

Fiber-Optic Tethers in ROV Operations

While ROVs play an essential role in infrastructure inspection, their effectiveness largely depends on their ability to communicate with operators at the surface. Unlike above-water drones, which can rely on wireless signals, ROVs must use physical tethers to maintain communication underwater due to the high signal attenuation in water. Hence, the need for fiber-optic tethers.

Fiber-optic tethers do more than just enable basic communication between the ROV and the surface: They facilitate the use of advanced technologies and methods that make inspections more effective.

Inspections often rely on visual data to detect cracks, corrosion or material degradation. Fiber-optic tethers enable the transmission of high-definition video feeds in real time, even in low-visibility underwater environments.

In murky waters where visibility is limited, sonar imaging is often used to map structures and detect damage that is invisible to the eye. Fiber-optic tethers enable the rapid transmission of sonar data, providing inspectors

(This page) The U.S. Coast Guard's SRS Fusion ROV was used with Linden Photonics' fiber-optic cables to search for victims of the Francis Scott Key Bridge collapse. (Next page) Vehicle with fiber-optic tether prepares to perform the world's longest underwater tunnel inspection.



with detailed 3D images of the underwater environment.

Many ROVs are equipped with manipulator arms that allow operators to physically interact with underwater structures, such as collecting samples or placing sensors. Fiber-optic tethers ensure that these manipulations can be controlled with precision, even over long distances.

Advantages of Fiber-Optic Cables

Fiber-optic cables transmit data using light, enabling much higher bandwidth compared to traditional copper cables. This is essential for ROV operations, which often involve transmitting high-resolution video feeds, sonar data, and control signals between the ROV and the surface in real time.

Unlike copper cables, fiber optics experience much less signal degradation over long distances, allowing ROVs to operate far from the deployment vessel. This is critical for inspecting large infrastructure, such as bridges and tunnels that may extend over hundreds of meters underwater.

Linden Photonics has developed fiber-optic cables that are not only thin and lightweight but also highly durable and resistant to mechanical stress, water ingress, and other environmental factors. This is particularly important in underwater settings, where cables can be subjected to harsh conditions, such as high pressure, currents and abrasion.

Linden Photonics has developed a range of advanced

fiber-optic cables designed specifically for harsh environments, including the subsea industry. Strong Tether Fiber Optic Cable (STFOC) and its buoyant variant (BSTFOC) are built for underwater ROV applications. These cables combine high strength and durability with a compact, lightweight form factor and varying levels of buoyancy.

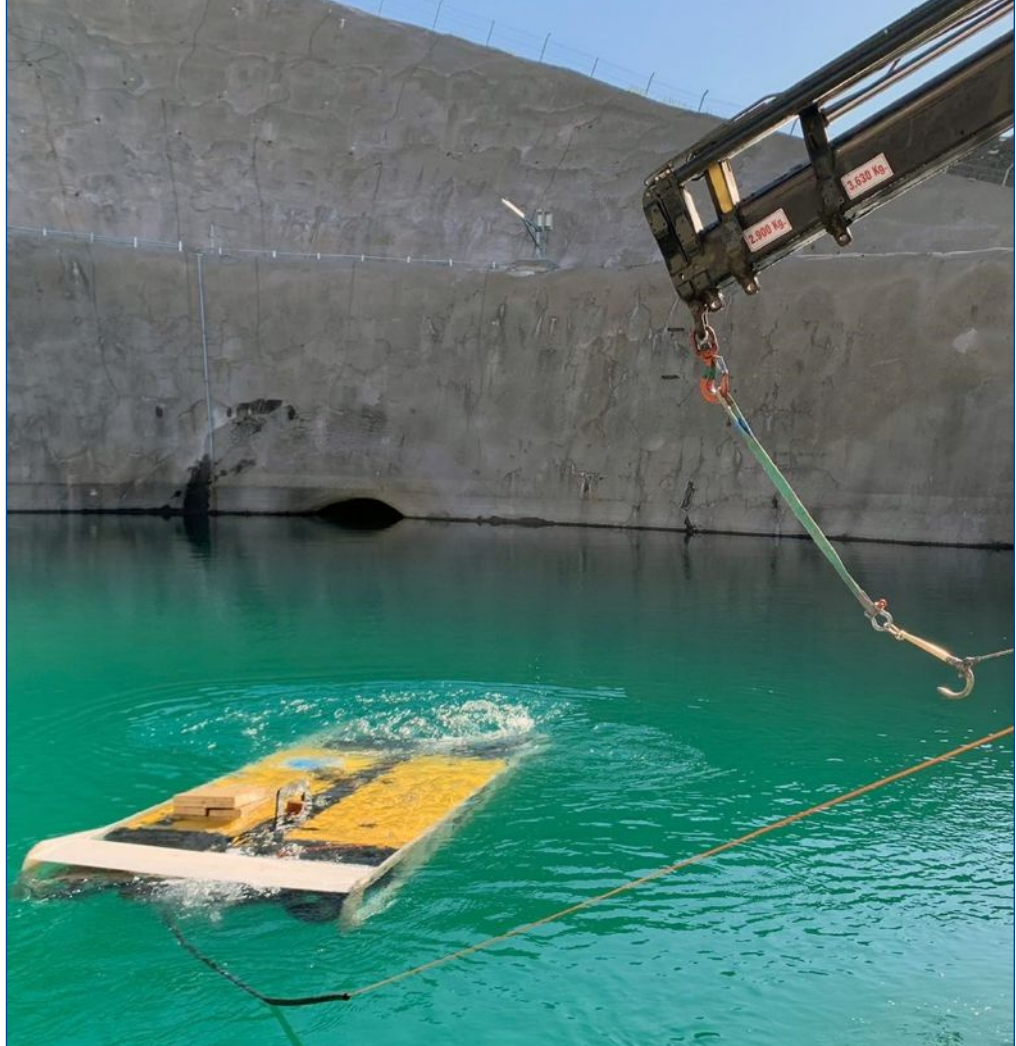
Cables can be reinforced with materials such as Kevlar, which provides significant tensile strength while maintaining flexibility. This allows the cable to withstand the forces exerted by underwater currents and the ROV's own movements. Cables are designed to minimize optical loss under high pressures, which is essential for deep-water operations.

The outer layers of the cables are constructed from materials that resist wear and tear from contact with rocks, debris, and other underwater hazards.

Case Study: Francis Scott Key Bridge Inspection

After the Francis Scott Key Bridge collapsed in Baltimore, Maryland, on March 26, 2024, Carl Shipley, head of the U.S. Coast Guard's Remotely Operated Vehicle and Underwater Port Security (ROV & UPSEC) program, was called to Baltimore Harbor to assist in the search for victims. Using the Coast Guard's Strategic Robotic Systems (SRS) Fusion ROV, Shipley and his team identified two vehicles within the wreckage and provided their GPS coordinates to dive teams by the end of the day.

However, three weeks later, one victim was still miss-



ing. When Maryland State Police requested further assistance, Shipley decided to try a new approach, inspired by techniques developed after the Lahaina, Hawaii, wildfires. The plan involved integrating short-range unmanned aircraft systems (SR-UAS) with the ROV to create a real-time map of the area, improving underwater target identification, though this method had never been field-tested.

Petty Officer First-Class Claudio Giugliano, an SR-UAS pilot with the Atlantic Strike Team, began by capturing aerial imagery of the bridge using a short-range drone. Shipley then turned these images into an orthomosaic map, overlaying real-time data onto the ROV's navigation system. This updated map was far more accurate than Google satellite images, which were outdated and less effective in identifying submerged objects, especially in changing environments like the collapsed bridge.

The combination of new aerial data and side scan sonar operations, led by Shipley and Petty Officer First-Class Miguel DeJesus-Vega, mapped over 317,000 sq. yards of the seafloor and enabled the team to identify remaining debris. This approach helped them narrow down search areas and determine that the missing victim was likely still trapped in the debris, requiring careful recovery efforts before starting demolitions.

Shipley believes this integrated approach will be valuable for future Coast Guard operations, including search

and rescue, marine environmental protection, and disaster relief efforts. The ability to coordinate aerial and underwater systems provides a clearer operational picture in disaster recovery and port reopening efforts.

"We now have the capability to assess above and below the surface," Shipley said.

The successful use of Linden Photonics fiber-optic cables in the Francis Scott Key Bridge inspection underscores the broader potential of this technology for infrastructure inspection. As more of the world's infrastructure ages, the demand for reliable, noninvasive inspection techniques will only increase.

Case Study: A Very Long Tunnel

While the Francis Scott Key Bridge inspection was conducted in a river environment, the same principles apply to other underwater infrastructure inspections, such as tunnels and pipelines.

A new world record for underwater tunnel inspections was set by Hibbard Inshore at 15.9 km (9.9 mi.) using a Saab AUV/ROV and a single continuous Linden fiber-optic cable. (The previous record was 14.1 km.) The inspection of the newly built tunnel provided the client with comprehensive data, including georeferenced 3D point clouds, sonar mosaics and other information, which can be compared to future inspections for monitoring over time.

“Unlike wireless communication, which is limited in underwater environments due to signal attenuation, fiber optics offer a reliable, high-bandwidth communication link between the ROV and its surface operators.”

Before starting the inspection, rebar was cut and removed at a depth of 500 m by a single ROV to clear the way for the inspection vehicle, which was an AUV/ROV that had to navigate three 90° bends before entering the main tunnel to successfully complete the inspection.

The vehicle has the capability to travel even farther distances for future projects. The team is now looking for the next opportunity to set a new world record for underwater tunnel inspections.

Conclusion

As fiber-optic technology continues to evolve, ROVs equipped with advanced cables will be able to handle even more complex tasks. For example, future advancements in fiber-optic sensors could enable ROVs to gather even more detailed data, such as real-time measurements of pressure.

The inspection in the aftermath of the Francis Scott Key Bridge collapse using the SRS Fusion ROV and Linden Photonics fiber-optic cables demonstrates the signif-

icant advantages of this technology in mission-critical underwater infrastructure inspection. Fiber-optic cables enable long-distance, real-time data transmission, ensuring that ROVs can thoroughly inspect complex underwater structures in challenging conditions. Moreover, the durability and flexibility of the cables ensure reliable performance throughout a mission.

As infrastructure continues to age and the need for safe, efficient inspection methods grows, fiber-optic cables will play an increasingly important role in enhancing the capabilities of underwater ROVs. Linden Photonics' innovative cable technology is well-positioned to meet the demands of this evolving field, providing the reliability, performance and durability needed for critical infrastructure inspections around the world. **ST**

Stephen O'Riorden has been in the fiber optics industry for over 20 years and is currently the president of Linden Photonics, a manufacturer of high-performance cables with customers worldwide. He holds six U.S. patents related to fiber-optic technology and a B.S. and M.S. in physics from the University of Massachusetts Lowell.

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Hovering AUVs

HAUVs for Imaging, Data Collection to Map Underwater Environment

By Craig Anderson



The ARV-i hovering AUV can autonomously monitor large areas or monitor changes in the environment over time.

Hovering autonomous vehicles (HAUVs) are set to revolutionize underwater exploration and data collection. These vehicles differ from traditional AUVs in that they can maneuver precisely in any direction. Some vehicles offer true 6 degrees of freedom (DOF) operation, enabling them to fully image the complex features of reefs, from imaging directly downward to capture benthic habitats to imaging more horizontally for imaging fish.

Other HAUVs, such as ARV-i by Boxfish Robotics, can remain underwater for long periods, docking in a charging bay and transferring data before going out again. These underwater resident HAUVs allow for detailed data collection over large areas over time or frequent monitoring of sensitive sites. Power can be supplied by several means, including cable and solar buoys, and data can be transmitted wirelessly or over fiber or copper cable.

Mission Planning

When choosing mission planning software, one must consider carefully whether to work with cloud software

or computer-based apps. In the field, internet access can be slow, unreliable and not always available. Computer-based apps, such as Boxfish Robotics' SafePath mission planner, have an advantage when working in more remote locations, on smaller vessels, enabling missions to take place with fewer dependencies. Missing planning software generally makes it easy to set up survey patterns (mowing the lawn) and may allow specification of image overlap.

Once the vehicle is put into the water, ideally, it starts automatically, and progress can be monitored through acoustic communications, such as with the Boxfish AUV. The current waypoint and the distance to that waypoint are shown and updated frequently on the SafePath software. A variety of commands can be issued over the acoustic link, including to pause or abort the current mission.

Autonomous Operation

HAUVs can use a combination of USBL acoustic positioning and DVL for precise measurement of movement and altitude; INS to measure acceleration, which is used



Optional Tethered Operation

Some HAUVs offer optional tethered operation to allow them to function as ROVs. This can assist in hazard identification prior to AUV missions or offer the operator more control when AUV operations are less ideal or not required.

Some HAUVs offer the ability to run autonomous operations while monitoring telemetry and the main camera via tether.

Photogrammetry to Create 3D Reconstructions

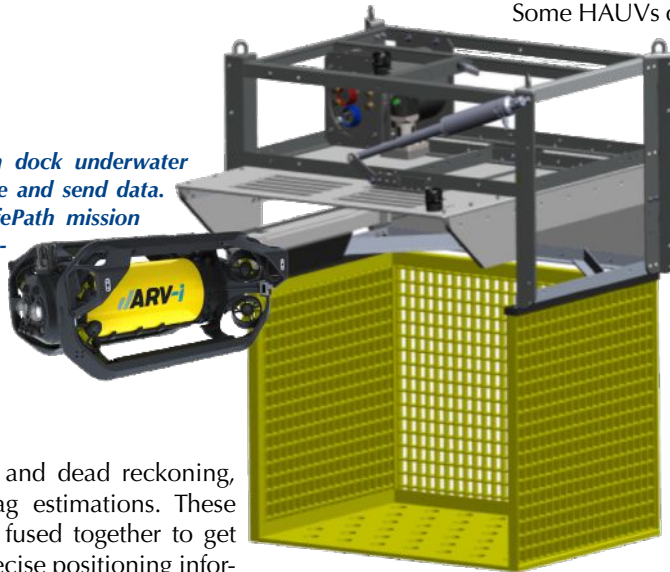
HAUVs typically offer 4K video or photo capture or both, which can be used to build 3D reconstructions of the underwater environment. RAW images allow for consistent adjustment of exposure,

white balance and contrast in the images. Image capture should allow for shutter speed adjustment, which can prevent motion blur while capturing images. Images can be captured from video but are lower in resolution and white balance, and exposure adjustment is often not possible due to the much lower dynamic range. JPEG images have similar issues.

Lighting is very important, and lighting that is distant from the camera lens and configured to minimize backscatter is important to getting the best data.

The images can be processed using software such as Agisoft Metashape, a powerful photogrammetry software that creates detailed 3D reconstructions from the collected image data. It's important to have a reference scale.

(Top) The ARV-i can dock underwater to wirelessly recharge and send data. (Bottom) Boxfish SafePath mission planner software interface.

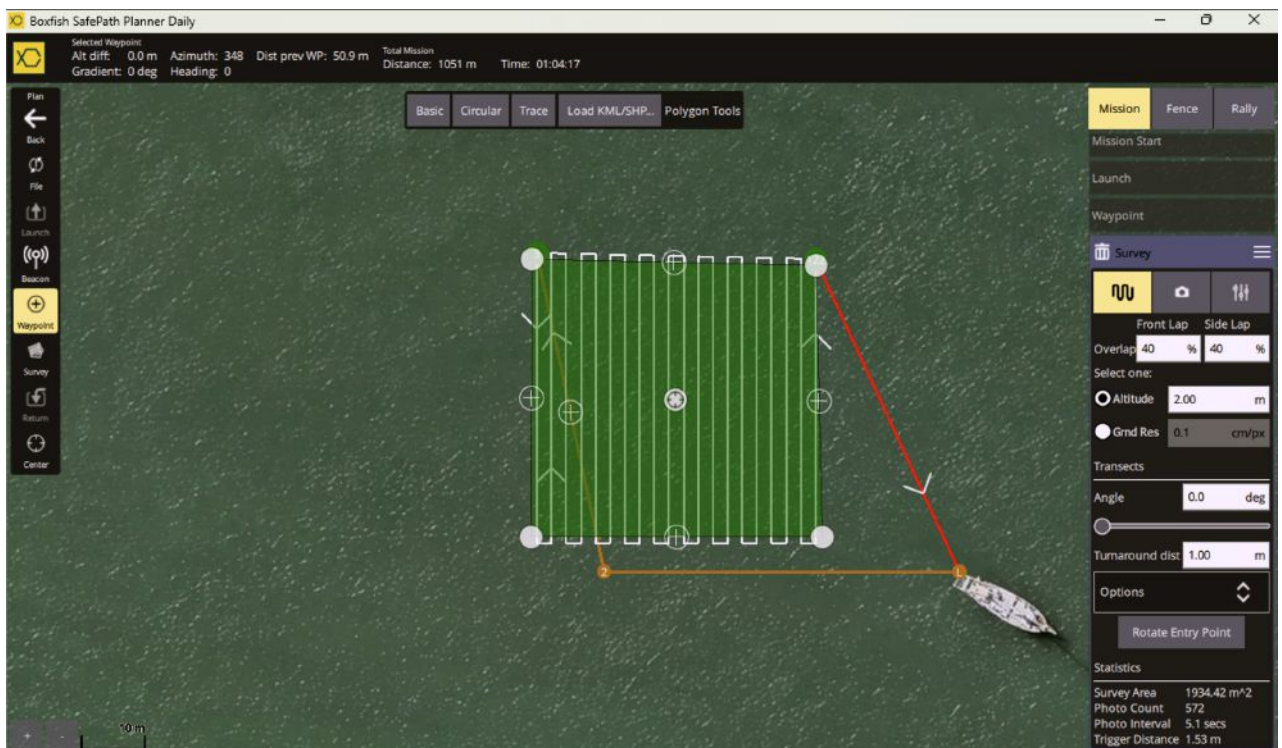


to estimate velocity; and dead reckoning, using thrust and drag estimations. These sensors are typically fused together to get both accurate and precise positioning information.

In addition, USBL systems generally provide an acoustic communications channel to monitor progress and control AUV operations.

Integrated Sensors for Comprehensive Data Collection

To enhance the capabilities of HAUVs, some vehicles can carry a range of sensors, including imaging sonar, CTDs, pH sensors, hydrophones, turbidity sensors and fluorometers. These sensors provide valuable data on water quality, temperature, salinity and other environmental parameters. The integration of these sensors allows for comprehensive data collection, enabling researchers to gain a deeper understanding of underwater ecosystems and their dynamics.



This can be done using laser scalers or stereo cameras.

The precision and quality of the images are important to create accurate, detailed, and reliable 3D reconstructions, which are essential for many applications in environmental monitoring and marine science and are just as applicable to archaeological surveys and infrastructure inspections.

Estimating Fish Species with Video Transects

HAUVs that can be operated horizontally (or at any angle) can be ideal for estimating the abundance of fish species. Wide-angle zoom lenses and dimmable lighting can minimize backscatter reflections for better imaging.

Customizable Boxfish AUV

The Boxfish Robotics AUV is a surface-launched, highly portable system that can be operated by just one person. It supports robust fiber-optic tether solutions for ROV or autonomous operation with video monitoring. Its unique, 6 DOF patented design can operate down to 600-m depth. The Boxfish AUV can carry a wide range of environmental sensors and sonars for data collection. It enables monitoring of autonomous mission progress and the capability to intervene during a mission if needed.

3D model by Dr. Leigh Tait, a marine ecologist at New Zealand's National Institute of Water and Atmospheric Research Ltd. (NIWA).



In addition, if tether communications are lost during an ROV operation, the vehicle can drive itself to the surface.

ARV-i: Resident Vehicle

Boxfish Robotics and Transmark Subsea have collaborated to create ARV-i, an innovative resident HAUV that can dock underwater. While docked, the ARV-i can wirelessly recharge and send data at Ethernet speeds. The ARV-i supports all of the features of the Boxfish AUV. The system enables completely autonomous operation to be monitored and controlled from a command center anywhere in the world. The ARV-i can be equipped with a range of sensors for comprehensive data collection. It can be deployed to autonomously monitor large areas or to monitor changes in the environment over time.

In 2023 and 2024, Boxfish Robotics collaborated with Mocean Energy in Scotland, installing a dock for Mocean's subsea battery pack as part of an underwater wave energy project. The ARV-i vehicle showed that it could leave the dock, inspect the installation and surrounding environment, and return to the dock.

The vehicle has also demonstrated its capabilities in Norway, where it was installed in a fish net for extended periods, capturing data on the fish population and parameters of the net.

Conclusion

HAUVs' ability to hover and capture high-resolution images, combined with the ability to integrate advanced sensors and user-friendly mission planning software, make them invaluable tools for researchers and professionals in marine science and environmental monitoring. As we continue to explore the ocean, these innovative vehicles will undoubtedly play a crucial role in advancing our understanding. **ST**



Craig Anderson is co-founder and head of R&D at Boxfish Robotics. He specializes in control systems, software and electronics, driving development of innovative marine robotics solutions for the global market.



Q&A: Richard Kohler

An Interview with the Deepwater Dive Explorer



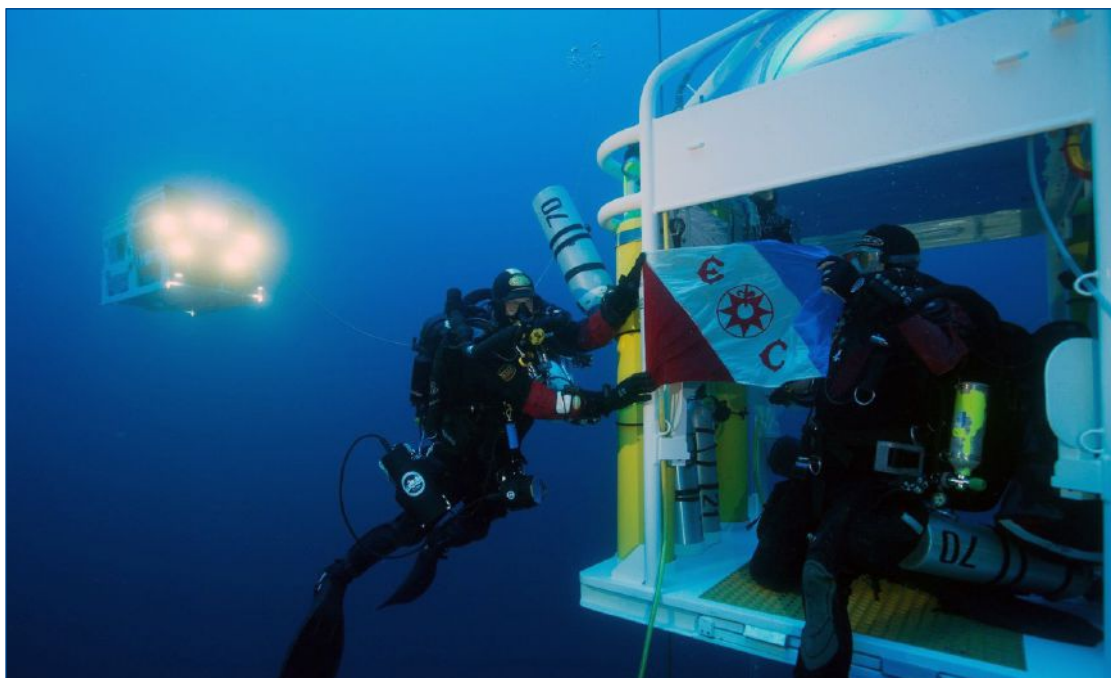
Richard Kohler got his first taste of scuba diving in 1969, and he was hooked immediately. In the more than five decades since his introduction to the underwater world, he has pushed further into deeper waters, exploring shipwrecks, such as the *Titanic* and its sister ship *Britannic*, and performing acts of service, such as locating and recovering the remains of lost airmen from World War II. His latest book is: “Mystery of the Last Olympian: *Titanic’s* Tragic Sister *Britannic*.” Kohler discussed his career with *Sea Technology*.

What initially attracted you to diving?

As a young boy growing up in Brooklyn, New York, I enjoyed watching television shows like “Sea Hunt” and “The Underwater World of Jacques Cousteau,” but there were two things in 1969 that would cement my drive to become an underwater explorer.

The first was watching the Apollo moon landing that July. Like every other young person around the world, I wanted to be an astronaut and explorer.

That same summer, my father took scuba diving lessons, and I was allowed to join him as he did his pool training. As he put the double hose regulator in his mouth and disappeared in a boil of bubbles into the pool, I was



amazed. Scuba diving with its life-support system exposure suit was allowing a regular guy like my dad to explore “inner space” and its alien environment.

Once he was certified, he would often allow me to assemble his diving gear and breathe from it, first on land and eventually in shallow water from behind our family boat. In time he would let me explore the turbid NYC waters, with a rope tied around my waist to a cleat on the boat. I could only wander so far and so deep, but the raw excitement of being an underwater explorer bit deep into my soul. In the shadows around me were jellyfish and crabs, tiny animals, and large fish. Strange things poked out of the mud, begging to be examined. The mechanical metronome of my exhaust bubbles was the music that filled my head as, with eyes wide open, I took it all in.

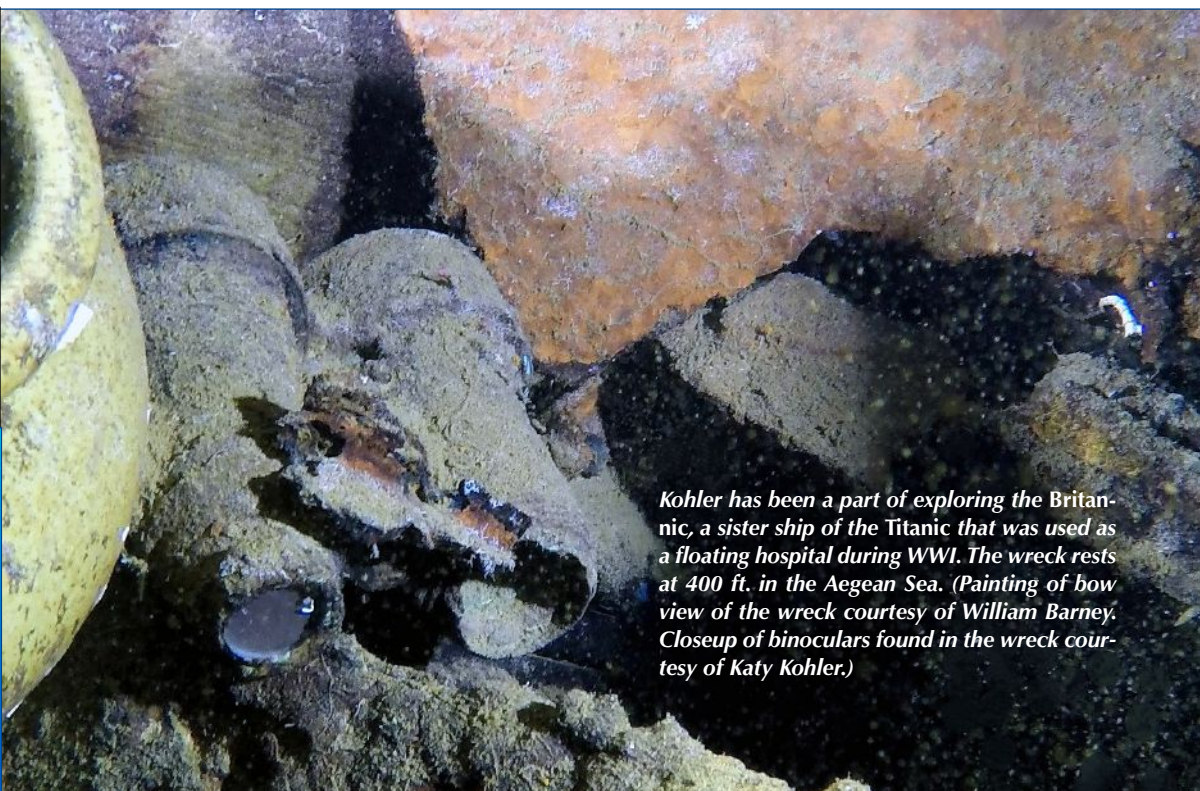
I may never have become an astronaut, but at eight years old, I was already an explorer and fledgling aquanaut. I would dive as often as allowed, and finally, at age 15, I was certified as a junior scuba diver, with my basic full certification the next year. Forty-six years later, I am still diving and as enthusiastic being underwater as was when I was eight.

As you worked your way into technical diving into deeper waters, what skills did you focus on, and what was your technology toolkit?

In my 46 years of scuba diving experience, I have watched the sport of scuba diving, its techniques, training and the equipment, change. And with each change, it expanded the range and depth of my exploration and ability.

In 1977, I used a single steel tank with 72 cubic ft. of air, and a 10-min. dive to 80 ft. was considered deep. There was no deep diving training, as deep diving was seen as a dangerous stunt and not approved by the training agencies.

My guides and mentors were older divers who had pioneered techniques to stay safe in deepwater and borrowed equipment from both the military and commercial dive fields, adjusted to the needs of the sport diver. Some of these included harness and rigging for double tanks, neoprene commercial drysuits for both exposure and buoyancy, as the equipment we would wear became heavier. Other techniques borrowed were carrying



Kohler has been a part of exploring the Britannic, a sister ship of the Titanic that was used as a floating hospital during WWI. The wreck rests at 400 ft. in the Aegean Sea. (Painting of bow view of the wreck courtesy of William Barney. Closeup of binoculars found in the wreck courtesy of Katy Kohler.)

redundant, or backup, supplies of air to breathe in an emergency or to decompress, as well as carrying redundant underwater lights and knives.

In 1987, I was using double aluminum tanks with a total of 160 cubic ft. of air and doing decompression dives, exploring shipwrecks as deep as 250 ft., like the famed *Andrea Doria*, known as the Mount Everest for shipwreck divers due to its dangerous and difficult conditions. The techniques for entering and exploring shipwrecks, I had now mastered, including the use of guidelines, fine motor skills to prevent kicking up the silt inside a shipwreck, and the understanding of how ships themselves are built and how they come apart as well. My dives were planned with the U.S. Navy decompression tables, which I would write on a slate, and I would use a depth gauge and redundant watches.

In 1997, I was using the largest steel diving cylinders available, giving me 240 cubic ft. of a helium-oxygen mixture to breathe at depth and another two tanks with 160 cubic ft. of oxygen mixtures under my arms for decompression. No longer breathing air underwater, I was much like commercial divers, but without the hoses and support of a hardhat diver, I was limited to the breathing gas I could carry and the amount of decompression I was willing to do in the open ocean. The maximum range for me at that point was 360 ft. for 30 min. spent exploring the bottom, paid for with a decompression obligation of 3 hr. to ascend slowly, lest I suffer the bends, decompression sickness.

Another advance at this time was the diving computer, worn on the diver's wrist, that calculated decompression obligations in real time. The computer is more efficient and accurate for calculating a bell curve type of

profile, taking into account where the diver is at every second underwater versus the tables method, which is a square linear dive profile based solely on maximum depth achieved and time spent at that point. In short, a dive computer gives a diver more bottom time for less decompression when used correctly.

In 2003, the availability and affordability of closed-circuit rebreather [CCR] technology for civilian divers would provide a quantum leap to my exploration ability. With this technology/equipment I can now dive to 600 ft. and spend almost 12 hr. underwater with a single closed-circuit rebreather before needing to resupply. Although CCR's have been as deep as 1,000 ft., there is a trade-off for getting a reasonable amount of time to explore versus the time spent in decompression for the technical sport diver who is not going into saturation, or spending time in the open ocean adrift at night.

You've done a lot of research into the Titanic's sister ship, Britannic. Can you tell us how you found the wreck site and what were the most memorable parts of diving the wreck?

In 2005, while working for the History Channel, I led an expedition to the RMS *Titanic* and made a series of dives to explore the wreckage and debris field in the Russian MIR submersibles. Those dives led me the following year to explore her sister ship, the HMHS *Britannic* in search of answers to questions about the way these ships were constructed and why both of them sank as quickly as they did.

Where *Titanic* is 12,500 ft. down at the bottom of the Atlantic and requires a submersible for people to explore



Kohler is a founding member of the Atlantic Wreck Divers.

and see firsthand, *Britannic* rests at 400 ft. in the warm and clear Aegean Sea, close to the Greek Island of Kea, and is accessible to the trained technical sport diver.

Where *Titanic* is shrouded in darkness and death, *Britannic* is surrounded by shoals of fish and covered in colorful marine growth, very much alive in its environment. This resonates with me as an explorer, and although I enjoyed my exploration of *Titanic* in the MIR submersibles, the ability for me to touch, swim into and around the wreck of the *Britannic*, is at the core of who I am as a diver. Understanding the history of the *Olympians*, as the *Titanic* and her two sister ships are known, makes for exploring the *Britannic* so much more poignant.

Originally designed as an opulent passenger liner whose primary purpose was to move immigrants from the Old World to the New, World War I changed her destiny and fate. Conscripted by the Royal Navy, *Britannic* never got to carry a single paying passenger. Most of her opulent fittings were removed and replaced with the equipment she would need to serve as His Majesty's Hospital Ship.

For the past 20 years, I have had the rare opportunity to go inside this massive intact ship, exploring and filming areas that have not seen the light of day since she sank over 100 years ago. Artifacts and equipment like hospital

beds, wheelchairs and medical equipment clearly align with her intended missions of mercy, but hidden away are vestiges of her more stately lineage. Expensive china silver and crystal serveware were secured aboard and never used, and in the very bowels of the great ship we have found the beautiful handpainted tile walls of the Turkish baths, proof that her designed purpose for luxury and pleasure were always there beneath the red cross and white hospital paint. I have explored in the darkest spaces of the boiler rooms, weaved my way in and around the engine room catwalks and down corridors and berthing compartments. I still have not seen it all, and there are yet more mysteries to answer.

You're a founding member of the Atlantic Wreck Divers. What stands out to you from those experiences?

In 1982, I met divers who took me under their wing and began to school me in the ways of deep shipwreck diving. No agency offered this type of education, as deep decompression diving and shipwreck diving in particular were considered dangerous. These men, all older than me and with years of diving experience, directed me on what equipment I should be using and why. The schooled me on techniques for safely navigating inside broken ships and understanding the plethora of dangers deep diving brought with it: nitrogen narcosis, deepwater blackout and the bends.

Kohler learned to master both dive safety and camera presentation for underwater television filming.



When the leader of our group told me he would rather slit his own throat rather than break decompression and suffer the bends, I believed him. The gravity of what we were doing was never lost on me as I would occasionally hear of a tragic diving accident and its fatal outcome.

Of all the lessons they hammered into me on our hours-long boat rides to and from dive sites, the ones of controlling panic have often gotten me out of a pickle. Fix a problem fully and completely lest it create a “snowball” effect and everything turns to crap. A loose strap can mean entanglement, which can lead to zero visibility and then increased breathing and then out of air. When panic rises inside, stop, close your eyes and control your breathing, as long as you’re breathing, you’re alive and can calmly and slowly fix the problem and live to dive another day.

We often found new shipwrecks as we pushed further and deeper offshore, and although that was and still is very exciting, I feel that the camaraderie of our group, the collective knowledge and shared passion, is the best part of being in the Atlantic Wreck Divers.

You’ve done a lot of television work. Can you describe the technical challenges of diving while filming and how you approach those?

My first TV project was diving on a German submarine 230 ft. deep, 60 mi. off the New Jersey coast in 1996. This was an exciting time as we had just begun adapting commercial diving gases like trimix and nitrox into our toolkit, and this was expanding our range, clarity of mind and safety. Of course, it was now more complicated and requires more equipment.

Doing this while working with a film crew aboard was taxing and at times distracting. But I learned how to serve

two masters. The first was me and my dive safety; the second was to get the “shot.” Working with a topside and underwater crew requires a clear sense of timing and the ability to intuit what the cameraman is looking for.

Speaking on camera was also a new skill I had to learn on the job, and some of my very early jobs are a little difficult to watch. Funny how I can dive deep into shipwrecks with little fear, but stick a camera in my face and try to remember a line and, boom, stage fright!

What are you working on now?

Some of the most satisfying work I have been doing of late is the projects that can make a real difference in people’s lives, like locating and recovering the remains of lost airmen from their downed aircraft from World War II.

I have also been back to *Britannic* the last five years, documenting the wreck inside and out with both video and still photography, as well as locating artifacts for possible recovery.

I also spend a few weeks each year looking for unidentified shipwrecks around the U.K. as far west as Donegal, Ireland, and as far east as Dover in the English Channel. The diving there is as varied and diverse as the hundreds of years of shipwrecks that surround the island nations.

Anything you want to add or emphasize?

I like what Tom Eadie said. He was a U.S. Navy diver who was awarded the Medal of Honor in peacetime for his work diving on sunken submarines and rescuing a fellow diver. To paraphrase: Any man can dive deep, but not every man can dive deep and accomplish something.

I like to think, with my work underwater, I’ve accomplished something. **ST**

international

SeeByte Collaborates with Kraken

SeeByte Ltd. and Kraken Robotics Inc. have signed a memorandum of understanding to enhance their complementary system offerings to bring customers an integrated solution across maritime mission planning, data collection, and data analysis.

Kraken specializes in the delivery of advanced synthetic aperture sonar (SAS) for maritime platforms, including uncrewed underwater vehicles of all sizes and the KATFISH towed SAS system.

SeeByte specializes in the development and supply of maritime software solutions, including the SeeTrack Mission Management System, Neptune Autonomy System and automated target recognition.

Teledyne Adds Partners in Asia

MacArtney Asia, a provider of underwater technology solutions based in Singapore, has been appointed as the regional reseller for Teledyne RD Instruments' ADCP and DVL products. This partnership will enhance the availability and support of Teledyne RDI's advanced ADCP and DVL technology throughout the region.

Teledyne Marine has also chosen iOne Resources Inc. as the new official distributor in the Philippines for several Teledyne Marine product lines. iOne Resources Inc. will represent Teledyne Marine brands, including RESON, PDS, ODOM Hydrographic, Bowtech, Gavia, Oceanscience, RDI, TSS and BlueView.

V.Group Expands Chennai Office

V.Group, a global ship manager and marine services provider, has opened an expanded office in Chennai, India, strengthening V.'s ability to engage with both customers and seafarers in the region. The expanded office houses more than 200 colleagues supporting V.'s crewing, seafarer recruitment, ship management, decarbonization and digitalization operations, as well as business functions, including finance and IT.

The Chennai office is also home to V.'s Operations Support Centre, supporting more than 400 vessels managed through its Fleet Cells around the world.

As one of India's oldest and most important ports, Chennai is a strategically significant hub for V. The company already has a number of existing clients as well as an established network of seafarers in the region. The new office consolidates this presence by combining two existing offices into one.

OCEAN Project Enters Final Phase

Scheduled to run for three years, The OCEAN project (Operator-Centred Enhancement of Awareness in Navigation) is entering its final phase, having already published a number of downloads, presentations and free training videos that are already making an impact on the navigational safety of vessels. The project is funded by the European Union and UKRI and comprises members from seven European countries: Norway, Greece, Spain,

Denmark, Portugal, Ireland and the U.K. By taking a holistic approach to navigational safety that encompasses training, the usability of technology, processes and procedures, human-centered design, and commercial pressures, the project hopes to identify factors that can influence outcomes and shed light on actions that can be practically implemented to improve navigational and situational awareness.

Furthermore, the project seeks to address issues that go beyond collisions and grounding of vessels and investigate and research ways to mitigate whale strikes and track lost and floating containers. The OCEAN Project has developed an app, currently in beta testing, to enable seafarers to add sightings of whales or containers into a database. The project is also open to exchanging data with similar initiatives to further enhance navigational safety.

NOR Adds Sonardyne Products to Rental Pool

NOR Offshore Rental has made a further, multi-million-pound investment in Sonardyne products for its rental pool as part of the expansion at NOR Ltd., its U.K. subsidiary office in Aberdeen.

This investment comes as result of increased demand for NOR's services and equipment globally. NOR has ambitions to outfit its Aberdeen office with the same services as the headquarters in Norway.

The investment includes stocking the rental pool with additional tooling and survey equipment, including SPRINT-Nav, Compatt 6+ and Fusion 2 systems to support the offshore construction industry.

Oceanic Systems Acquired

Oceanic Systems has been acquired by Energy Solutions UK Ltd.

Founded in 1996, Energy Solutions is a supplier of marine electrical systems that works with leading OEM boat builders, superyacht owners, and individual boaters to deliver innovative power and control solutions. This strategic acquisition enhances Energy Solutions' marine technology offerings, advancing its digital leadership in boat building and marine manufacturing.

Oceanic Systems will continue to operate as a stand-alone business. Its 15 employees will be integrated into Energy Solutions' operations to bring in Oceanic's technical capabilities, including PCB assembly with automated pick-and-place technology.

Heavy Weather Alert Tool

Extreme weather incidents are increasing globally, and the impact on cargo ships is evident. Maritime insurance specialist The Swedish Club reports that it registered claims exceeding \$25 million, attributable to heavy weather over the past five years.

In response, The Swedish Club has developed a Heavy Weather Alert tool as an addition to its Trade Enabling Loss Prevention tool.

Heavy weather can cause structural damage, shifted cargo, broken mooring lines, wet damage, lost cargo overboard and more. Heavy Weather Alert provides

timely loss prevention advice to insured vessels operating in proximity to severe weather patterns. Based on a vessel's position, in combination with up-to-date weather information and real-time data, the Heavy Weather Alert system automatically generates a customized loss prevention alert, with hands-on advice, when severe weather conditions are detected near a vessel's position.

Dredge for Conservation

IMS has delivered and commissioned a dual-function IMS 5012 LP Versi-Dredge to the Bureau of Reclamation, Lower Colorado Region of the U.S. Department of Interior, Multi-Species Conservation Program.

The 5012 LP Versi-Dredge with Starwheel Drive self-propulsion system was purchased through competitive tender and includes the SolidsMaster dredge cutterhead for hydraulically dredging and pumping sand and sediments, as well as the WeedMaster vegetation cutterhead for chopping and pumping aquatic vegetation.

The dual-function dredge is also equipped with a dredging GPS system and IMS's Transport-Launch-Retrieve trailer system, allowing for easy launch and retrieval of the dredge without the use of a crane.

The 5012 LP will be used in the conservation area for hydraulically dredging sand, silt, clay, reeds and cattails.

NNS Opens Office on ODU Campus

Hill's Newport News Shipbuilding (NNS) division is strengthening its collaboration and partnership with Old Dominion University (ODU) by opening an on-site NNS office, located in the ODU Engineering Systems building on the university's main campus in Norfolk, Virginia.

The office builds upon the 2023 announcement of NNS as the lead industry sponsor of the Monarch Accelerator Program to Engineering, which aims to increase the number of engineering and engineering technology majors and degrees, particularly from under-represented and underserved communities in Hampton Roads.

The new office allows ODU students to connect directly with NNS for internship, co-op and full-time employment opportunities, as well as professional development and mentoring.

More than 22 percent of the engineering workforce at NNS are graduates of ODU. The shipyard also sponsors the NNS Scholars program, which endows academic scholarships awarded annually to qualified junior, senior, and graduate students studying engineering, business, or computer science.

AAPA Ports Report

The American Association of Port Authorities (AAPA) has released its 2024 Port and Maritime Industry Economic Contribution Report. Among the report's findings are that ports' contribution to U.S. gross domestic product totals almost \$2.9 trillion and that more than \$2.1 trillion, accounting for over 40 percent of the total value of U.S. goods, passed through a port.

The report was created in collaboration with Congressional economists from Ernst & Young, using U.S. government data from 2023. **ST**

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Offshore Pile Driver



The MHU 6000W Wind Hammer opens new possibilities for offshore wind projects by handling larger and heavier piles in increasingly challenging environments. The Wind Hammer is engineered to drive larger piles in tougher environments and install longer piles in deeper waters to enable the deployment of a future generation of monopiles with top diameters of up to 9 m. It delivers from 200 to 6,250 kJ of energy to drive monopiles with diameters up to 9 m. MENCK - Acteon.

Propeller for Lower-Horsepower

Sharrow MX-A is the newest addition to the Sharrow MX series, delivering all the incredible benefits and patented technology of the Sharrow Propeller to a new range of motors: 40 to 200 hp. It's compatible with the most popular outboard motor brands, including Mercury, Yamaha, Honda, Suzuki, Tohatsu, Johnson and Evinrude. Sharrow Marine LLC.

Emissions Analysis for Ports

Port Emissions Report, an advanced analytical tool, is now available as a standalone product or as part of the newly introduced EmissionInsider Carbon Insight Suite. This innovative technology provides comprehensive emissions analysis tailored explicitly for ports, offering a new

level of reporting capability to support environmental sustainability. It tracks ship movements, vessel types and the associated emissions of pollutants such as CO₂, CO, CH₄, SO₂, NO_x, N₂O, PM10 and CO₂-equivalent greenhouse gases, enabling ports to identify critical areas for improvement. PortXchange Products B.V.

Multi-Scale ADCP



Workhorse Proteus has the processing horsepower to simultaneously sample at multiple spatial and temporal scales. This can unlock a new understanding of waves, turbulence and the changing currents below the surface. Features include the Proteus Advanced Doppler Sonar Platform (ADSP); Catalyst Processor for fast processing; new RDI AHRS and dynamic bin mapping; elegant planning software; five beams for direct measurement of ocean's vertical velocity; versatile deployment options; robust, repeatable broadband techniques; and multiple communication options. Teledyne RD Instruments.

Training Data Management

Data Dashboards is a series of innovative tools to empower customers with actionable insights from their data. The first Dashboard provides new insights into training performance data with a comprehensive view of key learning metrics, enabling managers to track

training performance against plans and quickly identify gaps that could represent compliance risk and that require attention. Ocean Technologies Group.

Vessel Motion Monitoring

A key feature of the BareFLEET system is designed to enhance safety and protect vessel integrity with impact force monitoring. This innovation aims to address the critical risks posed by hard impacts between vessels and offshore structures, harbor quaysides, or other vessels, all of which can lead to equipment damage, operational disruptions, and even endanger lives. AST Reygar.

Simplified Emissions Reporting



Emissions compliance platform VeriSTAR Green has been integrated with OrbitMI's maritime intelligence platform to simplify emissions reporting for shipping stakeholders and enhance environmental performance. By facilitating accurate and timely emissions reporting, the integrated solution enhances operational efficiency while offering ongoing support for statutory compliance and third-party verification, including emissions statements for shipowners and charterers. Bureau Veritas Marine & Offshore and OrbitMI Inc.

Personnel Locator

Wireless Connect POB (Personnel OnBoard) has expanded its scope to include accommodation vessels and barges. Connect POB is now tailored to meet the specific needs of operators in this sector, offering real-time insights into personnel movement, occupancy and safe-

ty compliance on accommodation vessels. Key features include real-time location management, which is vital in emergency situations, and real-time monitoring of mustering stations, which improves efficiency, accuracy and safety. Scandinavian Reach Technologies AS.

Boat Health Monitoring

MConnect is a cutting-edge, NMEA 2000-certified web server and screen editor. It connects to hundreds of data points on your boat and presents stunning graphics on your multifunction display. On and off board, MConnect is accessible from multiple devices. Maretron.

Depth Measurements via Satellite

Water depth data are available via satellite-derived bathymetry (SDB). SDB applies physics-based computer algorithms to optical imagery captured by commercial remote sensing satellites. This analysis detects and measures light reflecting off the seafloor to calculate water

depth. Depending on water clarity, SDB is routinely accurate to depths of 20 to 30 m. TCarta Marine LLC.

Wind Propulsion Software

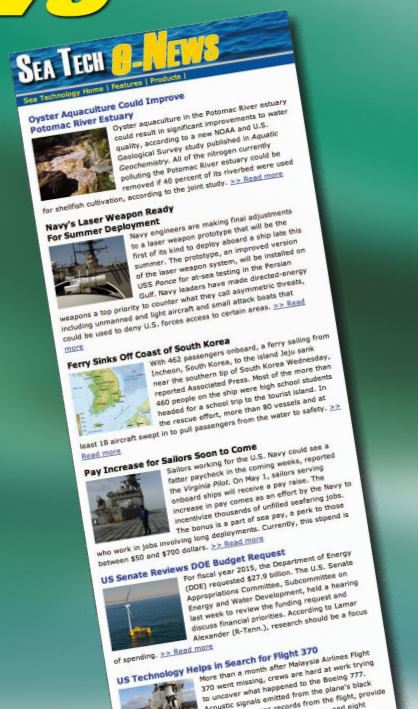
OpWind helps crews combine the operation of sails and propellers in the most efficient way in all sea conditions. OpWind automatically ensures that engine efficiency can be optimized with respect to propeller rpm and blade pitch angle when wind propulsion is also used to propel a vessel. The approach saves even more fuel than would otherwise be the case. Berg Propulsion AB.

Hybrid-Fuel Engine

X-DF-P is an option for the X-DF-A ammonia-fueled engines that offers the capability to run on liquefied petroleum gas (LPG). The "pre-fit" solution caters to vessels under construction for the anticipated global trade in ammonia. The engine, designed and optimized for ammonia fuel, will offer reliable and efficient running on LPG. WinGD. **ST**

SEA TECH e-NEWS

Featuring the government and industry news you need to know, *Sea Tech e-News* delivers timely information straight to your inbox, with details on recent product releases, updates on new hires and promotion, and workshops. We send out the newsletter every other week, so you'll get a steady stream of news edited down to what matters most.



DNV Cyber Acquisition

DNV has acquired CyberOwl, a global expert in cyber risk monitoring and threat management on board maritime vessels. The two companies have joined forces to strengthen the cyber defenses of the shipping industry by forming one of the world's largest specialists in maritime systems cybersecurity.

The partnership comes at a time when the sector must comply with new cybersecurity regulation and invest in incident detection, response, and recovery as increasing implementation of digitally connected systems on board vessels create new vulnerabilities. A typical fleet of 30 cargo vessels now experiences an average of 80 cyber incidents a year, according to a 2023 publication by CyberOwl, HFW and Thetius.

CyberOwl will team up with DNV's global network of 3,500 maritime risk experts and 500 cybersecurity specialists. Together, the two companies will address all aspects of a maritime organization's cybersecurity needs, safeguarding demanding IT and industrial control system environments in the sector.

DNV's acquisition of CyberOwl is the latest step in DNV's cybersecurity growth strategy. Earlier this year, DNV created one of Europe's fastest growing cybersecurity services businesses, DNV Cyber, by merging its existing cybersecurity business with two recently acquired companies, Nixu and Applied Risk.

CyberOwl will operate separately from DNV's ship classification business.

Eco-Friendly Boats For Oyster Farming

Maine Ocean Farms is supercharging its operations with custom-built electric workboats and Aqua superPower's marine fast charging, aiming to set a new standard for eco-friendly oyster farming.

This project is made possible thanks to a \$500,000 grant from the U.S. Department of Energy, Office of Energy Efficiency and Renewable

Energy, plus another \$500,000 in matching funds.

Aqua superPower leads this electrification project, in partnership with Maine Clean Communities. Fogg's Boatworks in North Yarmouth, Maine, will design and build the custom workboat, which will feature an advanced electric powertrain from Vita Power.

The team will gather real-time data to measure environmental and emissions reductions to share with the industry.

Data Management Partnership

Hoppe Marine GmbH, based in Germany, and Metis, based in Greece, have entered into a strategic cooperation for onboard data acquisition. The cooperation ensures the seamless integration of Hoppe's data collection systems with the Metis cloud-based performance management platform.

This partnership aims to expand the use of high-frequency data analytics in vessel performance management, offering customers greater flexibility for real-time monitoring and strategic decision making.

Cyber Threat Report

Marlink, a managed services provider of business-critical information and communication technology solutions, has released the latest global maritime cyber threat report produced by its Security Operations Centre (SOC).

The report, based on data gathered during the first half of 2024, demonstrates the changing tactics of cyber criminals, who are increasingly attempting to bypass previously effective security controls using new tools.

Marlink's maritime SOC actively monitored more than 1,800 vessels in the first half of 2024, including all types of cargo ships, as well as cruise ships, superyachts and off-shore vessels.

The data show that malicious activity in the first six months increased significantly compared to the previous year. SOC analysts

observed a continued rise in common threats, such as command and control attacks, along with the evolution of botnet attacks, which are growing in both complexity and volume. Phishing remains the top method attackers use to access corporate networks.

The SOC report has also detected an increase in blacklisted malicious traffic. This highlights the importance of maintaining up-to-date threat intelligence feeds and applying strict security policies to prevent unauthorized connections to high-risk sites.

The volume of botnet activity increased substantially, with new botnets leveraging more advanced techniques, including AI-enhanced botnets targeting IoT devices.

The SOC registered 23,400 malware detections and 178 ransomware detections in the first half of 2024. Firewall events, which occur when a process or application attempts to make a connection that violates a client's network security policy, rose above 50 billion, while security events reached 14.8 billion. The number of alerts increased to 1.4 million, and the number of major incidents managed by the SOC reached 79.

The sharp increase in malware detections also showcases the effectiveness of endpoint detection and response tools in identifying and containing widespread malware.

E-Foil Fast Ferry

Chartwell Marine's electric foiling high-speed trimaran demonstrator has entered build at Designcraft Ltd.

The £1.86 million project, funded by Innovate UK, is a partnership between Chartwell Marine, Solent University and Newcastle Marine Services to develop and build a scaled demonstrator for a simple and cost-effective zero-emission foiling fast ferry.

The goal of this collaboration is to support the decarbonization of short coastal journeys, which often run relatively empty during quieter periods of the day. The project also aims to reduce costs for ferry operators. **ST**

Wind Turbine Installation Tech

Exail will supply three Hydrins INS to Pliant Offshore for integration into Pliant Offshore's Installation Measurement System (IMS) to improve the accuracy and efficiency of wind turbine installations.

Pliant Offshore's IMS is designed to provide real-time measurements of the inclination and position of structures, such as monopiles, during installation. The system uses 3D point cloud technology combined with laser sensors to measure and virtually reconstruct objects with high accuracy.

The integration of Exail Hydrins INS enhances the system performance by providing precise positioning and motion compensation, even on moving vessels. This enables the IMS to take continuous measurements during the pile-driving process, guaranteeing the correct positioning and stability of wind turbines in challenging conditions.

Ørsted to Open New Office

Ørsted is expanding its U.S. co-headquarters in Rhode Island, including a new U.S. engineering, procurement and construction hub in the state. Ørsted, which has maintained its co-HQ in Rhode Island for more than six years, will move to a larger, 17,470-sq. ft. location in downtown Providence.

As part of its more than \$20 billion investment in U.S. energy, Ørsted has invested more than \$1.5 billion in Rhode Island as it expands its Northeast portfolio of offshore wind projects. Ørsted's expanded co-HQ in Providence is expected to open this winter.

Ørsted operates the Block Island Wind Farm, America's first offshore wind farm, and construction is underway on Revolution Wind, the state's first utility-scale offshore wind farm.

Ocean Energy for Subsea Tasks

C-Power has signed a memorandum of understanding with SLB joint venture OneSubsea to explore the use of converted energy from

ocean waves as a lower-cost, lower-carbon power source for subsea energy applications.

OneSubsea and Subsea7 will work with C-Power to test a next-generation SeaRAY ocean energy system in an 18-month field test, co-sponsored by the U.S. Department of Energy, slated to start at the PacWave South test site off the Oregon coast in 2025. OneSubsea will support the vision by delivering an integrated subsea solution, including an electric actuation system and a wireless telemetry system.

Rotor Sail Certification

DNV has awarded Hanwha Ocean type approval design certification (TADC) for its innovative rotor sail technology. This is the first certification of a rotor sail approved for installation in hazardous zones in South Korea.

The TADC confirms that Hanwha Ocean's Rotor Sail, designed with composite materials, is in line with DNV and international safety standards, guidelines, and regulations and is ready for practical application on commercial vessels.

The certification also covers the installation of the rotor sail in hazardous zones on board vessels, for example, on tankers and vessels carrying explosive liquids, gases and dangerous cargo.

New Partner for Wind Propulsion Collaboration

Vaisala has joined the WiSP 3 project, a joint industry collaboration initiated by Maritime Research Institute Netherlands, MARIN (*Sea Technology*, January 2024), to advance wind-assisted shipping as a viable solution for reducing emissions and improving fuel efficiency in the maritime industry. Vaisala will deliver its wind LiDAR systems for critical sea trials that will test and validate wind-assisted ship propulsion (WASP) technologies.

In addition to performance validation, the WiSP 3 project aims to update the regulatory framework—including the Energy Efficiency De-

sign Index (EEDI), Energy Efficiency Existing Ship Index (EEXI), Carbon Intensity Indicator (CII), and FuelEU—to enable fair comparisons of fuel savings and emission reductions across the maritime industry.

By comparing undisturbed wind data from LiDAR with wind anemometer-based measurements, researchers and WASP system providers can determine optimal wind propulsion algorithms, ensuring peak performance and enhanced energy efficiency.

WiSP 3 will run through April 2026.

Wave Energy in Taiwan

Eco Wave Power Global AB has signed an agreement for the sale of the first wave energy generation unit with I-Ke International Ocean Energy Co., a subsidiary of Lian Tat Co., with the purpose of bringing Eco Wave Power's wave energy technology to Taiwan.

I-Ke will provide the full financing for the 100-kW pilot project by buying a turnkey conversion unit from Eco Wave Power. This conversion unit for the wave energy power station includes all the hydraulic and electric conversion parts, coupled with the smart control and automation system.

I-Ke has identified the location for the first pilot station of 100-kW installed capacity on the east coast of Taiwan (along with an additional 83 potentially suitable sites). It is responsible for obtaining permits, land use consents and any licensing and approvals necessary to complete the installation of the planned wave energy projects.

I-Ke will locally produce the floaters, hydraulic cylinders and all other components of the technology, which are located on the seaside of the marine structure. I-Ke believes this will position Taiwan as the hub for later-stage expansion into Asia-Pacific.

The first stage of the project will be the development of a 20-MW wave energy power station in Taiwan, beginning with the 100-kW pilot and expanding in stages to a total targeted installed commercial capacity of 400 MW. **ST**

Turbine Maintenance Concept

KNUD E HANSEN continues to expand its portfolio in the offshore wind farm sector with a new wind turbine maintenance platform: the “Jack-up on Jack-up” concept. This four-legged vessel features a 15-m-wide working platform, which can be elevated to the height of the nacelle, thus providing a safe platform for maintenance work on the blades, eliminating the need for hazardous rope access. It can be positioned precisely beneath a turbine blade.

With a telescopic weather cover fitted on the platform, work on the blades can be done in practically all weather conditions, day or night, resulting in far more working hours annually than with conventional maintenance vessels and rope access. This enables a dependable schedule for planned maintenance.

Measuring 154 m long and 64.4 m wide, this vessel is designed for all kinds of maintenance work on wind turbines up to 20 MW, including replacement and handling of nacelles weighing up to 1,000 t at a hub height of 175 m, and managing blades up to 130 m long. This can be done while the vessel is jacked up in 80 m water depth.

Updated Report on Alternative Fuels

ClassNK has updated its report “ClassNK Alternative Fuels Insight,” initially released May 2024, to Version 2.0. This update includes the latest information on alternative fuel ships, including orders and deliveries, demand outlook, and cost simulations for ammonia-fueled ships. It supports customers’ future fuel options and investments.

The report provides the latest trends for each alternative fuel. Information on the demand for alternative fuels, which is estimated by ClassNK based on information on alternative fuel ships scheduled for delivery, and cost simulations for ammonia-fueled ships that are expected to be ordered more frequently in the future have been added. In

addition, the report provides information on the trend of green methane production projects that are expected to be used in LNG-fueled ships; the greenhouse gas (GHG) emissions assessment of biofuels as an effective GHG reduction measure for conventional fuel ships; and ClassNK support for an onboard CCS system, which is expected to be more widely adopted in the future. The report also provides information on the rating results of the Carbon Intensity Indicator in force from 2023 for ships verified by ClassNK, including results by ship type and size.

The report is planned for continuous updates: www.classnk.or.jp/hp/en/info_service/ghg.

Making the Case for Earth Observation Data Market

MSE International will lead a new project to support existing European enterprises in the co-creation of innovative services combining Earth observation (EO) data to meet the needs of various industry sectors, including renewable energy, ports and infrastructures, aquaculture, tourism, and emerging pollutants.

The project is being funded by the European Space Agency (ESA) within its Atlantic Regional Initiative.

The project will create and demonstrate a framework to accelerate EO-based application developments.

Market and innovation needs will be identified, plus capability mapping of major centers of expertise to identify strengths and current innovation projects within the Atlantic cluster organizations.

The project will identify potential synergies with space agencies and funding bodies outside Europe and develop roadmapping and consortiums to take forward two innovation priorities as demonstrators.

MSE aims to put together the case for investment, supported by an evidence base of technological advances and policy development impacts.

Power Cable Alliance

Ventus Energy and CPower Energy have created an alliance to benefit clients in the power cable for renewables sector.

Ventus Energy specializes in high-voltage capabilities, testing and termination, while CPower Energy specializes in cable pulling, construction support and service. Ventus has significant experience in cable works across 24 wind farms, and CPower’s team has successfully handled installation and repair tasks for more than 14 wind farms. Both companies are ISO accredited.

Subsea Cable Collaboration

RBR, Alcatel Submarine Networks (ASN) and Nanometrics are developing technology for ASN’s Climate Change solution in the scientific monitoring and reliable telecommunications (SMART) cable market.

RBR worked closely with ASN to develop and refine the simplicity of a system based on RBR’s BPR|zero technology. The custom variant of the existing BPR|zero for submarine cable usage has been miniaturized and ruggedized for the extreme environment typical of cable-laying ship deployments.

ASN is contracted to design, manufacture and deploy two pioneering SMART cable projects, with deployment scheduled for 2026. These SMART cable systems will enhance underwater data connectivity and provide real-time monitoring of seismic, tsunami, and environmental events.

Climate Literacy Guide

The U.S. Global Change Research Program has released the third edition of “Climate Literacy: Essential Principles for Understanding and Addressing Climate Change.” The guide presents important information for individuals and communities about Earth’s climate, the impacts of climate change and solutions.

A team of federal scientists, communicators, educators and program leaders collaborated to update the guide: www.climate.gov/teaching/climate. **ST**

Predation Event of Large Shark

U.S. researchers have documented a predation event of a pregnant porbeagle shark by a larger shark, with deciduous triangular teeth, in the open sea southwest of Bermuda. If predation is more widespread than previously thought, there could be major impacts for the porbeagle shark population that is already suffering due to historic overfishing, according to the study, published in *Frontiers in Marine Science*.

Porbeagles are sharks from the Atlantic and South Pacific Ocean and the Mediterranean. They are large, active, powerfully built (up to 3.7 m long and weighing up to 230 kg) and long-lived (up to 65 years). Females don't reproduce until they are about 13 years old, and then give birth to an average of four pups every one or two years, born live after a gestation period between eight and nine months.

Because of their slow reproductive cycle, porbeagle populations cannot recover quickly from persecution, recreational fishing, bycatch, and habitat loss and degradation to which they currently are exposed. Indeed, Northwest Atlantic porbeagles are listed as endangered on the IUCN Red List of Threatened Species, while the Northeast Atlantic and Mediterranean populations are critically endangered.

The researchers captured porbeagles off Cape Cod, Massachusetts, in 2020 and 2022. Each porbeagle was equipped with two satellite tags, a fin-mount satellite transmitter and a pop-off satellite archival tag (PSAT), before being released. Fin-mount tags send the current location to satellites whenever the shark's fin rises above the surface. PSATs continuously measure depth and temperature until the tag falls off, typically after a predetermined period, after which they float to the surface and transmit their stored data to satellites.

Among the tagged porbeagles was a pregnant female, 2.2 m long. The researchers hoped to obtain data from this female to help iden-

tify important habitats for porbeagle mothers and their newborns. Unexpectedly, this female's PSAT started to transmit off Bermuda 158 days after its release. This implied that the PSAT had popped off and was now floating at the surface.

Data then transmitted showed that this female had been cruising for five months at a depth between 100 and 200 m at night and between 600 and 800 m during the day, in waters with a temperature between 6.4 and 23.5° C. During this time, the fin-mount tag had transmitted only once, confirming that she remained underwater most of the time.

But suddenly, from March 24, 2021 over a period of four days, the temperature as measured by the PSAT remained at an approximately constant 22° C, at a depth between 150 and 600 m. Only one explanation was possible: That day, the unfortunate porbeagle had been hunted and eaten by a larger predator. The PSAT must then have been excreted about four days later, starting to transmit.

Two endothermic predator candidates large enough to predate upon mature porbeagles and located within the vicinity at the time of year of the predation event include the white shark *Carcharodon carcharias* and shortfin mako *Isurus oxyrinchus*, the researchers said.

Of the two candidates, a great white shark was the more likely culprit, as shortfin mako typically make rapid oscillatory dives between the sea surface and deeper depths during the day while in the open ocean, a behavior not registered by the PSAT.

Continuing to study predator interactions will enable estimating how often large sharks hunt each other and how these interactions affect the ecosystem.

Fiber-Optic Cable for Filming

NOVACAVI has supplied a custom-made neutrally buoyant fiber-optic cable with high tensile strength to the Rebikoff-Niggeler

Foundation, a nonprofit with a mission to facilitate marine research and in-situ observation and documentation of deep-sea environments by means of submersible technology.

The cable is for a new remotely operated camera system, which will be used for documentary filming and research in the pelagic zone down to 1,000- to 1,200-m depth.

Loop Current System Data

Important oceanographic data from Atlantic Ocean currents in the U.S. Gulf of Mexico have been gathered fully remotely via Sonardyne technology and a USV supplied by SeaTrac Systems. A number of Sonardyne Origin 65 ADCPs and Current Pressure Inverted Echo Sounders (CPIES) are currently on the seabed in the Gulf of Mexico, gathering long-term data on the Loop Current System (LCS). The LCS affects subsea operations, hurricane intensity, and nutrient and food cycles important to marine life.

Three further sets of data will be gathered over the next 18 months using the same uncrewed methods.

First Evidence of Life Deep in Greenland Bedrock

A new research study shows that microorganisms lived deep within the fractured bedrock of Greenland about 75 million years ago. At several hundred meters depth, researchers found minerals lining bedrock fractures, which serve as important geochemical archives for ancient life.

High-resolution geochronology of the calcium carbonate revealed how much uranium has decayed into lead. The dating gave ages of 64 to 75 million years.

These ages overlap with tectonic events related to the early stages, or precursors, of the opening of the Atlantic Ocean and the Labrador Sea. This suggests that deep fracture networks in western Greenland opened and were colonized by microorganisms, such as sulfate reducers, during these events.

The movements of the continents have thus influenced how the deep biosphere has been colonized. **ST**

contracts

Hill's, McLean, Virginia, Mission Technologies division was awarded a contract to modernize communications and IT networks to enable rapid decision making in the battlespace. Hill will develop, assess and implement solutions to improve system hardening to potential cyber threats; introduce new capabilities; and enable cloud migration. U.S. government.

Damen Shipyards, Gorinchem, Netherlands, has signed a contract for a standard BS 500 booster station that will be fitted out with Damen's Marine NOx Emission Reduction System. This EU Stage V-certified system will be mounted on top of the booster station to reduce NOx and particle emissions and provide sound reduction. Hegemann.

Aquatec, Basingstoke, U.K., has entered a rental partnership agreement with an international provider of electronic engineering equipment for the underwater industry. Aquatec's LEAKlog devices will be available for rent as leak detection solutions to the global offshore sector. Rental Technology & Services.

The U.S. Bureau of Safety and Environmental Enforcement (BSEE), Washington, D.C., has awarded a contract and the first task order for the decommissioning of eight orphaned pipelines in the Matagorda Island lease area, approximately 12 mi. off the Texas coast. Chet Morrison Contractors.

Mid-South Testing, Decatur, Alabama, has taken delivery of a second Mud Cat 225D after the first one performed 17 years of reliable service. Both dredges are currently operating. The newest unit is working on a 5.18-m deep, 8-acre industrial pond. Ellicott Dredge Technologies.

All American Marine, Bellingham, Washington, has delivered a 74-ft. diesel aluminum hydrofoil catamaran patrol boat with a full suite of

NavNet TZtouch3 multifunction displays from Furuno. California Department of Fish and Wildlife.

TechnipFMC, Houston, Texas, has been awarded an integrated engineering, procurement, construction and installation contract for the greenfield Kaskida development in the Gulf of Mexico. The contract covers the design and manufacture of subsea production systems, including 20,000 psi standardized subsea trees and manifolds. bp.

Forcys, Yateley, U.K., has signed a memorandum of understanding to combine its advanced underwater vehicle systems and sensor payloads with another company's diving systems and underwater vehicles to meet the evolving needs of navies. DRASS.

Abu Dhabi Future Energy Co. PJSC – Masdar, Abu Dhabi, United Arab Emirates, has signed an agreement with a big data analytics company powered by generative AI to develop an asset management tool for renewable energy projects worldwide. Presight.

Amasus, London, U.K., has signed an eSAIL (suction sail) contract for a 22-m unit to be retrofitted on a 90-m, 3,000-dwt vessel, scheduled for mid-2025. bound4blue.

Proserv's sampling division, Stavanger, Norway, will deliver a Multiphase Sampling Unit to the Brage platform offshore Norway, operated by OKEA ASA. The compact, lightweight unit suits scenarios where frequent separator sampling is not feasible. Aker Solutions. **ST**

meetings

JANUARY

January 7-9—Challenge of Science Leadership Training Course, Plymouth, U.K. www.barefoot-thinking.com.

January 15-17—Floating Wind Solutions, Houston, Texas. <https://floatingwindsolutions.com>.

January 29—Marine Measurement Forum, Exeter, U.K. www.marinemeasurementforum.com.

FEBRUARY

February 10-12—Geo Week, Denver, Colorado. www.geo-week.com.

MARCH

March 12-13—European Green Steel Industry Summit, Dusseldorf, Germany. www.wplgroup.com/aci/event/the-european-green-steel-industry-summit.

March 25-27—Undersea Defence Technology (UDT), Oslo, Norway. <https://udt-global.com>.

March 26-27—Digitalised Smart Ports Conference, Valencia, Spain. www.wplgroup.com/aci/event/digitalised-smart-ports.

March 30-April 1—Canadian Underwater Conference & Exhibition: Man & Machine Underwater, Vancouver, Canada. www.cuce.ca.

APRIL

April 8-10—Interspill, London, U.K. www.interspill.org.

SEPTEMBER

September 15-19—London International Shipping Week, London, U.K. www.LISW.com.

OCTOBER

October 22-24—WISTA International AGM & Conference, Barcelona, Spain. <https://wistainternational.com>.

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Kathryn E. Kovacs has assumed leadership of the U.S. Bureau of Safety and Environmental Enforcement (BSEE), succeeding Kevin M. Singh. Kovacs was previously deputy assistant secretary for Land and Minerals Management. Prior to joining BSEE in April 2022, she was a professor of law at Rutgers University. Her public service career also includes 12 years in the Department of Justice's Environment and Natural Resources Division, Appellate Section and the Baltimore City Law Department as an attorney.



Advanced Navigation, an Australia-based company specializing in assured position, navigation and timing (APNT) and autonomous systems, has expanded its defense arm in the U.S. through the appointment of **Wayne Prender** as global head of defense. Prender brings over 20 years of experience in the global defense industrial base. He joins Advanced Navigation following an 18-year tenure at Textron Systems, where he was the senior vice president of air systems.

Next Geosolutions Europe S.p.A., an international company in the field of marine geosciences and offshore construction support services, has appointed **Jurgen Beerens** as business development director for the North and Baltic Sea area. He is responsible for continually identifying new goals and business opportunities in offshore wind and renewable energies.

Subsea Technology & Rentals (STR) has welcomed **Maxime Even** as the general manager of its Singapore Technology and Service hub. With over two decades of experience in the offshore survey industry, Even will play a key role in supporting STR's clients in Asia-Pacific and the Middle East.

Innovasea, specializing in technologically advanced aquatic solutions for aquaculture and fish tracking, has announced that Innovasea President **Mark Jollymore** has been named the new chair of the board of directors at COVE, a world-leading innovation center and global tech hub focused on advancing marine technology. Jollymore has been a COVE board member since 2019.

Aquatec, a developer of subsea instrumentation, has appointed **Paul Griffiths** as sales manager for its Subsea Integrity Division. He will oversee sales operations and foster client relationships.

The World Ocean Council (WOC), a business alliance for corporate ocean responsibility, has announced that

Paul Holthus, its founder and CEO, will step down from his role at the end of 2024 after 15 years of leadership. Managing Director Stewart Sarkozy-Banoczy will become acting CEO.

Chartwell Marine, a vessel designer, has expanded into Asia-Pacific (APAC) with the hire of **Fabien Lecuona**, who will spearhead growth in the region from Singapore. Lecuona brings over 13 years of experience in APAC maritime and has worked in maritime electronics and engine manufacturing. He will promote low-carbon vessel designs.

Niru Dorrian has been appointed as ambassador to the United Nations Ocean Decade by the Institute of Marine Engineering, Science, and Technology (IMarEST). The IMarEST conceived the role of ambassador three years ago to align its activities with the crucial aims of the Ocean Decade. His priorities include catalyzing research, innovation and policy coherence by channeling member expertise. Dorrian's tenure will last three years, and he takes over from **Dr. Stephen da Mora**.

Phoenix has appointed **Travis Niederhauser** to the position of general manager for the Pacific region. He will direct the day-to-day activities of the San Diego and Hawaii offices, actively pursuing growth opportunities for all Phoenix services in the area and establishing organizational and financial goals. **ST**

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Oyster Aquaculture Could Improve Potomac River Estuary
Oyster aquaculture in the Potomac River could result in significant improvements in water quality, according to a new NOAA and US Geological Survey study published in *Estuaries and Coasts*. All of the nitrogen current polluting the Potomac River estuary was removed if 40 percent of its riverbed was removed for shellfish cultivation, according to the joint study. [Read more](#)

Navy's Laser Weapon Ready For Summer Deployment
Navy engineers are making final adjustments to a laser weapon prototype that will be first of its kind to deploy aboard a ship in summer. The prototype, an improvement of the laser weapon system, will be used by the USS Zumwalt for at-sea testing in the Gulf. Navy leaders have made the laser weapons a top priority to counter what they call asymmetric threats including unmanned and light aircraft and small attack boats that could be used to deny U.S. forces access to certain areas. [Read more](#)

Ferry Sinks Off Coast of South Korea
With 462 passengers onboard, the ferry sank off the southern tip of South Korea, the southern tip of South Korea reported Associated Press. On May 14, 460 people on the ship were rescued for a school trip to the island. The rescue effort, more than 100 boats, which took 18 hours to reach the ship. [Read more](#)

Pay Increase for Sailors Soon to Come
Sailors working for the U.S. Navy will receive a pay raise in the coming year. The Virginia Pilot, On May 14, 460 people on the ship were rescued for a school trip to the island. The rescue effort, more than 100 boats, which took 18 hours to reach the ship. [Read more](#)

US Senate Reviews DOE Budget Request
For fiscal year 2025, the US Senate requested \$27.7 billion for the Department of Energy and Water. The bill would increase the amount of money available for the review of the US Financial Review. [Read more](#)

US Technology Helps in Search
More than a month after the sinking of the ferry, 370 were rescued. US technology helped in the search for the ship. [Read more](#)

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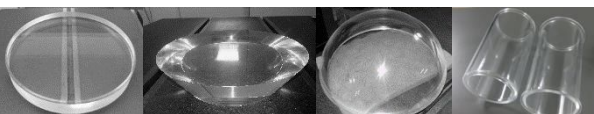
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Maria Loloni leads the Maritime and Industrial Symbiosis Programme at EIT Climate-KIC. She is an economist with extensive expertise in sustainable innovation, circularity and stakeholder engagement. Loloni drives collaboration between industries, research, civil society, and policymakers in the blue economy and heavy industry sectors toward a zero-carbon, prosperous, inclusive, and climate-resilient society.



The health of our oceans has never been more at risk. Rising sea temperatures, acidification, overfishing and pollution are escalating—causing irreversible damage to our ocean ecosystems.

In the past few years, more initiatives have been trying to solve these challenges. Most of these tackle challenges individually, as if trying to put out little fires one by one.

We need a different mindset. One that understands the complexity and interconnectedness of all challenges. One that understands the ocean as a system. One that tackles the root of the issues. Instead of trying to put out fires, we need to look at what started the fire in the first place.

Activities such as offshore energy production, shipping, coastal tourism, aquaculture and fishing play important roles in the global economy. However, they also bring a set of interconnected challenges that affect the ocean: pollution, overfishing and ecosystem breakdown. It would be naive to think that these challenges could be easily solved with high-tech solutions, as there are many social, political and economic factors linked to these.

By adopting a systems-thinking approach, we see well beyond what lies at the surface, and then we act by “intervening” in the system. Sometimes, the best way forward is through policy changes, communi-

ty-driven projects, or new economic and funding models, but if we want to implement lasting change, these interventions must also be connected and collaborative.

Take ocean acidification. It’s not just a science problem; it’s tied to carbon emissions from buildings, industries and transport, while also closely connected to international climate policies and the livelihoods of coastal communities. Once we understand these links, we can create more targeted, effective interventions that ensure long-lasting impact.

Systems thinking is at the foundation of EIT Climate-KIC’s work. Whether we work on urban transformation, circular economy, climate adaptation or the transition to a sustainable food system, we know that everything connects. And it’s the same when it comes to the sustainable management of the ocean.

A few months ago, we became members of the EU4Ocean Coalition, an initiative that brings together educators, policymakers, scientists, civil society, arts, and businesses working on and around the ocean. Our goal: to promote ocean literacy and encourage better stewardship of our seas. We want to help people understand the ocean as an interconnected system and how our innovation activities might have a positive or negative impact on several fronts.

This July, I had the opportunity to participate in the EU4Ocean “Ocean Literacy and Collaboration” Summer School organized by UNESCO in Malmö, Sweden. Bringing experience from our on-the-ground system transformation work in ports, we guided the participants through the steps of engaging diverse stakeholders in the ocean space. Local communities, governments, research, financiers, industry leaders—they all need a seat at the table to co-create their vision, as well projects and activities that

will make it a reality. Thanks to our collaboration with UNESCO, we’ve participated in similar ocean literacy activities organized in Venice, Italy, and Matosinhos, Portugal, spreading the message that multiple challenges should be examined simultaneously, and collaboration among diverse stakeholders is key to innovation. This goes beyond raising awareness: It’s about changing mindsets to encourage more holistic and effective action.

Looking at the ocean as one interconnected system affects how we manage it. Instead of responding to problems as they arise, we try to understand their causes and prevent them in the first place. This means we are shifting from reactive, short-term fixes to more thoughtful, long-term strategies that acknowledge the ocean’s complexity.

Ports, for example, are vital in global trade and have a significant environmental footprint. Through our globally award-winning LOOP Ports project (www.loop-ports.eu), we’ve demonstrated how a circular economy model can help ports reduce waste and emissions. This contributes to creating a more sustainable future for the entire sector.

Government, business, research, local communities—everyone has a role to play in building a healthier ocean, and collaboration is at the heart of our approach. No single sector or group can fix the ocean’s problems alone; our system transformation projects with the ports of Lavrio and Piraeus, Greece, and Valencia, Spain, as well as citizen-driven programs such as Climathon (climathon.climate-kic.org), show the sort of change that can happen through collaboration.

We must deepen our understanding of the ocean’s complexities and act with urgency to collaborate on a common vision that connects activities and increases awareness for a sustainable ocean. Systems thinking will enable long-lasting change. **ST**

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