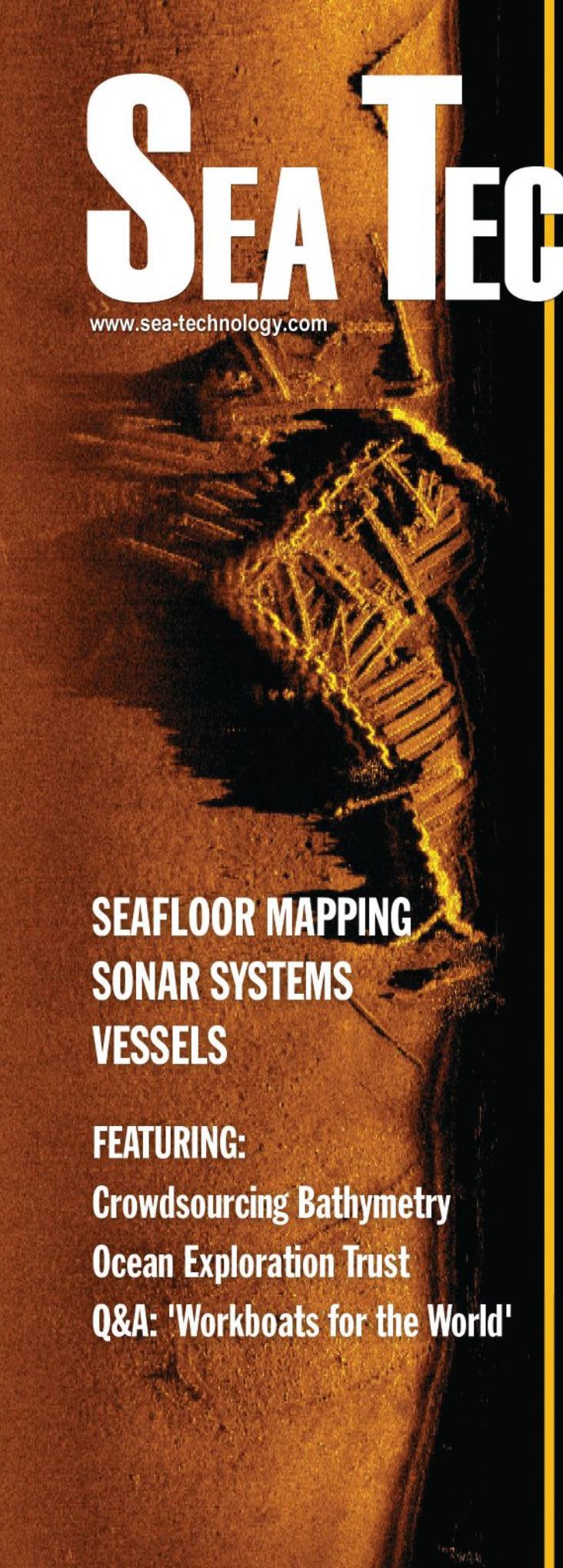


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JUNE 2023



A vertical strip on the left side of the cover shows a sonar scan of a shipwreck on the seafloor. The image is in shades of yellow and orange against a dark background, highlighting the metallic structures of the sunken vessel.

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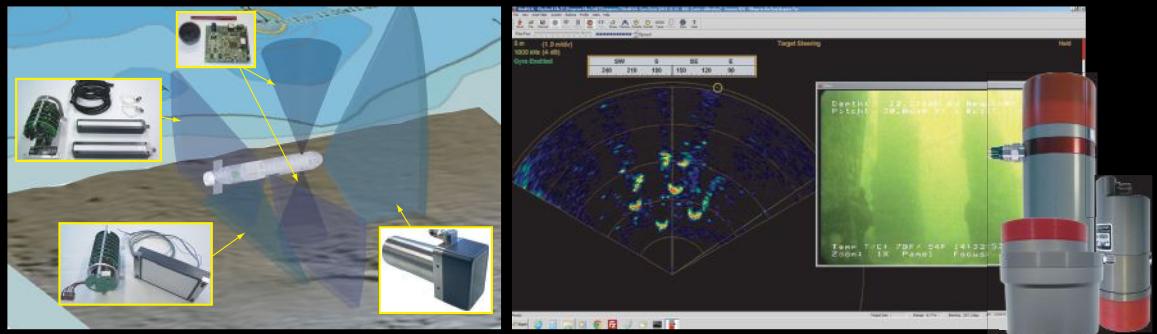
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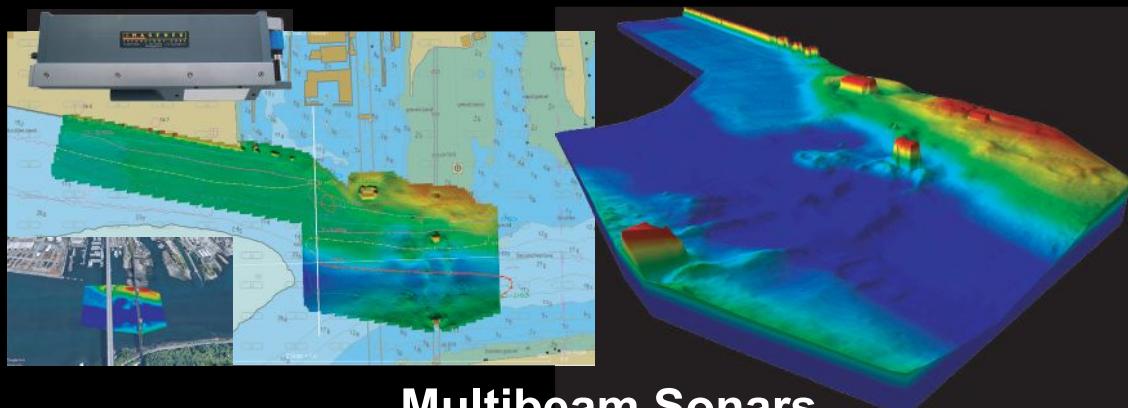
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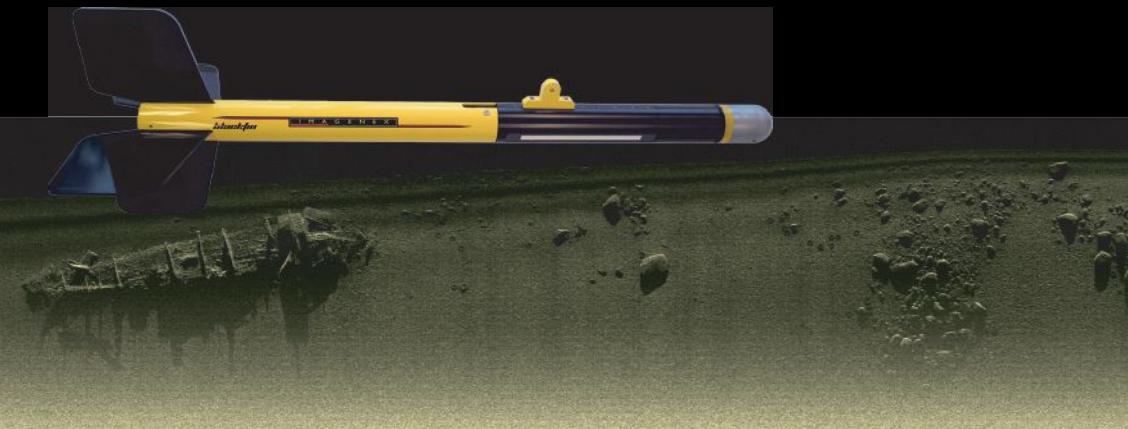
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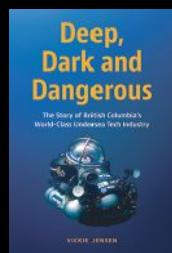


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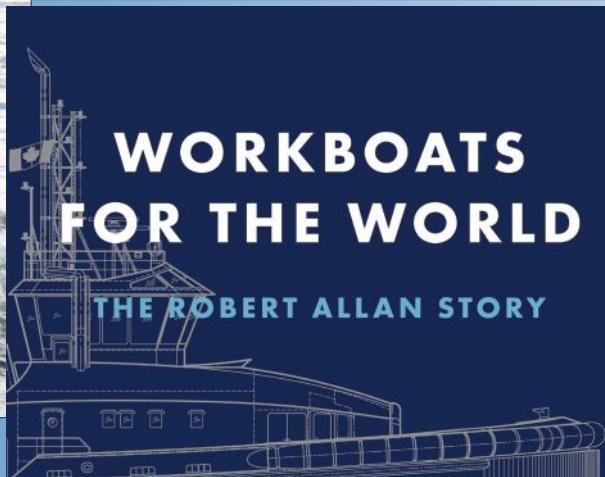
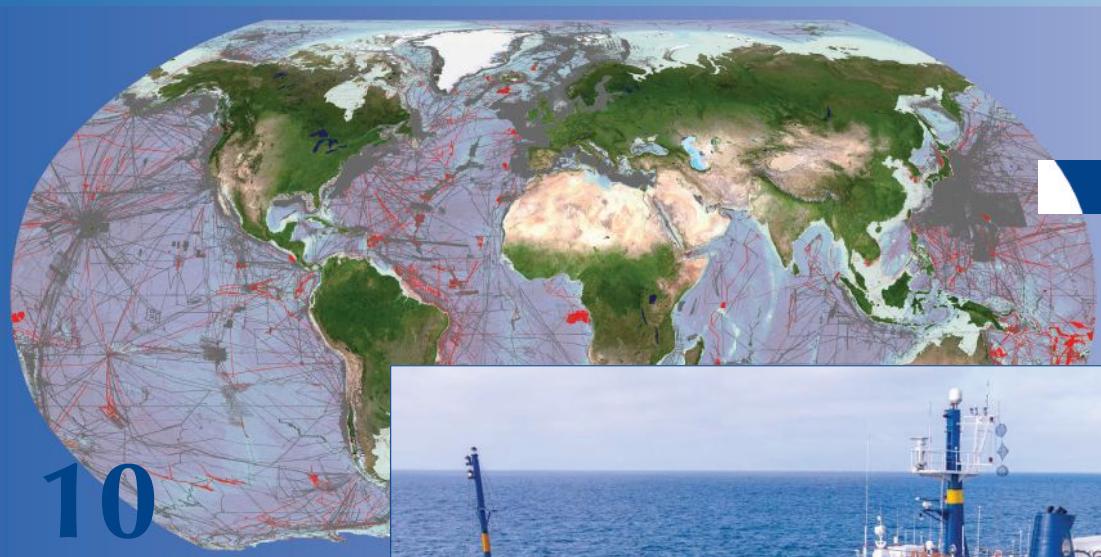
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R  
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Robert G. Allan, with Peter A. Robson

# CONTENTS

JUNE 2023  
Volume 64, No. 6

## FEATURES

10

### CROWDSOURCING BATHYMETRY

Matthew Zimmerman (*FarSounder*) explains how expedition vessels contribute to scientific research while underway.

15

### OCEAN EXPLORATION TRUST

Dr. Derek Sowers and Jamie Zaccaria (*Ocean Exploration Trust*) show how the nonprofit has been mapping and exploring the global ocean for 15 years.

21

### HIGH-RES RADAR

Sam Wood (*Navtech Radar*) introduces Terran360, W-Band radar that provides millimeter-level accuracy.

26

### ROBOTS IN THE WIND

Shawntel Johnson, Michael King and Josh Broussard (*Ocean Infinity*) demonstrate how remote-controlled and autonomous tech can support floating wind farms.

29

### Q&A: ROBERT G. ALLAN

The former head of the eponymous historic marine architecture firm discusses his new book, "Workboats for the World: The Robert Allan Story."

## DEPARTMENTS

6 Soundings

7 Editorial

33 International

35 Marine Resources

36 Ocean Research

38 Product Development

40 Marine Electronics

41 Marine Renewables

42 Contracts/Meetings

43 People

44 Professional Services Directory

45 Soapbox

46 Advertiser Index

### COVER IMAGE

YO88, known as "Betsy," a collier built in 1772, was sunk by British General Charles Cornwallis's forces in 1781 in an attempt to prevent the French fleet from entering the York River near the end of the U.S. Revolutionary War. This image was taken with side scan sonar using 1,800 kHz at a 30-m range. (Credit: Regan Lipinski, Marine Sonic Technology)

### NEXT MONTH

Molten salt nuclear power barge ... Energy storage systems for decarbonization ... Electric retrofit for PortsToronto ferry ... Alternative maritime power for greener ports ... Winch control on New Zealand research vessel.

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**) Historic WWII Wreck Found in Philippines.** In an extraordinary mission that took nearly five years of planning, Fugro has played a key role in locating the wreck of the *Montevideo Maru*, one of the worst international maritime disasters in history. In close partnership with the Silentworld Foundation and the Rabaul and Montevideo Maru Society, and support from Australia's Department of Defence, Fugro used its unparalleled deepwater hydrographic and oceanographic expertise to successfully identify the wreckage of the Japanese transport ship at a depth of more than 4,000 m off the coast of the Philippines. The *Montevideo Maru* was carrying approximately 1,060 prisoners of war and civilians when it was sunk by an American submarine in 1942 during World War II. The tragedy resulted in fatalities from at least 14 countries, including Australia, Denmark, England, Estonia, Finland, the Netherlands, Japan, Ireland, New Zealand, Norway, Scotland, Solomon Islands, Sweden and the U.S. In April 2023, 110 km northwest of Luzon in the Philippines, the Fugro team started the search on board the Fugro *Equator*, an advanced hydrographic survey vessel. Deploying an AUV with built-in sonar, a positive sighting was recorded after just 12 days. Verification of the wreck came a few days later using expert analysis from the project team, which comprised maritime archaeologists, conservators, operations and research specialists, and ex-naval officers.

**) Ammonia-to-Hydrogen Project.** Wärtsilä, Höegh LNG, Institute for Energy Technology, University of South-East Norway, Sustainable Energy and BASF SE have received funding of approximately €5.9 million from the Norwegian government for the development of ammonia as a hydrogen carrier for the energy market. This is a part of Norway's Green Platform program of initiatives and amounts to approximately 50 percent of the total budget for the joint project. The project is designed to enhance the availability of large-scale storage and transportation capabilities of clean energy. Hydrogen is emerging as a viable future fuel for addressing the move away from fossil fuels. However, it is difficult to store and transport due to its low volumetric energy density and potentially large vaporization losses. Ammonia is significantly better suited than hydrogen for this purpose since it can be stored in liquid form at moderate pressures and temperatures. The objective of the project is to enable ammonia to be converted back to hydrogen at the receiving destination. As a carbon-neutral renewable energy carrier, "green" ammonia is produced from hydrogen via electrolysis of water and nitrogen from the air. Green ammonia acts as a liquid battery with a high energy density compared to alternative solutions for the storage and transport of renewable power. The infrastructure for the large-scale transport of ammonia at sea already exists via a fleet of gas tankers having ammonia on the cargo list. The project aims to develop a system to convert ammonia back to hydrogen for installation on board a Höegh LNG vessel that will provide a floating receiving terminal that can be relocated as needed, requiring minimal use of coastal land and resulting in lower overall cost, improved safety and competitive hydrogen prices.

**) NOAA Funding for Marine Debris Projects.** NOAA Sea Grant has announced \$27 million of funding for projects that will address the prevention and removal of debris in marine and Great Lakes environments throughout the U.S. The projects will support transformational research and the creation of local coalitions to address urgent marine debris prevention and removal needs. "Marine debris is a pervasive problem, negatively impacting local economies, tourism, wildlife and ecosystems, and human health," said Jonathan Pennock, director of NOAA's National Sea Grant College Program. "The work supported by these projects presents exciting opportunities to tackle a wide range of debris issues, such as microplastics, single-use food packaging and derelict fishing gear, using an assortment of innovative approaches informed by and implemented with communities." This work is a component of \$562 million in targeted investments for NOAA in the areas of coastal resilience and habitat restoration through the Bipartisan Infrastructure Law, with funds leveraged from the Inflation Reduction Act, to help the U.S. build resilience to climate change. The projects were competitively selected through two opportunities supported by the Bipartisan Infrastructure Law and leveraging funds from the Inflation Reduction Act: the Marine Debris Challenge Competition and the Marine Debris Community Action Coalitions.

**) Milestone in Global Seabed Mapping.** An additional 5.4 million km<sup>2</sup> of new data, equal to an area twice the size of Argentina, has been added to the definitive map of the world's ocean floor, with 24.9 percent of the seabed now mapped as a result of Seabed 2030, an international effort spearheaded by GEBCO to complete the global seafloor map before the end of the decade. Mapping the ocean floor is a critical step toward informing decision making in areas such as resource management, environmental change and ocean conservation. It directly supports UN SDG 14, to conserve and sustainably use the ocean. Seabed 2030 is a formally endorsed Action of the UN Decade of Ocean Science for Sustainable Development 2021-2030 (the Ocean Decade). When Seabed 2030 was launched in 2017, only 6 percent of the world's seafloor had been mapped in high resolution. In six years, a monumental total of 90 million km<sup>2</sup> of bathymetric data have been acquired, leading to developments in scientific research and a range of discoveries. For example, a seamount catalog has been published recently that includes over 19,000 newly discovered undersea volcanoes. Such discoveries help to advance studies in ecology, ocean mixing and plate tectonics, and improve our ability to protect and sustainably manage the ocean. **ST**

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# editorial

*Rob O'Dwyer, Chief Network Officer, Smart Maritime Network*

## New Data Standardization For Vessel Reporting

Efficiency in maritime operations and across the wider supply chain is a desirable goal for industry and the wider public. For vessel operators, improved efficiency means reduced wastage of resources, better asset utilization, lower fuel consumption and greater profitability. For the rest of the supply chain, a more efficient shipping sector means fewer delays and better value for money in moving cargo, while society as a whole can benefit from greater access to goods and a reduced environmental impact from their transport.

One barrier to improving efficiency in vessel operations is a lack of transparency in actual ship performance due to the difficulties in collecting and analyzing data on how a ship is running day to day. Based, in many cases, on legacy processes often unchanged since the pre-digital era, large numbers of modern ships still rely on manually recorded noon reports as their primary source of information on voyage parameters, such as fuel consumption, distance and speed of travel, and the impact of weather on energy usage.

Each individual vessel operator will generally have its own format for recording noon report data, so data recorded by one shipping company are not directly comparable with data from another. Indeed, depending on chartering requirements or different ship management arrangements, ships within the same fleet can often have different reporting formats for similar data sets.

This becomes a problem when vessel operators look to improve efficiency by using third-party software tools to analyze their operational data and advise on optimization opportunities. With each company's data captured in a different format, a customized mapping or translation project will be required in each instance to upload the shipping company's data into the software application for analysis, introducing additional cost and resources before the value-creating analysis process can even begin.

Looking to improve upon this situation, the Smart Maritime Council, a cross-industry membership group focused on advancing technology harmonization and standardization in the sector, began a project to create a standardized list of data commonly found in noon reports with the goal of offering maritime stakeholders a central reference point for data mapping that can be applied by any relevant parties.

With a defined standardized data set available, vessel operators and software providers only need to conduct one initial mapping process to enable their own data formats to be linked to the standard. Once that is achieved, the shipping company will be able to share its data with any application provider that accepts the standard without the need for further customization.

Similarly, software providers can make their offerings more widely available to any users that have collected data in the standard format, allowing resources previously wasted on customized mapping projects to be redirected. This could lower software prices and/or support reinvestment of resources into improving maritime analytics programs to create additional value.

Following the completion of a three-year development project, the Smart Maritime Council's "Standardised Vessel Dataset (SVD) for Noon Reports" was launched in February 2023, providing a free and open list of defined data formats for common vessel operational data points typically found in the daily noon report. Building on the data structure described in ISO 19848 (Ships and marine technology — Standard data for shipboard machinery and equipment) and incorporating other relevant standards, the list of suggested standard IDs and formats is designed to be completely nonproprietary, company and vendor agnostic, and applicable by all users. Learn more at: <https://tinyurl.com/4k68jya3>. **ST**

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### Annual Review & Forecast

\*\**Oceanology International Americas*, February 14-16, San Diego, CA

## FEBRUARY

### Instrumentation: Measurement, Processing & Analysis

\*\**US Hydro*, March 13-19, Mobile, AL

## MARCH

### Electronic Charting/Vessel Management/

### Ports & Harbors/Dredging/Homeland Security

\*\**Ocean Business* 23, April 18-20, Southampton, U.K.

## APRIL

### Offshore Technology/Alternative Energy & Ocean Engineering

\*\**Offshore Technology Conference*, May 1-4, Houston, TX

\*\**XPONENTIAL 2023*, May 8-11, Denver, CO

\*\**UDT 2023*, May 9-11, Rostock, Germany

## MAY

### Communications, Telemetry, Data Processing

\*\**OCEANS 2023 Limerick*, June 5-8, Limerick, Ireland

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## JULY

Deck Gear, Cable, Connectors, Power Systems & Salvage

## AUGUST

Ocean Resources Development & Coastal Zone Management

\*\*IMAGE 2023, August 27-September 1, Houston, TX

\*\*OCEANS 2023 Gulf Coast, September 25-28, Gulf Coast, MS

## SEPTEMBER

Geophysical Exploration/Seafloor Engineering

## OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

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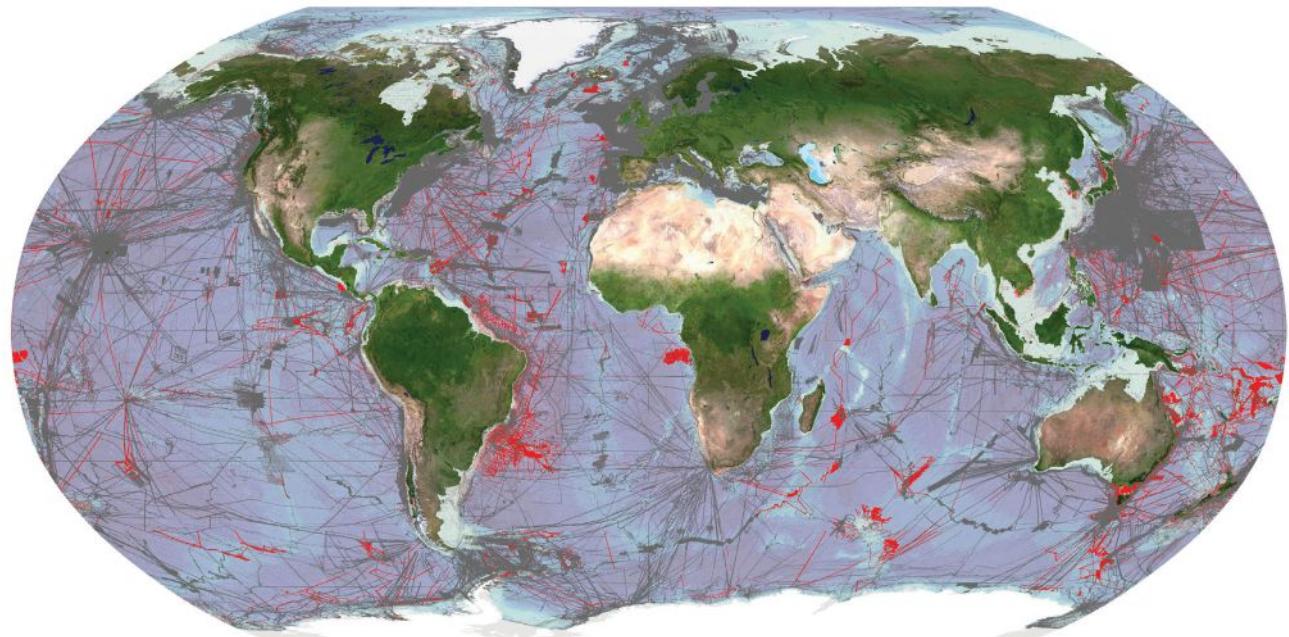
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# Crowdsourcing Bathymetry

*Expedition Vessels Contribute to Science While Underway*

By Matthew Zimmerman



As many of us working in the maritime industry know, hydrographic surveying is a hot topic. With less than 24 percent of our world's ocean floor mapped (<https://seabed2030.org/mapping-progress>), the message from Seabed 2030 that we know the topography of the Moon and Mars in greater detail than that of our own planet surely resonates within our community.

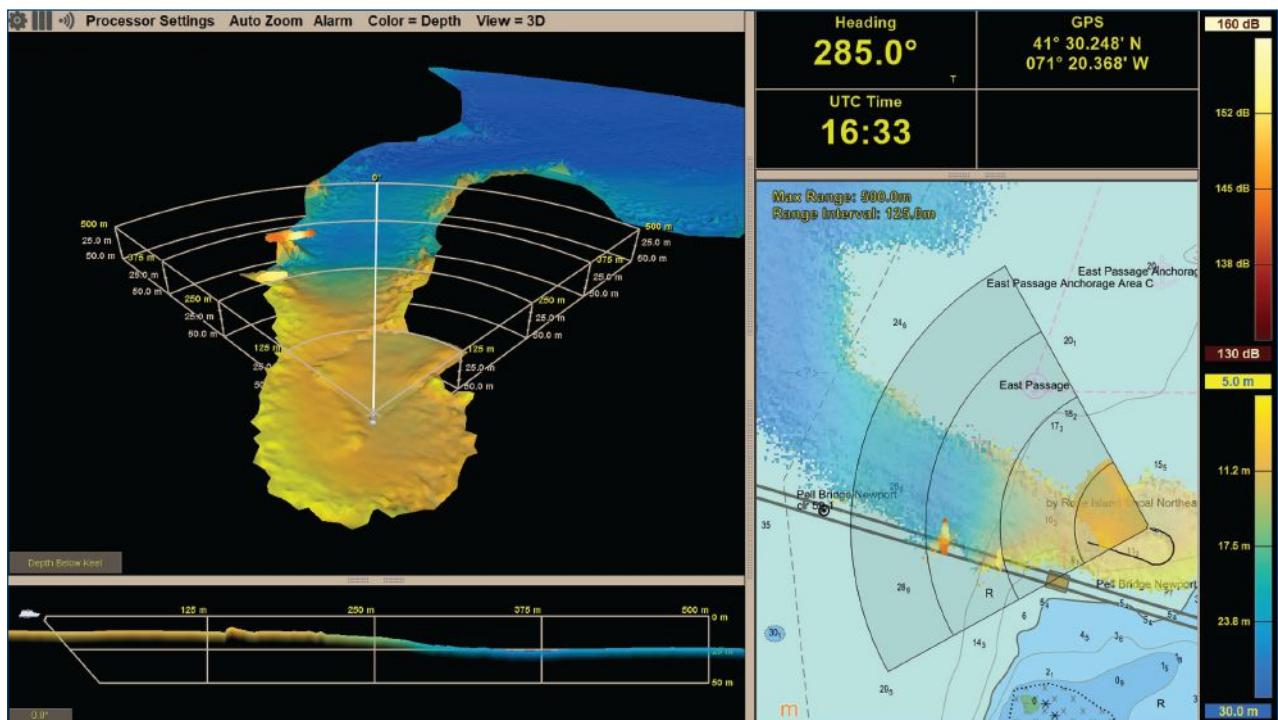
Seabed 2030 is a global initiative of the Nippon Foundation and GEBCO to map the world's oceans by 2030 and make it publicly available. By combining both professional and crowdsourced depth measurements, the project aims to unite our community in building a complete map of the oceans. Expedition vessels, including cruise ships and explorer yachts, are actively participating in these efforts today.

Mapping the seafloor's bathymetry is critical for both

**Map of the world's seafloor. The red/gray markings indicate the only areas that have been mapped at 100-m resolution or better. (Credit: Seabed 2030)**

safety and scientific endeavors. The most basic information needed by a crew to ensure safe sailing is the water's depth, and scientists use bathymetry to understand ocean circulation, tides, tsunami forecasting, fishing resources, sediment transport, and environmental changes. It's also important for commercial endeavors, such as infrastructure construction, cable laying and pipeline routing.

In well-charted areas, passengers aboard expedition vessels might assume that everything one needs to know



**(Top)** FarSounder's display software includes both a 3D view of the sonar data and a chart view with sonar, AIS, and ARPA data as overlays on standard S57/S63-format charts. Real-time, forward-looking data are available inside the sonar's field of view (i.e., the "pie wedge"), with local history mapping data stored indefinitely that can be displayed to visualize anywhere the vessel has previously transited. **(Bottom)** The location depicted in CHS chart 7053, with inset showing depth measurements from trusted community sources.

already exists on nautical charts. However, they would be mistaken. The U.S. has some of the best charts in the world, yet, according to NOAA: "About half of the depth information found on NOAA charts is based on hydrographic surveys conducted before 1940," and "in too many cases, the data is more than 150 years old. Sometimes, particularly in Alaska, the depth measurements are so old that they may have originated from Captain Cook in 1778." Take a moment to think about the reliability of such chart data when you're navigating in the "exotic" locations of your guests' itineraries.

## The Role of Sonar

Fortunately, expedition vessels have a wide range of navigation sensors they can use in conjunction with their charts to help them navigate poorly mapped waters more safely. While navigating in such locations, these explorers are able to be a part of the solution to improve global maritime mapping through a worldwide crowdsourcing initiative. They have the opportunity to contribute to the larger community by recording their depth and position observations along their travels.

"Measurements collected by commercial vessels during the course of their normal operations are a valuable contribution to the IHO's crowdsourced bathymetry efforts," said Jennifer Jencks, director of the International Hydrographic Organization (IHO) Data Center for Digital Bathymetry (DCDB) at NOAA's National Centers for Environmental Information and chair of the IHO Crowdsourced Bathymetry Working Group (CSBwg), <https://ihonet/en/csbwg>.

**"FarSounder is an official trusted node for the IHO Data Centre for Digital Bathymetry, and all contributions to the IHO's database are available for public use."**

ihonet/en/csbwg. "Contributions to the IHO's Data Centre for Digital Bathymetry are made available for public use and are included in the Seabed 2030 initiative."

Participation in these types of initiatives is an easy way for the expedition vessel industry to contribute to the wider, global community while operating in their "typical" manner.

Today, the most common depth sensor on all classes of boats and ships around the world is a single-beam echosounder. Even the least expensive sounders available on recreational boats can make fairly accurate depth measurements, and a variety of simple voyage data

recorders can be added to a vessel's electronics to enable the operator to participate in crowdsourcing efforts. Therefore, it should come as no surprise that the vast majority of crowdsourced bathymetry contributions are from single-beam echosounders.

However, relying on community-sourced data from echosounders alone often has limitations in the form of metadata; those added details about sensor installation that are often not well documented. Unfortunately, many boaters haven't made accurate measurements of where their echosounders and GPS antennas are installed relative to the sea surface and each other. This results in errors and biases in the contributed measurements. Without these critical details, community contributions have reduced value.

It's obvious that recording a ship's echosounder data should be the least that the industry does to participate in the global effort to map the seafloor. Most expedition vessels have very accurate as-built plans showing the exact installation locations of their echosounders and GPS antennas. Therefore, if that information is communicated accurately, their echosounder readings have the potential to include high-quality metadata.

Dr. Mathias Jonas, secretary general of the IHO, recognizes the role that these vessels can play: "Observations collected and contributed by the cruise ship and yachting industries provide depth measurements from locations often not covered by formal surveys," he said. "These unique contributions play a key role in our crowdsourcing efforts."

Of course, knowing what's underwater ahead of your vessel is also paramount to safe navigation. FarSounder's Argos series sonars are designed primarily as real-time,

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***"Expedition ships often operate in locations that are outside the standard commercial shipping routes ... 'These explorers can offer access to scientific observations, which may otherwise not be made.'"***

forward-looking sensors for obstacle avoidance. These navigation systems can provide 3D images of waters, riverbed and seafloor ahead of the ship out to 1,000-m range. FarSounder's sonars also include a local history mapping feature, which builds a map of the bathymetry everywhere the ship transits ([www.farsounder.com/blog/local-history-mapping-looking-forward-to-look-backward](http://www.farsounder.com/blog/local-history-mapping-looking-forward-to-look-backward)). The size of this map is only limited by the hard drive space available on the bridge computer.

The standard configuration of Argos sonars is a stand-alone system that keeps all the data inside the software. FarSounder customers have the option to participate in the company's Expedition Sourced Ocean Data Collection Program ([www.farsounder.com/blog/expedition-sourced-ocean-data-program-surveying-the-sea-floor](http://www.farsounder.com/blog/expedition-sourced-ocean-data-program-surveying-the-sea-floor)). As part of this program, participants are sent a USB hard drive, which records all the raw data received by their system. When the drive is full, it is sent back to FarSounder for compilation.

FarSounder is an official trusted node for the IHO Data Centre for Digital Bathymetry, and all contributions to the IHO's database are available for public use. Through the DCDB, the data are also shared with Seabed 2030. This is an opt-in program for select current customers and is focused on those who are traveling to "exotic" locations (though data from any location is of value to Seabed 2030).

#### New Applications for Crowdsourced Data

Crowdsourced data has many known uses, and new applications for the data are being developed by engineers, scientists and hobbyists around the world. One example is using crowdsourced data from trusted sources to help fill in the gaps of traditional hydrographic surveys. The Canadian Hydrographic Service (CHS) recently produced an update to chart 7053 detailing a part of the Northwest Passage using data collected by MV *The World*, a vessel equipped with Argos sonar, and made available through the DCDB. In this case, the CHS had no survey data from this section of the Northwest Passage. Using the customer-submitted recordings and metadata about the vessel, the CHS was even able to assess the quality and reliability of the measurements.

In another example, five cruise ships operating off the coast of Antarctica during last year's season participat-

ed in the FarSounder program, with additional vessels recording during this year's season. When those drives are returned, it is hoped that there will be recordings of multiple voyages over similar locations, which will allow for the generation of a large surveyed area. There are plans to repeat this effort in subsequent years through the FarSounder data collection program, with the hope of not only expanding the coverage of the surveyed area but also producing information about the seafloor as it changes over time. Such observations of the Antarctic seafloor have never previously been collected and could be a unique perspective for scientists who are studying climate change and polar ice caps.

Expedition ships often operate in locations that are outside the standard commercial shipping routes. These types of locations are often bypassed in official hydrographic surveys. Dr. Heath Henley, senior application engineer at FarSounder, highlighted the role of these vessels beyond tourism: "These explorers can offer access to scientific observations, which may otherwise not be made. It would be a shame to waste such opportunities, especially when they can be achieved with no significant cost while the vessel operates normally. We're proud that our customers are able to contribute in this way."

Through participation in crowdsourcing activities, maritime businesses have an opportunity to provide unique and valuable contributions to the global community and expand the limits of our understanding of our world.

FarSounder is proud to do our part in connecting our customers with the Seabed 2030 project. Keeping the oceans safe is a mutual goal worldwide, and we are pleased to have the partnership in place to provide Seabed 2030 with bathymetric data. **ST**

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Matthew Zimmerman is the CEO of FarSounder Inc. He has driven the technical development and vision of FarSounder since its inception in 2001. His focus on building and grooming an expert design and implementation team has led to best-in-class commercial products. He leads the team in the effort to create safer oceans through participating in the IHO's Crowdsourced Bathymetry Working Group (CSBWG).



# Ocean Exploration Trust

*Mapping and Exploring the Global Ocean for 15 Years*

By Dr. Derek Sowers • Jamie Zaccaria

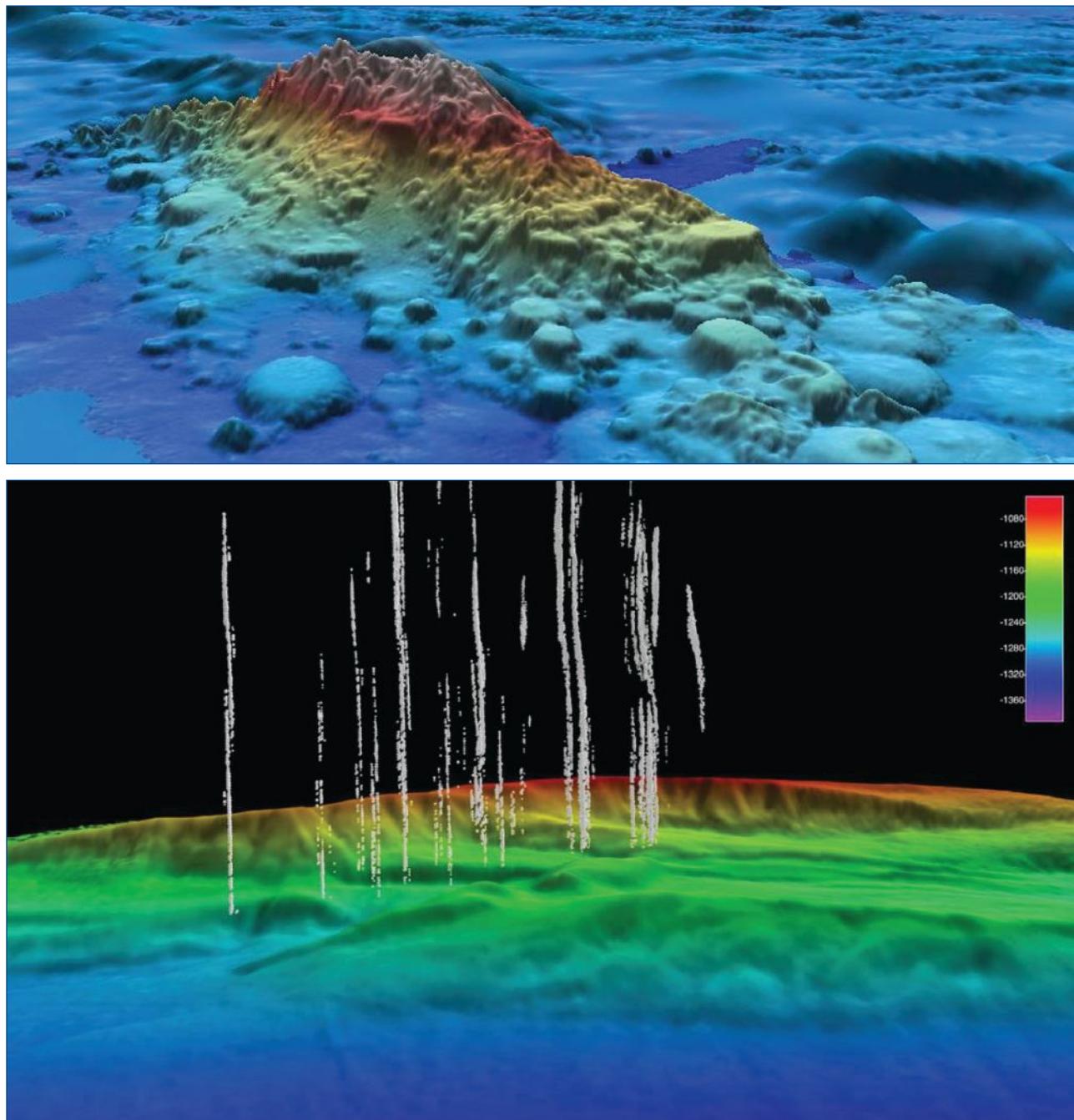
The Ocean Exploration Trust (OET), founded as a nonprofit in 2008 by famed oceanographer Dr. Robert Ballard (*Sea Technology*, July 2021), has been exploring the ocean for nearly 15 years. While livestreaming video of deep-sea dives with ROVs may be among our most well-known exploits, OET is also dedicated to revealing the mysteries of the deep through ocean mapping. The ocean covers 71 percent of the planet, yet only roughly a quarter of the seafloor has been mapped using mod-

ern multibeam sonar to generate data that are publicly available.

OET is committed to contributing to the efforts of the broader global ocean mapping community to generate high-resolution maps of the remaining 276 million sq. km of seafloor and to operationalize new technologies that enable the acquisition of these data to be more efficient. Higher resolution maps are essential for understanding marine habitats, the geological evolution of the



*Exploration Vessel (EV) Nautilus is owned and operated by the Ocean Exploration Trust (OET), a nonprofit established to explore the world's ocean and seek out new discoveries.*



**(Top)** High-resolution seafloor mapping has revealed interesting pancake-like features of a seamount in the Moonless Mountains chain in the Eastern Pacific. (Image created using QPS software.) **(Bottom)** Sound waves reflect strongly off gas bubbles emanating from the seafloor and are visible in multibeam echosounder data from the water column. (Image created using QPS software.)

oceans, marine geohazards (such as earthquakes and tsunamis), current circulation patterns, climate change, underwater cultural heritage sites, and a diverse range of other critical applications.

"We have better maps of Mars and the far side of the Moon than the 50 percent of America that lies beneath

the sea, which our Ocean Exploration Trust and EV *Nautilus* are trying to rectify," said Ballard. "OET is proud to be a platform for advancing innovation in seafloor mapping by integrating new technologies and promoting collaboration."

Our expeditions are launched aboard EV *Nautilus*, a 68-m (224-ft.) exploration vessel equipped with ROVs, acoustic mapping systems and other state-of-the-art technologies, including partner ASVs and AUVs. Ocean exploration is a complex endeavor, and *Nautilus* is outfitted with the latest tools and technology to provide scientists and engineers both on board and ashore with the data they need for continuing research in geology, biology, archaeology, and physical oceanography.

Since 2012, when OET first acquired a Kongsberg EM 302 multibeam echosounder system, EV *Nautilus*

has mapped over 870,000 sq. km (336,000 sq. mi.) of the seafloor in the Atlantic, Gulf of Mexico, Caribbean Sea and Pacific Ocean: over twice the area of California. Mapping of this vast ocean area has been punctuated with many exceptional discoveries: new seamounts, hydrothermal vents, canyons, brine pools, methane seeps, deep-sea coral mounds and shipwrecks.

Since 2015, EV *Nautilus* expeditions have been mainly on the Pacific Ocean along the west coast of North America and some of the most remote areas in the Central Pacific, focusing on deepwater explorations in U.S. waters surrounding the Hawaiian Islands, Johnston Atoll, Palmyra Atoll, Baker Island, Howland Island, Jarvis Island and Kingman Reef.

### Mapping the Unknown

Since we explore little-known ocean regions, we often need to create our own maps to plan efficient and safe near-seafloor operations. Before ROVs are deployed, our team must map the area to understand the region's characteristics and identify potential benthic habitats, seeps, and other features of highest exploration interest to the marine science community. *Nautilus*'s EM 302 multibeam sonar simultaneously collects bathymetric, seafloor backscatter and water column backscatter data to produce high-quality seafloor maps at depths to 7,000 m (23,000 ft.).

Through dedicated surveys and tactically designed

transits, OET collects data from unmapped areas worldwide. We are a partner of the Seabed 2030 initiative, an international collaborative project to combine all bathymetric data to create a comprehensive map of the ocean floor. The project was launched at the United Nations Ocean Conference in June 2017 and is aligned with the UN's Sustainable Development Goal #14 to conserve and sustainably use the ocean, seas and marine resources. We are proud to support the Seabed 2030 Project because a complete map of the seafloor is a critical step in understanding our planet through ocean exploration. OET is an integral spoke in a large wheel of international partners tackling this thrilling challenge.

Revealing structures below the seabed is just as important as discovering the seascape and habitats above. Complementing our multibeam mapping work, our team utilizes a Knudsen 3260 sub-bottom profiler to obtain insights into the shallow geology beneath the seafloor surface. Mounted inside the hull of *Nautilus*, this echosounder operates at low frequencies to penetrate and reflect echoes off of layers of sediment and rock, revealing a cross-section of the seafloor structure.

The dual-frequency profiler can operate at 3.5 and 15 kHz, allowing sound to penetrate up to 80 m below the seafloor at water depths ranging from 50 m to full ocean depth. An acoustic pulse is directed through the water column to the seafloor and then captured by the system as it bounces back from each layer. Scientists can use the

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*ROV Hercules is at the center of the Nautilus exploration program, working in tandem with ROV Argus to explore the geology, biology, archaeology and chemistry of the ocean.*

data to identify subsurface geological structures such as faults, ancient channels and buried levees.

In early 2023, OET installed a new Kongsberg Simrad EC150-3C 150-kHz transducer on EV *Nautilus*. Mounted on the ship's hull, the EC150-3C is the first of its kind to combine an acoustic Doppler current profiler (ADCP) and a Kongsberg EK80 split-beam fisheries sonar into one instrument. The ADCP, which measures the speed and direction of currents at various depths underneath the ship, will support safe ROV operations and provide data for improving oceanographic current models.

This new instrument will enable our team to thoroughly assess the currents beneath the ship to optimize how we deploy and recover any vehicles or instruments we use to explore the oceans. The integrated split-beam echosounder maps and characterizes features within the water column, such as biology, scattering layers and bubble plumes.

#### **ROV Assets**

The workhorse vehicle of our exploration program and main method for collecting physical samples is ROV Hercules, working in tandem with the light and camera tow sled ROV Argus to explore the geology, biology, archaeology and chemistry of the ocean. The Volkswagen Beetle-size Hercules is built to withstand pressures at depths of up to 4,000 m (13,100 ft.) with more than 6,000 lb.-force per square inch (psi). Hercules has multiple cameras, including a high-definition video camera

that allows for real-time telepresence. Video data are streamed up a fiber-optic cable through Argus and into the control van aboard *Nautilus* before being sent out to scientists, students, and the public watching worldwide via the internet through our round-the-clock livestreaming system.

A pair of manipulator arms enables the Hercules pilot to remotely collect biological and geological samples with precise dexterity. Hercules can deliver up to 113 kg (250 lb.) of samples or tools to and from the seafloor carried in specially designed collection containers. Other sensors located on Hercules measure pressure, depth, water temperature, oxygen concentration, and salinity to accommodate requests from scientists both on board and onshore. Our ROV capabilities allow for the flexibility of additional user-installed technologies, such as the NORBIT wide-band multibeam sonar or the Raman spectrometer.

The ROV Little Hercules is a smaller sister to Hercules, designed to function similarly but with a focus on gathering high-quality imagery using a 4K video camera at a depth rating of 6,000 m. Atalanta is a smaller version of Argus used in tandem with the ROVs Little Hercules or Hercules, where it hovers several meters above to provide a bird's-eye view of the ROV working on the seafloor.

#### **Community and Public Engagement**

Central to OET's mission is a robust education and



**OET is dedicated to training and inspiring the next generation of STEAM (science, technology, engineering, art and mathematics) professionals by showcasing many professional pathways and providing at-sea experience.**

outreach program to inspire learners of all ages and bring awareness to the importance of ocean exploration and the many vocational pathways available in STEAM-related (science, technology, engineering, art and math) fields. In collaboration with its partners, OET maintains a suite of education and outreach programs. Alongside 24/7 livestreams and interactive Q&A through Nauti lusLive.org, we share expedition stories online through social media, produced media and press outreach.

OET offers educators and students the chance to join our Corps of Exploration at sea through our Science Communication Fellowship (SCF) and Science and Engineering Internship Program (SEIP). The SEIP aims to train and provide real-world experience for community college, undergraduate, and graduate students studying

ocean sciences, technology, engineering, and video in the at-sea environment. OET offers five types of paid internships through SEIP: ocean science, seafloor mapping, video engineering, navigation and ROV engineering. Seafloor mapping interns learn to acquire, manage, and process seafloor mapping data from a multibeam sonar, sub-bottom profiler, and auxiliary sensors.

Additionally, OET is dedicated to prioritizing and creating meaningful opportunities that align with the priorities of the communities in which we are working. We are working closely with partners to advance how our expeditions can reflect and be guided by indigenous knowledge in the Pacific, including the Papahanaumokuakea Marine National Monument staff, along with the Office of Hawaiian Affairs-facilitated Papahanaumokuakea Cultural Working Group. We aim to broaden this approach with other Pacific Islands.

#### **Strength in Partnerships**

Since the NOAA Ocean Exploration Program was authorized into U.S. law by Congress in 2009, OET has been partnering closely with NOAA Ocean Exploration,

other government agencies, academic institutions, and the private sector to advance the field of deep-sea exploration and to engage the public and next generation. In 2019, OET along with the University of Rhode Island (URI), Woods Hole Oceanographic Institution (WHOI), the University of New Hampshire (UNH) and the University of Southern Mississippi (USM) were selected by NOAA Ocean Exploration to form the Ocean Exploration Cooperative Institute (OECl), a five- to 10-year alliance that is envisaged to extend NOAA's reach and capabilities for its ocean exploration portfolio. The key objectives of the OECl are: to explore, map and characterize the nation's vast ocean territory; develop and implement new technologies; and engage future generations of ocean scientists, engineers and stakeholders.

OET expeditions with *Nautilus* provide an ideal test platform to advance the use of uncrewed systems and multi-vehicle operations to increase the scope and pace of ocean exploration. In 2022, OECl partners successfully used the iXblue uncrewed surface vessel DriX to expand the footprint of mapping operations from *Nautilus* and to support multi-vehicle explorations with WHOI's midwater AUV Mesobot and HROV Nereid Under Ice.

In 2022, OET also completed three "From the Shore to the Abyss" expeditions in partnership with the National Geographic Society to synthesize knowledge from shallow coastal and deep-sea ecosystems. Partnerships support our ocean exploration and education mission,

including long-standing partnerships with the Office of Naval Research, National Marine Sanctuary Foundation, Office of National Marine Sanctuaries, and Ocean Networks Canada and emerging partnerships with the Bureau of Ocean Energy Management and the Defense POW/MIA Accounting Agency.

Another major goal of OET is to provide a rich foundation of publicly accessible data to enable follow-on exploration, research and management activities. To this end, data and samples collected on EV *Nautilus* expeditions are submitted to publicly available repositories within 60 days of the end of an expedition. Our Scientists Ashore program allows shore-based participants to view live video and some data feeds from ROVs Hercules and Argus; view data from seafloor and water column mapping efforts; participate in a text dialogue with shipboard scientists and other onshore scientists; and contribute to ROV dives and mapping operations.

## 2023 Expeditions

In 2023, EV *Nautilus* will undertake over 10 separate expeditions for a total of over 200 days at sea in the Central and Eastern Pacific to map and explore deep-sea habitats. A key focus this year will also be testing new advanced exploration technologies, including the ASV DriX (UNH); AUV Mesobot (WHOI); the Hadal Water Column Profiler (University of Hawaii); the Deep Autonomous Profiler (URI); the InVADER Raman spectrometer (Impossible Sensing); and the MiDAR active multispectral imaging instrument (University of Miami). This year's expeditions aboard EV *Nautilus* are funded by NOAA Ocean Exploration through the OECl, Ocean Networks Canada, the Office of Naval Research, the Bureau of Ocean Energy Management and the Defense POW/MIA Accounting Agency.

We invite you to join us as we expand ocean exploration throughout the Pacific Ocean, work with new partners and technology, and continue to bring the deep sea to classrooms and homes around the world. Discover the ocean with us at: [NautilusLive.org](http://NautilusLive.org). ST

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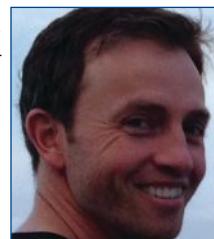
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*Dr. Derek Sowers has an M.S. in marine resource management from Oregon State University and a Ph.D. in oceanography from the University of New Hampshire. He has participated in numerous oceanographic expeditions spanning remote areas of the Arctic, Pacific and Atlantic Oceans.*



*Jamie Zaccaria has been the digital media specialist for the Ocean Exploration Trust since 2021 and has sailed on multiple at-sea expeditions. She holds an M.S. in biodiversity, conservation, and policy from the State University of New York at Albany and previously worked for the Sierra Club and Panthera.*



# High-Res Radar

## *Terran360 W-Band Provides Millimeter-Level Accuracy*

By Sam Wood

The maritime industry is undergoing a significant shift as it experiences an influx of investment in autonomous ship navigation. Around 90 percent of global trade is transported by sea; this amount is anticipated to grow three-fold by 2050, according to the U.S. Organization for Economic Co-operation and Development. There will be a transition toward a maritime transportation system that is more cost-effective, safer and greener.

The concept of Shipping 4.0—the fourth industrial revolution being spurred by AI and automation—coincides with this shift. It includes the increasing use of sensor technologies in offshore, nearshore and inland waterways.

With the advent of AI, low Earth orbit (LEO) satellite connectivity and other leading-edge technologies, the impact and speed of automation is reshaping the maritime space with increasingly connected and less or uncrewed vessels.

As with all industries, however, automation in maritime will likely enhance human capabilities rather than replace the need for human intervention. Automation will contribute crucially to situational awareness; it is a stark fact that 90 percent of injuries in marine operations derive directly from human error.

A data processing or decision support system can be installed on the bridge to improve situational awareness by gathering and processing data from various sensors on board. These sensors include: an automatic radar plotting aid (ARPA), GPS/GNSS, automatic identification system (AIS), electronic chart display and information system (ECDIS), satellite and radar. With information analyzed from these sources, the bridge can better understand the environment and make informed decisions.

While radar and other sensors such as LiDAR have been used in the maritime space for some time now, vessels still heavily rely on GNSS navigation, which has limitations. When navigating near large objects, most GNSS systems cannot provide positional accuracy within

a meter due to multipath issues, which poses a challenge to vessels maneuvering in ports, inland waterways and offshore wind farms. Furthermore, external signals on the same frequency band can interfere with GNSS and impact its accuracy.

### **W-Band Radar**

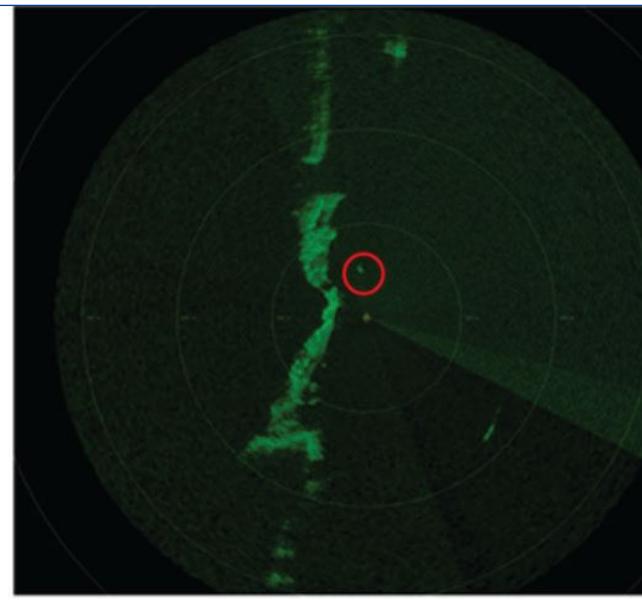
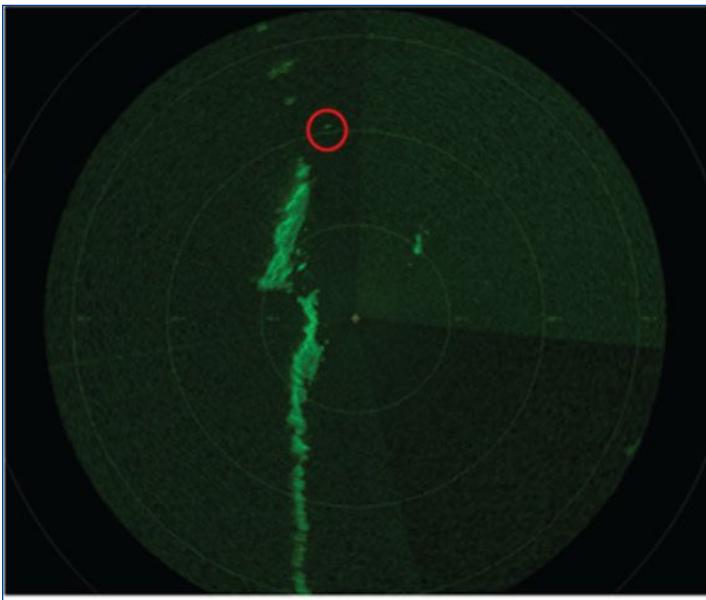
Radar has been integral to the maritime space since it was first designed and introduced during World War II to enhance safety and navigation and, at the time, to detect the enemy. Today, standard radar systems are used for the identification of obstacles within a set radius of many kilometers.

Most onboard marine radar systems operate on S-band and X-band. Operating at 3 GHz, S-band has a range of 74 km, or 40 nautical mi. X-band, with its higher frequency of about 10 GHz and wavelength of 3 cm, provides better target visualization with more precise, high-resolution images.

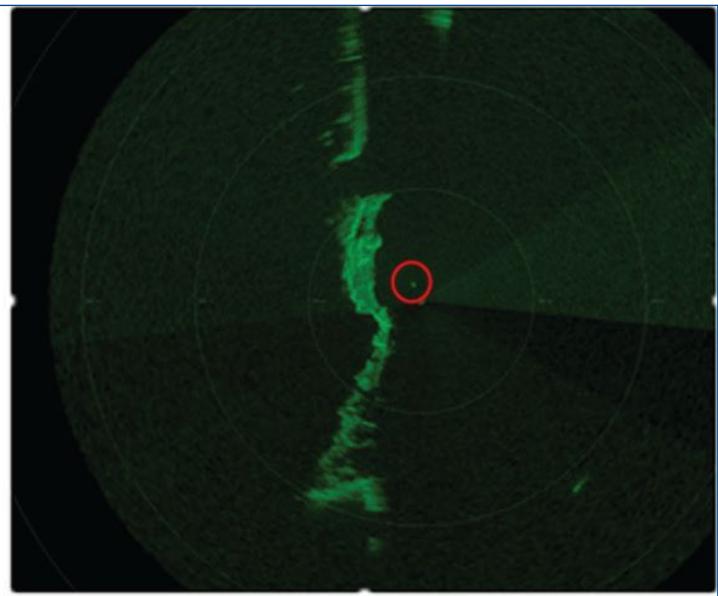
In contrast, W-band, operating at 76 to 77 GHz with 3-mm wavelength, can deliver the most spectacular imagery and accuracy, with a 500-m range, independent of GNSS and infrastructure. It is also resilient to rain, fog and glare. W-band is the perfect solution to augment X-band as it fills in nearfield detection.

W-band radar can be used in an increasingly wide range of near-distance applications, from berthing to the identification of small objects, such as swimmers and kayaks. It can also help with identifying bridge structures and can be used in wind farms and inland waterways. Its near-distance granularity enables a much clearer picture to aid navigation and safety. For instance, where X-band will see a bridge as an obstacle, W-band will see the whole structure, including where safe passage can be achieved.

Near-distance W-band radar has four key applications: localization with millimeter accuracy in constantly changing conditions; obstacle detection, including



(Top) Terran360 radar testing. (Bottom) Radar trial on a RIB in Devon, U.K.



small objects, within a 500-m radius, in relation to vessel position; dynamic positioning to maintain vessel station-keeping and heading; and autonomous berthing.

### Terran360

At Navtech Radar, part of Halma plc, we have developed an approach to autonomous navigation that uses W-band radar, called Terran360. Unlike conventional X-band marine radars (8 to 12 GHz), Navtech sensors use signals in the microwave frequency (76 to 77 GHz). This creates a much clearer picture of the local environment. It uses radar to map a particular route, then, on subsequent runs, radar data are used to localize a vessel's position within this route, providing centimeter-level precision.

This approach to localization distinguishes itself from alternative solutions that use GNSS, LiDAR and cameras with a range of up to 500 m offered by Navtech's radar. The radar-based localizers are unaffected by changes in weather or lighting and continue to work in GNSS-de-

nied environments, such as ports or inland waterways.

Radar-based localization demonstrates great potential as industry demands evolve with automation. It is accurate and robust and overcomes the limitations of GPS/GNSS and alternative sensor solutions.

### Offshore Applications

The growth of the wind farm industry has exacerbated the offshore risks for vessel navigation. With the global offshore wind energy market set to reach 240 GW by 2030, and 410 GW by 2040, turbines will become an increasingly common fixture in the world's shipping lanes. The structures are typically situated about 10 km offshore, in waters ranging between 5- and 50-m depth—coincidentally where the highest density of marine traffic passes.

High-resolution cameras with stabilized zoom lack the necessary accuracy required for the harsh maritime environment. While LiDAR offers an alternative, it is expensive and has limitations, and AIS can suffer from latency. For navigation within 500 m, W-band radar is ideal, offering odometry and localization within 10-cm accuracy. It provides real-time positional data, unaffected by rain and lighting changes, and can easily integrate with other systems.

### Nearshore Challenges

Crews rely on collision avoidance regulations known as COLREGs, first introduced in the 1970s, in order to maintain safe separation between vessels. The 41 COLREG rules support the intention that "every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision."

Given the more cluttered and unpredictable nature of nearshore marine activity, W-band is ideal in all light levels and weather for detecting and enabling tracking of various objects, such as buoys, small vessels, swimmers and kayaks, that X-band will invariably miss.

Terran360 W-band radar merges Navtech's frequency modulated continuous wave (FMCW) 360° sensor technology with Oxtobotica's leading autonomous vehicle software platform. It can be installed on a range of mobile port machinery, including rubber-tired gantry cranes, rail-mounted gantry cranes, straddle carriers, ship-to-shore cranes, automated guided vehicles, terminal trucks and terminal tractors.

In 2022, Navtech completed successful nearshore trials at the Port of Singapore. The 18-month trial used a vessel that had previously become the world's first vessel to secure the ABS remote control navigation notation, following initial remote operation trials. The 32-m-long harbor tug used in the trials demonstrated its ability to autonomously avoid collisions in various scenarios, such



**Terran360 W-band radar offers millimeter accuracy in localization.**

as when two other vessels approach simultaneously on colliding paths and when a nearby vessel behaves erratically. An onboard tug master supervised the trials, which promise to open up considerable opportunities for other ports looking to harness the power of autonomous operations.

### Inland Waterways

Inland waterways remain crucial for many countries' economies, enabling cheaper, more reliable and less polluting transportation of bulky cargo compared to road or rail. Navigating through such restricted waterways as rivers and canals presents a whole new set of challenges, however, when compared with near and offshore due to hydrodynamic and bank effects. Studies have shown that 46 percent of collisions occurred in restricted waters because of communication problems on board and bridge resource management deficiencies.

Collision avoidance technology is as vital to inland waterways as offshore, with demand set to increase as autonomous vessels become more prevalent. Currently, GNSS navigation plays a critical role, but it is limited in positional accuracy, particularly in narrow spaces, and interference from external signals. Onboard sensors such as cameras and LiDAR provide rich data about the environment, but their limitations, including poor performance in adverse weather or inadequate range, make them less suitable for marine autonomy. As such, collision avoidance technology remains a key area of development for safe navigation in inland waterways, with the potential to unlock greater economic and sustainable modes of freight. Terran360 can address this gap with high-resolution W-band imagery that offers greater accuracy and precision.

### Frequency Modulated Continuous Wave

Frequency modulated continuous wave (FMCW) is a unique radar configuration that measures both the distance and velocity of moving objects. FMCW achieves this by continuously varying the frequency of the transmitted signal at a known rate over a fixed time period. This type of sensor provides an extremely rich set of data, making it a vital tool for manned, autonomous and semi-autonomous vessel applications. FMCW offers superior detection capability for short-range small targets, enabling unparalleled situational awareness in challenging environments.

Compared to conventional pulsed radar systems, FMCW radars, such as Terran360, provide highly accurate distance measurements and update measurements more quickly. They can simultaneously measure the target range and velocity and operate in any adverse weather/atmospheric conditions.

As our seas become more cluttered and continue to be utilized for freight, the maritime industry will rely more and more on autonomy for enhanced situational awareness to improve safety and efficiencies. FMCW and W-band radar such as Terran360 can play a role in this process by complementing other sensor technology for more precise localization and navigation and short-range target detection. **ST**

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*Sam Wood is the industrial automation product manager at Navtech Radar, playing a pivotal role in the design and implementation of Navtech's new radar sensors. He seeks to engage with customers and help them explore the potential of radar-based automation. Wood is a business-minded innovator with an M.S. in aerospace, aeronautical and astronautical engineering from Imperial College London.*



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# Robots in the Wind

*Remote-Controlled, Autonomous Tech Supports Floating Wind Farms*

By Shawntel Johnson • Michael King • Josh Broussard

Floating offshore wind is opening new possibilities for wind power locations and will play a critical role in the global transition to cleaner energy supplies. As a sign of the times, five seabed leases were granted at the end of last year by the U.S. Bureau of Ocean Energy Management as a result of the first-ever offshore wind lease sale on the U.S. West Coast and the first-ever U.S. sale to support commercial-scale floating offshore wind energy development.

According to Equinor, about two-thirds of America's offshore wind energy potential is in deep waters. The narrow Outer Continental Shelf running along the Pacific seaboard drops down to more than 1,000 m (3,280 ft.), opening up new power opportunities in floating offshore wind. Equinor has secured a 2-GW lease in the Morro Bay area offshore California with the potential to generate energy to power approximately 750,000 homes.

While floating wind installation costs are currently

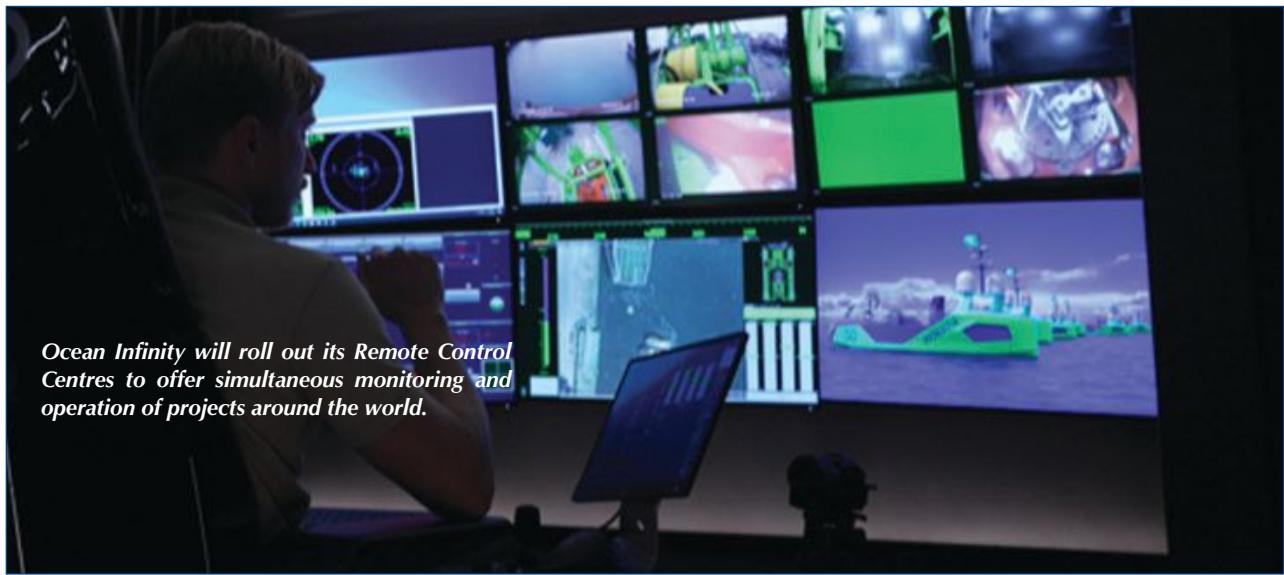
about five times those of fixed-bottom wind farms, as the technology matures, costs are set to plummet. A recent report by DNV has claimed that technological advancements will lower the levelized cost of energy (LCOE) for floating wind below \$100/MWh by 2025 and below \$40/MWh by 2050. This could lead to an increase in cumulative installed capacity to 264 GW by 2050.

Safe working protocols, best practices and the most cost-effective systems concerning the site inspection, pre-construction, operation, and maintenance phases of offshore wind farms have been developed for projects in Northern Europe in the last two decades. While a lot of these hard won lessons will carry over into U.S. West Coast developments, one area where there is a steeper learning curve ahead is subsea requirements.

Inshore areas are relatively cluttered with shipping traffic, and in many parts of the world the novelty value of offshore wind is wearing off, creating challenges for

*Ocean Infinity's Armada fleet is a multipurpose platform that will enable remote-controlled, lean-crewed and eventually uncrewed operations.*





*Ocean Infinity will roll out its Remote Control Centres to offer simultaneous monitoring and operation of projects around the world.*

obtaining planning permission for farms anywhere within sight of shorelines. In short, the locations that are physically viable for fixed turbines, in terms of water depth, wind conditions, etc., in areas that are likely to secure permission are getting used up fast. Plus, contrary to fixed turbines, which require heavy-lift vessels to install the foundations, transport and assemble the parts on site, and erect the turbine, floating turbine platforms are often assembled in port and towed to the site with the help of tugs and anchor handling vessels, which offers flexibility in terms of local infrastructure requirements.

The deepwater floating wind model somewhat precludes the usage of traditional towed arrays to obtain seabed data; a tried and tested methodology typical in European waters. The North Sea, for example, has an average depth of 90 m, at which the seabed is mappable by surface towed sensors to an acceptable level of detail for most wind farm pre-construction survey operations. In contrast, at 1,000-m depth, as frequently found off the U.S. West Coast, it is necessary to obtain the data with technology closer to the seabed; this is where AUVs can best support these new developments.

### **HUGIN AUV Fleet**

With 14 Kongsberg HUGIN AUVs rated at 6,000 m and six HUGINs rated at 3,000 m in production for delivery later this year, marine technology and data specialist Ocean Infinity has one of the largest fleets of AUVs outside of the navies of large nation states. The vehicles all have a broad spectrum geophysical sensor package, including two types of side scan sonar, multibeam sub-bottom profilers, magnetometer, digital imaging system, and in some cases a laser profiler. High-endurance batteries in some of the vehicles allow underwater missions of up to four days; a doubling of the standard two-day endurance. The AUVs also pack environmental sensors recording turbidity, along with optical backscatter, temperature and depth sensors. In addition, Ocean Infinity offers ROVs, hybrid AUV/ROVs, USVs, and crewed and autonomous clean energy ships.

In 2021, Ocean Infinity, which was established in 2017, expanded its offerings with the acquisition of sub-sea specialist company MMT, adding equipment and personnel expertise. This Swedish company has been heavily involved in offshore wind in Northern Europe since the early 1990s.

It's not just the hardware that the floating wind power industry will be calling upon in the next decade, it's also the skills to operate with this kit. Ocean Infinity has built up those skills by thus far conducting over 500,000 line kilometers of AUV work. At the company's start, it launched eight HUGIN AUVs, each with an independent mission that surpassed a water depth of 5,200 m; the deepest dive undertaken by multiple AUVs commercially known at the time. It was also a first for a fleet of HUGINs to simultaneously descend further than 5,000 m. This fleet performed surveys at five different locations, with the AUVs launched, monitored and recovered from a 115-m multipurpose offshore vessel. Other high-profile work includes subsea searches for Malaysian Airlines MH370 and the successful finding of the South Korean supertanker MV *Stellar Daisy* and Argentine submarine *San Juan*. This work involved AUVs along with ROVs and AUV/ROV hybrids covering large areas of seabed in short time frames.

AUVs will not have the whole floating wind game sewn up, of course. AUVs require forward motion to retain any control, so station-keeping, hovering and manipulation of seabed objects are not in their skill set. With these challenges in mind, Ocean Infinity is working with Saab Seaeye on operations with the Sabertooth ROV/AUV hybrid vehicle. This combines the endurance and speed of an AUV with the maneuverability, hovering, and object interaction competencies of an ROV.

### **Robot Ships**

To accommodate the large data requirements of the new floating wind seabed concessions, remote vessel operations and robotic surface vessels will play key roles. For the U.S. West Coast, Ocean Infinity's 78-m Armada

ships offer the right package of size, environmental profile and lean crew capabilities.

In partnership with Ocean Infinity, Vard has designed this unique multipurpose platform that will enable on-shore remote-controlled, lean-crewed and eventually uncrewed operations. The first Armada 78 has already arrived in Norway, to Vard Søviknes, after its maiden voyage from Vietnam, in January this year, closely followed by a second.

The first phase of Ocean Infinity's Armada fleet will comprise eight 78-m vessels that represent a giant leap forward for the maritime industry, with the latest technologies in fuel cell propulsion, low Earth orbit satellite communications, AUV deployment systems, electric work-class ROVs, seabed drills and back deck equipment.

The vessels use hybrid solutions that are designed to evolve through various stages of future fuels implementation. This will ensure that they remain at the forefront of low-emission performance to minimize the environmental impact of operations.

Additionally, Vard's daughter company, Seaonics, is delivering modular launch and recovery systems for the vessels' moonpools that can be adapted to various marine operations, such as Ocean Infinity's growing work in offshore renewables.

Ocean Infinity's HUGIN vehicles are currently deployed from chartered vessels, and the vessels will be replaced over the course of this year and next year by the 78-m Armada fleet. Following closely on their heels will be a fleet of six 86-m ships due to commence build in 2024 at Vard, with delivery for the first ships due early 2025.

## Remote Operations

All of these vessels have been built with Ocean Infinity's Remote Control Centres (RCCs) in mind. The first state-of-the-art RCC will officially commence live operations in Southampton, U.K., this summer, after performing test operations for the last year.

The RCCs will enable, for the first time, anywhere in the world, multiple ships operating in a range of maritime jurisdictions to undertake complex tasks with lean-crewed or uncrewed vessels, over the horizon from a shore-based location, via the latest communication technologies. The objective is to manage remote vessel operations simultaneously all around the world.

In due course, the technology provided by the RCCs, along with the corresponding vessel and communications technologies, will enable, in jurisdictions that will allow it, completely uncrewed operations. These are set to include complex operations that could prove critical for the floating wind rollout, such as uncrewed launch and recovery of AUVs in a wide range of sea states.

The Southampton RCC is equipped with 20 individual control pods, or "bridges," each with a (marine specification) helmsman's seat for situational awareness. Managerial staff, such as vessel captains, work on more conventional office-type workstations inboard and on a raised dais from where multiple activities and vessels can

be overseen. The ethos of close collaboration and care of duty has been built into all design aspects.

A skilled and qualified operator in the RCC could operate one vessel or ROV in one location at any given hour, then a different vessel in a different location in the next hour. This presents opportunities for customers to reduce unnecessary, unplanned and costly downtime. For example, if an RCC-managed AUV launch happens to be delayed by bad weather, the RCC-based AUV fleet manager, instead of finding other tasks to perform aboard a loitering ship, can switch to another operation in another location.

It is likely to be some time, however, before autonomous or remote-controlled vessels will be navigating, launching and recovering AUVs in U.S. waters due to a challenging legal and regulatory landscape. Many maritime requirements in the U.S. are managed at state level, some even at port level, but the sheer area of seabed that will need to be covered as we build up floating wind capacity means that a larger framework enabling more robot operations will be ideal. Forward-focused companies such as Ocean Infinity are banking on having the spread of equipment, skills and experience ready for the future. **ST**

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*Shawntel Johnson is the director of business development for search and recovery services at Ocean Infinity. With 17 years of experience in the maritime industry, her in-depth knowledge of the salvage business has helped Ocean Infinity become a world leader in search, salvage and seabed security. Her career began in 2006 with a commercial diving company based in Seattle, Washington. In 2010, she moved to Houston, Texas, to oversee salvage operations, including the Costa Concordia. At Ocean Infinity, she has been involved in the development of the U.S. renewables and defense service lines, the search for the airliner MH370 and the successful searches for the submarine San Juan and supertanker Stellar Daisy.*



*Michael King works in sales and business development at Ocean Infinity, providing strategic commercial support and insight, particularly on uncrewed systems and their applications. With a technical background as a geophysicist, he started his career working offshore in oil and gas exploration around the world. Subsequently, he specialized in hydrographic and geophysical surveys in Europe, mostly for offshore renewable projects.*



*Josh Broussard is the chief technology officer for Ocean Infinity. He has been part of the business since its inception and is a key enabler for some of the company's most ambitious offshore operations. Under his guidance, Ocean Infinity has deployed its robotic fleet in multi-vehicle operations, with as many as eight assets operating in a single coordinated, long-range operation. He has served as the technical lead in many subsea operations, including the search for the airliner MH370 and the search and location of the submarine San Juan and supertanker Stellar Daisy. He holds a B.S. in engineering technology and a master's in business administration.*



# Q&A: Robert G. Allan

*Workboats for the World: The Robert Allan Story*

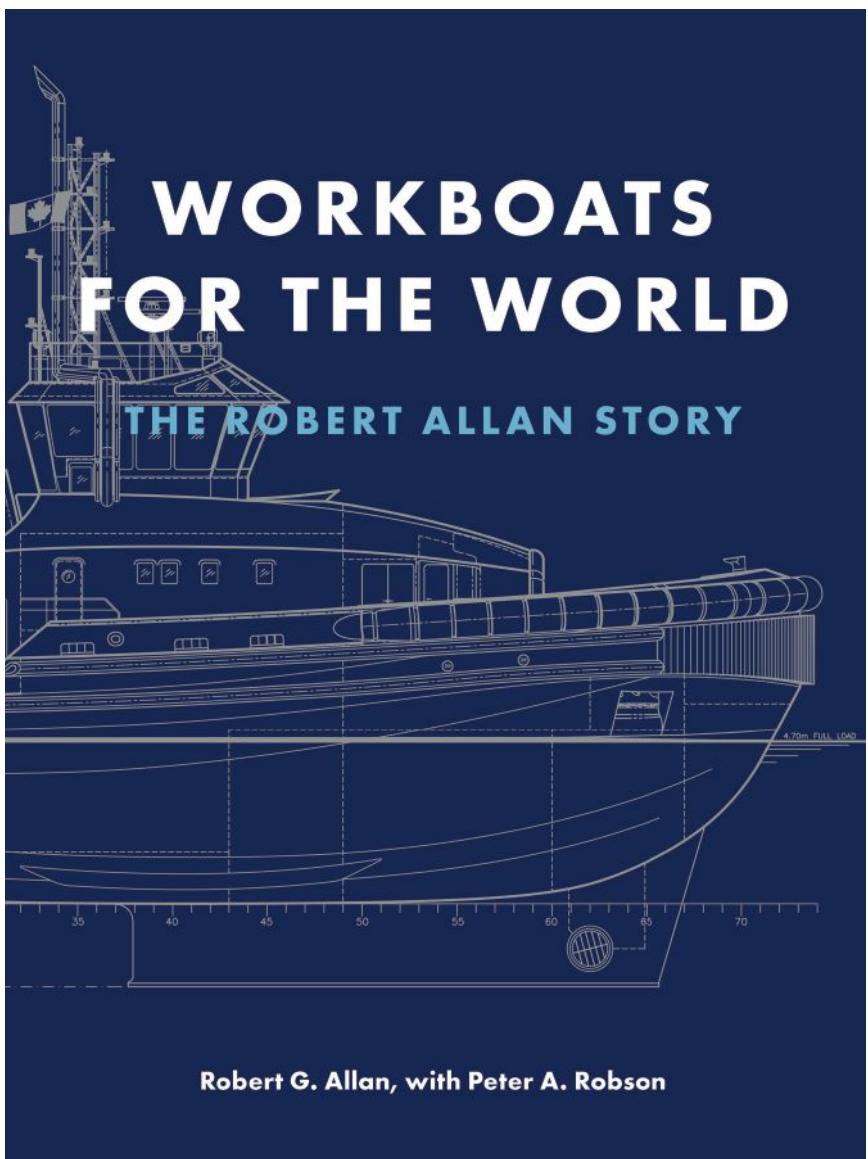
Robert Allan Ltd. is a marine architecture firm founded in 1928 in Vancouver, British Columbia, Canada. What began as a local firm has since evolved into a company with extensive international reach, starting with designing stealth speed boats for rum running all the way to the current energy transition with low- and zero-carbon emission vessels. The family-built company has maintained its leadership in the workboat industry for nearly a century, and it continues its strong presence in the global market.

Robert G. Allan discussed his new book, "Workboats for the World: The Robert Allan Story," with *Sea Technology* to commemorate the history of the company as it moves into a new phase of ownership.

## **Why did you decide to write this book?**

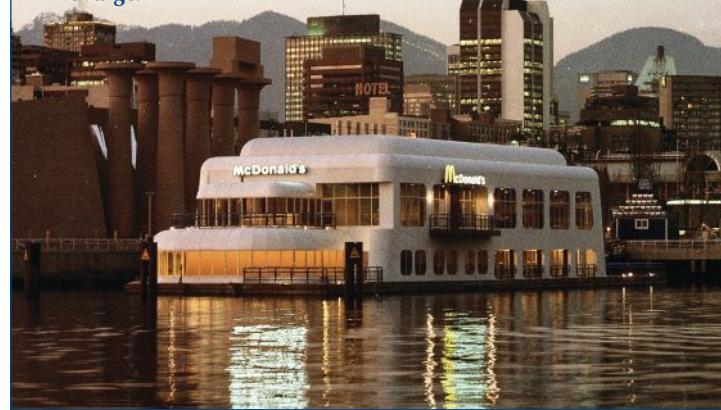
The concept of a history of Robert Allan Ltd. had been in my mind for quite some time. With the COVID outbreak in 2020, just a little over a century since my grandfather came to Canada, the stars seemed aligned. The company was 93 years old, I wasn't getting any younger, and I had time to devote to researching the 'gray' areas in our history.

However, the primary motivation was to ensure that my sons and grandchildren and the new owners em-





(Above) Robert Allan (senior) and Robert F. Allan. (Below) The McDonald's Friendship, a.k.a. McBarge.



ployees of Robert Allan Ltd. had a clear record of the business history.

***Take us back to the beginning: Why and how did the company start? What were the main challenges, and how were they met?***

My grandfather emigrated to Vancouver from Scotland in 1919. He started work for Wallace Shipyards (later Burrard Drydock Co. Ltd.), soon becoming chief superintendent. In 1928 he hung out his shingle as a consulting naval architect. The Great Depression occurred shortly thereafter. Business was almost nonexistent until about 1934, when a few commissions enabled him to carry on. This was a 'one man in the basement' business from 1928 until 1945, when my father joined, and then it was

'two men in the basement' until the mid-1950s, when business picked up and they hired their first draftsman. In 1963, with 'seven men in the basement,' the company was formally incorporated as Robert Allan Ltd. and moved into its first proper office.

***How many generations of Allans have been involved in the business? What would you say is the most significant contribution of each of those generations?***

Three generations, all 'Robert Allan,' owned and managed the company from 1928 until 2008.

Robert Allan, my grandfather, was a highly skilled naval architect, but he could be difficult with people. He was credited with creating

the generation of big wooden seiners that dominated BC fisheries from about 1939 to 1959. He also designed many inland and coastal ferries and a few sumptuous yachts.

Robert F. Allan, my father, was also a highly skilled naval architect but much better at managing people and dealing with clients. He redefined the tug and barge fleet of BC between 1959 and 1970, when a new generation of steel, diesel-powered tugs replaced the older wooden steam tugs and modern steel barges replaced wooden scows.

I assumed command of the company in 1981, after my father died. The early '80s were very difficult years, with high inflation and global recession. We hung on, and an early investment in CADD [computer-assisted design and drafting] systems gave us an advantage in the 'automation' of ship design. With the advent of OPA '90 [the Oil Pollution Act of 1990 in the U.S. that set higher liability limits for oil spills] and similar legislation in Europe, the demand for high-performance tanker escort tugs provided the opportunity to test new ideas about that genre, and we were highly successful in creating a global market for our design services.

***Give us an overview of the types of vessels the company creates. Which ones are your biggest sectors? What are the locations of your largest pools of clients?***

We pride ourselves on being innovators in the world of commercial workboats, and have successfully designed many different vessel types: fish boats, research vessels, icebreakers, patrol boats, crew boats, supply vessels, ferries, barges and fireboats, and more!



However, we are definitely best known for designs for tugboats of all types. Tugs today account for approximately 80 percent of our business, and typically there will be 80 to 100 tugs built annually to a Robert Allan Ltd. design—about one-third of global tugboat newbuilding, excluding countries such as China.

Seventy-five to eighty percent of our clients are outside of North America and include most major towing companies. Our largest clients are in Turkey, where the world's most prolific tug builders are located, and in Hong Kong/China, another large volume tug builder.

***This international company was born in Vancouver, Canada. Has the local environment—natural, business and social—influenced the character of the business. If so, how?***

Our business was born serving the local market in BC, where virtually all coastal commerce is conducted by tug and barge. We grew up with the coastal towing industry, learning to understand what owners needed in these rugged workhorses. We strive to continue to learn from our clients about the performance of each new design.

***What is the company's philosophy and culture?***

My father set the standard for this business by his own powerful individual and work ethics. I recently tried to articulate that as follows: 'His most important lessons (largely unspoken) were those on how to behave in business; treat your clients and employees with honesty and integrity and they will reward you with their trust. That is an important lesson and one I have always tried to follow.'

I believe that philosophy is apparent to everyone in the office, resulting in an incredible team spirit of which we are incredibly proud, with extremely high staff retention.

***There's a chapter called 'The Odd-Job Jar.' Can you highlight a tale or two?***

There are some projects that simply don't fit well in descriptive pigeonholes, and these are always fun, especially when it involves some blue-sky thinking/creativity. One of my most memorable was McDonald's *Friendship* Restaurant, affectionately known as 'McBarge,' for Vancouver's Expo '86. As part of a team tasked with creating a signature restaurant for McDonald's restaurants in a very short time, our job was to make sure it floated upright and level, which sounds easy, but none of the 'civil'



(Above) John Cabot, a Canadian Coast Guard offshore fisheries science vessel built by Seaspan. (Below) Pax and Dux, extreme dual-fuel escort tugs designed to operate in frigid conditions.



side of the team had ever thought much about the weight or CG [center of gravity] of what they were designing. We had to track all of that for all disciplines and make sure it all worked. The end result was terrific!

**Talk to us about the ownership transition: Why has the company been sold? Who owns it now? What is your hope and/or advice for the new owner?**

By 2006 it was apparent that none of my three sons would follow in the tradition of naval architecture. I had to consider the company future beyond my eventual retirement—assuming I didn't die at my desk first, given the typical hours worked for the previous 40 years!

Eventually, a deal was struck with an initial team of 10 senior employees to buy the company from me over the next decade. The shareholding structure is such

that the ownership group would continually expand to bring in other deserving employees, to the point where today we have 27 or 28 employee owners.

This process has exceeded my wildest dreams for a successful transition, and under the direction of first Ken Harford and now Mike Fitzpatrick the company continues to go from strength to strength.

**Anything you'd like to add or emphasize?**

I am often asked if I have regrets that none of my sons followed the family tradition, and the answer is always a resounding 'NO'! I am immeasurably proud of my sons, who each have excelled in their own chosen fields, and the company is run today by those who have contributed most to its long-term success. I have been able to easily step back from the day-to-day running of the business and enjoy my 'mostly retired' status today!

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Learn more about "Workboats for the World" at: <https://harbourpublishing.com/products/9781550179873>. ST

# international

## Kongsberg Discovery Launches

Kongsberg Gruppen (KONGSBERG) has launched the new business area Kongsberg Discovery from its former Sensors and Robotics division, with a focus on advanced robotics and sensor technology to map, monitor, and understand the ocean to help solve global climate, food, and security challenges.

The new business area has more than 1,000 employees in Horten, Trondheim, and Oslo, Norway, in addition to offices in Spain, the U.K., the U.S., Canada, Singapore and Malaysia.

Kongsberg Discovery is led by Martin Wien Fjell, who has held several management positions in KONGSBERG over the past 10 years and has led global customer support in Kongsberg Maritime since 2017.

## Mud Cat Dredge for Work in Israel

Mud Cat has commissioned a brand-new MC 100E electric dredge for Admir Projects Ltd. at a wastewater plant in Israel. The MC 100E will dredge sludge from wastewater ponds and pump it to geotextile tubes for dewatering. Amir is another repeat buyer with multiple Mud Cat and IMS Versi-Dredge units and is a leading dredge contractor in Israel.

## Japan's First LNG Dual-Fuel Chemical Tanker

Under the Zero-Emission Accelerating Ship Finance Program jointly operated by Development Bank of Japan Inc. (DBJ) and ClassNK, ClassNK has evaluated the LNG dual-fueled chemical tanker *Fairchem Pioneer*, developed by Fukuoka Shipbuilding Co. Ltd. and Fairfield Japan Ltd. (FJL). It will be the first LNG dual-fueled chemical tanker in Japan. The vessel is currently under construction at Fukuoka Shipbuilding and will be chartered to FJL. DBJ provided financing to Fukuoka Shipbuilding.

Under the Program, ClassNK evaluates ships based on a comprehensive scoring model jointly developed by DBJ from the perspective of "decarbonization, environmentally friendly performance and innovativeness," while DBJ provides investment and financing.

## Space Services to Support Maritime Autonomy

One Sea and the European Space Agency (ESA) have established a strategic collaboration to promote the development of new space-enabled services to support the maritime sector's transition toward autonomous shipping. Autonomous shipping offers new opportunities to deploy safe, commercially viable and environmentally sustainable maritime operations.

Satellite communications and satellite navigation play a key role in the adoption of autonomous shipping technologies and operations. During offshore passages, ships are often further from land than satellites, which can offer invaluable secure and resilient communication channels for monitoring, command and control of autonomous ships. Furthermore, in ports and congested areas, high-precision position, navigation and timing (PNT) pro-

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vided by satellites is also critical for the safe operation of autonomous shipping.

This new partnership will combine One Sea's unique expertise in the maritime sector and in autonomous shipping with ESA's technical competence and mandate through the Business Applications and Space Solutions program to support the development and demonstration of space solutions in addressing user needs.

### E-Learning Addition to OLP

Through a new partnership, Ocean Technologies Group (OTG) customers can use Series One of the KeelX "Safe Handling and Transportation of Dry Bulk Cargoes" e-learning through the Ocean Learning Platform (OLP). These titles will provide shipowners with a valuable resource to bolster their crews' existing knowledge while aboard or ashore as part of ongoing training, or even as part of pre-boarding processes, helping reduce risks to safety and to mitigate against possible claims.

Utilizing case studies and real-life scenarios, the KeelX titles provide learners with an in-depth understanding of how to handle and transport specialist dry bulk cargoes safely, including unprecedented situations and multiple operational scenarios.

### Fendercare Marine Rebrands

Fendercare Marine has rebranded to James Fisher Fendercare to simplify and streamline its identity for customers and the global markets it serves by further aligning with its parent company James Fisher and Sons plc. The rebrand comes with a renewed customer-focused strategy and new leadership team.

### SMG Launches Decarbonization Consultancy

Maritime safety provider Stream Marine Group (SMG), which helps companies transition to the use of alternative fuels, has launched its support and consultancy service Stream Marine Technical. Over the past year, SMG has seen significant growth as the industry looks at how it will meet the International Maritime Organization's ambitious decarbonization targets.

### Saildrone Joins Seabed 2030 Project

The Nippon Foundation-GEBCO Seabed 2030 Project and USV company Saildrone have signed a memorandum of understanding to collaborate on advancing ocean mapping technology in support of the global effort to map the entire ocean floor. All data collected and shared with the Seabed 2030 project is included in the free and publicly available GEBCO global grid.

### New DNV Tech Center in Netherlands

DNV has opened its new Technology Centre on Groningen's Zernike campus, a vibrant ecosystem of education, business and research activities. The new sustainable facility is equipped with the latest testing equipment to support DNV's research into the decarbonization of energy systems.

The Technology Centre will articulate research and technology qualification for the energy sector to: demon-

strate and qualify low-carbon technologies; optimize and repurpose existing gas infrastructure; provide innovative metrology for energy systems; lead research on hydrogen and H<sub>2</sub>-derived fuels; and conduct safety analyses and failure investigations.

### GeoAcoustics Receives King's Award

GeoAcoustics Ltd., a manufacturer of hydroacoustic technology for commercial and scientific applications, has been honored with the King's Award for Enterprise for International Trade. The established supplier to the global subsea sector is one of 148 organizations in the U.K. to be recognized with a prestigious King's Award for Enterprise. The award recognizes GeoAcoustics' six years of continuous growth outside of the U.K.

### JW Fishers Sonar for Alaska Safety

The Department of Public Safety in Anchorage, Alaska, has purchased a dual-frequency side scan sonar system from JW Fishers Mfg. to add to its search and rescue departments.

The equipment can be deployed from a small vessel and operated by one person. The towfish is towed behind a vessel at low speeds to search large areas quickly without putting divers' lives at risk.

### California Approves Emissions Reduction Tech

Clean Air Engineering – Maritime Inc. (CAE-M) has received approval from the California Air Resources Board (CARB) for its latest vessel stack exhaust capture and treatment system, the ShoreKat. This cutting-edge shore-based technology is designed to reduce emissions while minimizing the impact on vessel performance and operating costs. The approval successfully concludes a CARB-sponsored grant project issued to Pasha Terminals LP as part of the Green Omni Terminal Project in the Port of Los Angeles.

The ShoreKat technology is a highly efficient air pollution control system that removes particulate matter, nitrogen oxide, and other harmful pollutants from exhaust gases produced by ships and other marine vessels. The technology uses ceramic filters as part of its process to capture and treat pollutants from exhaust gas before it is released as clean air into the atmosphere.

### Barge Company Chooses Caterpillar

Associated Terminals is transitioning its fleet of 15 derrick barges from multiple brands of equipment to an all-Cat lineup: Cat marine engines, Cat wheel loaders and excavators, and Cat generators. This switch comes with support from Cat dealer Louisiana Cat, both before and after the sale of any product.

### River Associates Acquisition

River Associates Investments L.P. has acquired I&I Sling Inc. and Slingmax Inc. This acquisition complements River's purchase of Yale Cordage in 2020. The two businesses offer innovative custom solutions in synthetic ropes and heavy-lift slings. Each company will continue to operate autonomously. **ST**

## Report on Environmental Damage of Deep-Sea Mining

The potential profits from deep-sea mining will flow to some of the world's largest economies and to the shareholders and investors of a handful of private sector mining companies, while developing states and vulnerable groups will bear the burden of the harm of deep-sea mining, according to a new report from the Environmental Justice Foundation (EJF). The report highlights how deep-sea mining would irreparably damage unique, biodiverse ecosystems that have evolved over millennia.

Seven of the countries that have exploration rights hold almost two-thirds of the 31 exploration contracts awarded to date: China, Russia, South Korea, France, Germany, India and Japan. China holds exploration rights to the largest area overall: 18% of the total area under exploration contracts to date. Private companies also hold half of the contracts for polymetallic nodule mining exploration, the most prominent commercial target of mining operations. Canada-based The Metals Company (TMC) holds exploration rights to 52.5% of the area normally reserved for developing states under the UN Convention on the Law of the Sea (UNCLOS).

Organisms that live attached to collected minerals or lie in the way of collector vehicles will be crushed and torn out during mining, and the communities of wildlife at mining sites could take several decades or centuries to recover, if they recover at all, says the report.

Applications for commercial mining may be considered as early as mid-2023. The report highlights the urgent need for precautionary measures to prevent irreversible environmental harm, the EJF said.

## Australia Blue Economy Cooperative Nonprofit

The Blue Economy Cooperative Research Centre (BE CRC) has a new partnership with Echoview Software, a specialist in hydro-

acoustic data processing science and software.

Established in 2019, BE CRC is an independent nonprofit company and a Cooperative Research Centre under the Australian government's CRC program. With a 10-year life, the BE CRC brings together 44 industry, government, and research partners from 10 countries with expertise in aquaculture, marine renewable energy, maritime engineering, environmental assessments and policy and regulation.

The BE CRC undertakes industry-focused research and training to support the growth of the blue economy, with an emphasis on offshore aquaculture and renewable energy production.

## AiP for Green Ammonia FPSO

An industrial-scale concept for a floating production unit to produce green ammonia has secured approval in principle (AiP) from DNV, affirming the technical feasibility of the design. The project is now ready to start the basic design phase.

The NH3 FPSO concept is being developed by Netherlands-based SwitchH2 BV and Norway-based BW Offshore and will be built through conversion of an existing very large crude carrier or a dedicated newbuild. Receiving power primarily from a wind farm, the unit will produce hydrogen by electrolysis of seawater and nitrogen via an air separation unit, combining these in an ammonia synthesis unit. The ammonia gas produced will be condensed, and the liquid ammonia will be stored in the hull and later offloaded to an ammonia carrier. The NH3 FPSO will be permanently moored but can be relocated as necessary. Offloading will be done through a floating hose.

## Porous Liquid Could Hold Key To Carbon Capture, Storage

A new solvent developed by researchers at Queen's University Belfast can separate gases efficiently and could cut global carbon emissions. Separating mixtures of gases

into their components enables the capture of carbon dioxide from fossil fuel power stations and other energy intensive industries. Once captured, carbon can then be injected back into the ground.

The current processes that are used to do this require large amounts of energy and have their own colossal carbon footprint. About 16 percent of U.S. energy is used in chemical separation processes, with emissions equivalent to several million cars on the road.

The process developed at Queen's University uses a new type of solvent: porous liquid. It is much more energy efficient and could save about 30 percent in energy compared to the current process. Porous liquids can dissolve very large amounts of gas and selectively dissolve one gas from a gas mixture.

## Training Program for Next-Gen Marine Fuel Traders

Marine energy solutions provider KPI OceanConnect has launched "get fuelled," a two-year global trainee program to foster the next generation of marine fuel traders for the global energy transition and sustainability. It includes comprehensive training in marine fuel trading, supply and logistics, and the opportunity to work with leading experts. Trainees will have the chance to relocate to one of KPI OceanConnect's 16 offices worldwide. The program also combines courses at the Danish Maritime Academy in Copenhagen from September 2023, leading to a foundation degree in shipping and the qualification of bunker trader.

## CO<sub>2</sub> Tanker Development

Transport of CO<sub>2</sub> by ship to offshore storage areas and onshore terminals will be a major industry requiring a new kind of vessel. KNUD E. HANSEN has designed a dedicated CO<sub>2</sub> carrier: a DP-2 ship with an anchor loading system. It will have tanks for storage and transfer equipment for offloading and optional heating of CO<sub>2</sub> for an underground injection site. A twin skeg features two contra-rotating propellers for station-keeping and fuel savings. **ST**

# oceanresearch

## Split-Beam Sonar Testing

ASL Environmental Sciences has conducted successful field trials of a new prototype split-beam sonar to a maximum depth of 220 m in the Saanich Inlet near the Institute of Ocean Sciences (IOS), Sidney, British Columbia, Canada. This milestone marks the first such deployment of the prototype instrument, as part of a collaboration between researchers at Memorial University, the Department of Fisheries and Oceans Canada, and ASL.

This new split-beam echosounder prototype is designed to run autonomously for months at a time, enabling researchers to collect long time series data. This is useful when studying fish behavior throughout changing seasons, or when deploying in remote environments.

Split-beam echosounders use multiple receive channels to de-

termine target location within the acoustical beam. Unlike ordinary single-beam echosounders, split-beam echosounders may determine not only the range but also the direction of arrival of incoming signals. This facilitates accurate measurements of target strength. When detecting fish over multiple pings, a split-beam sonar can track the fish and estimate its swimming speed and direction.

## Plastic Microfibers Limit Juvenile Mussel Growth

A new study has demonstrated, for the first time, the effect of exposing juvenile mussels to polyester and cotton microfibers at environmentally relevant concentrations over a prolonged time scale. The young mussels subjected to higher levels of plastic microfibers showed restricted growth, which could have

compounding effects throughout the marine ecosystem as well as potential commercial implications.

The team, comprising scientists from Plymouth Marine Laboratory, University of East Anglia and the University of Plymouth, exposed juveniles of the mussel species *Mytilus* to three treatments of microfiber, which reflects both current and predicted future concentrations of polyester and cotton microfibers in the natural environment.

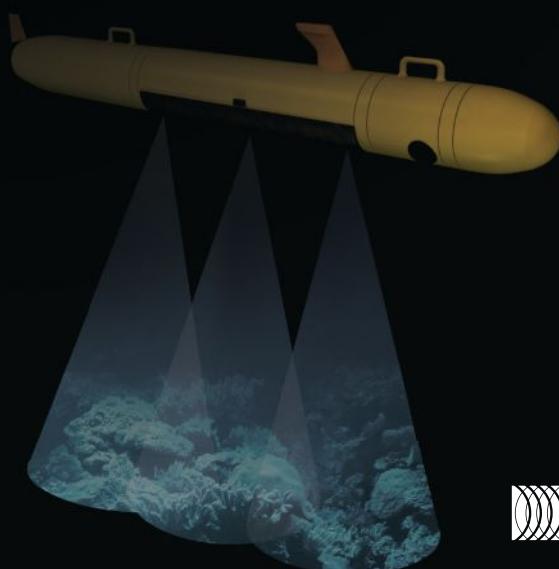
Studies suggest that as much as 4.8 to 12.7 million metric tons of plastic enters the global ocean every year, and this is expected to rise as plastic manufacturing rates are forecast to increase. Fibers are one of the most common forms of microplastic identified in environmental studies, accounting for up to 91 percent of the total identified microplastics in some studies.

Fibers that are less than 5 mm are termed microfibers and these tiny fibers are predominantly generated

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from the fragmentation of textiles, stemming from the day-to-day use and washing of clothes, and from the weathering and abrasion of marine infrastructure, such as netting and rope.

Microfibers are typically composed of polyester, polypropylene or nylon. Studies also report the presence of naturally derived and semi-synthetic microfibers (e.g., cotton, bioplastic) in environmental samples, which have received relatively little attention compared to their plastic counterparts.

Microfibers of 10 to 500 µm (0.01 to 0.5 mm) in size were used in this experiment, which was conducted in a controlled temperature laboratory with night and day cycles. Mussels were exposed to polyester microfibers at 8 and 80 microfibers per liter, and to cotton microfibers at 80 microfibers per liter. Mussels exposed to 80 polyester microfibers per liter were significantly smaller than the control mussels after 32 days exposure, and their growth rate was on average 36 percent lower than the control mussels. Mussels exposed to cotton microfibers did not show a statistically significant decrease in growth.

The researchers hypothesize that the polyester microfibers caused a change in feeding behaviors to avoid consuming microplastics, diverting energy away from growth to process ingested microfibers or repair damage caused by these microfibers. Other toxicity studies show that microplastics can cause adverse health effects at the molecular and cellular level in adult *Mytilus*, and energy may be diverted from growth and reproduction to compensate. These results highlight the importance of conducting longer experiments on the impacts of microplastics on marine life.

### Southern Resident Killer Whales' Food Supply Declines

With less Chinook salmon around, the endangered population of Southern Resident killer whales off the coasts of Washington and British Columbia is spending far less time in that region, a new study by Oregon State University's Marine

Mammal Institute shows. The Salish Sea around the San Juan Islands has traditionally been a hotspot for the whales. They would spend the summer months feeding on Chinook salmon, much of which belonged to the Fraser River stock that passes through the islands on its way to spawning grounds upriver.

But 17 years of whale sighting data show that as the Fraser River Chinook salmon population

dropped, the time spent by the Southern Residents around the San Juan Islands also declined: by more than 75 percent. The findings were published in *Marine Mammal Science*. This new study shows that as the whales' primary summer feeding grounds are becoming less reliable and productive, they are having to search elsewhere for prey, raising further concerns about the health of the population. **ST**

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# SEA TECH e-NEWS

The thumbnail image shows the front page of the Sea Tech e-News newsletter. It features several news headlines and small images. Headlines include: "Oyster Aquaculture Could Improve Potomac River Estuary Quality," "Navy's Laser Weapon Ready For Summer Deployment," "Ferry Sinks Off Coast of South Korea," "Pay Increase for Sailors Soon to Come," "US Senate Reviews DOD Budget Request," "US Technology Helps in Search for Flight 370," and "2014 Sea Technology Buyers Guide Now Available". Each headline has a brief summary and a "Read more" link.

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.

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## Sediment Plume Monitoring



The ROV-mounted Niskin Array enables turbidity and water quality monitoring to aid with the accurate modeling of sediment plumes and their wider impact for better informed management decisions and regulations. The modular, stackable arrays can create a larger network if required and are rated to 6,000 m. OSIL.

## Combat Submarine

Neyk N3 is designed to carry out missions in any areas of the world where threats might occur. The submarine is ideal for the initial disabling of key targets such as radar stations, missile installations and command posts. It is ideally suited to protect long coastlines from submarine and ship attacks. By stationing a line of subs along the coastline in rocky areas, with a small amount of support in manpower, fuel and armaments, the Neyk can eliminate targets unnoticed. Ocean Submarine.

## Offshore ROV

SRV-8X Optimus, a larger and more powerful version of the SRV-8, offers more sensors for deeper underwater missions. The ROV is battery operated and rated to 500 m. It is ideal for search and rescue, civil inspection, military defense, and offshore drilling. Oceanbotics Inc.

## DC Power Supply

Comprising three models, the 9240 Series provides up to 200 W of clean output power in a compact 2U half-rack form factor. Multi-range operation provides the maximum power

at any volt/amp combination within the rated voltage and current limits (up to 60 V or 10 A). B&K Precision Corp.

## Waterborne Fish Feeder

FlowFeeder gently delivers feed to fish at depth, minimizing pellet damage and loss that's common with air-blown feeding systems. It can deliver feed to multiple pens from a single, centralized point and reduce energy costs by up to 50 percent. Feeding can continue even during heavy waves, strong currents or surface threats, such as harmful algal blooms or sea lice. Innovasea Systems Inc.

## Bright Monitor



Designed to operate in direct, bright sunlight or in other high ambient light conditions, the 17-in. SRM-HTRWP-17C is a sunlight-readable, water-resistant display. The resistive touchscreen features 1,500 nits of brightness. The stainless steel enclosure ensures that the monitor will withstand shock, vibration and rugged environments. Operating temperatures range from -22° to 185° F. TRU-Vu Monitors Inc.

## Rugged Mission-Critical Display

GVDU3000-902 is designed to operate in harsh environments and features an IP68 rating and MIL-STD-810, MIL-STD-461, and MIL-STD-1275 environmental qualifications. The 12-in. display supports projected capacitive (PCAP) multi-point touchscreen technology and features standard MIL-C-38999

connectors for power, video, and other interfaces. Curtiss-Wright Corp.

### ADCP with Edge Processing

The new Origin ADCP family comprises the Origin 600 and Origin 65. Origin 600 has a five-beam configuration with a central vertical beam. Paired with a maximum sampling frequency of 4 Hz on all beams, it's suitable for waves and turbulence applications, as well as mean currents. Origin 65 has an integrated modem that enables remote actions, and the PIES functionality delivers high-precision time-of-flight and average in-situ sound velocity data. Sonardyne International Ltd.

### Vision System



Discovery Vision Systems come in two versions: the Discovery Camera and the Discovery Stereo. The camera provides small ROV platforms with a compact imaging and lighting payload that streams 4K low-latency piloting video and records crisp still images for direct 3D modeling. The stereo, rated to 4,000-m depth, maintains a wide

field of view (75°x75°) and low latency for the piloting video stream, while onboard computing instantaneously calculates 3D depth maps for measurements and coverage monitoring. Voyis Imaging Inc.

### Sonar Software Update

SonaSoft 4.0 adds the display of local history mapping (LHM) to the 3D viewer; an auto zoom mode that lets the user focus on the 3D range of the system in the 3D viewer; and other UI updates and improvements. This release brings a host of internal and tooling updates for a more robust system. FarSounder Inc.

### Digital Workflows

Seamless integration between QPS software and the TrueOcean Marine Data Platform (MDP) accelerates data exchange by enabling direct upload of QPS proprietary data to the MDP without data conversion and including valuable metadata from the QPS format. Data can be viewed directly in the platform and extracted into other QPS products for additional analysis. Unique capabilities include geospatial searching using a map-based interface. QPS and TrueOcean GmbH.

### Remotely Operated Towed Vehicle

ViperFish is an ROTV sensor platform tailored for USVs. With its compact, streamlined design and

precise 3D control, ViperFish can safely survey narrow, hard-to-reach areas, with stable sensors close to the seabed for optimal data collection. It can be integrated with EIVA's software toolbox, NaviSuite, in order to leverage autopilot and survey automation capabilities, for example, real-time data processing. EIVA a/s.

### Electromagnetic Modem

RadiEM can transmit data through the water-air boundary, water column, seabed and subsea structures, as well as connect digital devices in networks below the water, with those networks on land and in the air. EM signals sustain integrity where sound and light scatter, and because EM fields are silent and invisible, they are more secure and safer for the marine environment. CSignum Ltd.

### Liquid-Cooled System Modules

The iC7 series delivers precise motor control and modular control capacity. Each iC7 drive is equipped with hardware-based protection against unauthorized access, with a built-in crypto chip on the control unit for end-to-end encrypted data transfer. It uses a microSD card to copy settings, log data, download software and activate additional features, all protected by the crypto chip ensuring end-to-end encrypted data transfer. Danfoss. ST

An advertisement for HYPACK. The top half features a photograph of a boat on the water. Overlaid text reads "Your Sensors. Our Software. Survey The World With HYPACK!". Below this, a block of text says: "HYPACK gives you a clear view above and beneath the surface. We provide software for all of your hydrographic and dredging needs." At the bottom, there are three product names: "HYPACK® | HYSWEEP® | DREDGEPACK®". To the left is the HYPACK logo, which includes a stylized fish icon inside a circle. To the right is a circular inset showing a 3D color-coded seabed map with various bathymetric features.



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## Electric Ferry for Lisbon

The first of 10 new, all-electric ferries to usher in a new age of emission-free commuter services along Lisbon's Tagus River is the latest example of green transformation in Portugal's capital city. The vessel, with an integrated power, automation, energy storage and propulsion solution from ABB, has been delivered to the ferry operator Transtejo by the Astilleros Gondán shipyard. Replacing a fleet of older, fossil fuel-burning ferries, the 40-m, 540-passenger vessels will also improve passenger comfort and reduce operational and maintenance costs.

With power distribution managed by ABB Onboard DC Grid, ensuring that output of each ship's 1,860-kWh battery pack is safe, reliable and optimized, ABB estimates the new ferries will cut about 6,500 tons in CO<sub>2</sub> emissions every year; the equivalent of the emissions from 1,400 passenger cars.

ABB is also providing the control and rectifier systems for shore power and an advanced communications system that identifies the vessel arriving, its charging status and the power required, enabling the ferries to recharge in 5 to 10 min.

## Adapting Self-Driving From Cars to Boats

Avikus, HD Hyundai's autonomous navigation in-house startup, will adapt the automotive self-driving platform from Hyundai AutoEver, a subsidiary company of Hyundai Motor Group, to its self-boating platform as part of a collaboration contract between Hyundai AutoEver and Avikus.

The two companies will work together to apply Hyundai AutoEver's vehicle software platform, mobilgene, to NeuBoat, an autonomous operation solution for leisure boats developed by Avikus. NeuBoat provides steering and docking capabilities far beyond monitoring and alerts, corresponding to the user's selected level of navigation assistance. Mass production is tar-

geted for 2026. Hyundai AutoEver's mobilgene is a software platform that was developed based on the global development standard AUTOSAR and has been applied to more than 200 types of controllers mass produced by the automobile industry. Hyundai AutoEver will apply it to autonomous ship operation and use it to provide key solutions for future mobility in various fields, such as robotics, advanced air mobility and defense.

## Shore Power System Converters for Port of Brest

At the busy port of Brest in France, the Brest ESID (the Defense Infrastructure Service Establishment) has installed a unique shore power system equipped with GE Power Conversion's converters. It is now up and running, delivering critical electric power to ships in port. This equipment helps to reduce the port's carbon and noise emissions.

Shore power supply tests, conducted in partnership with Ceglec Portes de Bretagne, a company in the VINCI Energies group, have been successfully completed as part of the installation and commissioning process.

With its dynamic power management capability, GE Power Conversion's system is particularly adaptive. The conversion systems can be reconfigured automatically, according to the needs of different ships berthed in port, without interruption to electrical power supply. For example, if a dock needs to draw more power than its allocated converter's capacity, another converter automatically connects to ensure continuity of service.

## Australia Subsea Robotics Hub

Advanced Navigation, an innovator in AI for robotic and navigation technologies, has opened what it bills as the largest subsea robotics facility in Australia, located in Balcatta. The manufacturing and R&D facility will produce revolutionary underwater technologies, including the autonomous underwater

robot, Hydrus. The Hydrus design synthesizes numerous cutting-edge navigational, sonar, propulsion and data capture technologies with sophisticated artificial neural network (ANN) intelligence.

Advanced Navigation's underwater navigation and robotic technologies support research, aquaculture, offshore renewable energy, transportation, surveillance, biotechnology and high tech services. With support from the University of Western Australia and Curtin University and philanthropic organization Minderoo, Advanced Navigation develops sustainable technologies to foster the growth of the blue economy.

## Uncrewed SAR Vessel

Scottish search and rescue (SAR) technology innovator Zelim has developed the *Guardian* class of fast rescue craft, controlled by Sea Machines Robotics' SM300 maritime autonomy, enabling unmanned operation of the vessel. The 8.5-m *Guardian* with SM300 remote command and control is the world's first rescue vessel capable of uncrewed operation, according to the companies. The SM300 hardware integrates with the *Guardian*'s propulsion system and sensors, enabling vessel control while streaming real-time situational awareness and casualty detection to a remote command center anywhere in the world. The SM300 software provides the ability to autonomously execute transit routes and broad area search patterns, as well as manually operate the craft with real-time teleoperation via a remote command center.

## MASS Whitepaper

With maritime autonomous surface ships (MASS) likely to become a reality by 2025, ClassNK has published a whitepaper that outlines MASS use cases, perspectives on safety requirements, gaps with existing technologies and risk assessments. It also proposes a framework for safety assessment at the design and development phase and the PDCA (plan-do-check-act) cycle at the operational phase. View it at: <https://tinyurl.com/mr2ea6fz>. **ST**

# marinerenewables

## Winds of Change

Design and engineering consultancy Houlder will participate in the Winds of Change project led by Smart Green Shipping (SGS). The project will see an SGS FastRig wing sail retrofitted to a large vessel.

The project has received funding from the U.K. Department for Transport as part of the Clean Maritime Demonstration Competition Round 3 (CMDC3), delivered in partnership with Innovate UK. The collaboration involves the University of Southampton, SGS, Humphreys Yacht Design, Houlder, Malin Group, Caley Ocean Systems, Argo Engineering, Lloyd's Register, MOL DryBulk and Drax. It runs from April 2023 to 2025.

Houlder's role will span engineering system integration and vessel performance monitoring. Houlder will initially complete a vessel survey and then study the integration feasibility of the FastRig on the ship, identifying any safety risks and ensuring that regulatory and class society technical requirements are addressed in full. It will further develop the concept design for the integration of the FastRig, then work closely with Malin Group and Caley Ocean Systems on the installation and vessel modifications required.

The Houlder team will support the sea trials and demonstration of the wing sail. Sensors will be installed to monitor the performance of the vessel and its engine, both before and after the FastRig has been installed, and when the wing sail is both stowed and active. This monitoring will enable calculation and verification of the power savings (fuel and emissions) from the FastRig, plus specific items of technical interest, such as leeway angle, heel angle and motion damping due to its presence. The data collection and analysis will also support SGS's computational simulation.

## Launch Academy Accelerator

Tugdock, a startup based in Cornwall, U.K., has been selected to join the 2023 cohort of the Na-

tional Launch Academy, run by the Offshore Renewable Energy (ORE) Catapult. Launch Academy is ORE Catapult's national flagship technology accelerator program, designed to enhance the U.K.'s offshore wind supply chain and support cost reduction by advancing innovative solutions to industry problems.

Equinor is supporting the 2023 cohort of the Launch Academy, with a focus on developing solutions to challenges facing the emerging floating offshore wind industry in the Celtic Sea. Tugdock has been selected to work with Equinor, as its patented marine buoyancy bag technology meets a significant infrastructure challenge for the floating offshore wind industry.

Floating offshore wind farms are located in deeper waters much further offshore than fixed wind turbines. This gives them access to higher winds that generate more power. The Celtic Sea has been identified as one of the best locations for floating offshore wind in Europe, with 4 GW of floating offshore wind capacity targeted by 2035 and 20 GW more anticipated by 2045.

## Hybrid Mooring Testing

Hybrid mooring lines made of chain and polyamide rope are a promising technical and economic solution for future floating wind farms. The MONAMOOR collaborative research project, led by France Energies Marines and Ifremer, will gain a better understanding of the aging mechanisms of these synthetic fibers; design and adapt modeling tools; and test monitoring instruments for the long-term behavior of this type of mooring.

A demonstrator named MONABIOP has been designed, assembled and successfully deployed for 10 months of testing on the Mistral Mediterranean test site. The 7-tonne buoy has a hybrid semi-tensioned chain-nylon mooring and tension and elongation sensors. It represents, on a reduced scale, the average dynamic forces generated

by a floating wind turbine. Another experiment is being conducted in parallel to study the colonization kinetics of polyamide lines by living organisms (algae, mollusks, etc.) and the influence of elongation on this phenomenon.

## Geo-Survey for Floating Wind

TerraSond and Benthic, geo-services brands in Acteon's Data and Robotics division, have been awarded a combined geophysical and geotechnical survey work scope by the BlueFloat Energy and Renantis partnership for the Bellrock and Broadshore wind farms northeast of Aberdeen, Scotland. When operational, the Bellrock and Broadshore wind farms will have capacities of 1,200 and 900 MW, respectively.

## Crowley Opens Wind Services

Crowley has established a new wind services office in Eureka, California, as part of its actions to develop an offshore wind terminal at the Port of Humboldt Bay. Services at the Humboldt Bay Offshore Wind Heavy Lift Marine Terminal will support tenants in the manufacturing, installation and operation of offshore wind floating platforms, and the use of large heavy cargo vessels, as well as provide crewing and marshalling services.

## Remote ROV Inspection For Offshore Wind

Fugro has conducted the world's first fully remote inspection of offshore wind farm assets, using its Blue Essence USV with Blue Volta, an electrical ROV. The inspection at the Aberdeen offshore wind farm in the North Sea (the European Offshore Wind Deployment Centre) was jointly funded by Vattenfall and ORE Catapult.

The eROV was remotely launched and recovered from Fugro's remote operations center in Aberdeen to inspect the structure of the wind turbines to assess their stability and safety. A seabed map was also created with data from a deep-water multibeam echosounder on the hull of the vessel. Real-time data enabled Vattenfall to make quick decisions on asset maintenance. **ST**

# contracts

**ABB, Helsinki, Finland**, has secured a contract with a Finnish shipbuilder to supply an integrated power and propulsion package comprising two Azipod propulsion units and the Onboard DC Grid power system for two new advanced multipurpose patrol vessels of the Finnish Border Guard. Meyer Turku.

**Stolt Tankers, Rotterdam, Netherlands**, has signed a two-year agreement to apply GIT's XGIT-PROP graphene-based marine coating to the propellers of 25 ships. XGIT-PROP is an eco-friendly product that reduces marine growth and improves propulsion efficiency while ensuring no harmful toxins and biocides are released into the ocean. Graphite Innovations & Technology.

**DNV, Høvik, Norway**, will support setting science-based targets for net-zero goals within the framework of the Egypt Vision 2030 national plan to reach the country's UN Sustainable Development Goals. Egyptian General Petroleum Corp.

**BMT, London, U.K.**, and Singapore's homegrown shipbuilder Penguin Shipyard International will design and build the next generation of fire and rescue boats called "MFV-R." Singapore Civil Defence Force.

**Framo AS, Bergen, Norway**, will supply an FPSO contractor with its Submerged Turbine solution for regenerating energy from the waste cooling water flowing from offshore installations. Yinson Production.

**RTE (Réseau de Transport d'Électricité), Paris, France**, has awarded a contract for geotechnical investigation for future offshore substations (OSS) at two floating wind farm sites in the Gulf of Lion in the Mediterranean Sea. Seabed conditions will inform reliable and efficient OSS design and help derisk development. Fugro.

**CRP Subsea, Wigan, U.K.**, has provided dynamic bend stiffeners for

the IQuay jettyless LNG transfer system to protect the flexible pipes to and from the IQuay, allowing for more operational uptime even in inclement weather. ECOConnect Energy.

**Caterpillar Marine, Houston, Texas**, has signed a memorandum of understanding to adopt solutions that enable the use of methanol in a fleet. The implementation of dual-fuel methanol engines focuses on new tugs and conversions of existing Cat-powered tugs. Svitzer. **ST**

# meetings

*Note: The coronavirus (COVID-19) pandemic could affect event dates. Check event websites for the latest updates.*

## JULY

**July 11-12—Restoring Estuarine and Coastal Habitats, Scarborough, U.K.** <https://tinyurl.com/3ju6dwv5>.

## AUGUST

**August 20-24—World Water Week, Stockholm, Sweden.** [www.worldwaterweek.org](http://www.worldwaterweek.org).

**August 28-September 1—IMAGE 2023, Houston, Texas.** <https://tinyurl.com/uc2db9k3>.

## SEPTEMBER

**September 6-8—Fleet Maintenance & Modernization Symposium, San Diego, California.** [www.navalengineers.org/Symposia/FMMS2023](http://www.navalengineers.org/Symposia/FMMS2023).

**September 11-15—London International Shipping Week, London, U.K.** <https://londoninternationalshippingweek.com>.

**September 12-13—International Antifouling Conference, Gothenburg, Sweden.** <https://anti-fouling-conference-2023.confetti.events>.

**September 18-20—FWS – South America Offshore Wind, Rio de Janeiro, Brazil.** [andrew.chadder@questfwe.com](mailto:andrew.chadder@questfwe.com) or <https://fws-southamerica.com>.

**September 18-22—National Marine Electronics Association (NMEA) Conference & Expo, Orlando, Florida.** 410-975-9425, [mreedenauer@nmea.org](mailto:mreedenauer@nmea.org) or [www.nmea.org](http://www.nmea.org).

**September 25-28—OCEANS 2023 Gulf Coast, Biloxi, Mississippi.** <https://gulfcoast23.oceansconference.org>.

## OCTOBER

**October 3-5—International Boat-Builders' Exhibition and Conference, Tampa, Florida.** [www.ibexshow.com](http://www.ibexshow.com).

**October 22-25—AAPA Annual Convention & Expo, Aurora, Colorado.** <https://aapa.getregistered.net/2023-annual-convention-and-expo>.

**October 24-27—WISTA International AGM and Conference, Montevideo, Uruguay.** <https://wistainternational.com/event/2023-wista-international-agm-conference>.

## DECEMBER

**December 4-6—Marine Renewables Canada Conference, Ottawa, Canada.** <https://marinerenewables.ca/event/marine-renewables-canada-2023-conference-december-4-6-in-ottawa>.

## 2024

## FEBRUARY

**February 26-29—Blue Innovation Symposium, Middletown, Rhode Island.** <https://blueinnovationsymposium.com>.

## NOVEMBER

**November 4-7—EURONAVAL, Paris-Nord Villepinte, France.** [www.euronaval.fr](http://www.euronaval.fr).

**November 7-10—Europort, Rotterdam, Netherlands.** [www.europot.nl](http://www.europort.nl).

For more industry meetings, visit [sea-technology.com/meetings](http://sea-technology.com/meetings). **ST**

# people

AIRMAR Technology Corp. has named **Suzanne Hawley** as the brand manager for the company's wholly owned distributor, Gemicco Marine Electronics Specialists. Hawley comes to Airmar with extensive marketing and PR experience in the marine electronics industry, including 20 years as the owner of Hawley Communications.



Crowley has named **Mark Coplen** as vice president of project management for Crowley Wind Services. He will expand Crowley Wind Services' project management capabilities to support customers in its offering of engineering, procurement and construction management for the offshore wind market. Coplen has extensive expertise in the sustainable energy sector, leading offshore wind services, operations and technology.

OceanTools Ltd. has promoted **Brian Hector** to general manager. He joined OceanTools as technical sales manager and has almost 30 years of experience in the subsea industry.

**Mike Konstantinidis** is now managing director of vessel optimization and head of ZeroNorth's Athens office. He leads a new business area to bring high-frequency data captured by onboard sensors to the ZeroNorth platform to enrich its data analysis capabilities and data models.

Steerprop has appointed **Tom Ekegren** as Arctic segment director to develop the sales and life cycle solutions of Steerprop's Arctic business area. He is a master mariner with an executive MBA and comes to Steerprop from ice-breaker owner and operator Arctia Ltd.

Forcys has appointed Captain **Christian Haugen**, U.S. Navy (retired), to lead business development efforts in the U.S. for autonomous and remotely operated platforms for a range of maritime operations, including asset protection, littoral strike, mine warfare, submarine rescue, and submarine and anti-submarine warfare.

Process Vision has appointed **Jo Shailes** as marketing director (consultant). She brings a wealth of experience and expertise to the role, having spent many years in marketing leadership positions in the energy industry.

**Claude Lorius**, winner of the International Balzan Foundation's 2001 Balzan Prize for Climatology, has passed. He was a pioneer in the development and implementation of new methods to determine historical climate conditions from ice cores. **ST**

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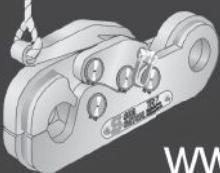
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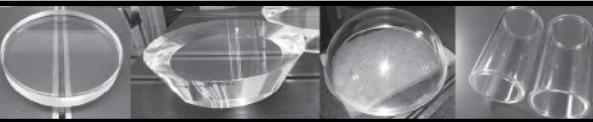
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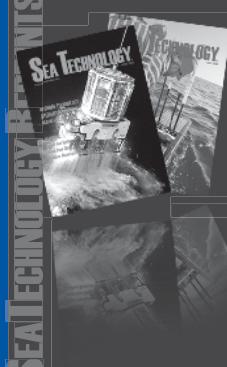
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Kramer Wimberley is a master scuba diver and trainer, an archeology diver, and a coral reef conservationist. For more than a decade, he has been a lead dive instructor and board member of Diving with a Purpose (DWP). DWP provides wreck site documentation, support for submerged heritage preservation and conservation projects, and training programs. DWP's primary focus is on slave ships across the African Diaspora.



The story of enslaved people is a story of resilience and discovery. A global economic business model that turned human beings into beasts of burden for over 240 years was integrated into every aspect of human activity (politics, education, entertainment, etc.). As a human family, we are still coming to terms with the decisions we've made regarding slavery, and part of that process is cleansing the wounds of slavery by exploring its damaging effects so that we don't repeat its mistakes.

Diving with a Purpose (DWP) was born when Kenneth Stewart, a retired copy repairman for Kodak and IBM, and Brenda Lanzendorf, who was the sole archaeologist at Biscayne National Park in Florida, set the goal of exposing recreational scuba divers to an uncomfortable part of our history by studying the remains of slave-bearing ships.

DWP's first project was the search for the wreck of the pirated slave ship *Guerrero* in the Florida Keys, which ran aground in 1827 carrying 561 enslaved Africans, 41 of whom died while the ship was being pursued by the British naval vessel *Nimble*. Salvagers tried to save both ships, but the pirates commandeered the salvagers' ships, recaptured over 300 of the rescued enslaved, and fled to Cuba.

By documenting the ship, DWP was developed to train recreational

divers as citizen scientists and maritime archaeology wreck site survey divers. Lanzendorf trained the first group of divers and helped create the train-the-trainer program.

Connecting people to the story of the *Guerrero* is healing to me personally as an African-American because knowing who you are and where you come from is empowering, informative and life affirming. Not knowing where I come from had disconnected me from an essential part of myself, and working for DWP has helped me and others to reclaim our past.

In addition, DWP focuses on conservation to improve the future of the ocean environment. With the Florida Keys National Marine Sanctuary and its Maritime Heritage Coordinator Brenda Altmeier, DWP has developed the Collective Approach to Restoring our EcoSystem (CARES) program. CARES monitors the coral ecosystem by teaching recreational scuba divers to identify key indicator fish and invertebrate and substrate species representative of a healthy coral reef.

Altmeier initiated the idea of conducting a benthic characterization of the reefs around the wrecks of slave ships. There is value in assessing the impact of a wrecking event on the marine environment, including whether the wreck has permanently altered the environment. Conducting periodic coral ecosystem surveys enables us to create time-lapse series to assess the progress or decline of the marine environment and the state of historically significant shipwrecks for the purpose of conservation.

Technology aids our data collection and analysis. Providing a visual representation of data enables non-divers to see 3D renderings of artifacts and marine organisms. With the use of technology, science can engage passively with historic remnants and the reef with minimal impact on the environment. Technol-

ogy enables investigators to be less destructive in the process of discovery because artifacts don't have to be removed from the ocean for examination (removal affects provenance and can be costly in preservation subsequent to removal).

In addition to reef monitoring, DWP volunteers support the mission of out-planting corals onto the reef and conducting surveys of the area to look for the presence or absence of key indicator species to determine the overall health of the reef. We teach participants coral, fish and invertebrate biology as part of this process, as well as the science of data collection and community outreach presentation skills. Participants also learn about climate change, ocean acidification, anthropogenic factors affecting the reef, invasive species, and coral diseases and their impact, most notably Stony Coral Tissue Loss Disease.

With the aid of underwater photogrammetry technology, we can collect data on the health of the reef and catalog it using photo mosaics. Photogrammetry enables us to gather detailed images of the substrate, underwater topography and coral species. Researchers can then identify changes related to the spread of diseases, as well as events, such as shipwrecks, that damage the coral reef, or violent storms that can alter the underwater topography.

The ocean produces at least half of our planet's oxygen, and it influences weather and climate and absorbs carbon dioxide. Coral reefs exist in less than 1 percent of the ocean, but they protect more than 90,000 mi. of coastline from storm energy; act as nurseries for over 6,000 fish and invertebrate species; and aid in the development of cutting-edge scientific and medical research.

Together, we can care for our ocean resources in order to benefit the future while connecting to our past. **ST**

# june advertiser index

Airmar Technology Corporation .....	36
<b>www.airmar.com</b>	
Bartington Instruments Ltd. ....	5
<b>www.bartington.com</b>	
Blueprint Subsea.....	17
<b>www.blueprintsubsea.com</b>	
EvoLogics GmbH.....	47
<b>www.evologics.de</b>	
General Oceanics, Inc. ....	20
<b>www.generaloceanics.com</b>	
HYPACK - a Xylem brand .....	39
<b>www.HYPACK.com</b>	
IMAGE 2023.....	25
<b>https://www.imageevent.org/2023</b>	
Imagenex Technology Corp.....	3
<b>www.imagenex.com</b>	
Knudsen Engineering Ltd. ....	12
<b>www.knudseneng.com</b>	
MSI Transducers.....	36
<b>www.msitransducers.com</b>	
*Monterey Canyon Research Vessels, Inc. ....	43
<b>www.shanarae.com</b>	
OCEANS 2023 Gulf Coast .....	13
<b>https://www.gulfcoast23.oceansconference.org</b>	
*South Bay Wire and Cable Company, LLC .....	37
<b>www.southbaycable.com</b>	
SubCtech GmbH .....	33
<b>www.subCtech.com</b>	
R.M. Young Company .....	33
<b>www.youngusa.com</b>	

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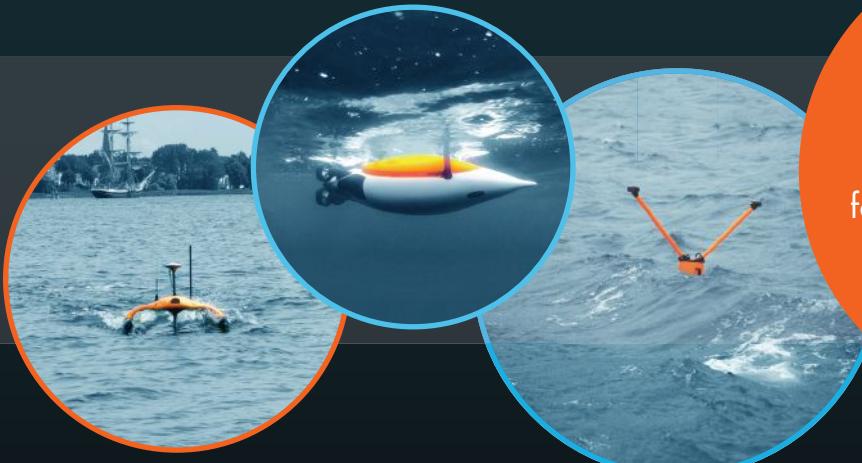
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