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May/June 2026
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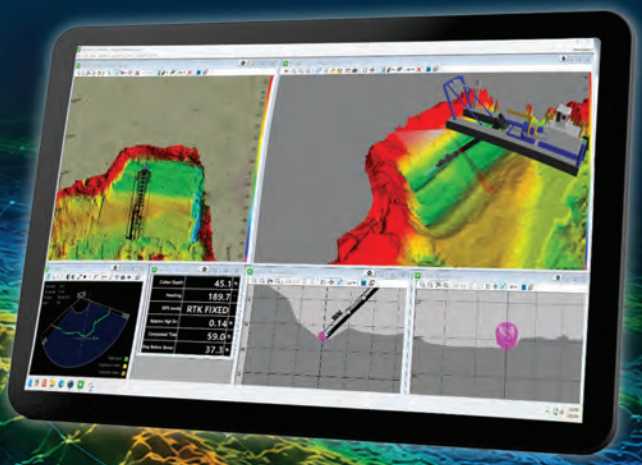

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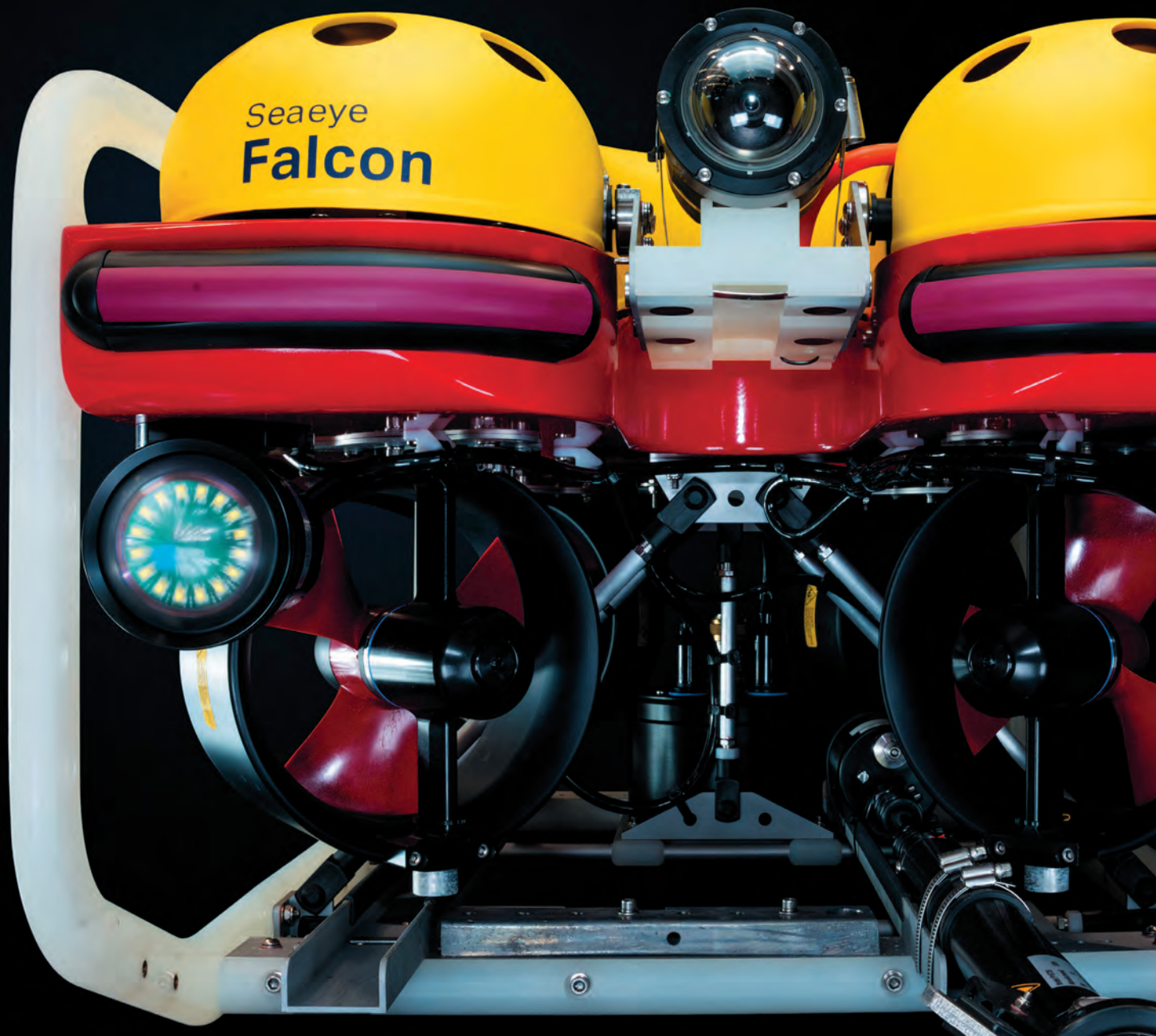

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On the Cover
Image courtesy Amundsen Science

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Editorial

Scan the QR code to access the **Marine Technology TV** YouTube page:

This edition encompasses a range of topics, from dredging and deck machinery, to university work, uncrewed vessels and ocean data. We explore challenges, trends, research and collaborations across disciplines and industries.

Starting on page 8, David Strachan's subsea defense column takes a look at the intersection of national security and data collection vessels. Lander Lab writer Kevin Hardy presents a second part to his o-ring series on page 14 (see Jan/Feb 2026 for the first part).

On page 18, Woods Hole Oceanographic Institute presents a first glimpse into the Ocean IQ Consortium, an opportunity to translate ocean data into decision-ready insight. On page 26, Wendy Laursen, our Australia-based writer, dives into university research to save the Great Barrier Reef from a fourth mass-bleaching event.

Dredging takes the spotlight on page 23, as five companies offer their insight into industry trends and solutions to meet global demand.

We then cross paths with the CCGS Amundsen, a Canadian Coast Guard icebreaker that serves as a scientific research vessel in warmer months, carrying teams of international, multidisciplinary researchers throughout the Arctic. We explore their breadth of scientific deck machinery, including ROV ASTRID, which you can learn more about in our most recent **MTR TV** interview on YouTube.

Finally, we provide several industry updates, highlighting new products, company news and vessel announcements.

In addition to encompassing a range of important themes, this issue feels special, as it marks one year since I joined ***MTR*** as managing editor. The year has been filled with new experiences, new travel, new faces, and most enjoyably, new stories. The maritime industry has always been an inviting one, and I thank you all for helping me find my place in these pages.

There's more exciting things to come, so stick around and we'll see you in July.

Celia Konowe
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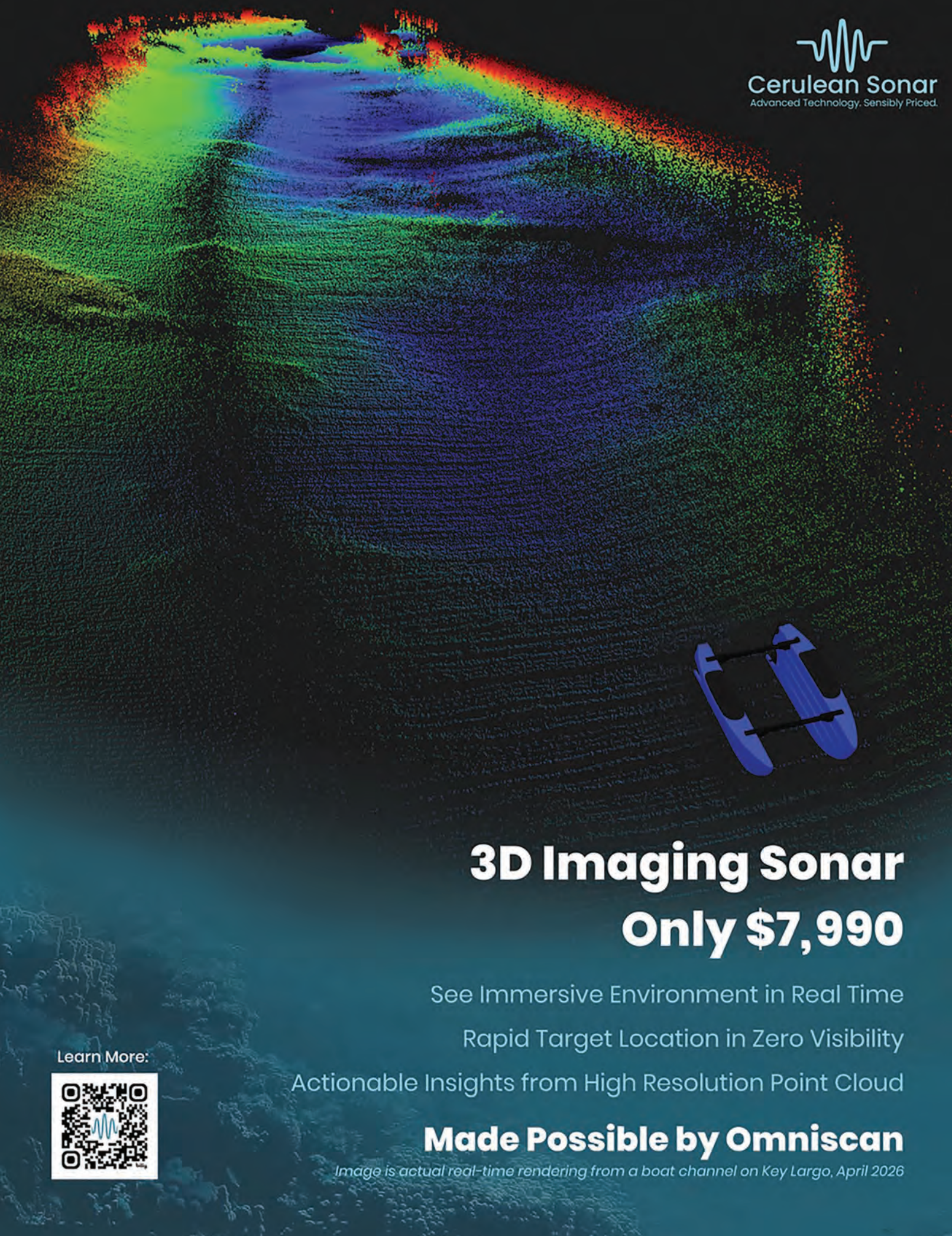

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Image is actual real-time rendering from a boat channel on Key Largo, April 2026

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U.S. Naval Oceanographic Office conducts a hydrographic survey by launching an unmanned surface vessel, supported by a Bahrain Coast Guard escort, in the U.S. Central Command area of responsibility.

Official U.S. Navy photo

A DOUBLE-SIDED TRIDENT: Dual-Use Environmental Data Underpins Subsea Defense

By David Strachan, *Strikepod Systems*

On December 15, 2016, the USNS Bowditch, a Pathfinder-class oceanographic survey vessel, was operating approximately 50 nautical miles off the coast of Subic Bay, Philippines when she was approached by a Chinese Dalang III-class rescue and salvage vessel, the ASR-510. Bobbing in the water nearby was a U.S. littoral battle space glider (LBS), a Teledyne Webb Slocum glider designed to measure a wide range of environmental data, including temperature, depth, and salinity. As the Bowditch was preparing to recover the glider, the ASR-510 launched a small boat, approached the AUV, and seized it as the stunned Bowditch crew looked on. Bridge-to-bridge calls demanding its return were ignored, and the incident quickly escalated into a diplomatic confrontation, with the Pentagon demanding the immediate return of what it described as a sovereign immune U.S. vessel. China eventually returned the glider, some five days later.

This was not the first time the Bowditch had been harassed by China's maritime forces. Fifteen years before, while conducting hydrographic survey operations in the Yellow Sea, the vessel was confronted by a People's Liberation Army-Navy (PLAN) frigate and ordered to halt its survey and immediately depart the area. (She would later return under the watchful eye of a U.S. Navy destroyer.) While both of these incidents raise legal and diplomatic questions surrounding both crewed and uncrewed vessels operating on the high seas, they also underscore how hydrographic survey and oceanographic data collection sit squarely on the front line of national security—both literally, in the conduct of everyday operations at sea, and figuratively, by providing the critical environmental intel-

ligence that informs and shapes operations in an increasingly contested underwater battlespace.

Throughout the world, seafaring nations maintain fleets of research and survey vessels equipped with a wide range of sensors designed to characterize both the water column and the seafloor. On any given day, dozens of these vessels are dotting the world's oceans, sampling their chemical composition, measuring their depth, and charting their floors and coastlines to ensure the safe navigation of vessels operating both on and below the surface. These operations provide an ongoing picture of an environment that is complex, dynamic, and operationally challenging. For scientists, the data are the building blocks of knowledge, offering insights into fragile underwater ecosystems, the effects of climate change, deep ocean circulation, and geological forces. But to those for whom the underwater domain is a battlespace, the data are key to ensuring mission success, and can mean the difference between life and death.

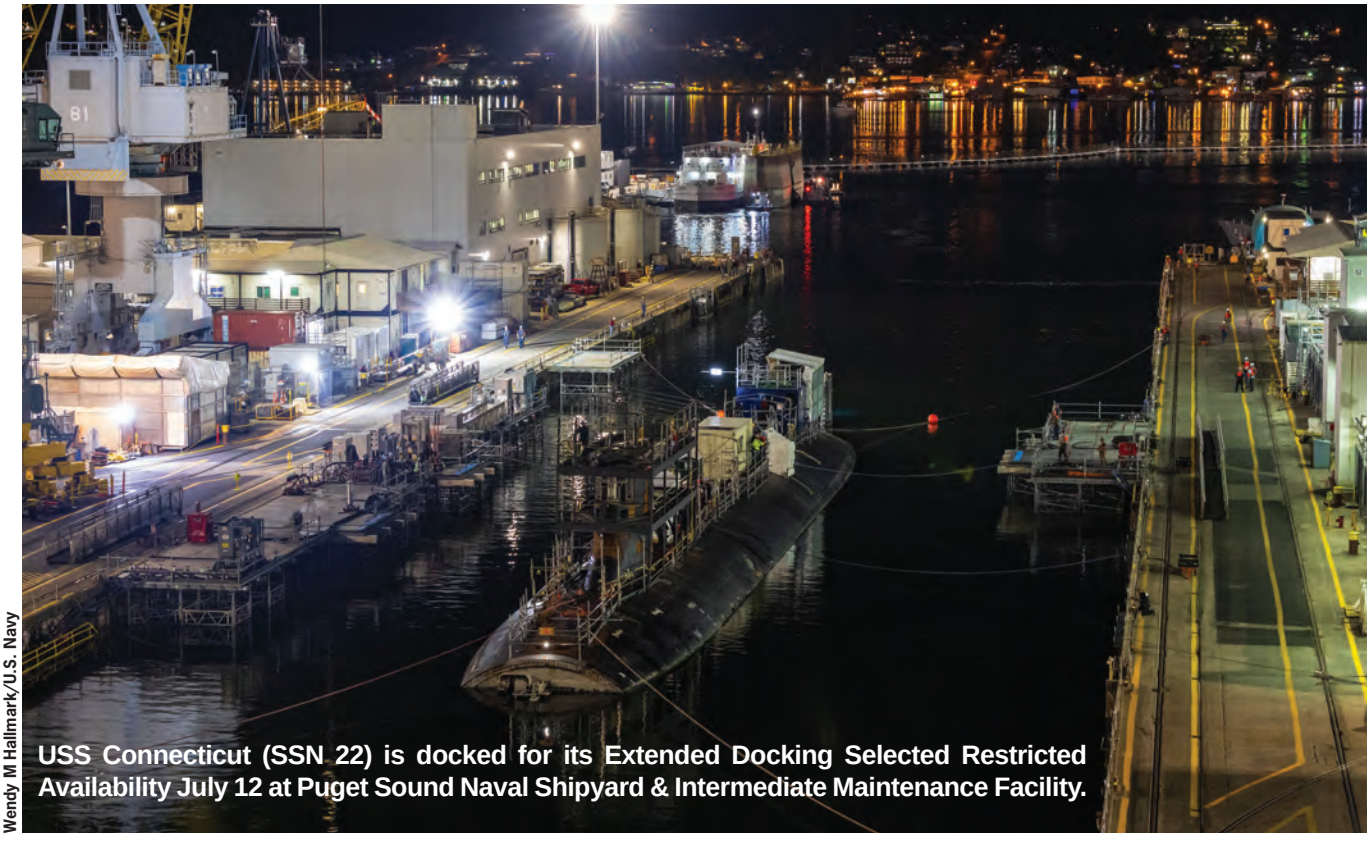
As crewed and uncrewed undersea operations proliferate and their geographic reach expands, a current, accurate picture of the operational environment is essential. Yet even as more oceanographic data is being generated than ever before, the ocean depths remain largely opaque, with entire swaths of the seabed uncharted. The consequences of incomplete environmental awareness can be severe. In 2021, the USS Connecticut, a U.S. Navy Seawolf-class nuclear-powered attack submarine, struck an uncharted seamount while transiting the South China Sea, injuring 11 crew members and causing extensive damage. (Nearly five years later, Connecticut remains in drydock under repair, with a return to service scheduled for September, 2026.) In 2005, the USS San Francisco struck an unchartered seamount off the coast of Guam, resulting in multiple injuries and one death among the crew.

Beyond navigational safety, environmental data such as bathymetry, seabed composition, currents, salinity, and temperature provide navies with the means to protect their undersea forces, or monitor those of their adversaries. Modern anti-submarine warfare (ASW) is not just a contest of humans, machines, and sensors, but of models, algorithms, and, increasingly, artificial intelligence. But no matter how sophisticated the data processing, it is only as effective as the data itself. Sound energy bends, attenuates, and scatters depending on water temperature, salinity, pressure, seabed composition, and topography. Without thorough knowledge of these characteristics, it would be extremely challenging if not impossible to classify or localize acoustic contacts, or to gain operational advantage by exploiting phenomena like temperature gradients to foil active sonar.

U.S. and Western navies rely extensively on dedicated survey ships like the Bowditch as well as fleets of autonomous systems, fixed sensing networks, or partnerships with civilian institutions to obtain critical environmental intelligence. Hydrographic survey operations, in particular, can provide both defensive awareness of vulnerabilities, as well as of-

U.S. Navy photo

The USNS Bowditch oceanographic survey ship at sea.



Wendy M Hallmark/U.S. Navy

USS Connecticut (SSN 22) is docked for its Extended Docking Selected Restricted Availability July 12 at Puget Sound Naval Shipyard & Intermediate Maintenance Facility.

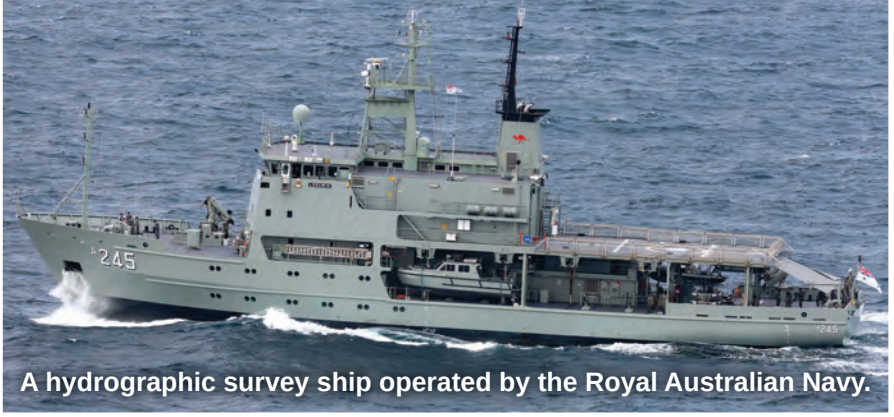
fensive options by mapping the locations of submarine telecommunications cables, pipelines, seabed sensor arrays, or the contours of strategically important chokepoints for prepositioning sensor or weapon systems

U.S. and Western adversaries are also well aware of the need for up-to-date environmental intelligence in order to successfully operate in, and exploit the opacity of, the undersea domain. Both Russia and China operate large fleets of oceanographic research vessels, ostensibly for benign research missions, but are also suspected of engaging in dual-use intelligence gathering and even sabotage. Russia's Yantar in particular is widely regarded in Western security circles as a special mission platform masquerading as a research vessel. Yantar, is attached to Russia's benignly named Main Directorate for Deep Sea Research (GUGI), a highly secretive branch of the Ministry of Defense headquartered on the Kola Bay, which is also known to operate a fleet of special-purpose submarines and deep-sea submersibles. Yantar has been observed operating near critical underwater infrastructure in the Baltic, North, and Irish Seas, and even off the southeast coast of United States near Naval Submarine Base King's Bay, home to U.S. Navy ballistic missile submarines. Equipped with a wide range of sophisticated crewed and uncrewed deep diving submersibles, Yantar is capable of mapping, imaging, as well as inspecting, deploying, or manipulating objects on the sea floor for purposes of identifying the locations of seabed sensors, submarine telecommunications cables, or crash debris from missile tests or aircraft mishaps. Yantar is closely monitored by NATO navies wherever she operates, but she is also known to operate "dark," turning off her AIS transponder

to make it more difficult to be tracked, a highly suspect activity for an oceanographic research vessel

China's expansive and growing fleet of research and survey vessels, operated under the guise of government agencies, universities, and civilian research institutes, is also capable of generating environmental intelligence of direct relevance to PLAN operations. While survey operations are largely concentrated in the South China Sea and Western Pacific, China has been extending its reach with surveys of the Indian Ocean as well as the Arctic, where the U.S. Coast Guard routinely monitors vessels operating within the U.S. Extended Continental Shelf (ECS). Chinese oceanographic vessels often deploy numerous underwater gliders and profiling floats, providing a near real-time operating picture of the underwater environment, and enabling PLAN submarines to operate covertly in the waters of neighboring states, many of whom are in increasingly acquiring their own submarine fleets to secure their maritime interests. Like Yantar, Chinese vessels also periodically go dark, or sometimes deliberately spoof their positions to conceal operations, particularly when operating in the waters surrounding Taiwan where detailed seabed imagery could inform submarine, amphibious assault, and mine warfare operations, as well as identify the locations of subsea cables that could be targeted during conflict.

As the undersea domain becomes increasingly operationalized and contested, hydrographic survey will become more tightly and critically woven into subsea defense, and oceanographic research vessels, both crewed and uncrewed, will likely find themselves increasingly on the front line of national security and geopolitical stability. In an era of gray zone operations, proliferating autonomous systems, and intensifying great-power maritime competition, oceanographic data is not only scientific information—it is environmental intelligence that is fundamental to subsea navigation, undersea warfare, seabed operations, and strategic deterrence.



A hydrographic survey ship operated by the Royal Australian Navy.

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Photos © Fugro

SCALING THE UNCREWED FLEET:

From Single Vessels to System-Level Operations

By Marco Gilissen, Global Director Marine Geophysics, Fugro

Oceanology International has long been a showcase for emerging marine technologies, but in recent years it has also become a marker of something more fundamental: how quickly those technologies are maturing.

This year, one trend stood out. The conversation is no longer centered on whether uncrewed surface vessels (USVs) can demonstrably work, but rather how they can be scaled effectively. From small pilot platforms to larger, more capable vessels, the industry is entering a phase where the technology is proven. Now, it is all about the integration, coordination, and operational models, from individual capability to system-level thinking.

From standalone vessels to connected operations

In the early stages of adoption, USVs were often deployed as standalone assets, proving their ability to collect data safely and efficiently. That phase has largely been successful.

Today, as attention turns to a wider set of use cases, the focus is moving towards how these vessels operate as part of a broader ecosystem. This includes integration with remotely operated vehicles (ROVs), offshore infrastructure, and, increasingly, other USVs operating in parallel.

As this evolution continues, we are beginning to see a transition from one operator controlling one vessel, to a model where operators oversee multiple assets simultaneously. Over time, this will naturally shift further toward supervisory roles, where human input is focused on intervention rather than direct control.

Managing complexity at sea

Scaling operations introduces a new kind of complexity, something that other industries have already faced up to. Within space technology, for example, where remote operations have been embraced for some time, missions are often dealing with extreme distances, but typically operate in relatively stable environments. The marine environment, by contrast, is highly dynamic.

Weather, traffic, subsea conditions, and operational variables all combine to create a constantly changing picture. Managing multiple uncrewed assets within this environment requires not only robust technology, but also well-designed, rigorous and verifiable operational frameworks.

Situational awareness becomes even more critical at this level. Operators must be able to understand what multiple vessels are doing, how they are interacting with their surroundings, as well as having the means to take over control at any one time.

At the same time, there is a clear need to avoid cognitive overload. Providing more data is not always the answer; providing the right data, in the right way, is what enables effective decision-making.

Rethinking the role of the operator

As operations scale, the role of engineers in the loop is fundamentally changing.

Remote operations centers (ROCs) are becoming the central hub of offshore activity, where data is gathered, monitored, interpreted, and acted upon across multiple assets. Here, consistency is essential. Clients and stakeholders expect ROCs to replicate the clarity and transparency provided by a traditional vessel bridge, regardless of how many assets are being managed. Information must be presented clearly, consistently, and in a way that supports confident decision-making.

This shift to remote operations also places greater emphasis on new skillsets. While maritime experience remains essential, today's operations are equally shaped by strong capabili-

ties in data interpretation, software and systems engineering, as well as human-machine interaction.

Designing operations, not just vessels

One of the key themes from this year's Oceanology International was that scaling USVs is not simply about building larger or more capable vessels, but the need to scale up the associated operational concepts at the same time. This includes understanding how vessels will be deployed, how they interact with other assets, and how risks are managed.

Designing for failure is particularly important at scale. When multiple vessels are operating simultaneously, the ability to safely manage faults, whether in sensors, communications or control systems, becomes even more critical.

Fail-safe mechanisms, clear intervention protocols, and the ability to bring any vessel into a safe state are essential components of scalable operations.

Standardization and consistency

As USV operations grow, the need for consistency across the industry is becoming more apparent. Today, different jurisdictions, operators, and organizations often apply varying standards and approaches. While progress is being made by industry bodies and regulators, global alignment is happening more steadily.

For operators managing multiple assets across different regions, this lack of consistency can create challenges. Standardized frameworks, protocols, and terminology will be key to enabling wider adoption and smoother integration.

Even something as simple as language matters. Referring to systems as "uncrewed" rather than "autonomous" can influence how they are perceived, particularly among stakeholders focused on safety and risk.

The next phase of maritime operations

As the evolution of remote and autonomous technologies continues, it is apparent the future of maritime operations will not be defined by a single vessel, but by how effectively fleets of uncrewed systems can work together. Success will depend on the ability to scale innovation with confidence.

LANDER LAB #19

O-RING SEAL DESIGN, PART 2:

RADIAL SEALS FOR EXTERNAL PRESSURE

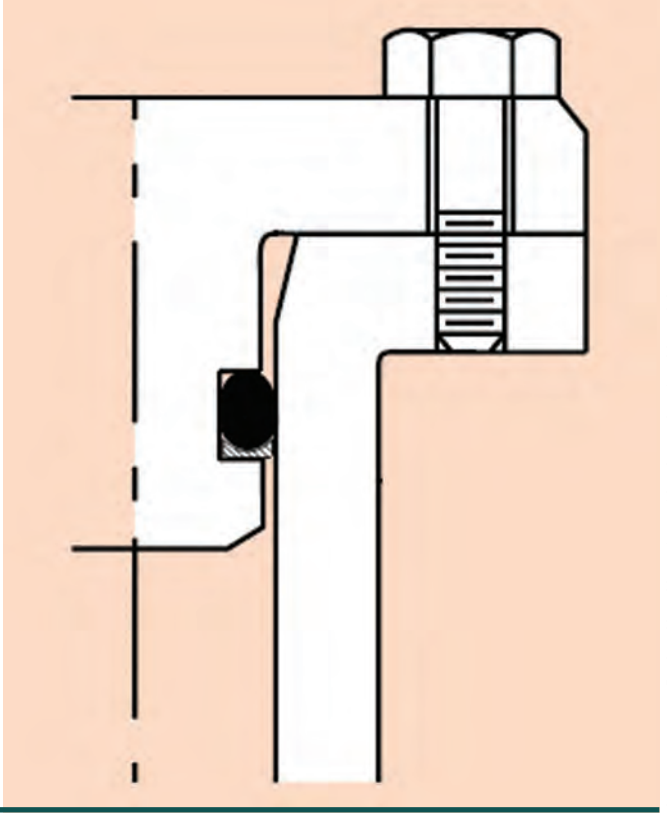


Image courtesy Parker Hannifin, adapted by the author for this article

By Kevin Hardy, MTR Columnist, President, Global Ocean Design LLC

Ocean engineers are first tasked with keeping the water on the outside. A breach in the hull can mess-up a good day at sea.

Our discussion of o-ring seal design began with a look at Face Seals in the Marine Technology Reporter, Jan/Feb 2026, pp. 20-23.

There is important background and basics in that article that relate just as much to this article, but not fully repeated here. To summarize those basics:

1. There is no better design reference for o-ring seal design than the Parker O-ring Handbook (ORD-5700). A pdf is available to download for free (See "Citations" below). It is mandatory reading for ocean engineers, and contains much more detail than possible in any article.
2. The o-ring seal creates a barrier to fluid flow. The o-ring seal assembly consists of an o-ring captured in a groove.
3. Assembly lubricants should always be used sparingly. They are used to decrease friction and allow the o-ring to respond to pressure and move inside the groove.
4. The leading cause of o-ring failure is extrusion through a gap.
5. A Radial seal requires a gap to assist with assembly that the Face seal design does not.

A Radial seal is chosen when: 1) there is limited flange area for a face seal and endcap retaining bolts, or 2) as a secondary back-up seal to a primary face seal. Occasionally, two radial seals are used. The first seal to see pressure is the primary. The second seal to see pressure, in the event of the failure of the primary, is the secondary.

O-ring stretch: If the ideal design groove is in between two o-ring sizes, you can stretch the smaller o-ring to fit the larger groove. You can make a smaller o-ring larger, but you cannot make a larger o-ring smaller. When an o-ring is stretched on installation in the groove, the cross-section is flattened. Beyond 2-3% of stretch, the groove depth must be reduced to retain the necessary squeeze. Parker recommends not stretching the o-ring over 5% as that reduces life. (Ref: Parker ORD 5700, Section 3.5, "Stretch").

The temporary ID expansion to reach the groove during assembly typically does not exceed 25-50%.

Durometer: A higher durometer o-ring resists extrusion better. A lower durometer o-rings are more tolerant of surface imperfections. Using a 70-durometer o-ring with a 90-durometer back-up ring provides the best of both.

Outside groove versus Inside groove: An o-ring groove on the OD of a plug is considered a "Male" groove. They are much easier to machine, anodize, clean, assemble, and inspect. A groove on the inside of a mating end cap is considered a "Female" groove. These are seen much less frequently.

Figure 1 (above)

An o-ring is shown in a radial groove with the endcap secured. Note the use of a back-up ring and lead-in chamfers.

Design Approach

Referring to Figure 2: The radial seal design sequence is:

1. Using the Parker o-ring Radial seal design tables (ORD 5700, Section 4.2, Design Table 4-1), and Limits of Extrusion chart (See Figure 4), determine the maximum allowable gap. Charts show either "diametral" or "radial," so be aware when applying the numbers to "bore" (diametral) or "gap" (radial = ½ diametral).

2. Determine the minimum amount of material that can be removed from the ID of the tube to produce a circular bore. Too much weakens the pressure case.

3. Subtract (2 x gap) dimension from the bore dimension. This is the Plug OD. If using aluminum that will be anodized, adjust the dimensions to allow for surface growth (See "Anodizing" below.)

Picking the gap: In designing the mating plug and bore, use the Parker spec for specifying the plug OD and the bore ID. (Ref Parker ORD 5700, Design Table 4-1.).

There are some trade-offs:

The larger the o-ring cross-section, the larger the allowable gap.

The smaller the o-ring cross-section the less compressive

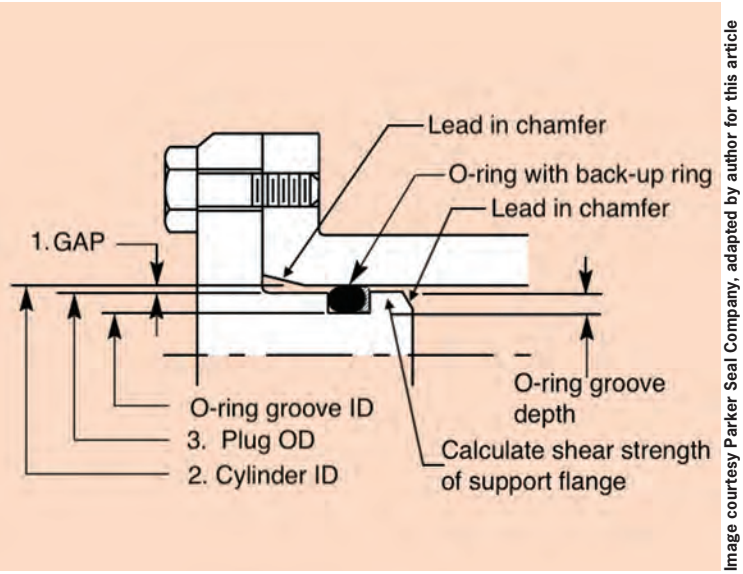
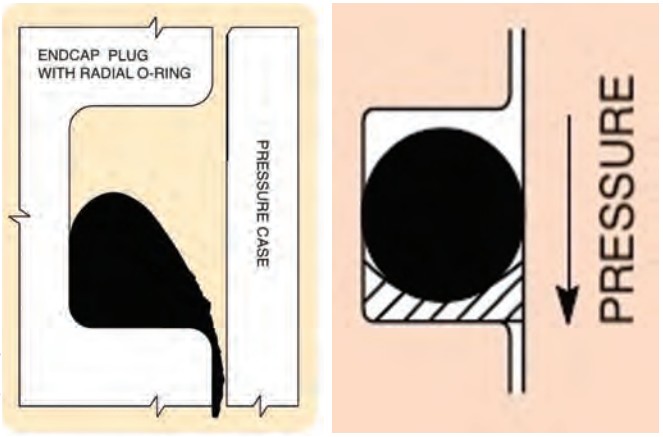


Image courtesy Parker Seal Company, adapted by author for this article

Figure 2

The Radial seal design sequence is shown: 1) determine gap, 2) determine tube ID, 3) with those two numbers, calculate plug OD.



Images courtesy of Parker Hannifin, adapted by the author for this article

Figure 3
The primary failure condition of an o-ring is extrusion into a gap (left). A back-up ring (right), made of a higher durometer material, acts as an anti-extrusion device.

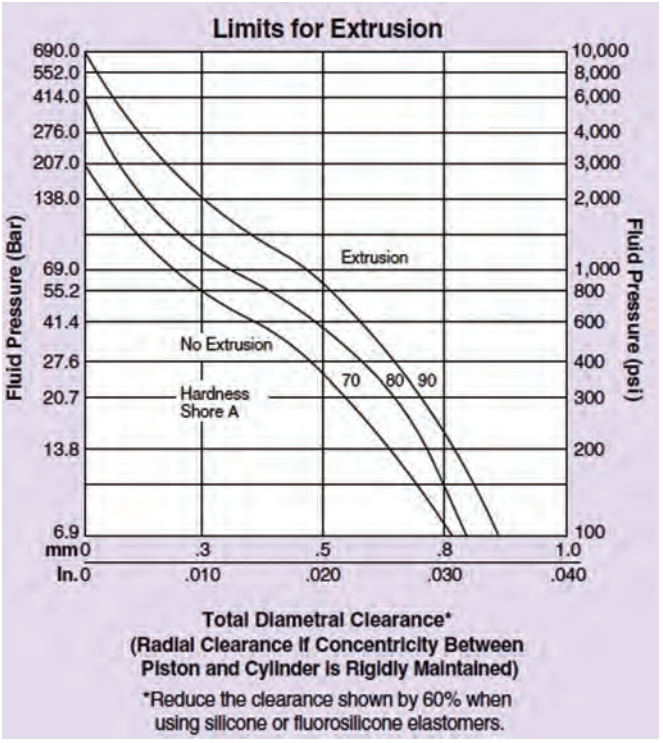


Image and text courtesy of Parker Hannifin

Figure 4
"Although based on data obtained from o-rings, the 90-durometer curve can also be a useful guide to back-up ring performance." (ORD-5700, Section 3.1.4, Figure 3.2.)

force is required, making assembly easier.

Picking a small gap requires more precise machining.

For a typical .070" cross-section o-ring, a diametral clearance of 0.002"-0.005" is allowed. That means a maximum radial gap on one side of 0.0025".

Back-up ring: I recommend always using a back-up ring with a radial o-ring. They are cheap, take up little space, and are designed to keep an o-ring from extruding. (See note 4 above.)

Place the back-up ring on the low-pressure side of the o-ring. The o-ring sees the pressure first. The back-up ring acts like a catcher's mitt, a backstop to the o-ring.

I prefer to use the Parker Parbak 90-durometer Buna-N back-up rings in the event I need to stretch the o-ring to fit a slightly larger groove. I also like that they are a single continuous part. The skive cut Teflon back-up rings have no ability to stretch, and leave an undesirable gap between the ends if the centerline distance is oversize.

A single back-up ring is sufficient when pressure is applied from one side, generally the case for submerged instrumentation. If pressure is imposed alternately on both sides of an o-ring, such as in a pressure compensated system, use of two back-up rings, one on each side of the o-ring, is indicated. (Ref: Parker ORD-5700, Section 6)

Parbak part numbers begin with an "8-", then the three digit dash number of the o-ring. For example, a 2-018 o-ring will use an 8-018 Parbak back-up ring. Pretty sane.

Use the Parker o-ring Limits for Extrusion curves (ORD-5700, Section 3.1.4, Figure 3.2.) to confirm the usefulness of back-up rings. (See Figure 4.) In low pressure seals, the curves will indicate wider permissible clearances than those in the basic radial seal design charts. In high pressure applications, the curves will indicate whether adding a Parbak will permit the use of standard catalog groove dimensions or better. The dimensions in the chart refer to "radial clearances," so double that for "diametral clearances."

It is always preferential to build a prototype for pressure testing to confirm all aspects of the design. One of my engineering mentors, Dr. Frank Snodgrass, passed along sage wisdom, like "Nature always sides with the hidden flaw."

Surface Finish: As a general guideline, surface roughness values on the sealing surfaces should not exceed 32 rms. (See Figure 5.) It is also good practice to machine surfaces by turning a part in a lathe or a spot face tool that produces a circular pattern that follows the direction of the groove. That spec is often shown on the engineering drawing as a circle-C. A part made with an end mill or router can produce micro-grooves that cut across the o-ring, which can be problematic as they undercut the o-ring across the width. Such a finish needs to be inspected closely.

Anodizing: Anodizing aluminum is a ceramic coating made by oxidizing the surface material. It builds up the surface layer by ½ the specified thickness. I generally call out

0.002” thickness, where 0.001” is into the base material, and 0.001” grows outward. This changes the dimensions of the finished part. Allowing for this change is very important when the diametral gaps for radial seals are so tight. ODs get bigger by 0.002,” ID’s get smaller by 0.002”, groove depths remain the same as the bottom and top grow outward in the same direction, grooves get narrower, while some dimensions, like tube OD and length get larger, but don’t matter. Adjust relevant part dimensions on the print before you pass it to the machinist.

Lead-in chamfers: A chamfered lead-in to the bore of 10-20 degrees to compress the o-ring will simplify assembly. The OD of the chamfer is slightly larger than the OD of the o-ring. Break the corners of the chamfer to remove the sharp edges that may cause unintended damage to the o-ring. I also place a chamfer on the leading edge of the piston to help align and center the plug in the bore during assembly. Break the sharp corners as well to remove any sharp edge that might damage the bore sealing surfaces. It’ll also provide a better anodize finish.

Care in assembly: Treat open o-ring seals with the same care as an open wound. Cleanliness and careful handling of the seals and sealing surfaces is vital.

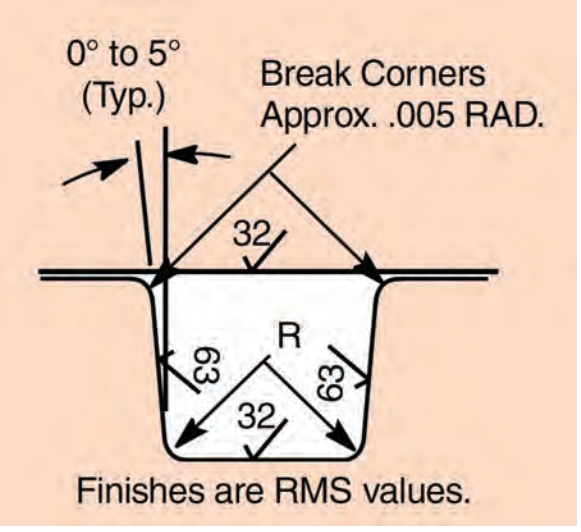


Image courtesy of Parker Hannifin, adapted by the author for this article

Figure 5
Recommended surface finishes of the o-ring groove are described. Primary sealing surfaces requiring the smoother finishes are top and bottom, as shown here. Front and back of the groove can be rougher. The groove draft angle of 0-5° is often left to the machinist. My shop typically uses 0°.

Additional notes:

1. Parker’s Application Engineering Department personnel are available to review your project, including temperatures, pressures, groove (gland) design, bolt torque, surface finish, etc. They will offer alternate design ideas if that’s helpful. The Parker O-Ring & Engineered Seals Division is located in Lexington, KY, USA, Phone: 1-(859) 269-2351, Fax: 1-(859) 335-5128, **www.parkerorings.com**.
2. Use of DeepSea Power & Light’s free software, “Under Pressure,” will assist the engineer in determining optimal pressure case and end cap dimensions. It’s very helpful for “what if” variations. The program may be downloaded at no cost at **https://www.deepsea.com/under-pressure-design-software**.

Acknowledgements

The author acknowledges Scripps’ machinist Mert Ingraham, who first shared with me the 1960’s o-ring design guidelines developed at a younger Scripps. I still have those noted in my copy of the ORD-5700. When tight tolerances were required, we’d call out “a Mert fit.”

Citations

Parker Hannifin Corp., ORD-5700, 50th Anniversary Edition, 2021 **https://www.parker.com/content/dam/Parker-com/Literature/O-Ring-Division-Literature/ORD-5700.pdf**

Flitney, Robert, Seals and Sealing Handbook, Sixth Edition, Elsevier, 2014

“Lander Lab” is a hands-on column of Ocean Lander technologies and strategies, a unique class of unmanned undersea vehicles, and the people who make them. It is meant to serve the global ocean lander community in the manner of Make Magazine and other DIY communities.

Comments on this article, or suggestions for other stories of interest are welcome. Ocean lander groups are encouraged to write in about their work. Please feel free to contact Kevin Hardy **khardy@marinelink.com**.

Thanks for reading.

OCEAN CONSORTIUM

FROM UNCERTAINTY TO ADVANTAGE: WHOI Launches New Initiatives for Industry Partners

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By Leslie-Ann McGee, *Chief Innovation Officer, Woods Hole Oceanographic Institution*

In ocean industries, uncertainty is not an abstract challenge. It is a direct driver of cost, risk, and operational failure. For maritime and subsea operators, that uncertainty has real consequences: infrastructure failure, defense challenges, operational downtime, permitting delays, safety risks, and capital exposed to conditions that are difficult to model, price, or insure.

The challenge is not a lack of ambition or investment. It is that the ocean remains difficult to observe, measure, and test under real conditions. For organizations operating at sea and in extreme environments, this creates a persistent gap between what is assumed and what is actually known. Closing that gap is inherently difficult. Beneath the ocean surface and beyond Earth's atmosphere, operators face sparse data, long feedback loops, limited access, and little margin for failure. In both domains, assumptions are costly and credibility is earned only through systems that perform under real conditions.

At Woods Hole Oceanographic Institution (WHOI), confronting this reality has defined nearly a century of work. Our experience is grounded in data collection in the most demanding environments on Earth. We are now excited to make our oceanographic knowledge more accessible to the industry—let's close one of the blue economy's most persistent gaps by translating ocean science into decision-ready insight.

WHOI OceanWorks:
A Front Door for Industry Collaboration

WHOI OceanWorks was launched in 2025 to serve as a front door for industry engagement, built on the recognition that much of the value embedded in ocean science and technology has yet to reach the point of use because the pathways to application are fragmented.

For decades, WHOI has developed advanced sensors, autonomous systems, and predictive models. Many of these innovations have remained in a difficult middle ground, too applied for academic funding, too early or complex for private capital, and challenging to integrate into operational environments.

OceanWorks addresses this gap by providing a clear and structured entry point for industry engagement. It connects operators, companies, and decision-makers directly with WHOI capabilities and ongoing research. By aligning scientific expertise with operational problems earlier, it enables faster learning, more relevant testing, and clearer insight into performance under real conditions.

This translation is already visible in practice. Autonomous systems like WHOI's REMUS vehicles, proven in defense and now widely used in commercial seabed mapping and offshore energy, replace assumptions with high-resolution data that reduces risk, shortens timelines, and lowers costs.

For companies, this creates a more direct path to actionable insight. For WHOI, it ensures that its science is applied where it has the greatest impact.

Ocean IQ: A Consortium for Real-World Validation

The Ocean IQ Consortium was created with a clear recognition: no single organization, public or private, can independently fund, test, and validate the full range of data, models, and systems required to operate confidently at sea. It brings together companies, technologists, and researchers who share a reliance on the ocean, even if their business models, timelines, and regulatory paths differ.

Unlike traditional consortia focused on product development, Ocean IQ is centered on evaluation, testing, and shared evidence. Members gain direct access to WHOI's expertise, facilities, data, and talent, with the ability to assess performance under real conditions. For industry participants, the

value lies in earlier insight into what works, what fails, and where further investment or redesign is needed.

This is particularly relevant in emerging areas where uncertainty limits progress. In marine carbon dioxide removal, for example, WHOI monitoring approaches combine sensing, models, and long-term observations to distinguish real signal from natural variability, reducing uncertainty for regulators, insurers, and investors.

Ocean IQ is grounded in ocean science and designed for organizations that need credible insight under real-world constraints. Participants join to answer high-consequence questions about risk, feasibility, and performance before committing capital, scaling systems, or advancing deployment.

Ocean Intelligence: Turning Data into Decisions

At the core of both OceanWorks and the Ocean IQ consortium is WHOI's concept of ocean intelligence. It integrates observations, physics-based models, advanced analytics, and AI to understand conditions, impacts, and uncertainty in ocean-influenced systems.

Ocean intelligence begins with science, but its purpose is practical. It makes risk understandable in complex, remote environments where physics, conditions, and operations intersect in ways that are difficult to simulate and costly to observe. With clearer insight, decision-makers can act with greater confidence in high-consequence settings. In shipping and offshore operations, for example, tools like WhaleSpotter convert sparse observations into real-time decision support, helping reduce whale strike risk while maintaining operational efficiency.

As clarity improves, capital follows. Markets respond to credible data, validated performance, and reduced uncertainty.

Coordinated shipboard operations enable WHOI teams to collect, process, and integrate oceanographic observations in real-world marine environments.

© WHOI

WHOI teams integrate ocean observations, advanced instrumentation, and data acquisition to support operational awareness and decision-making in complex marine environments.

Space-based systems help collect, transmit, and integrate ocean observations, linking remote sensing with real-time analytics and operational decision-making.

Closing the ocean investment gap depends not only on scaling solutions, but on generating the evidence required to understand and price risk. For insurers, this supports more accurate underwriting. For operators, it reduces failure rates and extends asset life. For infrastructure and logistics companies, it enables planning and permitting grounded in real operational and environmental conditions.

The ocean itself is not monetized. Decision advantage under ocean uncertainty is. Poorly informed activity increases risk and impact, while well-instrumented operations improve performance, reduce harm, and generate the data needed for resilience at scale. Across sectors, sensing, modeling, and operational insight form a common foundation for more effective decisions.

Capabilities Shaped by Extreme Conditions

WHOI's relevance to maritime, subsea, and space industries is built on experience in environments where failure carries real consequences. Its capabilities reflect decades of work under those conditions:

- Sensors engineered to withstand pressure, corrosion, and biofouling
- Autonomous and robotic platforms designed for deep, remote, GPS-denied operations
- Models that integrate physics and machine learning to forecast complex, high-impact events
- Hardware that must perform reliably the first time, even in extreme environments

These tools were not developed for markets. They were developed because ocean science required them. That origin is why they translate effectively into industrial use.

Through OceanWorks and Ocean IQ, partners gain direct access to these capabilities through targeted projects, shared research, and long-term collaboration focused on generating evidence and improving performance.

Talent Built for Uncertainty

Beyond tools and data, WHOI's value lies in its people. That value comes from an integrated workforce that brings together scientists, engineers, marine crews, advanced fabrication and machine shops, and science support teams as a single operational capability. Together, they design, build, deploy, and operate systems in real ocean conditions.

This way of working has been shaped over decades in sparse-data, high-stakes environments where there is little margin for error. Concepts move quickly into fabrication and field deployment, with performance assessed under real conditions. The result is a coordinated system that enables faster iteration, more reliable deployment, and a clearer understanding of performance where it matters most. OceanWorks and Ocean IQ provide structured ways for industry to engage directly with this capability.

An Invitation to Join

Success in the blue economy depends on solutions and decisions that hold up in real ocean conditions.

Grounded in our mission to advance independent ocean science, WHOI brings its capabilities to bear on real-world challenges by connecting research, engineering, and operations directly with industry needs.

Now is the time to engage earlier, test what matters, and shape decisions with evidence. OceanWorks provides a direct path into WHOI's capabilities. Ocean IQ offers a way to work alongside others to evaluate and validate under real conditions.

ScioSense launches UFC23 ultrasonic flow converter for high-precision, ultra-low-power smart metering

The new UFC23 sensor combines improved resolution and offset stability with ultra-low standby current, enabling high-end battery-powered water, heat, gas and leak detection meter designs across a wide range of smart metering applications.

ScioSense, a leading developer and manufacturer of semiconductor-based environmental and flow sensors, today launched the UFC23 – the 4th generation ultrasonic flow converter for measurement in water, heat and gas meters.

How can meter manufacturers improve measurement accuracy, extend battery life, and retain control of their preferred system architecture? In modern applications, flow calculation is increasingly handled by a central host microcontroller – requiring a converter that can deliver accurate measurement at very low flow rates and long battery life, two demands that are often difficult to achieve together. The UFC23 is designed for meter manufacturers that want very high measurement precision and extremely low power consumption, while keeping flow calculation on their own central microcontroller.

The UFC23 extends the ScioSense ultrasonic flow portfolio with **a pure front-end architecture** that omits the on-chip Central Processing Unit (CPU) used in previous flow converters. This gives Original Equipment Manufacturers (OEMs) the flexibility to fit the system architecture now preferred by many meter designers, while also delivering improved analogue front-end performance.

In a typical DN15 water meter setup, the UFC23 provides single-shot standard deviation of 35ps and offset stability of ±7ps with 128-sample averaging and a drift of less than 10ps over the range from 0 to 50°C. This level of precision and stability supports the signal quality needed in high-end water meter designs, including **R1000-class** measurement requirements. At the same time, the UFC23 is optimized for battery-powered systems, with standby current of typically **0.8µA** and an operating current as low as **6.6µA at an 8Hz** sample rate.

The UFC23 integrates the functions required to drive ultrasonic transducers, captures received signals, and extracts high-precision time-of-flight data. It supports both 3.3V single-ended drive for water applications and **full-bridge drive** for gas applications. A programmable gain amplifier with increased gain and bandwidth helps the UFC23 handle weak receive signals, while a programmable ultrasonic burst generator operating up to 4.4MHz and based on an external reference of up to 20MHz allows designers to tune operation to the transducer and application.

The UFC23 also includes features that help improve system-level efficiency and measurement robustness. Designers can monitor the amplitude of up to three received waves and use extended pulse-width measurement to improve first-hit detection. A **batch mode** allows the sensor to collect up to **12 measurement** bundles before waking the host controller, helping to reduce total system power consumption. The UFC23 also supports temperature measurement with external platinum sensors for heat meters and hot-water systems.

Image courtesy of ScioSense

> *"UFC23 addresses a clear requirement in the metering market for a high-precision, ultra-low-power ultrasonic flow converter that fits modern system architectures. It enables manufacturers to pair ScioSense analogue and timing performance with their chosen host microcontroller and software environment."*
>
> **Norbert Breyer, Director of Marketing and Product Management, ScioSense**

Since the UFC23 supports multiple designs, manufacturers can reuse the same sensor across different product families. Typical applications include smart water and heat meters, smart gas meters, water heaters, pump control systems, and smart faucets.

The UFC23 operates from a 2.5V to 3.6V supply, supports an operating temperature range of -40°C to 85°C, and is supplied in a QFN32 package. Samples are **available now**, and evaluation kits are available through key distributors at launch.

For more information, go to https://www.sciosense.com/ufc23/

Credit: Robert Vasiluth

PLANTING THE SEEDS OF INSPIRATION: EELGRASS RESTORATION

By JoAnne Castagna Ed.D.

When Robert Vasiluth was a child, his Uncle Gill would always encourage him to make a difference in the world while they played checkers, swam, or hiked.

"He was always interested in the stuff I was building in first grade, always believed in me and wanted me to become an innovator. Not just any innovator but one that does something good for the world that nobody has ever done before," said Vasiluth, a life-long resident of Long Island, New York.

After years of Vasiluth slacking in school, a disappointed and dying Uncle Gill asked him at a family gathering, "Well?" Vasiluth swore to him that when something comes his way he will be all in.

"He had cancer and could barely walk and breathe," said Vasiluth, who would not see his uncle again. "This strong man I had admired my whole life saw something in me and planted the seeds of inspiration."

Quite literally this is what happened. In 2015, Vasiluth created an innovative and unique method for planting eelgrass seeds (Zostera marina) in Long Island, New York's waters that's helping to revitalize the dying eelgrass population, improve the marine ecosystem, and mitigate climate change.

Long Island is a peninsula that stretches out from New York City into the Atlantic Ocean. The waters around Long Island include the Great South Bay in the south and the Long Island Sound in the north.

In the past century, these waters have lost nearly 90 percent of its eelgrass beds due to wasting disease, a marine illness, as well as pollution, dredging, and warming waters. This isn't just a local problem. It's estimated that the world has lost approximately seven percent of its eelgrass.

Restoring these eelgrass beds is critical because they provide habitat for many kinds of marine life, improve water quality by filtering out pollution, and the plant's root system stabilizes the sediment on the seafloor and as a result protects shorelines from erosion.

Eelgrass beds also play a significant role in mitigating climate change. The beds have a remarkable capacity to capture and retain carbon dioxide (CO2) from the atmosphere, the greenhouse gases that are responsible for global warming, and storing it for long periods of time. In fact, its carbon-storing abilities are up to five times more than a rainforest.

Over the years, conservationist have tried to restore these forests of the sea by scattering the eelgrass seeds into the water hoping they take root and grow. This method has worked in many places, but it requires a lot of money and hard work, which is hard to keep up with the eelgrass loss rate.

Vasiluth came up with another restoration method that's showing promise. It's called the SEAS Method that stands for Seeds of Eelgrass Attached to Shellfish. Rather than scattering seeds into the water, they are glued to baby clams that are placed in the water where they bury themselves into the

seafloor, planting the seeds.

Looking back, Vasiluth realizes that this idea may have germinated when he was a young child visiting his grandmother on Martha's Vineyard in Massachusetts.

"The best part of my childhood was going to the beach, boating and fishing. While on Martha's Vineyard, I remember slowly walking into the saltwater and spying on a large horseshoe crab. I followed it deep into the water. Eventually, I had to go under water and hold my breath. When I opened my eyes to look for the horseshoe crab, I saw eelgrass for the first time. It was an amazing experience. One that I have never forgotten."

Vasiluth became enamored with swimming under water. The following year, during one of his dives he saw an unusual green plant amongst the eelgrass and showed it to his grandmother.

"She told me these are eelgrass seeds and that you can eat them," said Vasiluth. "She peeled back the outside layer of what is called an eelgrass spath that holds the seeds. Kinda like peas in a pod."

Years later, Vasiluth would be on a boat fishing with his family on the Long Island Sound. He dived under water. "All day I looked for eelgrass and couldn't find it. I did find some other plant and showed it to my father who told me it was Rupia, also known as Widgeon Grass, sort of like a weed. I asked him if we could bring the eelgrass from the vineyard to here and he giggled and said maybe one day it will come back."

Vasiluth started to educate himself on ways to bring eelgrass back to Long Island's waters by talking with various conservation organizations and when he learned about the symbiotic relationship between clams and eelgrass he came up with the SEAS Method and today he is bringing eelgrass back to his childhood waters.

The SEAS Method artificially mimics the symbiotic relationship between clams and eelgrass. Each clam is an oasis for the eelgrass. Clams are little filtering machines that filter water and bring oxygen down into the sediments, helping the eelgrass roots to do well. In turn, eelgrass catches food that comes down to the sea floor that the clam can feed on. When the clams defecate this fertilizes the eelgrass seeds. The two help each other

Credit: Robert Vasiluth

ROBERT VASILUTH AS A CHILD WITH HIS FATHER.

Credit: Emma DeLoughry

ROBERT VASILUTH HOLDING UP A BAG OF EELGRASS SEEDS AFTER A DIVE AT FISHER'S ISLAND.

survive, which may be very good for the clam population that has also drastically declined in Long Island's waters.

To finance the SEAS Method, Vasiluth founded the non-profit SAVE Environmental that stands for Submerged Aquatic Vegetation Engineers, an organization created to promote nature-based solutions.

SAVE Environmental partners with other organizations that provide funding and facilities that include The Nature Conservancy, Cornell University, Save the Great South Bay, Connecticut College, SUNY Stony Brook University, Save the Sound, and 11th Hour Racing.

Vasiluth in cooperation with his partners follow the following seasonal routine for the SEAS Method. First, he gets permits to restore eelgrass beds in certain waters. Once he has them, he gathers volunteers to join him on scuba diving or snorkeling trips to locate reproductive eelgrass shoots.

The divers place the shoots in bags that are brought to the water's surface and placed into coolers filled with saltwater. The coolers are shipped to several marine facilities where the shoots are moved to flowing seawater tanks. In a few weeks the seeds fall from the shoots and are sorted, using screens. The gathered seeds are placed in fresh flowing sea water.

Next, about five to ten eelgrass seeds are glued to baby clams, using a safe, non-toxic and biodegradable adhesive called Cyanoacrylate, that is commonly used in aquarium tanks to glue corals to rocks. Once the seeds are glued, the shellfish are placed back into the flowing saltwater tanks and stored.

Last, the clams are placed in a boat that's equipped with a special spreader machine Vasiluth built from an old treadmill that releases the clams into the water and controls how far apart the clams are placed. "I call it my eelgrass sowing machine," said Vasiluth, who adds that it is a prototype that he plans on fine tuning. "It's funny, my father who is deceased was a machinist and I've built a most fantastic machine for growing eelgrass."

The clams bury themselves into the seafloor planting the seeds. Seeds that grow from deep in the soil develop a strong root system and are more likely to survive then seeds being scattered on top of the seafloor. The number of seeds glued on the clams are enough to produce at least one eelgrass plant.

So far, clams have been placed in several areas around Long Island including Smithtown Bay, Great South Bay, Shinnecock Bay, Barrett Beach, Fire Island, and Sterling Harbor.

Vasiluth often gets volunteers to glue the seeds, and this includes school children.

One of these schools was Sayville High School in Sayville, Long Island, New York. James Bertsch, a trustee for Sayville's Board of Education explains how the experience is beneficial for students, "Taking action to affect change is a powerful learning tool. Our students learned that the Great South Bay needs to be saved, and they learned we can all do something to help."

"Lecturing students about losing 95 percent of our clams and eelgrass due to poor water quality isn't a great way to make the learning stick. Sticking eelgrass seeds to clams makes the point stick so much better." Bertsch, who also is a director for Save the Great South Bay, believes so much in Vasiluth's method that he recently put a wetsuit and mask on to help Vasiluth collect eelgrass seeds.

Bertsch praises the success of the SEAS Method, "Two years ago, Vasiluth planted eelgrass seeds at Barrett Beach, Fire Island and the seeds took and it's thriving today."

Vasiluth has a lot planned for the SEAS Method. Presently, numerous trials of his method are being tested in waters around the country that are showing promise.

He believes his Uncle Gill would be pleased with what he is doing. Ironically, his uncle was a frogman in World War II. He would wear a scuba suit and go underwater to pull mines out of the English Channel to protect citizens. Today his nephew is doing the same to save Long Island's water and the planet.

"I'm quite sure my Uncle Gill, father, and grandmother who's also passed are all still with me every step of the way. Their teaching has navigated me till this day, but I have more to do. I'm determined to succeed in saving not only eelgrass, but most importantly, all the priceless creatures that exist within and beyond the disappearing meadows of life."

To learn more, contact Dr. JoAnne Castagna, Founder of 2 Bourkes PR, a public relations service that specializes in the writing and marketing of environmental articles. She can be reached at Joanne@2bourkespr.com or www.2bourkespr.com.

Image courtesy DSC

DIGGING DEEPER:

Challenges and Trends in the Dredging Industry

By Celia Konowe

Dredging, like all sectors of the maritime industry, is experiencing rapid evolution, accelerated by increased demand and diverse challenges. Projects for waterways, infrastructure and submerged utilities grow more complex every year, and thus dredging companies must meet industry needs while ensuring awareness of and compliance with all relevant safety standards.

The problem(s)

The obstacles facing the dredging industry are not brief, nor are they simple. They range from submerged utility strikes and infrastructure protection to workforce shortages, injury prevention, regulatory coordination and navigational safety. Overall, the common denominator is awareness—of solutions, regulations and most importantly, our surroundings underwater.

One of the biggest challenges in dredging has been the inability to see the work area below the dredge. Operators have traditionally relied on experience, machine response and indirect indicators to guide their work, said experts at DSC Dredge. Even the best technicians are often working without a clear view of what is happening below the waterline or an easy way to track performance beyond what is directly in front of them.

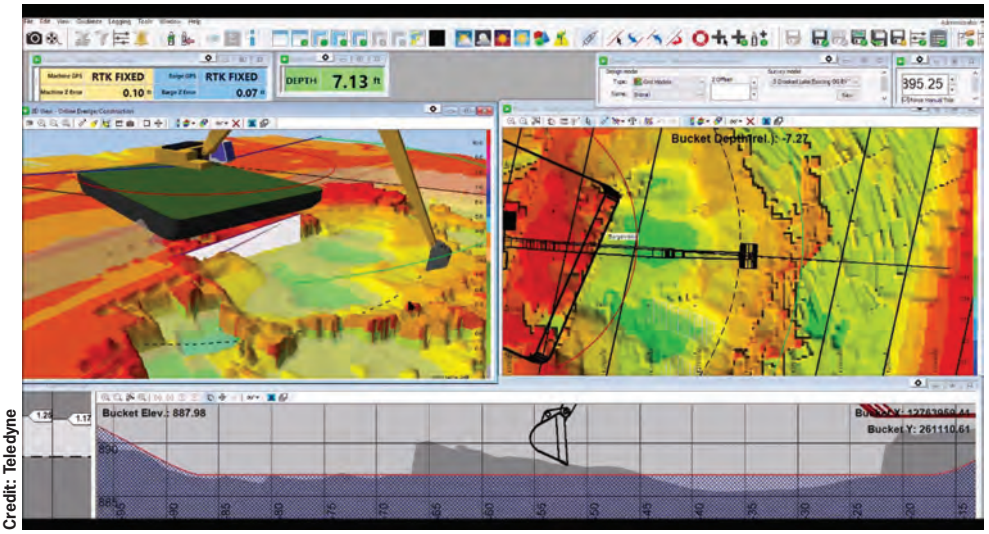
Projects are also becoming progressively more dangerous, as post-Panamax ship sizes have increased, requiring ports and harbors to deepen channels. “Maintaining ever deeper channel depths requires dredgers to dig deeper and deeper, removing overburden material, originally considered as protective to buried pipelines, power transmission lines and fiber optic cable runs,” said Lou Nash, general manager at Measurtronics. “As a result, dredge cutterheads, clamshell crane and excavator buckets are, by necessity, operating in close proximity to submerged hazards unseen (and in some cases unknown) by the machine operator.”

Incidents can be deadly and those in the water are more costly. “Awareness of the machine cutting tool’s location relative to submerged hazards or infrastructure must not get ‘lost in the noise,’” he emphasized.

In addition to more dangerous projects, operators are also being asked to improve key metrics simultaneously. “Projects are getting more complex, but there is also pressure to work even more efficiently, deliver accurate results, reduce fuel use and keep environmental impact as low as possible,” explained Natasja Verboom, sales manager for survey systems, Europe and Africa, at Teledyne Marine. “It is no longer just about completing the project; it is about getting it done in a smarter and more controlled way.”

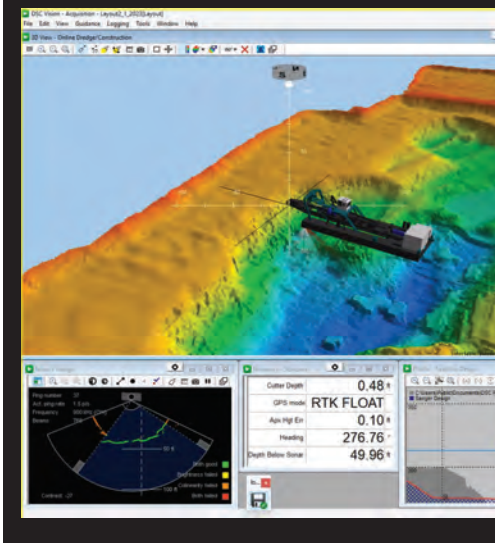
“Operators are under pressure to minimize over-dredging, reduce fuel consumption, and meet strict regulatory requirements, while still maintaining production targets,” added experts from HYPACK. “At the same time, many projects involve complex environments and require integrating data from multiple systems.”

Although technologies are available to increase situational



Credit: Teledyne

Credit: DSC Dredge



awareness while dredging, and to complete work faster and more efficiently—without jeopardizing safety—Nash feels that the industry is still behind. "It is a known fact that the construction industry has historically been a laggard in the adoption of technology in comparison to other industries," he said. "It has been my observation that marine contractors and dredgers lag the construction industry by a number of years."

The technology

Despite vast industry challenges and the feeling of being behind, numerous technologies are available, ranging from sensors to sonar to software.

Teledyne's PDS dredge guidance systems combine software with positioning and motion sensors to track the dredge and individual components in real time, explained Verboom. "PDS shows these movements against the seabed model, the design model, set limits or any objects that need to be avoided. It gives the operator a complete overview what is happening underwater."

The company also offers a range of sonars, including Teledyne RESON SeaBat multibeam echosounders and Teledyne BlueView imaging sonars, which are ideal for safe work around pipelines or other subsea objects. SeaBat provides dredge operators with seabed depth information at all points in a project, while BlueView adds another layer of visibility underwater, working like an acoustic camera that is less affected by murky water than a standard camera.

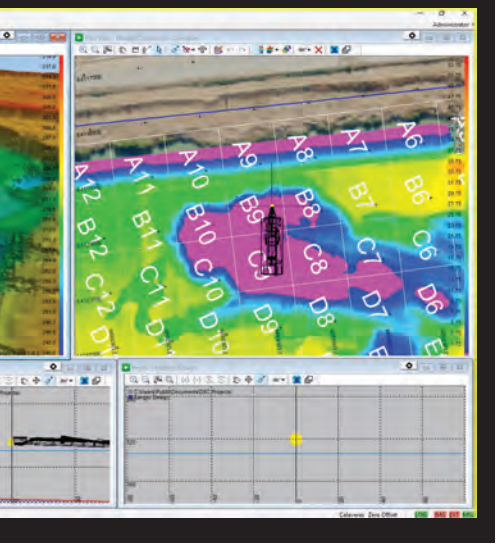
Cerulean Sonar employs similar imaging and bathymetry products, including the Omnican 3D, which combines side scan and multibeam data acquisition. "Users are provided with rapid dense data collection (3D point cloud) as well as overlayed imaging for real-time assessment and the ability to post process all within our proprietary software, SonarView," explained CEO Damian Hennessey.

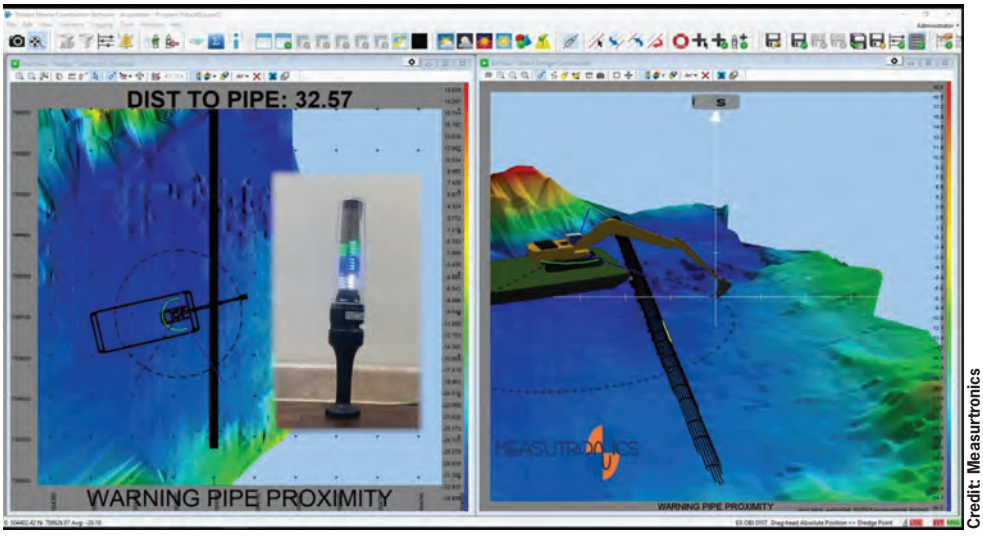
DSC Vision, according to exerts at DSC Dredge, combines sonar technology with positioning, giving operators a visual understanding of the dredging environment as they work and the ability to adjust in real time. When it comes to training, new operators can learn faster with a visual reference of the work area, rather than relying entirely on trial and error.

While DSC Vision monitors what is happening below the water, Dredge Rx focuses on the dredge itself. The latter is a remote monitoring system that provides operators, management and support teams with access to real-time dredge data, including production, position and system alarms. This level of access enables teams to stay connected to operations whether they are onboard or offsite. It also allows DSC's product support team to connect remotely to assist with troubleshooting, helping reduce the need for travel and supporting faster resolution when issues arise. Historical production data, equipment hours, alarms and system activity can all be reviewed, giving teams better visibility into performance and usage.

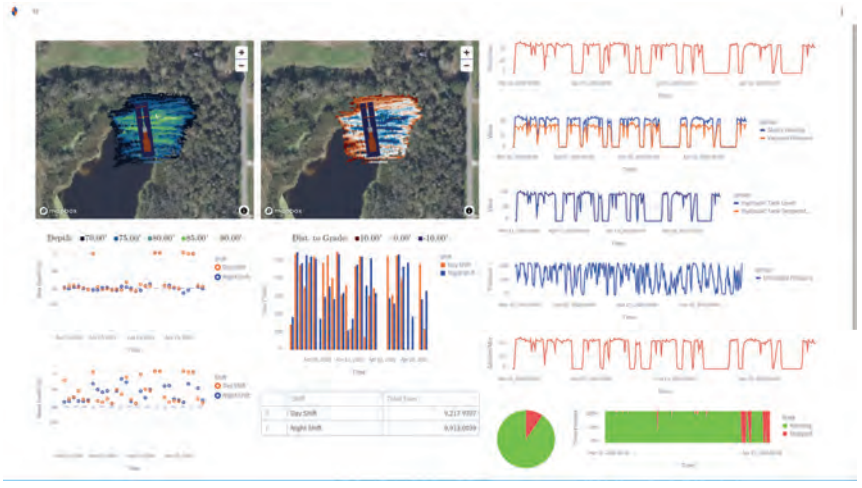
HYPACK offers DREDGEPACK, a software solution designed to support a range of dredge types, including cutter suction, crane (clamshell), hopper, and excavator dredges, explained the HYPACK team. It provides real-time positioning, dredging guidance, and production monitoring. Additionally, HYPACK LINK is a dredging intelligence software suite that is designed to bridge the gap between field operations and strategic management, by combining near real-time operational awareness with advanced analytics and reporting.

Measurtronics' Trimble Marine Construction (TMC) based guidance and positioning systems are machine manufacturer, age and application agnostic, able to accommodate any machine types or methods used in the dredging industry. When geospatial positions of submerged and buried infrastructure or hazards are known, marine positioning systems can provide





Credit: Measurtronics



Credit: Measurtronics

real-time guidance to machine technicians, allowing them to operate their digging tools with a higher degree of safety.

Receiving inputs from the TMC-based guidance systems, StackLite enhances operator awareness by means of both visual and audible alarms, Nash explained. With user-defined limits, the same indications as a traffic light (green means go, red means stop), and TMC's ability to track any number of designated offsets or points of interest, StackLite can also monitor and provide alarming information on spuds, anchors and anchor lines. Additionally, The ConnectedDredge remote dashboard system was developed with the intent of giving the same value of real-time positioning and guidance to project managers and other remote stakeholders, allowing more immediate responses to dredging inefficiencies.

Trends meet demands

Dredging solutions converge at the intersection of customer demands and shifting industry trends. "The primary demand," Hennessey explained, "is greater value from every mission, which means less time, more data and faster interpretation of that data to make critical decisions quickly."

"There is also a strong demand for flexibility and scalability, as projects vary widely in size and complexity," said the HYPACK team. "Customers expect software that can adapt across different dredge types and integrate easily with a variety of sensors and third-party systems."

Customers are also looking to reduce the number of personnel required onboard, moving towards autonomous operations—trends that are no strangers to the subsea industry. "There is also a strong push toward improving communication between the dredge, operators and management teams so that operations and potential issues can be monitored in real time," explained William Wetta, senior vice president of product development and chief technology officer at DSC Dredge.

Additionally, dredging companies see growing demands for alternative power solutions such as natural gas, LNG, and grid-powered systems and positioning technologies that are resilient to global navigation satellite system jamming and spoofing threats.

While new technologies are welcomed—and critical—to meet evolving dredging trends and customer needs, the push continues for more effective, safer solutions aligned with regulations. Yet, demands for more data at faster rates, combined with deeper and further digs, place unprecedented strain on an industry that some claim is effectively digging in the dark.

"Nothing is easier on the water," Nash emphasized, "and 'good enough' never is."

Image courtesy of Maria Byrne / University of Sydney

Coral bleaching was found to be followed by an unprecedented outbreak of black band disease, killing Goniopora corals.

CORAL REEF RESCUE UNDERWAY

Australia's Great Barrier Reef suffered during the 2014-2017 Third Global Coral Bleaching Event. It's suffering again now during the fourth, and Australian universities are leading efforts to keep it alive.

By Wendy Laursen

Researchers and rangers have deployed the first batch of aquaculture-reared young corals on to the Great Barrier Reef. It took 130 people to collect an estimated 14.6 million coral eggs during spawning to get the project started. Then in February this year, they deployed 44,608 seeding devices, each containing around 10 young corals, from 13 vessels.

Now they watch and wait.

Their aim: to help the Great Barrier Reef survive global warming in the decades ahead.

Researchers from the Australian Institute of Marine Science (AIMS) and partners have established an interlinked network of weather stations, moorings, buoys and other sensor-loaded devices to collect data on tropical marine ecosystems and assembled a team of oceanographers to coordinate efforts and analyze the information.

"The instruments we use operate in difficult environments and can get damaged. A tenacious barnacle can ruin months of data," said AIMS Oceanography and Shelf Processes Team Lead Simon Spagnol, who oversees a network of buoys and moorings as part of AIMS' work with IMOS (Integrated Marine Observing System).

"You might put down a wire as thick as your thumb but when you pull it out it might have quadrupled in diameter due to barnacles and other sea creatures becoming attached. This can mess with sensors and prevent you from collecting important data.

"There are some easy fixes, like applying zinc cream or copper tape to prevent encrustations. It is important to be in problem solving mode to ensure you can collect the best data for as long as possible from these instruments."

Weather station at Davies Reef.

Image courtesy of Marie Roman / AIMS

Other impediments to data collection include severe weather events, such as cyclones which have been known to wipe out infrastructure and sensors for long periods.

There are approximately 300 temperature loggers helping gather data on sea temperatures on Australia's reefs. They are exchanged annually or more frequently if there is a coral bleaching event. A collaborative effort across universities and government agencies also monitors conditions at key times and locations using IMOS Event Based Sampling's autonomous ocean gliders.

University of Sydney marine biologists have identified a devastating combination of coral bleaching and a rare necrotic wasting disease that wiped out large, long-lived corals on the Great Barrier Reef during the record 2024 marine heatwave.

The study, led by Professor Maria Byrne and Sydney Horizon Fellow Dr Shawna Foo, found that bleaching triggered by extreme ocean temperatures was followed by an unprecedented outbreak of black band disease that killed massive Goniopora corals, also known as flowerpot or daisy coral, at One Tree Reef on the southern Great Barrier Reef.

Tracking 112 tagged Goniopora colonies over a year, the team found that three-quarters had died by October 2024, while only one quarter showed partial recovery. Population surveys of more than 700 colonies revealed the same pattern: widespread bleaching, rapid disease progression and high mortality.

Byrne said the loss of these large, structure-forming corals will have lasting effects on reef biodiversity, coastal protection and food security. "Coral reefs support more than a billion people worldwide. What we're witnessing is a collapse in the natural resilience of these ecosystems. Ambitious global action to reduce emissions is now the only path to their survival."

Researchers from James Cook University (JCU) have found that coral bleaching on the Great Barrier Reef is influenced not only by extreme summer heat, but also by winter conditions months earlier.

"Most bleaching prediction tools focus on summer heat and assume that corals start each summer in the same condition," said JCU student Valerie Cornet, who led the study. The team analyzed in-water and aerial bleaching observations alongside sea surface temperatures across the central Great Barrier Reef from Townsville to Port Douglas, focusing on the 2016/17 bleaching seasons.

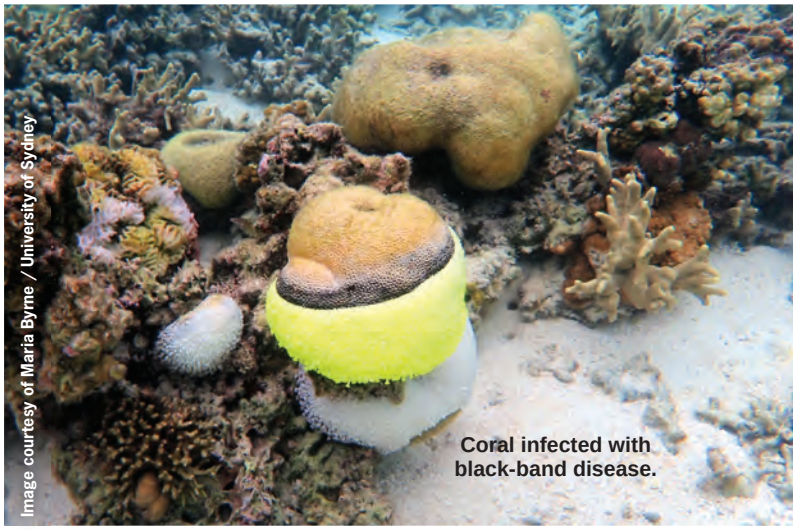


Image courtesy of Maria Byrne / University of Sydney

Coral infected with black-band disease.

"2016 and 2017 were the first consecutive years of severe bleaching," said JCU Professor Scott Heron, who supervised the study. "The scale and severity of these mass bleaching events were unprecedented, affecting vast areas of the reef. This gave us a rare opportunity to study how repeated heat stress and recovery periods interacted, including effects before summer conditions set in."

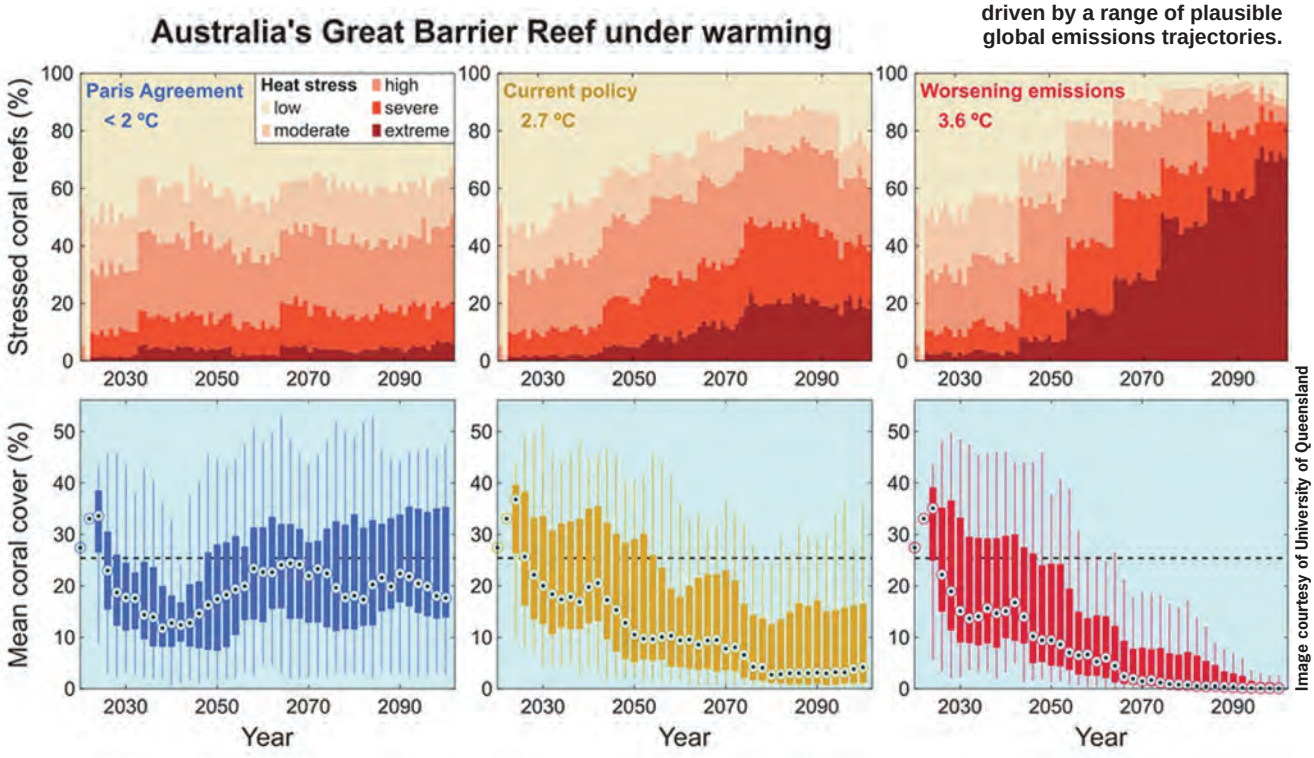
Their results showed that sustained high winter temperatures worsen bleaching the following summer. In contrast, moderate winter heat may reduce bleaching impacts because it stimulates corals to produce heat-shock proteins, boosting cellular repair and metabolic activity. It can also shift their symbiotic algae to more heat-tolerant types.

These results could improve early-warning systems and predictive models.

The most sophisticated modelling to date forecasts that under the current global emissions pathway the Great Barrier Reef could lose most of its coral by the end of the century, but curbing climate change and strategic management will help coral resilience.

A research team led by the University of Queensland (UQ) simulated different future climate scenarios driven by a range of plausible global emissions trajectories.

Dr. Yves-Marie Bozec from UQ's School of the Environ-



A research team led by the University of Queensland simulated different future climate scenarios driven by a range of plausible global emissions trajectories.

Image courtesy of University of Queensland

Baby coral being deployed overboard.

Images courtesy of Marie Roman / AIMS

ment said the comprehensive modelling of individual corals included their ability to adapt to warmer water, large-scale reef dynamics and their interconnections on ocean currents.

"We ran all of those factors with the most up to date climate projections – and the news was not good," Bozec said. "We forecast a rapid coral decline before the middle of this century regardless of the emissions scenario. Corals may partially recover after 2050, but only if ocean warming is sufficiently slow to allow natural adaptation to keep pace with temperature changes."

The ecosystem model, ReefMod-GBR, simulated the lifecycles of multiple coral species on 3,806 individual reefs. Each modelled reef had tailored environmental settings including water quality, larval connectivity with neighboring reefs, outbreaks of the coral-eating Crown of Thorns starfish and the risk of cyclones and coral bleaching until 2100.

The study has a glimmer of hope, even on the current emissions trajectory. Reefs in areas where the water doesn't heat up as dramatically because it is well mixed, fared better than others. And the better-connected reefs with good access to larval replenishment from other nearby reefs were healthier.

Therefore, management efforts to safeguard strategic parts of the coral reef network can have a beneficial impact.

"The window for meaningful action is closing rapidly but it hasn't shut," Bozec said.

All images courtesy of Amundsen Science

BREAKING THE ICE ON ARCTIC RESEARCH

By Celia Konowe

Deck machinery, such as winches, launch and recovery systems, and cranes, can transform almost any vessel into a floating laboratory, supporting the technology necessary for scientific data collection and analysis. The Canadian Coast Guard Ship (CCGS) Amundsen is no exception, as Canada's only icebreaker equipped with scientific facilities in support of national and international multidisciplinary research programs. On board, the vessel boasts 65 scientific systems, 22 fixed and portable laboratories, and 300m2 of wet and dry workspace to perform chemical and biological experiments, analyze sediments and prepare the deployment of autonomous instruments.

The CCGS Amundsen is unique in its dual role, performing icebreaking and escort duties in the St. Lawrence Seaway in winter and Arctic science in the summer. Double duty means that all scientific equipment that is not part of the vessel must be loaded and installed on the Amundsen before the start of the annual Arctic expedition. Then, at the end of the expedition season, all equipment and collected samples are packed up and offloaded from the ship during an eight-day demobilization period.

The scientific cargo and equipment for the five months of the 2026 Amundsen Expedition, explained Marine Research Coordinator Anissa Merzouk, comprises "containers, winches, oceanographic moorings equipment, large equipment such as the ASTRID Remotely Operated Vehicle (ROV), as well as all the instruments, consumables and chemicals for 200 scientists from 30 institutions throughout Canada, Europe and the United States who collaborate on nine multidisciplinary research programs."

Mobilization

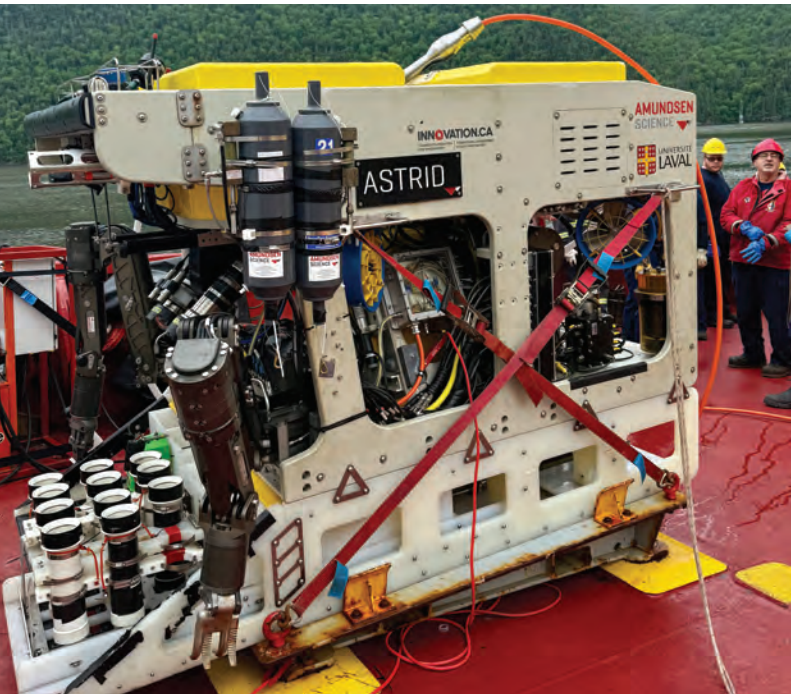
The mobilization period takes place at the Canadian Coast Guard base in Quebec City where the Amundsen docks for a two-week period between June and July. This year, the mobilization team expects to load 80,000 kg of scientific deck equipment and containers onto the vessel, said Quentin Lahaye, an oceanographic instrumentation professional.

"With the Amundsen Science team and the ship's crew, we prepare a mobilization plan weeks in advance that serves as a communication and planning tool and contains all the steps needed to ready to ship for the expedition," explained Merzouk. "The mobilization plan proposes a sequence of loading activities that fits the many constraints and requirements for skilled support by the crew and Coast Guard base staff, such as cranes for loading containers and large equipment, re-fueling the ship and loading the dozens of pallets of food needed to feed 79 people, three times a day for 140 days at sea." In the middle of the two-week mobilization period, scientific sea trials take place, consisting of five days in the St. Lawrence Estuary and Saguenay Fjord where the team tests and integrates the sampling equipment and data collection instruments.

"The mobilization period is a crucial phase of the expedition, as everything has to be onboard, installed and tested before the ship's departure," Lahaye emphasized. "There is a tremendous amount to coordinate in order to ensure everything is ready by departure day. The mobilization period often feels like a sprint, with everyone giving their all to prepare the ship and scientific operations for the months ahead."

Another major challenge is storage space management and workspace allocation. “I always compare this aspect of the mobilization to a gigantic 4-D puzzle with the fourth dimension being time. For example, the 2026 Expedition is divided into five segments or legs of 28 days each, where each leg will host different scientific teams with different sampling activities and objectives,” said Merzouk. “Since they will use the same limited laboratory and work spaces onboard, we have to load and store their equipment somewhere on the ship during mobilization until they arrive at the start of their leg, then they install their labs for four weeks, to finally uninstall everything and put their boxes back into storage at the end of their leg until demobilization.”

Despite the chaos and stress of mobilization, Merzouk said it marks the start of another exciting research season aboard the Amundsen. “After months of working on spreadsheets and receiving emails, I love the mobilization period because it allows me to connect in person with the scientists and students of the Amundsen community and act as the bridge between them, the Amundsen Science team and our partners at the Canadian Coast Guard. It’s a very intense period but mobilization is definitely the high point of the season for me: it’s the fulfillment of weeks of planning and the result of a huge team effort.”



“I love watching the ship gradually fill with scientific equipment as we prepare for the expedition. When we first arrive, the vessel feels almost empty. But by the end of mobilization, the labs are fully equipped, containers are packed with supplies, and instruments and sensors can be found in every corner of the ship,” added Lahaye. “It’s always exciting to meet teams who have spent months preparing and developing these systems, and to help them integrate everything aboard the ship.”

ASTRID

One of the key pieces of technology aboard the Amundsen is ASTRID, an ROV made by Forum Energy Technologies. Weighing about 1.5 tons, it’s currently configured to go to 1500 meters of depth and explore for more than 250 hours.

“One of the cool things about this ROV is that it’s got a very small footprint, which means that we can put it on various vessels, including small ones. The winch is small, as well as the ROV itself. It makes it a very flexible system,” said Gabrielle Inglis, ROV project manager and technician. ASTRID also has two ORION 7 function manipulators that help scientists take samples and manipulate findings in the environment. It has a set of sample drawers for storage, allowing items to be brought up from the sea floor.

ASTRID also has an AML Oceanographic Conductivity, Temperature and Depth (CTD) sonde; a Teledyne TOGS5 for heading, pitch and roll; a PS-20 depth sensor; a Teledyne doppler velocity logger; and a Kongsberg Ultra Short Base Line (USBL) cNODE. There are also multiple cameras capabilities, including a SubC 1 Cam alpha HD, a Rayfin MK2 Benthic 4K and digital video recording redundancy.

During operations, the ROV team is four or five people to keep it running and manage repairs. “But we really say we just

drive the bus," joked Inglis.

"There's quite a bit of advanced planning involved, as you can imagine," said John O'Brien, a research scientist with the Department of Fisheries and Oceans (DFO). The scientific personnel assemble a list of mission objectives and identify dive sites months before setting off. "There's a high degree of collaboration, not only within the scientific team, to make sure we align our objectives to achieve the most in the limited dive windows that we have for the most people."

Other important considerations for the ROV include weather and risk factors like strong currents or hazardous locations. Despite the challenges though, deploying ASTRID comes with new discoveries and adventures.

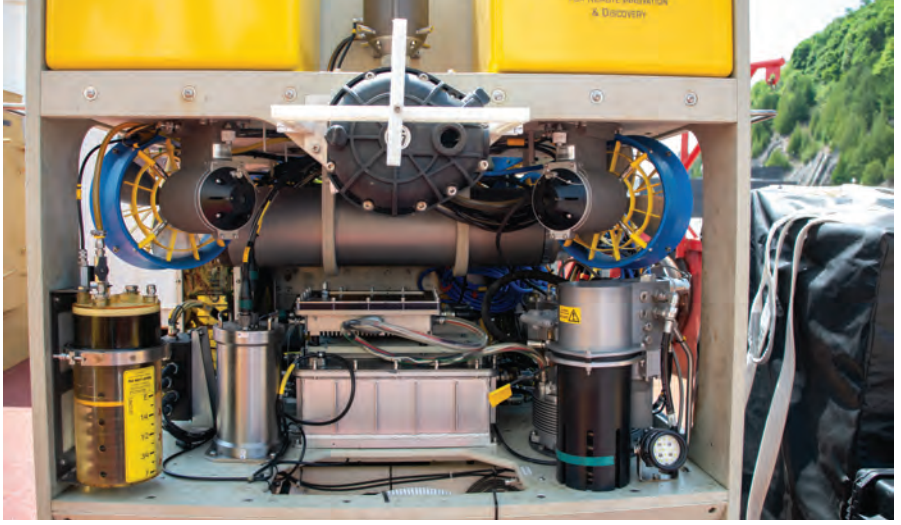
"We have a good team and we are really happy to see each other again and to work and spend time together," said Bárbara Neves, research scientist at DFO. "It becomes a family."

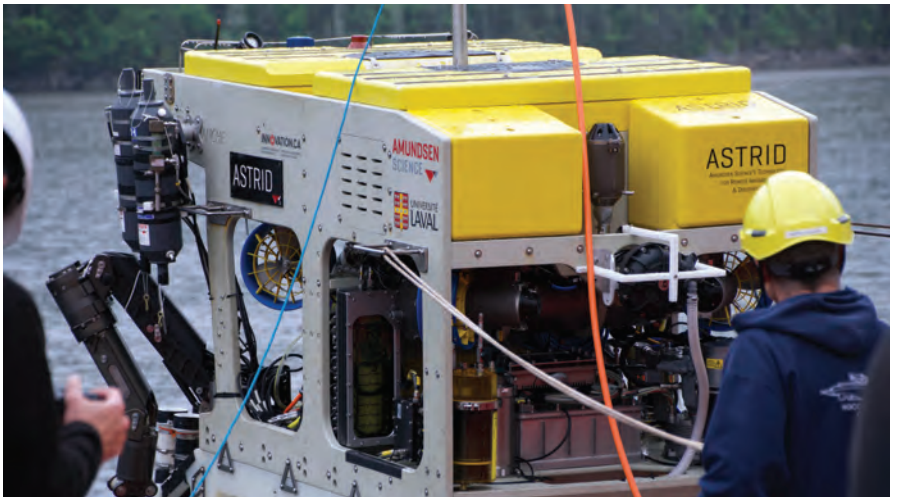
"I'm excited to collect some really good samples," she added. "We have some new projects coming up and the possibility of using the ROV for targeted, very specific samples that otherwise we couldn't collect."

Setting Sail

CCGS Amundsen's 2026 season starts on July 10 and, at 139 days, marks the longest expedition since 2009. The vessel will carry more than 185 scientists from Canada and beyond over the course of five legs, studying the marine and coastal environments of the Labrador Sea, the Canadian Arctic and Greenlandic waters. Amundsen will travel first from Quebec City to Iqaluit, then to Pituffik Space Base, then on to Resolute Bay, before returning to Iqaluit and finally Quebec City.

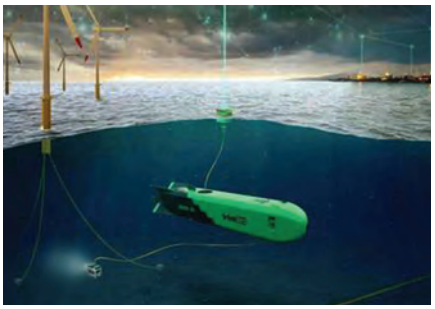
"This season, we are welcoming many new research teams aboard the Amundsen. They are bringing a wide range of new equipment and technologies that will be deployed throughout the expedition," said Lahaye. "Every season brings its own experiences and challenges, and the 2026 expedition promises to be especially rich in new projects, collaborations and discoveries."





■ Chance Maritime Technologies

■ HonuWorx



■ Kraken Robotics

■ NOAA Awards $21.6m for Uncrewed Systems Supporting Mapping, Charting

NOAA has announced a $21,600,909 million award for the purchase of uncrewed marine systems to be used on new charting and mapping vessels being built for the agency. This will support NOAA's mission to deliver tools and information to help mariners safely transport the $2.3 trillion worth of cargo that comes in and out of the nation's ports and harbors. The contract was awarded to Chance Maritime Technologies from Lafayette, Louisiana for up to eight total systems over five years.

The new systems offer a spectrum of command and control options. These include direct operator control, supervised control with semi-autonomous capabilities like collision avoidance and dynamic course tracking, and, for certain circumstances, fully autonomous operations. The collaborative design of the vessels and uncrewed marine systems ensure that NOAA is compliant with regulations and help to ensure safe operations.

In 2025, NOAA hosted the keel-layings for two new charting and mapping vessels to expand the NOAA fleet. The uncrewed systems will be used on those vessels, Surveyor and Navigator, to complement traditional seafloor mapping methods. The systems will also be equipped to support other data collection efforts such as fisheries acoustic surveys.

NOAA Marine and Aviation Operations manages and operates NOAA's fleet of 15 research and survey ships and 10 specialized environmental data-collecting aircraft. Operated and maintained by civilians and NOAA Commissioned Officer Corps officers, this fleet is one of the nation's largest dedicated to federal research. The vessels, which range from large oceanographic research vessels to smaller charting ships, support a wide range of marine activities, including fisheries surveys, nautical charting, and ocean and marine studies.

■ NATO DIANA Program Enables R&D Contract with HonuWorx

NATO's Defence Innovation Accelerator for the North Atlantic (DIANA), on behalf of Defence Research and Development Canada (DRDC) has awarded an R&D contract to UK based technology company HonuWorx, marking the first research and development contract awarded on behalf of an Allied nation under NATO DIANA's Rapid Adoption Service.

The contract follows DRDC's decision to engage NATO DIANA and its Rapid Adoption Service to identify a DIANA innovator capable of addressing a Canadian capability need. Through this process, HonuWorx was selected to undertake a targeted engineering study as a follow on activity from NATO DIANA's challenge program.

The Rapid Adoption Service enables NATO Allies and NATO bodies to co develop, prototype and, ultimately, acquire technologies at speed and at scale. Under the Rapid Adoption Service framework, DIANA can award R&D and prototype contracts on behalf of Allies through an "opt in program," reducing administrative barriers and accelerating adoption timelines. Successfully demonstrated prototypes can then transition through to production without further competition.

HonuWorx, headquartered in Aberdeen, Scotland, was selected in 2025 for NATO DIANA's Critical Infrastructure and Logistics Challenge. During Phase 1 of the DIANA program, the company was paired with COVE, the DIANA accelerator site in Dartmouth, Nova Scotia, where it worked closely with end users and technical experts to refine its solution.

The company's patented uncrewed subsea systems deliver inspection and intervention capabilities without the need for surface vessels, enabling persistent, lower-cost operations with minimal surface footprint.

Under the new R&D contract, HonuWorx will conduct an engineering study to extend the operating depth of its system and address specific end-user requirements for intervention in deepwater environments. The work will include development of a high fidelity simulation suite to demonstrate mission potential in challenging operational environments, reducing technical risk and supporting the initial steps toward a deployable system.

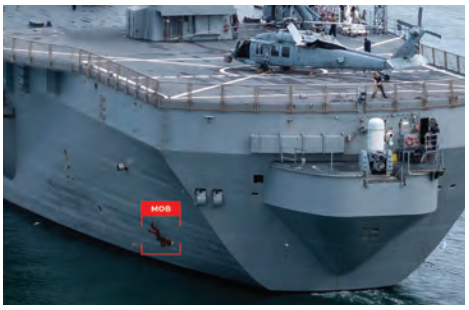
NATO DIANA's legal, commercial and adoption teams worked closely with DRDC to co develop the contract specification and establish the opt in program under the Rapid Adoption Service, enabling DIANA to act on Canada's behalf.

The opt-in program allows other Allies and NATO bodies to join in future R&D, trials, or prototyping, supporting multinational cooperation, interoperability and faster adoption. The Rapid Adoption Service directly supports NATO's Rapid Adoption Action Plan, agreed by Heads of State and Government at the 2025 Hague Summit, which aims to reduce technology adoption timelines across the Alliance to a maximum of 24 months.

■ Kraken Robotics, SEFINE SISAM Collaborate on Mission Planning, Target Recognition Solutions

Kraken Robotics Inc. announced it has

Zelim



Bedrock Ocean Exploration

Matthew Tirman

GoSubsea/Envirent

signed a Memorandum of Understanding (MOU) with SEFINE SISAM (Strategic Unmanned Systems Research Center) during the SAHA exposition in Türkiye.

As part of the agreement, Kraken will work with SISAM to integrate KATFISH into its mission planning software and develop automatic target recognition (ATR) capabilities for Kraken Synthetic Aperture Sonar.

Kraken and SEFINE recently demonstrated Kraken's KATFISH and unmanned surface vessel (USV) launch and recovery system from SEFINE's RD-22 USV off the coast of Istanbul, Türkiye, validating rapid, high-resolution detection and classification of mine-like objects and critical underwater infrastructure in an operational environment.

Zelim Opens New Canada Office in Nova Scotia

Zelim announced that it is has established a site in Atlantic Canada, marking its commitment to strategic expansion in the North American maritime market. The site will be located at the COVE ocean facility in Dartmouth, Nova Scotia, a major technology hub for maritime innovation.

Starting in April 2026, the office premises will serve as a base for Zelim to advance ongoing partnerships and future opportunities in the region for its AI-enabled technologies, which are designed to enhance the safety and security of operations at sea.

The move builds on Zelim's foothold in the Canadian cruise, ferry and defense industries. In 2024 Zelim demonstrated its flagship man-overboard detection and monitoring system, ZOE, to the Canadian Coast Guard and other maritime partners. Following this, the company was selected in 2025 for the NATO DIANA Phase II program, through which ZOE was used in a major NATO naval exercise and introduced to the Royal Canadian Navy. Since then, Zelim also secured a commercial contract with BC Ferries in February 2026 to equip four new-build ferries with its ZOE technology.

Headquartered in Edinburgh, UK, Zelim has been preparing for its next phase of international expansion, with the recent launch of a defense business unit and key additions to its senior leadership team, positioning the company for continued momentum in the global defense, cruise and ferry, port, and offshore energy sectors.

The Canada office will be led by Zelim's newly appointed regional Vice President, Brigadier General (Retired) Tom Dunne. Having served as a search and rescue (SAR) leader with both the Royal Canadian Air Force and the United States Coast Guard, Tom brings deep knowledge of SAR operations in challenging maritime environments.

Bedrock Appoints Matthew Tirman as CEO

Bedrock Ocean Exploration, a leader in autonomous subsea data and intelligence, announced the appointment of Matthew Tirman as Chief Executive Officer as the company builds on deployments and rising demand across global offshore markets.

Tirman brings more than two decades of experience in scaling deep-technology companies across geospatial intelligence, data platforms, and high-growth global commercial operations. He previously helped lead Satellogic through early commercial traction to tens of millions in revenue and its public market debut. Under his leadership, Satellogic delivered imagery and data products to defense and intelligence customers worldwide, and space system sales to include a broad area maritime constellation. As CEO, he will drive Bedrock's strategy, go-to-market execution, and operational growth. Founder Charles Chiau will continue as Chief Technology Officer, focusing on hardware and software advancements as Bedrock enters its next phase of innovation in delivering AI-driven, autonomous subsea intelligence for enterprise and government customers at a global scale.

"The opportunity ahead is massive," said Tirman, the new CEO of Bedrock. "It's similar to the early days of the space economy, where access to high-quality data unlocked entirely new markets. Today we support sustained operations in complex offshore environments across the Gulf of Mexico, UK, and North Sea, and we are experiencing exceptionally strong demand across government and commercial sectors."

Bedrock is building the largest private fleet of autonomous underwater vehicles, supporting the offshore energy, hydrographic mapping, and maritime security industries. Its vertically integrated platform with multi-sensor subsea data can be deployed without specialized infrastructure and operate in a wide range of offshore environments, from small vessels to large-scale ships. Bedrock's Mosaic platform offers data access, visualization, and collaboration, while Trident supports remote fleet operations and mission coordination, enabling it to deliver faster surveys, lower costs, and more reliable data than traditional methods.

■ Cellula Robotics

Colleen Hahn

■ Teledyne Marine

■ Puntacana Foundation

■ GoSubsea, Envirent Form Rental Alliance for End-to-End Offshore Solutions

Two of Norway's offshore companies, GoSubsea and Envirent, have announced a strategic partnership that combines technical expertise with expanded service offerings.

In 2025, both companies were recognized with the prestigious Gaselle Award, highlighting their position among Norway's fastest-growing and most profitable medium-sized enterprises. This latest announcement comes amid continued growth, with both organizations preparing to move into larger facilities to support expanding operations.

The partnership marks a step in improving access to integrated subsea ROV tooling and survey equipment for the offshore industry.

By combining their rental fleets and capabilities, GoSubsea and Envirent will enable customers to source more comprehensive equipment packages through a single, streamlined channel, reducing mobilization timelines and improving operational efficiency across a wide range of offshore projects.

The alliance agreement is effective immediately.

■ Hahn Appointed VP, Tech Transfer and Strategy at Cellula Robotics

Cellula Robotics has announced the appointment of Colleen Hahn as Vice President, Technology Transfer and Strategy, strengthening the company's senior leadership team as it continues to expand its presence in the United States and advance its global growth strategy.

In her new role, Hahn will focus primarily on the United States market while supporting Cellula's wider global strategy through market intelligence, customer engagement, strategic outreach, and partnership development across the company's subsidiaries and partner network.

Hahn brings experience in partnership development, commercialization, and strategic market growth across advanced technology sectors, including recent work focused on autonomous technology commercialization in the US defense market. She also brings a track record of engagement across the wider defense and autonomy community.

"Cellula has built a strong reputation for delivering advanced subsea capability with real operational relevance," said Hahn. "I am pleased to join the company at an important stage in its growth and look forward to supporting its US market development while helping strengthen the partnerships, customer engagement, and strategic alignment that will contribute to its long-term success."

■ Teledyne Expands Iceland Facility, Boosts AUV Output and UK Supplier Collaboration

Teledyne Marine has further expanded its Teledyne Gavia manufacturing facility in Iceland, increasing output of autonomous underwater vehicle (AUV) systems while strengthening collaboration with UK based suppliers.

Located at Vesturvör 29 in Kópavogur, the facility now occupies the full 5,200 m² building after Teledyne acquired the remaining space. The added floor space expands engineering, manufacturing, support, and operations to facilitate higher build rates and a smoother production flow.

The expansion supports growing demand for Gavia AUV systems in defense, security, and commercial markets and provides headroom to meet long term program needs.

Teledyne Gavia is also expanding production with a network of UK based suppliers to increase volume, improve supply resilience, and meet regional sourcing expectations—especially for UK and European defense programs. This includes a strategic collaboration with M Subs and BMT, and the addition of UK based suppliers, for Teledyne AUVs. Teledyne Gavia also operates a dedicated service facility in Fareham and has a new support facility opening Q2 in Plymouth to support Royal Navy users.

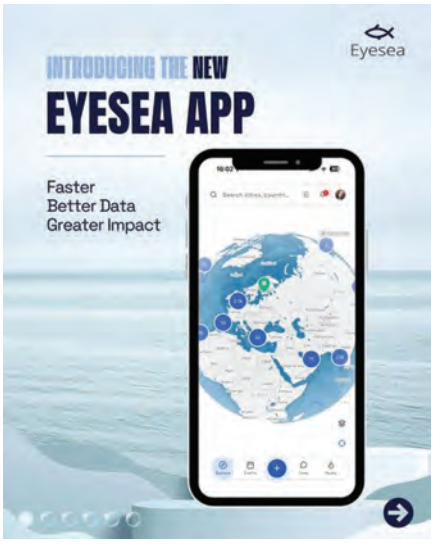
The expansion reflects Teledyne Gavia's long term investment in Iceland as a center of excellence for AUV design and manufacturing. Additional upgrades are planned to modernize the site, support workforce growth, and improve production readiness as demand for Gavia, Osprey and SeaRaptor AUV systems increases.

■ Puntacana Foundation Launches Coral Restoration Farm in Dominican Republic

The Puntacana Foundation inaugurated the Marine Innovation Center (CIM), a new facility designed to promote research, environmental education, and the restoration of coral reef ecosystems throughout the Caribbean. Located in Playa Blanca, within the Puntacana Resort, on one of the country's most iconic coastlines, the CIM represents the next step in a conservation commitment that began more than thirty years ago.

The inauguration, held in conjunction with Earth Day on April 22, 2026, brought together partners from the environmental, business, and philanthropic sectors, including the Puntacana Group,

Eyesea



the Dominican Foundation for Marine Studies (FUNDEMAR), The Nature Conservancy (TNC), and Oceankind, as well as the Minister of Environment and Natural Resources of the Dominican Republic, Armando Paíno Henríquez.

The CIM has a specialized laboratory with 32 tanks, expandable to 64, which will support coral restoration, marine monitoring, and the reproduction of key reef species. This facility integrates controlled laboratory environments with active programs in the adjacent marine sanctuary, enabling scientists and technicians to quickly move from research to field application.

Coral reef restoration in the Caribbean has historically faced a fundamental contradiction, as traditional techniques rely on extracting fragments from already declining natural populations. This new center was designed to directly address this challenge, incorporating tools such as machine learning for monitoring coral health, molecular biology for disease detection and prevention, assisted evolution, and sexual reproduction techniques to develop more resilient corals. The goal is not just to restore reefs, but to do so at the speed and scale demanded by their accelerating loss.

Beyond its scientific mission, the CIM will open a permanent interactive exhibit to the public this summer, inviting both resort visitors and the community at large to learn about the threats facing reefs and the solutions being developed to protect them. Fundación Puntacana has maintained that scientific credibility and citizen participation strengthen each other, and that lasting conservation requires not only better tools, but also a society that understands the importance of reefs.

The Center is also the anchor institution of the Dominican Republic's Marine Innovation Hub, a national platform that integrates Fundación Puntacana, FUNDEMAR, and The Nature Conservancy under a shared mission of applied research and large-scale reef restoration. This Hub, supported by Oceankind, operates through two world-class facilities: one in Punta Cana and FUNDEMAR's laboratory in Bayahibe, and is actively working on developing a legal and financial structure to ensure its long-term sustainability.

The Marine Innovation Center was made possible through the vision and investment of Grupo Puntacana, the philanthropic partnership with Oceankind and numerous private donors from the Puntacana Resort community, as well as the scientific collaboration of The Nature Conservancy, FUNDEMAR, and a network of international partners.

Eyesea Announces Launch of New Pollution Reporting and Monitoring App

Eyesea announced the official launch of its new Pollution Reporting and Monitoring App, a milestone in advancing the organization's mission to map, track, and reduce marine pollution worldwide.

The new app delivers on Eyesea's original vision of a unified platform that combines real-time, in-person reporting from seafarers and coastal communities with gamification, pollution modeling, environmental zone overlays, and sophisticated maritime geospatial analysis. By integrating these elements, the platform empowers users across the maritime ecosystem to actively participate in identifying and addressing pollution at scale.

Key Features of the app include:

- Crowdsourced Pollution Reporting
- Gamification Features
- Pollution Modeling
- Computer Vision
- Maritime Geospatial Analysis
- Satellite Image Spectrometry Analysis
- Custom Dashboards

The addition of satellite spectrometry relating to oil and plastic enhances Eyesea's ability to validate and augment user-reported data, bridging the gap between localized observations and global monitoring systems.

With dedicated dashboards for individuals and companies, the platform supports a wide range of use cases-from independent environmental monitoring to corporate sustainability tracking and compliance.

GeoAcoustics

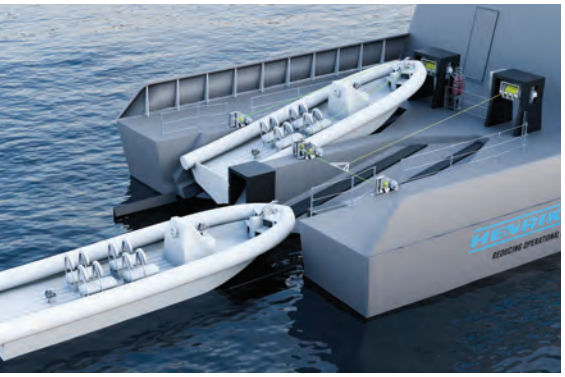
GeoAcoustics Chooses Celestial Tech as Bangladesh Channel Partner

GeoAcoustics Ltd has appointed Celestial Tech as its official Channel Partner in Bangladesh. The agreement will see Celestial Tech represent the full GeoAcoustics product portfolio, including the new GeoMB multibeam echosounder, GeoScan side scan sonar systems, and Genulse sub-bottom profilers.

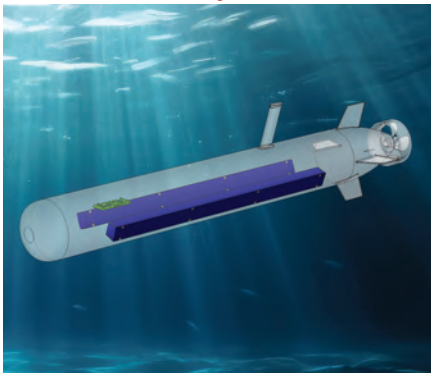
Celestial Tech is a technology provider with focus on delivering advanced engineering and geospatial solutions across Bangladesh's growing marine, inland waterway, and infrastructure sectors. With increasing demand for accurate hydrographic data to support port development, dredging operations, river management, and offshore energy projects, the partnership strengthens local access to GeAcoustics sonar systems.

Through the partnership, Celestial Tech will provide sales, integration, and first-line support for GeAcoustics systems. This includes solutions optimized for shallow water bathymetry, sediment characterization, and high-resolution seabed imaging, which are all key requirements for inland waterway and coastal survey applications in and around Bangladesh.

Henriksen



Klein Marine Systems



Forum Energy Technologies

Henriksen Launches New Slipway LARS System

A newly designed automatic launch and recovery system for small boats and unmanned surface drones (USVs), has been developed by Henriksen AS of Norway and will be presented for the first time at Seawork (Stand F34) in Southampton, June 9-11.

The new system enables the automated launch and recovery of craft from the stern ramp of a mother vessel. The Henriksen slipway system now makes it possible for a police or military crew to board a RIB (Rigid Inflatable Boat) and be under way on the water in less than two minutes. A rapid response time can be invaluable for customs and police interception tasks while the new HSS can also quickly deploy unmanned surface vessels, or drones, for mine clearance operations.

The new system employs the Henriksen AS expertise in the design of boat lifting and capture claw hooks that can automatically secure a line onto a craft and efficiently draw it up onto its own berth aboard the mother ship.

The Henriksen HSS is being manufactured at the company's new factory in Tønsberg beside the Oslo fjord in Norway.

Klein Marine Systems Launches MANTIS UUV Side Scan Sonar

Klein Marine Systems, a leader in advanced side scan sonar and underwater imaging technology, announced MANTIS UUV, an integrated multi-channel side scan sonar system designed to bring high-quality imaging, onboard processing, and streamlined integration to unmanned underwater vehicles.

Klein's MANTIS UUV represents a new implementation of advanced side scan sonar technology for unmanned underwater vehicles, combining latest-generation components with processing for dynamic focusing, multiple-look processing, and adaptive beamforming. The result is consistent, high-resolution sonar imagery across changing survey ranges and speeds, creating an ideal foundation for machine learning and AI-assisted analysis.

Built for demanding autonomous missions, MANTIS UUV is engineered for UUV platforms where space, power, speed, and data handling are critical to mission success.

The system combines Klein's advanced side scan sonar performance with a compact payload architecture designed to support route survey, mine countermeasures support, search and recovery, hydrographic and geophysical survey, offshore infrastructure inspection, and environmental mapping.

At the core of MANTIS UUV is Klein's SmartArray Technology, an integrated system architecture that embeds key electronics directly within the transducer array. This approach helps reduce system footprint, lower size and power demands, and preserve valuable vehicle payload space.

MANTIS UUV is designed to operate at higher speeds across all ranges, while processing sonar data onboard in real time so operators and autonomous systems can act on information faster. Ethernet-based connectivity simplifies integration with modern UUV platforms and supports real-time review, playback, and analysis workflows.

Forum Energy Technology Launches New LARS Model

Forum Energy Technologies (FET) has unveiled its latest solution in subsea handling equipment, the Model 6000 (M6000) Launch and Recovery System (LARS).

Part of FET's Dynacon product line, the M6000 provides a compact, all-in-one solution for inspection and light work-class ROV operations. It integrates the A-frame, winch and hydraulic power unit into a single skid-mounted package, allowing for a single-point lift with no need for additional cabling or hose connections. This design streamlines mobilization and demobilization, reducing vessel interface time and onboard footprint.

The first M6000 system, equipped with a Perry Super Mohawk ROV was delivered to a US-based client this year and is already in operational service. The system was manufactured and tested at FET's US manufacturing facility in Bryan, Texas, allowing client interface and witnessing during the fabrication process.

Developed for deployment with inspection and small work-class ROVs such as FET's Comanche and Super

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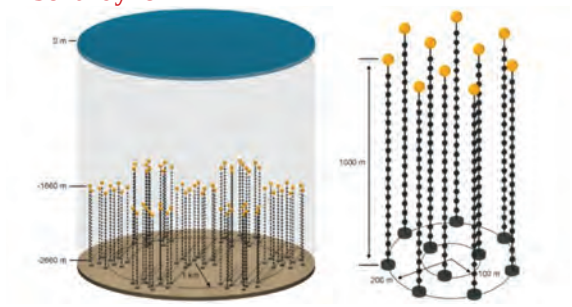
Sonardyne



K. Holzapfel/Technical University of Munich

Evotec

Mohawk, the system delivers optimal performance for inspection, maintenance and repair (IMR), cable lay, and pipeline or structural inspections. Applications are versatile, ranging from wind farms and dam surveys to pre-survey and light construction tasks.

Key features include a gimbal docking head with swing and sway functionality, a compact footprint and pre-wired, plug-and-play electrical integration. Together, these developments enhance safety and efficiency by minimizing setup time and maximizing reliability in the field.

The M6000's design is DNV-certified and incorporates the latest hydraulic and control technologies. With a safe working load of up to 5,200kg and umbilical capacity of 3,300m, it provides robust handling performance within a reduced footprint.

The model was brought into production in 2025 following successful field deployment with a client earlier this year.

Sonardyne's Fetch Positioning Technology to Support Deepsea Neutrino Detector

A new deep-sea neutrino detector being built to transform our understanding of the universe will use precise positioning from underwater technology company Sonardyne.

An array of Sonardyne's Fetch instruments will provide the precise and stable underwater positioning the 3,000 m deep Pacific Ocean Neutrino Experiment (P-ONE) needs to accurately detect and analyze high-energy neutrinos.

P-ONE, a multi-national, multi-institute scientific collaborative project, will help scientists to unlock insights into extreme cosmic phenomena like black holes and supernovae. The cosmic neutrino telescope will be built off the coast of British Columbia, Canada, leveraging Ocean Network's Canada's existing world-class advanced deep-sea infrastructure.

Alongside exploring the universe, P-ONE will also deliver vital data for oceanography, climate science and tectonic research, advancing both astrophysics and marine technology.

The P-ONE detector will involve the anchoring of a three-dimensional array of thousands of advanced optical sensors creating a vast detection grid. These will detect the faint light (Cherenkov radiation) created when high-energy neutrinos interact with water molecules.

The P-One collaboration's goal is to build a full detector array that would cover multiple square kilometers. The initial pilot array, and a potential future full array, will be connected into ONC's existing cabled infrastructure, which spans thousands of kilometers in the Cascadia Basin.

Designed as a long-life autonomous seabed node, Sonardyne's Fetch can operate for up to 10 years, making it ideal for extended deep-sea monitoring campaigns. Its adaptable design allows for a range of sensors to be integrated, supporting everything from seabed deformation studies to broader ocean science.

Evotec Launches Remote ROV LARS Solution

Evotec has developed Evotec CORE Remote, a solution that enables launch and recovery of (Remotely Operated Vehicles (ROVs) to be performed from shore as a single, automated operation.

Evotec CORE Remote is now in operational use by DeepOcean from its Remote Operations Center (ROC) in Haugesund. Operations are carried out using the unmanned vessel USV Challenger, purpose-built for remote subsea operations.

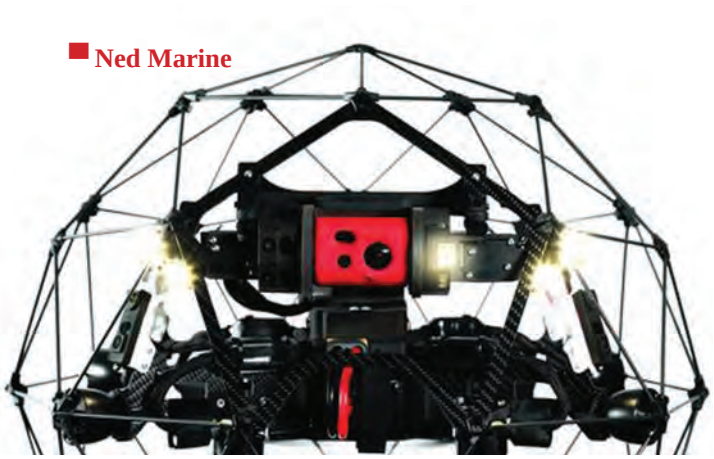
The solution is about restructuring the operation itself. "When you standardize how operations are performed, you achieve a more predictable and consistent execution. At the same time, it enables better utilization of both vessels and operator competence," said Kurt Erik Steinsäker Nesje, VP Automation at Evotec.

For DeepOcean, remote operations represent a different way of organizing work. When operators no longer need to be physically offshore, the need for rotation and mobilization is reduced, while operations can be carried out with an even higher level of safety.

"The savings come from reducing the number of people who need to be offshore, away from their families for 14 days for an operation that may only take two days," said Roald Rykkje, Senior Project Engineer - Methods at DeepOcean.

Remote operations also enable more flexible use of operator resources.

"When an unmanned subsea vessel is in transit, you can work on ROV opera-



Ned Marine

ScioSense

tions for another vessel that is on site," said Rykkje.

"This is not just about technology, but about how the entire operating model is structured. We see remote operations increasingly becoming the starting point for how operations are designed and executed," Häkon Voldsund, VP Sales & Marketing at Evotec, added.

Ned Marine Launches Drone and Subsea ROV Inspection Services

Dutch non-destructive testing specialist Ned Marine has launched drone and remotely operated vehicle (ROV)-based inspection services aimed at vessels, offshore installations and industrial assets.

The company said the new services combine aerial drones and subsea ROVs with existing non-destructive testing (NDT) capabilities, including visual inspections and ultrasonic thickness measurements.

Ned Marine said drone-based inspections would allow surveys of confined spaces, offshore and onshore wind turbines, storage tanks and industrial structures without the need for scaffolding, rope access or diving operations.

According to the company, the inspections could be completed significantly faster than traditional methods, reducing operational downtime for vessels and offshore assets.

Its subsea ROV inspection services will support hull inspections, cathodic protection assessments, structural monitoring and pre-docking surveys at depths of up to 300 meters.

ScioSense Launches UFC23 Ultrasonic Flow Converter

ScioSense, a developer and manufacturer of semiconductor-based environmental and flow sensors, has launched the UFC23, the 4th generation ultrasonic flow converter for measurement in water, heat and gas meters.

The new UFC23 sensor combines improved resolution and offset stability with ultra-low standby current, enabling high-end battery-powered water, heat, gas and leak detection meter designs across a wide range of smart metering applications.

The UFC23 extends the ScioSense ultrasonic flow portfolio with a pure front-end architecture that omits the on-chip Central Processing Unit (CPU) used in previous flow converters. This gives Original Equipment Manufacturers (OEMs) the flexibility to fit the system architecture now preferred by many meter designers, while also delivering improved analogue front-end performance.

In a typical DN15 water meter setup, the UFC23 provides single-shot standard deviation of 35ps and offset stability of ±7ps with 128-sample averaging and a drift of less than 10ps over the range from 0 to 50°C. This level of precision and stability supports the signal quality needed in high-end water meter designs, including R1000-class measurement requirements. At the same time, the UFC23 is optimized for battery-powered systems, with standby current of typically 0.8µA and an operating current as low as 6.6µA at an 8Hz sample rate.

The UFC23 integrates the functions required to drive ultrasonic transducers, captures received signals, and extracts high-precision time-of-flight data. It supports both 3.3V single-ended drive for water applications and full-bridge drive for gas applications. A programmable gain amplifier with increased gain and bandwidth helps the UFC23 handle weak receive signals, while a programmable ultrasonic burst generator operating up to 4.4MHz and based on an external reference of up to 20MHz allows designers to tune operation to the transducer and application.

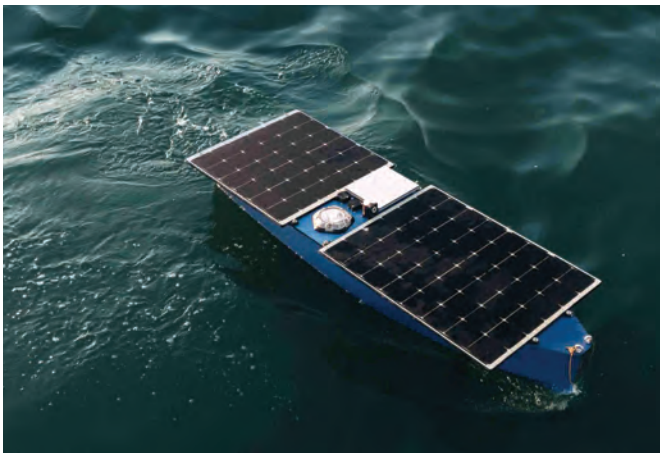
The UFC23 also includes features that help improve system-level efficiency and measurement robustness. Designers can monitor the amplitude of up to three received waves and use extended pulse-width measurement to improve first-hit detection. A batch mode allows the sensor to collect up to 12 measurement bundles before waking the host controller, helping to reduce total system power consumption. The UFC23 also supports temperature measurement with external platinum sensors for heat meters and hot-water systems.

Since the UFC23 supports multiple designs, manufacturers can reuse the same sensor across different product families. Typical applications include smart water and heat meters, smart gas meters, water heaters, pump control systems, and smart faucets.

The UFC23 operates from a 2.5V to 3.6V supply, supports an operating temperature range of -40°C to 85°C, and is supplied in a QFN32 package.

■ Saildrone

■ Sofar Ocean



■ Saildrone Introduces High-Endurance Anti-Submarine and Strike USV

Saildrone has announced its newest platform, Spectre. At 52 meters (170 feet) long, weighing 250 tons, and capable of up to 30 knots, Spectre is a high-endurance USV designed to deliver multi-mission effects above and below the surface. Spectre's design is engineered from the keel up for long-range, quiet, persistent operations.

Ficantieri Marinette Marine will build the aluminum hull form for both variants of Saildrone Spectre at its Wisconsin system of shipyards, which has the capacity to build five Spectre vessels per year. A staple shipyard for the US Navy, Fincantieri's experience and workforce make it an ideal partner to meet customer demand for Saildrone's newest platform. Construction will begin shortly, with the first vessel undergoing sea trials in early 2027.

The 43-meter (140-foot) composite Saildrone Wing will be manufactured by American Magic Services (AMS) at the American Magic High Performance Center in Florida.

Saildrone is the first, and only, company to achieve ABS class certification for its USVs. ABS has already granted Approval in Principle for Spectre, which complies with High Speed Naval Craft certification. The autonomy software that controls Spectre has been honed over more than a decade of operations at sea and is fully capable of complying with COLREGS in both day and night conditions.

Like the Saildrone Voyager and Surveyor, Spectre leverages wind, solar, and diesel propulsion, but Spectre also runs twin shaftlines with dual electric and diesel propulsion, enabling near-silent electric propulsion up to 12 knots, before kicking in 5,000 horsepower of Caterpillar diesel engines to propel the vessel up to 27 knots with full fuel and a 25-ton payload.

Spectre has a range of 3,280 nautical miles in flat water and 2,790 nm range in Sea State 4. Controllable-pitch propellers enable extremely efficient operations throughout the speed range, allowing for controllable acoustic signatures and near-silent slow-speed operations for tow bodies such as thin-line towed arrays and variable-depth sonar systems.

The concealed payload deck provides room for containerized payloads, ranging from dual 40-foot containers, up to five 20-foot containers, or a mixture of configurations in between. This configuration, close to the waterline, allows easy deployment of payloads via the transom, while the bulwarks protect them from prying eyes and the relentless driving sea spray that will be relentless at high speeds in rough weather.

Spectre has two variants depending on customer requirements:

- **Saildrone Spectre Silent Endurance**
  - o Spectre Silent Endurance features the Saildrone Wing, which offers added range, endurance, sensor height, and get-home capability for missions of more than 8,000 nautical miles. Its hybrid propulsion, which enables nearly silent transits at up to 12 knots, is optimized for ASW and other acoustically sensitive mission sets.
- **Saildrone Spectre Stealth Strike**
  - o Spectre Stealth Strike, leveraging a wingless configuration, maximizes speed and minimizes visual and radar signature. Its lower profile is ideal for operations where speed, visibility, and signature impact mission performance. From the outset, Spectre was designed to operate without the wing for kinetic strike roles, which require higher sprint speeds and low-profile stealth operations.

■ Sofar Ocean Launches Spotter Scout USV

Sofar Ocean, an ocean intelligence platform, launched Spotter Scout, a solar-powered uncrewed surface vehicle (USV) built by Online Oceans, a UK-based marine robotics company, that enables persistent ocean sensing in remote and deep-water locations—no moorings, crew, or depth limits.

Remote ocean monitoring is typically expensive and complex. Traditional mooring systems are hard to deploy, maintain, and relocate, and often cost more than the sensors they support. This makes them difficult to justify for shorter-term deployments.

Spotter Scout removes these constraints. The USV holds position in deep water, transits between locations on command,

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■ NOAA

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■ Sonardyne

(L-R) Aidan Thorn, Marine Robotics Business Development Manager, at Sonardyne, Iain Vincent, Director & General Manager, at ecoSUB Robotics, and Anders Wikmar, Survey and Technical Director, at Njord Survey.

and can return home after six or more months unattended. While deployed, it collects the same surface and subsurface data trusted by thousands of Spotter Platform users worldwide, and sends every observation to the Spotter Dashboard and API in real time.

Spotter Scout is engineered for long-term performance in the harshest ocean conditions. Its flooded hull has no sealed air volume to breach, keeping it operational in sea states 7 and 8. A keel-mounted 2kWh battery provides the ballast needed to self-right in extreme conditions and, paired with a 340w solar array, ensures continuous operation. Spotter Scout supports cellular, Iridium, and Starlink connectivity, enabling reliable communication from nearshore to the open ocean. If a project's needs change, an operator can reposition it with a simple browser-based command sent via desktop or mobile.

■ NOAA Ship Thomas Jefferson Returns to the Great Lakes to Map the Region

For the first time since 2022, the NOAA Ship Thomas Jefferson is underway in the Great Lakes. The vessel and its crew of NOAA Corps officers and professional mariners are working with NOAA scientists to map the waters of western and central Lake Erie and eastern Lake Ontario this year to improve navigation safety. Survey work will also occur within Lake Ontario National Marine Sanctuary to identify critical habitats located within the area.

Western Lake Erie, one of the shallowest areas within the Great Lakes marine transportation system, is highly trafficked by commercial and recreational vessels and has not been surveyed since the 1940s. NOAA's nautical navigation products and services from seafloor mapping surveys are critical for a safe, and secure ocean economy. These tools reduce collisions, identify dangers to navigation, and facilitate more efficient and successful fishing operations.

The Great Lakes are the least mapped region of the U.S., making this work even more important for mariners in the region. In addition to operations on larger vessels like the Thomas Jefferson, NOAA also maps critical areas of the Great Lakes each year using navigation response teams. This year, those teams will map Thunder Bay National Marine Sanctuary; western Lake Erie; Braddock Bay and Vicinity, New York; and Green Bay, Michigan and Wisconsin.

These projects also contribute to the collaborative Lakebed 2030 initiative to map the Great Lakes, as well as the Great Lakes Restoration Initiative's habitat mapping program.

This summer, the Thomas Jefferson will augment operations with a DriX, an uncrewed surface vehicle near Oswego, New York to accelerate mapping efforts. The DriX is equipped with high-resolution multibeam sonar, used to map the seafloor and detect objects in the water column or along the seafloor. The DriX is operated using "supervised autonomy," meaning that a NOAA pilot is always monitoring the system and ready to take control if needed. The system is capable of operating for upwards of four days at a time before returning to shore for routine checks and refueling

■ Sonardyne Navigation Selected by Njord Survey for ecoSUB AUVs

Swedish innovator Njord Survey has chosen Sonardyne navigation technology for its ecoSUB Robotics autonomous underwater vehicles (AUVs) to transform subsea survey operations.

Using Sonardyne's smallest navigator, SPRINT-Nav U, on ecoSUB's low-logistics AUVs, Njord Survey is targeting at-scale survey operations, starting with UXO surveys.

Underpinned by accurate navigation, deployment at scale will enable parallel operations, reducing vessel dependency, logistics, cost and time for these types of survey.

Combining detection and verification and allowing re-tasking, with the same easily transportable platforms, also means surveys can be delivered faster and more flexibly, without compromising data quality.

Njord Survey plans to put its ecoSUB straight into operation on client projects to demonstrate benefits from day one as it proves and evolves its survey offering.

■ **Exail**

■ **OMS Group Acquires Second Exail DriX O-16 for Subsea Cable Installation**

OMS Group and Exail announced the acquisition of a second Exail DriX O-16 Uncrewed Surface Vessel (USV), accelerating OMS Group's deployment of autonomous survey capabilities to support the growing demand for subsea cable infrastructure worldwide.

The first DriX O-16, purchased last year and to be named USV Elite, is scheduled to be launched in mid-2026. Together, the two vessels will support subsea cable installation campaigns globally, performing seabed surveys, route verification, and monitoring for critical telecommunications cable infrastructure.

With an operational endurance of up to 30 days and a range of approximately 3,500 nautical miles, the DriX O-16 is designed to support long-duration survey missions with minimal reliance on crewed vessels. The platform also accommodates advanced survey sensors, including the Kongsberg EM124 multibeam echo sounder, enabling precise, high-resolution seabed mapping required for large-scale subsea infrastructure projects.

The DriX O-16 will be integrated into OMS Group's expanding survey ecosystem, alongside the planned deployment of Autonomous Underwater Vehicles (AUVs) and the establishment of a Remote Operation Centre (ROC) in Singapore, enabling remote supervision, real-time data validation, and coordinated multi-vehicle operations.

The DriX range of USVs, which includes the H-8, H-9 and O-16, is designed to address the evolving needs of offshore operations through scalable and flexible autonomous solutions.

■ **Cellula Robotic Envoy AUV Surpasses 2,000km Submerged on Hydrogen Fuel Cell**

Cellula Robotics Ltd has demonstrated more than 2,000 km of fully submerged endurance with its Envoy Autonomous Underwater Vehicle (AUV), powered by a hydrogen fuel

■ **Cellula Robotics**

cell, exceeding the platform's published performance specification in a representative underwater mission profile.

Completed fully submerged, the mission provides a realistic indication of usable underwater range beyond a straight-line transit figure. Over the course of the profile, the Envoy AUV executed more than 4,000 turns and maneuvers, each of which increased energy demand compared with steady, linear travel.

The milestone was achieved using hydrogen fuel cell technology developed with Infinity Fuel Cell and Hydrogen, Inc., whose fuel cell solution supports Envoy's long-endurance performance below the surface.

For operators, endurance is what turns technical capability into offshore results. Longer fully submerged missions can reduce the number of recoveries and relaunches required, support mission continuity, and make better use of vessel time in programs where logistics, weather windows, and offshore intervention all affect cost and execution.

The Envoy AUV remained on mission for 385 hours and covered 2,023 km submerged on hydrogen fuel cell power. The result demonstrates persistent, long-range AUV performance in a real underwater operating context and reinforces hydrogen fuel cells as a practical enabling technology for extended autonomous subsea operations.

While on mission, Envoy's hydrogen fuel cell system generated water as a by-product, underscoring the lower-emission potential of fuel cell-powered subsea operations alongside their endurance benefits

■ **Leonardo DRS Selects Sea Machines' STORMRUNNER AUSV For Maritime Counter-UAS Solution**

Sea Machines Robotics announced that Leonardo DRS has selected their new eight-meter offshore class of autonomous unmanned surface vessel (AUSV) developed for the defense-market to demonstrate their maritime mission equipment package (M-MEP) for counter-unmanned aerial system (C-UAS) missions.

■ **MacGregor**

Purpose-built for autonomous maritime patrols and interdiction, STORMRUNNER is powered by Sea Machines' SM300-SP Autonomous Command and Control system, delivering high endurance, speed, and payload capacity for complex maritime missions. With a 40+ knot top speed, 700+ nautical mile endurance, and modular payload bay, STORMRUNNER provides a durable platform for advanced mission systems such as the Leonardo DRS M-MEP. STORMRUNNER is built from 100% high density polyethylene (HDPE) plastic.

Countering unmanned aerial systems have become a growing and immediate requirement for defense forces particularly in the maritime domain across the globe, notably the Arabian Gulf, Red Sea, and Baltic. Adversaries increasingly employ UAVs to surveil, disrupt, or threaten business and naval operations. By combining C-UAS mission equipment packages from Leonardo DRS with Sea Machines' STORMRUNNER AUSV, naval commanders gain the ability to detect, tract, and neutralize aerial threats at sea, without placing sailors or high value maritime assets at risk.

■ **MacGregor to Supply Deck Machinery for Ultra-Large Cable-Laying Vessel**

MacGregor has been selected to supply a comprehensive package of offshore and merchant deck machinery for ultra-large cable-laying vessels. The vessel will be constructed at Tersan Shipyard in Turkey.

The contract, secured in close collaboration with Nemo Marine, was booked during Q1 2026, with delivery scheduled for 2027.

The specialized package is designed to support the vessel's operational requirements:

- Offshore Deck Machinery: Essential equipment tailored specifically for cable-laying activities.
- Merchant Deck Machinery: High-performance vessel-moving winches designed for critical functions, including anchoring at roadsteads and ensuring safe mooring in ports.

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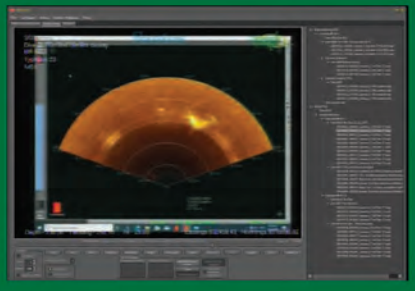

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