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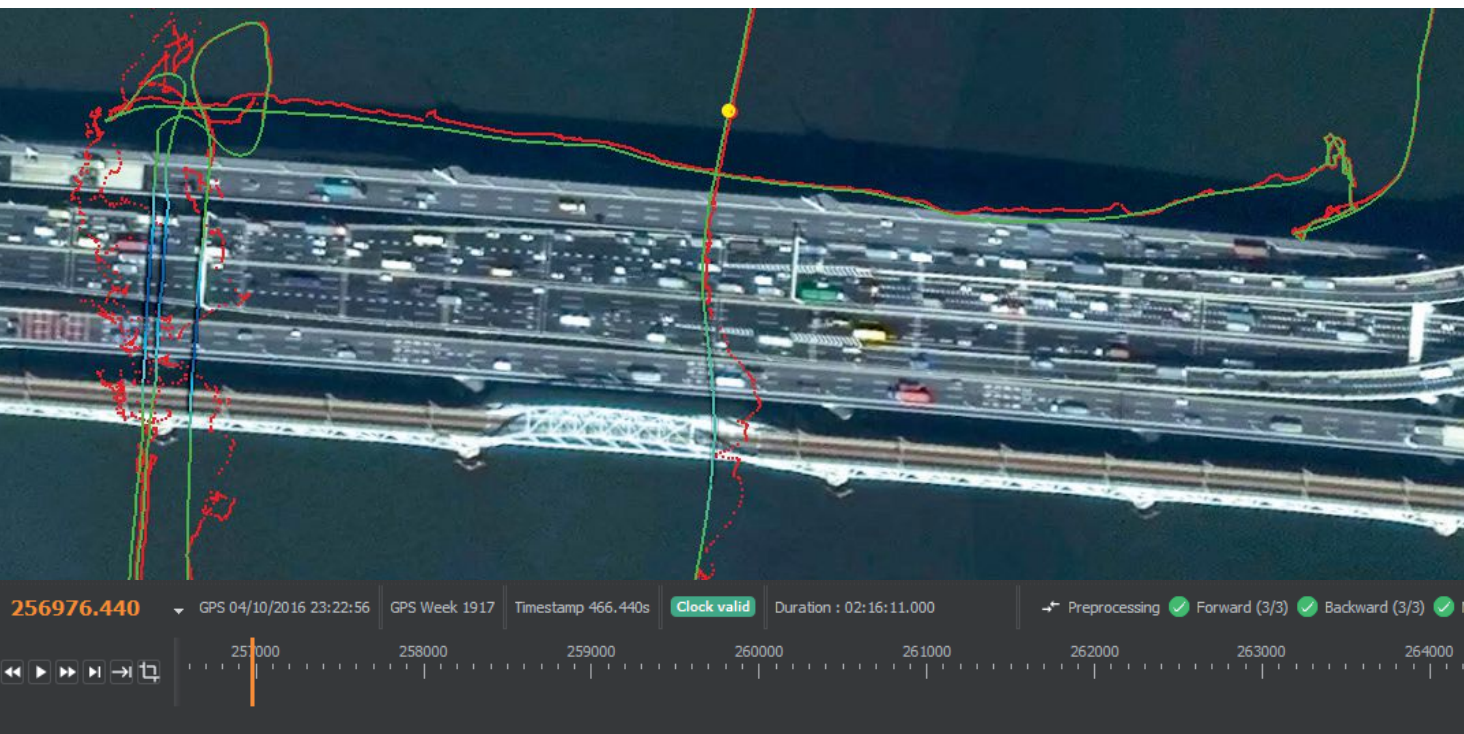
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SEPTEMBER 2020



**Ocean Resources
Development &
Coastal Zone Management**

FEATURING:
ROV-Based Coring
Measuring Mining Plume Sediment
Capturing Invasive Lionfish



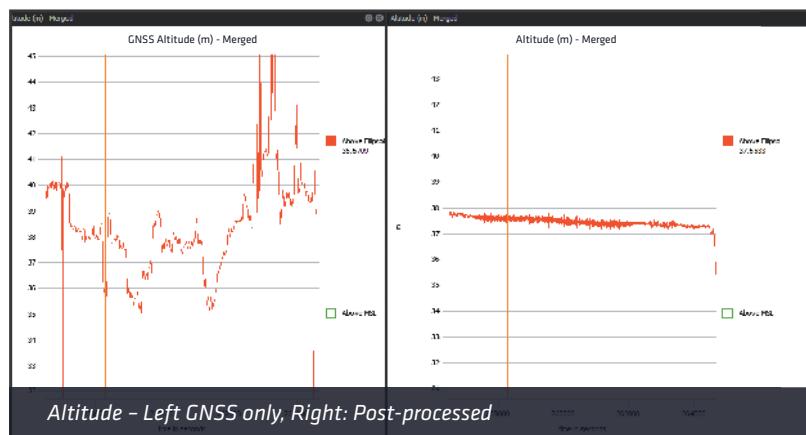
Quality: Green -> centimetric position; Blue -> decimetric < 30cms; Red -> Raw GNSS data

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AUGUST

Geophysical Exploration/Seafloor Engineering

**SEG 2020, October 11-16, Houston, TX

SEPTEMBER

Ocean Resources Development & Coastal Zone Management

**AUVSI XPONENTIAL 2020, October 5-8, Dallas, TX

**Global OCEANS 2020: Singapore - U.S. Gulf Coast, October 5-30,
Live Virtual and On-Demand

**EURONAVAL, October 20-23, Paris Le Bourget, France

**Offshore Energy 2020, October 26-28, Amsterdam, The Netherlands

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

**International Water Conference, November 8-12, San Antonio, TX

**Oceanology International 2020, December 1-3, ExCel London, U.K.

NOVEMBER

Undersea Defense/Antisubmarine Warfare

**UDT 2020, December 8-10, Rotterdam, The Netherlands

DECEMBER

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COVER IMAGE

RPS's Level 2-certified Floating LiDAR 4.5 Buoy being deployed for testing offshore Perth, Australia, in July 2018. This buoy, now deployed off the coast of New York, is used for offshore wind farm assessments and is environmentally friendly, producing zero emissions. (Credit: Drone image by David O'Connor, Intrepid Drone Services)

NEXT MONTH

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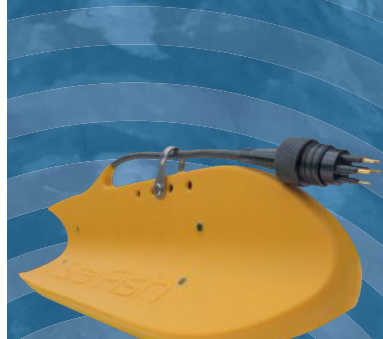
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Priorities for 'Meaningful' Ocean Protection

This year, the U.S. celebrated the 20th anniversary of the executive order calling for a national system of marine protected areas (MPAs). In 2000, a group of scientists and conservationists forged a common vision that led to the creation of a National Marine Protected Areas Center to strengthen and expand the nation's system of marine protected areas.

At Capitol Hill Ocean Week (CHOW) 2020 in June, the focus was on defining "meaningful" ocean protection. Six key priorities emerged from the discussions.

One is planning for climate change. Whether shielded by remote locations, or statute and management measures, or both, protected ecosystems demonstrate remarkable resilience recovering from disturbance. These benefits make protection a key tool in countering the effects of climate change. Protected areas and their managers need to adapt to the changing environment, including evaluating mobile protected areas that can help species adapt to climate change and its impacts.

A second is that science needs to inform protected area management. Meaningful protection of species and ecosystems requires us to understand what is needed to sustain biodiversity. An estimated 95 percent of the ocean remains unexplored, and 91 percent of ocean species are unclassified.

A third is that protection must be comprehensive. For protected areas to effectively sustain a healthy ocean and Great Lakes, they must be connected, comprehensive and representative. Protected areas should be designed with larger systems of marine protected areas in mind. These systems must adequately represent ecosystems present, allow for species movement, and protect corridors and refuges that animals will rely on due to climate change.

A fourth is that collaboration is essential. We have one global ocean. Collaboration is key to sustaining it. Across economic sectors, academic disciplines and national borders, partnerships and dialogue will drive successful ocean protection.

A fifth is that effective management and protection must engage diverse groups of stakeholders. Protected areas must be inclusive. This involves addressing concerns about access, as well as how goals for protection are set and how protection itself is understood. Natural resources and cultural heritage are closely intertwined, especially for groups with deep, long-standing ties to local waters. Protected areas must facilitate these relationships and incorporate diverse knowledge systems in their planning.

A sixth is that protection must include the high seas. The world's high seas are a crucial common resource. Unfortunately, they're also poorly understood and threatened by climate change, overfishing, shipping, plastic pollution and deep-sea mining. Effectively protecting the high seas is critical to ensuring sustainability of the world's marine resources.

The National Marine Sanctuary Foundation is proud to support the vision of the national system of MPAs executive order and the National MPA Center. Working with the Lenfest Ocean Program, we are launching the Marine Biodiversity Dialogues to assess where, and to what extent, the U.S. is protecting marine biodiversity, from the nearshore to the borders of our Exclusive Economic Zone. The framework will help decision makers, natural resource managers, and stakeholders at local, regional and national levels match biodiversity goals to ocean protection efforts, targeting the highest priority areas for biodiversity conservation. It will help define approaches to managing marine ecosystems that provide the necessary protection to sustain biodiversity and maintain marine areas for ocean, human and species health.

We are all stewards of our ocean and Great Lakes. These treasured places rely on us to be their voice in the halls of Congress, state legislatures, city halls and corporate boardrooms, advocating for greater protection and sustainable business practices that will help them thrive for future generations. **ST**

)) Pioneering Modular Vessel Design, Manufacturing. In the TrAM project, 14 partners are working together to develop a zero-emission, fast passenger vessel through advanced modular production. “Trying to change the industry’s perception of modular and more standardized vessels has been the biggest challenge,” said modular experts Tobias Seidenberg and Christoph Jürgehake of the Fraunhofer Institute for Mechatronic Systems Design IEM. The project is revolutionary both in terms of zero-emission technology and manufacturing methods, and will contribute to making electric-powered, high-speed vessels competitive in cost. Today, ships are often designed as one-offs, even though many of them are built according to almost exactly the same specifications. TrAM will create modules that can be reused across application cases. The modularity models from the automotive and aviation industry will be adapted. The proposed modular concept will be validated and refined through one physical demonstrator and two replicators. The demonstrator will be a zero-emissions passenger ferry that will service a multi-stop commuter route into the Norwegian city of Stavanger from January 2022. The replicators will be developed for the rivers and channels in London and Belgium.

)) First Atlantic-to-Mediterranean Saildrone Voyage. Two Saildrone USVs, known as SD 1030 and SD 1053, have completed the first-ever Atlantic to Mediterranean mission. This historic nine-month voyage began in Cabo Verde, off the coast of West Africa, entered the Mediterranean Sea through the Strait of Gibraltar, and finished in Trieste, at the top of the Adriatic Sea. SD 1030 and SD 1053 sailed a combined distance of 15,015 nautical mi. (27,810 km or 17,280 mi.). They had to deal with rapid marine growth in tropical waters, crowded shipping lanes in the Strait of Gibraltar, light winds, strong currents, transiting nine EEZs and interacting with six navies. With the COVID-19 pandemic as a backdrop, “This voyage has been a great demonstration of the resilience of unmanned systems to continue essential ocean science during troubled times,” Saildrone Founder and CEO Richard Jenkins said.

)) Cherokee Nation Team Honored for Deepwater Exploration Guide. NOAA’s Office of Ocean Exploration and Research is honoring a team of Cherokee Nation Strategic Programs employees for their dedication in helping explore and better understand the ocean. Shannon Hoy, Samuel Candio, Elizabeth Lobecker and Derek Sowers authored the



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first NOAA OER Deepwater Exploration Mapping Procedures Manual. In a formal letter of recognition, Chief Rachel Medley of the OER's Expedition and Exploration Division highlighted the team's "extraordinary effort, initiative and dedication" and noted the significance of their accomplishments, as well as the project's role in helping guide ocean mapping initiatives and deepwater exploring "for many years to come." According to Medley, the manual is the first of its kind and represents years of accumulated knowledge, best practices and procedures through expeditions conducted on NOAA Ship *Okeanos Explorer*. Currently, only 15 percent of the world's oceans are mapped to modern high-resolution standards. The NOAA Office of Ocean Exploration and Research is the only federal organization dedicated to exploring the global ocean.

)) Industry Study of US Offshore Wind Energy. The U.S. has an opportunity to accelerate offshore wind energy growth and benefit from 28 new gigawatts of clean energy and \$1.7 billion in U.S. Treasury revenue by 2022, a new study from research group Wood Mackenzie finds (www.noia.org/wp-content/uploads/2020/08/Offshore-wind-economic-impact-analysis-white-paper-final-1.pdf). The study confirms additional lease areas are needed to meet demand, reduce energy costs, increase competition, and ultimately generate thousands of jobs and billions in investment. Additionally, the findings offer guidance to decision makers about new offshore wind leases, which can be a short-term solution to jump-start recovery from a coronavirus pandemic-driven economic slowdown. Total investment in the U.S. offshore wind industry will be \$17 billion by 2025, \$108 billion by 2030 and \$166 billion by 2035. From 2022 to 2035, capital investment of \$42 billion will go to turbine manufacturers and the supply chain, \$107 billion will go to the construction industry, and \$8 billion will go to the transportation industry and ports. Annual capital investment for O&M activities will increase to \$2.4 billion in 2035.

)) US Coast Guard Turns 130. The U.S. Coast Guard was born August 4, 1790, just 14 years after the U.S. was founded, when Congress approved Alexander Hamilton's proposal to build 10 cutters to protect the revenue of the new nation. Initially, the Coast Guard was called Revenue-Marine, which merged with the Life-Saving Service in 1915. Since then, the Coast Guard has guarded U.S. waterways in peace and war, applying science and technology. **ST**

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Surveying Cobalt Crust

ROV-Based Coring Machine Supports Deep-Sea Mining

By Fumisato Tajima • Naoki Uto • Dr. Shinichi Takagawa

Cobalt-rich ferromanganese crust is a promising mineral resource covering the surface of deep seamounts. Its thickness ranges only up to 25 cm, but the coverage area is significant. This crust contains important metallic resources, including platinum. Details are summarized by the International Seabed Authority of the United Nations (ISA).

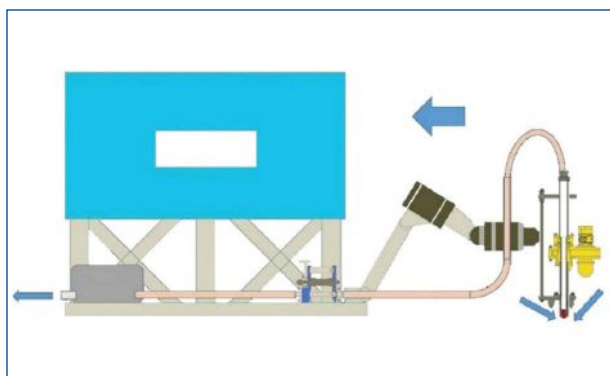
Before deciding to mine this resource from sites on the seafloor, it is necessary to estimate the total volume of each mineral by obtaining core samples from the area of interest. A conventional drillship is not good for core sampling of this thin crust. A benthic multi-coring system (BMS) is much smaller than a drillship, but it is not ideal because it has poor mobility over the seafloor.

We have developed a new coring machine that can be operated using a manipulator on a conventional work-class ROV or manned submersible. The operator pilots the machine onto a site on the seafloor to obtain core samples. When sampling is complete at one site, the vehicle moves to another location and starts coring again. This process can recover many core samples at different places on the seafloor during one dive of the vehicle. Multiple dives for core sampling will reveal the area-to-area differences of mineral content, and the data can inform decisions for industrial mining.

Design Basics

The coring machine is a small, lightweight payload on an ROV. The vehicle operator maneuvers the machine to the targeted point on the seafloor, and the machine is kept stable. The core sample is confirmed visually while the vehicle is on the seafloor. The direction of the core is determined, and damage to the core surface is minimal. Ten cores can be obtained during one dive of the vehicle, and each core is secured in its container.

The machine has a firm frame structure and two parallel cylinders to push down and elevate the drilling head. On the bottom of the frame structure, three thorn-like



Basic layout of ROV with manipulator and coring machine.

protrusions are prepared for counter torque of drilling, and a support ring for bit is prepared to stabilize the cut-in motion of the bit into bare rock. Drill pipe comprises an outer rotation pipe that drives the bit and an inner nonrotating pipe that scratches a line and snaps the core. On top of the drill pipe, a flexible semitransparent hose is connected, and the other end of the hose is connected to a core rack. The core rack has 10 transparent core cases with a revolver-type mechanism. Behind the core rack, a suction pump produces reverse circulation water flow.

Size

Conventional coring sizes are 60 to 100 mm in diameter, which necessitates a machine of large size and weight to avoid disturbance at the center of the core. This applies to an unconsolidated soil core, but a consolidated rock core is a different case. Cobalt crust is consolidated rock, and only cores of smaller diameter are needed. A core diameter of 30 mm was selected in order to get a diameter a little larger than 1 in.

The core samples must contain not only the crust but also the rock beneath the crust for research on crust formation processes. Penetration length of the first machine

model was 220 mm, later elongated to 370 mm in the second machine model.

Clear Vision

Conventional coring supplies drilling water to the surface of the seafloor through the drill pipe, and this creates a thick cloud of sediment that obscures the visual field of the operator. The newly developed machine uses a reverse circulation method for drilling water. The suction pump creates reverse circulation of water flow, and the water enters at the bit position into the drill pipe, and after running into the hose and core case, the water goes out behind the suction pump. The seawater around the coring point is sucked at the drill bit position, preventing the formation of a sediment cloud and enabling clear vision at the drilling site.

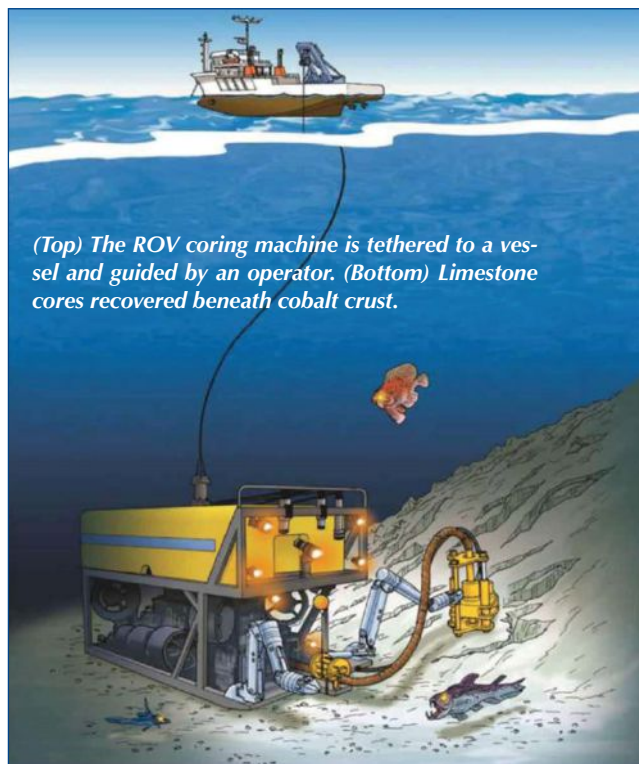
Easy Handling

Once the vehicle is placed on the targeted location on the seafloor, the coring operation starts. The machine operator is requested to handle the frame structure by manipulator. Additional downward force by the vehicle is not necessary while the machine is set within $\pm 10^\circ$ from the vertical attitude. Only the manipulator is required to keep the machine stable. However, when coring a vertical wall, a larger vehicle is required to pick up and hold the machine on the vertical wall with some pushing force.

Core Recovery

When the outer rotating pipe is driven, the bit rotates and the seafloor is excavated, retaining a circular pillar-like core in the center of the drill pipe. The core enters the nonrotating inner pipe. The inner pipe is not a straight pipe; it has an inside inclination at the entrance. Due to this inclination, the deeper the core enters the pipe, the larger side force the core receives. Finally, the core is snapped off from the mother rock.

As the drilling water is running around the snapped core in reverse direction, the core enters the core case via hose. The hose is semitransparent and the core case is transparent, so the color of the cuttings is apparent. The color gives information about the rock being drilled,



(Top) The ROV coring machine is tethered to a vessel and guided by an operator. (Bottom) Limestone cores recovered beneath cobalt crust.



and the operator can adjust the rotation speed and/or pushdown speed. Also, the movement of the snapped core in the hose and the trapped core in the core case can be clearly seen. Thus, the core recovery can be confirmed.

Instead of a solid full-length core, this machine can obtain several pieces of short, snapped cores that constitute full length. As the snapped core leaves the mother rock soon after the break, the snapped surface remains fresh, and the full-length core can be easily reconstructed in the laboratory.

Direction of Core

The core is a circular pillar, so the original direction of the rock is usually very difficult to determine. However, a new method was introduced to find the original direction of the core. A hard chip is fixed at the entrance of the inner nonrotating pipe, and this hard chip creates a scratched straight line on the surface of the core. This scratched line helps to reconstruct the snapped cores into a full-length core by aligning the scratched lines into one line. This line gives the original direction of the mother rock by referring to the direction sensor fixed on the machine. It can be utilized for geomagnetic analysis.

Less Damaged Core

In the case of conventional single-pipe drilling, the inside surface of the drill pipe rotates around the core, and the core is often eroded by abrasion or broken by collision with the running wall of the drill pipe. The inner nonrotating pipe of the new machine can solve this problem. Although the inner pipe has an inclination and part of the core receives side force and friction, the other part receives no force. Thus, a less damaged core can be obtained. Laboratory tests showed that coring limestone with single-pipe drilling could obtain only powdered limestone, but perfect circular pillar-shaped cores could be obtained by the double-pipe system of the new machine.

Multi-Core Recovery Per Dive

While coring, the flow line of the drill head through the hose, core case and suction pump is in alignment,

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and the snapped core enters a core case, where a mesh secures the core. After the full length of snapped cores is secured in the core case, the core rack revolves one step for a new core case. After remounting the coring machine from the seafloor onto the vehicle, the vehicle can move to new sites for new cores without surfacing.

In the Field

Two operations have been carried out at sea so far with the new coring machine. The first was in 2018 at 400-m depth for cobalt crust, and the second was in 2019 at 2,000-m depth for limestone just beneath cobalt crust.

The vehicle used during these operations was the Hyper-Dolphin ROV of JAMSTEC. The coring machine requires four hydraulic lines: drill head, cylinder, suction pump and core rack rotation. The Hyper-Dolphin has three hydraulic lines for payload, and these lines were connected to the first three gears. The core rack rotation was driven by pulling a ratchet gear using the ROV's manipulator.

The first operation revealed that high-speed rotation with a diamond bit was good for coring cobalt crust. The second operation revealed that low-speed rotation with a metal bit was good for coring limestone beneath cobalt crust. A trained operator should be able to complete a coring operation in about 30 min.

The operations at sea demonstrated the easy boring capability of the new coring machine, which can be applied to anchoring, seafloor devices and other purposes. Thus, use of the new coring machine can extend beyond deep-sea mining applications. **ST**



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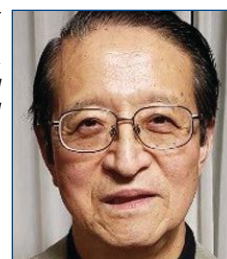
Fumisato Tajima is a mechanical engineer with KOKEN Boring Machine Co. Ltd. in Tokyo, with a background in electromagnetic measurement. He is in charge of machine improvements, laboratory testing and field testing for new drilling machines.



Naoki Uto is a division director and mechanical engineer for tool development with KOKEN Boring Machine Co. Ltd. He is involved in research and development of equipment related to submarine mineral resources.



Dr. Shinichi Takagawa is a technical adviser with KOKEN Boring Machine Co. Ltd. He is a naval architect and is developing various drilling/coring machines for underwater use based on his experience developing deep manned submersibles, a full-depth ROV and a drillship.



Monitoring Deep-Sea Mining's Effects

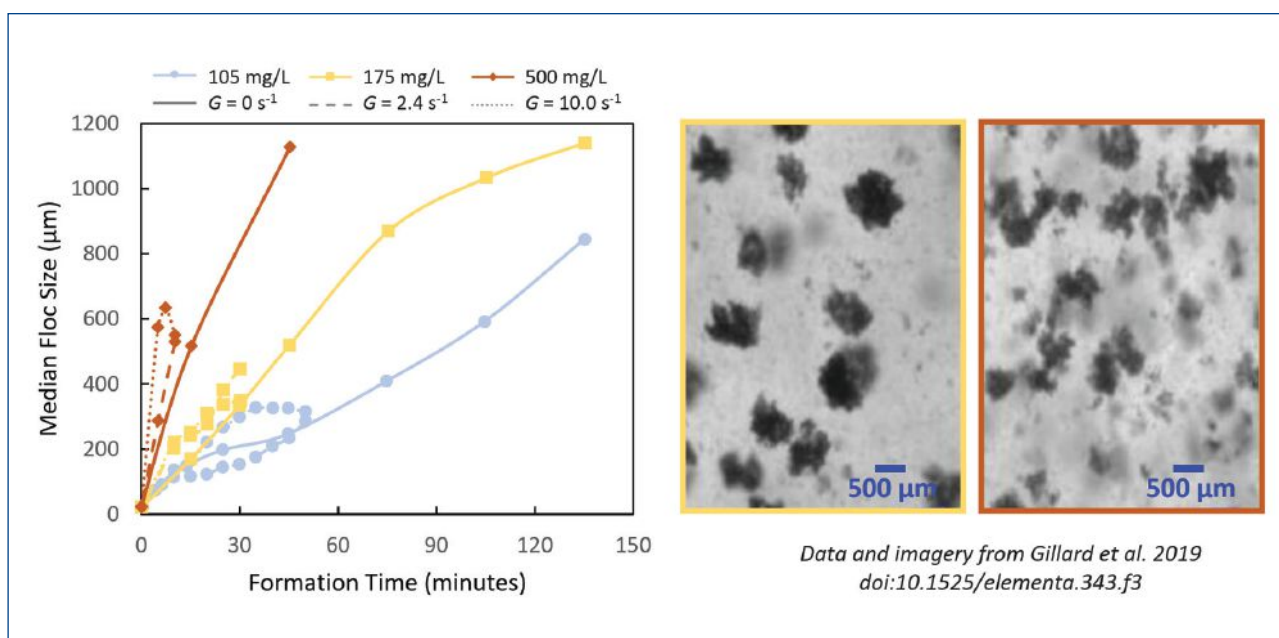
New Instrument to Measure Sediment Properties in Mining Plumes

By Dr. Wayne Homer Slade • Dr. Thomas Peacock • Dr. Matthew Alford

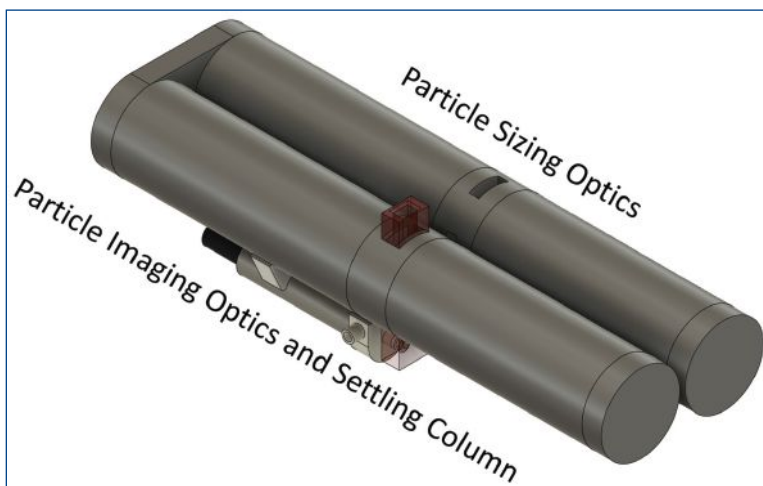
With the significant development of exploratory deep-sea mining activities, the demand for routine environmental monitoring in the deep sea has become pressing. Today, no commercial instrumentation exists that can monitor the parameters of importance for regulators and operators. A collaboration led by Sequoia Scientific Inc., the Massachusetts Institute of Technology (MIT) and Scripps Institution of Oceanography (SIO) has been funded to develop a commercial instrument for deep-sea environmental monitoring of mining activity.

The past decade has seen a substantial increase in activities surrounding the potential development of a global

deep-sea mining industry, with numerous governments and private companies developing research and engineering programs (see also Peacock and Alford, *Scientific American*, May 2018). The driving force for this industry is the existence in the abyssal ocean of vast reserves of minerals such as cobalt, nickel, copper and manganese—crucial components in advanced battery and clean energy technology for decarbonization of global economies. The minerals exist in a variety of forms in the deep ocean, including as polymetallic nodules, baseball-sized rocks lying on the seabed. Extraction methods involve driving a collector vehicle that harvests the nodules and a riser



Sediments from a candidate mining site were subjected to varying shear in the lab while observing particle size over time. Flocs readily form via settling as well as shear aggregation. Left panel: median floc size as a function of formation time, plotted for different initial concentrations (line color) and shear rate (line style). Middle and right panels: images of flocs formed during the experiment. Data and imagery adapted from Gillard et al (2019), CC BY 4.0 License, <https://doi.org/10.1525/elementa.343.f3>.



Submersible instrument housing concept with particle sizing imaging optics. Settling column is used to measure size-settling velocity distribution. In this concept, a pump is shown for flushing and pulling a sample into the column.

trations of sediment in the deep ocean is very limited. The standard approach since the late 1970s has been to use sediment trap technology that collects particles falling toward the seafloor, custom camera or video technology that can image particles, or laser diffraction-based instruments, such as Sequoia's LISST-100X and LISST-200X systems.

The basic sediment trap consists of a broad funnel with a collecting jar at the bottom. The funnel opening covers a standard area (typically 0.25 sq. m) and has baffles at the top to keep out very large objects. The traps are clamped to moorings at specific depths (e.g., 2,000 m to quantify flux from the euphotic zone, 500 and 10 m above the bottom to characterize flux to the bottom), or directly above the bottom

boundary layer where they can catch sediment near the ocean bottom. Such sediment traps are currently the only means for scientists to get hard data about the amounts and kinds of material transported to the deep ocean.

Sediment traps must be returned to shore for analysis and, for practical purposes, have no reasonable spatio-temporal resolution. One effort to advance the capabilities of sediment traps is the Sediment Event Sensor (SES) system developed at the Monterey Bay Aquarium Research Institute (MBARI) in California. This system introduced a mechanical cycling imaging and cleaning platform to allow a sediment trap to be reused many times and build up a time series of data. As with a standard sediment trap system, however, the size of the device imposes operational limitations and it also has no real-time capability.

For estuarine and near-coastal systems, the purpose-built INSSEV (IN Situ Settling Velocity) and INSSECT (IN situ Size and Settling Column Tripod) systems, which are deployable settling chambers with imaging capability, have been used to make in-situ measurements of particle size distributions and settling speeds, but these have never been modified for use in the deep ocean.

The LISST-STX was a laser-diffraction based system for measuring settling velocity in water depths down to 300 m. It was manufactured by Sequoia Scientific from 1998 to 2016. This is the only settling velocity instrument that has ever been commercially available; a total of 58 units were manufactured and sold.

Eisma developed a suspension camera in combination with an image analysis program to measure in-situ particle size of suspended matter with diameters of 4 microns and larger, capable of going down to 4,000 m (and with some adjustments down to 7,000 m). This general approach of using a floc camera or video system to measure particle size and/or settling velocity has been developed and deployed by a number of research groups over the past few decades and is well established.

All systems described above suffer from two major shortcomings: They have never been made commercially available (except the LISST-STX), and they cannot provide real-time or near-real-time data at high temporal resolution (measurement frequency of minutes or sec-

system that transports the nodules to the ocean surface.

A key concern surrounding deep-sea mining is the extent of the sediment plumes that will be generated by seafloor mining activities and how they will impact deep-sea benthic habitats. There is great uncertainty in predicting the scale of such plumes. The challenge is that given the persistent lack of funding for abyssal research, there is currently no technology capable of making the necessary in-situ measurements of suspended sediment properties (particle size distribution, settling velocity, concentration) that underlie plume prediction.

Regulatory Challenges

Exploration and exploitation regulations of the International Seabed Authority (ISA, see for example ISBA/25/LTC/6/Rev.1) dictate that anyone granted permission to operate on the seabed in international waters must gather environmental data on the properties of suspended sediment. Contractor field studies to date (for example, impact studies published by exploratory contractors GSR and BGR in 2018) and laboratory studies have provided some insight into the nature of the sediment that will be disturbed and transported by the water column. Typical particle sizes are in the range 5 to 50 microns, with a strong propensity to form 100 microns to millimeter-scale flocs with settling speeds in the range of 0.1 to 1 mm per second. However, the data obtained have been determined in lab-based environments, i.e., after the sediment has been removed from the ocean and the particle size distribution and packaging in and out of flocs has been disturbed. Currently no in-situ data exist, nor is there instrumentation to measure these sediment properties, and in real time, at depths of 6,000 m.

Current State of the Art

The current state-of-the-art technology for in-situ and/or real-time monitoring of the properties and concen-

onds) to the surface. To our knowledge, no underwater equipment manufacturer today offers a commercially available deep-sea settling velocity instrument. The only commercially available systems for PSD measurements in the deep sea are the LISST-Deep instrument system developed by Sequoia (rated to 4,000 m) and the HoloSea holographic camera from 4Deep in Halifax, Canada. The latter has a 500-m standard rating; however, 4Deep can provide custom models with a 5,000-m rating.

Developing a Solution

The state-of-the-art instrumentation is insufficient for the in-situ measurements of suspended sediment properties (particle size distribution, settling velocity, concentration) needed for plume prediction. The U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) recognized that these parameters were missing for responsible development and monitoring of deep-sea mining operations. Consequently, in a Small Business Innovation Research (SBIR) call in 2019, ARPA-E called for proposals to address these shortcomings.

Answering the call, Sequoia, MIT and SIO formed an R&D partnership that was subsequently awarded a grant to address this technology gap. The goal of the R&D project is to develop sensor technology capable of operating at depths of 6,000 m that can provide baseline environmental data prior to operations and underpin environmental monitoring and modeling of deep-sea polymetallic nodule mining operations. Specifically, an

instrument system that can provide real-time or near-real-time measurement of in-situ particle size distribution, settling velocity and concentration will be developed for integration on common deep-sea platforms, e.g., moorings, bottom landers and autonomous vehicles.

The partnership's approach is to perform a systematic and progressive technology R&D program that advances existing laser scattering, settling column and particle imaging technology for application to the deep-ocean environment at an operating depth of 6,000 m. Laser scattering technology will be developed to tackle the demands of operating in the deep-ocean environment for the purpose of making near-real-time measurements of particles smaller than 20 to 40 microns. In combination, image-based technology capable of measuring particle/floc sizes larger than approximately 40 microns and their associated settling speed will be packaged for the deep ocean. Both technologies will be combined into a single instrument package for integration with AUV, ROV and deep-ocean mooring mountings.

Broadly, technology development will be led by Sequoia. Once a prototype system has been collaboratively developed by the team and initially tested at Sequoia, MIT will test instrument performance and benchmark it against standard lab-based methods for measuring particle (including floc) size distribution and settling velocity as a function of particle size. Upon completion of these tests, the system will be adapted into a custom deep-ocean housing and SIO will test its performance at full



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operational pressure. The project team will then participate in preliminary ocean trials, initially deploying the instrument at depths down to 1,000 to 2,000 m, and afterward in an actual deep-sea mining exploration campaign or prototype collector test. Testing and refinement of a prototype instrument is expected during late 2021 into early 2022, followed by commercial availability in late 2022.

Besides the potential user base in the deep-sea mining industry, future users of the proposed new sensor could come from the ocean science, oil and gas, sediment transport, and coastal engineering sectors. An instrumentation package that can measure particle size, concentration and settling velocity in real time or near real time would be potentially attractive for scientists, managers and engineers in these sectors. For further information, contact Sequoia Scientific at: info@sequoiasci.com.

Acknowledgments

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References

For a list of references, contact Wayne Slade at wslade@sequoiasci.com. **ST**

Dr. Wayne Homer Slade is the vice president of science and technology at Sequoia Scientific. Slade received his M.S.E.E. focused on signal and image processing and intelligent algorithms and Ph.D. (oceanography) focused on ocean particle optics from the University of Maine. Slade specializes in the development and deployment of optical sensors in challenging ocean environments.



Dr. Thomas Peacock is a professor of mechanical engineering at the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts. Peacock received his B.S. from Manchester University, U.K. (physics) and D.Phil. from Oxford University, U.K. (physics). He is the director of the ENvironmental Dynamics Laboratory (ENDLab).



Dr. Matthew Alford is a seagoing physical oceanographer, the associate director of the Marine Physical Laboratory and co-founder of the Multiscale Ocean Dynamics group at SIO/UCSD. Professor Alford received a B.A. in astrophysics at Swarthmore College in 1993 and Ph.D. in 1998 from the Scripps Institution of Oceanography.





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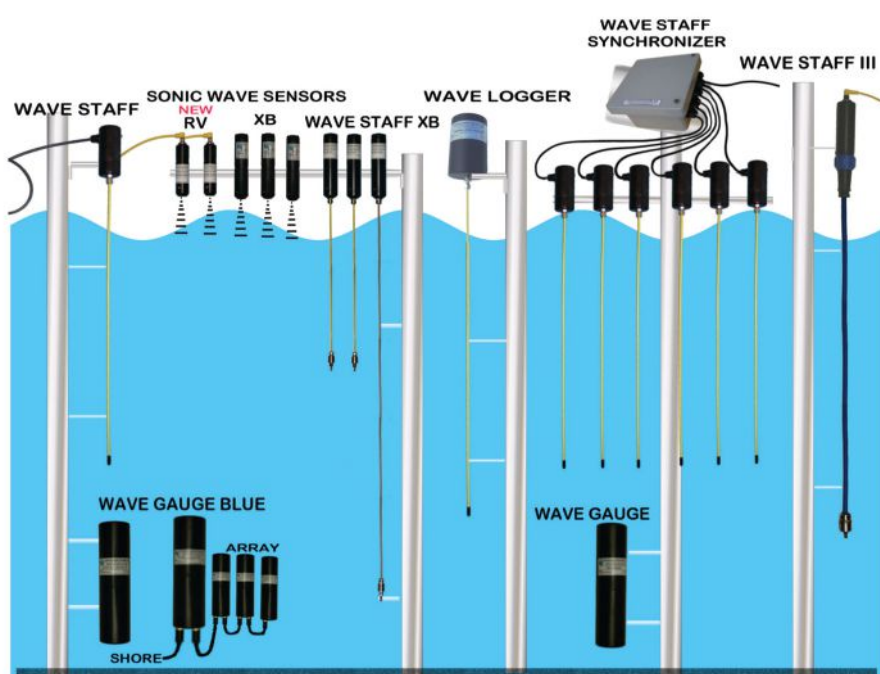
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Offshore Energy

This year, it is not business as usual. The COVID-19 virus disrupts every aspect of our daily lives. Companies all over the world are adapting to a new reality. To make good decisions in these confusing times, it is essential to have a broad view. Information from one's own sector and neighboring markets can help you spot business opportunities. Sharing knowledge with a community creates strong and valuable networks and sparks innovation. It all starts with connecting people.

Navingo believes that on October 27 and 28 it can present a successful edition of the Offshore Energy Exhibition & Conference in Amsterdam, an edition where face-to-face and virtual connections will be combined. Of course, there will be some restrictions with regard to the COVID-19 situation to make sure that people can connect safely in person. Safety measures in place will include wider aisles, one-way lanes, set routes, time slots for visitors, sanitation stations and reservation systems in different areas.

"Creating an exhibition during corona times is challenging. A situation as this forces you to think outside of the box to create solutions for the never changing need for people to connect," said Nancy Slob-Corpeleijn, project organizer of events at Navingo.

Connect Online And Offline

The goal is to provide an event that will allow exhibitors, visitors, speakers and sponsors to connect both online and offline with matchmaking, live roundtable discus-



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sions, webinars and presentations. While most of these concepts usually only come to life during an event, Navingo wants to expand some of these digital concepts to be available year-round, with the possibility to connect face to face at the exhibition.

One example, is the virtual booth. This addresses uncertainties regarding international travel, a situation made more challenging because travel policies vary per continent and country. By creating branded stands where the exhibitor and visitor can meet virtually using video conferencing, Navingo will be providing international exhibitors with exposure that allows them to participate without having to be physically present.

"These concepts will connect the event floor together with the digital environment of Navingo Career and recently launched Offshore Energy platform. In that way, we can service our customers and global audience regardless of their location," said Anne Visser, director of operations at Navingo. "We see these times as an accelerator for innovative initiatives. These new concepts will be an added value for our customers and clients, because they fulfill our main goals: connecting the offshore and maritime industry."

Offshore Energy Platform

The online Offshore Energy platform combines all the elements Navingo excels in, making the platform a connector of communities. Expect daily news from markets of interest, in-depth articles and vid-



“The energy transition and sustainable solutions are the main topics of focus on the new platform.”

eos, insights from industry leaders, an overview of the important players in the business landscape and job boards.

Offshore-energy.biz focuses on the energy transition. The driving force behind this is the state of the Earth. CO₂ emissions are warming up the planet and pollution is damaging ecosystems. To ensure a sustainable future, the energy transition must be set in motion. Being future-proof within the oil, gas, maritime, offshore wind and marine energy industries means being part of the energy transition and investing in sustainable solutions. This is the way forward, for our business and planet.

This is why the energy transition and sustainable solutions are the main topics of focus on the new platform. The communities—the offshore, maritime and energy industries—are front-runners in this change. A large part of the energy transition will take place at sea, and sustainable innovations will reshape the maritime sector.

By combining markets, Offshore Energy connects the gears that set the energy transition in motion. Maritime

ingenuity is needed to construct wind farms and infrastructure for other forms of marine renewable energy that are needed to meet energy demands. Electric power is transmitted by subsea cables. Oil and gas helps fuel the energy transition. Without dredging, ports cannot function. Everything is connected.

Offshore Energy offers insights and foresight, providing an overview of what is going on in our industries. The platform informs about projects, new products, companies, market opportunities and trends. It provides day-to-day news, combined with in-depth articles and videos.

For the platform, Navingo has combined the editorial power of Offshorewind.biz, OffshoreEnergyToday.com, LNGWorldNews.com, SubseaWorldNews.com, World-MaritimeNews.com and MarineEnergy.biz. If you want to narrow your focus, you can use the different landing pages for specific sectors. There is clear navigation online between markets, regions and topics. This makes it easy to look at your point of interest from every angle.

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ROV Combats Invasive Species

ReefSweeper Captures Lionfish in US, Caribbean Waters

By Marla Isenstein

Since their discovery off the North American coast in 1985, invasive lionfish, native to the South Pacific and Indian Oceans, have had a calamitous impact on marine ecosystems. Ichthyologists suspect the invasion began when aquarium fish were released into the wild off the coast of Florida. This species is particularly threatening because of their broad diet of native fish and crustaceans. The problem is compounded by the lionfish's ability to reproduce rapidly and their lack of natural predators. They compete with native organisms for limited resources, alter habitats, and can cause extinctions of indigenous animals and plants.

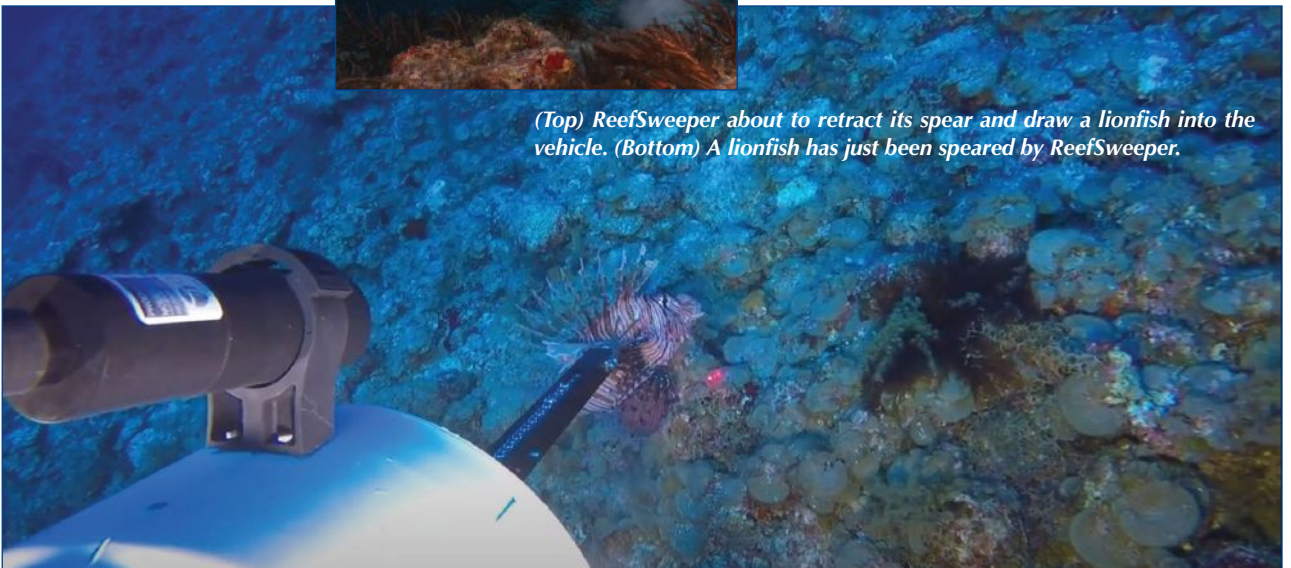
Past methods of catching lionfish using divers were limited by depth and subsurface

time restrictions and could be cost prohibitive. Alternative methods such as trapping techniques presented the undesired consequence of bycatch.

After the first sightings, lionfish exploded in population and are appearing in ever increasing geographic ranges. Flash forward to present day and lionfish have been observed from as far north as Rhode Island to as far south as Brazil; in the Atlantic Ocean, Caribbean Sea, Mediterranean Sea and the Gulf of Mexico. These voracious predators are known to consume over 50 species of fish, and postmortems show large numbers of fishlings in their stomachs. Their range extends from depths of less than 1 to over 300 m. Lionfish can thrive throughout a variety of habitats, including natural and artificial reefs, hard bottom, seagrass beds and mangroves. Lionfish distribution data have been collected by the U.S. Geological Survey since 1992, along with data



(Top) ReefSweeper about to retract its spear and draw a lionfish into the vehicle. (Bottom) A lionfish has just been speared by ReefSweeper.





(Top) A successful field trial yields a full containment cage. (Right) A bevy of lionfish ready to send to local restaurateurs.

from NOAA as well as other government agencies, academic researchers and community organizations, and the trend is clear: Lionfish are taking over.

Partnership

The loss of habitat and indigenous fish in seas around their hometown of Somerset, Bermuda, was especially poignant for Liz Martin and her husband Darius Martin. "Our community was really seeing changes caused by the increase in lionfish populations," said Liz. "For commercial fishermen, sport fishermen and the tourist trade, the erosion of our native fish populations and their replacement with lionfish was really starting to have an impact."

In 2017, Liz and Darius decided to take action, co-founding Atlantic Lionshare Ltd. with the goal of fending off the ever-increasing population of lionfish and a strategy to build a solution that could be rolled out wherever the invasive species was present. Their mission

was two-fold: to diminish the damage lionfish are currently inflicting on marine habitats by harvesting them in sufficient quantities with no bycatch, and to promote the consumption of lionfish and establish them as both a delicious and nutritious food source (lionfish has a white, flaky, mild, tender and tasty flesh that has been compared to snapper and can be prepared in numerous ways, including ceviche, grilling or pan-frying).

"After studying the problem for a while, it was evident that due to the depth the lionfish prefer, an ROV was the way to proceed," Liz said. So she set out on a quest to find a company that could help build an ROV to hunt lionfish.

The search led Atlantic Lionshare to SeaView Systems Inc., a Michigan-based underwater technology company with expertise developing a diverse range of custom ROVs and a track record of solving unconventional problems.

Atlantic Lionshare joined forces with SeaView Systems in late 2017 to design a custom ROV to eradicate lionfish populations and halt further degradation of delicate ecosystems.

Custom ROVs

SeaView's robust 20-plus-year history with ROVs illustrated its capabilities in designing and building custom ROV technologies. Expertise in control electronics, unique mechanical systems and overall ROV



configuration/modification has been SeaView's mainstay from the company's inception. SeaView also designs and markets a range of specialty electronics for various oceanographic and underwater applications.

SeaView's previous experience with custom ROVs includes the design of Chiton, a segmented, flexible ROV with ligaments that slacken and tighten to fit through narrow spaces and inspect up to 20,000 ft. (6.1 km) of tunnel; Titan, a battery-powered ROV that enables full video and profiling sonar survey for distances up to 32,000 ft. (10 km) of tunnel; and SurfROVer, a subsea crawler designed to operate in sea states up to level

three, with the ability to traverse from the challenging environment of the nearshore littoral zone to depth.

"We have been modifying inspection- and observation-class ROVs like the Saab Seavey Falcon and the BlueROV2 from Blue Robotics for years," said SeaView's Matthew Cook. "This particular project presented a unique combination of challenges, from exploiting our fiber-optic upgrades using our in-house designed mul-

tultiplexers to solving the interesting challenge of capturing and containing lionfish using an ROV.”

“SeaView brought together all the pieces for us,” said Darius. “From experience with a wide range of mechanical and electronics systems, an innovative spirit, and a roll-up-your-sleeves culture, SeaView was the team we wanted to work with to bring our vision to fruition.”

ReefSweeper Design

In order to take advantage of as much readily available technology as possible and keep the focus on the new innovations needed for this unique vehicle, SeaView and Atlantic Lionshare decided early on to build on a framework from an existing ROV for the prototype. They selected the industry standard Saab Seaeye Falcon based on its rugged design and SeaView’s longstanding familiarity with the platform based on the design of many previous modifications.

Early on, SeaView recognized that the final ROV design would pose complicated data requirements from a variety of inputs to support the operator.

While the standard copper umbilical used on Falcons had insufficient bandwidth, SeaView had vast ex-



The ReefSweeper’s record depth to date is 140 m/490 ft.

perience upgrading Falcons to fiber-optic communications. “We knew this would be a particularly sticky wicket and would take a lot of ingenuity,” said SeaView’s Geoff Cook.

“Our industry-proven fiber-optic umbilical upgrade kit was the perfect solution to get the data bandwidth we needed.”

The ReefSweeper custom ROV features backbone hardware designed to take advantage of two of SeaView’s 2.4-kW, 48- to 375-VDC subsea power supplies, the SVS-109 fiber multiplexers, and the SVS-309 two-channel HD-SDI video-to-fiber converter.

Then, the real work began. The design called for an extracting chamber, a spearing mechanism and a containment cage capable of carrying a payload of 150 lionfish. In addition, the design provides a wide-angle HD video camera for spotting fish, an HD camera for targeting the fish and two SD cameras, one for monitoring the fish extraction chamber and one for the containment cage.

The ReefSweeper adds three vertical thrusters to the standard Falcon, which provides a more stable platform, plus one more thruster for the fish extraction chamber. The operating system designed by SeaView builds on the Pixhawk flight controller and a customized version of ArduSub, once again leveraging existing technologies to get as far and as fast as possible.

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Success in the Field

Initial field trials were conducted in the summer of 2018 in Bermuda. After some learning experiences, ReefSweeper's performance met the primary goals of all parties involved, first and foremost, catching lionfish. Secondary goals such as seamless deployment off a vessel of opportunity, easy operation by a novice operator and general ease of maneuverability were also met.

"We are thrilled about the performance of the ReefSweeper," said Darius. "The ability to deploy the vehicle from a boat with only two crew members helps keep costs manageable."

For the past two years, the ReefSweeper has been operating in the Atlantic and Gulf of Mexico, pulling in fish from depths down to 140 m/490 ft.

Liz and her crew sell the lionfish to local restaurants, with profits going right back to Atlantic Lionshare to fund the operation.

"It really is satisfying seeing a slew of lionfish on the deck of the boat," said Liz. "We hope to have a fleet of



Lionfish for sale at a local market in Bermuda.

our patented ReefSweepers working to control lionfish populations in the near future."

SeaView plans to continue to push the envelope with innovative engineering designs, especially when used in combination with off-the-shelf products where suitable. This approach has been proven to be a win-win for SeaView and customers, saving time and money.

SeaView's Geoff Cook has literally tasted the rewards of this project at a Bermudian restaurant, where he was happy to see lionfish on the menu. "It's been a challenging but rewarding project to work on," he said. "How many problems can

you name where you can ultimately eat your way to a solution?" **ST**

Marla Isenstein received her B.S. in environmental engineering from the University of Michigan. Her responsibilities at SeaView Systems Inc. include testing and quality control of SeaView products, as well as technical writing.

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Protecting the Great Lakes

Monitoring Invasive Species in Ballast Water

By Emma Johnson • Dr. Mary Burkitt-Gray

The Great Lakes are a chain of deep freshwater lakes in east-central North America, comprising Lakes Superior, Michigan, Huron, Erie and Ontario. With their unique ecology and vast size, they are widely regarded as one of the Earth's great natural features. Although Lake Baikal in Russia has a larger volume of water, the combined area of the Great Lakes is over 244,000 sq. km, making them the largest surface of freshwater in the world. These gigantic basins were carved out by glaciers over thousands of years and filled by meltwater as the glaciers receded, resulting in the awe-inspiring lakes we find today.

The Lakes have been hubs of industry, trade and travel for hundreds of years. Lakes Erie and Ontario and the southern portion of Lake Michigan are now surrounded by high population densities, including the cities of Chicago, Detroit and Toronto. Urbanization and dense industrial activity, and the shipping that accompanies these, has resulted in rising pollution levels in the lakes. Since the late 20th century, the Canadian and United States governments and independent organizations have

dedicated significant resources to reversing the impacts of years of pollutant stress.

Commercial shipping is a potentially significant source of lake pollution. With over 100 ports, the Great Lakes have become a key driver for commercial shipping in North America, primarily for bulk cargo but also break bulk, containerized cargo and project/out-of-gauge cargo. Greenhouse gases from ship engines are a recognized contributor to global climate change and ocean acidification. Furthermore, invasive (non-native) species brought in through ballast water can have a devastating ecological impact.

Over 180 alien species have become established across the Great Lakes during the last 200 years, resulting in significant changes to the native ecosystem. The impact of this invasion is significant and widespread; the damage from these organisms costs hundreds of millions of dollars per year, threatens human health, and has a devastating impact on local industries such as tourism, fisheries and agriculture. Invasive species are challenging



Green Bay at Lake Superior. (Credit: Shutterstock)



(Inset) FastBallast. Lake Superior.

to eradicate because they often lack natural predators, and their sometimes uncontrollable population growth can threaten the natural biodiversity of habitats. It is extremely difficult to control the spread of an invasive species once it is established; thus, prevention is the most cost-effective approach to preventing further damage to the Great Lakes.

Species Introduction

Human activity, such as shipping, is the principal pathway through which non-native species enter the Great Lakes. The primary cause of aquatic invasion is firmly rooted in ballast water discharge, with some evidence suggesting that up to 65 percent of invasive species entered the Great Lakes via ballast tanks. In the years following the opening of the St. Lawrence Seaway in 1959, species not native to the Great Lakes were introduced at an unprecedented rate. These organisms, ranging from algae to mollusks to fish, continued to arrive unchecked year after year.

Zebra mussels, which were transported from the Caspian and Black Sea regions in the 1990s, are particularly pervasive. They have caused a host of problems, including clogging the water intakes of power generation plants and destroying native species' food sources. Zebra mussels are well known for their ability to fuse to any hard surface, growing in sharp clusters that can cut the hands and feet of swimmers, block pipes and foul boat hulls. As efficient filter feeders, they've dramatically changed the biodiversity of the Lakes by reducing the phytoplankton biomass in the waters they invade. The zebra mussel had previously colonized rivers and lakes across Western Eu-

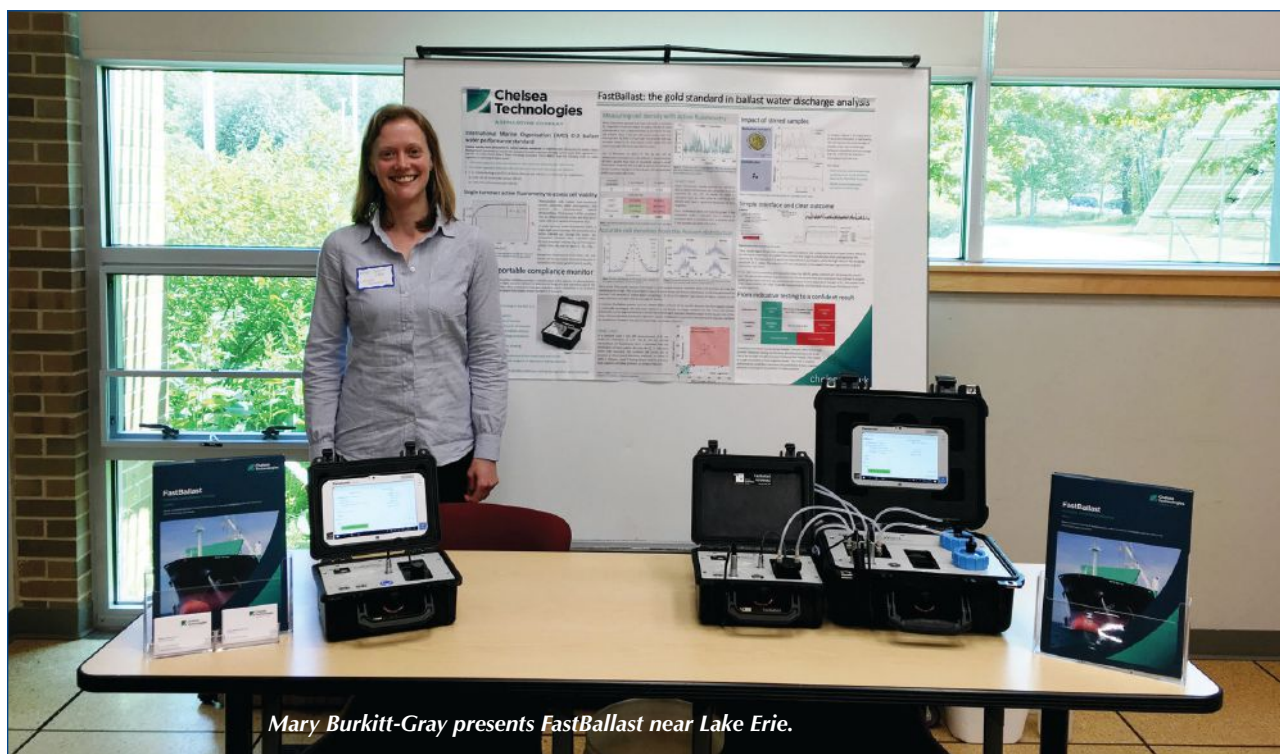
rope thanks to the region's extensive network of canals and widespread shipping.

Ballast Water Regulation Compliance

In part to address the mounting environmental concerns in the region, the U.S. federal government introduced the Vessel Incidental Discharge Act (VIDA) in 2018. VIDA restructures the way the Environmental Protection Agency (EPA) and the U.S. Coast Guard (USCG) regulate incidental discharges, primarily from commercial vessels, into waters of the United States and the contiguous zone.

However, the act has presented considerable challenges to industry. Some vessel operators have expressed concerns over the undefined nature of the compliance testing methodology required by the regulations. Having already made significant financial and logistical investment in ballast water treatment systems (BWTS), some operators have highlighted that it remains unclear whether systems will be able to comply with rapidly changing regulations in the future. Consequently, operators who are yet to invest in BWTS are looking for manufacturers who can demonstrate a robust solution that can future-proof their fleets against emerging regulatory standards.

In 2019, Chelsea Technologies was invited to take part in the Great Lakes Practicums to demonstrate the efficacy of FastBallast, our portable ballast water compliance monitor, alongside monitoring technologies from five other manufacturers. The Practicums were also an opportunity to introduce the FastBallast Flow Through unit, which can be installed on a ship for long-term ballast



Mary Burkitt-Gray presents FastBallast near Lake Erie.

tank monitoring. Attendees included state and federal authorities, shipowners, researchers and environmental organizations.

The primary objective was to demonstrate the usability and practicality of various compliance monitoring systems that are currently available. Each participant was provided with five samples of lake water to test for viable organisms, with dilutions ranging from “gross exceedance” of regulatory standards down to compliant or near-compliant organism densities. The samples were tested by representatives from each equipment manufacturer, and they also demonstrated the manufacturer’s methodology and discussed the scientific merits behind the various technological approaches. The samples were also analyzed using verification-level microscopy methods by scientists from the Universities of Wisconsin Superior and Minnesota Duluth. Due to sample size and experiment conditions, the collection of results was secondary to open discussion about the techniques and their applicability in the Great Lakes.

The Great Lakes present some unique challenges to ballast water monitoring equipment. Some regions contain high levels of dissolved tannins that result in a dark pigmentation to the water, presenting a challenge to fluorescence-based detection of organisms. In addition, some species of phytoplankton within the Great Lakes form large colonies or chains comprising tens or hundreds of cells. Counting individual cells within these structures is almost impossible without lengthy examination under a microscope. Because voyage times in the Great Lakes are often short, with ships hopping between ports only a few miles apart, rapid testing methods are essential. This requirement effectively rules out microscope-based analysis and drives interest in rapid detection methodologies.

FastBallast is setting the gold standard for such rapid

detection devices, in turn helping to reduce the impact of invasive species worldwide. Unlike microscopy-based analysis methods, where samples need to be assessed in laboratories by specialists in water microbiology, testing with Chelsea’s FastBallast compliance monitor can be carried out by any crew member during ballast water discharge operations, producing results in under 10 min.

FastBallast is a portable ballast water compliance monitor for use with discrete or flow-through water samples. It can determine the phytoplankton cell density of ballast water at the IMO D2 and USCG discharge standards (10- to 50- μm range) with accuracy and precision almost equal to microscopy techniques. FastBallast has an established presence in many locations around the world and is proving of significant interest to port and environmental authorities worldwide. Ultimately, FastBallast will help drive industry change by making compliance monitoring fast, easy and reliable.

FastBallast is a rapid and portable indicative monitor that incorporates single turnover active fluorometry (STAF) to provide an accurate assessment of living phytoplankton cells within a 20-mL stirred sample of ballast water. Rapid 100- to 400- μs STAF pulses allow FastBallast to generate a data set of 480 fluorescence measurements over 8 min. These data are analyzed in real time using a patented method based on Poisson theory to provide an accurate measure of phytoplankton cell density regardless of cell size. This is particularly important in the Great Lakes where a diverse community of phytoplankton exists.

FastBallast performed well in the Practicums in terms of usability and practicality. FastBallast provides a pass or fail classification in under 10 min., and its small size and water-resistant casing make it a truly portable instrument. Compared to laboratory testing, FastBallast measure-



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“FastBallast can significantly reduce invasive species’ ecological impact through ballast water discharge.”

ments can be performed without any scientific training and without the need for hazardous reagents, high-tech facilities or expensive consumables. Indeed, attendees commented on the attractive simplicity of operation and the rapid turnaround of results.

Other indicative analysis tools that were demonstrated at the Practicums had a range of measurement targets and technological approaches and some therefore faced inherent time, space, environmental and equipment challenges. Plankton communities and water quality in freshwater systems like the Great Lakes differ substantially from salt and brackish water systems on which their tools may previously have been tested. However, there was great interest in tuning the processes and technologies to better serve monitoring objectives in the Great Lakes.

Conclusion

Federal and international policy and requirements for ballast water monitoring are currently under development. Now is the time for stakeholders in the Great Lakes region and worldwide to identify their priority monitoring objectives and support the development of practical, relevant and reliable indicative ballast water monitoring approaches to meet these objectives in the unique and precious Great Lakes ecosystem.

FastBallast can significantly reduce invasive species’ ecological impact through ballast water discharge. Having been selected by the Canadian government in 2018 for a monitoring test pilot by the Great Lakes Laboratory for Fisheries and Aquatic Science, Chelsea Technologies continues to affirm its commitment to working closely with regulators, authorities and environmental experts to future-proof compliance with ballast regulations and protect the environment from further damage. **ST**

Emma Johnson has an M.S. in marine and aquatic biology from the University of Portsmouth. Her specialty is sales and marketing of Chelsea Technologies’ range of maritime products, including compliance monitoring of washwater from exhaust gas scrubber systems and ballast water discharge.

Dr. Mary Burkitt-Gray is a scientist at Chelsea Technologies with a Ph.D. in chemistry from King’s College London. She researches and develops ultra-sensitive fluorescence detection techniques.

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Furuno Makes Acquisition

Furuno has acquired the Danish company EMRI A/S, specializing in autopilots, steering control, joystick dynamic positioning and maneuvering systems.

EMRI is an original equipment manufacturer (OEM) supplier to several major industrial players with a large installed base.

Modus Mediterranean Survey

Modus Seabed Intervention Ltd. has completed bathymetric survey and inspection work at a new deepwater well exploration site in Mediterranean waters, offshore Israel. M-Surveys awarded the project to Modus, which used its latest 3,000-m-rated hybrid AUV (HAUV) system to complete the offshore scope of work in water depths up to 1,800 m, the deepest dive Modus has undertaken to date with an AUV.

ChartWorld ECDIS Approval

ChartWorld has received ECDIS type approval from the Japan MLIT (Ministry of Land, Infrastructure, Transport and Tourism) to support Japan-flag vessels. The certificate covers ChartWorld's eGlobe G2 system in touchscreen and regular configurations and ChartWorld's cyber-secure gateway, eChart Secure Gateway.

Singapore Still Top Shipping Hub

The Baltic Exchange, in collaboration with Xinhua, the Chinese state news agency, has published the 2020 Xinhua-Baltic International Shipping Centre Development (ISCD) Index. The index, in its seventh edition, ranks the performance of the world's largest cities that offer port and shipping business services.

Based on factors including port throughput and infrastructure; depth and breadth of professional maritime support services; and the general business environment, the latest report shows: the top five international shipping centers remain the same as in 2019; Singapore tops the list for the seventh consecutive year, followed by London, Shanghai, Hong Kong and Dubai; and there is a continued rise in Middle East and Mediterranean locations.

Governments Support Seafarer Protections

An international maritime virtual summit hosted by the U.K. government featured 12 other governments pledging their support for actions needed to ensure the welfare of the world's seafarers during the COVID-19 pandemic, including making sure that crew changes can take place in a safe and timely manner.

The government representatives at the summit expressed support for recommendations made by the International Maritime Organization (IMO) developed in consultation with industry groups, which encourage all IMO member states to support crew changes by implementing measures to facilitate movement of key personnel, notwithstanding the tightened border restrictions imposed due to the pandemic.

European Rep for Arctic Rays

Arctic Rays LLC has named Hamburg-based Ing.-Büro G. Pinnow (IGP) as its European sales representative.

Markus Weis is the principal force at IGP. He has broad experience with technical products used in the deep-ocean environment.

Cutting Manufacturing's Carbon Emissions

DNV GL has launched an international industry consortium in collaboration with Dutch glass production expert company Celsian to develop the technology required for a gradual transition from natural gas to hydrogen as a fuel in energy-intensive industrial production processes. The program provides an important building block for the successful rollout of the sustainable hydrogen value chain.

A major challenge for energy-intensive industrial production processes is to make existing heating processes carbon-free. As electrification is often not an option, a fast and sustainable route to reduce the carbon intensity for industrial heating processes is to substitute natural gas with hydrogen.

Bibby HydroMap Auctioned Off

Gordon Brothers, a global advisory, restructuring and investment firm, has successfully sold the assets of Bibby HydroMap Ltd. through BidSpotter.com, an online auction website for industrial goods.

Formerly known as Osiris Projects, Bibby HydroMap was established in 1997. The company provided hydrographic, geophysical, unexploded ordnance, and ROV and asset inspection surveys.

Teledyne Impulse-PDM Distributor

Teledyne has appointed Groove Associates Ltd. as an official distributor of Teledyne Impulse-PDM. Teledyne Interconnect (through Teledyne Impulse-PDM) and Groove Associates, having worked together as supplier/customer on connector sales, have now aligned strategies with an agreement including electrical and optical interconnection systems and dry-mateable, wet-mateable and underwater-mateable connectors from Teledyne Impulse, as well as mechanical, electrical and optical connectors from Teledyne Impulse-PDM.

Atlantic Coast Pipeline Canceled

Duke Energy and Dominion Energy are canceling construction of the 600-mi., \$8 billion fracked gas Atlantic Coast Pipeline. The project had become increasingly controversial as communities, environmental organizations and racial justice advocates raised concerns over the effects it would have on public health, water quality and the climate.

Chevron to Acquire Noble Energy

Chevron Corp. has entered into a definitive agreement with Noble Energy Inc. to acquire all of the outstanding shares of Noble Energy in an all-stock transaction valued at \$5 billion, or \$10.38 per share. The total enterprise value, including debt, of the transaction is \$13 billion.

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Fleet Addition for TDI-Brooks

The RV *Miss Emma McCall* has recently joined the TDI-Brooks' fleet of offshore research vessels. It is a multi-use oceanographic research vessel outfitted for a wide variety of oceanographic research duties for operations in the Northern/Southern Gulf of Mexico, U.S. East Coast and elsewhere in the Americas.

HII Strengthens Unmanned Focus

Huntington Ingalls Industries' (HII) Technical Solutions division has completed a strategic equity investment in Sea Machines Robotics Inc., a Boston-based company that specializes in advanced software for USVs. HII continues to expand in the rapidly growing autonomous and unmanned maritime systems industry. Earlier this year, it added UUV capabilities with the REMUS and Seaglider product lines through the acquisition of Hydroid.

Sonar for Canada's Biggest Yacht

FarSounder's Argos 500 forward-looking sonar system is set to be fitted on the largest recreational motor yacht ever built in Canada. At 164-ft. (50 m), the groundbreaking *Danzante Bay* is being built by Crescent Custom Yachts near Vancouver. The vessel is slated to launch in 2021 and will be fitted with some of the most advanced navigation technology available.

Crowley Aids Coronavirus Response

Continuing its uninterrupted supply chain services to government agencies, Crowley Solutions and its partners have completed the sourcing and delivery of 5 million N95 masks to the state of Maryland to assist its pandemic response. Crowley Solutions managed sourcing, purchasing, certifying, transporting, customs clearance and delivery to get the masks to emergency response and first responder personnel.

USCG Patrols Sitka During Pandemic

Personnel from U.S. Coast Guard (USCG) Sector Juneau continue to conduct missions in Sitka with assistance from small boat teams from Coast Guard Maritime Safety and Security Team Seattle through September. Mission goals include search and rescue, recreational and commercial vessel safety, and the protection of Alaska's fisheries. The Coast Guard and partner agencies will continue to maintain a regular presence on the water and conduct boardings at sea with special safety procedures in place during the COVID-19 pandemic.

Milestone for Composite Ships

The Realisation and Demonstration of Advanced Material Solutions for Sustainable and Efficient Ships (RAMSSES) project reached a milestone at Damen Schelde Naval Shipbuilding's location in Vlissingen-East, the Netherlands, where the recently assembled full-scale composite ship's hull section in development over the last three years was unveiled. This offshore vessel hull is one of 13 demonstrators of the RAMSSES project. RAMSSES will conduct testing to demonstrate the viability of large composite ships for sustainable shipping. **ST**

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\$9.5 Million in Grants from MARAD

The U.S. Department of Transportation's Maritime Administration (MARAD) has awarded \$9.5 million in grants to eight marine highway projects under the America's Marine Highway Program. The funding supports the enhancement of navigable waterways and expands existing waterborne freight services in Illinois, Indiana, Kentucky, Louisiana, New York, New Jersey, Oregon, Tennessee, Washington and American Samoa.

"This federal assistance will provide additional options to reduce congestion on the roads and help the surrounding local communities' and the regions' economic recovery," said Transportation Secretary Elaine Chao.

New NSF Director

Dr. Sethuraman Panchanathan was confirmed by the U.S. Senate to serve as the 15th director of the National Science Foundation (NSF). Panchanathan was nominated by the Trump Administration in late 2019 to succeed Dr. France Córdova, whose six-year term ended in March.

Panchanathan was the founding director of the School of Computing and Informatics and was instrumental in founding the Biomedical Informatics Department at Arizona State University (ASU). He founded the Center for Cognitive Ubiquitous Computing at ASU. In 2014, Panchanathan was appointed by President Barack Obama to the U.S. National Science Board.

Coastal Restoration in Texas

The Bureau of Ocean Energy Management (BOEM), U.S. Army Corps of Engineers (USACE) Galveston District and Texas General Land Office (GLO) have entered into a memorandum of understanding to address coastal restoration in Texas. This effort is intended to streamline and synchronize Gulf of Mexico sediment resource identification for Texas coastal protection and restoration projects and plans.

USACE and GLO have a combined mission that includes Texas coastal storm risk management and ecosystem restoration (CSRM/ER). A series of ongoing events, including sea level rise, land subsidence and reduced sediment, are resulting in the loss of beach, dune and wetland systems that act as a storm buffer to the mainland of Texas.

A framework will be developed to collect and share data and optimize engineering, economic and environmental criteria by matching potential sediment sources with future restoration projects and post-construction renourishment requirements. The plan will provide each group with robust communication strategies and shared resources to evaluate alternatives to maximize use of offshore minerals for CSRM/ER, applicable nationwide.

Bill to Phase Out Large Mesh Driftnets

The Senate has unanimously passed the Driftnet Modernization and Bycatch Reduction Act, a bipartisan bill to

phase out harmful large mesh drift gillnets utilized in the federal waters off the coast of California, the only place the nets are still used in the United States.

Large mesh driftnets, which are more than a mile long, are left in the ocean overnight to catch swordfish and thresher sharks. Other marine species, including whales, dolphins, sea lions, sea turtles, fish and sharks, can also become entangled in the large mesh nets, injuring or killing them. Most of these animals, referred to as bycatch, are then discarded.

Turtle Island Restoration Network has led a coalition of concerned citizens and partner organizations for nearly 20 years, working to stop the devastating impact of this driftnet fishery on sea turtles, whales, dolphins and other ocean animals. In 2018, California passed a four-year phase out of large mesh drift gillnets in state waters to protect marine life. The Driftnet Modernization and Bycatch Reduction Act would extend similar protections to federal waters within five years and authorize NOAA to help the commercial fishing industry transition to more sustainable gear types.

NOAA Report Shows Healthy US Fisheries

The 2019 Status of U.S. Fisheries Report from NOAA outlines the status of 461 managed stocks or stock complexes in the U.S. to determine which stocks are subject to overfishing, are overfished, or are rebuilt to sustainable levels. The overfishing list reached a record low. Of 321 stocks for which a determination can be made, 299 (93 percent) are not subject to overfishing. The overfished list rose slightly in 2019; one stock was removed from the overfished list (Gulf of Maine yellowtail flounder), but four were added (Pacific sardine/northern population, Atlantic Coast bluefish, Gulf of Maine white hake and George's Bank winter flounder). There are two once-overfished species on the rebuilt list: American plaice and Southern California cowcod. This brings the number of rebuilt stocks to 47 since the year 2000.

Also available are key economic data from the 2017 Fisheries Economics of the U.S. Report. Commercial and recreational fishing generated \$244 billion in annual sales (up 11 percent), contributing \$111 billion to the gross domestic product (up 8 percent) and supporting 1.74 million jobs (up 3.3 percent).

Encouraging Scientific Innovation for EPIC

The Earth Prediction Innovation Center (EPIC) was authorized by Congress to create a community-driven modeling system that leverages innovations from the broader weather enterprise. The U.S. House Subcommittee on Environment held a hearing where witnesses testified that EPIC must be independent, autonomous, and encourage participation and collaboration from the private and academic sectors of the weather community.

"Congress authorized EPIC to help the U.S. once again become the world leader in weather forecasting," said Chairwoman Eddie Bernice Johnson (D-Texas) and Ranking Member Frank Lucas (R-Okla.). "It is imperative that EPIC fulfill its legislative mandate of creating a truly community-driven modeling system." **ST**

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Compass Heading Data Logger



Starmon is a robust logger ideal for analyzing heading direction and tilt movements on subsea gear and robotics. It has multiple sensors in a compact titanium housing. In addition to heading, pitch and roll, and 3D tilt-acceleration, Starmon measures depth and temperature. Star-Oddi.

Rescue and Support ROV

Commander MK III Rescue was designed for manned submarine rescue and underwater operation support. The six vectorized thrusters are 800 W each, enabling speeds up to 7 kt. The ROV pilot has a high-resolution live image of the operation thanks to HD cameras. Mariscope Meerestechnik.

Weather Monitoring

Optimum Ship Routing and advanced weather services have been integrated into the digital chart table, NavStation. This combines all planning and routing processes on a single, cyber-secure platform. NAVTOR and Weathernews Inc.

Acoustic Sensing for Wells

Odassea is a joint subsea fiber-optic service that enables operators to execute intervention-less seismic imaging and reservoir diagnostics. It integrates hardware and digital systems in order to strengthen digital capabilities in subsea reservoir monitoring and production optimization. Halliburton Co. and TechnipFMC.

PAH Measurement Updates

Sea Sentry's new features are: an upgraded PAH+ sensor for scrubber washwater application; new solid standard to check the calibration status of the turbidity and PAH+ sensors; new connectors; increased cabinet protection; improved labeling; and reworked electronics enclosure. Chelsea Technologies Ltd.

Multibeam Sonar



WINGHEAD is a 1,024-beam echosounder, with the iconic NORBIT curved arrays, a frequency agility from 200 to 700 kHz, and a resolution of $0.5 \times 0.9^\circ$ at the center frequency of 400 kHz. Its weight in air is less than 7 kg, including mounting brackets and GNSS/INS. NORBIT US Ltd.

Next-Generation Antenna

The v240M Gen-II and Intelligent Mediator Gen-II enable auto-switching between C- and Ku-band communications, GEO and MEO satellite tracking, and management of up to eight antennas and modems. The antenna can be easily adapted to Ka-band for tri-band operation if required. Intellian Technologies.

Cable Protection

This patented integrated cable protection system is for interarray and export cables for fixed and floating offshore wind installations. It includes a combination of bend restrictors and a bend stiffener, foundation interface device, standard dynamic unit, and detachable pull head. Balmoral Comtec Ltd.

Vessel Data Conversion

LinkUp single-function gateway

modules convert vessel and engine information to NMEA 2000. On-board sensors measure liquid levels, temperature, pressure and other system parameters. Configuring LinkUp gateways is simple using a mobile device and the companion Veratron LinkUp Configurator app. Veratron US Inc.

Updated App

TZ iBoat's latest version includes: official raster and vector nautical charts (worldwide coverage); unlimited GFS weather forecasts and five premium models; 3D view and satellite images; routes, marks and catches in just one tap; all data accessible online and offline; optional radar and AIS modules; Iridium GO! compatibility; and automatic backup and synchronization via TZ Cloud. Nobeltec Inc.

Underwater Modem

VR4 UWM is for tracking and recording tagged fish populations. It is a submersible receiver capable of identifying all Innovasea coded transmitters and communicating data remotely to a surface modem on demand. The subsea acoustic communications are conducted via a fully integrated OEM version of Teledyne Benthos' CM-903 compact modem. Teledyne Benthos/Innovasea Systems Inc.

UV Sanitation Robot

This heavy-duty robot is capable of carrying out UV sanitation without human assistance. With the use of an included tablet, operators control and initiate commands wirelessly over Wi-Fi. The stainless steel bot is battery powered and has eight UV-C fluorescent lamps with a 360° beam angle configuration for maximum exposure. Larson Electronics LLC.

Environmental Management

EnviroManager+ is an add-on to EnviroManager that enables shipping companies to apply their own environmental procedures in an instant and deliver timely, position-based information and clarity across the fleet with location-specific policies. This ensures crews have the right in-

formation at the right time to make the best decisions. OneOcean.

Buoyancy Jacket

COBRA now has CE certification from SGS, marking compliance with essential EU regulations and harmonized standards, as well as leading industry standards such as NORSOK. The certification provides divers with added confidence in the equipment's ability to deliver reliable and high-performance support in hostile underwater environments. JFD.

Navigation Light Controller

5971 NMEA2000 controls the switching of LED navigation lamps and monitors each lamp's power draw, ensuring any lamp or wiring failures are monitored and an alarm is raised if necessary. The controller measures the power-on hours of each lamp and warns when they need replacement. Oceanic Systems (UK) Ltd.

GNSS Signal Splitters



Smart Power TW162 (one antenna, two receivers) and TW164 (one antenna, four receivers) offer system redundancy and fail-over capability. They support the full GNSS spectrum: GPS/QZSS-L1/L2/L5, QZSS-L6, GLONASS-G1/G2/G3, Galileo-E1/E5a/E5b/E6, BeiDou-B1/B2/B2a/B3 and L-band correction service. Tallysman Wireless Inc.

Coronavirus Containment

IQSafe safely isolates individuals who have been identified with any bacterial or viral infection, including COVID-19. Utilizing designated cabins, IQSafe will keep the air pure and free of pathogens while decontaminating surfaces. NEXT. **ST**

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Sercel Invests in Robots

CGG announced that Sercel has acquired a 34 percent shareholding in AMBPR, a start-up that designs and markets autonomous robots for repairing (sanding and painting) large metallic structures used in the maritime and energy industries. Sercel recognized the potential of AMBPR through Axandus, Sercel's Industrial Accelerator program, which helps start-ups to scale up their industrial growth. The two companies have also signed an exclusive industrial partnership agreement whereby Sercel will manufacture AMBPR robots. Sercel will increase its stake in AMBPR to 51 percent in 2021.

Cybersecurity Guidance

ABSG Consulting Inc. (ABS Consulting), a subsidiary of ABS focused on safety and risk management, and American Steamship Owners Mutual Protection and Indemnity Association Inc. (the American Club) have joined forces to provide education, training and insurance guidance that address maritime cybersecurity.

As digital transformation in the maritime industry brings both opportunities and new challenges, owners and operators are relying more on smart technologies and operational data to drive decisions and run their businesses. Comprehensive cybersecurity programs are not only necessary to protect operations but are also critical to protect the overall safety of crew and the environment. More frequent cyber attacks, increased digitalization and emerging global regulatory focus are adding to immediate demands to address and reduce cyber risk across the industry's value chain. Cybersecurity has become a business imperative, and new measures will have an impact on how maritime vessels and facilities will be covered by insurers.

Mako ROV Supervises Dive

Commercial diving contractor CanPac Marine Services used the SEAMOR Mako ROV to monitor conditions and assist CanPac's dive team as it replaced damaged diffusers on a stormwater outfall in a high current area offshore of Victoria, British Columbia, Canada, at a depth of 60 m (200 ft.).

CanPac's diving supervisor used the Mako to check the condition of the work site and scan for any potential hazards before deploying the dive team. The Mako also helped identify areas to focus on ahead of time so that divers could address them directly.

The Mako served as a second set of eyes enabling the supervisor to monitor the divers and the work site in real time to safely manage any developing hazardous situations. In case of emergency, the supervisor could have used the Mako to conduct the rescue of a diver.

International Standard to Reduce Cyber Risk

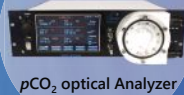
A new standard from ASTM International's ships and marine technology committee (F25) is designed to assist and support the maritime industry in addressing cyber



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risks by leveraging existing safety management systems (SMS). The new standard (soon to be published as F3449) includes guidelines to improve cyber safety, address vulnerability, recommend and outline training, and raise knowledge and awareness of cyber threats by leveraging documented, auditable SMS mechanisms. Most maritime operating companies have SMS as required by the International Maritime Organization's (IMO) International Safety Management (ISM) Code and, more recently, Subchapter M in Title 46 Code of Federal Regulations (CFR) for the tug and barge industry in the U.S.

DMO, RBR Collaboration

Del Mar Oceanographic (DMO) and RBR have signed a collaboration agreement for the provision of Wirewalkers with RBR CTDs and sensors in Australia and New Zealand. The DMO Wirewalker, originally designed at Scripps Institution of Oceanography, is a vertically profiling instrument platform powered by ocean waves. Attached to a free-drifting or moored buoy, it ratchets down along a suspension wire under wave power. At a predetermined depth, the ratchet releases and the profiler ascends at its terminal velocity (about 0.5 m/s), decoupled from sea surface motion. A very clean data record is obtained to within 1 m of the sea surface.

AUV Circumnavigates Atlantic

A Slocum G2 Glider named Silbo, manufactured by Teledyne Webb Research, has completed an over four-year journey circumnavigating the Atlantic Ocean in four legs, a first for an AUV. Launched in the early spring of 2016 from Cape Cod, Massachusetts, Silbo's journey included stops in Ireland, the Canary Islands and the U.S. Virgin Islands. Other than a scratched hull repair, the only maintenance that Silbo received during its stops was an external cleaning and a fresh set of batteries.

Propulsion for XOCEAN USV

XOCEAN aims to transform the way subsea data are collected. The

three-year-old company based in Ireland provides turnkey underwater data acquisition services with its growing fleet of innovative USVs. Thanks to Torqeedo's electric propulsion systems, they are nearly 100 percent emission-free.

XOCEAN's XO-450 USV is a composite wave-piercing catamaran powered by a pair of Torqeedo Cruise 2.0 electric pod drives, with a Power 24-3500 lithium-ion bat-

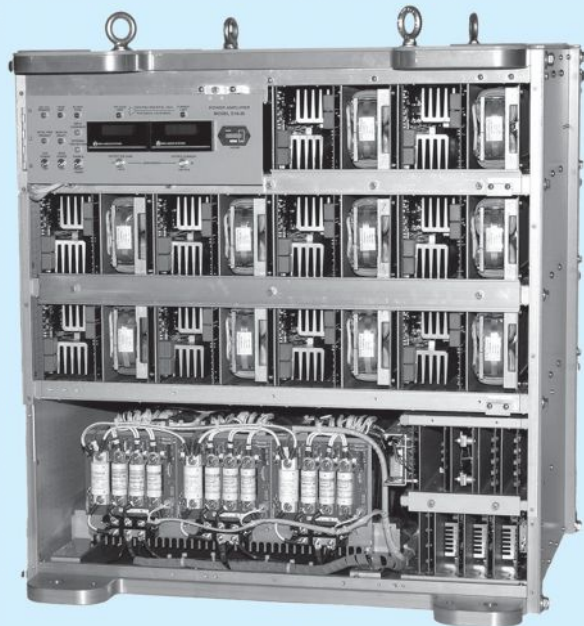
tery and a lightweight micro-generator. Solar panels on deck provide efficient recharging during daylight hours.

The two electric thrusters are controlled separately to adjust the speed on each side, steering the boat on the desired course. A pair of Torqeedo Ultralight outboards at the bows enhance the vessel's station-keeping abilities when gathering data. **ST**

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Drone Inspects FPSO Tank

A drone has successfully inspected a 19.4-m-high oil tank on board a floating production, storage and offloading (FPSO) vessel. The video shot by the drone was interpreted in real time by an algorithm to detect cracks in the structure.

Scout Drone Inspection and DNV GL have been working together to develop an autonomous drone system to overcome the common challenges of tank inspections. For the customer, costs can run into hundreds of thousands of dollars as the tank is taken out of service for days to ventilate and construct scaffolding. The tanks are also tough work environments, with surveyors often having to climb or raft into hard-to-reach corners. Using a drone in combination with an algorithm to gather and analyze video footage can significantly reduce survey times and staging costs while improving surveyor safety.

Partnership for Azerbaijan Market

Motive Offshore has signed a memorandum of understanding with Orca Offshore. The two-year agreement with the offshore design, fabrication and installation specialist focuses on Azerbaijan and is an exclusive agreement between the two organizations.

Together, the companies have already secured a six-figure contract with a major engineering, procurement and construction client in Baku, Azerbaijan, and plan to continue working together to bring their products and services to the local market in Azerbaijan.

Data for Fuel Efficiency

Norwegian shipowner Eidesvik has signed with Yxney Maritime to start using the Maress cloud-based system for data-driven decarbonization of vessel operations. The initial agreement is for six of the fleet's advanced offshore vessels.

The Eidesvik fleet has actively been used to test technologies such as LNG and batteries, as well as the

recent announcement to install an ammonia-driven fuel cell system on one of the vessels. Maress provides detailed insight into the fuel consumption and emissions from the fleet of offshore vessels.

Decom Market in Brunei

Decom North Sea (DNS) has made a landmark agreement to deliver a mutually beneficial relationship between its members and Brunei's growing late-life and decommissioning sector.

Darussalam Enterprise (DARE) was created to support the growth of small and medium Brunei local enterprises. As the Southeast Asian offshore industry's late-life and decommissioning phase begins to gather pace, the relationship with DNS represents a first for DARE in this particular sector.

Whilst typifying DNS's fundamental objective to connect sector capability with opportunity, the agreement also reflects the ongoing strategy, led by its Decommissioning Leadership Group, to internationalize the knowledge and skills of its supply chain member companies.

Myanmar Manages IUU

Vessel monitoring systems (VMS) will help Myanmar reduce illegal, unreported and unregulated fishing (IUU) and protect the sovereignty of its Exclusive Economic Zone. There has been a 90 percent decline in Myanmar's marine fishery resources in the past 40 years, and Myanmar's Department of Fisheries (DOF) has been very active in the last year to implement sustainable fisheries management systems.

A type approval process was launched to select the best VMS mobile terminal units, and CLS's Triton was selected. Now, all offshore vessels are required to have a VMS installed.

These offshore fishing vessels in Myanmar's national fleet are boats over 30 ft. in overall length, or with an engine of more than 25 hp. Offshore vessels are not allowed to fish within 10 nautical mi. from shore,

as that coastal zone is reserved for small-scale, traditional fishers and inshore vessels.

An approval process for VMS was launched, and CLS partnered with Myanmar firm AGB Communications and was one of six firms selected. CLS's Triton advanced VMS was type approved for use in Myanmar, with local delivery and installation by AGB. Vessel owners may purchase from any one of the six firms.

Out of the 3,238 offshore fishing vessels in Myanmar, 2,579 have now been installed with VMS.

Offshore Waste Disposal

ASCO has marked the launch of a transformative industrial waste disposal service with a contract award for its Waste Division from independent operator Serica Energy. The contract is a milestone in ASCO's Zero Waste to Landfill initiative, which has been created to support clients in the reduction of waste production by implementing locally assisted sustainable solutions for the onshore management of offshore waste.

Inspection Services in Angola

Oceaneering International Inc.'s Asset Integrity Group has secured a three-year contract with Cabinda Gulf Oil Co. Ltd. (CABGOC), a Chevron subsidiary. Oceaneering will provide inspection services onshore Cabinda, Angola, and offshore Angola on Blocks 0 and 14.

Interactive Online Tool

Trelleborg has developed the Mimir Offshore Interactive Environment, part of Mimir Digital Intelligence, the hub for digital solutions from Trelleborg's offshore operation. It is available at: <https://tinyurl.com/y2h3f8fk>.

The 3D tool showcases solutions available from Trelleborg for both topside and subsea applications, including solutions engineered for a variety of water depths, from shallow to deepwater. The tool allows users to navigate around different offshore environments, zoom in and out, and explore various oil and gas and renewable applications. **ST**

environmental monitoring

Metal Pollution in Baltic

Environmentally hazardous metals in the waters and sediments of the Baltic Sea is a major problem. Marcelo Ketzner and his research team from Linnaeus University conducted an expedition to map metal pollution and methane gas in the seabed. They are studying the levels of arsenic, mercury and cadmium in the sediments, and examining the amount of methane in the seabed and how much of that is emitted from the seabed into the water and air, thereby, increasing greenhouse gas in the atmosphere.

The researchers took part in an ocean expedition on the new RV *Svea*, led by Stockholm University and Geological Survey of Sweden. The expedition started ran from the far north to the far south of Sweden, sampling in 14 sites along the route to study water temperature, salinity, oxygen levels, sediment, methane gas, organic material and other chemical parameters.

Report on PAM in High Tidal Flow Environments

The Pathway Program has published a new report incorporating international expertise on passive acoustic monitoring (PAM) in high tidal flow environments. It was compiled following an online workshop in April 2020 that brought together over 40 PAM experts from Canada, Denmark, the U.K. and the U.S.

The Pathway Program is a multi-year collaborative initiative between the Offshore Energy Research Association and the Fundy Ocean Research Centre for Energy to improve understanding of fish and marine mammal interactions with tidal energy devices by defining, testing and validating an environmental monitoring solution for the in-stream tidal energy industry and increasing regulatory confidence in monitoring capabilities. One goal is to develop a toolbox of methods to be applied, with fine tuning, to as wide a range of applications as possible. The report advocates the need for open dialogue between regula-

tors and the research community, and that deployment methodologies and data processing algorithms should be adjusted based on the specifics of a given site or application and regulatory requirements.

The report can be downloaded at: <https://tinyurl.com/y34m4n9f>.

Global E-Waste Mounting

A record 53.6 million metric tonnes (Mt) of electronic waste was generated worldwide in 2019, up 21 percent in just five years, according to the UN's Global E-waste Monitor 2020, which predicts global e-waste (discarded products with a battery or plug) will reach 74 Mt by 2030, almost a doubling of e-waste in just 16 years. E-waste is fueled mainly by higher consumption rates of electric and electronic equipment, short life cycles, and few options for repair.

Only 17.4 percent of 2019's e-waste was collected and recycled. This means that gold, silver, copper, platinum and other high-value, recoverable materials conservatively valued at \$57 billion, were mostly dumped or burned.

According to the report, Asia generated the greatest volume of e-waste in 2019, some 24.9 Mt, followed by the Americas (13.1 Mt) and Europe (12 Mt), while Africa and Oceania generated 2.9 Mt and 0.7 Mt, respectively.

E-waste is a health and environmental hazard, containing toxic additives or hazardous substances such as mercury, which damages the human brain and/or coordination system.

Measuring pCO₂ via Glider

The ocean is a net sink for anthropogenic CO₂; without this oceanic uptake, atmospheric CO₂ would be significantly higher today than what is currently observed.

The impact of ocean acidification can already be perceived, and current projections suggest those changes will persist.

ALSEAMAR has integrated the mini CO₂ sensor from Pro-Oceanus

into the SeaExplorer glider rated to 1,000-m depth, which uses infrared detection to measure the partial pressure of CO₂ gas dissolved in water. In order to strengthen the understanding of CO₂ dynamics in the ocean, a SeaExplorer performed a campaign in the northwestern Mediterranean Sea during the first half of 2020. The glider was also equipped with a GPCTD-DO from Sea-Bird Scientific. This mission aimed to study the seasonal distribution of CO₂ at sea in both winter and summer. The data show temperatures and pCO₂ were lower in winter and higher in summer, with a measured increase of about 50 µatm.

This campaign highlights the potential of measuring pCO₂ with a glider for the scientific community.

COVID Marine Soundscape

AutoNaut has helped the Flanders Marine Institute (VLIZ) to seize upon the quiet of COVID lockdown to map the underwater soundscape of the Belgian section of the North Sea. Using its near-silent AutoNaut USV, VLIZ recorded current noise levels, which will be compared with the marine soundscape once normal sea traffic and marine activities restart.

This will help to determine the impact of man-made noise on natural sea life and the marine environment.

ADCPs Monitor Krill

Today, one-third of commercially important marine fish stocks in the ocean are suffering from the effects of overfishing. As krill is becoming an important supplement for fisheries looking to harvest new resources, sustainable management of krill fisheries has come to the fore.

Scientists at NOAA's Southwest Fisheries Science Center are working to understand the interactions between krill, their predators and the fishery by using a suite of moorings equipped with Nortek's Signature100 ADCPs and gliders deployed in the Antarctic Peninsula's waters. The moorings generate near-complete time series of biological conditions in the vicinity of fishing areas. **ST**

Electric First for US Navy

The U.S. Navy has taken delivery of the USS *Zumwalt*, its first full-electric power and propulsion ship. GE's Power Conversion business was the designer and provider for the high-voltage system (HV), propulsion drive trains consisting of multiphase converters and advanced induction motors (AIM) for the DDG-1000 class of futuristic destroyers.

FarSounder on NAVSEA USV/UUV R&D Project

FarSounder has been selected as a subcontractor on a research and development project led by GMATEK Inc. This project is contracted by the U.S. Navy's Naval Sea Systems Command (NAVSEA), Program Executive Office - Unmanned and Small Combatants (PEO-USC).

This research project will apply machine learning and deep-learning artificial intelligence technology to identify solutions and develop a system to mitigate and compensate for sensor degradation on board USVs and UUVs. GMATEK will include FarSounder's Argos 350 among the sensors.

LR to Certify Algerian, Thai Navy Vessels

Lloyd's Register (LR) has been selected to provide assurance and certification services to Hudong-Zhonghua

Shipbuilding Group (HZ) for projects with the Algerian Naval Force and the Royal Thai Navy. The Algerian Naval Force project, comprising a 96-m corvette, will be designed and constructed to LR's Naval Ship Rules. The corvette is designed for patrol, escort and protection of maritime interests within the nation's Exclusive Economic Zone. It is scheduled for delivery in 2022.

The second project comprises a 210-m landing platform dock (LPD) ship for the Royal Thai Navy. The expected delivery date is 2023.

More Gavia for Poland

The Ministry of Defence of Poland has procured, through Remontowa Shipbuilding, two additional Gavia AUVs for its second and third *Kormoran*-class new mine countermeasures vessels.

The anticipated delivery of two systems will be added to the current Gavia AUV fleet, which has already been successfully operated by the Polish Navy for mine countermeasures. To complement the Gavia AUVs previously procured, the acquisition will include all required topside equipment, as well as AUV operation and maintenance training.

Elbit Intelligence Tech for Southeast Asian Navy

Elbit Systems Ltd. was awarded a contract to provide and integrate intelligence suites on board vessels of a navy in Southeast Asia. The contract will be performed over a two-year period. Elbit Systems will supply and integrate comprehensive suites comprising AES-212 electronic intelligence systems, NATACS naval tactical communication intelligence systems and jamming capabilities, SPECTRO XR electro-optical payloads, M670 hull-mounted sonars, TRAPS towed reelable active/passive sonars, underwater communication systems, and combat management systems. The program also includes maritime radars, satellite communication capabilities and training services.

Drone Fleet for Mine Clearance

ECA Group awarded UMS SKELDAR a procurement contract to supply the UAV SKELDAR V-200 as part of the naval mine countermeasures capability replacement, a program led by Belgium Naval & Robotics (a consortium including Naval Group and ECA Group) that will supply 12 mine-hunters equipped with drone systems (Toolbox) to the Belgian and Royal Netherlands navies. This contract is the first to materialize the stand-off concept by using Toolbox, a system comprising a variety of drones to fulfill autonomous mine clearance missions at sea.

Offshore Patrol Vessels for African Navy

Israel Shipyards has made an agreement with an African navy for the supply of two OPV 45 offshore patrol vessels to combat the increasing threat of piracy in the region. The OPV 45s will be equipped with day/night observation systems and stabilized weapon systems, both Israeli-made. The agreement includes ongoing support and training of the technical and operational teams, and a maintenance program. **ST**

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contracts

COMSAT, Herndon, Virginia, is leasing an additional antenna at its Santa Paula, California, teleport. The 12.8-m antenna transmits and receives in both C-band and L-band frequencies, bolstering capacity for the tracking, telemetry and command (TT&C) and traffic operations of the Inmarsat satellite network. Inmarsat.

essDOCS, Swieqi, Malta, has entered a partnership to extend the use of CargoDocs electronic bills of lading (eBoLs) in India. The partnership will provide integrated electronic document capabilities, enabled by essDOCS' CargoDocs DocEx solution, accessed through the P-CaSo collaborative platform connected to PCS 1x, a modern port community system under the aegis of the Indian Ports Association. Portall Infosystems.

Mitcham Industries Inc., The Woodlands, Texas, and its wholly owned subsidiary, Klein Marine Systems Inc., have entered into an agreement with a major European defense contractor to jointly upgrade existing technology to create synthetic aperture sonar systems for commercial and military markets. Undisclosed.

OneOcean, London, England, will use its EnviroManager as the core environmental service across a shipping fleet to reduce environmental risks, avoid potential fines and help a shipping company pursue a competitive zero-spillage policy. Intership Navigation.

The Damen Shipyards Group, Gorinchem, Netherlands, has sold a full-option Cutter Suction Dredger (CSD) 500 to work on the ambitious waterways program in the province of Buenos Aires. Servimaginus.

OceanTools, Aberdeen, Scotland, has secured an order for the design and manufacture of highly specialized deepwater subsea housings, to be manufactured from super duplex

stainless steel. Proeon Systems Ltd., Safety and Control Systems Integration Co.

iXblue, Saint-Germain-en-Laye, France, will equip the CORAL project's new 6,000-m AUV with a Sams-150 synthetic aperture sonar, Phins C7 INS and Echoes 5000 sub-bottom profiler, and will use its Delph Software suite for SAS and navigation post-processing. Ifremer.

Claxton, Great Yarmouth, England, of subsea services group Acteon has signed a master service agreement covering Norwegian operations that includes Claxton's range of drilling support services and asset life extension and decommissioning equipment and services. Aker BP.

Silverstream Technologies, London, England, will install its air lubrication technology, the Silverstream System, on board eight newbuild LNG carriers being constructed at Hyundai Heavy Industries and Hyundai Samho Heavy Industries in South Korea. Knutsen LNG, JP Morgan Asset Management and Korea Line Corp.

Fugro, Leidschendam, Netherlands, has begun the geophysical survey phase of a large multidisciplinary site investigation contract for the East Anglia Hub project. The phased site investigations support the development of wind farms in the U.K. southern North Sea. ScottishPower Renewables.

ASL Environmental Sciences (ASL), Victoria, Canada, will perform a hydroacoustic study of eulachon fish (*Thaleichthys pacificus*) distribution in the vicinity of Deltaport Terminals off the mouth of the Fraser River for a mitigation plan to be used during dredging activities. Hemmera Envirochem Inc. and the Vancouver Fraser Port Authority.

Pelagic Research Services (PRS), Wellfleet, Massachusetts, will support ocean observatories with its deep-sea ROV Odysseus as part of a 14-day expedition this September. Ocean Networks Canada. **ST**

SEA TECH e-NEWS

Oyster Aquaculture Could Improve Potomac River Estuary
Oyster aquaculture in the Potomac River estuary could result in significant improvements to water quality, according to a new NOAA and U.S. Geological Survey study published in *Aquatic Geochemistry*. All of the nitrogen currently polluting the Potomac River estuary could be removed if 40 percent of the river were used for shellfish cultivation, according to the study. [Read more](#)

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

Ferry Sinks Off Coast of South Korea
With 462 passengers onboard, a ferry sailing from Incheon, South Korea, to the island Jindo sank near the southern tip of South Korea Wednesday, reported Associated Press. Most of the more than 400 people on the ship were high school students headed for a school trip to the tourist island. In the rescue effort, more than 80 vessels and at least 18 aircraft sought in to pull passengers from the water to safety. [Read more](#)

Pay Increase for Sailors Soon to Come
Sailors working for the U.S. Navy could see a pay raise in the coming weeks, reported the Virginia Pilot. On May 1, sailors serving the Virginia Fleet will receive a pay raise. The increase in pay comes as an effort by the Navy to attract and retain sailors. The Navy is also working to increase the number of sailors serving on the fleet. The bonus is a part of sea pay, an award who work in jobs involving long deployments. Currently, sea pay is between \$50 and \$700 a month. [Read more](#)

US Senate Reviews DOE Budget Request
For fiscal year 2021, the Department of Energy (DOE) requested \$27.3 billion. The U.S. Senate Appropriations Committee, Subcommittee on Energy and Water Development, held a hearing last week to review the funding request and discuss financial priorities. According to Lamar Alexander (R-Tenn.), research should be a focus of spending. [Read more](#)

US Technology Helps in Search for Flight 370
More than a month after Malaysia Airlines Flight 370 went missing, crews are hard at work trying to uncover what happened to the Boeing 777. Accurate signals emitted from the plane's black box, which houses records from the flight, provide a hint to the location of the plane, and eight countries are participating in the effort to scan the waters off the coast of Southeast Asia. Crews from the Sea Systems Command told Sea Technology how the U.S. Navy is helping in the search. [Read more](#)

2014 Sea Technology Buyers Guide Now Available
Published annually by Compass Publications, the 2014 edition of the *Sea Technology Buyers Guide* is now available. The buyers guide features a market analysis and seven sub-directories, including industrial firms, services, federal government organizations, educational institutions, nautical research vessels and geophysical survey vessels.

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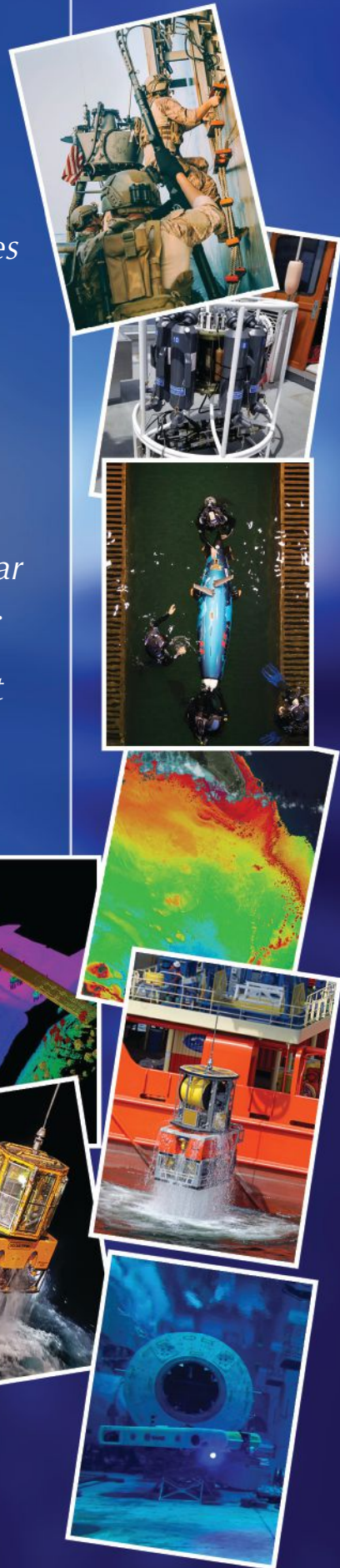
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meetings

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

OCTOBER

October 1-2—Offshore & Floating Wind Europe, Virtual. luke.brett@thomsonreuters.com or <https://events.newenergyupdate.com/offshore>.

October 5-8—AUVSI XPONENTIAL, Virtual. meetings@auvsi.org or www.xponential.org.

October 5-30—Global OCEANS 2020: Singapore – U.S. Gulf Coast, Virtual. <https://global20.oceansconference.org/participate/register-now>.

October 6-8—World Conference on Floating Solutions, Rotterdam, Netherlands. admin@pavingthewaves.blue or www.pavingthewaves.org.

October 11-16—SEG, Houston, Texas. exhibits@seg.org or <https://seg.org/AM/2020>.

October 12-14—Climate Risk Summit, London, England. +44 (0)20 7576 8118, events@economist.com or <https://events.economist.com/events-conferences/emea/climate-risk-summit-2020>.

October 14-15—OilComm, Houston, Texas. www.oilcomm.com.

October 14-15—World Ocean Tech and Innovation Summit, Halifax, Canada. oceanspeakers@economist.com.

October 20-23—EURONAVAL, Paris Le Bourget, France. www.euronaval.fr.

October 21-22—NOIA Fall Meeting, Virtual. www.noia.org.

October 26-28—Offshore Energy, Amsterdam, Netherlands. +31 (0) 10 209 2600, service@offshore-en

ergy.biz or offshore-energy.biz.

NOVEMBER

November 9-11—MAST Asia, Tokyo, Japan. admin@mastconfex.org. or <https://mastconfex.com/asia2020>.

November 3-5—Marine Renewables Canada Conference, Halifax, Canada. amanda@marinerenewables.ca.

November 5—North American Marine Environment Protection Association Annual Conference, New York City. j.devaney@namepa.net or <https://namepa.net/event/2020-annual-conference-and-awards-dinner>.

November 10-12—Marine Autonomy & Technology Showcase, Southampton, England. dcook@noc.ac.uk or <https://noc-events.co.uk/mats-showcase-2020>.

November 16-20—BlueTech Week, San Diego, California. www.tmapluetech.org/bluetech-week.

DECEMBER

December 1-3—Oceanology International, London, England. +44 (0)1202 669244, j.riegal@saltwater-stone.com or www.oceanologyinternational.com.

December 1-3—Pacific Marine Expo, Seattle, Washington. 206-282-6858, Ken@SaundersonMarketingGroup.com or www.PacificMarineExpo.com.

December 2-3—LNG Latin America & the Caribbean, Buenos Aires, Argentina. <http://LNGlatinamerica.com>.

December 8-10—UDT, Rotterdam, Netherlands. Charlotte.Aldrich@clarionevents.com or www.udt-global.com.

December 16-17—West Coast Defense Contracting Summit, San Diego, California. 202-552-0179, marketing@defenseleadershipforum.org or www.eventbrite.com/e/west-coast-defense-contracting-summit-2020-registration-106082497606.

2021

JANUARY

January 19-20—Floating Wind Solutions Conference & Exhibition, Houston, Texas. 832-862-3390 or <https://floatingwindsolutions.com>.

FEBRUARY

February 2-5—SMM (Shipbuilding, Machinery & Marine Technology), Hamburg, Germany. +49 40 3569 2445, nora.hirschfeld@hamburg-messe.de or www.smm-hamburg.com.

February 23-25—Subsea Expo, Aberdeen, Scotland. www.subseaexpo.com.

February 25-26—Floating Wind Solutions, Houston, Texas. <https://floatingwindsolutions.com>.

MARCH

March 2-4—World Ocean Summit & Expo, Lisbon, Portugal. ocean.summit@economist.com or <https://events.economist.com/events-conferences/emea/world-ocean-summit>.

MAY

May 18-20—Aquaculture UK, Aviemore, Scotland. +44 (0)1453 836363, www.aquacultureuk.com or carvonio@divcom.co.uk.

JUNE

June 15-17—Seawork and Marine & Coastal Civil Engineering Expo, Southampton, England. www.seawork.com and www.mcceexpo.com.

SEPTEMBER

September 13-17—London International Shipping Week, London, England. +44 1296 682104, ljacobs@elabor8.co.uk or <https://londoninternationalshippingweek.com>.

NOVEMBER

November 2-5—Aquatech Amsterdam, Amsterdam, Netherlands. +31 (0)6 51815306, a.koomen@rai.nl or www.aquatechtrade.com/amsterdam.

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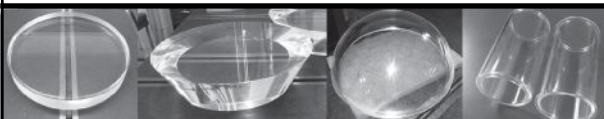
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Blue Tech Critical to Integrated Ocean Management—Amy Trice and Sandra Whitehouse

Amy Trice is the director of ocean planning at Ocean Conservancy. She is a scientist and a policy expert in ocean governance and integrated ocean management, particularly in the U.S.



Sandra Whitehouse (pictured) is a scientist and consultant at Ocean Conservancy who has served for over 20 years as an ocean policy adviser to multiple organizations and institutions, including as chief scientific officer for AltaSea.

The use of integrated ocean management (IOM) has accelerated over the past 15 years, and today, approximately 70 countries are in various stages of development and implementation.

While there has been significant progress, there is still a long way to go until the majority of ocean areas are understood, monitored and managed in a comprehensive manner. The need is especially pressing for developing countries that are building out their blue economies and for small island developing states that are on the front lines of climate change.

There is also a recognition that integrated ocean management needs to be a global effort, especially with respect to the global science and technology enterprise.

The goal is to balance ocean health and wealth. This approach received global attention and support through the publication of “Blue Paper 14: Integrated Ocean Management” by the High Level Panel for a Sustainable Ocean Economy, a multigovernment effort seeking solutions to develop the sustainable blue economy and conserve ocean ecological resources. It describes a planning process to achieve the overarching goal and presents five case studies from across the world where this approach has been implemented and lessons can be learned. The paper states that the

key elements of developing and implementing a plan are coordination among relevant management agencies, robust engagement of ocean stakeholders, including the ocean science and technology community, and utilization of the best available science.

One of the case studies outlines the ocean planning work in the Northeast region of the United States, which was catalyzed in large part by the drive to develop offshore wind farms. Developers supported the planning process primarily because permitting certainty is increased by elucidating areas that minimize conflicts with other users or ecological resources. These projects can contribute to decarbonization by providing renewable energy to densely populated coastal areas with high-energy demands. They also create jobs that pay well throughout the supply chain during construction, operation and maintenance.

Integrated ocean management plans can include hundreds to thousands of data sets about ecological resources, such as marine mammal migration routes, diving duck habitat, critical fish habitat and benthic sediment structure, as well as information about how the ocean is used, such as recreational boating activity, commercial fishing densities and commercial vessel traffic.

In areas where data are either missing or outdated, the costs associated with filling essential data gaps using traditional methods such as direct observations can be significant. However, as more and more “blue” technologies are developed and deployed to collect and analyze information about the ocean, the costs per sample are expected to come down, along with a shorter time between collection, processing and data availability. Ideally, real-time, spatially explicit data will become available for more and more ocean spaces.

Some examples of blue technologies that have been used so far include: robots to inspect wind turbine foundations; innovations in underwater communication pathways to make ocean data transmission easier; robots designed to look like fish in order to be unobtrusive in offshore aquaculture farm operations; and new uses of night vision technology for detecting marine mammals.

In addition to the myriad of blue technologies that are needed to support integrated ocean management, there are cluster organizations that are seeking to propel the development of these technologies. These organizations can be found throughout the world and include AltaSea, TMA BlueTech and SeaAhead in the United States and the Irish Maritime Energy and Resource Cluster and the Fórum Oceano in Europe.

Throughout the world, societies are seeking more and more from our ocean’s resources while a momentum grows to protect 30 percent of it by 2030. Integrated ocean management is a means to allow for sustainable development of the blue economy and to identify important ecological areas that need protection. Accelerated growth in the blue technology sector will be a major contributor to achieving that critical balance between exploiting the ocean’s wealth and looking after its health.

“As we face the real and growing impacts of the climate crisis and an ongoing global pandemic, we cannot rely on business as usual to move forward—not with the health of our ocean, the wealth of the blue economy and the wellbeing of coastal communities at stake,” said Janis Searles Jones, CEO of Ocean Conservancy. “Integrated ocean management is an approach to ensure conservation goals are prioritized for their contributions to a sustainable blue economy.” **ST**

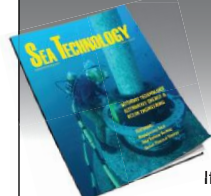
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