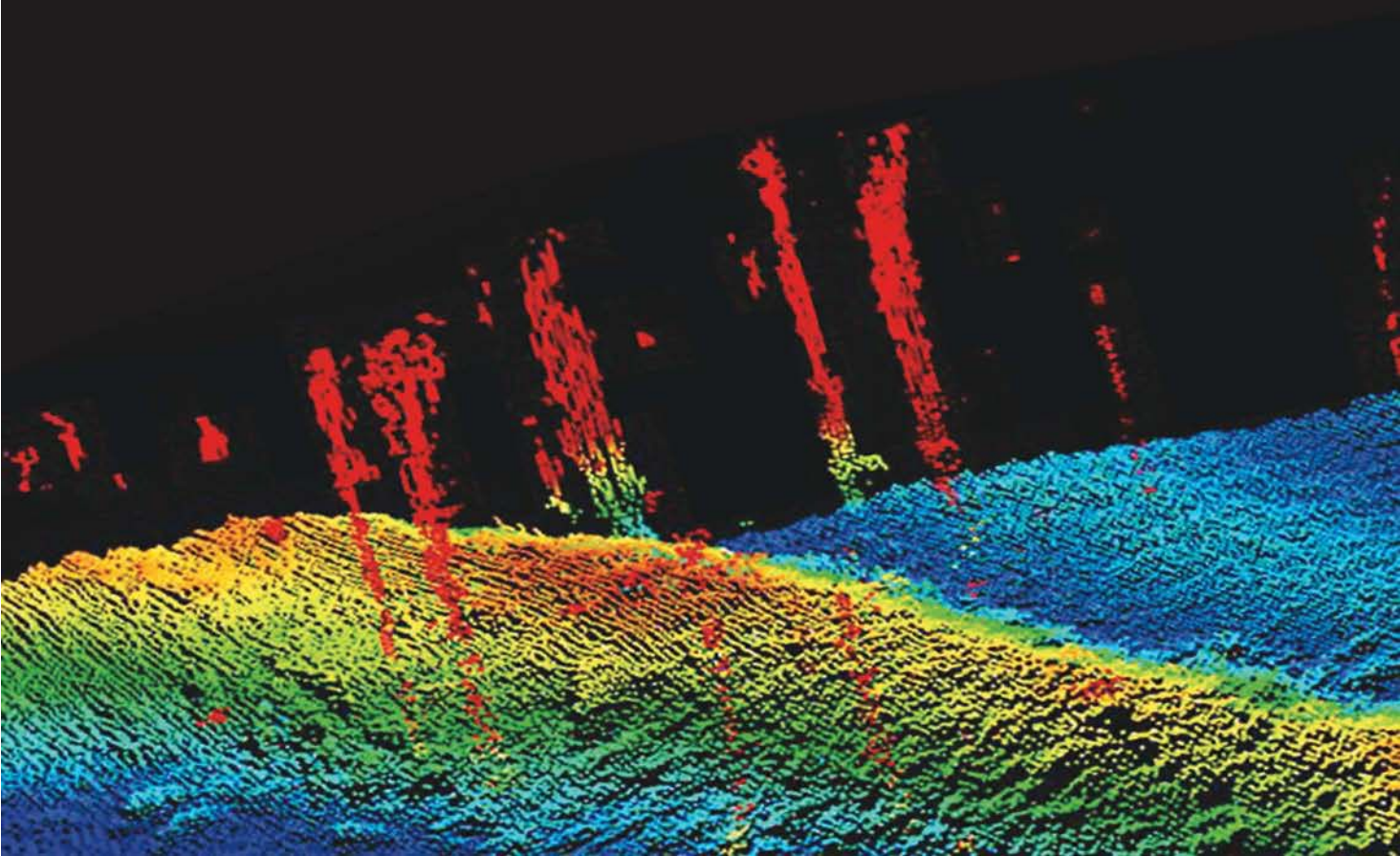


GET YOUR COMPANY DISCOVERED!

Our online *Buyers Guide* continues to feature Industrial Firms, Products and Services listings as well as those for appropriate educational institutions, geophysical survey vessels, and oceanographic research vessels.

Industrial Firms, Products and Services listings are featured in the print version of *Sea Technology's* Annual Review & Forecast issue.

VISIT OUR WEBSITE FOR MORE INFO
ABOUT GETTING YOUR COMPANY LISTED



SEA TECHNOLOGY[®]

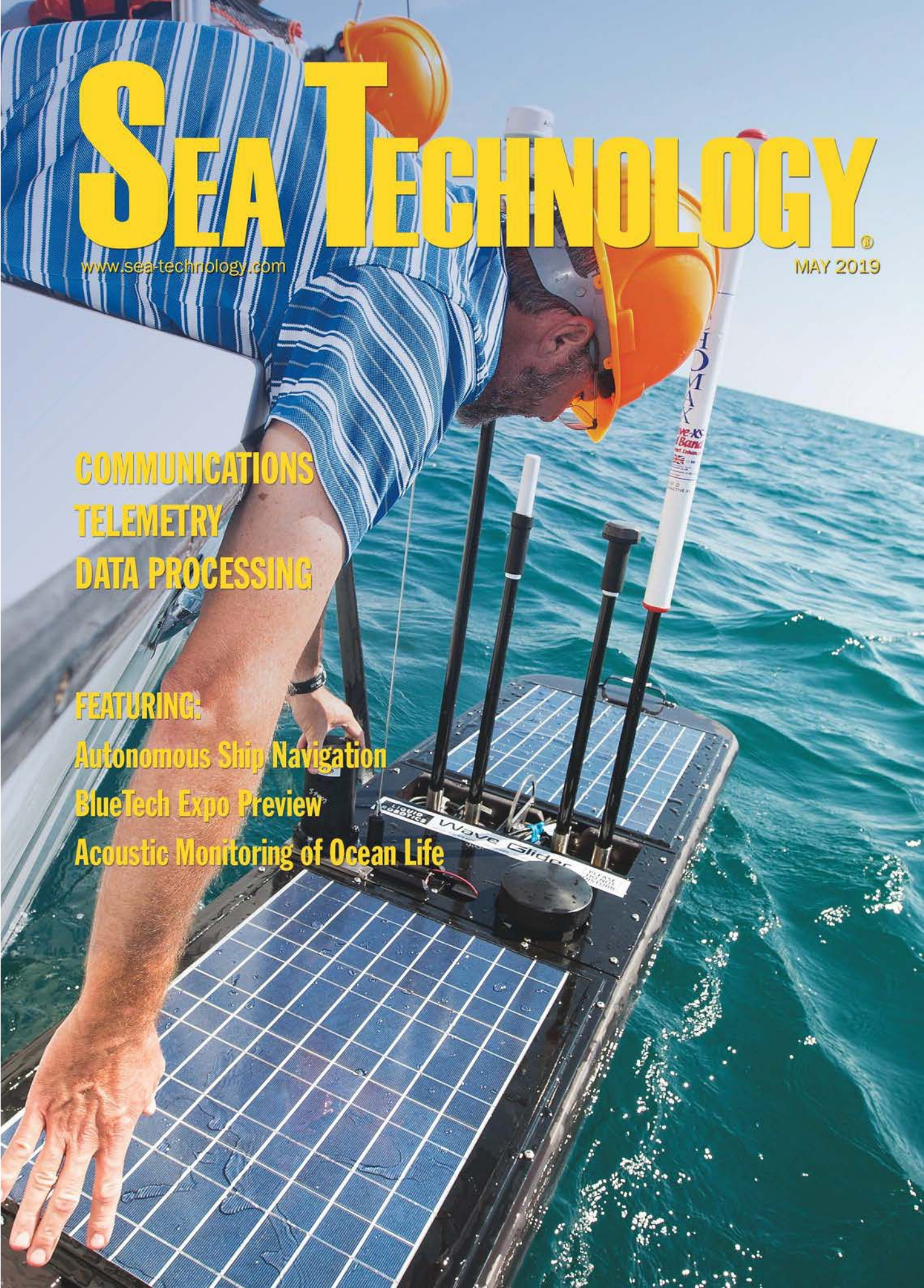
www.sea-technology.com

MAY 2019

COMMUNICATIONS
TELEMETRY
DATA PROCESSING

FEATURING:

Autonomous Ship Navigation
BlueTech Expo Preview
Acoustic Monitoring of Ocean Life





SEA-BIRD
SCIENTIFIC

SeapHOx™ V2

Ocean pH Sensor + CTD

Are you Looking for Stable, Long-Term pH Measurements?

The SeapHOx™ V2 is the optimal pH sensor for moored deployments. Here's why:

- High-accuracy ISFET pH sensor
- Proven long-term pH deployment stability (up to 1 year before recalibration)
- High frequency 6-second sampling speed
- Internal memory and batteries support over 760,000 samples
- Integrated pump and flow path with anti-biofouling measures



seabird.com/SeapHOxV2

seabird@seabird.com | +1 425 643 9866

metOcean
telematics

Connecting the oceans.

All 361,419,000 km² of them.

DOD PROVISIONING
GTS PROCESSING
DATA SERVICES
TRANSCIVERS
HANDSETS
MODEMS
AIRTIME



metocean.com



iridium



www.CSnetInternational.com • 321.327.7915



EXPERTS IN ***SUBSEA DATA COMMUNICATIONS***

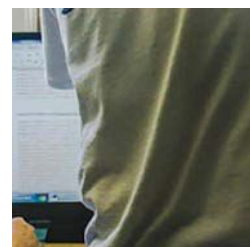
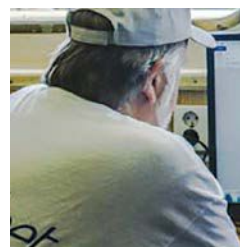
CSnet International provides broadband oceanographic, meteorological, seismological and hydrographic data services worldwide through the use of Ocean Observing Systems.



RELIABLE **END-TO-END SOLUTIONS 24/7**

CSnet owns and operates the Offshore Communications Backbone that provides researchers, engineers and decision-makers in science, government and the marine industry the most complete, accurate, factual and timely data available.

Get CSnet International on your team when you need reliable data streaming in the world's deepest oceans or in the harshest environments.



TYPICAL PROJECTS SERVED

- Environmental Assessment and Monitoring
- MetOcean Data Acquisition
- Ocean Observing Systems for Science & Industry
- Tsunami and Seismic Warning Systems
- Pipeline and Infrastructure Monitoring
- In-situ Sensor Evaluations and Sensor Integration



CONTENTS

MAY 2019
Volume 60, No. 5



enquiries@blueprintsubsea.com
sound by design

FEATURES

- 10** **TOWARD AUTONOMOUS SHIP NAVIGATION**
L3 Technologies, Unmanned Maritime Systems Division; Maritime & Coastguard Agency (MCA); and U.K. Hydrographic Office (UKHO) collaborate on formulating the future of maritime situational awareness data.
- 15** **BLUETECH EXPO**
—Event Preview
- 16** **LISTENING TO OCEAN LIFE**
Dr. Joseph J. Luczkovich, Dr. Roger A. Rulifson and Dr. Mark W. Sprague (East Carolina University) report on their project monitoring fish and marine mammal sounds with a Wave Glider.
- 23** **CLEAN PACIFIC**
—Conference Preview
- 24** **THE URBAN SHARK**
Dr. Chris Harvey-Clark (Dalhousie University) and Glen Dennison (Marine Life Sanctuaries Society, Underwater Council of British Columbia) discuss how manned submersible dives revealed juvenile bluntnose sixgills off the coast of Vancouver.



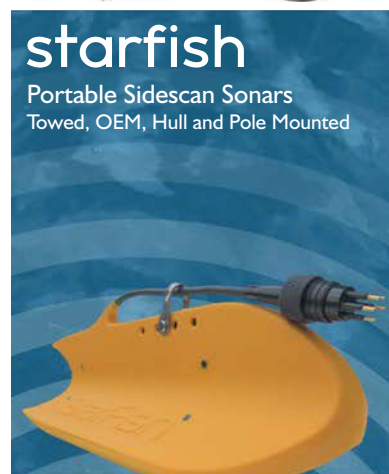
oculus

Multibeam Imaging Sonars
Single and Dual Frequency Operation



seatrak

Micro-USBL Tracking Beacons
Bidirectional Acoustic Data Modems



starfish

Portable Sidescan Sonars
Towed, OEM, Hull and Pole Mounted

DEPARTMENTS

- | | |
|-------------------------------|---|
| 7 Editorial | 36 Navy Currents |
| 9 Soundings | 37 Meetings |
| 28 Ocean Business | 39 Contracts |
| 30 International | 40 Professional Services Directory |
| 32 Product Development | 41 Soapbox |
| 34 Marine Electronics | 42 Advertiser Index |

COVER IMAGE

Real-time reports of the location of whale calls and recordings of fish spawning sounds were made recently off North Carolina with autonomous Liquid Robotics' Wave Glider (shown being launched) and submerged tow body with a passive acoustic monitoring system on board. (Credit: Cliff Hollis, East Carolina University)

NEXT MONTH

Toward a U.S. desalination hub... New dual-frequency sonar... Green hydrogen tech to fuel shipping... China's new seafloor observatory... Conference Review: NOIA Annual Meeting.

Copyright 2019 by Compass Publications, Inc. *Sea Technology* (ISSN 0093-3651) is published monthly by Compass Publications, Inc., 4600 N. Fairfax Dr., Suite 304, Arlington, VA 22203; (703) 524-3136; FAX (703) 841-0852. All rights reserved. Neither this publication nor any part of it may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior permission of Compass Publications Inc. Periodicals postage paid at Arlington, Virginia, and additional mailing offices. Subscriptions may be purchased at the following rates: domestic, \$60 one year; \$80 two years; foreign air mail, \$144. Single copies \$4.50 plus shipping and handling (current issue only). POSTMASTER: send address changes to Compass Publications, Inc., P.O. Box 600, Deer Isle, ME 04627-0600. CUSTOMER SERVICE, Tel. 1-800-989-5253 or 1-207-348-1057.

find out more
www.blueprintsubsea.com



Meet Me in DC™

The Ocean Technology Event Connecting Government and Industry

► **TECHNICAL PROGRAM – June 4**
Use Newseum C Street Entrance
Panels and case studies:



SAAB AUV-62 (photo credit: Saab Seaeye)

- Ocean Autonomy:
 - Vehicles/Sensors, Software, Control Systems moderated by Carl Gouldman, U.S. IOOS
 - Seafloor Residency/Long-Term Persistence moderated by Mike Wardlaw, ONR Maritime Sensing Group
- Ports & Harbors - Security & Safety: Moderated by Jason Smith, Director for Legislative Affairs, National Security Council/USCG
- Ocean Clean Up moderated by Nancy Wallace, NOAA Marine Debris Program
- Overcoming Export Challenges moderated by Ann Ngo, US Commercial Service

Register to Attend • Submit a Case Study online

► **EXHIBITION – June 5**
Use Newseum 6th Street Entrance
The latest advances in blue technology
and services on display
Free to Attend - Register in Advance online



(Photo credit: L3 ASV Global)



3:30 - 5:00 p.m.

Oceanology International invites you to a special **OceanSocial** Networking Function, held in the BlueTech Expo exhibition hall. Free to Attend. RSVP in Advance online

**THE EXHIBIT HALL IS NEARLY SOLD OUT
- BOOK YOUR EXHIBIT SPACE TODAY!**

Co-hosted by: House Oceans Caucus



SPEAKER
RDML Timothy Gallaudet
NOAA Assistant Secretary
of Commerce



SPEAKER
Margaret Henderson
Campaign Manager,
Stronger America
Through Seafood

Platinum Sponsor:



KONGSBERG

Additional Sponsors:



publisher C. Amos Bussmann
managing editor Aileen Torres-Bennett
assistant editor/ Amelia Jaycen
online news producer
production manager Russell S. Conward
assistant design/ Joshua Ortega
website manager
advertising Susan M. Ingle Owen
service manager

ADVERTISING REPRESENTATIVES:

HEADQUARTERS

C. Amos Bussmann
4600 N. Fairfax Dr., Suite 304
Arlington, VA 22203-1553
Tel: (703) 524-3136 • FAX: (703) 841-0852
seatechads@sea-technology.com

NORTH AMERICA, EAST COAST

Sue Ingle Owen
Advertising Service Manager
Tel: 703-524-3136
seatechads@sea-technology.com

NORTH AMERICA, WEST COAST

John Sabo
Barbara Sabo
Gregory Sabo
John Sabo Associates
447 Herondo St. #305
Hermosa Beach, CA 90254
Tel: (310) 374-2301
bsabo@jsaboassoc.com

EUROPE

John Gold
John F. Gold & Associates
"Highview"
18a Aultone Way
Sutton, Surrey, SM1 3LE, England
Phone/FAX Nat'l: 020-8641-7717
Int'l: +44-20-8641-7717
johnfgold@gmail.com



Sea Technology back issues available on microform.
Contact: NA Publishing, Inc.
P.O. Box 998, Ann Arbor, MI 48106-0998
1-800-420-6272

COMPASS PUBLICATIONS, INC.

4600 N. Fairfax Dr., Suite 304
Arlington, VA 22203-1553
Tel: (703) 524-3136
FAX: (703) 841-0852
oceanbiz@sea-technology.com
www.sea-technology.com

publishers of:
Sea Technology
Commercial Fisheries News
Fish Farming News
Commercial Marine Directory
Fish Farmers Phone Book/Directory
Sea Technology Buyers Guide/Directory
Sea Tech e-News

*Celebrating more than 55 years
of serving the global ocean community
- Since 1963 -*

An 'Oceanic Awakening'

If you connect things, you create greater efficiency, understanding and value. That's smart. Working in isolation is not.

It's with this fundamental truth that Roger Holm, president of Wärtsilä's Marine Business and one of the Lloyd's List Top 10 Technology Leaders 2018, leads the Helsinki-headquartered smart technology group's bold mission to create a fully integrated smart marine ecosystem.

The world's in flux; only a dozen years remain for global warming to be kept to a maximum of 1.5° C, and the world population is projected to reach 9.7 billion by 2050. The UN also estimates that 66 percent of the world's population will live in urban areas by 2050. Meeting the needs of a proliferating world population means increased demands on natural resources, increased pressure on city infrastructure and increased activities in shipping. As Sir David Attenborough recently stated: "If we don't take action, the collapse of our civilizations and the extinction of much of the natural world is on the horizon." We need to do something about this.

Ships are currently responsible for 3 percent of the world's CO₂ emissions. But given projected growth in world transportation needs, studies show that these emission levels are likely to increase significantly and could represent as much as 14 percent of the total global emissions by 2050. A significant dent in this grisly statistic can be made through minimizing ships' fuel consumption and transitioning to cleaner operations. Transforming our industry can quite literally transform society and bequeath to our children a better future.

Digitalization, with its multifarious benefits, is what Wärtsilä is unwaveringly focused on. The corporation wishes to use connectivity and digitalization to lead the shipping industry's transformation. Better port-to-port fuel efficiency, reduced congestion in ports and high-traffic areas, the introduction of real-time communication between stakeholders—these are the goals. But the feat requires collaboration across multiple segments and industry verticals and active involvement in leveraging emerging technologies to create new business opportunities to benefit all. The challenge truly lies in the fact that the marine industry is heavily regulated, extremely complex and fragmented, with many stakeholders pursuing different, sometimes diverging objectives.

In order to create a unified critical mass to instigate positive change, Wärtsilä launched "An Oceanic Awakening" in 2018—a global initiative focused on the radical transformation of the world's marine industry into one supremely efficient, ecologically sound and digitally connected ecosystem. The rationale stems from a need to look more actively at the industry's interaction with the surrounding environment and other stakeholders.

Subsequently, the SEA20 forum was inaugurated. Enabled by Wärtsilä, driven by think-tank Nordic West Office, this platform aims to bring 20 of the smartest and most ecologically ambitious marine cities by 2020 into a collective that will drive real societal change. Helsinki, Hamburg, Rotterdam, Trieste and Washington state are officially signed up, owing to their important roles in the marine ecosystem—either because of the volume of trade they handle, their history, or because of the investment they are making in innovative solutions to foster more sustainable shipping.

Under the auspices of SEA20, an assembly of key influencers from five marine cities have congregated to determine how these cities can best take advantage of a smart marine ecosystem. Through participatory design, the collective intelligence has produced a series of visions on how the cities of the future could better engage with the ocean. Visions spanning cutting-edge transport provision along urban coastlines, the introduction of marine-centric innovation hubs and the positioning of offshore smart ports will be used to inspire politicians and the global marine sector to address problems caused by rapid urban growth. Collaboration for change is the name of the game with "An Oceanic Awakening." **ST**

EMPOWERING



WORLD LEADER IN UNDERWATER e-ROBOTIC SYSTEMS



SAAB

SAAB SEAEYE

THE FUTURE IS ELECTRIC

)) Live Subsea Broadcast via Optical Modem. Pioneering subsea communications technology from Sonardyne International Ltd. has been used to stream the first live broadcast to global audiences from an underwater submersible. International news agency Associated Press (AP) used Sonardyne's BlueComm wireless through-water optical modem technology from a two-person submersible operating in waters off the Seychelles, in the Indian Ocean. AP said that the broadcast via YouTube was "the first multi-camera live signal in full broadcast quality from manned submersibles using optical video transmission techniques, in which the pictures transmit through the waves using the electromagnetic spectrum." The broadcast is part of the Nekton Deep Ocean Research Institute's First Descent expedition. Nekton's goal is to undertake at least 50 "first descents" to generate data to support a Seychelles' government commitment to protect 30 percent of its national waters.

)) Launch of Earth Challenge 2020. In recognition of the 50th anniversary of Earth Day, Earth Day Network, the U.S. Department of State (through the Eco-Capitals Forum) and The Wilson Center launched Earth Challenge 2020 (EC2020), the world's largest-ever coordinated citizen science campaign. EC2020 released the six core research areas/questions that citizens scientists can help answer by collecting data via a mobile application to contribute to international research efforts on the health of the planet: What is the extent of plastics pollution; what is in my drinking water; what are the local impacts of climate change; how are insect populations changing; how does air quality vary locally; and is my food supply sustainable? For each research question, there will be recruitment of a team of scientists, citizen science practitioners, educators and others to design a coordinated approach, including identifying: how these broad questions align with frameworks like the UN Sustainable Development Goals (SDGs); what existing citizen science projects can be partnered with to help answer these critical questions; and how the data collected through an EC2020 mobile application released globally in April 2020 can best add value. These teams (earthchallenge2020.earthday.org/pages/research-teams) will be critical to the EC2020 goal of creating a robust and usable open-source data set to empower people around the world to build safer, healthier communities.

)) More LNG Development in Russian Arctic. Total has signed definitive agreements with Novatek for the acquisition of a direct 10 percent interest in Arctic LNG 2, a major liquefied natural gas development led by Novatek on the Gydan Peninsula, Russia. Total's overall economic interest in this new LNG project will be approximately 21.6 percent. Arctic LNG 2 builds on the success of Yamal LNG. Arctic LNG 2 fits into Total's strategy of growing its LNG portfolio through competitive developments based on giant low-cost resources primarily destined for fast-growing Asian markets. Arctic LNG 2 will develop more than 7 billion boe of resources in the Utrenneye onshore gas and condensate field. Production will be delivered to markets by a fleet of ice-class LNG carriers via the Northern Sea Route and a transshipment terminal in Kamchatka for cargo destined for Asia and one close to Murmansk for cargo destined for Europe. Start of the first liquefaction train is planned for 2023.

)) First African-American Female Aviator Receives Coast Guard Air Medal. Lt. Ronaqua Russell, a native of St. Thomas, U.S. Virgin Islands, became the first African-American female aviator in the Coast Guard to receive the Air Medal. The first of two ceremonies to honor her achievement took place at Tuskegee's Moton Field, where, 77 years ago, the first African-American aviators in the U.S. Armed Services broke down racial barriers to earn their wings and later go on to fly several heroic and critical combat missions in World War II. One of these Tuskegee Airmen was 1st Lt. Henry E. Rohlsen, Russell's great uncle and namesake for the international airport in St. Croix. Russell received the Air Medal in recognition for her actions in response to Hurricane Harvey. Her Coast Guard HC-144 Ocean Sentry aircraft was the very first in the sky following behind the Category 4 storm's destructive track. Russell also aided the response to Hurricane Maria, assisting with evacuations and large supply movements. In 2017, Hurricanes Harvey, Irma and Maria are estimated to have caused more than \$265 billion in damage to the U.S. Russell is currently stationed at Air Station Miami as an HC-144 Ocean Sentry aircraft commander. She is a 2012 graduate of the Coast Guard Academy. She cites "The Fab 5," a group of the five African-American women pilots in the Coast Guard, as a major influence.

)) Seabed 2030 Partners with Five Deeps Expedition. A memorandum of understanding (MOU) was signed between The Nippon Foundation-GEBCO Seabed 2030 Project and the Five Deeps Expedition, laying the groundwork for previously unexplored areas of the seafloor to be mapped and the resulting data made available for public use. Seabed 2030 is a collaborative project between The Nippon Foundation and GEBCO to inspire the complete mapping of the world's ocean by 2030 and to compile all bathymetric data into the freely available GEBCO Ocean Map. GEBCO is a joint project of the International Hydrographic Organization and the Intergovernmental Oceanographic Commission and is the only organization with a mandate to map the entire ocean floor. The Five Deeps Expedition is the world's first manned expedition to the deepest point in each of the five oceans. By the year 2030, a global grid will represent a complete map to coincide with the conclusion of the United Nations' Decade of Ocean Science. **ST**

Toward Autonomous Ship Navigation

Formulating the Future of Maritime Situational Awareness Data

By L3 Technologies, Unmanned Maritime Systems Division • MCA • UKHO

The technology available to the maritime world is changing fast; unmanned and autonomous systems are redefining the way the world works at sea. The way in which offshore construction is undertaken, how navies and coast guards provide security, ways the seabed is surveyed, how freight is moved, and how people are transported all have scope for massive change.

The key to ensuring these technological advances are of maximum benefit to maritime operations is to provide a coordinated approach between technology, data suppliers, standards and regulations. The integration and development of autonomy in the last decade has allowed

for reduced manning on board vessels, unmanned workboats and unmanned security platforms and will eventually allow for unmanned large ships.

Unmanned vessels utilize powerful onboard processing and software to read, interpret and fuse sensor data together, typically from automatic identification system (AIS), radar, cameras and LiDAR aligning the data with historical information on a particular environment. The vessels create a digital world model, calculate potential routes, assign risks and make decisions on safe navigational routes ahead that are not only collision-regulation (COLREG) aware but also move them toward their end-

L3 Technologies C-Worker 7 ASV, an example of an unmanned workboat.





(Top) L3 Technologies is developing an object-detection capability (example: sailboat classification) using machine vision to interpret camera images. (Bottom) Example of a camera sensor monitoring the coastline, comparing terrain shape with database information to confirm location.

goal or destination. However, this is only half of the picture, or, more accurately, the world model. The data used to form the background of the world model—location of land, obstructions, navigation marks, guidance and rules, local information, visual references and more—is in a format historically developed for humans to read and interpret.

In the age of the digital ship, important safety and efficiency opportunities exist, arising from the development of a new data format or digital world model for the developers, owners and operators of vessels in need of unmanned capabilities.

With that in mind, the U.K.'s Department for Transport (DfT) provided funding to L3 Technologies' Unmanned Maritime Systems division, the Maritime & Coastguard Agency (MCA) and the U.K. Hydrographic Office (UKHO) to undertake a project on the future of marine navigational data and charts. The project's intent was to establish the future requirements of maritime situational awareness data provision for autonomous vessels and the

advantages of data-dense, machine-readable charts.

Shortfalls of Nautical Charts

The main area of concern is the navigational data required to "drive" an autonomous vessel, including the lack of any stated rules, regulations or standards relating to an autonomous vessel. While autonomous vessels are aware of their surroundings and use sense and avoidance technologies, these vessels will still need navigational data to get from A to B, avoid certain areas and operate in busy spaces such as ports. To suggest that autonomous vessels will only use the International Hydrographic Office (IHO) standard S-57 Electronic Navigational Chart ENC data is inappropriate: ENCs are fundamentally designed to be viewed and interpreted by a human being and used in conjunction with the human's knowledge and visual interpretations of a situation to make decisions.

The question then arises: How do we get to a point where an autonomous vessel has the same decision-making capability and capacity as a human? The vessel needs to be able to understand and interpret its environment based on a back catalog of experience and knowledge, as well as situational awareness.

New Elements for Navigational Charts

The project developed a series of conceptual ideas that, when stacked together, would make for a rich information source that could be utilized by autonomous vessels for safe navigation: integration and exploitation of future IHO/UKHO work; visual imagery database that onboard cameras and processors can use to aid navigation, confirm position and guard against GPS spoofing or failure; informational and instructional layers where the information often provided in text format on charts is turned into logical guidance rules with geographical limits in a computer-readable format; unique identification database of all objects and marks (this information would encumber a conventional chart and confuse the human reader but could be easily interpreted by a computer);

“Monitoring dynamic objects, identifying static objects, confirming position relative to the coast or navigational marks, and monitoring the weather and sea state are all critical to safe navigation.”

and updating and information-sharing techniques, such that the systems can share real-time updates and navigational information, compared to charts that some operators may not update for a year or more.

Integration with Future IHO, UKHO Work

The UKHO follows internationally approved standards that are developed and agreed upon by IHO member states. Although there are a wide variety of standards, the primary interest for this project was S-57, the current IHO Transfer Standard for Digital Hydrographic Data. S-57 has limitations for supporting autonomous navigation because it was designed for a human as the end-user.

In 2010, a new standard, S-100, came into force. Unlike S-57, S-100 is inherently more flexible and makes provision for such things as the use of imagery and gridded data types, enhanced metadata and multiple encoding formats. It also provides a more flexible and dynamic maintenance regime via a dedicated online registry.

The main benefit of the S-100 framework is that it is extensible and the data model can be updated as new requirements emerge. It is vital that these future requirements are considered now to ensure autonomous vessels can utilize the data produced by hydrographic offices around the world.

Vision Technologies, Imagery Databases

Vision is, without a doubt, one of the most critical elements to situational awareness. Monitoring dynamic objects, identifying static objects, confirming position relative to the coast or navigational marks, and monitoring the weather and sea state are all critical to safe navigation.

Significant amounts of work are being undertaken in urban/city/highway environments to provide this information to the self-driving and smart-car community. L3 Technologies' Unmanned Maritime Systems division has been conducting similar work in the maritime domain.

An L3 project called Simulation and Vision in Extreme Environments (SIMVEE) is using machine vision to interpret camera images to detect and recognize obstacles. Machine vision is a fundamental tool for sophisticated, autonomous decision making. The SIMVEE project is about developing this capability using both real world and synthetic imagery. Models are being developed, including deep neural networks to classify certain vessels, for example, sailing boats or motor boats, in extreme environments and weather conditions. Multiple simulators are being used to generate synthetic images in different scenarios.

Training intelligent, deep neural networks requires capturing images in a variety of conditions, including different weather conditions, backgrounds, positions and

camera lenses. It is both expensive and time consuming to collect such a variety of images in the real world and often difficult in extreme environments. Using synthetic imagery solves this problem. Simulations make it possible to generate extreme conditions and situations that are rare in real life but would help to train a model more accurately, e.g., a situation in which a boat is upside down. This provides a variety of conditions that are necessary to train the systems and create robust models. The final goal is to support operator and vessel situational awareness for collision avoidance.

Instructional Layers

Waterways can be hectic and complex environments with a large number of moving vessels, navigational obstructions and restrictions that can change over time. To help manage this environment and reduce risk, organizations such as the MCA, local harbor authorities, U.K. Ministry of Defence, UKHO and others issue information on charts.

The amount of information that can be placed on human-readable charts is limited. It is typically graphically represented with side information notes, and if too much information is added the chart can become over-cluttered. The situation for an autonomous system is vastly different; a computer can handle very complex, multi-layered information sets with ease, allowing for more information to be included, to enable logical machine-readable instructions for actions.

Instructional layering has the potential to be extremely powerful for making operations safer and managing the introduction of autonomous vessels into operations alongside conventional traffic.

Example categories for instructional layers include depth, speed limits, marked channels, traffic separation schemes, communication, fishing restrictions, anchorages, military areas, environmental areas and national infrastructure, each with their own set of operational rules. There would be the option to add an instructional layer for the autonomy level of vessels. This would work by limiting the role of autonomous vessels in an area based upon the complexity of the area and the sophistication level of the vessel.

L3 Technologies' Unmanned Maritime Systems had been developing autonomous navigation technologies for the last decade and currently has an advanced COLREG-aware autonomous navigation system. The system can navigate safely around all sorts of scenarios and traffic but is currently configured for the particular mission and area of operation. This configuration and set of operating procedures implicitly embed information that would more appropriately be contained in an instructional layer. For example, when surveying, the rules the

Make no compromise between performance and ease-of-use.

Navigation Grade INS
for ROVs, up-to 4 000 m



Survey Grade INS
for ROVs, up-to 6 000 m



Plug and play
pre-calibrated
Third-party DVL

autonomous vessel should follow are different in shipping lanes, nature reserves, the harbor and open water. Following these and many other “local knowledge” rules is where autonomous vessels excel. The new instruction layers are a way for the vessel to follow the rules directly, rather than the ambiguity of a human attempting to convert them in an ad-hoc way.

Unique Identifiers

Autonomous vessels can follow the rules precisely, manage large amounts of data and never get bored, unlike their human equivalents. If every static or moored object shown on a chart had a unique identification number that correlated with an imagery database, then a machine is ideally suited to checking that each has been identified and keeping a careful progress status. This could be a useful means of providing secondary navigational data, instead of GPS, and certainly a way of determining a potential GPS spoof. A chart may show an area of “mooring posts” but not define how many or where this information would overload a human-readable chart. If they were identified with unique ID numbers and positions in a machine-readable format, this would be a highly accurate method for an autonomous vessel to verify its location, progress against goals and navigational status.

UKHO holds unique IDs in the form of feature object IDs (FOIDs) for all charted features; however, at present, they are not linked to the real-world element. The general view is that, unless we were trying to connect real-world features to the unique IDs, the current FOIDs would be sufficient.

Updating Vessel-Based Information

Clearly, whatever navigational services are required by autonomous vessels, the crucial aspect of maintaining and updating the data is as important in an autonomous environment as it is in today's manned shipping environment. Indeed, today, the maintenance and updating of charts and publications is a Safety of Life at Sea (SOLAS)

requirement and should follow suit in autonomous vessels.

In the world of autonomous vessels, it is expected that communications between the vessel and shore be open at all times, enabling more frequent or real-time updates to be pushed from official sources, such as the UKHO, so that the vessels can listen and update their navigational database and products automatically, irrespective of where they are in the world. This would be an advantage over the current situation in the manned shipping environment; however, thought needs to go into how to prove that an autonomous vessel has indeed received and applied the latest available updates. Today, that function is carried out by mariners and confirmed by port state inspectors. An equivalent model will need to be defined and used to provide the assurance that the vessel is up to date and conforms to SOLAS regulations for navigational data and situational awareness.

What's Next?

The consortium of L3 Technologies, MCA and UKHO has worked effectively to explore the opportunities for future “smart charts” to aid the safe navigation of autonomous maritime systems and smart ships. During the project, it was identified that the concepts discussed would benefit not only fully autonomous or remote vessels but also manned craft using “smart bridge” technologies that are emerging in the market. These enhance the master's situational awareness and offer collision/grounding-avoidance capabilities. Taking any project from concept to reality is a big step and will require the backing of regulators, government and industry. **ST**

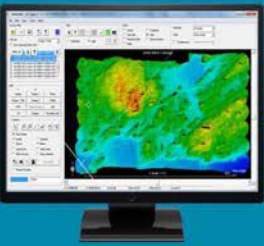
L3 is an industry leader in developing and fielding advanced solutions for military, commercial and research customers.

The Maritime and Coastguard Agency (MCA) is responsible for maritime regulation, safety and counter-pollution in the U.K.

The U.K. Hydrographic Office (UKHO) is a leading center for hydrography, providing marine geospatial data to inform maritime decisions.

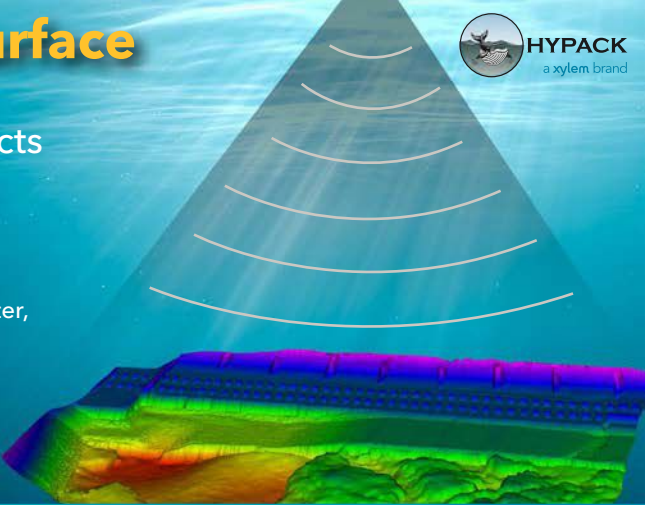
Your View Below the Surface

HYPACK software gives you a clear view beneath the surface and collects the most accurate data!



HYPACK®
Software for Single Beam, Side Scan, ADCP, Magnetometer, and Sub-bottom Support.

HYSWEEP®
Software for Multibeam, Backscatter, and Topographic Laser Systems.



sales@hypack.com • HYPACK.com

BlueTech Expo

We all understand the importance of strong industry connections with government. A thorough understanding of the state of the art and current capabilities of technology is critical to an informed acquisitions process and for crafting effective legislation and policy. In no business space is this truer than in those sectors that utilize ocean technology.

Sea Technology magazine and the International Ocean Science & Technology Industry Association (IOSTIA) will hold the second annual BlueTech Expo at the Newseum from June 4 to 5 in Washington, D.C., to foster relationship building between the ocean science and tech industry and government.

IOSTIA

IOSTIA, iostia.org, is the only association of its kind located in Washington, D.C. It focuses squarely on ocean science and technology issues.

IOSTIA, is a 501(c)(6) industry association that represents businesses and provides technology and services for sectors that sustainably and commercially utilize the oceans. IOSTIA provides benefits, programs, services—and a unified public policy voice—to create new opportunities and encourage a favorable business environment for ocean science and technology companies.

Sessions

The sessions will be held Tuesday, June 4. BlueTech Expo 2019 will include a one-day technical program that will focus on thought-provoking case studies and panel discussions to identify needs and discover best practices and lessons learned in exciting and emerging areas of interest.

This year's themes to be covered in the sessions are: Ocean Autonomy; Seafloor Residency and Long-Term Persistence; and Port and Harbor Security and Survey. There will be a Special Hot-Topic Legislative Session focused on ocean plastics and debris. There will also be a Special Lunch Session that will feature government speakers discussing export challenges for ocean technology businesses.



Expo

The Expo will be held Wednesday, June 5. Exhibitors will showcase their latest technology solutions and services and share customer success stories with

members of Congress and their staff, end-users, and key federal agency decision makers. This free-to-attend exhibition provides a convenient opportunity to network with industry innovators and technology leaders, researchers, and policy makers.

OceanSocial

On Wednesday, June 5, BlueTech Expo will feature the OceanSocial. Oceanology International invites you to attend this business networking function. Hosted in



the exhibit hall, OceanSocial will provide a unique opportunity to enjoy complimentary drinks and light hors d'oeuvres while you connect with colleagues and exhibitors at this collaborative networking

event. OceanSocial is the perfect way to end the day and wrap-up an exciting 2019 BlueTech Expo.

CHOW

BlueTech Expo is conveniently scheduled in coordination with Capitol Hill Ocean Week (CHOW), capitolhilloceanweek.org, and is a great opportunity for industry, government, military and nonprofit organizations (NPOs) to come together to discuss challenges, opportunities and the crucial role science and technology plays in the safe utilization and exploration of our world's oceans.

Registration

To register for BlueTech Expo and learn more about the event, visit bluetechexpo.org. **ST**

Listening to Ocean Life

Monitoring Fish, Marine Mammal Sounds with Wave Glider

By Dr. Joseph J. Luczkovich • Dr. Roger A. Rulifson • Dr. Mark W. Sprague

Remote observations of marine animal behavior have one distinct advantage over direct observations: The observer is not present to disturb the animals. There are no vessel noises, no diver's bubbles, no people present that could alter the behavior of the animals being observed.

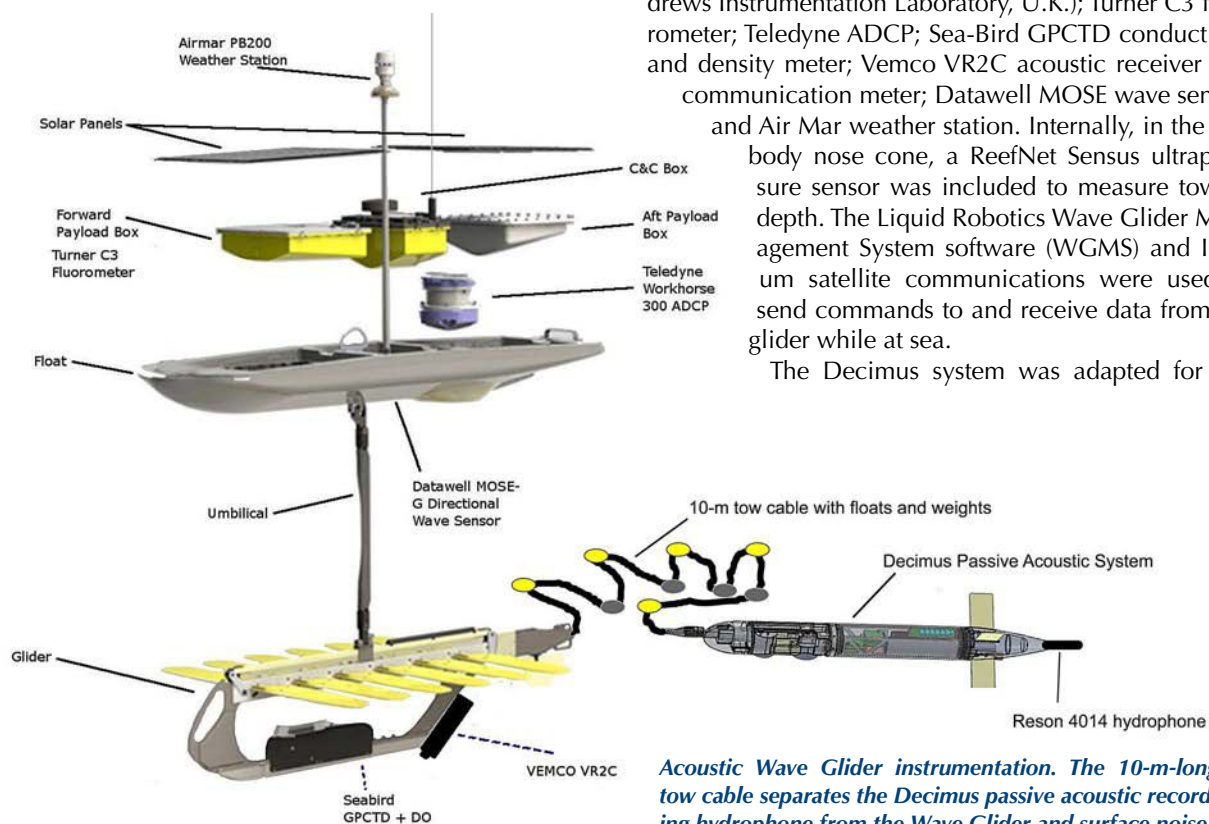
We report here on how an autonomous vehicle, a Liquid Robotics SV2 Wave Glider (Liquid Robotics, Sunnyvale, California) equipped with hydrophones and acoustic tag detectors, can be a tool to study the behav-

ior and habitat use of fishes and whales in the coastal environment. With that objective, we have used a new instrument—"Blackbeard," the Acoustic Wave Glider (AWG)—to conduct affordable, long-term, passive acoustic monitoring of marine animals and the coastal ocean acoustic environment.

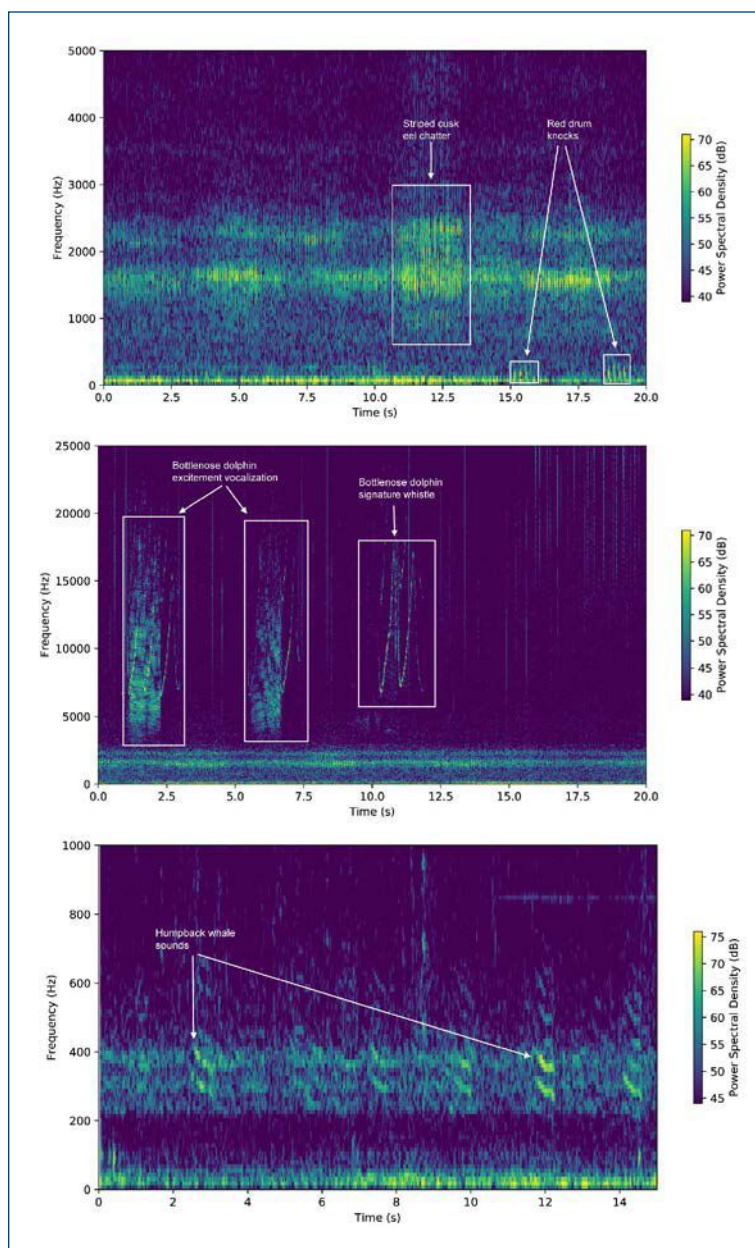
Decimus and the Acoustic Wave Glider

Blackbeard has several instrument sensors, including: Decimus towed passive acoustic system (SAIL, Saint Andrews Instrumentation Laboratory, U.K.); Turner C3 fluorometer; Teledyne ADCP; Sea-Bird GPCTD conductivity and density meter; Vemco VR2C acoustic receiver and communication meter; Datawell MOSE wave sensor; and Air Mar weather station. Internally, in the tow body nose cone, a ReefNet Sensus ultrapressure sensor was included to measure towing depth. The Liquid Robotics Wave Glider Management System software (WGMS) and Iridium satellite communications were used to send commands to and receive data from the glider while at sea.

The Decimus system was adapted for use



Acoustic Wave Glider instrumentation. The 10-m-long tow cable separates the Decimus passive acoustic recording hydrophone from the Wave Glider and surface noise.



Spectrograms showing red drum knocks and striped cusk eel chattering sounds (top); bottlenose dolphin excitement calls and whistles (middle); and humpback whale calls (bottom).

in the tow body; it consists of a Teledyne Reson 4014 hydrophone input to a SAIL high-performance data acquisition card sampling at up to 1 MHz, storing data in binary format on a 256-GB storage card, and outputting the detection data over cable connection to the WGMS. Binary audio data are converted to Windows audio file (WAV) format after Decimus recovery.

AWG Passive Acoustic Monitoring

Blackbeard AWG was deployed with the Decimus passive acoustic recorder in a series of three sea trials

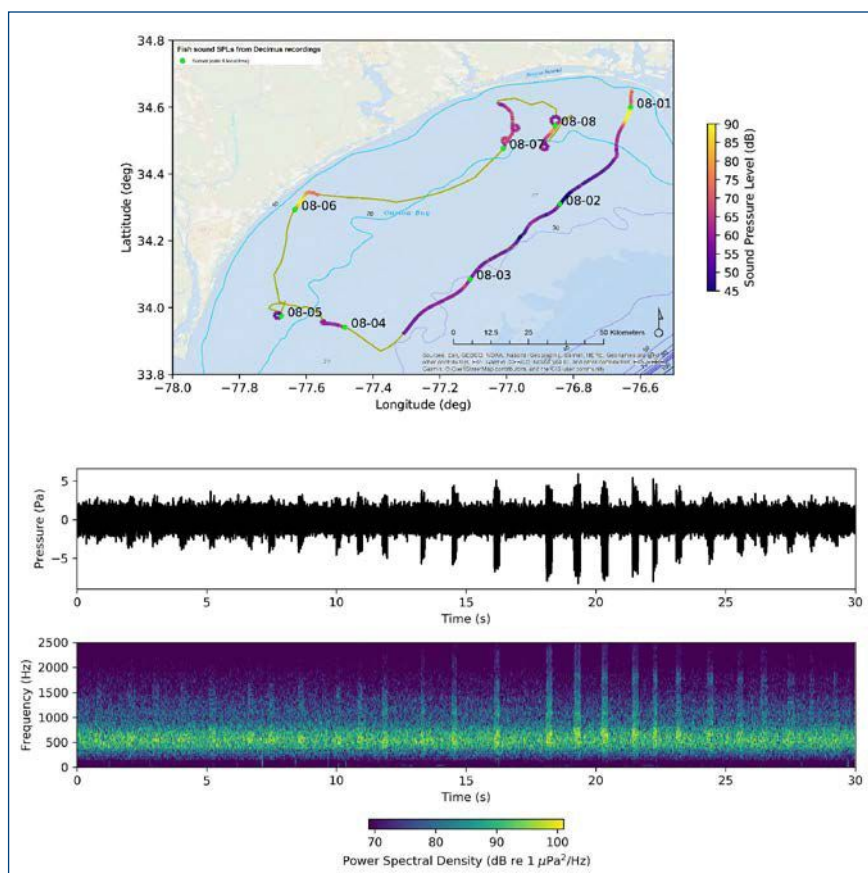
to tune the buoyancy of the tow body. In North Carolina sea trials starting in 2015, the AWG followed all commands and was able to navigate a course of preprogrammed waypoints at a speed of 1 to 2 kt. (0.5 to 1.0 m/s). The AWG was sent along a course to record the wild soniferous animals in sea trials three, five and six. However, because the tow body was very negatively buoyant in trials three and five, dragging along the bottom, the Decimus was damaged in trial three and had to be recovered earlier than planned. Nonetheless, the Decimus made excellent recordings during all three trials, sent autodetection data to shore via the satellite connection, and after recovery the recordings were processed for spectral analyses.

Fishes are known sound producers. They can be recorded and their species identity determined; in some cases, their behavior can be associated with specific sounds. Choruses and individual calls of many fish (red drum, *Sciaenops ocellatus*; weakfish, *Cynoscion regalis*; spotted sea trout, *Cynoscion nebulosus*; striped cusk eels, *Ophidion marginatum*; sea robins *Prionotus* sp.; and oyster toadfish *Opsanus tau*) were recorded during all sea trials. Marine mammal sounds (humpback whales, *Megaptera novaeangliae*, and bottlenose dolphins, *Tursiops truncatus*) were recorded during these excursions as well.

Spectrograms of the recordings were produced as a function of time and sound frequency, with various colors showing the sound intensity (power spectral density in decibels referenced to 1 $\mu\text{Pa}^2/\text{Hz}$). The fish sounds are in the lower frequency range (the red drum “knock” calls have a dominant frequency of 0.125 kHz; striped cusk eel “chattering” calls are dominant at 1.5 kHz, with a range of 1.0 to 2.5 kHz).

Recordings shown in accompanying spectrograms were taken September 16, 2015 at 17:30:14 local time during sea trial three, when red drum were spawning in North Carolina. The red drum calls are advertisement or spawning calls. This recording marks the first time this species has been recorded making spawning calls offshore in North Carolina and not in an estuary, and thus extends the knowledge of their critical spawning habitat to include offshore areas.

Bottlenose dolphin and marine mammals prey heavily on these soniferous fishes. The bottlenose dolphins were likely listening for soniferous fish prey, using the fish sounds for general location, then localizing them with higher frequency echolocation vocalizations. The whistles with overlapping bursts of sounds from the bottlenose dolphins (spectrogram at 1 to 3 sec., then again 5 to 7 sec., 4 to 20 kHz) heard later in the recording are likely to be dolphin excitement calls. There were still fish calling after the dolphins’ whistles and excitement calls, but these sounds were lower in intensity and perhaps from distant fish choruses far from the recording hydrophone.



Fish-associated sound pressure levels varied as the AWG moved. Spectrogram shows SPL in a recording of a spotted sea trout call as the AWG passed by.

The objective of sea trial five was to test the Decimus passive acoustic tow body buoyancy adjustments. Trial five was conducted June 8 to 12, 2016. Although we successfully launched and recovered the AWG, the tow body continued to be negatively buoyant and dragged along the bottom (confirmed by the acoustic records of the housing dragging the bottom). However, no damage was detected upon recovery.

As a result of the negatively buoyant tow body dragging along the bottom, the AWG was difficult to control and had a reduced water speed. The AWG was swept up in the Gulf Stream northeasterly current and taken away from the preprogrammed course. After passing by Cape Lookout Shoals, navigational control was established, and the AWG was recovered off Ocracoke Inlet, North Carolina.

Excellent sound recordings of oyster toadfish and other marine fishes were recorded on this mission in spite of the buoyancy issues with the tow body. Additionally, the AWG pilots learned about navigational limitations in strong currents, steering it away from Cape Lookout Shoals. After passing these shoals, the current speed remained strong while near the Gulf Stream, but the pilots were able to slow the AWG down-current velocity (speed

over ground) by heading directly into the current. In this situation, the AWG was pointed into the current and the tow body was extended behind the submarine while the AWG traveled down-current at a speed equal to the difference between the current speed and the AWG water speed. This orientation allowed the AWG to spend more time recording the soundscape and to delay the arrival of the AWG at Ocracoke Inlet until recovery.

Additional tow body buoyancy tests were conducted during the summer of 2017 to solve the buoyancy problems encountered during the first two trials. The buoyancy of the tow body was tuned while deployed from the dock at Morehead City in a tidal current, with the pressure sensor included in the nose cone to measure depth after adding various weights and buoyancy foam. The best adjustment was 386 grams of lead in the nose cone and 475 cubic centimeters of #6 foam in the tail cone. These tests resolved the buoyancy problems with the Decimus tow body.

In sea trial six from August 1 to 9, 2017, the AWG was sent along a programmed sequential course for nine days, reporting back to shore with AWG telemetry position data, current profiles, fluorometry measurements, sound recordings, wave data and weather data. Blackbeard towed the Decimus passive acoustic recorder at approximately 10-m depth without touching the bottom or colliding with any underwater reefs, because the tow body was neutrally buoyant using the buoyancy adjustments as described above. The AWG was able to navigate in a southwesterly direction against the prevailing Gulf Stream current and return to navigate around artificial and natural reefs offshore in Onslow Bay. It was recovered without incident on August 9, 2017 near the initial release point, as planned. It was judged to be fully commissioned and ready for future deployments.

Analysis

Upon recovery, the recorded sounds from this mission were analyzed. Sound pressure levels (SPL in decibels referenced to 1 μ Pa) were measured from the calibrated hydrophone along the track of the AWG in each mission, and auto-call detection algorithms were used to identify whale and dolphin calls. The auto-detection of whistles, moans and specific whales was reported in real time from the Decimus, and reports were sent to shore via WGMS; these were confirmed in processing.

After recovery, the recordings on the disk were downloaded and audio files (WAV files) analyzed using standard bioacoustics software. The Pamguard software (pamguard.org) was used here in post-mission processing of the recordings to detect bottlenose dolphin whis-

ties. Fish sounds were characterized by playbacks in Pamguard and identified by human listeners. Excellent recordings were made of spotted sea trout choruses, with the AWG passing directly over calling individual fish about 7 m below the tow body. Thus, spotted sea trout were heard in the area to the east of Beaufort Inlet in August, demonstrating that they likely spawn outside of the estuary at this time of year.

Humpback whales were recorded in quieter water farther offshore near the Gulf Stream. Sciaenidae (spotted sea trout, weakfish and red drum) calling was summarized using a power spectral band sum between the frequencies (0.25 to 0.5 kHz), and the SPL was plotted along the track of the AWG. SPL associated with *Cynoscion nebulosus* and other fishes was greatest after sunset each night, as has been noted for Sciaenidae fishes. Many of these calls were recorded in a depth of 20 to 30 m and close to the inlets and artificial reefs, demonstrating the importance of access to estuarine waters and complex structure for these fishes during spawning. Deeper water along the 30-m isobath had lower fish-associated SPL, suggesting these fish prefer shallower spawning habitats (less than 30-m depth).

Conclusions, Future Studies

The Wave Glider and Decimus towed passive acoustic system worked very well after buoyancy tuning was completed. The system allowed us to record red drum, weakfish and spotted sea trout spawning calls on the

continental shelf near inlets and an artificial reef for the first time off North Carolina. The passive acoustic system documented essential fish habitat locations for these important recreational and commercial fish species. Such fishes could be negatively affected by seismic surveys, wind power, and oil and gas energy development projects planned for the continental shelf off North Carolina.

In addition, we documented other soniferous species of fishes (striped cusk eel and oyster toadfish), which are prey for marine mammals such as bottlenose dolphins.

Although we did not detect any North Atlantic right whales (*Eubalenoptera glacialis*) in these trials, these marine mammals are critically endangered and occur off North Carolina during their migration from feeding areas off Canada to calving grounds off the Georgia and Florida coast. The AWG could be deployed to detect right whales during their migration and alert energy companies and scientists about their location. Because the Wave Glider is mobile with an Iridium satellite connection, the Decimus system could be towed into areas scheduled for construction and seismic surveys during energy development projects, and it could provide real-time alerts (via the Liquid Robotics WGMS) to onshore and vessel-based operators when right whales are nearby. Real-time algorithms on the Decimus can process the recorded signals while still at sea and send a message alert via WGMS if a signal matches either dolphin whistles or right whale “up calls”; similar detection algorithms are being developed for common species of fishes.

— Making Hydrographers’ Tasks Easier



Navsight Marine Solution

State-of-the-art Motion
& Navigation Solution



Qinertia

The Next Generation INS/GNSS
Post-processing Software

A fleet of passive-acoustic-equipped Wave Gliders could be used to monitor offshore areas proposed for energy development and provide additional protection against injury to whales and spawning fish populations during offshore construction projects.

Acknowledgments

We acknowledge the support of the National Science Foundation Major Research Instrumentation grant (1429315) to the co-authors and JP Walsh.

Captain Eric Diaddorio and Mark Keusenkothen, ECU Office of Diving and Water Safety, assisted with launch and recovery operations.

We thank the ECU Wave Glider pilot team: Tyler Peacock, Cecilia Krahforst, Patrick Harris, Ramone Lopez, Rebecca Asch, Chuck Bangle, Phil Deville, Chris Thaxton, Ryan MacKenzie and Ryan Bradley.

The Division of Research and Economic Development and Engagement (REDE), Thomas Harriot College of Arts and Sciences, Department of Biology, Department of Physics, and Institute for Coastal Science and Policy (ICSP) at East Carolina University supplied matching funds for this work.

We thank Graham Weatherup, Richard Baggaley, Angus Aitken (Saint Andrews Instrumentation Laboratory) and Ryan Carlon (Liquid Robotics), who helped with tuning the buoyancy of the tow body and operation of the Decimus.

References

For a list of references, contact Joseph Luczkovich at luczkovichj@ecu.edu. **ST**

Dr. Joseph J. Luczkovich is a professor of biology and has been a research scientist at East Carolina University for 28 years. He specializes in fish bioacoustics and ecology. He received a Ph.D. in biological sciences from the Florida State University and was a postdoctoral fellow at the Harbor Branch Oceanographic Institution.



Dr. Roger A. Rulifson is a professor of biology and has been a research scientist at East Carolina University for 35 years. He specializes in marine and anadromous fish migration and ecology. He received a Ph.D. in marine science and engineering from North Carolina State University.



Dr. Mark W. Sprague is an associate professor of physics at East Carolina University, where he has been for 25 years. He specializes in underwater acoustics and modeling of fish sound propagation. He received a Ph.D. in physics from the University of Mississippi.





SENSORS FOR:
Ocean, Harbors
Intracoastal
Lakes, Ponds
Wave Tanks

MEASURE:
Waves
Tides
Levels

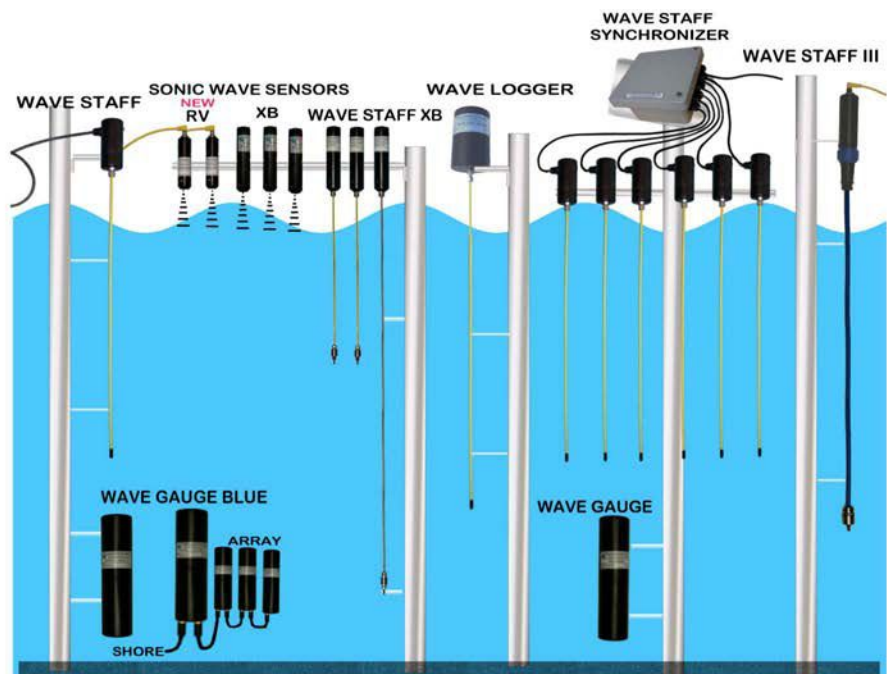
DATA VIA:
Cable
Logger
Wireless

WE SUPPLY:
Tech Support
Software
Accessories
Custom Work

Ocean Sensor Systems

For Details Visit Us on the web or call 954-796-6583 USA

WWW.OCEANSENSORSYSTEMS.COM



Getting the best out of your Inertial Navigation System

Accurate positioning and reliable data are crucial to conduct successful subsea operations. Ultimate navigation performance can be reached by using a post-processing software allowing to fine-tune sensors parameters offline and thus avoiding a long iterative process and costly dives.

Delph INS Advanced Subsea maximises iXblue INS performance

iXblue, a global leader in the design and manufacturing of advanced inertial navigation solutions has developed Delph INS, a post-processing and batch productivity tool for its Inertial Navigation Systems (INS) including Phins Surface, Phins Subsea, Phins Compact, Rovins and Rovins Nano. Intuitive and user-friendly, Delph INS is a powerful tool to make operations more efficient, saving vessel time and not requiring in-depth INS knowledge.

Strong data management, visualisation, editing and processing features together with export capabilities make Delph INS software ideal for quick and easy navigation enhancements. By combining the raw data from the INS and from the aiding sensors (GNSS, USBL/LBL, DVL, depth sensor) during post-processing, it provides higher accuracy for the position, velocity or attitude of the platform. Thanks to the advanced forward/backward processing algorithms, it can significantly improve the performance obtained in real-time, specifically for portions of the operation where some of the sensors or measurements were not fully available.

New features for the upgraded version of the software

An upgraded version of Delph INS is being released including new features such as INS/DVL advanced calibration thanks to post-processed forward/backward computation. For instance, it allows the user to employ a non-calibrated DVL with an INS and to recover the calibration value afterwards. This is very convenient when a DVL is damaged and needs to be replaced. It thus enables the use of a non-calibrated DVL in real-time with the INS and the alignment of the system during post-processing.

New enhancements have also been made regarding the management of missed IMU (Inertial Measurement

Unit) frames by increasing the standard deviations during the time information is lacking. The standard deviation is then tightened as soon the frames are back on and valid. This process is automatic and cannot be tuned by the user.

Finally, the software now also produces new quality analysis and quality check reports, providing quick and easy information on the reliability of data collected.

Overall, Delph INS Advanced Subsea offers a cost-effective and scalable solution for all subsea applications (ROV, AUV, Towfish positioning), compatible with industry standard software as well as with custom software.



Pipeline inspection

TOTAL OCEAN MARKET COVERAGE 2019

JANUARY

Annual Review & Forecast / Buyers Guide/Directory

****Oceanology International Americas**, February 25-27,
San Diego, CA

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

****U.S. HYDRO 2019**, March 18-21, Biloxi, MS

****Ocean Business**, April 9-11, Southampton, U.K.

MARCH

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

****AUVSI XPONENTIAL 2019**, April 29-May 2, Chicago, IL

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

****Offshore Technology Conference**, May 6-9, Houston, TX

****UDT 2019**, May 13-15, Stockholm, Sweden

MAY

Communications, Telemetry, Data Processing

****BlueTech Expo**, June 4-5, Washington, DC

****Oceans '19 MTS/IEEE Marseille**, June 17-20, Marseille, France

****CLEAN PACIFIC 2019**, June 18-20, Vancouver, Canada

JUNE

Seafloor Mapping/Sonar Systems/Vessels

JULY

Deck Gear, Cable, Connectors, Power Systems & Salvage

AUGUST

Geophysical Exploration/Seafloor Engineering

****SEG 2019**, September 15-20, San Antonio, TX

SEPTEMBER

Ocean Resources Development & Coastal Zone Management

****Offshore Energy 2019**, October 7-9, Amsterdam, The Netherlands

****CLEAN GULF 2019**, October 28-30, New Orleans, LA

****Oceans '19 MTS/IEEE Seattle**, October 28-31, Seattle, WA

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

****International Water Conference**, November 10-14, Orlando, FL

NOVEMBER

Undersea Defense/Antisubmarine Warfare

DECEMBER

Diving, Underwater Vehicles & Imaging

****Underwater Intervention 2020**, February 4-6, New Orleans, LA

****EXTRA SHOW DISTRIBUTION** (additional shows will be added as information is obtained)

SEA TECHNOLOGY®

WORLDWIDE INFORMATION LEADER FOR
MARINE BUSINESS, SCIENCE & ENGINEERING

The only magazine that addresses the
total oceanographic field from undersea
defense to offshore oil...globally

Recognized by tens of thousands as the
authority for design, engineering, and
application of equipment and services
for government and industry.

...and most of all, IT SELLS!

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

BONUS INFORMATION TO KEEP OUR READERS UP-TO-DATE

- Capital Report
- Company Profiles
- Contracts
- Environmental Monitoring
- International
- Marine Renewables
- Marine Resources
- Meetings
- Navy Currents
- Ocean Business
- Ocean Engineering
- Ocean Research
- People
- Product Development Reviews
- Soapbox

OTHER OPPORTUNITIES

- Sea Technology Buyers Guide/Directory (2020 edition closes November 1, 2019)
- Sea Tech e-News
- Commercial Fisheries News
- Fish Farmers Phone Book/Directory
- Fish Farming News
- Commercial Marine Directory
- Direct mail list rentals
- Reprints/PDFs
- Banner and skyscraper Web ads

EDITORIAL CONTACTS

Aileen Torres-Bennett
Amelia Jaycen

ADVERTISING CONTACTS

C. Amos Bussmann
Sue Ingle Owen

Follow Us On:



Compass Publications, Inc.

4600 N. Fairfax Dr., Suite 304, Arlington, VA 22203-1553 • Tel: 703.524.3136 • Fax: 703.841.0852 • www.sea-technology.com
oceanbiz@sea-technology.com (editorial) • seatechads@sea-technology.com (advertising/production)

1963 - 2019 Celebrating More Than 55 Years of Serving the Global Ocean Community

CLEAN PACIFIC

The CLEAN PACIFIC Conference & Exhibition will happen June 18 to 20 in Vancouver, British Columbia, Canada. CLEAN PACIFIC brings together the tight-knit response community in the Western United States and Canada to address spill prevention and response matters pertinent to that region's environmental sensitivities. It is a must-attend event for those involved in spill prevention and response for oil and hazardous materials in the marine and inland environment. The goal of CLEAN PACIFIC is to deliver a valuable event that covers the most pressing matters in the Western United States and Canada and offer ample time for attendees to network and cultivate the relationships that are crucial before, during or after a response.

Show Program

Three concurrent tracks will take place at CLEAN PACIFIC: Planning and Preparedness; Response and Recovery; and a brand-new track on Communication and Engagement. Over a two-day period, each track will hold multiple educational sessions led by spill prevention and response experts from industry, government and First Nation representatives.

On Wednesday, June 19, the day will begin with the Welcome and Keynote Session. Conference sessions will be held throughout the day, including: Planning for National, State and Local Transboundary Issues; Innovation in Exercise Design; Planning and Response Considerations for Non-Floating Oil Spills; Environmental Assessment and Restoration; Response Case Studies; Wildlife: Readiness and Response; Before a Spill Incident; During



an Incident; and After an Incident: Lessons Learned Translated into Actions. The day will conclude with a welcome reception on the exhibit floor.

On Thursday, June 20, the day begins with a keynote address, followed by conference sessions, including: Responder Competencies and Evolving Regulations; Arctic Issues; Salvage and Pollution Mitigation; Current Events in Response Technology; Volunteer Management: Help Them Help Us!; and First Nations' Perspective and Experience.

Exhibition

The CLEAN PACIFIC exhibit hall will feature spill response organizations, regulatory agencies, supplier/manufacturers and service companies showcasing their latest solutions and technologies. Attendees will have the opportunity to meet face to face with all of the exhibitors to discuss their unique challenges.

For more information, visit cleanpacific.org. **ST**



The Urban Shark

Manned Sub Dives Reveal Juvenile Bluntnose Sixgills off Vancouver

By Dr. Chris Harvey-Clark • Glen Dennison

A Canadian-made prototype manned submersible, deployed from the waterfront of Vancouver, British Columbia, Canada, was instrumental in the discovery of the presence of juvenile sixgill sharks, *Hexanchus griseus*, in 100-m depths. The relative ease of finding juveniles of this “urban shark” species close to the city of Vancouver in depths deeper than divers can penetrate or fishermen regularly fish reflects the presence in nearshore habitat for a species that is well known south of the U.S.-Canada border in the large marine catchment area of the Salish Sea.

Background

The bluntnose sixgill shark is a large-bodied carnivorous shark typically found in deepwater (to 2,000-plus m) throughout the oceans and in certain shallow waters. It has been rarely observed from deep-sea research submersibles. Sixgills have a wide dietary range, from marine mammals to teleost fish and benthic invertebrates, and are one of the largest species of carnivorous sharks, with total lengths (tl) approaching 5 m. Females mature at 4.2 m and males at 3.0 m. Although worldwide in distribution, there are no validated aging studies of this species, which is thought to be slow growing and long lived. The sixgill is considered data deficient and a species of special concern by the Committee on the Status of Endangered Wildlife and Canada’s Species at Risk Act.

Species vulnerability is a reasonable consideration due to large physical size prior to maturity and presumed longevity. Globally, only one inshore nursery area has been identified for this species: Puget Sound, Washington, known for concentrations of sixgill juveniles. Acoustic telemetry and tagging studies documented numerous sharks in the 2-m-tl range in Elliot Bay and Admiralty Inlet in the waters around Seattle. In the early 1990s, a directed fishery for sixgill sharks in British Columbia coincided with subsequent decrease in diver observations of this species at locations known previously for their presence.

Publications characterizing recent presence or abun-

dance of juvenile sixgill sharks in the waters of British Columbia are scarce. One study reveals a 90 percent decrease in shark observations at a site at Hornby Island over a five-year period. In 2017, eight juvenile sixgill sharks were tagged, five male and three female, in the Strait of Georgia at depths between 156 and 280 m; these juveniles were documented spending 94 percent of total time at depths in excess of 100 m. This agreed with findings in 2009 in Puget Sound, where tagged juvenile sharks spent the majority of their time below 100-m depths.

Rare reports of this species in British Columbia exist in gray literature from scuba diver observations published in sport-diving magazines. These observations at Whytecliffe Park, West Vancouver, and around Vancouver Island at Tahsis, Hornby Island and Barkley Sound have been primarily of larger semi-mature and mature animals (tl 3.0 to 4.5 m). Observations of larger animals on a regular basis at many locations effectively ended by 2005.

The objective of our study was to determine the feasibility of using a three-man research submersible in conjunction with attractants at a location close to urban Vancouver as a census method for sixgill sharks that extends the search range for uncommon taxa beyond the depths normally encountered by divers and fishers. We predicted that with relatively low survey effort, by sampling beyond the range of sport divers/fishers, the presence or absence of sharks could be ascertained.

Methods

On September 5 and 7, 2017, submersible survey dives to 97.6 and 107.9 m were conducted off West Vancouver at lat. 49.357510, long. 123.292900, approximately 1 km from shore. These dives were conducted using a newly designed and constructed submersible, the Aquatica Stingray 500 three-man, 1-atm research submersible (aquaticasubmarines.com). The submersible is a Canadian-built, 152-m-depth-rated system with extended bottom-time capabilities, equipped with 4-by-



(Top) The prototype Stingray 500 three-man submersible being deployed by crane at the marina launch site close to the dive site. (Bottom) A juvenile male sixgill shark estimated at 2.0 m tl, adjacent to ballast chamber of Aquatica manned submersible (diameter of chamber 60 cm for scale). Sharks were highly attracted to metal and electrical elements of the submersible.

4,000-lumen LED floodlights facing forward and computer-based current/tide/depth/altitude measurement instrumentation. The submersible carries two observers and one pilot within a 1.52-m-diameter, clear-acrylic dome that provides unrestricted 270° forward/up/down field of view.

An olfactory attractant on a deepwater mooring attached to a surface float was deployed on September 3, 2017 at the dive location. The attractant consisted of mashed frozen bigeye tuna (*Thunnus obesus*) blood, flesh and viscera held in three plastic 20-liter buckets perforated with multiple 1-cm holes, together with several whole commercial tilapia (*Oreochromis nilotica*). The attractant was suspended 3 m from the bottom and allowed to disperse via currents estimated at 2 to 3 km/hr. The submersible was maintained on the bottom, stationary at the location of the attractant with LED floodlights providing illumination because this depth is aphotic. Horizontal visibility was limited from 2 to 4 m due to seasonal plankton abundance. Presence of marine taxa was recorded using a handheld camcorder (Sony AX100); image review and extraction for publication was accomplished using Final Cut Pro X editing software.

Results

Bottom times on station were 3 and 8 hr., respectively; the latter being a longevity record for this submersible, with a total submerged time approaching 12 hr. Bottom topography was flat, sloping to deepwater with a fine mud substrate at the survey location. Bottom seawater temperature range was 9.7 to 10° C, and tidal currents ranged from 0 to 3 km/hr. during the observation period at the study site.

On September 5, 10 dogfish sharks (*Squalus acanthias/suckleyi*) were sighted, as well as four Quillback rockfish (*Sebastes maliger*) and numerous planktonic species, including nereid worms and squid. However, no sixgill sharks were sighted.



On September 7, more than 20 dogfish sharks were observed foraging in the mud adjacent to the submersible for scraps of attractant. Several spotted ratfish (*Hydrolagus collei*) remained close to the submersible, and one Quillback rockfish took up residence behind the pilot station of the submersible for the entire duration of the dive and only left the submersible when it ascended to within 30 m of the surface. Numerous small (1-cm-diameter)

unidentified planktonic octopods attached to the dome of the submersible, as well as several small (6 cm tl) flatfish (unknown species). Three juvenile sixgill sharks (tl estimated at 2.0, 1.2, 2.0 m, respectively), including one animal with visible claspers (male, 2.0 m tl), were observed over the 8-hr. station period. The first sighting was of a larger animal (2 m tl), which rapidly passed the submersible on the port side in limited visibility and could not be sexed. The second, smaller (1.2 m tl) animal was observed foraging for scraps of attractant on the bottom mud in front of the submersible and could not be sexed. The third (2.0 m tl) male animal spent a prolonged period (3 hr.) intermittently near the submersible and appeared to be attracted by the electrical elements of the submersible (batteries, lights) and the acrylic passenger compartment, repeatedly approaching and bumping these items with the rostrum. All animals approached the submersible initially from down-current locations, indicating the olfactory attractant played a role in enticing the animals to within 2 m of the large, brightly lit craft. There were

SEPTEMBER 16-20, 2019
HONOLULU, HAWAII, USA

OCEAN OBS'19



AN OCEAN OF OPPORTUNITY

Visit our site for more information.

WWW.OCEANOBS19.NET

Follow us on twitter @Oceanobs19



AMT Analysenmesstechnik GmbH
Joachim-Jungius-Strasse 9
D-18109 Rostock, Germany
Tel.: +49-381-4059-380, Fax: -383
E-mail: info@amt-gmbh.com
www.amt-gmbh.com

AMT Deep Sea Underwater Sensors



CO₂ - pH - Redox - Conductivity - Oxygen

“The objective of our study was to determine the feasibility of using a three-man research submersible in conjunction with attractants at a location close to urban Vancouver as a census method for sixgill sharks.”

no visible skin or oral/dental lesions or fishing gear noted on the sharks.

Analysis

Using the Stingray submersible with attractant proved to be a highly effective strategy in pursuing an elusive subject. The low amount of effort per observation indicates that sixgill juveniles were relatively abundant in the deeper waters close to Vancouver at the time of observation. Catch per unit effort (CPUE) measurements are commonly used by biologists and managers to indicate the presence and abundance of commercial fish and are generally expressed as number or mass of a species caught per thousand hooks per unit time. In this instance, it is difficult to convert short duration observational data (11 hr. observation, three sharks seen, 3-m visibility) into a meaningful CPUE equivalent for sixgill sharks. If the attractant under 3-m visibility is counted as one hook over 11 hr. of observation, that means a rate of 272 sharks/1,000 hooks or 0.272 sharks per hook per hour. Using 20-hook-long lines in nearby Puget Sound, a study in 2010 established a mean CPUE of 0.13 sharks caught per hour for this species, with a maximum level of 1.3 sharks per hour. In terms of CPUE at 0.27, the impression in this study was that juvenile sixgill sharks were relatively locally abundant.

With a birth tl of 68 cm and a growth rate estimated at 12 cm per year, these observations dovetail with previous telemetry evidence for migration of juvenile sixgill sharks into and possibly transiting the deeper waters off the littoral of Vancouver en route to Howe Sound. Whether this is a seasonal or year-round presence remains a subject for future study. Sport scuba divers have rarely reported larger specimens (2 to 3 m tl) of this species seasonally in late summer from locations in West Vancouver such as Whytecliffe Park, where thousands of divers per year consistently visit the location daily down to the 35-m limits of sport diving. A low rate of observation for this species within sport diving limits belies the fact that other studies indicate the juvenile sharks spend the majority of their time below diving limits and, therefore, sixgill sharks may be far more abundant than previously appreciated below these depth limits. The population size for

sexually mature sixgills in the Salish Sea was estimated at approximately 7,900 using genetic techniques in 2005. While the abundance of juveniles is unknown, they are less frequently sighted than adults by divers, perhaps reflecting the bathymetric segregation of juveniles in a species known for cannibalism.

Previous telemetry studies have tracked juvenile sixgill sharks leaving Puget Sound, Washington, traversing the Strait of Georgia and Juan De Fuca, and passing the Vancouver waterfront. In one case, a shark made a circuit of Howe Sound for two consecutive years, each year returning to Elliot Bay, Seattle. The Vancouver/Howe Sound region has been historically overfished for more than 100 years, resulting in the local extirpation of taxa, including certain rockfish (*Sebastes* sp.), which form part of the prey base for sixgill sharks. The manned submarine dives have demonstrated the deepwater presence of these and other important sixgill prey species such as ratfish and dogfish contiguous with shark observations. Some of these sixgill prey species have been rarely observed locally within sport-diving depth limits around Vancouver in the past 30 years.

The presence of juvenile sixgill sharks reveals that while present in the Vancouver region, they are mostly found beyond the range of divers and fishermen, and this agrees with predictions by other studies based on depth distribution for juveniles of this species. That the juvenile sixgill sharks observed were free of lesions and fishing gear would indicate they are recruiting from areas of relatively low fishing effort in a region with high fishing pressure from both sport and commercial fishing.

Acknowledgments

Thanks to Harvey Fleming, owner of Aquatica Submarines, and the crews of Aquatica Stingray 500 who made this exploratory research possible.

References

For a list of references, contact Chris Harvey-Clark at chrisharveyclark@gmail.com. **ST**

Dr. Chris Harvey-Clark, Dalhousie University, is a marine biologist and veterinarian specializing in the health of aquatic species. He is the author of more than 60 papers, books and chapters on coldwater species and veterinary aspects of marine life. He is also a professional underwater cameraman with more than 100 nature-TV and film broadcast credits, most recently "Sharkwater II: Extinction." He conducts research on northern elasmobranchs, notably the Greenland and sixgill shark, and the Atlantic torpedo ray.



Glen Dennison is a citizen scientist and marine life activist with a special interest in technology and electrical engineering. He helped forge a campaign to preserve and study nine glass sponge reefs in Howe Sound and the Georgia Strait. Dennison is involved with the Marine Life Sanctuaries Society and the Underwater Council of British Columbia. In 2017, he was honored by the Coastal Ocean Awards for his study of Howe Sound's glass sponge reefs and has been honored for his inventive design and application of technologies to examine these prehistoric sponges.



NEW

Improved Electronics
Low Power Consumption

Mini Rosette®/CTD Water Sampler 1018 M with Model 316 or 320 Idronaut CTD

- Lightweight, small, compact
- Allows operation from a small boat
- Conducting cable or battery-powered
- Programmable timed operations
- Pressure-activated bottle closing (optional)
- Deep & shallow water models available
- Optional Teflon®-coated Water Sampler
- CTD compatible
- Flag Pulse to CTD A/D input



General Oceanics Inc.

1295 N.W. 163 St., Miami, FL 33169
Tel: (305) 621-2882, Fax: (305) 621-1710
E-mail: Sales@GeneralOceanics.com
<http://www.GeneralOceanics.com>

EVERYWHERE THERE'S WEATHER

Sensors to Measure:

- Relative Humidity
- Precipitation
- Temperature
- Pressure
- Visibility
- Wind



WWW.YOUNGUSA.COM

YOUNG

New York Company Takes Delivery of New Barges

Bouchard Transportation Co. has taken delivery of two vessels from VT Halter Marine and Bollinger Shipyards: the ATB unit MV *Evening Breeze*, a 4,000-hp, Tier 4-approved, 112-by-35-by-17-ft. vessel equipped with an Intercon coupler system; and Barge No. 252, which measures 318 by 70 by 28 ft., has a 55,000 barrel capacity, and will be used to transport petroleum products in the U.S.

Panama Canal Extension Upgraded to Stable

Moody's Investors Service upgraded the 20-year \$450 million senior unsecured bonds issued by the Panama Canal Authority (ACP) to A1 from A2, with a stable outlook, based on the waterway's strong performance since the expansion's inauguration. Moody's noted that the expanded canal has increased overall tonnage and attracted new market segments, contributing to the waterway's strong performance. According to Moody's, "stronger cash-flow generation coupled with a relatively low leverage has resulted in very solid financial metrics."

Aloha-Class Vessels Built for Hawaiian Demands

Kaimana Hila, the newest containership to join the Matson Navigation Co. fleet, was christened in a ceremony in March. At 3,600 TEUs, the *Aloha*-class vessel soon to be delivered from Philly Shipyard Inc. is the largest containership ever built in the U.S. The *Aloha*-class design features dual-fuel engines with LNG capability, double-hull fuel tanks, freshwater ballast systems, and a more fuel-efficient hull design. Constructed specifically to satisfy the future freight demands of Hawaii, the vessels bear increased cargo capacity, with the ability to accommodate a diversified mix of cargoes.

MacArtney Canada Moves into COVE

MacArtney Canada Ltd. recently moved into new offices at the COVE (Centre for Ocean Ventures & Entrepreneurship) in Dartmouth, Nova Scotia, Canada. Currently comprising a team of sales, engineering, shipping and logistics staff, MacArtney Canada will occupy new facilities on the water's edge, in an old Dartmouth Coast Guard facility. With the ability to install full launch and recovery systems on their doorstep, MacArtney Canada plans to increase its SubConn connector stock as well as cable inventory and cable-molding options.

IOSTIA Launches Career Center

The International Ocean Science & Technology Industry Association (IOSTIA) has launched a new career center that connects professionals across all disciplines and career stages with employers offering career opportunities.

The IOSTIA Career Center is powered by YourMembership and has tools for both job seekers and employers, including anonymous resume submission, social media job content and brand advertising.

ROV Inspects Dam in Sierra Nevada Mountains

Phoenix International Holdings, in partnership with Underwater Acoustic International (UAI) and Ocean Tech Services, mobilized a sonar team and ROV team to the Wishon Reservoir to perform a comprehensive underwater acoustic imaging and visual inspection of the Wishon Dam for the Pacific Gas and Electric Co. (PG&E).

The intent of the inspection was to collect a baseline of current conditions to enable planning for effective repair and remediation. The acoustic imaging was accomplished using a high-resolution underwater acoustic steered beam imaging system from UAI. The visual inspection was performed using an inspection-class ROV.

USV Company Rebrands to Bring Tech to Market

Marine Advanced Research Inc. has changed its name to Marine Advanced Robotics Inc. The name reflects the company's shift in focus from technology research and development to a market-driven application of its WAM-V vessels, according to its CEO. WAM-V is a class of USVs that range in size from 8 to 100 ft. and are currently operating in 10 countries.

Ports Association Mourns Steve Cernak

Port Everglades Chief Executive and Director Steven M. Cernak passed away in March 2019 following a long, valiant battle with cancer. He was the immediate past chairman of the American Association of Port Authorities (AAPA) and immediate past chairman of the Florida Ports Council. Cernak was recognized with the AAPA 2019 Cruise Award and was named one of the *South Florida Business Journal's* 250 powerful leaders.

Autonomous Systems Developer Opens Technology Center in Boston

Sea Machines Robotics, a U.S.-based developer of autonomous vessel control systems, opened a new advanced technology center in Boston. The workspace, which is dedicated to accelerating product development and accommodating an expanding team, is located adjacent to the company's headquarters and vessel testing sites in East Boston's historic shipyard.

Fast Response Cutter Delivered to USCG

Bollinger Shipyards delivered the USCGC *Joseph Doyle*, the 33rd fast response cutter (FRC) to the U.S. Coast Guard (USCG), which took delivery in March in Key West, Florida. The 154-ft. *Sentinel*-class FRC has a flank speed over 28 kt., state-of-the-art command, control, communications and computer technology, and a stern launch system for the vessel's 26-ft. cutter boat.

Moving Vessel Profiler Systems Remain Essential for Leidos Hydrographic Surveys

Leidos continues to use AML Oceanographic's moving vessel profiler (MVP) systems as a staple in both manned and autonomous hydrographic survey operations. The company recently purchased another MVP30 to increase the amount of water column profiling it conducts while decreasing the amount of vessel downtime inherent with

manual methods for similar data acquisition, as well as achieving a high-quality data product.

Davis Instruments Celebrates 50th Anniversary

In 1969, newly minted Stanford M.B.A.s Bob Selig and Jim Acquistapace purchased a small plastic sextant manufacturer named Davis Instruments. Today, the partners celebrate 50 years of successfully introducing hundreds of innovative and award-winning products into the marine, fishing and outdoor markets, and launching a revolution in weather monitoring equipment.

Seaspan Installs KVH Broadband Connectivity in 107 Vessels Worldwide

Seaspan, one of the world's largest container ship operators, completed the implementation of KVH mini-VSAT broadband connectivity for all 107 managed vessels in its global container ship fleet. Seaspan selected KVH's TracPhone V7-HTS/AgilePlans and KVH's TracPhone V11-IP for the vessels.

Ropeless Fishing Now Legal in California

A three-month early closure at California Dungeness Crab Fishery prompted legalization of ropeless fishing. In a fishery worth an annual \$84 million in revenue, the closure had a large impact. To solve the problem, the Center for Biological Diversity and the California Department of Fish and Wildlife, with the support of the PCFFA fisher's association, found common ground. An agreement has been reached giving fishers the opportunity to continue fishing with a viable and commercially used alternative: ropeless fishing.

USCG Seeks Input on Tillamook Bay

U.S. Coast Guard (USCG) officials seek public comment by June 1 at <https://bit.ly/2ZfNZuk> while conducting a waterways analysis and management system (WAMS) review of Tillamook Bay. USCG uses WAMS to validate the adequacy of the existing aids to navigation (ATON) system and get a better understanding of the uses of each waterway and general safety issues. WAMS focuses on the waterway's present ATON system, marine casualty information, port/harbor resources, changes in marine vessel usage and future development projects.

Humphree USA Stabilizers Available At Three New West Coast Suppliers

Humphree USA appointed three new dealers for its marine stabilization systems on the West Coast of North America: S3 Maritime in the Seattle area, Newport Harbor Shipyard in Southern California, and Raven Marine in British Columbia. S3 Maritime offers complete yacht systems, service and support from its facility in the Salmon Bay Marine Center on the Lake Washington Ship Canal. Newport Harbor Shipyard, established in 1981, is a full-service facility with lift capacity up to 90 t. and the capacity to service yachts up to 150 ft. Raven Marine is based near Sidney and serves British Columbia and the Pacific Northwest in maintaining, repairing, shipping and caring for yachts. **ST**



SUBSALVE USA

UNDERWATER LIFT BAGS
ENGINEERED FROM THE BOTTOM UP!

The World's Best Underwater Lift Bags from 25 lbs. to 50 tons. Water Load Test Bags to 50 tons. IMCA Compliant. ABS Approved.

INNOVATORS IN BUOYANCY AND ENGINEERED INFLATABLES.

MARK V/ORCA • RAPID RECOVERY SYSTEMS • AIRCRAFT LIFTING BAGS
WATER LOAD TEST BAGS • VEHICLE RECOVERY SYSTEMS • CABLE & PIPELINE FLOATS
LIFEBOAT DAVIT TEST KITS • FEND-AIR • INFLAT-A-TANK • PIPE PLUGGERS

P.O. Box 2030, North Kingstown, RI 02852, USA
Tel: +1 401 884 8801 Fax: +1 401 884 8868
www.subsalve.com richard@subsalve.com



Ocean Engineering

subCtech
Subsea Technologies

pCO₂ Underway
■ Scientific ocean monitoring

Li-Ion Batteries
■ Highest capacity, reliability, safety
■ Your power source for subsea, AUV, ROV

Added Value
■ Customizing and personal support
■ Longest service & design lifetime
■ Simplest operation on board

OSLO BATTERY DAYS 2019

Battery Systems

Subsea Batteries

Vehicle Batteries

OceanPack (FerryBox)

CO₂ optical Analyzer

Battery Systems

SubCtech GmbH www.subctech.com

info@subctech.com
www.gosubsea.com

ISO 9001

international

Safety Report Focuses on Systemic Failures

Bureau Veritas, TMC Marine and the London P&I Club produced their latest guidance focusing on systemic failures on board ships related to the requirements of the International Safety Management (ISM) code.

Systemic failures lead to ship detention by port state control, pollution or injuries and fatalities. Key elements highlighted include management of change, work-planning meetings, the importance of a permit-to-work system and the circular nature of the safety management system. Download the report at <https://bit.ly/2VPEIXx>.

Survey Aids Norwegian Bridge Project DOF

Subsea Norway AS was awarded the contract for Statens Vegvesen to perform geophysical mapping in Bjørnafjord in Norway. The project was executed using the HUGIN AUV Chercheur owned by Canadian company Ocean Floor Geophysics Inc. in combination with the small survey catamaran *GeoCat* owned by DOF Subsea Norway AS. The aim of the work was to obtain the basis for engineering design services for a bridge over Bjørnafjord in connection with the Ferry Free E39 project.

Metal Shark Opens Croatian Office

Shipbuilder Metal Shark opened a dedicated European engineering office, its first location outside of the United States. Metal Shark Croatia is located in the city of Rijeka on Croatia's northern Adriatic coast. The facility currently employs nearly 20 naval architects, machinery systems engineers and electrical engineers who collaborate with Metal Shark's domestic engineering team in support of the company's shipbuilding operations at its three facilities in Alabama and Louisiana in the U.S.

IMEA Seeks Collaborators for Veterans Program

The International Marine Electronics Alliance (IMEA) is seeking board members, donors and partners to further its mission of marine electronics safety and education. IMEA collaborates with other nonprofit associations and government agencies to advance education, scientific knowledge and testing of marine electronics. IMEA plans to provide educational programs to enable military service veterans to transition into the marine electronics workforce through an apprenticeship program.

Flag State Performance Table Released

The International Chamber of Shipping (ICS) has published the latest update of its Flag State Performance Table, which provides an indication of the performance of individual flag administrations, using information available in the public domain.

Since the table was launched 15 years ago, ICS says the data have helped to demonstrate ongoing improvement. Among the 12 largest flag states, responsible for 80 percent of world merchant tonnage, none currently have more than one potential negative indicator, and nine of these have no negative indicators.

iXblue Expands in Australia

Through the development of Australian capabilities, iXblue, conducting business with more than 60 countries, continues to expand its global footprint. iXblue has announced the expansion of its capabilities in Australia after 10 years with a Brisbane-based team. In 2019, it will focus on developing local expertise in inertial navigation systems for defense and civil markets.

Pleuger Industries Moves to Germany

After 18 years in the Flowserve group, Pleuger Industries, a German manufacturer of submersible motor pumps, is once again represented on the market as an independent company. An American investor bought the brand and transferred the strategic management to German hands. From its headquarters and production site in Hamburg, Pleuger Industries now supplies customers with submersible motor pumps, plunger pumps and thrusters that are made in Germany.

Teledyne Software Implemented in African Navy Vessels and Offices

Teledyne CARIS will deliver solutions to the South African Navy Hydrographic Office including software that will be implemented as part of a larger project to be executed by Southern African Shipyards (SAS), where a new hydrographic survey vessel is being built. Three additional survey motor boats are also slated for manufacture, to be equipped with HIPS and SIPS. The South African Navy Hydrographic Office will be refurbished and Bathy DataBase and Hydrographic Production Database will be used to produce paper charts, ENC's and digital products.

World Ocean Council Membership Grows

The World Ocean Council (WOC) announces two new members. SEYPEC, Seychelles' National Petroleum Transport Co., provides the storage and supply of petroleum products, the bunkering of vessels, aviation refueling operations and the management of its shipping arm. BMT, an international design, engineering, science and risk management consultancy, provides products and services to oil and gas, defense, renewable energy, ports, risk management and maritime transport industries.

Optimization Solutions Provided in UAE

Unique Group entered into an agreement with Add Energy Asset & Integrity Management to provide management consultancy and software solutions to energy and manufacturing companies in the UAE. Unique Group will offer engineering solutions to increase safety, optimize expenditure and maximize performance through CMMS data improvements, maintenance optimization, materials management and operational support.

Kongsberg Acquires Rolls-Royce Commercial Marine

Kongsberg Gruppen completed the acquisition of Rolls-Royce Commercial Marine (RRCM). RRCM will operate under the Kongsberg brand and the Kongsberg Maritime legal entity. With the unification of Kongsberg

Maritime and RRCM, Kongsberg is represented in 40 countries, has more than 11,000 employees and an annual turnover of more than NOK 22 billion, with a fleet of more than 30,000 vessels.

Ultra-Large Container Ship Fitted with Scrubber

Yara Marine Technologies announced the successful installation of an inline hybrid scrubber system for an undisclosed customer in the ultra-large container segment. The company says it is the biggest ship engine to be successfully fitted with an inline hybrid scrubber system. The project marks an important milestone in expanding areas where shipowners can achieve full IMO compliance with SOx scrubbers. The inline hybrid scrubber system also covers the vessel's five auxiliary engines.

James Fisher Opens Base in Nigeria

James Fisher Subsea Excavation (JFSE) has completed its first project in Nigeria and established a base in the country. Its tools will be permanently based in Port Harcourt to service clients in Nigeria's energy industry. A JFSE team deployed the company's Twin R2000 tool off the coast of Forcados in a six-week project that involved post-lay trenching of 20-in. pipeline and backfilling for a local energy and petroleum company.

Law Bans a Wide Range of Single-Use Plastics

The European Parliament approved a new law banning throwaway plastics such as cotton-bud sticks, cut-

lery, straws, stirrers and plates. More than 80 percent of marine litter is plastics, and plastic residue is found in many marine species such as fish and shellfish and is present in the human food chain. The new law banning single-use plastics will come into force across all EU member states by 2021. The directive will also ban plastic balloon sticks, single-use polystyrene cups and those made from oxodegradable plastics (plastics that fragment into tiny pieces). EU member states will also have new recycling targets with increased responsibility for producers.

Guide Offers a Plan for Sulphur Cap Compliance

ClassNK has developed "Guidance for onboard use of Compliant Fuel Oil with SOx regulation from 2020" and an implementation plan sample for switching to compliant fuel oil. ClassNK will also provide related appraisal services for the 2020 sulphur cap. It identified five properties of compliant fuel oil, explaining their characteristics and potential safety implications.

Emergency Towing Test Held in Norway

Samson held a sea exercise to validate performance of its emergency vessel attachment and towing system (EVATS) with the Norwegian Coastal Administration in a fjord southwest of Sortland, Norway. Samson, the Alaska Maritime Prevention & Response Network and Norwegian Coast Guard crew members participated in a system briefing and orientation before the sea trial. **ST**

JW FISHERS

A perfect tool to locate missing objects

the Pulse 8X underwater metal detector.

Rated #1 by U.S. Homeland Security

- Easy operation
- Detects ALL metals
- Interchangeable coils
- Visual and audio readout
- Commercial grade
- Land & underwater detecting
- In use by FBI, US Navy and law enforcement agencies worldwide

JW Fishers Mfg., Inc.
1953 County Street
East Taunton MA 02718 USA
(800)822-4744 or (508)822-7330
Email: info@jwfishers.com
www.jwfishers.com

productdevelopment

For more information on any of these products, visit our website at www.sea-technology.com/products

Navigation-Grade Accelerometer

iXal A5 is a navigation-grade accelerometer with a high input range (± 100 g) and an insensitivity to magnetic field. It is based on vibrating beam and vibrating inertial accelerometer technology, with applications including surface and underwater navigation, bridge monitoring and offshore platform monitoring. iXblue.

Hydrographic Data Processing

CARIS Onboard 2.1 allows users to scale bandwidth and apply automated processes to data in near real time. It offers standalone capability, interchangeable export formats and new licensing technology. A redesigned control center monitors the automated system and allows data review from any network-connected device. Teledyne CARIS.

High-Speed CANbus Cables



Raychem CANBus cables transmit data at speeds up to 1 Mb/s and have operating temperatures ranging from -65 to 200°C . These 120- Ω twisted-pair cables are available in constructions that meet SAE J1939 and SAE J1939-11 and -15. TE Connectivity.

Sonar and Sub-Bottom Profiler

The new 2300 system combines a line of side scan sonars, sub-bottom profilers and (optional) MPES bathymetry into one fully integrated 2,000-m-rated system. EdgeTech.

High-Performance IMU

The Horizon IMU is based on

closed-loop FOG technology that enables ultralow bias and noise levels and is designed specifically for hydrographic surveying in dense areas where only a single antenna can be used. SBG Systems S.A.S.

Next-Generation USV

The Accession-Class USV for survey use in nearshore and offshore industries has a modular design that allows extension of its length of 3.5 m to a maximum of 5 m for additional payload equipment and/or power for extended endurance. Unmanned Survey Solutions.

Marine Weather Receiver

Adding the BBWX4 SiriusXM marine weather receiver and antenna to the NavNet TZtouch or TZtouch2 network allows users to view real-time weather content that overlays on NavNet plotter raster or vector charts. Furuno USA Inc.

Autopilot Display

The P4 autopilot has a 5.7-in. VGA color screen, an industrial-grade encoder switch and large course change knob. With additional P4 displays and remote controllers (tiler or joystick), the system offers full autopilot functionality, with multiple stations in strategic locations. ComNav Marine Ltd.

Acoustic Sensing Solution

SigmaWave is a distributed acoustic sensing (DAS) seismic downhole tool designed in partnership with Fotech Solutions. It enables continuous, real-time seismic measurements along the entire length of a fiber optic cable. Sercel.

Smart Hydrophone

The icListen Kayak includes bandwidth from 10 Hz to 200 kHz, 24-bit resolution, high sensitivity and built-in processing, in a small size and low power. It has been optimized for arrays and is ideal for UAVs, ROVs and gliders, with versions for towing behind quiet ves-

sels in a linear array coming soon. Ocean Sonics Ltd.

New Software Release

HYPACK 2019 v1.19.1.0 (32 or 64 bit) includes a settings-color scheme and preservation of files during re-installation, including chart licenses and permits, web map files and the target classification database. It has an enhanced graphics mode and generates instant profiles of matrix files. HYPACK.

Waterproof Touchscreen Monitor



SRMHTRWP-15V features a 15-in. screen with more than 1,500 nits of brightness for use in direct sunlight. It has a five-wire resistive touchscreen, and the waterproof stainless steel panel-mount enclosure enables it to be flush mounted. TRU-Vu Monitors Inc.

Compact Trenching System

QTrencher 500 has a high-voltage transmission for maximum thrust and jetting performance to depths of 3 m. It has the latest surface control and power cabin layout, a 12.5-Te wide-angle A-frame and an umbilical winch with a steel-armored umbilical for operation in 2,500 mwd. Soil Machine Dynamics Ltd.

Embeddable Analog HD DVR

Model 4023 is a compact HD digital video recorder (DVR) for embedded OEM applications. It captures analog HD video and stereo audio to USB storage media. It provides both DVI and composite NTSC/PAL outputs for display on an external monitor. Sensoray Co Inc.

Communications Hub USV

The 3.5-m Comms Hub built for deployment as a long-duration sur-

face gateway has a flexibility in sensor fit that enables tasks including data harvesting, precision positioning and communications from and to subsea assets, with onward relay via satellite for over-the-horizon missions. AutoNaut Ltd.

Corrosion Analysis Software



Larkton CM corrosion rate estimation and materials selection software was created using carbon dioxide and hydrogen sulphide corrosion models and experimental data. It allows input of more detailed data and has options for a range of materials used in down-hole equipment. Larkton Ltd.

Maneuvering Simulation Software

DynaSim can generate multiple ship tracks to evaluate harbor safety and estimate the likelihood of collision for various types of vessels, traffic densities, effects of navigation channel geometries and environmental conditions. Dynaflow Inc.

Underwater Robotic System

The latest version moves with direct sonar integration, works in underwater conditions with an automatic station hold and inspects to greater depths with hybrid power and 12-hr. battery life. Deep Trekker Inc.

VE.Can Network Sensor Adapter

The 5802 NMEA2000 to VE.Can adapter allows network connectivity from NMEA200 sensors to the VE.Can network. Power interfaces from 10 to 70 V and connectors can be used to chain multiple devices together. Oceanic Systems Ltd.

Maritime VSAT Antenna

TracPhone V11-HTS is a 1-m Ku/C-

band maritime VSAT antenna with data speeds as fast as 20 Mbps down/3 Mbps up. It has an integrated modem, a below-decks unit including high-throughput modem, network management software and built-in Wi-Fi and Ethernet. KVH Industries Inc.

Acoustic Doppler Current Profiler

RD Instruments' Pinnacle ADCP has a swappable configuration, in-

dependent or interlaced long-range and high-resolution modes, continuous sampling, enhanced compass data, a deployment status indicator, increased data and advanced monitoring. Teledyne Marine. **ST**

Sea Technology
invites you to visit
our BLOG site at
sea-technology.com/blog



**IT SHOULDN'T
BE SO HARD TO
COLLECT DATA
YOU CAN TRUST**

The Aqua TROLL 500 Multiparameter Sonde integrates with your systems and delivers reliable data right to your tablet or mobile phone. Choose from a full line of drift-resistant sensors, including fluorometers. Learn more at www.in-situ.com/seatech2

 **In-Situ**
YOUR EYES IN THE FIELD™

WATER QUALITY | WATER LEVEL | FLOW | TELEMETRY | APPS & SOFTWARE | AQUACULTURE

marineelectronics

Teledyne Important Partner In Titan Project

OceanGate's Titan manned submersible has reached a major milestone by successfully completing a 4,000-m validation dive off the coast of the Bahamas. This dive makes Titan the only commercially operated manned submersible capable of reaching this depth. The vessel allows up to five crew members.

Teledyne Marine has become a key partner and extensive technology provider to OceanGate for this innovative project. Teledyne Benthos acoustic modems have been designed into the vehicle to provide real-time "text" communications up to 6 km, allowing for the critical exchange of information between the vehicle's pilot and the surface throughout the dive. OceanGate has also enabled the modem's positioning capability through the use of

Benthos DAT to capture the position of the vehicle relative to the ship.

A 6,000-m Teledyne RDI phased-array Pioneer DVL, with XRT extended tracking, has been installed to provide critical precision vehicle navigation capability at full depth, complemented by a Teledyne RDI Citadel CTD.

Teledyne BlueView's 2D and 3D high-resolution imaging sonar systems are installed. The 2D system is used to support navigation and obstacle avoidance while the 3D sonar provides detailed 3D point clouds of areas/objects of interest.

Smart Maritime Council To Drive Tech Collaboration

Representatives from major maritime technology companies and related industry stakeholders gathered in London for the inaugural meeting of the Smart Maritime Council, a new initiative created by the Smart Maritime Network to support col-

laboration and standardization in the development of IT systems for the shipping sector.

Smart Maritime Network was formed in January 2019 to promote the benefits of enhanced integration and data sharing among stakeholders in the maritime and transport logistics sectors, providing a platform to inform the industry on technological developments and innovations while providing wider opportunities for relationship building and knowledge sharing.

The Smart Maritime Council includes maritime technology developers, systems integrators and other key stakeholders. Vessel operators are represented in the membership to provide the end-user's perspective on maritime technology development. The council will hold five more meetings in 2019.

Cat Marine Tech Complies With New EU IWW Regs

Caterpillar Marine has developed new technology solutions for European Union inland waterway

Did You Miss The Boat?

Didn't get your company listed in the *Sea Technology Buyers Guide/Directory*?

Good news - you're not dead in the water. Act now and your company listing and/or advertisement can still be part of the current electronic version of the *Buyers Guide* in our Newcomers section.

Enjoy 24/7 exposure online with direct URL and email linking directly to your website.

SEA TECHNOLOGY
magazine

sea-technology.com/bg-listings

(IWW) vessels. The new solutions are designed to comply with the next generation of regulatory emissions required for EU IWW applications and will be available starting in 2020 for various power ranges. This includes engines with less than 130 bkW; 130 to 300 bkW; and 300 to 1,350 bkW.

Evolution of Underwater Camera Systems

Approximately 71 percent of the planet is covered in water. Up to 1 million species live in the oceans, with up to 66 percent not yet named or discovered. There are hundreds of thousands of marine species waiting to be captured and shared by video. The tools to capture underwater video will continue to be in high demand, especially as technological advancements dramatically increase their effectiveness.

The earliest underwater video is generally accepted to have been filmed in 1940 by Austrian biologist and diver Hans Hass; it premiered in Berlin in 1942. Titled "Pirsch unter Wasser" ("Stalking under Water"), the video is 16 min. long. In 1947, Hass released an 84-min. underwater film titled "Menschen unter Haien" ("Men among Sharks").

In 2019, JW Fishers (JWF) continues to develop advanced underwater video systems for a variety of projects. The MC-2 mini-camera, recently upgraded from the MC-1 to include powerful LED lights, is the ideal tool for commercial companies in need of capturing underwater video footage while utilizing a diver. Many customers mount the camera on their helmet and keep in contact with ship-based surveyors via JWF's video recording system (VRM) that also allows the mini camera to be pole mounted for easy manipulation and deployment in hard to reach places.

Accelerator Program Supports Oil, Gas Tech Pioneers

Autonomous underwater swarm robots and micropolymers to re-instate well integrity are just some of the exciting new technologies that have secured funding through the Oil & Gas Technology Centre's

TechX Pioneer Accelerator Programme. Nearly 200 applications from more than 35 countries were received this year, covering oil and gas and clean tech solutions to maximize economic recovery and transition to a low-carbon economy.

The final 16 companies were whittled to 10 for this year's cohort, starting in May. Each start-up gets up to £100,000 to develop its business and technology as part of an

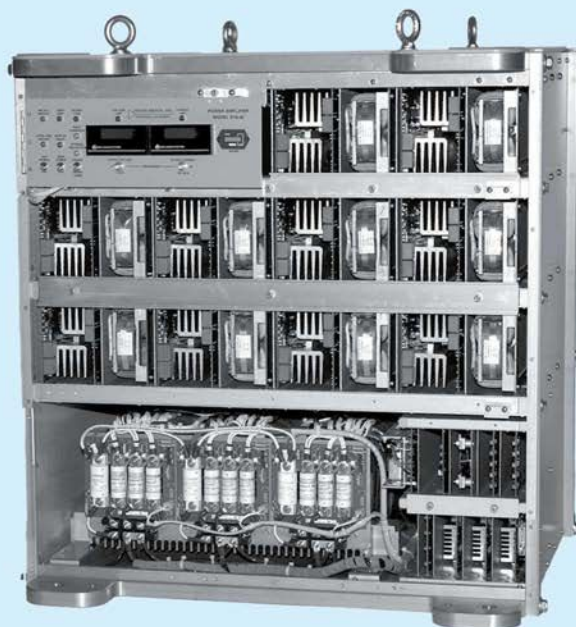
intensive 16-week accelerator program that includes expert mentors, development partners and deep access to the industry.

After graduating, pioneers have the opportunity to join a 12-month incubator called TechX+, with two companies awarded an additional share in £130,000 funding from BP.

All funding is provided with no equity or payback, and the pioneer retains intellectual property. **ST**

POWER AMPLIFIERS SWITCHING & LINEAR

**For more than 30 years we have been
building amplifiers to drive reactive loads.**



Model S16-20
20kVA continuous; 50kVA 20% duty
35 x 31.5 x 35.5 inches; 985 lbs.

Visit our Web site www.instrumentsinc.com



Instruments, Inc.

7263 Engineer Rd., San Diego, CA 92111-1493
(858) 571-1111 FAX (858) 571-0188 info@instrumentsinc.com
Copyright 2019

Data-Gathering Autonomous Vessel For Royal Navy

L3 ASV has delivered a long-endurance autonomous vessel known as the C-Enduro to the U.K. Royal Navy for military data-gathering trials by the Mine countermeasures and Hydrographic Capability (MHC) program as the Navy seeks to exploit autonomous technology.

The 4.8-m vessel has 10 sensors combining scientific and hydrographic survey equipment. The vessel operates using L3 ASV's proprietary control system, ASView, and is fitted with L3 ASV's advanced autonomy package, ensuring situational awareness and smart path planning. ASView enables a range of autonomous control modes, including line following, station-keeping and geofencing.

Navy-Sponsored Scientist Awarded For Seafloor Mapping

For creating the most comprehensive global map of the ocean floor, Dr. David Sandwell received the Charles A. Whitten Medal, sponsored by the American Geophysical Union (AGU). Sandwell is a geophysicist at Scripps Institution of Oceanography. Named after scientist Charles A. Whitten, the medal is given to honor "outstanding achievement in research on the form and dynamics of the Earth and planets." Since the 1990s, sponsored by the Office of Naval Research (ONR), Sandwell has com-

bined satellite data with acoustic depth measurements to develop a detailed, accurate map of the seafloor.

"Dr. Sandwell's groundbreaking work provides the first high-resolution map of the ocean floor," said Dr. Tom Drake, head of ONR's Ocean Battlespace and Expeditionary Access Department.

"This has opened new research areas for oceanography, marine geology and geophysics—critical topics for the U.S. Navy."

Teledyne Marine Delivers Unmanned Systems to UAE Navy

Teledyne Marine – Vehicles announced through local partner Trust International Group (Abu Dhabi) the sale and delivery of unmanned systems to the United Arab Emirates Navy to support search and recovery applications.

The sale included both a Gavia AUV and a SeaBotix vLBV300, which will provide the UAE Navy with a highly effective rapid response capability from a low-logistics AUV and an observation-class ROV capable of cooperative and complementary mission profiles from search/detection and classification to intervention.

Kongsberg Hydroacoustic, Bridge Tech Chosen for South African Navy Survey Vessels

Kongsberg Maritime, through its Cape Town-based business partner Unique Hydra (Pty) Ltd., has been selected to deliver a cutting-edge integrated hydroacoustic and bridge system technology package for the Replacement of the SA Navy Hydrographic Capability Project. Kongsberg technology will be used on a new hydrographic survey vessel being built by Southern African Shipyards (SAS), due for delivery in 2022. Kongsberg Maritime will deliver a turnkey survey package for diverse environments to the new ship, including: EM 304 deepwater multibeam echosounder, EM 2040 shallow-water multibeam echosounder, TOPAS PS 40 parametric sub-bottom profiler, EA640 single-beam echosounder, K-Sync synchronization system, MDM 500 marine data management system and Seapath 380-R3 combined GNSS and INS.

The vessel will feature the K-Bridge INS and K-Pos dynamic positioning.

Three survey motor boats will also be delivered.

Gaps Acoustic Positioning System For French Mine Warfare Applications

The French General Directorate of Armament for Technical Naval Applications (DGA Technique Navales – DGA/TN, formerly GESMA) has selected iXblue's Gaps acoustic positioning system for its AUV positioning and monitoring applications. Incorporating iXblue's Phins inertial navigation system, the Gaps system is equipped with a pre-calibrated USBL antenna and offers very high-precision georeferenced positioning performance, particularly in shallow waters and noisy environments. Its telemetry function also allows for the recalibration of the INS on board the underwater vehicle thanks to an acoustic communication link, as well as for the command and control of the AUV. **ST**



ARE YOU MOVING?

Keep your *Sea Technology* subscription up-to-date at
sea-technology.com/change-of-address

For further assistance, contact us at
circulation@sea-technology.com
or
(207) 348-1057

meetings

JUNE

June 4-5—BlueTech Expo, Washington, D.C. 772-485-0333, mj.mcduffee@iostia.org or www.bluetechexpo.org.

June 4-6—Capitol Hill Ocean Week, Washington, D.C. <https://marinesanctuary.org/capitol-hill-ocean-week>.

June 12-14—International Conference on Marine Navigation and Safety of Sea Transportation TransNav, Gdynia, Poland. +48 58 5586136, transnav@am.gdynia.pl or <http://transnav2019.am.gdynia.pl>.

June 17-19—MAST Asia, Tokyo, Japan. +33 663 232 473, eike.eickhoff@mastconfex.org or <https://mastconfex.com/asia2019>.

June 17-20—OCEANS 2019 Marseille, Marseille, France. Technical Chair@oceans19mtsieemarseille.org or www.oceans19mtsieemarseille.org.

June 18-20—CLEAN PACIFIC Conference & Exhibition, Vancouver, Canada. www.cleanpacific.org.

June 18-20—Technology, Systems, and Ships, Washington, D.C. asnehq@navalengineers.org or www.navalengineers.org/Symposia/Technology-Systems-and-Ships-2019.

June 19—Sea Scotland Conference, Edinburgh, Scotland. info@seascotland.scot or www.seascotland.scot.

June 24-26—Anti-Submarine Warfare, London, England. +44 (0) 207 368 9300, enquire@iqpc.co.uk or www.defenceiq.com/events-anti-submarinewarfare.

JULY

July 10-12—Offshore Energy and Storage Summit, Brest, France. 519-253-3000 ext. 2638, rupp@uwindsor.ca or www.osessocty.com/oses2019.

July 23—Arctic Day, Washington, D.C. meetings@navalengineers.org or www.navalengineers.org/Symposia/Arctic-Day-2019.

July 23-25—HydroVision International, Portland, Oregon. www.hydroevent.com.

AUGUST

August 20-21—AUVSI Unmanned Systems, Washington, D.C. 571-858-4364 or ehallberg@auvsi.org.

SEPTEMBER

September 1-6—European Wave and Tidal Energy Conference, Naples, Italy. ewtec2019@ewtec.org or <https://ewtec.org>.

September 3-6—SPE Offshore Europe, Aberdeen, Scotland. www.offshore-europe.co.uk.

September 8-11—SMM Hamburg, Hamburg, Germany. +49-(0)40 3569-2445 or nora.ebbinghaus@hamburg-messe.de.

September 9-13—London International Shipping Week, London, England. +44 1295 814455, sales@shippinginnovation.com or <http://londoninternationalshippingweek.com>.

September 16-20—NMEA and RTCM Marine Electronics Conference and Expo, West Palm Beach, Florida. 410-975-9425, mreedenauser@nmea.org or www.expo.nmea.org.

September 16-20—OceanObs'19, Honolulu, Hawaii. 202-448-1245, cyanoff@oceanleadership.org or www.oceanobs19.net.

OCTOBER

October 2-3—OilComm, Houston, Texas. 484-869-2378, dmuirhead@accessintel.com or www.oilcomm.com.

October 3-5—INMEX SMM India, Mumbai, India. nora.ebbinghaus@hamburg-messe.de or www.inmex-smm-india.com.

October 6-9—Teledyne Marine Technology Workshop, San Di-

ego, California. 508-563-1639, Margo.newcombe@teledyne.com or www.teledynemarine.com/tmtw2019.

October 7-9—Offshore Energy Exhibition & Conference, Amsterdam, Netherlands. +31 10 209 2600, marketing@offshore-energy.biz or www.offshore-energy.biz.

October 8-10—PACIFIC 2019, Sydney, Australia. +61 (0)3 5282 0500, expo@amda.com.au or www.pacificexpo.com.au.

October 27-31—OCEANS 2019 Seattle, Seattle, Washington. info@oceans19mtsieeseattle.org or <https://seattle19.oceansconference.org>.

October 28-30—CLEAN GULF Conference & Exhibition, New Orleans, Louisiana. www.cleangulf.org.

NOVEMBER

November 5-7—International Conference on Marine Engineering and Technology Oman, Muscat, Oman. +44 (0)20 7382 2656, marketing@imarest.org or www.icmetoman.com.

November 10-14—International Water Conference, Orlando, Florida. 412-261-0710 ext. 13, t.bombalski@eswp.com or www.eswp.com/water.

November 13-15—CLEAN GULF, New Orleans, Louisiana. 713-343-1878 or cbuchholtz@accessintel.com.

November 18-22—BlueTech Week, San Diego, California. www.bluetechweek.org.

November 20-22—Sustainable Ocean Summit, Paris, France. www.oceancouncil.org.

November 21-23—Pacific Marine Expo, Seattle, Washington. cdimmerling@divcom.com or www.pacificmarineexpo.com.

For more industry meetings, visit sea-technology.com/meetings. **ST**

Sea Technology magazine

A Digital Media Presence as Vast as the Ocean Itself

Get the latest headlines on all things maritime on your desktop, mobile phone, or tablet, courtesy of *Sea Technology*'s online outlets.



Follow us on Facebook and Twitter for breakthrough stories and events. With exclusive content and interviews, we'll keep you afloat with the latest happenings throughout the industry.

Keep up with in-depth feature-length stories and editorials on our website, **SEA-TECHNOLOGY.COM**. Want a more traditional yet interactive experience? With our *Sea Technology* e-book, enjoy all the things you've loved about us for more than 50 years in a digital format.

Simply visit **SEA-TECHNOLOGY.EPUBXP.COM**



Sign up for our free e-mail newsletter, *Sea Tech e-News*. This bi-weekly e-newsletter brings the industry's latest headlines directly to your inbox. Sign up at

SEA-TECHNOLOGY.COM/ENEWS



Get completely free access to the *Sea Technology Buyers Guide/Directory*, the only complete directory serving the ocean/marine/offshore community. Alphabetical listing of manufacturers, their products and services with URLs, pertinent U.S. government departments and agencies, oceanographic research vessels, geophysical survey vessels, and educational institutions — all at your fingertips. Just visit **stbuyersguide.epubxp.com**.

VISIT OUR BLOG AT SEA-TECHNOLOGY.COM/BLOG

WEBSITE: sea-technology.com

E-BOOK: sea-technology.epubxp.com

BUYERS GUIDE: stbuyersguide.epubxp.com

E-NEWS: sea-technology.com/form_aboutenews.html

FACEBOOK: facebook.com/seatechnologymag

TWITTER: twitter.com/SeaTechnology

LINKEDIN: linkedin.com/company/sea-technology-magazine

BLOG: sea-technology.com/blog



contracts

Oceaneering International Inc., Houston, Texas, will provide support for offshore facilities in Norway, including engineering maintenance, ROVs, integrated subsea tooling, risk and reliability services and technology solutions. Equinor.

Indian Register of Shipping, Mumbai, India, secured a five-year contract from India's largest shipping company to undertake emergency response service for 33 vessels. Shipping Corp. of India.

Furuno USA Inc., Camus, Washington, will provide sonar, sensors and a pilothouse alert system for a new generation of vessels joining a fleet of 300 towboats and nearly 1,000 inland barges operating in U.S. waters. Kirby Inland Marine.

MacGregor, Singapore, will provide the on-vessel mooring system

for a semi-submersible deepwater floating production unit (FPU) in a natural gas field in the South China Sea. China National Offshore Oil Corp.

ABB, Billingstad, Norway, will supply a comprehensive power and propulsion package including two Azipod steerable propulsion systems for China's first domestically built cruise ship. Shanghai Waigaoqiao Shipbuilding Co. Ltd.

Space Flight Laboratory, Ontario, Canada, has been awarded the prime contract to develop the next-generation cluster of formation-flying microsatellites that can geolocate radio frequency (RF) signals. HawkEye 360 Inc.

Ellicott Dredge Technologies, New Richmond, Wisconsin, sold an IMS Model 7012 HP JetMaster dredge. The system will perform annual maintenance of Tok Bali supply base, which serves the oil and gas industry in offshore Peninsular Ma-

laysia and the Gulf of Thailand. Matrix Reservoir Sdn. Bhd.

ChartWorld GmbH, Hamburg, Germany, will provide the CIO+ tool for voyage planning. The tool helps automate the process of applying additional data in ECDIS using user-chart objects. Furuno.

SEAMOR Marine, Nanaimo, Canada, will provide a Chinook ROV to be deployed for a mission to survey the last remaining year-round ice area in the High Arctic, a collaboration called "The Last Ice Project." Fisheries and Oceans Canada.

essDOCS, Swieqi, Malta, will integrate its CargoDocs DocEx solution into a blockchain-based application for companies to digitally manage letters of credit and trade documents. Voltron. **ST**

Subscribe to *Sea Technology*
sea-technology.com/subscribe-free

FOLLOW SEA TECHNOLOGY ON...



twitter.com/SeaTechnology

An effective medium reserved for listing professional and consulting services. Size: 3-3/16" wide x 1" deep, to a maximum depth of 3". Rates: \$95 per one-inch insertion for 1-6 times; \$90 each for 7-12 consecutive times. Payment terms: net 30 days. Discounts: 10% for advance payment for 6 or more insertions without copy change; no agency commissions. No charge for typesetting. Send your electronic file or text and images (300 dpi) to seatechads@sea-technology.com by the 10th of the month preceding insertion month.

Relax.
We can take the pressure.



Subsea Instrumentation Housings and Junction Boxes
Contact us for a FREE Brochure

10,000 N. Technology Drive, Fountain Hills, AZ 85268
877-3PREVCO (Toll-Free) 480-837-0100 480-718-7723 (Fax)
noleaks@prevco.com www.prevco.com

SONOTRONICS
MARK YOUR EQUIPMENT



Mark your underwater equipment for later recovery in case of loss. With *close to 50 years* of experience in the manufacture of sonic pingers, hydrophones, and receivers, SONOTRONICS can provide equipment for your underwater tracking needs.

www.sonotronics.com
(520)746-3322

MetOcean Equipment Leasing

ADCPs, CTDs, Water Quality Loggers (Tu, DO etc),
Acoustic Releases, Ice & Zooplankton Profilers,
Mooring Frames & Cages, Pingers, etc.

Reliable Rentals at Reasonable Rates 

www.ASLENV.com

GALVANIC TIMED RELEASES

Cost-effective electrochemically degraded links available in durations ranging from one minute to 100 days. Trigger closure mechanisms, open escape panels, release cable support buoys or subsurface instrument locator floats. Stock and custom-designed releases available from:

International Fishing Devices, Inc.
935 Town Hall Ave., Unit 1, Jupiter, FL 33458
Ph: (954) 574-9517

André LaBonté
P.O. Box 60, Waipua, New Zealand 0545
Ph.Fax: 011-64-9-432-0645

underseareleases.com



SEACATCH
TOGGLE RELEASE

Tel: 253-858-1985 Fax: 253-858-1986
Email: jmcmillan@seacatch.com

WWW.SEACATCH.COM

 **HYDROSPACE Group**
PVHO Windows and Acrylic Pressure Vessels



**Fabrication – Certification – Engineering – Repair
Replacement – Hydrostatic Testing – Custom Design**

Contact: Michael Azer Tel + (909) 989-7773 - pvho@HydrospaceGroup.com
www.HydrospaceGroup.com

R/V MICHAEL UHL	R/V SURVEYOR
	
• 95 x 24 x 8 • 5000 mile range • 5 crew • A-frame	• 103 x 24 x 8 • 3000 mile range • 5 crew • A-frame
• Current USCG COI • 32 passengers • Assorted winches • Hydro Pro Marine Crane	• Current USCG COI • 28 passengers • Assorted winches • Marine Knuckle Crane

Maritime Logistics has available for charter two versatile research support vessels. Based in central California. Vessels have open 50x22 aft steel decks & rails for easy attachment of equipment. Operations supported but not limited to: diving, construction, towing, vibra-core, SEAmagine Submarine deployment & recovery, torpedo, mine, buoy, target placement & recovery ROV, AUV, CPT, fisheries and ECO studies, hydrographic, sonar, side scan, 3D towed and attached surveys systems; and many others.

MARITIME LOGISTICS

1704 Spring St., Ste. 102 Paso Robles, CA 93446 805-431-7393 kayak38@aol.com

SUBSEA MODULES

CUSTOM BUILT HOUSINGS FOR 100, 300, 1000 meter plus
IDEAL FOR SCIENTIFIC, ELECTRONIC AND VIDEO SYSTEMS

Contact: Steve Greenaway, Research Director UK
Tel. UK. 44. (0) 1793 814992
www.greenawaymarine.com



View the *Sea Technology Buyers Guide/Directory* online!
Go to <http://www.sea-technology.com>.

NOT LISTED? If you wish to be listed in the Industrial Firms section of the next edition of the *Sea Technology Buyers Guide/Directory*, please visit www.sea-technology.com, and complete our online listing form.

Questions? seatechnologybg@sea-technology.com.

Dr. Mohammad R. Khosravi is currently a researcher at the Department of Electrical and Electronic Engineering at Shiraz University of Technology in Shiraz, Iran. Khosravi



now serves as a guest editor of Springer Nature Applied Sciences (SNAS), The Journal of Supercomputing and Current Signal Transduction Therapy, and he has served as a guest editor for Current Medical Imaging Reviews.

In recent years, underwater acoustic sensor networks (UASNs), mostly simulation based, have become a hot research topic. This research covers network protocol design, robotics and autonomous systems, environmental issues, and signal processing.

A key aspect of undersea signal processing is related to sonar systems. Sonar signal processing comprises a large number of signal-processing algorithms to achieve functions such as target detection, localization and classification. One task of sonar is to extract specified features from the acoustic received signals and expound on this information precisely and clearly, without ambiguity for the end-user. The extraction of the specific features and the selection of a proper classifier are essential to the recognition and classification of sonar signals.

For UASN simulation, there are many software tools, including Network Simulator (NS), Network Simulator-v2 (NS2) and Network Simulator-v3 (NS3); NS2 and NS3 are newer versions of NS. In addition to the NS family, OPNET, OMNeT++, QualNet, JSim and many other simulators are open-source tools for network simulation. These are comprehensive platforms for simulating many types of computer and data communication networks, so researchers should use an augmented software package in addition to

these platforms to create a proper environment for simulating UASNs. For example, AquaSim can be applied with NS2 to simulate underwater environments.

Although these tools might be helpful for simulating UASN protocols such as routing and MAC (medium access control), there is not yet a complete model as per a real-world underwater network. For instance, in NS2 (along with AquaSim), the model considered for a physical layer (PHY) is very simple. This model uses an ideal inequality to describe a radius range (communication coverage) of messages transmitted from a sender node and a fixed velocity for acoustic waves. In contrast, for some NS3-based packages, the developers have tried to give a more exact PHY model with a nonfixed acoustic wave propagation velocity (in real-world conditions, velocity depends on depth, temperature, etc., whereas some simulators consider an approximate speed of 1,500 m/s in all conditions).

It seems that some parts of a real-world underwater acoustic network cannot easily be captured by simulators, e.g., real communication computations considering all the challenges of a wireless acoustic channel (all losses, channel fading and so on). Complexity of the network protocols design problem and the need for an object-oriented programming environment (because of UASN architecture) for underwater wireless networks add to the challenges for UASN simulators.

A main problem of open-source software tools for network engineers is to use C or C++ along with, for instance, Linux commands and object-oriented programming languages. This might not be a major problem for researchers working in the academic fields of computer science and engineering. However, it is a big and basic obstacle for researchers in electrical engineering

who are interested in network simulation and protocol design. Matlab is a typical tool for researchers, and encouraging international developers (academic or industrial) to provide a Matlab-based package for UASNs that doesn't require skills for different programming languages would open up more resources.

Although there are now some open-source Matlab toolboxes for networks on the internet (Matlab itself is not open source, but additional open-source toolboxes can be supported by Matlab), researchers still require a better, and complete, simulation platform using Matlab to cover all open-system interconnected (OSI) layers under the best modeling. In research areas such as image processing and pattern recognition, this task has been taken up by MathWorks (Matlab's developer) and independent scientists.

Since Matlab is widely used in academic circles, researchers and scientists must attend to this shortage of network simulation and create new open-source toolboxes. Another possibility is for MathWorks to create such toolboxes for Matlab, similar to existing tools in the latest versions of Matlab. Perhaps a new simulator could have integrated tools for simulating both network protocol design and signal processing. If such options become available, UASN researchers will become more accurate, qualified and efficient in their work.

As a final point, a more comprehensive simulator could enable industrial developers to precisely evaluate the performance of a network before configuration of network devices. This is important because these networks are expensive and key to data communication among sensor nodes for systems in the oil and gas industry, environmental and resource monitoring, marine electronics and ocean energy conversion systems. **ST**

may advertiser index

AMT Analysenmesstechnik GmbH 26 www.amt-gmbh.com	*ixblue 13, 21 www.ixblue.com
Airmar Technology Corporation 44 www.airmar.com	MSI Transducers 44 www.msitransducers.com
Blueprint Subsea.....5 www.blueprintsubsea.com	MetOcean Telematics 3 www.metocean.com
BlueTech Expo 2019 6 www.bluetechexpo.org	Ocean Sensor Systems, Inc. 20 www.oceansensorsystems.com
CSnet International, Inc. 4 www.csnetinternational.com	OceanObs'19.....26 www.oceanobs19.net
*EvoLogics GmbH.....43 www.evologics.de	SBG Systems S.A.S.....19 www.sbg-systems.com
*J.W. Fishers Mfg. Inc.....31 www.jwfishers.com	Saab Seaeye Limited.....8 www.seaeye.com
General Oceanics, Inc.....27 www.generaloceanics.com	Sea-Bird Electronics, Inc. 2 www.seabird.com
HYPACK, Inc. 14 www.hypack.com	SubCtech GmbH 29 www.subCtech.com
*In-Situ Inc.....33 www.in-situ.com	*Subsalve USA Division 29 www.subsalve.com
*Instruments, Inc. 35 www.instrumentsinc.com	R.M. Young Company 27 www.youngusa.com

*For more information, consult the digital 2019 *Sea Technology Buyers Guide/Directory*: <http://stbuyersguide.epubxp.com>

SIGN UP ONLINE TO RECEIVE SEA TECHNOLOGY magazine!

Available free of charge* to qualified individuals (those involved in the marine industry) - in print or in digital format or both.

www.sea-technology.com/subscribe-free

Also available, at no charge: our bi-weekly e-newsletter, *Sea Tech e-News*. Sign up here:

<https://sea-technology.com/enews>

*readers outside of the U.S. may sign up for a free digital subscription

If you prefer a more personal touch, please contact us at +703 524 3136 or seatechads@sea-technology.com.



MISSION STATEMENT

Sea Technology is the worldwide information leader for marine business, science & engineering. Our goal is to provide our global audience with current information on the various segments of the worldwide marine/ocean industry through state-of-the-art and application articles, news columns, and staff reports; and to provide our advertisers with a cost-effective, valuable, and useful vehicle by which to promote their products and services.

For permission to photocopy portions of *Sea Technology*, please contact the Copyright Clearance Center • 222 Rosewood Dr. • Danvers, MA 01923 • Phone (978) 750-8400 • FAX (978) 750-4470

Sea Technology news magazine, including Underwater Engineering, UnderSea Technology, Oceanology International Offshore Technology, and its website, is edited for executives, scientists, engineering and technical personnel in industry, government, and education engaged in the field of undersea defense, oceanography, anti-submarine warfare, marine sciences, underwater exploration, diving and construction, drilling, and mining. While effort is made to verify material published, opinions of authors are not necessarily those of the publisher, and the publication accepts no responsibility in connection with any liability that might occur as a result of published material.



SMART SUBSEA SOLUTIONS

S2C TECHNOLOGY: COMMUNICATION AND TRACKING COMBINED

- time, space and cost-saving solutions
- low power consumption for autonomous operations
- advanced data delivery algorithms, addressing and networking, remotely configurable settings
- extendable platform with multiple configuration options: power-saving Wake Up module, acoustic releaser, additional sensors, custom solutions, OEM versions available

USBL POSITIONING SYSTEMS

simultaneous positioning and communication - no need to switch between positioning mode and modem mode

- flexible SiNAPS positioning software
- reliable data transmissions
- range: up to 8000 m
- accuracy: up to 0.04 degrees

LBL POSITIONING SYSTEMS

highly accurate, precise and stable performance, simultaneous positioning and data transmissions

- flexible SiNAPS positioning software
- reliable data transmissions
- range: up to 8000 m
- accuracy: better than 0.01 m

UNDERWATER ACOUSTIC MODEMS

reliable data transmissions even in adverse conditions, customizable R-series modems, light and compact M-series "mini" modems, the HS high-speed modems, special editions for developers, S2C communication and positioning emulator - remote access or standalone device

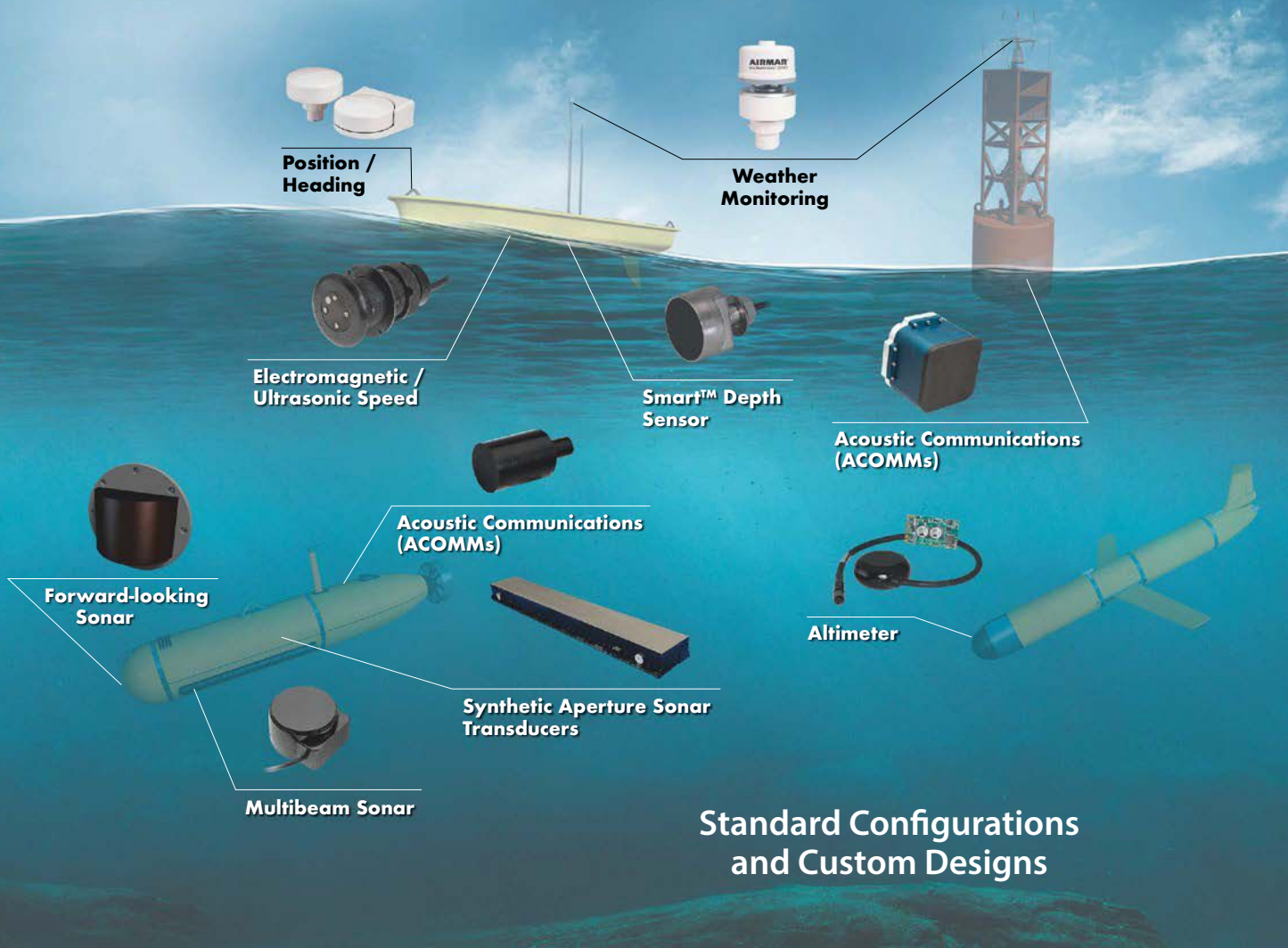
- range: up to 8000 m
- depth: up to 6000 m
- data rate: up to 62.5 kbps

NEW!
ULTRA-COMPACT
"TINY" MODEMS



S2C M (left) and the new S2C T "tiny" modem - 20% smaller and lighter

Acoustic Transducers and Arrays



From prototype to production AIRMAR and MSI push the boundaries of sonar technology. Whether you need a simple single element sensor or a large multi-element array, we have the solution. We specialize in partnerships providing strong engineering support, innovative technology, advanced manufacturing capabilities and exceptional customer service.



AIRMAR.COM



MSITRANSDUCERS.COM