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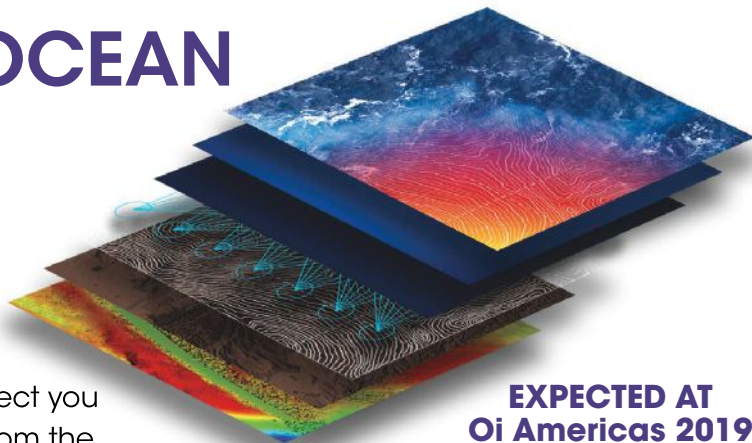
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Blue Economy Challenges And Opportunities

As the ocean continues to support expanding use from a range of sectors and becomes an ever increasing component of the global economy, it also faces the effects of that use, as well as the broader impacts of climate change. These issues are creating both challenges and opportunities.

The ocean will continue to be in the global spotlight as negotiations on a new international, legally binding instrument under the U.N. Convention on the Law of the Sea (UNCLOS) continue. The process to develop regulations on biodiversity in areas beyond national jurisdiction, i.e., the high seas, which cover about 45 percent of Earth, will result in area-based management and marine protected areas, environmental impact assessment requirements, the transfer of marine technology, and a regime for marine genetic resource management and benefit-sharing.

Deep-sea mining in the next few years will bring additional attention to the critical role of ocean resources, given the potential for ocean minerals to support the growth of renewable energy. Concurrently, offshore wind farm activity will continue to expand, particularly in the U.S. and Asia. There could also be technology breakthroughs in the next few years for harnessing wave, current and tidal energy. However, the rise of new uses of ocean space is testing the status quo. For example, fishing interests have lately challenged the spread of offshore wind. Both sectors provide critical products for society, and proactively addressing maritime multiple use is increasingly needed, as witnessed by the steady roll out of marine spatial planning (MSP) efforts.

The increased use of ocean space and resources will need to be data driven. Data on existing and potential economic activities and the status of ocean conditions, resources, biodiversity and ecosystems will underpin MSP and improved ocean management.

The expanding amount of fixed and mobile industry infrastructure necessitates data to ensure that ocean use is safe, responsible and sustainable, and to provide the most cost-effective means to increase ocean knowledge. Industry vessels and platforms can be used to host sensors or deploy instruments in an era of shrinking research budgets and fleets. The World Ocean Council's Smart Ocean-Smart Industries program enables "matchmaking" of industry assets with data collection technology and ocean-observing priorities, with an emphasis on such areas as the Arctic, which will continue to change faster and more fundamentally than any other part of the planet as ice cover recedes.

Climate change is leading to the increased severity and frequency of extreme weather events, with devastating effects on coastal areas and ecosystems. These events immediately and significantly affect people, livelihoods, communities, businesses and economies. The need to ensure that ports and critical coastal infrastructure across the globe are adapted, ready and resilient to handle the effects of extreme events has never been more compelling, especially for small islands and developing countries.

A potential climate solution is to remove carbon dioxide from the atmosphere via negative emission technologies (NETs), as mandated by the 2015 Paris Agreement. The range of NET-related solutions potentially includes ocean alkalinity shifts, direct CO₂ injection, growing seaweed for deep-ocean deposition, expansion of coastal ecosystems that store carbon, and adjusting ocean primary productivity.

A healthy ocean is essential for a sustainable blue economy. Ocean health continues to decline due to a variety of sea-based impacts, including invasive species from biofouling and ballast water, marine sound and marine debris, especially plastics. The unprecedented public concern about the ocean due to awareness of the plastics problem has created a critical opportunity for the ocean technology, business, science and government communities to engage in developing solutions for a range of ocean challenges. To learn more, read Oceanworks CEO Rob Ianelli's article on page 45. **ST**

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SEA TECHNOLOGY
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 **IOSTIA**
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)) IMO Focuses on Plastic Pollution. The International Maritime Organization (IMO) has adopted an action plan to enhance existing regulations and introduce new supporting measures to reduce marine plastic litter from ships. Discharging plastics into the sea is already prohibited under regulations for the prevention of pollution by garbage from ships in the International Convention for the Prevention of Pollution from Ships (MARPOL), which also obliges governments to ensure adequate port reception facilities to receive ship waste. Recognizing that more needs to be done to address the environmental and health problems posed by marine plastic litter, IMO member states agreed on actions to be completed by 2025, which relate to all ships, including fishing vessels. The action plan supports IMO's commitment to meeting the targets set in the UN 2030 Sustainable Development Goal 14 on the oceans. Measures include a proposed study on marine plastic litter from ships, enhancing public awareness and strengthening international cooperation.

)) Seabed 2030 Project Advances. The first regional mapping meeting for The Nippon Foundation-GEBCO Seabed 2030 Project was held in Stockholm, covering the Arctic, Antarctic and North Pacific regions. The successful meeting brought together leading ocean-mapping experts, oceanographers, scientists and private companies to discuss technical elements, including data acquisition, visualization, expedition coordination and the role of future technologies. With the goal of mapping the entirety of the world's ocean floor by 2030, the project divides responsibility for different areas of the ocean between four centers, located at the Alfred Wegener Institute, Germany, covering the Southern Ocean; the National Institute of Water and Atmospheric Research, New Zealand, covering the South and West Pacific Ocean; the Lamont-Doherty Earth Observatory, Columbia University, U.S., covering the Atlantic and Indian Oceans; and Stockholm University, Sweden, in partnership with the University of New Hampshire, U.S., for the Arctic and North Pacific Ocean. Regional products are fed to the Global Data and Coordination Centre hosted at the British Oceanographic Centre in the U.K. The meeting identified numerous sources of new bathymetric data.

)) Subsea Market Rebounding. The Westwood's Subsea Vessels Operations & Hardware Market Forecast 2019 to 2023 report reveals that the subsea market is showing signs of recovery. The recovery in oil prices to above \$70/bbl continues to spur a new wave of offshore investment. Westwood is forecasting a rebound in offshore activity, with subsea vessel operations and hardware expenditure expected to amount to \$152 billion over 2019 to 2023. The recovery in the subsea market has significantly supported project sanctioning, with the number of greenfield projects passing the final investment decision stage in 2018, increasing by 154 percent compared with 2016, at the low point of the downturn. This is supported by positive macro drivers in the near and long term, albeit the recovery remains dependent on geopolitics and OPEC. Supply-chain conditions remain challenging, and despite the strength of free-cash flow to operators, this has not yet translated to an improved commercial environment for services and equipment. Operators are also managing their risk exposure through phased developments and standardized solutions for equipment.

)) Hurtigruten to Power Vessels with Dead Fish. Cutaways from fisheries and other organic waste will soon be used to power Hurtigruten's fleet of green cruise ships. With a growing fleet of 17 ships, Hurtigruten is the world's largest expedition cruise line. The company has invested heavily in green technology, including fueling ships with liquefied biogas (LBG), which is fossil-free, renewable gas produced from dead fish and other organic waste. By 2021, Hurtigruten plans to operate at least six of its ships on a combination of biogas, LNG and large battery packs.

)) AUV Sonar Supports San Juan Search. EdgeTech's side scan sonar technology was used to help find the missing Argentine submarine ARA *San Juan*. The deepwater search was performed by Ocean Infinity and its fleet of 6,000-m-rated AUVs equipped with the sonar. The *San Juan* was imaged by the sonar operating at a frequency of 230 kHz and a 400-m-range scale. The submarine had been missing for a year before being discovered in more than 900 m of water.

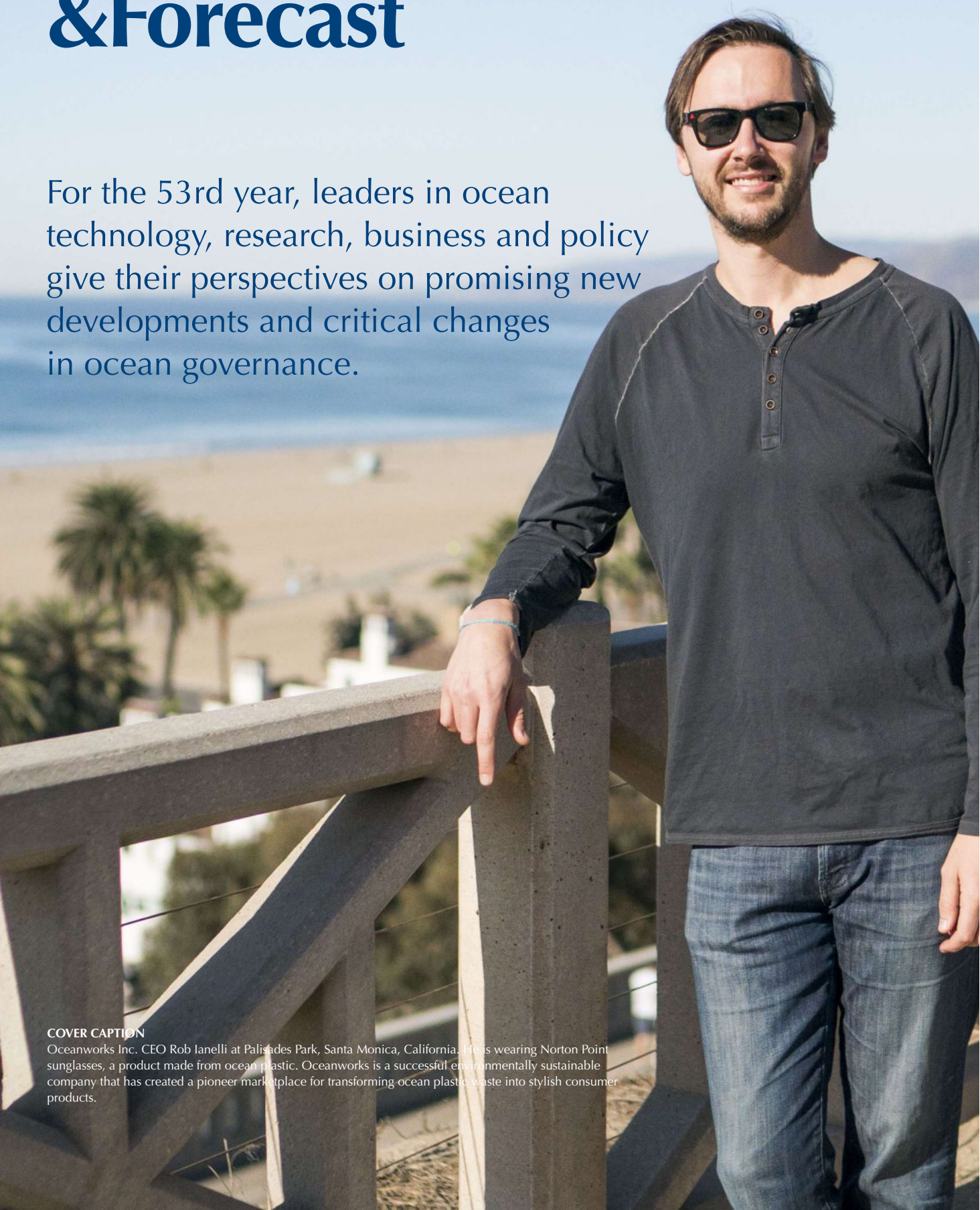
)) Live Broadcast from Belize Sinkhole. The Blue Hole Belize Expedition 2018 fleet went on a historic and scientifically important three-week mission to map the world's largest marine sinkhole. Led by Aquatica Submarines, the team of scientists, explorers and film makers included Ocean Unite co-founder and Virgin Group founder Sir Richard Branson and oceanographic explorer and documentary filmmaker Fabien Cousteau, grandson of the pioneering conservationist Jacques Cousteau. A live broadcast from deep inside the blue hole took place in Aquatica's Stingray 500 submarine in December on Discovery Channel with Branson and Cousteau on board. Sonar expert Mark Atherton from Kongsberg Mesotech was a key member of the science-based sonar and scientific data collection team. He operated Kongsberg sonars aboard a research vessel, contributing to an invaluable high-resolution map of the entire sinkhole. The expedition aids understanding of the geological history and geometric structure of the blue hole, which contributes new data to the global scientific community studying sinkholes and cenotes. **ST**

Annual Review & Forecast

For the 53rd year, leaders in ocean technology, research, business and policy give their perspectives on promising new developments and critical changes in ocean governance.

COVER CAPTION

Oceanworks Inc. CEO Rob Ianelli at Palisades Park, Santa Monica, California. He is wearing Norton Point sunglasses, a product made from ocean plastic. Oceanworks is a successful environmentally sustainable company that has created a pioneer marketplace for transforming ocean plastic waste into stylish consumer products.



Review&Forecast

We Can No Longer Ignore Our Oceans

By Sen. Sheldon Whitehouse (D-R.I.)

Co-Chair

U.S. Senate Oceans Caucus

Every day now, it seems we see news headlines spelling out the end of the oceans as we know them. Whether from pollution, warming, acidification, deoxygenation or other troubling consequences of climate change and overuse, the warnings from our oceans are dire.

However, their fate is not yet sealed. There is hope. There are steps we can and must take to save our seas.

One light in the darkness is the spirit of bipartisanship—rare these days in Washington—around oceans issues. The Senate Oceans Caucus, founded in 2011, brings together nearly 40 Democrats and Republicans to work together on marine issues. Republican Sen. Lisa Murkowski of Alaska and I co-chair the Caucus, with Republican Sen. Dan Sullivan of Alaska and Democratic Sen. Tammy Baldwin of Wisconsin as honorary co-chairs (we cover the Great Lakes, too!). I co-created the caucus with Sen. Murkowski with the mission of advancing marine policy and research. Despite all the partisan rhetoric and other policy battles, 2018 was a productive year for the group.

One of our longstanding priorities has been combating the growing marine debris crisis. Each year, nearly 8 million metric tons of plastics enter the oceans from land. Once in the ocean, this plastic breaks down under the sun and waves into tiny particles that can enter the marine food web. Recent research has found these microplastics in a wide range of food and beverages that humans ingest, from seafood to bottled water to table salt.

Last year, Sen. Sullivan and I introduced the Save Our Seas (SOS) Act. Among other things, this bipartisan bill reauthorizes NOAA's marine debris program and urges the president to engage with other countries on understanding and preventing marine litter. The bill received broad support from environmental advocates, plastic industry leaders, aquariums and other corporate actors. After working the bill through the House and Senate, we were able to deliver our SOS Act to the president's desk on October 11 to be signed into law.

The SOS Act was a great first step in taking action on this issue, but there is still much more work to do. Sen. Sullivan and I joined forces again to co-lead a hearing on plastic pollution in the Senate Environment and Public Works Committee. We are incorporating testimony received during that hearing with other expert feedback to draft SOS Act 2.0, which we plan to introduce early in the new Congress. This is an opportunity to be proactive about debris, preventing it from reaching our oceans or, even better, from being created in the first place. Our goal is to improve waste management infrastructure around the world and biodegradable plastics research by partnering with industry, non-governmental organizations and other governments.

With progress underway on marine debris, the Senate Oceans Caucus is getting to work on another of its priorities: ocean data and monitoring. It is said that we know more about our moon than our oceans



and have better maps of Mars' surface than our seafloor. It's time for that to change.

Sen. Murkowski and I are currently developing the BLUE GLOBE Act (Bolstering Long-term Understanding and Exploration of the Great Lakes, Oceans, Bays, and Estuaries Act) to give our oceans the attention and investment they deserve. This bill will improve coordination among our ocean-facing agencies, allowing for better data collection, integration and access. The BLUE GLOBE Act will also drive innovation in ocean research and technology and help build a new blue tech workforce.

In addition to my work within the Senate Oceans Caucus, I'm working hard to support coastal resiliency and readiness. Though we still have a chance to stave off the worst consequences of climate change, we can no longer pretend we are immune to sea level rise, increased storm surge and other coastal threats driven by changing oceans. To help coastal communities prepare for these changes, the first grants from my National Oceans and Coastal Security Fund were announced in November. This fund, co-managed by the National Fish and Wildlife Foundation and NOAA, is a dedicated resource for hardening coastal infrastructure, building community resiliency, investing in restoration, and supporting ocean and coastal research. Congress approved \$30 million for the fund in fiscal year 2018, and I will be pushing to keep this significant new source of funds going.

Life first emerged in our oceans eons ago, and we have a responsibility to protect the ocean for our future generations. I'm working diligently with my colleagues on both sides of the aisle to give our oceans the protections they deserve. I have big goals for 2019, and hope you will join us in making it the year of ocean action. **ST**

Review&Forecast

Congress Must Back NOAA's Groundbreaking Efforts

By Rep. Eddie Bernice Johnson (D-Texas)
Chair

U.S. House Committee on Science, Space, and Technology

As 2018 comes to a close, another devastating hurricane season concludes with it. Thousands of people have been affected by this year's series of calamitous storms, which brought record wind speeds and rainfall to our coastal communities. The ability to alert the public well

before these dangerous weather events is vital to preserving American life and property and is a task that falls to



NOAA. From operating unmanned systems on the ocean floor to satellites in space, NOAA provides a number of essential services in weather forecasting, satellite operation and coastal restoration to expand the development, innovation and efficiency of weather-forecasting technology.

Housed under NOAA, the National Weather Service (NWS) provides each American's local weather station with the crucial data informing daily weather forecasts. NWS receives the data used in its models from satellites and buoys operated by other divisions within NOAA. For example, the National Environmental Satellite, Data, and Information Service (NESDIS) operates and coordinates NOAA satellites in partnership with NASA. In space, these satellites collect data daily to feed forecast models and provide the essential services that inform weather watches and warnings. Given the complexity and costliness of the advanced technology that drives NESDIS, robust government support is critical to the success of the program.

In addition to weather forecasting, NOAA supports the nation's coastal communities and the ocean economy through the National Ocean Service (NOS). NOS works to ensure safe and efficient transportation and ocean commerce, provides expertise in responding to oil and chemical spills, and manages marine sanctuaries and protected areas. The detailed information they provide safeguards our coastal economy and marine resources; without NOS, the valuable resources contained in our oceans could be badly damaged.

Harmful algal blooms (HABs) are one such threat to our marine and coastal ecosystems, and they have proliferated in the last few decades. During an algal bloom, algae grows rapidly and in large quantities, blocking sunlight and increasing the oxygen content of the water. Higher oxygen content can suffocate fish and other marine species, like coral reefs. Moreover, some species of algae emit toxins that are harmful not only to marine life but also to humans. Currently, Florida is fighting off a bloom that has resulted in deaths of more than 100 manatees and 200 Kemp's ridley sea turtles. In order to address this toxic concern, the NOS has a number of programs dedicated to monitoring, preventing, controlling and mitigating HABs. NOS provides public access to early-warning systems, allowing the public to see where blooms are located and where they might spread in the future. NOS collects bloom data using satellite imagery, buoy data, field observations and public health reports. By supporting this important office, NOS will be able to more accurately predict these events and track a variety of other threats to the health of our oceans.

In addition to algal blooms, marine and coastal ecosystems face a number of dangers, including marine debris. Scientists estimate that every year approximately 8 million metric tons of plastic end up in the ocean, posing risk of ingestion and entanglement to marine life. The Marine Debris Program (MDP) is NOAA's response to our mammoth ocean plastics problem. MDP's mission is to investigate and prevent the adverse impacts of marine debris. I am looking forward to working with NOAA and

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Review&Forecast

The Fight to Protect Our National Marine Sanctuaries

By Rep. Salud Carbajal (D-Calif.)
Member, Congressional Oceans Caucus
U.S. House of Representatives

“From climate change to increased plastic pollution to renewed threats of new offshore oil and gas drilling, our oceans face unprecedented challenges. Many of our oceans are experiencing rising sea levels, changes in water temperature, acidification, loss of marine mammal life and fishery declines due to increasing global temperatures.”

Ocean waters have helped us curb climate change impacts by absorbing harmful heat-trapping gases like carbon dioxide emissions and generating half the oxygen we breathe. However, if we do not act quickly to protect our ocean’s ecosystem, we are risking the health of our entire planet.



From climate change to increased plastic pollution to renewed threats of new offshore oil and gas drilling, our oceans face unprecedented challenges. Many of our oceans are experiencing rising sea levels, changes in water temperature, acidification, loss of marine mammal life and fishery declines due to increasing global temperatures.

Protecting this unique ecosystem is vital for both our well-being and our economy. As policy makers, we must adopt good-stewardship policies that help preserve our oceans for generations to come. That is why I support our national marine sanctuaries and better ocean management policies.

Our national marine sanctuaries are treasured waters that serve to protect biologically diverse and sensitive habitats like kelp forests, deep-sea canyons and historical archaeological sites. On the Central Coast of California, we are lucky to have the Channel Islands and Monterey Bay National Marine Sanctuaries in our own backyard, two of 13 total nationwide.

This past summer, I was fortunate enough to tour the Channel Islands National Marine Sanctuary with a group of 22 Central Coast veterans. During the visit, I learned about the extraordinary conservation efforts being spearheaded by some of our very own veterans, such as Ken Tatro.

Tatro served in the United States Navy from 1958 to 1964 and continues to serve our country as a volunteer with the Channel Islands Naturalist Corps. He leads stewardship efforts to protect the sanctuary by educating visitors on the unique resources found within the Channel Islands during whale-watching trips, island hikes and community events—which I had the chance to experience first-hand.

Preserving the Channel Islands National Marine Sanctuary not only ensures future generations can experience our cherished local treasure, but also strengthens our lo-

supporting their research to mitigate the globe’s ocean plastics disaster.

It is time for Congress to back the groundbreaking efforts being made at NOAA. Data available to Congress and the public results in more informed decisions that can greatly impact our environment and the health of our people. For the past two decades, annual warmer-than-average temperature records have reliably been broken. We, both as a nation and globally, must learn about and adapt to our changing environment. Data from our agencies have shown the clear connection between climate change and the increase in severity and frequency of tropical storms.

Scientists have made it clear that the severity of global warming will only continue to grow, and if we do not take proper action, we will be left with irreversible, sometimes fatal consequences. Global warming has dire effects on nearly every aspect of our lives. As wildfires scorch our western states and severe weather events drown our coastal cities and towns, it is crucial that we prepare for what is ahead and make the right investments to mitigate the toll global warming is taking on our people, our environment and our economy.

A push for funding and support of research and innovation at our NOAA facilities will undoubtedly increase the efficiency of weather forecasting in the United States and ensure that the National Weather Service lives up to its mission of protecting life and property. As chairwoman of the House Committee on Science, Space, and Technology, I look forward to the possibilities the future holds in engaging with NOAA. The very roots of the Science Committee began in discovery, research and paving the way through uncharted territory. In the 116th Congress, I look forward to getting back to those roots. **ST**

cal economy. In California, our national marine sanctuaries are economic hubs that generate millions of dollars in economic activity and support thousands of jobs along the coastline. They are vital to sustaining the state's \$1.9 trillion coastal economy. NOAA estimates that between 2010 and 2012, harvest from commercial fishing in four California national marine sanctuaries produced about \$69.2 million. This had a multiplier effect, which generated \$70 million in income that supported 1,840 coastal jobs.

Despite these abundant and clear benefits to our economy, President Donald Trump wants to open up these protected areas for dirty fossil fuel development. Last year, President Trump ordered a secret review of our national marine sanctuaries and monuments to assess new locations for offshore oil and gas leasing.

Fifty-three thousand public comments filed with the Department of Commerce expressed support for continuing to guard our marine monuments and sanctuaries from oil and gas exploration (<https://bit.ly/2i0zYPn>).

Despite the public's desire to protect these public waters, the administration has failed to provide the American people a clear outline of what the future holds for our ocean resources.

The overwhelming support is unsurprising considering the catastrophic consequences many of our coastal communities have experienced from pipeline ruptures and oil spills.

In January of 1969, an oil spill from a drilling platform off the coast of Santa Barbara County spewed more than 3 million gallons of crude oil into the Pacific shoreline. It was the largest oil spill in California's history, with lasting effects on Santa Barbara's unique marine life and economy.

The 1969 oil spill was followed by the 2015 Refugio oil spill, also off Santa Barbara County, that spilled more than 100,000 gallons of crude oil into our oceans and shut down commercial fisheries. This had profound consequences on Santa Barbara's local economy, which relies heavily on the red sea urchin and the red rock crab. In 2013 alone, the red sea urchin generated \$3.3 million for Santa Barbara's economy and constituted 32 percent of the state's total sea urchin commercial fishing industry.

Rescinding any marine sanctuary designation or decreasing any current boundaries to allow for offshore drilling would threaten marine resources that help sustain commercial fisheries and local tourism, both of which are essential to California's economy.

The Channel Islands National Marine Sanctuary and National Park hosts one-third of Southern California's kelp forests, which is the California red sea urchin's main source of food and a multimillion-dollar fishery that contributes to our sushi industry. Similarly, travel and tourism accounts for one out of eight jobs in the Central Coast.

The Monterey Bay National Marine Sanctuary, often referred to as the Serengeti of the Sea, is internationally recognized for its truly unique wildlife views, and thousands of people travel far and wide to see this one-of-a-kind treasure. NOAA reported that total travel spending revenue in 2003 for the five counties adjacent to

the Monterey Bay National Marine Sanctuary was \$5.9 billion. The sanctuary also supports the Monterey Bay Aquarium—which in 2009 saw 2 million visitors and produced \$71 million in direct spending.

Just north of the Monterey National Marine Sanctuary, commercial fishing in the Cordell Bank National Marine Sanctuary created almost \$1.7 million in economic output on a three-year average. In the Greater Farallones National Marine Sanctuary, on a three-year average, commercial fishing earned more than \$15 million in harvest revenues.

California's marine sanctuaries were the product of years of public engagement with local communities and enjoy wide support throughout California. In supporting our marine sanctuaries, we recognize that healthy sustainable ecosystems and economic growth are not mutually exclusive.

As a representative for California's unparalleled coastline in Congress, I will continue to fight for better ocean management policies that protect our marine sanctuaries and grow our economy. **ST**

Review&Forecast

Strengthening the Nation's Blue Economy

*By RAdm. Timothy Gallaudet, Ph.D., U.S. Navy (retired)
Assistant Secretary of U.S. Commerce for Oceans and
Atmosphere, Acting Head
NOAA*

When I retired as an oceanographer of the U.S. Navy after 32 years of service, I thought my days pursuing my passion for the oceans might be over. However, I could not have found myself in a more exciting position than leading the United States National Oceanic and Atmospheric



Administration. Now, more than a year into this position, I continue to learn about the innovative products and services that NOAA provides the American public, businesses and industry, which help strengthen our economy. Some are critical, life-saving tools, based on fundamental science, environmental observations and forecasts, and others ensure strong conservation and restoration of our ocean and coastal resources.

Among the major commercial beneficiaries of these activities are the seafood supply chain, maritime shipping, offshore energy and mineral exploration, as well as coastal tourism and recreation businesses. These industries are part of our nation's growing blue economy. Supporting and advancing the blue economy is a crucial part of NOAA's role in the Department of Commerce.

The good news is that the blue economy is expanding. It grew at 5.7 percent last year, double the growth rate of the rest of the economy. Coastal regions are home to 40 percent of the U.S. population and the U.S. blue economy contributes \$320 billion to our gross domestic product. At NOAA, we're working to strengthen the blue economy with a special focus on reducing the nation's \$16 billion seafood trade deficit and expanding domestic aquaculture.

Boosting Seafood Production

The United States leads the world in sustainable fisheries management and our domestic fisheries management system has produced great economic and environmental success stories. However, seafood is traded globally, and our domestic fishermen are rarely allowed to compete on a level playing field. We are working to reduce, eliminate and streamline regulations on our commercial fishermen so that they can fish up to the maximum sustainable yield. We are also working with Congress to end the importation of illegal, unreported and unregulated seafood through the Seafood Import Monitoring Program.

While NOAA works to expand fishing opportunities and access to foreign markets for our wild-caught fishing industry, we know we must do more to develop a viable domestic aquaculture industry. The fact that the U.S. has one of the largest Exclusive Economic Zones (EEZs) in the world yet ranks 17th in worldwide aquaculture production highlights our need to do more.

NOAA is investing in aquaculture research efforts, recently releasing more than \$11 million in grants that support researchers working side by side with the aquaculture industry to sustainably and wisely expand aquaculture around our coasts and into our federal waters.

Maritime Commerce

Another major part of the nation's blue economy involves maritime commerce. Today, more than ever, coastal communities and ports play a vital role in the transport of goods in the global marketplace. Some 99 percent of U.S. overseas trade moves through our ports. With billions of tons of product valued at trillions of dollars, even small improvements in our ports' efficiencies have tremendous economic impact. In 2018, NOAA installed precision navigation products in the port of Long Beach, California, where a combination of high-resolution bathymetric surveys of the seafloor and real-time oceanographic and meteorological data on swells, tides, currents, wind, temperature and salinity is now increasing the allowable draft for cargo ships to enter the port. The result is that cargo ships can carry up to \$2 million in extra product per foot of allowable draft per transit. We are looking to expand precision navigation to ports around the nation, including projects in the Lower Mississippi River and the Port of New York/New Jersey.

Ocean Exploration and Mapping

With one of the world's largest EEZs, we are truly an ocean nation, but we have not taken full advantage of all the resources at our disposal. We have not fully explored,

characterized or mapped all of our territorial waters. We continue to make major discoveries, such as this past summer's discovery off the southeast Atlantic coast of an 85-mi.-long, deep coral reef and the NOAA-funded discovery of the stern of the World War II-era U.S. destroyer *Abner Read* off Alaska. Beneath the sea lies tremendous energy, critical minerals, unique biological compounds with pharmaceutical potential and untold chapters of our cultural history.

NOAA has a major role to play in exploring, mapping and characterizing our ocean. This work not only benefits shipping, marine transportation, fishing, energy development and tourism but also national security. This work is advancing new technologies, including unmanned vehicles that can characterize the deep sea in real time and high-resolution images and video. We are examining ways to expand activities related to mapping of our Exclusive Economic Zone, and we are partnering with industry and other ocean nations on Seabed 2030, the international project to map the global seafloor by 2030.

World-Class Weather Prediction

The health and growth of our nation's blue economy depends upon providing world-class weather forecasts for those on land and at sea. NOAA is taking bold steps to advance our hurricane and overall weather forecasting skill. These advancements are already evidenced by the accuracy of forecasts for hurricanes Florence and Michael. NOAA's newest weather prediction tool, the Next Generation Global Prediction System (NGGPS), is dramatically improving U.S. operational weather and hurricane forecasting. Powered by the more efficient Finite-Volume on a Cubed Sphere (FV3) dynamic core, NGGPS is providing a new level of accuracy to weather forecasts.

In addition to better modeling and increased computing power, NOAA's major investments in geostationary and polar-orbiting satellites are revolutionizing weather forecasts. This past March, we launched GOES-S, the second in a series of geostationary satellites. Now called GOES-17, the satellite provides faster, more accurate and more detailed data in real time to track storm systems, lightning, wildfires, coastal fog and other hazards affecting our West Coast, Hawaii and Alaska. This past May, the first satellite in NOAA's new Joint Polar System became operational. It features the best technology NOAA has ever flown in a polar orbit to capture more precise observations of the world's atmosphere, land and waters. In 2019, NOAA will have a full complement of advanced geostationary and polar-orbiting satellite technology in space, setting the stage for faster, more accurate, life-saving weather forecasts.

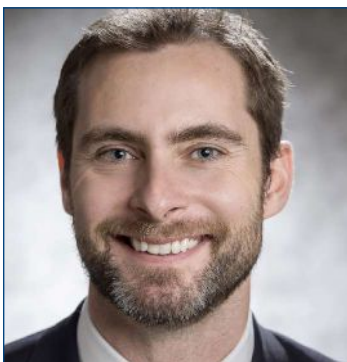
Finally, humans are drawn to the sea for more than economic activity. We go for relaxation, recreation, reflection and inspiration. NOAA works every day to ensure our ocean, coasts and beaches are clean, safe and productive places to live, work and play. NOAA's support for a healthy and productive marine environment is fundamental to the growth of the blue economy. **ST**

Review&Forecast

Can Marine Energy Unlock Opportunities For Other Ocean Industries?

By Alejandro Moreno
Director
Water Power Technologies Office
U.S. Department of Energy

Expanding demand for ocean-derived food, materials and energy is driving a transformation of the marine landscape. The ocean is quickly evolving as an important economic engine around the world. Scientific and technological advances in the ocean waters and the economic activity they can drive are often collectively referred to as the “blue economy.” Ranging from traditional industries such as fisheries, tourism and maritime transport, the blue economy has expanded to include offshore renewable energy, aquaculture and maritime biotechnology. However, the success of these emerging industries faces



developmental challenges that must be addressed. Blue economy industries are dependent on two important components: coastal communities and access to reliable offshore power. Coastal and island communities play a leading role in the proliferation of traditional offshore industries but face limited access to resources and rely heavily on imported fuel and clean water to meet basic needs. The lack of reliable power sources independent of land-based power grids limits maximization of economic opportunities further offshore.

The U.S. Department of Energy’s (DOE) Water Power Technologies Office (WPTO), <https://bit.ly/2zk6HFH>, is advancing cutting-edge technology with research and investments to drive U.S. leadership in the emerging marine energy field, including addressing barriers to the continued growth and development of the blue economy. Specifically, WPTO is researching new approaches to desalination to ensure water security; onboard energy generation for at-sea instrumentation; reliable remote recharging; and energy storage. Associated solutions would create viable pathways for blue economy industries to thrive, while supporting sustained economic development. These efforts tie into broader DOE inter-agency initiatives, such as the recently announced Water Security Grand Challenge (<https://bit.ly/2qWbCrH>), in which DOE will partner with the Environmental Protection Agency to advance transformational technology and innovation to meet the global need for safe, secure and affordable water.

Making Hydrographers’ Tasks Easier

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Post-processing Software

“...marine energy is both predictable and reliable, reducing the reliance on large energy storage systems or backup generators that typically accompany other systems. Readily available power at sea could be a key enabler for many sectors and markets within the blue economy...”

The Blue Economy

The blue economy is diverse and continues to evolve (<https://bit.ly/2telKgn>). According to a recently drafted report for the European Commission, just the living resources sector of the blue economy (fisheries, aquaculture, etc.) has grown by 22 percent from 2009 to 2016 (<https://bit.ly/2tKMKnL>). In a report published by the Organization for Economic Cooperation and Development (OECD) in 2016, it's estimated that the global value of ocean-related industries was \$1.5 trillion in 2010 and will exceed \$3.0 trillion by 2030 (<https://bit.ly/2Q5nx4P>).

Powering the Blue Economy

The various markets and sectors within the blue economy may provide marine energy technology developers with crucial first customers, ideally leading to increased revenue generation, investor confidence and, most importantly, more operational experience for devices. In theory, this is a reinforcing feedback loop: Once a developer gains customers and revenue, they can more effectively self-fund research and development, create new technological innovations, find new markets and customers, and generate new revenue, thus continuing the cycle.

WPTO has been working to understand some of the customer requirements for markets within the blue economy and how they might be translated into research objectives for marine energy technology developers. In December 2017, WPTO hosted a multiday workshop on Alternate and Distributed Applications for Marine Energy (<https://bit.ly/2AgrsS6>), which investigated the challenges and opportunities within six specific markets, bringing together subject matter experts from across the country to collaborate with technology developers. By addressing common R&D gaps for multiple markets, WPTO hopes to create new pathways to market for marine energy technologies and kick-start the reinforcing feedback loop.

WPTO's R&D strategy across its entire marine energy portfolio aims to enable technological breakthroughs that reduce the cost and barriers to market for marine energy devices. The knowledge and experience gained from broader blue economy-related markets could potentially translate to grid-scale electricity markets.

Power Constrained

The blue economy is growing; however, power is not readily available in all parts of the world, especially off-

shore or in remote coastal areas. For example, metocean buoys or AUVs far offshore are limited in their operations by the power that can be supplied by onboard batteries, impacting collection and transmission of critical data. Power also remains a constraint in other sectors within the blue economy due to limitations of traditional power-generation technologies. Internal combustion engines depend on a reliable fuel source for sustained operation, which is not cost-effective or practical far offshore. Solar is limited to the ocean surface, typically out of direct contact with seawater and subject to rapid decreases in efficiency due to fouling from salt spray, biological growth and bird droppings. Small-scale wind systems tend to be lower in power density, prefer a relatively stable platform (not ideal for applications like buoys), and, like solar, they need to be above the ocean's surface.

Marine energy can potentially overcome many of these limitations. Seawater is 784 times denser than air, which theoretically reduces the physical footprint required to extract a given amount of power relative to other resources.

Marine energy converters are marinized from their inception and explicitly designed to extract energy from dynamic waves, tides or ocean currents. Many marine energy systems can also generate power beneath the surface, improving stealth characteristics and storm survivability. Finally, marine energy is both predictable and reliable, reducing the reliance on large energy storage systems or backup generators that typically accompany other systems. Readily available power at sea could be a key enabler for many sectors and markets within the blue economy, unlocking untapped growth potential.

Conclusion

There is a transformation within traditional and emerging maritime industries harnessing advanced technology to provide environmental and economic benefits, which requires innovation in energy systems. Ocean observation systems, seawater desalination, underwater vehicle recharging stations, and even offshore aquaculture are all examples of marine applications and industries that have growing needs for power at sea. Marine renewable energy could become an important part of the blue economy by enabling a host of new opportunities: generating jobs, supporting new markets and revolutionizing existing power-limited industries. WPTO will continue its efforts to drive new marine energy technology innovations to provide power for the blue economy and the nation. **ST**

Review&Forecast

Balancing Near-Term Imperatives with Long-Term Investments

By Jessica F. McGrath

Policy Advisor

Danielle Dodge

Knauss Fellow

Terrence Quinn

Director

Division of Ocean Sciences

U.S. National Science Foundation

The U.S. National Science Foundation's (NSF) Division of Ocean Sciences (OCE) supports research, infrastructure and education over different time scales to advance understanding of all aspects of the global oceans, including their interactions with people and the Earth system. These activities provide knowledge of the fundamental ocean system that is critical to addressing many of our nation's most pressing challenges involving Earth processes.



With an annual budget of more than \$300 million (fiscal year 2018), OCE works with the ocean sciences academic community to direct funding toward advancing the frontiers of knowledge, developing the next generation of researchers, and enhancing the public's understanding of ocean sciences. OCE represents this community in the federal context, coordinates with interagency and international partners on science and technological innovation, manages infrastructure, and participates in policy development through national and international forums.

Rapid Response Research

NSF utilizes Rapid Response Research Proposals (RAPIDs) to quickly address the needs of the research community in response to unexpected natural or anthropogenic disasters.

RAPIDs can be requested when there is a severe urgency regarding availability of, or access to, data, facilities or specialized equipment, including quick response research projects (<https://bit.ly/2iYtv92>).

RAPIDs also provide insight into longer-term patterns. A RAPID awarded after Hurricane Matthew (2016) contributed toward identification of long-term hurricane impacts on the Carolina coast. Scientists were able to investigate how two decades of hurricanes have affected North Carolina estuaries. This combination of quick-response research coupled with long-term observations uncovered trends in nutrient flow, phytoplankton populations and

organic matter impacting the region (<https://bit.ly/2QAvCB>).

Coastlines and People

Rapidly growing populations in coastal areas are experiencing emerging threats from environmental phenomena and natural hazards. NSF is bringing together various stakeholders to determine research priorities needed to advance understanding of how coastal populations and natural processes respond to such variability in an emerging initiative called Coastlines and People (CoPe, coastlinesandpeople.org). This initiative is a joint effort of the NSF Directorate of Geosciences in collaboration with the Directorates for Social, Behavioral, and Economic Sciences, Engineering, Education and Human Resources, and Biological Sciences.

More than 400 scientists, stakeholders and community leaders participated in a series of workshops in September 2018. The goals of the workshops focused on identifying fundamental research gaps needed to address environmental challenges, better inform decision making, and increase broader impacts and engagement.



Ocean Observations Initiative

Since 2016, NSF's Ocean Observations Initiative (OOI) has become an integrated infrastructure program



consisting of a network of more than 800 individual sensors distributed across four global arrays, two coastal and a cabled array (oceanobservatories.org). Continuing the program's success, the Woods Hole Oceanographic Institution (WHOI) is now heading up the project

management office of OOI 2.0, in addition to serving as the science lead for the OOI Global Arrays and the Pioneer Coastal Array. The University of Washington, Oregon State University and Rutgers University will continue supporting the Cabled Array, the Endurance Coastal Array and the network cyberinfrastructure, respectively.

Long-Term Ecological Research

First established in 1980, NSF is approaching the 40-year anniversary of the Long-Term Ecological Research Program (LTER, lternet.edu). OCE began supporting the LTER program in 1998 with the Plum Island Ecosystems, and it has since expanded. Currently, research programs are located at 28 LTER sites across the globe to support ecological discovery on long-term and large-scale phe-



The RV Sikuliaq (left).

nomenon, with OCE now supporting eight sites and the network office.

One of OCE's newest LTER sites established in 2016, the Northeast U.S. Shelf, enhances the OOI investment through utilization of the Coastal Pioneer Array to help understand and predict changes in planktonic food webs. Such efforts, along with other sustained observations made across the 28 sites, serve the wider ecological community, providing publicly available data through the LTER Data Portal (portal.lternet.edu/nis/home.jsp).

International Ocean Discovery Program

The International Ocean Drilling Program (IODP) is celebrating its 15th year as the systematic method of exploring the bottom of the ocean, discovering insights into the workings of our planet. Since its inception, the IODP has broadened the base of international participation and collaboration to more than 20 countries (iodp.org). The *JOIDES Resolution's* (JR) recent summer expedition to the Brothers submarine volcano in the southern part of the Kermadec Arc explored the magma-derived hydrothermal system, including fluid-rock interactions, the distribution of metals/metalloids and their pathway to the seafloor, and the nature of microbial life in this extreme environment. The JR is anticipated to begin operations in the waters around Antarctica in 2019 and the south Atlantic in 2020 and 2021 after spending recent years operating in the Indian and Pacific Ocean basins.

Academic Research Fleet

The U.S. Academic Research Fleet (ARF) included 18 vessels and one deep-ocean research submersible (DSV ALVIN) in calendar year 2018, ranging in size, endurance and capabilities. The ARF enables NSF and other federally and state-funded scientists to conduct research in coastal (including the Great Lakes) and open-ocean waters. Coordination of ARF vessels occurs through the University-National Oceanographic Laboratory System (UNOLS), which enables scheduling of all scientific sea-going missions for the ARF in collaboration with the U.S. funding agencies. NSF is the cognizant oversight agency for the ARF.

NSF received congressional appropriation in 2018 for partial funding for three regional-class research vessels (RCRVs). Oregon State University will operate the first RCRV, the RV *Taani*, which is expected to be delivered in early 2021. The East Coast Oceanographic Consortium, led by the University of Rhode Island, will operate the

second RCRV, which is expected to be delivered in late 2021. A new solicitation for the third RCRV awaits 2019 budgetary guidance.

Conclusion

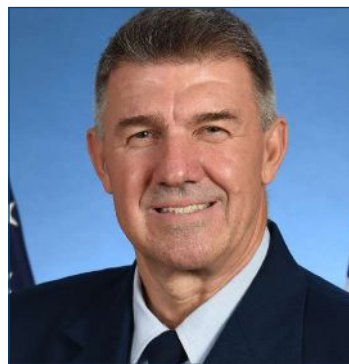
NSF remains committed to advancing the frontiers of science and technological innovation as a continuing initiative. Balancing long-term investments with near-term imperatives is critical to adequately address current perceived threats, inform major challenges, impact society and inform future policy decisions. NSF will continue to address this need through short-term programs such as rapid response research grants and active policy engagement while also using the recommendations provided in "Sea Change: 2015-2025 Decadal Survey of Ocean Sciences" (*Sea Technology*, June 2015) as a long-term guide to ensure a strong ocean science enterprise through 2025. **ST**

Review&Forecast

Innovating Now to Meet Tomorrow's Complex Maritime Challenges

By Admiral Karl L. Schultz
Commandant
U.S. Coast Guard

Today, emerging threats to the international rules-based order of the maritime environment are neither regionally focused nor locally containable. Illicit networks, natural disasters, great power competition and hostile nation-states and adversaries who wish to do us harm do not respect borders.



As challenges to our nation's security, prosperity and global influence grow more complex, the need for a *ready, relevant* and *responsive* United States Coast Guard has never been greater. While we respond to disasters, rescue mariners in distress, conduct law enforcement and regulate our waterways, we also operate 24/7/365 to keep our nation secure.

The Coast Guard, while the smallest of the five U.S. Armed Forces, is a global force with unique authorities and capabilities. As the only military service located in the Department of Homeland Security (DHS), we are an instrument of national power both at home and abroad. We provide options and solutions across the full spectrum of operations, from security cooperation up to armed conflict. We shape how countries conduct maritime law enforcement and establish governance. Our cooperative initiatives foster a more secure maritime en-

vironment through regional associations, multi- and bilateral agreements, training, and capacity building.

As the 26th Commandant of the Coast Guard, service readiness is my top priority. Fundamentally, the key to Coast Guard success has always been our people—the cornerstone of readiness—that make up our diverse workforce of active duty, reserve, civilian and auxiliary.

Today, the demand for Coast Guard services has never been higher amid the backdrop of relatively flat-lined, or constrained, operating budget. We face significant readiness challenges, including lost purchasing power, deferred maintenance on our capital assets, and a strained and undersized workforce.

If your Coast Guard is to continue answering the call while excelling in expanding theaters, we cannot use past thinking to resolve current challenges. We should not default to doing something because it has always been done a certain way. We must be smart, innovative and accept prudent risk. We must empower and reward our workforce, especially our youngest members who often bring forward the best ideas, to develop novel ways to increase the efficiency of operations and mission support.

Accelerating ‘Flash-to-Bang’

To that end, innovation is a key component of the Coast Guard’s Strategic Plan 2018 to 2022. We must allow our mission-support enterprise to explore service delivery alternatives that obtain the most for our purchasing power and accept that alternatives may require changes to both operations and support from how “it has always been done.”

We will strive to lower the barriers to innovation and recognize that “smart failures” in low-risk venues in the short term yield lessons learned that lead to long-term organizational success.

To deliver innovation at the speed of need, we must shorten the “flash-to-bang”—the time between idea and test, as well as the time between a successful test and potential implementation. We must strengthen our expedited acquisition process to adopt new technologies faster and capitalize on relationships with the Department of Defense (DOD) and DHS to identify shared solutions.

The 2017 and 2018 Atlantic Basin hurricane seasons were historic in ferocity and scope. When Hurricane Harvey inundated the greater Houston area in 2017 with 52 in. of rain and flooded neighborhoods, we realized that technological advances could enhance our traditional response operations. To improve our search-and-rescue efficiency and effectiveness when lives hang in the balance, we are leveraging DHS mobile communications tracking technologies to locate signals being emitted from distressed mariner cell phones. We are installing “blue force trackers” to ensure comprehensive, real-time Coast Guard aircraft and vessel monitoring for enhanced tasking in steady-state and emergency response situations. We are also experimenting with advances in software algorithms to utilize social media feeds to “heat map” concentrated areas of distress. Leveraging these faster “flash-to-bang,” low-cost technologies serves as a

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“With increased activity in the maritime reaches and growing competition for resources, the future is now in the Polar Regions. Our sustained presence there is imperative to ensuring our nation’s security, asserting our sovereign rights and protecting our long-term economic interests.”

force multiplier and ensures full-capacity response operations down the road.

Indo-Pacific Theater

Wherever the Coast Guard operates, we bring rules-based order to the maritime commons and provide an example to countries around the world. In the Indo-Pacific theater, the Coast Guard partners with DOD to play a critical role ensuring an open, prosperous and inclusive region. To counter predatory operators and nation-states that poach resources from the high seas and specific countries’ Exclusive Economic Zones, we mature other nations’ inherent capabilities to police their own waters. We support emerging nations in developing their own coast guards to ensure theater security cooperation.

But our effectiveness in the Indo-Pacific is limited by the tyranny of distance. To realistically confront threats in such a complex domain, we must innovate to expand our footprint, influence and reach. The Coast Guard needs the ability to access reliable, relevant and interpretable data that can truly forecast where need is greatest and risk will occur.

To get at this problem, Coast Guard forces in Alaska developed the FishTactic initiative, a mission planning tool and winner of the 2017 Coast Guard Innovation Award. FishTactic software aggregates, analyzes and fuses data into a singular maritime domain awareness picture to predict future activity and optimize Alaskan fishing enforcement. Operations combating illegal, unreported and unregulated (IUU) fishing, a form of transnational organized crime and a major scourge of the Indo-Pacific—can benefit substantially from the predictive power of data science. Strategic planners and Coast Guard cutters can use the software to better predict where illicit activity exists, which is critical for cutters that must transit several days to reach an area where IUU fishing is thought to be occurring. Most importantly, FishTactic is both affordable and mobile, hence, easily put into the hands of operators (i.e., a short “flash-to-bang”).

Polar Operations

Looking to the high latitudes, more commonly referred to as the Polar Regions, the Coast Guard is the United States’ primary maritime presence in the Arctic and Antarctic. There, we enhance maritime domain awareness, facilitate governance and promote partnerships to meet security and safety needs in these vital areas. While we focus on creating a peaceful and collaborative environment in the Polar Regions, we are confronted by great

power competition in these strategically important high latitudes.

Our role has never been more crucial there. The Arctic holds vast resources, and its maritime geostrategic relevance is rising, including critical shipping lanes. In 2017, a record 9.74 million tons of goods were transported on the Northern Sea Route above Russia, and that number will only increase. Looking south, for six decades the Antarctic Treaty has been the cornerstone of governance promoting international cooperation, ensuring nonmilitarization and suspending territorial claims. In the next three decades, several crucial elements of this treaty will come up for renewal, including the current ban on commercial drilling.

With increased activity in the maritime reaches and growing competition for resources, the future is now in the Polar Regions. Our sustained presence there is imperative to ensuring our nation’s security, asserting our sovereign rights and protecting our long-term economic interests. As we progress toward funding the construction of the nation’s first heavy polar icebreaker in more than 40 years—the polar security cutter—we are preparing for future high-latitude operations.

On November 19, 2018, DHS launched two miniaturized satellites, CubeSats, into low-Earth polar orbit for the Coast Guard to assess the potential of this technology to augment and improve communications in the Arctic environment, monitor large areas for illegal activity and help locate persons lost at sea. These types of relatively inexpensive satellites could also potentially be employed to gather and transmit sea ice and debris hazard information in remote regions without time- and resource-intensive aircraft searches.

Innovation

As we have for the last 228 years, the Coast Guard, with our bias for action and operational agility, will continue to lean in to answer the nation’s call. The Coast Guard brings enduring value to the nation that can only be maximized by adapting to the changing character of maritime operations. That requires both smart risk taking and harnessing the power of innovation. We will foster a culture of experimentation and strengthen service innovation initiatives, as well as accelerate the process of moving the best ideas to service-wide implementation. Only by doing this can we help deliver a *ready, relevant* and *responsive* United States Coast Guard optimally positioned to foster economic prosperity and national security for the foreseeable future. **ST**

Review&Forecast

Key Enabling Technologies Power NATO, EU Maritime Activities

Dr. Emilio F. Campana

Director, Department of Engineering, ICT and Technologies for Energy and Transportation, Italy National Research Council; Italian Representative for Research, NATO Science and Technology Board

Dr. Giovanni Sembenini

LTC, Head, NATO and Non-European Countries R&T Programs, Italian Secretariat General of Defence/National Armaments Directorate

Dr. Sandro Carniel

Senior Scientist, Institute of Marine Sciences, Italy National Research Council

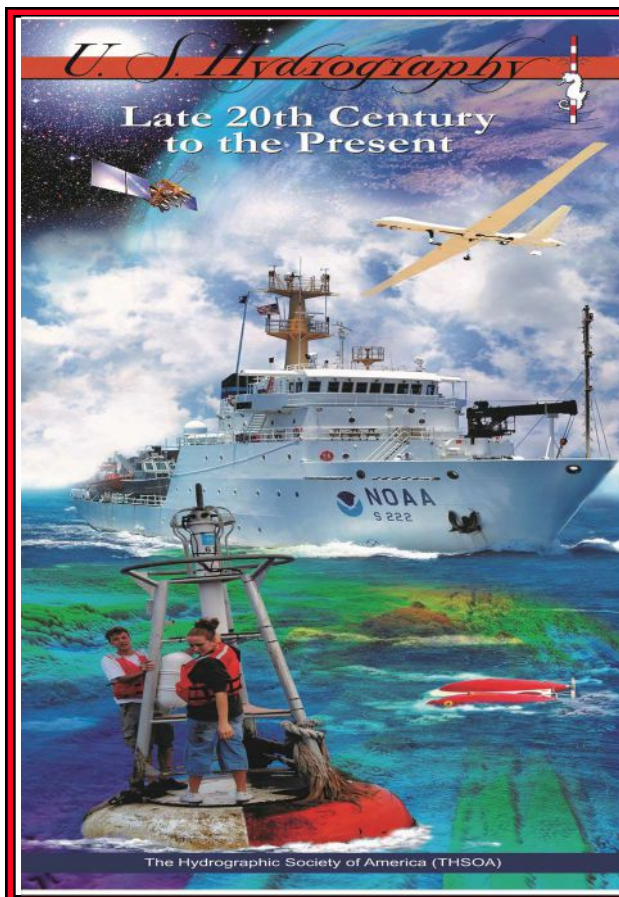
On the basis of the 2010 Strategic Concept and NATO's three core tasks (collective defense, crisis management and cooperative security), the 2011 Alliance Maritime Strategy (AMS) derived the following strategic roles: deterrence and collective



defense, crisis management, cooperative security and maritime security.

In the following years, the adaptation to the changed security environment has been pursued along a reinforcement of the Alliance Maritime Posture (AMP), describing NATO's functions and the use of the Alliance's naval forces.

The AMP encompasses oceans, seas and littorals (on, above and below the surface) and comprises the Alliance's naval forces, their presence within the maritime domain, and the operational and cooperative activities that they conduct in the performance of three main functions, contributing to Alliance security. These functions are: the strategic function—the presence of maritime forces creates strategic effects and demonstrates NATO's intent to operate without constraint, yielding a range of attractive, measured and viable political and military options; the security function—the maintenance of a safe and secure maritime environment can be undertaken through a range of maritime security activities and operations; and the war-fighting function—during peace time and in a crisis, maritime forces provide deterrence and



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can contribute to operations to advance Alliance security interests.

In this context, maritime and joint exercises are key to maintaining and improving combined maritime skills and readiness for all operations; future exercises could then include protection of sea

lines of communication, amphibious forces, anti-submarine warfare capacity and countering hybrid threats in the maritime domain.



Mission-Oriented Research and Innovation in the EU

In order to address the strategic functions, it is essential to maintain a technological advantage that is the natural result of innovative processes. Interestingly enough, the role of innovation and technology edge has been highlighted and stressed as a priority by the EU in several contexts. This was also evident in the process toward the definition and launch of future European funding schemes (including the Ninth Framework Program), where the concept of “mission-oriented research and innovation” was put forward and discussed. Mission-oriented projects are to be intended as large projects (Grand Challenge), or a group of them, capable of reaching a challenging goal, preferably identified by measurable intermediate deliverables.

In order to have maximum impact, a mission should clearly address outcomes, development time frame and financial profile. An example of a Grand Challenge is fostering “healthy, clean and sustainable oceans.” It is clear that such missions are not to be solely driven by science needs; they also have to address societal challenges (related to the environment, energy, mobility, security, etc.), thus producing actionable items to ensure a feasible, positive evolutionary process.

From Societal Challenges to Missions: the Role of KETs

Addressing societal challenges through missions requires significant investments in science, technology and innovations. Identifying the essential technology building blocks (defined as KETs, or key enabling technologies) has been a high priority for the EU industrial policy in the recent past, forming the base of the program structure and technological scope of the “Leadership in Enabling and Industrial Technologies” pillar of Horizon 2020.

KETs were revised in 2018 by the European Commission and grouped into three main areas: production technologies, such as advanced manufacturing technologies (robotics, green propulsion technology), advanced materials and nanotechnologies, life-science technologies (new chemistry, biotechnology); digital technologies, such as micro-nano-electronics and photonics (smart sensors, quantum technology, supercomputing), artificial intelligence (data generation and handling, big data analysis, machine learning, smart robots, decision-making

technologies); and cyber technologies, such as security and connectivity (secure and authenticated communication, data connectivity, cyber-physical convergence systems, e-security).

KETs as Link Between NATO and EU

Many of the KETs examples criss-cross the needs of the maritime defense and security sector.

Therefore, it is not surprising that the links between NATO and EU maritime activities could grow and become stronger along these lines, also in light of a changing security environment and the definition of the EU Global Strategy for Foreign and Security Policy (EUGS) that started a process of closer cooperation in security and defense.

“Addressing societal challenges through missions requires significant investments in science, technology and innovations. Identifying the essential technology building blocks has been a high priority for the EU industrial policy...”

The EU member states agreed to step up the European Union’s work in this area and acknowledged that enhanced coordination, increased investment in defense and cooperation in developing common capabilities are key requirements. This is indeed the main aim of a permanent structured cooperation on security and defense (PESCO). Through PESCO, member states decided to increase their effectiveness in addressing security challenges and advancing toward further integrating and strengthening defense cooperation within the EU framework. Collaboration will include the field of maritime semi-autonomous systems for mine countermeasures, harbor and maritime surveillance and protection, and the upgrade of maritime surveillance.

NATO and EU efforts to increase mutual cooperation have also been underlined by a joint declaration (JD) by the president of the European Council, the president of the European Commission and the secretary general of NATO in July 2018. The JD strengthens existing maritime cooperation, e.g., in the Mediterranean (including fighting migrant smuggling and trafficking); increases the ability to respond to hybrid threats; addresses the need for a timely exchange of information, including on cyber attacks; and offers the benefits of parallel and coordinated exercises.

To realize as many positive outcomes as possible from a shared set of KETs, the capabilities developed through the research and innovation and defense initiatives of the EU and NATO must remain coherent, complementary, interoperable and available to both organizations. The prompt fielding of KETs into mission operations will be essential in the coming years. **ST**

Review&Forecast

S&T Applications, Trends In the Maritime Domain

By Dr. Catherine Warner
Director

Centre for Maritime Research and Experimentation
NATO Science and Technology Organization

For 60 years, the Center for Maritime Research and Experimentation (CMRE), www.cmre.nato.int, has been providing science and technology (S&T) in support of NATO. The CMRE has advanced oceanographic science and instrumentation, moored scientific platforms, underwater acoustics and communication, conventional and advanced sonar systems, and cetacean risk mitigation policy. It is currently a leading center for advances in unmanned autonomous vehicle applications and operations.

Recent accomplishments include: demonstrating the potential for AUVs to support NATO anti-submarine warfare and naval mine warfare missions; demonstrating the remote operation and management of a fleet of undersea gliders, fusing the acquired data into underwater battle-space characterization products in near real time; and further promulgating the use of underwater digital communications using JANUS, the first digital underwater communications standard.

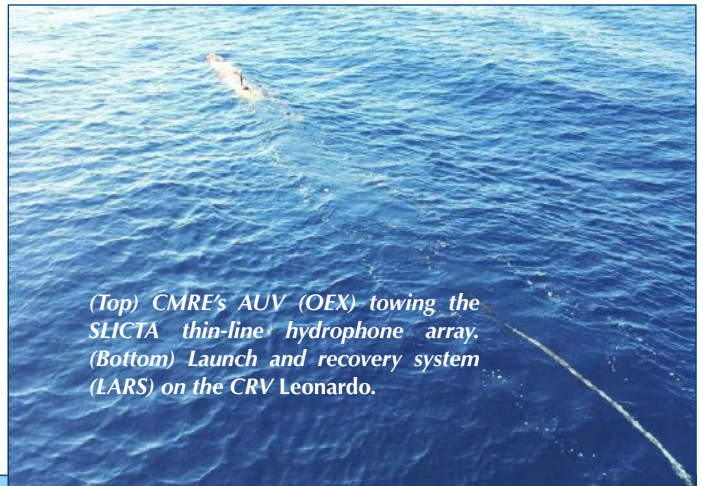
Trends and Outlook

In defense as well as other sectors, the dominant trends driving advances in ocean technology are maritime unmanned systems (MUS) and autonomy. Together these disciplines are opening up new capabilities costing far less than traditional systems while in some cases offering improved sensors, signal processing and detection opportunities. There is an opportunity to deliver capability faster and with lower costs while keeping the man out of the minefield. In fact, this year, 13 NATO nations signed a declaration of intent to collaborate on the development of MUS. CMRE's view of these and other trends are reflected in its program of work as follows.

Countering Emergent Submarine Threats.

Low-frequency active sonar (LFAS) will continue to develop as the primary technique for detecting modern, quiet submarines at useful ranges. Areas of development include advanced waveforms for clutter mitigation and implementation of AUV-aided multi-static sonar operations provid-

ing improvements in detection, classification, localization and tracking. This year, CMRE combined research in areas of acoustics, signal processing and deep learning via convolutional neural networks. CMRE has been exploring the design and development of advanced sensing capabilities that could be hosted on low-power, long-endurance autonomous platforms, such as buoyancy gliders and Wave Gliders. The aim is to build autonomous networks for passive acoustic monitoring of confined areas against submersed threats. This work led to proof of concept for many techniques that CMRE will further test in sea trials and operational environments in 2019, including: development of a distributed multi-hypothesis tracker for multi-static sonar; development of a cognitive sonar architecture that adapts its processing parameters to environmental and clutter conditions; preliminary tests on the use of convolutional neural networks for discrimination between target and clutter; linear beamforming and intensity vector signal processing approaches applied to 3D acoustic vector sensor data collected from a buoyancy glider; a new occupancy grid mapping framework to drive autonomous cooperative behaviors for area survey and target localization with bearing-only sensors; work on the extension and generalization of CMRE's Cooperative Autonomous Decision Making En-



(Top) CMRE's AUV (OEX) towing the SLICTA thin-line hydrophone array.
(Bottom) Launch and recovery system (LARS) on the CRV Leonardo.



gine to handle more complex missions, composed of different cooperative tasks; and development of a simulation framework to effectively test autonomous behaviors with its novel features (e.g., distributed task allocation in limited communications environments).

Tactical Decision Aids. Because the environment controls sensor performance at sea, understanding the environment is essential to knowing how our sensors will operate and their optimal placement for mission success. CMRE has developed a multi-static (sonar) tactical planning aid for use in determining sensor deployment in ASW missions. Real-time environmental data on sea state, sound speed and bottom properties are provided via deployed, persistent gliders. This information, essential for submarine detection, is then assimilated by oceanographic models to provide temperature and salinity profiles throughout the entire area of operations. The oceanographic models are also able to provide forecasts of the environment up to several days in advance. The primary output of the tool is the geographical rendering of the extent of sonar coverage around a platform. Multiple platforms may be quickly configured and dropped onto a map view with subsequent acoustic calculations conducted automatically. CMRE's onboard environmental sensing and modeling suite, the Rapid Acoustical Prediction Service (RAPS), was demonstrated in two NATO operational exercises with success.

Engineering Developments. In addition to conducting maritime scientific research, CMRE's engineering department provides the Centre cutting-edge technology development, allowing experimentation at sea with innovative and field-tested solutions. This engineering work often involves taking off-the-shelf products and remaking them to exploit the Centre's scientific research. Some of the advances achieved this year include: deployment of the underwater network software-defined Cognitive Communications Architecture (CCA) on the Centre's 21-in. AUVs (OEX), Wave Glider and Gateway buoys; deployment of a high-gain, 192-element, cardioid-array antenna from an AUV for the first time in a NATO context; development of acoustic vector sensors that were deployed on a buoyancy glider for the first time in a NATO context; construction of a 21-in. AUV launch and recovery system, successfully operated from both CMRE vessels (NRV *Alliance* and CRV *Leonardo*); and deployment of our new Liquid Robotics SV3 Wave Glider with a MOOS payload and an ultrashort baseline (USBL) underwater acoustic positioning system towfish during a NATO exercise.

Conclusion

NATO established CMRE in 1959 in response to the threat of advanced Soviet submarine forces. The concept of combining scientists from all the NATO nations along with a first-class engineering department and access to sea-going research vessels has more than proved its worth to NATO and its nations.

Today, CMRE continues to help NATO maintain its technological edge through its expertise in robotics, autonomy and artificial intelligence, paving the way for game-changing developments in the maritime domain.

The ability of multidisciplinary research teams to conceive new ideas, have their engineering team design equipment and prototypes (often from scratch), and then take them to sea for experimentation is providing innovative solutions for today.

The innovations listed in this article will pave the way for an exciting 2019. **ST**

Review&Forecast

Keeping up with Growing Energy Demands

By Randall Luthi
President
National Ocean Industries Association

The offshore energy industry has consistently been at the forefront of technological advances. Today, offshore technology rivals that of the space industry, making it possible to find and develop oil and natural gas in previously unreachable areas. However, finding and producing oil and natural gas is only half the battle and is secondary to having access to offshore areas in the first place.

The National Ocean Industries Association (NOIA) has long advocated for increased access to offshore areas, and with 94 percent of the Outer Continental Shelf (OCS) currently off limits to oil and gas leasing and Democrats now in control of the U.S. House of Representatives, we certainly have our work cut out for us.

On top of these challenges to access, for the past few years, depressed commodity prices, stricter regulatory requirements and competition from onshore development at home and from other countries offering attractive offshore lease and royalty terms have had severe impacts on new exploration in the U.S. Gulf of Mexico—the hub of America's offshore energy industry. However, NOIA remains optimistic that the tide is beginning to turn and progress is being made on several fronts.

Access

There is no question that having just six percent of our OCS available for oil and natural gas leasing is incredibly shortsighted and puts the U.S. at a strategic disadvantage. Other countries, such as Russia, China, Norway, Canada, Brazil, Guyana and Mexico, are developing energy projects off their shores to meet rising global energy demand. That is why, in 2017, the Trump Administration proposed a new offshore leasing program to replace the Obama Administration's restrictive 2017 to 2022 Offshore Leasing Program, which needlessly locks up 94 percent of the



OCS. Trump's draft proposed program for 2019 to 2024 would open 90 percent of the OCS for oil and gas leasing and proposes 47 lease sales. (The next version, the proposed program, which could include fewer sales but likely still offer increased access, had not been released at the time of this writing.)

Gulf of Mexico

The operating environment in the Gulf shows tangible signs of improvement, pointing to an industry that is poised to shift into high gear—oil prices are higher, rig rates and supply chain prices are more competitive, companies have improved the efficiency of their operations, and revisions to overly burdensome regulations are in the works. The Trump Administration has introduced several major changes aimed at improving conditions offshore, including a lower shallow-water royalty rate for the Gulf of Mexico. Aiming to encourage producers to increase investment in the Gulf of Mexico, in 2017, the Trump Administration lowered royalty rates in shallow-water areas from 18.75 to 12.5 percent. The deepwater royalty rate remains at 18.75 percent.

The lower shallow-water royalty rate seems to be having a positive impact toward revitalizing that segment of offshore energy development. Bidding activity in the August 2018 Gulf of Mexico lease sale drew renewed interest in shallow-water tracts, increased competition for offerings and \$178 million in high bids—\$53 million more than the previous sale held in March 2018. The results of the August sale reaffirmed the paradoxical state of an offshore energy industry in slow recovery mode; the future is brighter, but shifting out of reverse takes time. The next Gulf of Mexico lease sale is proposed for March 2019. Further progress will be made if the Department of the Interior continues to revise royalty rates for projects located in challenging geologic formations or near their end of life. Adaptive royalty provisions will make the U.S. offshore more competitive against U.S. onshore and international offshore opportunities.

Financial Assurance/Bonding

Progress has also been made toward reversing additional financial assurance/bonding requirements issued by the Obama Administration in 2016. Based on compelling feedback from industry, implementation of the most onerous requirements was halted as the Bureau of Ocean Energy Management (BOEM) worked on proposed revisions expected to focus attention on leases that lack a clear and financially secure chain of ownership. Having a concrete proposal will allow companies to move forward with dialogue to reach a long-term solution that focuses on the actual issue and not the unknown. (The proposed revisions were expected to be issued by the end of 2018 but had not been released at the time of this writing.)

Well-Control Revisions

A revised version of the blow-out preventer (BOP) and well-control rule issued in 2016 by the Obama Administration was also anticipated by the end of 2018 but

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had not been published at this writing. After industry expressed concerns that the rule included provisions that did not increase safety, but would, rather, increase risk, the Bureau of Safety and Environmental Enforcement (BSEE) issued an amended version in May 2018 seeking feedback from industry and the public.

NOIA and allied trades responded in August 2018 recommending that BSEE replace a prescriptive drilling margin requirement with a performance-based standard, requesting that BSEE align its proposed BOP revisions with the 21-day testing interval outlined in API Standard 53 Fourth Edition and recommending that real-time monitoring be applied to operations using subsea BOPs and surface BOPs from a floating rig defined by API Standard 53.

A Bright Offshore Energy Future

While the immediate challenges facing the offshore oil and gas industry appear significant, the long-term outlook for offshore energy is bright. The U.S. and the world will continue to need oil and natural gas for the foreseeable future.

In the latest Annual Energy Outlook released by the U.S. Energy Information Agency (EIA), fossil fuels are predicted to supply nearly 80 percent of U.S. energy demand in 2050.

Likewise, a growing global middle class that wants cars, air conditioning and household appliances is expected to grow energy demand by 28 percent by 2040. Globally, EIA still expects fossil fuels to account for 77 percent of energy consumption.

Fortunately, the United States has an abundance of oil and gas, and industry has the technology and the know-how to tap these valuable resources.

However, to keep up with growing energy demands, we will need all forms of energy, including offshore wind. With strong winds, a shallow continental shelf and close proximity to population centers, the Atlantic seaboard is driving strong interest in offshore wind development, and the offshore oil and gas supply chain stands to benefit. In fact, the construction of America's first offshore wind farm, Block Island Wind Farm, was aided by companies traditionally involved in offshore oil and gas work, including Montco Offshore and Gulf Island Fabrication, proving that offshore oil and gas and offshore wind can thrive together. BOEM has awarded wind energy leases off every state from Massachusetts to North Carolina and is in the planning stages for future wind lease sales, including a potential floating wind project off the coast of California.

The face of the offshore energy industry is changing. NOIA believes those changes are for the better, and we will continue to advocate for increased offshore access for the production of all forms of energy. Smart energy policy that includes increased offshore access and a regulatory regime that encourages and incentivizes all forms of offshore energy development will create jobs, spur broad offshore economic growth, strengthen our energy and national security, and provide affordable and reliable energy for Americans and our allies. **ST**

Review&Forecast

Increasing Our Ocean Security: How A Healthy Ocean Benefits Us All

By RAdm. Jonathan White, U.S. Navy (retired)
CEO, President
Consortium for Ocean Leadership

In 2017, I started talking about ocean security, or the concept that our national, homeland, energy, food, water and economic securities, as well as our public health and safety, depend on a healthy ocean—which in turn depends on ocean science and technology.



Unfortunately, 2018 provided plenty of concrete examples where ocean security impacted lives and prosperity: Hurricanes and wildfires (driven by oceanic conditions) threatened national, homeland and economic security on the U.S. East and West Coasts; harmful algal blooms caused respiratory issues and economic losses off Florida's Gulf Coast; and the ever-growing collection of plastics in the ocean continued to accumulate and threaten the ocean's health. Over the past year, the Consortium for Ocean Leadership (COL) has redoubled our commitment to increasing ocean security throughout our programs, events and advocacy.

Food and Economic Security

During our 2018 industry forum, "U.S. Offshore Aquaculture: Will We Fish or Cut Bait," diverse stakeholders explored whether or not the United States should join other nations and pursue offshore finfish aquaculture, and what would be needed to do so. Ensuring the food security of our growing global population while increasing the health and resilience of our global fisheries is critical, and many have presented offshore aquaculture as one solution. The proceedings from this forum will be released in early 2019.

During 2018, ocean plastics and marine debris became part of the public consciousness like never before. In June, COL played a key role in bringing the Ocean Plastics Lab—an international traveling exhibit and hands-on education tool—to the United States for the first time. Thousands of visitors interacted with the exhibit on D.C.'s National Mall and learned about the scientific and technological capabilities that help us understand and address the problem. COL also hosted a Congressional briefing, in conjunction with the House Oceans Caucus, titled "The Ocean Plastic Pollution Problem: Solvable With Science, Innovation, and Education," where experts from academia, industry and aquaria spoke to a standing-room only crowd about potential solutions.

“While 30 out of 50 U.S. states directly touch a coast—ocean, gulf or Great Lake—every state and every American relies on the ocean and will benefit from increased ocean security. This requires interdisciplinary approaches; it is not enough to simply know that the ocean is changing, but understanding why, how and what can be done, as well as how it impacts people and communities, is essential.”

Homeland Security

The National Ocean Sciences Bowl (NOSB) celebrated its 21st successful year, with the 2018 Finals theme of “Our Ocean Shaping Weather.”

Although advances in ocean science capabilities are improving resiliency against weather hazards, some students experienced the relationship between ocean science and homeland security firsthand when two regional competitions were cancelled due to impacts from a well-forecast Hurricane Harvey. The NOSB community showed their mettle in the face of hardship, inviting affected teams to participate in another regional competition and raising funds to help cover travel costs.

Ocean security doesn't just happen on its own; it takes concerted, interdisciplinary efforts. While our activities described above highlight the importance of these securities that make up ocean security, we also did work around individual components that are necessary to strengthen ocean security.

Advancing Partnerships

In March, our annual public policy forum, “Power of Partnerships: Advancing Ocean Science and Tech,” brought together more than 200 individuals from federal agencies, NGOs, academia, industry and Congress to discuss how interagency and public-private partnerships must further the ocean science and technology enterprise.

Leveraging the power of interdisciplinary science and cross-sector collaboration are key to ensuring a safe, healthy and navigable ocean that supports communities across the globe.

Enhancing Ocean Observations

In October, COL turned over operations and management of the Ocean Observatories Initiative (OOI) to a coalition of academic and oceanographic research institutions headed by Woods Hole Oceanographic Institution. After carrying OOI from design through construction and into operations, we look forward to helping steer the continued scientific advancements that will be derived from this groundbreaking program.

Similarly, the Interagency Ocean Observation Committee (IOOC) integrates observing systems across agencies, institutions and nations and has been involved in putting on the decadal Ocean Obs '19 conference taking place this September.

We also helped ensure decision makers understand the importance of ocean observations with a Congressional briefing, co-hosted by the IOOS Association and

in conjunction with the Senate Oceans Caucus, titled “Buoying Our Nation's Economy: The Role Of Ocean Data in Supporting the Blue Economy.” Experts from ocean industries described ocean data's important role in ensuring safety, generating resources and facilitating adaptation.

Ensuring Science Funding

Much of our advocacy work centered around making sure our key ocean science agencies—the National Science Foundation, NOAA, NASA and the Navy—are adequately funded. This included holding in-person meetings and submitting letters and testimony highlighting their importance.

Looking Forward

As we move into 2019, we will continue to build on our 2018 efforts around ocean security. This includes expanding our interdisciplinary efforts and redoubling our advocacy work around themes that will strengthen our ocean security.

While 30 out of 50 U.S. states directly touch a coast—ocean, gulf or Great Lake—every state and every American relies on the ocean and will benefit from increased ocean security. This requires interdisciplinary approaches; it is not enough to simply know that the ocean is changing, but understanding why, how and what can be done, as well as how it impacts people and communities, is essential. Turning data from ocean observations into good decisions requires synthesizing information across many fields, not just ocean science. Addressing the myriad threats to ocean security relies just as strongly on other fields of study as it does on ocean science, including social science and medicine.

Ensuring our nation has strong ocean security will require dramatically increased partnerships and collaboration across the “Ocean Enterprise”—all public, private, academic and nonprofit sectors that support or utilize ocean science and technology.

From a state government setting scallop-catch limits based on ecological data to a factory manufacturing parts for autonomous underwater vehicles, an NGO advocating for science-based management, or an aquarium's hands-on science education program, sound ocean science is both the basis for and the goal of the Ocean Enterprise.

Bringing the cross-sector groups to the table is necessary to navigate the future of the Ocean Enterprise and fulfill the goals of ocean security, and we plan to work towards this goal in 2019. **ST**

Review&Forecast

Working with Government To Grow Industry

By Rich Lawson

CEO

International Ocean Science and Technology Industry
Association

As 2018 draws to a close, it's a great time to reflect on the past year with an eye toward future opportunities. From my vantage point leading the International Ocean Science and Technology Association (IOSTIA), our main focus is on those blue technology sectors that lie predominantly outside offshore oil and gas interests. Further, our mission is largely directed toward providing a voice in government for those whom we serve and to assist in developing new business opportunities.

As a result of our focus and mission, we've had the privilege of being involved in some key pieces of legislation that hold the prospect of reshaping both the focus of government and investment into the technologies that provide new insights and opportunities as we seek to explore, understand and sustainably exploit our seas.

Early in 2018, we worked closely with policy makers to solicit industry input to understand what might constitute game-changing technology that could reshape how we explore and gather data in our ocean. As you would expect, many ideas were discussed, ranging from the overarching big data problem to pragmatic challenges of increasing the effectiveness of battery technologies and in-situ recharging solutions that leverage renewable ocean energy sources.

And while ideas are crucial, how government affects change can make the difference between effective adoption and commercialization of novel technologies. Will new and potentially duplicative bureaucracies or strong public-private partnerships yield better outcomes? As government considers legislation seeking to kick-start a blue tech evolution, maintaining strong connections and effective communication with industry is critical to the development of effective and appropriately focused legislation.

Later in 2018, we had the opportunity to work with lawmakers on legislation focused on improving the United States Coast Guard's mission capabilities through more effective procurement of the latest blue technologies. And while there was the initial and expected criticism on display during public hearings, the direction of the resultant legislation was pragmatic, if not inspiring. The centerpiece of this new legislation is the creation of



a Blue Technology Center of Expertise that seeks to "promote awareness within the Coast Guard of the range and diversity of Blue Technologies and their potential to enhance Coast Guard mission readiness, operational performance, and regulation of such technologies."

It's obvious that bringing legislative focus on blue technology is good for our industry. And while the funding and establishment of the center lay ahead, the Congressional Budget Office in its review noted that the Coast Guard has experience with similar centers, and a modest appropriation of \$500,000 will be required to open the doors. It is IOSTIA's position that the establishment of this center should include strong collaboration with industry and academic partners to maximize its effectiveness.

Ultimately, the Center of Expertise legislation was included in the Save Our Seas Act, which was signed into law in October. This broader, bipartisan law reauthorizes the NOAA Marine Debris program, bringing much needed funding stability and calls for stronger international cooperation to battle plastics and other debris in the world's oceans.

The point of discussing these legislative actions is to highlight the important role the government plays in our industry. With bipartisan action, the commitment of government to focus and fund represent the single greatest opportunity outside of the defense industry and oil and gas to push the development of blue technology forward. And certainly, when science is the focus, government and academia are the critical players in town.

But focusing only on funding the earliest stages of new ideas comes with risk. Without persistent emphasis placed on our industry by government, it becomes more difficult to attract the commercial investment needed to bridge the funding "Valley of Death" and to, thus, realize the type of game-changing emerging technologies that we are all aiming for.

So, what lies ahead for our industry as we look to 2019? With a divided Congress, can we hope for action that moves the needle? That remains to be seen, but while our ocean champions on the Hill are largely unheralded by wider audiences, they remain determined nonetheless. From IOSTIA's interactions in 2018, I can say that legislators and policy makers have been focused on making a difference, overcoming political challenges, and showing an interest in strong and collaborative support from industry.

Immediately ahead in 2019 is the requirement for the Coast Guard to implement (subject to appropriations) its Center of Expertise and to provide its vision for the other components of the Save Our Seas Act. It is clearly an ambitious time line to craft a vision and strategy, identify and nurture partnerships, and launch this new program. In addition, other relevant agencies within government are busy pursuing other blue technology opportunities as well.

In these efforts throughout government, IOSTIA and our member companies stand at the ready as a resource and a partner. In November, a delegation of IOSTIA members participated in a specialized blue tech exhibition at Coast Guard headquarters. It is our hope that

this first collaborative effort will anchor stronger industry relations in the months ahead.

Our focus and the opportunity we see in the coming year will be creating and adapting programs to enhance connections between government and industry. A good example is IOSTIA's second annual BlueTech Expo, which will expand to a two-day event in 2019 in response to demand for a more effective dialogue on blue technology capabilities. The 2019 BlueTech Expo will also include a very specialized small business showcase at the Bureau of Safety and Environmental Enforcement offices in Virginia.

In many ways, our industry is defined by small-business innovators. Larger companies play a vital role as well by leveraging their technical and topical expertise and opening doors that positively influence legislation and grow opportunities for all.

In conclusion, 2019 presents a tremendous opportunity to continue our work of providing a platform for growing and enhancing our industry's connection with government in a way that informs government about emerging technology and capabilities and helps industry be a better government partner. In this effort, there will be exciting new opportunities across the spectrum. **ST**

Review&Forecast

Coral Bleaching Requires Action

By Dr. Phil Dustan
Biology Professor
College of Charleston

The message of the award-winning film "Chasing Coral" (chasingcoral.com, sea-technology.com/qa-jeff-orlowskis-chasing-coral) is clear: Global warming has arrived. It is not a thing in the future. It is now and growing more severe every day.

Coral reefs and rainforests are to conservation as apple pie and motherhood are to the American way. Every day we report the growth of commerce—new cables across the oceans carrying terabits of data per second, larger ships and expanding trade—but fail to realize that expansion is taking place at the expense of ocean health. Nothing goes on in the biosphere without disturbing something else. Bob Dylan's "You Gotta Serve Somebody" begins to drone louder in the background.

The state of the reefs is bad and getting worse by the minute. There are no intact coral reefs on the planet any more. Rising temperatures, decreasing pH and overwhelming humanity are driving these jewels of the biosphere into extinction. "Chasing Coral" highlighted the vulnerability of the Great Barrier Reef to increasing temperature as a bookend to Exposure Lab's earlier film "Chasing Ice" (chasingice.com). Melting glaciers and bleaching corals are global warming signals from opposite climates.

In 2016, the Great Barrier Reef lost about 30 percent of its coral from thermal bleaching; in the Coral Triangle



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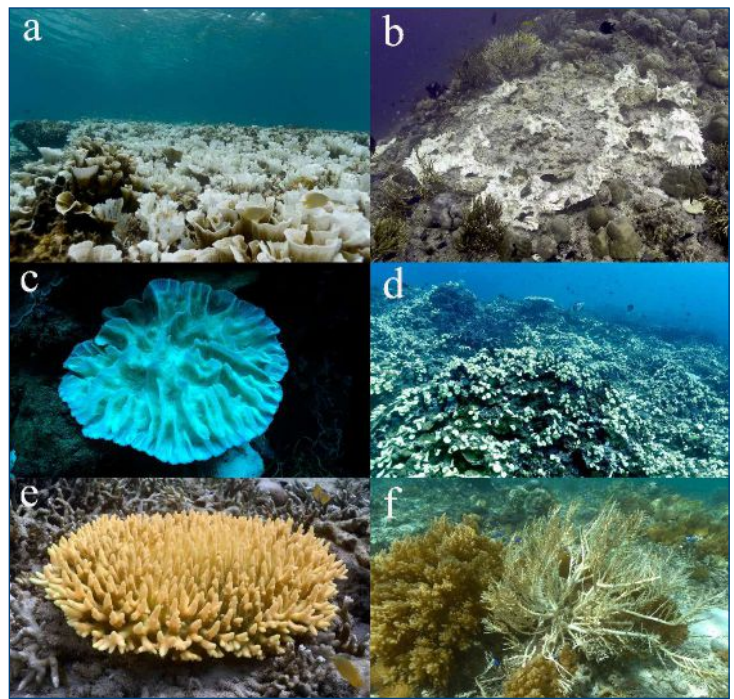
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(Top left) A very large, 300- to 500-year-old star coral, *Porites lutea*, in Menjangan Island, Bali, at about 4-m depth that bleached severely in 2015/2016. The coral colony lost living tissue but lived while the reef corals around it died from the bleaching. (Credit: Dr. Phil Dustan) (Top right) (a) A large grove of lettuce coral, *Echinopora*, that forms the reef flat of Symphony Reef bleached in 2015/2016 in Menjangan Island at about 1.5-m depth; (b) soft corals, *Sinularia*, in Menjangan Island at about 10 m slowly starve to death when they lose their symbiotic algae through bleaching; (c) stony coral, *Pectinia*, on a wall at 20 m in Menjangan Island turned ghostly when it bleached and the diffuse blue-green light reflected off the bright-white underlying skeleton through its near-clear tissues; (d) field of bleached soft coral, *Sarcophyton*, slowly starving around 10 m in Menjangan; (e) a bleached coral, *Acropora*, that

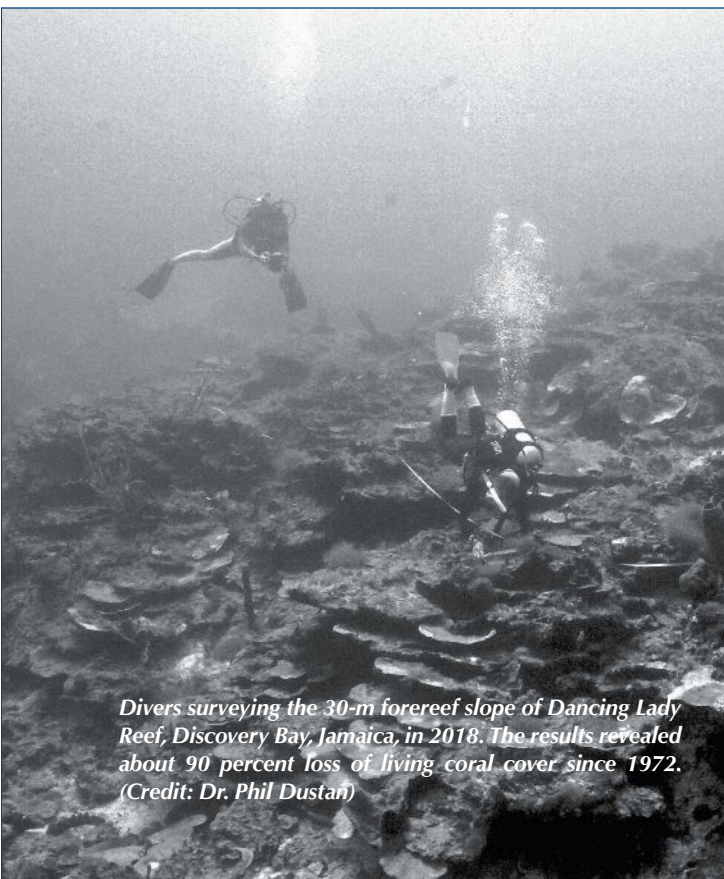


has upregulated fluorescent golden protective sunscreen pigments in the absence of symbiotic zooxanthellae in Menjangan at about 1.5 m; (f) *Nephthea* in the Bali Strait at about 4 m, a bush-like soft coral whose skeleton simply breaks apart when it dies because it is formed from thousands of individual microscopic spicules held together by living tissue. (Credit: Dr. Phil Dustan) (Below) Table coral colonies, *Acropora*, in Menjangan Island at about 4 m: one alive in 2011, the other dead in 2017. Note how the live colony is an oasis of life with schools of green chromis, *Chromis viridis*, hovering over the living colony; they are absent from the dead colony. (Credit: Dr. Phil Dustan)

in Bali, my colleagues and I measured a 44 percent loss ([youtube.com/watch?v=yxOfLTnPSUo](https://www.youtube.com/watch?v=yxOfLTnPSUo)), and there are similar reports from around the world.

The 50 Reefs initiative (50reefs.org) is seeking regions where reefs are least vulnerable to climate change, a far cry from the days when a trip to almost anywhere in the tropics was fabulous. The seas have absorbed more than 90 percent of the excess warming of anthropogenic climate change. Mass bleaching was first reported in the 1980s. At first, it was just a curiosity to the scientific com-





Divers surveying the 30-m forereef slope of Dancing Lady Reef, Discovery Bay, Jamaica, in 2018. The results revealed about 90 percent loss of living coral cover since 1972. (Credit: Dr. Phil Dustan)

munity; now it is a struggle for existence as nowhere, no matter how remote or deep, is safe from the heat. In the early 2000s we thought that the deeper reefs, below 30 to 40 m, would be relatively safe and could serve as biodiversity refuges or reservoirs to repopulate the shallows. But the relentless heating goes much deeper, and the low light at depth makes it more of a challenge for corals to repopulate their symbiotic algae, let alone the reef substrate.

“Chasing Coral” won the 2017 Sundance Audience Award for U.S. documentaries, numerous awards at other film festivals, a Peabody Award for storytelling, and an Emmy for Outstanding Nature Documentary. The message is getting out, but it is clear that action, not awards, will be the true measure of the film’s success (chasingcoral.com/take-action).

There are still a few wondrous reefs left, but the message is clear: We are running out of time.

Captain Jacques Cousteau, a friend and mentor, often spoke of humans as a young species that did not know how to behave. He would say that we are like small children, fighting, breaking, destroying because we do not know any better. Then with a wry half smile he would add something like, “Can you imagine what the world will be like in half a billion years when we have become conscious? But first we must get through the next 50 years with all knowledge intact.”

He said that 30 years ago. The time to grow up is now, before we lose everything and leave it to the next generation to wonder why we were so reckless to value money over living treasure. **ST**

Review&Forecast

Fisheries & Aquaculture: Climate Right For Industry Growth, but Hurdles Remain

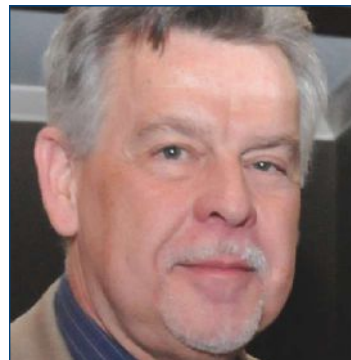
By Rick Martin

Publisher

Commercial Fisheries News and Fish Farming News

It is safe to say the first two years of the Trump presidency have been filled with both promise and pitfalls for U.S. commercial fishermen and fish farmers.

Now, what lies ahead—particularly in the wake of the 2018 midterm elections—has many in the industry feeling unsettled about the near-term future.



Delivering on his campaign promise to ease government regulation and break down barriers to U.S. business expansion, President Trump, since taking office, has certainly scored points with many fishermen and fish farmers weary of what they view as long-standing over-regulation at the federal level.

Yet, at the same time, his trade policies and aggressive approach toward enacting tariffs have made many in the seafood industry nervous over market instability and the resulting economic impact.

Tariffs that level the playing field—for U.S. seafood producers hoping for some relief as they compete with a flood of less expensive imports—are generally viewed favorably.

But, much of the seafood harvested in this country is destined for export markets and any disruption in foreign trade has the potential to cause deep ripple effects within U.S. fisheries industries and communities.

It is a complicated equation, as in the case of Maine lobsters, for example.

Lobsters from Maine are shipped all over the world, not only providing vital markets for a perishable product whose production can exceed demand, but also ensuring a better price for lobsters that are sold domestically.

During periods of peak harvest, Maine lobster fishermen rely on the Canadian processor market to buy tons of product and absorb over-capacity. Any barriers that impede that trade, perhaps, for instance, Trump’s retooling of NAFTA, would be a bad thing.

However, Maine lobster also competes with live product from Canada in many lucrative export markets, including Europe and China. Most recently, Canada has been reaping the benefits of the U.S. trade war with China, much to the concern of the Maine lobster industry.

Additionally, commercial fishermen are growing increasingly concerned with Trump Administration plans to expand offshore oil and gas exploration and produc-

“Tensions reached a near fever pitch this past year following a disastrous period for an already threatened and greatly diminished North Atlantic right whale population. The result is a major initiative to reduce whale entanglements... a shift to so-called ‘ropeless fishing’ technologies.”

tion in U.S. waters. Fishermen who were already feeling pinched by the growth of offshore wind farm development now have another potential threat to their lucrative fishing grounds.

Whale Protection

Interaction between commercial fishermen and marine mammals has always been problematic.

But tensions reached a near fever pitch this past year following a disastrous period for an already threatened and greatly diminished North Atlantic right whale population.

The result is a major initiative to reduce whale entanglements in commercial fishing gear—with support in some quarters now building for a shift to so-called “ropeless fishing” technologies.

As contributing writer Joyce Rowley wrote recently in *Commercial Fisheries News*, a group called the Ropeless Fishing Consortium was born of the 2017 to 2018 unusual mortality event (UME) of 20 whale deaths.

Of the 11 deaths with known causation, more than half were by gear entanglement—four in 2017 and two in 2018.

The UME deaths represent 4 percent of a declining population of now approximately 438 right whales at a time when there were no calves born in 2018, and only five born in 2017.

Ropeless fishing would leave no rope in the water column in whale and turtle habitats, except during gear retrieval as needed, to reduce the risk to zero.

All of the ropeless methods currently being tested use acoustics to identify the traps and trawls while on the bottom so any transducer can locate the gear, including other fishermen and law enforcement.

The acoustics can be further coded so only the trap owner and law enforcement know who owns the gear and can trigger a release to bring the traps to the surface, Rowley reported.

To say lobster fishermen have been slow to embrace this concept would be a vast understatement. It's expensive, unproven and, many would argue, largely unnecessary—given other industry measures to reduce the threat of entanglements.

That said, there is a recognition that the industry has a bullseye on its back and that lobstermen will need to continue to participate in the days ahead toward developing viable solutions to the entanglement crisis.

MSA Reauthorization

Originally co-sponsored in the House more than 40 years ago by Reps. Don Young (R-Alaska) and Gerry Studds (D-Mass.), the Magnuson-Stevens Fishery Conservation and Management Act (MSA) is viewed by many

as one of the reasons the U.S. has some of the best-managed and most sustainable fish stocks in the world.

The bill is named for its Senate champions, Warren Magnuson (D-Wash.) and Ted Stevens (R-Alaska).

Efforts are currently underway to revise, update and reauthorize the MSA, and there is strong industry support for a bill introduced by Young that passed in the House last July.

Young's bill, H.R. 200—the Strengthening Fishing Communities and Increasing Flexibility in Fisheries Management Act—would require that stocks be rebuilt according to an appropriate biological time frame determined by the regional councils that manage the stocks.

H.R. 200 would also introduce other important measures that would better allow the councils to adapt their management plans to fit changing ecological conditions and the needs of fishing communities, which will become increasingly important as our coastal areas experience the effects of climate change.

Where MSA reauthorization will go in the coming months with a new Congress is anyone's guess, but industry remains hopeful.

Aquaculture Adrift?

Many in the U.S. fish-farming community have applauded the Trump Administration's goal to drastically increase domestic aquaculture production, particularly through expansion of marine aquaculture.

Secretary of Commerce Wilbur Ross has talked frequently of reducing the seafood trade deficit, with roughly 90 percent of all the fish consumed here currently coming from foreign markets.

“A strong U.S. marine aquaculture industry will serve a key role in U.S. food security and improve our trade balance with other nations,” the department said.

That all sounds good, and a bill introduced last year by Sen. Roger Wicker (R-Miss.) would make NOAA essentially a “one-stop shop” for the permitting process required to conduct marine aquaculture in federal waters—another key step toward expansion.

That said, this past September the U.S. District Court for the Eastern District of Louisiana ruled that NOAA does not have authority to regulate aquaculture under the Magnuson-Stevens Act (MSA).

While NOAA was deciding whether to appeal the ruling, an agency spokesperson said, “Given conflicting court decisions and the desire for regulatory certainty, NOAA supports congressional efforts to clarify the agency's statutory authority to regulate aquaculture.”

Without that clarity and a clear path to obtaining offshore aquaculture leases (versus permits), it is hard to see U.S. open-ocean aquaculture gaining much commercial traction in the foreseeable future. **ST**

Review&Forecast

Firing Line Report

By Aileen Torres-Bennett
Managing Editor
Sea Technology magazine

Every year, participants in our annual Firing Line Survey hail from around the world. This year, most of them are based in Europe (32.3 percent), followed by those based in the U.S. (25.8 percent), Asia (19.4 percent), Canada (12.9 percent), and South America (9.7 percent).



Sales

Most respondents (41.9 percent) reported more sales in 2018 than the previous year. Those reporting level sales with 2017 make up 35.5 percent of those surveyed, and those reporting a decrease in sales make up 22.6 percent.

A majority of respondents report an optimistic outlook for 2019, with 64.5 percent expecting a higher sales volume. Those expecting level sales with 2018 make up 29 percent of those surveyed, and 6.5 percent expect lower sales volume.

The survey asked which product categories were the most active in terms of sales for 2018, and participants highlighted: acoustic sensor systems, communications/telemetry, echosounders, GPS/DGPS navigation systems, mapping/survey systems, recorders/indicators, software/data processing, multibeam sonar, side scan sonar, underwater vehicles, and other, unspecified products.

Most orders came from government (civilian and military) and academia/research institutions.

Participants were asked which customer base has the most potential, and they listed oil and gas, telecommunications, government, defense, renewable energy, environmental sampling, academia and research institutions as promising areas.

A respondent that listed oil and gas said it is a growing market because there is increasing need for more production and maintenance of offshore assets. This respondent also said telecommunications is a growing market, related to the need for infrastructure maintenance.

One person who cited government as a potential growth area said that there is a need for more electricity production without the use of carbon-based fuels.

A respondent who listed marine renewable energy as an area for business growth said this would be prompted by a mandated end to nuclear power in his/her country.

The survey asked if the current level of federal budget spending has affected business, and most respondents

replied that the budget for military and civilian agencies has had very little to moderate effect on them.

National, International Outlook

When asked about the general mood in their country's marine industry, responses ran the gamut from pessimistic to optimistic, with most sensing a general positive mood at home, describing it as "hopeful," "enthusiastic," "upbeat" and "increasing slowly." The U.S. and Germany were said to have a good outlook, while Venezuela and the Caribbean were said to be cautious, Spain was said to be "quiet," and Turkey's market seems to be on the downturn.

One respondent from Japan said the country "should develop management in [the] marine and waterfront frontier. Marine wind power exploitation will be required more and more."

A person from the U.K. said the market there is moderate, and he/she is "hopeful of improvement."

A respondent from Brazil said it looks promising for the offshore industry there.

Someone from Argentina felt the domestic marine industry is "very enthusiastic, but moderated by unclear laws."

The outlook for the international market is more of a mixed bag. Positive responses said it looks "very good," "upbeat" and "active." Toward the other end of the spectrum, responses said the international market looks "uncertain" and "nervous," and there is "much desire to do" but "little budget."

Marine Renewable Energy

The annual survey continues to ask about the growth of the market for marine renewables. Those involved with the renewable energy industry report continued growth, with one respondent declaring: "It's our biggest area of projected growth."

Another respondent said marine renewable energy is "very important and a niche with much potential."

"We are providing services for the construction and operation of offshore wind parks, and it is quite lively," said another respondent.

Other areas of marine renewable energy activity for respondents include ROV tooling, environmental assessment, operational services and wave measurement devices.

Trends, Predictions

For the latest survey, we asked participants if they've noticed new trends or directions in the ocean space and whether they have predictions for 2019. Marine renewable energy was pointed out as a new trend/direction that will continue. Other predictions include greater emphasis on deep-sea exploration and mining, remote-sensing technology, AUVs and ASVs, unmanned systems, cloud-based data, anti-submarine warfare, and innovation to conserve ocean resources.

One respondent said more government attention needs to be paid to ocean research: "We need the oceans more than we need more space exploration." **ST**

Safety in Seas Competition is Open

NOIA is currently accepting entries for the 2019 Safety in Seas Awards Competition through February 8, 2019. NOIA confers two distinct safety awards annually: The Culture of Safety Award, for organizational immersion in and commitment to safety that has resulted in measurable and sustained safety performance; and the Safety Practice Award, for specific technologies, approaches, methods or projects with direct impacts on improving safety.

Largest Containership Built in US Completed

Honolulu-based ocean cargo transportation firm Matson Inc. recently christened the largest container vessel ever built in the U.S., the *Daniel K. Inouye*. Built at Philly Shipyard in Pennsylvania, the 48,409-t, 850-ft. *Aloha*-class vessel is the first of two commissioned from Philly Shipyard by Matson, and the first of four new ships that will be put into service over the next two years. A fully integrated Furuno navigation system was selected for fitting on the ship.

Sensor Tech Company Joins Innovation Center

Sensor Technology Ltd. is expanding manufacturing operations to Nova Scotia at the Centre for Ocean Ventures & Entrepreneurship (COVE), a collaborative facility for applied innovation in the ocean sector. The company has been expanding its manufacturing plant in Collingwood, Ontario, due to increased demand and technology advances, and now it needs a second location. Nova Scotia Business Inc., the business development agency for Nova Scotia, worked with Sensor Technology Ltd. to help facilitate its expansion to COVE on the Dartmouth waterfront.

Geospace Acquires Fiber-Optic Sensing Tech

Geospace Technologies has acquired the PGS Americas OptoSeis fiber-optic sensing technology business. Geospace intends to retain PGS's employees dedicated to the OptoSeis business and will continue operating the business in Austin, Texas. The OptoSeis fiber-optic technology has been deployed in a marine reservoir monitoring system in the Jubarte field located offshore Brazil and has also been demonstrated as a viable technology for large-scale cabled land seismic data acquisition systems.

Wireless Surveillance Installed At Mexican Port

InfiNet Wireless successfully deployed a video surveillance system solution in Guaymas, a port in northwestern Mexico. In recent years, the previous network infrastructure had been severely affected by hurricanes and corrosion resulting from sea salt in the air. The legacy system was not adequate to monitor the entire port area. After first considering a fiber-optic solution, Guaymas port management eventually settled on a wireless solution to operate reliably in adverse weather conditions.

New Ferries for New Orleans Transit Authority

Two new 105-ft., 150-passenger, high-speed aluminum catamaran passenger ferries constructed for the New Orleans Regional Transit Authority (RTA) have been completed and are ready to enter service. The first of the two new ferries was delivered to New Orleans in July 2018. The second vessel is complete at Metal Shark's Franklin, Louisiana, shipyard, where it successfully passed U.S. Coast Guard inspections.

Japanese Agency Orders Modular AUV

Hydroid received an order for a new-generation REMUS 6000 AUV from the Japan Agency for Marine-Earth Science Technology (JAMSTEC) as part of the Strategic Innovation Promotion Program (SIP): Innovative Technology for Exploration of Deep Sea Resources. The new-generation REMUS 6000 is based on modular architecture that allows for the addition of multiple payloads, customer sensor packages, forward fins and additional battery sections, as well as low-power core electronics.

Drill Center Scanned with Fixed-Line Tool

Newton Labs M3200UW underwater laser scanner was recently used in a laser survey of a drill center by DOF Subsea. Scans were gathered at a depth of 4,500 ft. with the M3200UW scanner deployed on a work-class ROV. Location data were provided by an IMU, and navigation software was used for coordination of all sensors and rendition of the final results.

Partnership Based in Brazil Focuses on Support for Shipping, Oil and Gas

Unique Group is partnering with BRAeMar Serviços Portuários e Offshore Ltda., a provider of knowledge and skill-based marine services. Based in Rio de Janeiro, the partnership will facilitate comprehensive support for the shipping, energy and oil and gas markets in Brazil and across Latin America. Founded in 1997 with a focus on environmental issues and the support of marine industries and oil and gas exploration and production, BRAeMar will be the sole representative agency for Unique Group in the region.

Volvo Penta to Supply Engines, Drives For 46 New USCG Cutter Large Boat RIBs

Volvo Penta of the Americas will supply the engines, drives and controls for the new U.S. Coast Guard (USCG) cutter boat large (CBL) rigid-hull inflatable boats (RIBs), which are being built at Metal Craft Marine. The boats will be powered by Volvo Penta 3-l 220-hp diesel Aquamatic sterndrive systems with HD controls. USCG contracted with Metal Craft to build a minimum of 46 new 7-m RIBs. The RIBs are designed for a top speed of more than 35 kt. carrying up to 13 passengers with an operating range of 200 nautical mi. in up to 4-m wave heights. They will be carried on three classes of USCG cutters.

USCG Inspections in Alaska

The U.S. Coast Guard Sector Anchorage inspections division inspects barges and tugs from Prince William

Sound, west through the Aleutian chain and north to the Arctic Ocean, including the North Slope and all of Alaska's inland rivers. They also inspect tour boats, ferries, cruise ships, freight ships, oil tankers, fishing boats and more than 400 fuel storage facilities throughout the state. Inspections include structural integrity, seaworthiness, fire hazards, ability to save a life in a man-overboard situation, navigational functionality and crew competency.

Technology Industry Association Hosts Blue Tech Event at USCG Headquarters

The International Ocean Science and Technology Industry Association (IOSTIA) conducted a blue technology exhibition for the U.S. Coast Guard (USCG) and demonstrated cutting-edge ocean technologies during Blue Technology Focus Day. The event included presentations from RAdm. Michael Haycock and the USCG Dive Team. IOSTIA plans to host similar programs with other federal agencies throughout 2019.

Phoenix Completes Rescue Exercise in Alaska

The Phoenix Submarine Rescue Team mobilized the submarine rescue diving and recompression system (SRDRS) on board the MV *HOS Dominator* and completed eight days of submarine rescue operations with the U.S. Navy's Undersea Rescue Command (URC) off the coast of Ketchikan, Alaska, culminating in the mating of the Pressurized Rescue Module (PRM) with a U.S. submarine.

Corvus to Open Battery Factory in Norway

Contracts for the factory location and the production equipment are final, and plans for a fully automated factory for maritime batteries in Bergen, Norway, will proceed. The new factory will be located at Midtun in Bergen, about a mile south of the city center. The supplier chosen for the production equipment is Intek Engineering AS of Raufoss, Norway, and the factory will be fully operational in the third quarter of 2019.

Autonomous Acoustic Surveillance System In Development with Canadian Funding

GeoSpectrum Technologies (GTI) will develop a passive autonomous acoustic surveillance system (PAASS) with funding under the Innovation for Defence Excellence and Security Program (IDeAS). The project will demonstrate the feasibility of using a networked array of persistent autonomous platforms for the layered surveillance and tracking of underwater objects, including submarines and UUVs. PAASS will also be capable of detecting surface vessels, making it a useful tool for counter-narcotic and illegal trafficking operations.

Fire-Suppression Technology Company Ends Use of Hydrofluorocarbon Products

Sea-Fire Marine, manufacturer of fire detection and suppression systems for recreational, commercial and naval vessels, announced that it will cease distribution of hydrofluorocarbon-based suppression fluids in Europe. Instead, it will use 3M Novec 1230, which has negligible global warming potential. **ST**

international

First UK Company Signs on to Participate in Plastic Reduction Plan

Spinlock is the first company from the Isle of Wight to sign onto a global commitment to eradicate plastic waste and pollution at source. The New Plastics Economy Global Commitment aims to create a new normal for plastic packaging. Targets will be reviewed every 18 months and will become increasingly ambitious. Businesses that sign the commitment will publish annual data on their progress to drive momentum and transparency.

ROV Operator Opens Office in Middle East

ROVOP has expanded in the Middle East, opening a new base staffed by operations director Doug Middleton and business development consultant Michael O'Donnell. The Middle East operation will provide ROV services in the drill support, IRM and construction markets within the oil and gas sector via a diverse fleet of ROVs.

Climate Change Services Group Begins in Japan

The Carbon Trust and ClassNK Consulting Service signed an agreement to develop a commercial partnership offering climate change and sustainability services. The partnership will explore opportunities to deliver advice and consulting to Japanese businesses, as well as in selected markets across Asia. Companies will have access to technical advice and support for setting their own climate change targets, reporting environmental impacts and achieving reductions.

Hyperbaric Rescue Facility and Lifeboats Complete Mating Trials in 11 Hours

JFD successfully completed mating trials with its portable hyperbaric rescue facility (HRF) with Boskalis DSV *BOKA Atlantis*. The mating trials with the HRF and two self-propelled hyperbaric lifeboats (SPHLs) were completed in a period of 11 hr. During the trial, JFD successfully mated with the port and starboard SPHLs to the portable HRF. The entry locks of the SPHLs were pressurized to 305 msw, equivalent to the equipment's maximum working depth. The speed with which the SPHLs are mated is critical, as transferring the divers as quickly as possible can be vital to saving their lives.

Corrosion Control Service Offered in Middle East

Unique Group and Deepwater Corrosion Services Inc. will offer corrosion control solutions in the Middle East. Deepwater's solutions include cathodic protection (CP), permanent CP monitoring, CP design and engineering and corrosion inspection and survey. The company also offers sacrificial (SACP) and impressed current (ICCP) systems that can be retrofitted.

Autonomous Systems Collaboration is Underway

Sonardyne, L3 ASV and the National Oceanography Centre (NOC) will focus on longer-term navigational accuracy for AUVs in deepwater, while reducing power

requirements and increasing autonomy in marine operations. The P3AUV project will involve trials using Sonardyne underwater positioning technology on NOC's autosub long-range (ALR) and L3 ASV's C-Worker 7 ASV. The project recently completed trials in Loch Ness.

Innovation Centre Opens in Southern Sweden

Kalmar opened its new Innovation Centre in Ljungby, southern Sweden. Approximately 200 people will be based at the facility designed to support new collaborative ways of working with modern architecture and cutting-edge technology. Kalmar intends to strengthen its R&D capabilities and prototype production and testing for its mobile equipment portfolio. The center will also serve as a key hub for developing Kalmar's digitalization capabilities, zero-emission machine product portfolio and automation technologies.

Ashtead Acquires Canadian Company

Ashtead Technology has acquired Canadian underwater inspection company Welaptega. The transaction comes just 10 months after the company completed a joint venture with Forum Energy Technologies, creating an independent provider of subsea survey and ROV equipment services with a fleet of 19,000 assets worth more than £100 million. The acquisition is Ashtead's third deal since it was acquired by Buckthorn Partners and APICORP in 2016.

Actuator Launched for Oil and Gas Exploration

New technology developed by MacArtney and ION Geophysical, including a SailWing actuator and control system designed to ensure the correct positioning and stability of seismic survey source arrays, has been launched to gather data for enhanced exploration and production of oil and gas. The SailWing actuator and its control panel are designed to control sources towed from a seismic vessel that gathers data intended for 3D interpretation of the subsurface.

Marine Catalytic Reduction Market Is Expected to Reach \$5 Billion by 2024

A recent report by Global Market Insights suggests that the marine selective catalytic reduction system market will exceed \$5 billion by 2024. According to the report, increasing maritime nitrogen emissions and concerns over its adverse effects on human health and the environment will drive growth and product adoption, as well as rising concerns about NOx emissions coupled with stringent legislation. The report notes that the IMO introduced a limit to nitrogen emissions by engines with power output more than 130 kW.

Canadian Microbiological Monitoring Company Acquires Microbial Division of aqua-tools

LuminUltra, a Canadian specialist in microbiological monitoring tools, has completed acquisition of the Rapid Microbial Solutions (RMS) division of France-based aqua-tools. The acquisition includes the award-winning B-QUA ballast water test kit and ATP (adenosine triphos-

phate) measurement products. aqua-tools continues to operate as a separate business, focusing solely on its infection control solutions.

Open Call for Scottish-Japanese Collaborations

The second call for a three-year initiative that forges R&D partnerships between Scotland and Japan is now open. In the first phase of the initiative Scotland and Japan invested £8.8 million into five collaborative R&D projects. The second call focuses on the blue economy and topics in renewables, aquaculture and carbon capture storage. The current market value of the blue economy is valued at £50 billion, and the global market is projected to reach £140 billion by 2035.

Subsea Cable Specialist Expands into Israel

Hydro Group is expanding into a new market with Israeli-based distributor Aretha Technologies Ltd., which will offer subsea electrical and optical cables, ROV tethers and other Hydro Group products. Established in May 2018 by Ofer Kleiner and Moshe Eisenkraft, the firm based in Kfar Saba, Israel, is the official agent for engineering firms active in the defense, aerospace and renewable energy industries.

Norwegian Company Checks Ballast Installations

Optimarin ventured on board Subsea7's *Seven Pacific* to demonstrate upgrades of existing ballast systems to full U.S. Coast Guard (USCG) compliance. Optimarin was the first manufacturer to achieve USCG approval in December 2016, and it originally installed its UV-based technology on board the offshore construction and pipe-laying vessel in 2015. Since then, the 667-m³ system has been running smoothly, with minimal maintenance. Optimarin now has more than 500 operational units, of which approximately 250 are retrofits. The Norwegian-headquartered firm has performed about 50 of the simple USCG upgrades to existing systems.

Oceaneering Expands in Chandigarh, India

The company's engineering support team is expected to grow to 30 engineers by the end of 2019. The team provides services across all integrity engineering trades, enabling standardization and full life-cycle project execution. Chirag Jayswal has been appointed senior integrity engineering manager. With Oceaneering since 2010, he will transition from his current role within the offshore design center, where he led a team of engineers.

James Fisher Completes South China Project

James Fisher Ocean Team (JFOT) has completed its first excavation for COOEC Subsea in the South China Sea, and the team is gearing up for additional projects in 2019. JFOT was established to provide service in China from experts in global controlled flow excavators (CFE), James Fisher Subsea Excavation (JFSE), which has worked in the region since 2009. The project for COOEC Subsea in Zhujiangkou Basin, 170 km southwest of Hong Kong in the South China Sea, was for post-lay trenching of 7 km of subsea cable. **ST**

productdevelopment

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

Subsea Cameras



The IP Multi SeaCam and IP Apex SeaCam subsea cameras offer efficient and high-quality compression, along with support for common real-time IP streaming and camera management protocols. DeepSea Power & Light LLC.

Mission Sensor System

The Pro 5 mission specialist series (MSS) sensor configuration for ROVs has increased thrust, longer tether lengths and higher resolution video. The three-thruster system has a forward speed of more than 4.4 kt. VideoRay LLC.

Data-Ready AUV Platform

The HUGIN Superior AUV has upgraded SAS processing, side scan sonar imagery, bathymetry, sub-bottom profiler, camera, laser, magnetometer, turbidity and diverse environmental sensors for methane and CO₂ measurement. Kongsberg Maritime AS.

X- and S-Band Radar Systems

The R5000 interface allows multi-station systems, and multiple R5000 processors can be networked together to create a multi-radar system. Options include a 12- or 25-kW up-mast transceiver, or 25-kW down-mast option, and 6-, 9- and 12-ft. open-array antennas with solutions available to suit CAT 1 (H) and CAT 2 (H) SOLAS vessels. Simrad.

Ultrafast Scanning Sonar

CH500 and CH600 Searchlight Sonars can complete a 360° circle in about 3 sec., with selectable scanning steps from 6 to 24°. They include a built-in stabilizer to

compensate for pitch, heave and roll, and 11 display modes. Furuno U.S.A. Inc.

Marine Control Drives

Slipping clutch marine control drives (MCD) 2000, 4000 and 5000 perform as fixed-ratio drives when underway and as variable-ratio drives when a power divider is required, splitting main engine power for another operation, such as driving FiFi pumps, lifting cargo, hauling lines or turning generators. Twin Disc Inc.

Compact Pan-and-Tilt Camera



Hammerhead is intended for use on multiple platforms, including ROVs, HOVs, ASVs, landers and fixed platforms. The unit features absolute position feedback and unlimited rotation in both axes at speeds up to 5 rpm with user-settable soft-stops. In-air weight for the oil-filled version is 2.7 kg. Arctic Rays LLC.

Cyber Security Services

Fleet Secure Endpoint is based on ESET technology and powered by Port-IT to protect networked computer systems. Fleet Secure Cyber Awareness is a training app for mobile devices to teach seafarers about common cyber-criminal tactics. Inmarsat.

Portable Cable Reels

Rugged portable cable reels (PCRs) allow fast deployment of small-diameter oceanographic cables. They can be used with towed de-

vices such as side scan sonar, underwater cameras, antenna systems and hand-deployed sensors, as well as for storing and deploying tethers for ROVs and UUVs. 2KR Systems.

Integrated Navigational Planning

The Navigator Solutions Portfolio is an integrated, navigational and route optimization platform connecting onboard solutions to shore-based decision support for sharing internal information. It includes onboard, onshore and weather routing in one workflow. StormGeo.

Subsea Streaming Video Gear

The Grenadier camera line has live video streaming that can be transferred over gigabit Ethernet and uncompressed HD video over HD-SDI. MantaRay Parallel Lasers attach to the top of a camera and project two parallel beams that provide the distance and scale of underwater objects. SubC Imaging.

Bespoke Peli-Case and Mount



Custom Peli-case fits the surface components of an R2Sonic multi-beam echosounder SIM box and INS for use in ABP Humber's 5-m RIB boat, plus a custom transom transducer mount for Sonic sonars. Swathe Services.

Workboat Technology

New releases include a 32-ft. *Defiant* pilothouse vessel with Sharktech autonomous technology, developed with L3 ASV, and a high-power diesel outboard for military, government and commercial markets, developed with Cox Powetrain. Metal Shark.

INS and LBL Survey Software

Fusion 2 LBL and INS software combines software, vessel-fit hardware and communication interfaces. Sonardyne International Ltd. **ST**

environmental monitoring

Ashtead Delivers Installation Monitoring Services at Utgard

Ashtead Technology has successfully completed a subsea installation monitoring project for Subsea 7 in support of Equinor's Utgard development in the central North Sea.

The contract, which was awarded by i-Tech Services on behalf of Subsea 7, saw Ashtead's deflection monitoring system (DMS) used to capture critical data required to safely deploy a subsea template in water depths of 110 m from a Subsea 7 vessel.

The DMS monitors structure deflection, heading, pitch, roll, depth and suction at differential pressures in real time.

MacArtney Tech Monitors Water Level in Wadden Sea

Since June 2018 MacArtney Germany has delivered, maintained and serviced water level measuring stations in the Schleswig-Holstein Wadden Sea, a UNESCO World Heritage site near the Island of Sylt.

The measuring stations comprise a 2.5-m-long stainless steel pole that is vertically anchored in the tidal flats. The pressure sensors are positioned approximately 20 cm above the seabed to determine changing water levels. On the upper part of the pole is the Tide Master device and modem. The water levels are measured every 10 min. over a distance of 16 km along the Hindenburg dam, which links the Island of Sylt with the mainland.

The systems were operated for about four months.

Enhancing Observations From OOI Cabled Array

In July 2018, a team of researchers and engineers from Rutgers University and the University of Washington Applied Physics Laboratory deployed the Cabled Observatory Vent Imaging Sonar (COVIS) to the Ocean Observatories Initiative (OOI) Cabled Array. COVIS, a multibeam acoustic sensor, is installed at 1,600-m depth at the ASHES hydrothermal vent field within the

Caldera of Axial Seamount, an active volcano on the Juan de Fuca plate spreading zone, 300 mi. off the Oregon coast.

Selecting a site for COVIS and calibrating the sound backscatter response to heat content after installation required high-frequency measurements of the hot water being expelled from diffuse venting sites around ASHES. The COVIS team built temperature arrays using RBR*solo*³ temperature and RBR*duet*³ temperature and depth loggers.

Two of the arrays were recovered for immediate data analysis, and the remaining three will stay on site for a year. Upon recovery in 2019, they will provide data for groundtruthing the acoustic results from COVIS.

Marine Robots to Improve UK Weather Forecasts

In October, the RRS *James Cook* departed on an expedition during which a new automated system of collecting climate data was trialed. The new technology could help improve long-range European weather forecasts in the future.

A team of scientists from the U.K. National Oceanography Centre (NOC) was on board to acquire data from an array of instruments in the Atlantic Ocean, between Africa's West Coast and the U.S. East Coast. Data from these instruments, referred to collectively as the RAPID array, are gathered once every 18 months by a research ship, but on this expedition the researchers were testing a new system using marine robots to retrieve data from the instruments.

The RAPID array instruments were deployed on moorings. A new unit, developed by NOC, was attached to a mooring to gather data from all the instruments on the wire and then transmit the data using sound signals to a Wave Glider at the sea surface, which sent data by satellite to scientists at NOC.

MVPs to Map Irish Waters

The Geological Survey of Ireland (GSI) has purchased AML Ocean-

ographic's moving vessel profiler (MVP) to improve the productivity, safety and data quality of their survey operations. Working in partnership with the Marine Institute of Ireland under the joint program INFOMAR, they have committed to having all Irish waters mapped by 2026. The addition of MVP30-350 systems to two 16-m survey catamarans will facilitate on-time completion of the project.

The underway profiling systems will automatically and continuously collect SVPT and output the data to the multibeam echosounder in real time while the vessel travels at 8 to 10 kt.

The first of the two systems was commissioned aboard RV *Mallet* in November 2018, with delivery of the second MVP30-350 for RV *Keary* to occur in 2019.

Government Must Address Climate Change, ACS Says

In light of the release of the Fourth National Climate Assessment Volume II, the American Chemical Society (ACS) urges policy makers to address humanity's role in climate change and reduce greenhouse gas (GHG) emissions; the report should move the administration and Congress to take immediate steps to deal with this growing crisis.

As noted in the ACS policy position on Global Climate Change: "The American Chemical Society (ACS) acknowledges that climate change is real, is serious and has been influenced by anthropogenic activity. Unmitigated climate change will lead to increases in extreme weather events and will cause significant sea level rise, causing property damage and population displacement. It also will continue to degrade ecosystems and natural resources, affecting food and water availability and human health, further burdening economies and societies. Continued uncontrolled GHG emissions will accelerate and compound the effects and risks of climate change well into the future."

ACS is the world's largest scientific society and is a not-for-profit organization chartered by the U.S. Congress. **ST**

Nautel, General Dynamics to Upgrade Canadian Sonars

Nautel and General Dynamics will upgrade and maintain underwater sensors on the *Halifax*-class frigates for the Royal Canadian Navy as part of the underwater warfare suite upgrade contract awarded to General Dynamics Mission Systems-Canada. Nautel will supply NS72-36 sonar amplifiers and Mk II broadband transducers for dramatically improved underwater threat detection and tracking capabilities.

Naval Group, ECA Offer Mine-Hunting Solution

Naval Group and ECA Group have established a technological and commercial partnership in unmanned mine warfare. The first practical application was completed as part of the response to the consultation launched by Belgium for a Belgian-Dutch cooperation for the supply of 12 mine hunters.

As partners in a consortium formed for this call for tender, Naval Group and ECA Group are offering an innovative solution for robotic mine warfare, fully integrated on board an MCM military vessel.

Mine-hunting practices are being revolutionized via unmanned systems. This paradigm shift will affect naval forces as a whole.

Sea Trials Complete for Indian Navy's First DSRV

JFD has successfully completed the sea trials of the deep search-and-rescue vehicle (DSRV) for the first of two third-generation submarine rescue systems being delivered to the Indian Navy. The DSRV carried out underwater mating with a bottomed submarine at a depth of more than 300 ft., followed by a target mating and hatch opening at 45°. On successful mating with the bottomed submarine, JFD and the Indian Navy carried out a safe transfer of personnel from the submarine to the DSRV.

The DSRV also conducted a record dive representing the deepest submergence by a manned vessel in

Indian waters, as well as ROV operations at a depth of more than 750 m and side scan sonar operations at a depth of more than 650 m, all of which represent significant firsts for the Indian Navy.

New Head for NUWC Division Newport's USW

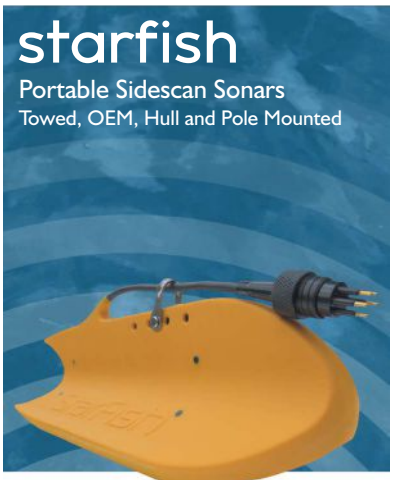
Hector Lopez has been selected as head of the Naval Undersea Warfare Center (NUWC) Division Newport Undersea Warfare (USW) Weapons, Vehicles and Defensive Systems Department, the largest of the departments at NUWC with more than 650 federal employees. He is responsible for technical leadership and full-spectrum engineering in support of research, development, acquisition and in-service activities associated with torpedoes, unmanned vehicles, countermeasures and towed defensive systems.

Australia's Shipbuilding Future

At the opening of the Naval Shipbuilding College in Adelaide, Australia, former Australian Defence Minister Christopher Pyne said building a suitable workforce would be the hardest part of Australia's Navy upgrade because it is difficult to convince people to join the industry. The Australian government is investing \$90 billion into the continuous shipbuilding program, expected to create 5,200 shipbuilding jobs within 10 years to build Australia's new fleet of 12 offshore patrol vessels, nine *Hunter*-class anti-submarine frigates, 12 future submarines and 21 Pacific patrol boats.

Kongsberg Bridge Simulator For Australian Navy

Kongsberg Digital has been selected to deliver and support a suite of K-Sim navigation-ready ship's bridge simulators for the Royal Australian Navy. The simulators will be delivered for a new training facility at HMAS *Stirling* in Perth starting May 2019, with existing bridge simulators at HMAS *Watson* in Sydney being upgraded from December 2018. **ST**



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ROVOP Acquires ROV Fleet for Vessels, Rigs

ROVOP, an independent provider of underwater ROVs, has purchased an entire fleet of 28 ROV systems from M2 Subsea.

The fleet expansion will enable ROVOP to better support customer operations by strengthening deployment capabilities globally, with a particular focus on Latin America, Africa, the Middle East and Asia. The fleet is expected to be deployed in the vessel and rig markets.

L3 ASV to Conduct Autonomous Nav Study for UK

L3 ASV has received U.K. government funding for a pioneering project on autonomous navigation of maritime vessels. The company will conduct a study with its partners in the Maritime and Coastguard Agency (MCA) and United Kingdom Hydrographic Office (UKHO), fo-

cusing on the future of marine navigational data and charts.

The project is funded by the Department for Transport's Transport Technology Research Innovation Grant (T-TRIG) and aims to promote early-stage science, engineering or technology innovations with the potential to advance the U.K.'s transport system.

L3 ASV's T-TRIG project will begin by exploring the characteristics of navigational data and charts: what they comprise, their structure and how they are updated. The project will identify the technical data requirements to enable the development of a Smart Chart system to provide information to autonomous vessels for safer navigation.

Rovco Expands Fleet With Falcon DR ROV

Rovco has expanded its ROV and hydrographic survey capabil-

ities with the addition of a Saab Seaeye Falcon DR ROV to its fleet. The 1,000-m-rated, long-range Falcon DR will enhance Rovco's ability to deliver intricate and demanding missions that require a variety of high-bandwidth sensors, either at depth or over long distances.

The Falcon DR will support Rovco's R&D projects by carrying out research into autonomous path planning using the company's SubSLAM live 3D vision system.

The addition of the Falcon brings Rovco's range of survey-class ROVs up to five.

Maritime E-Procurement Undergoing Evolution

ShipServ announced the output from its latest research white paper, "e-procurement in Maritime; 2021 and Beyond," based on insights from leading chief purchasing officers and managers (CPOs/CPMs). The research showed that while maritime e-procurement is currently at an embryonic level in terms of its evolution—scoring two



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out of 10—more than one-third of those surveyed believe the market will change beyond all recognition in the next five years, driven by developments in advanced technology and applications.

Fifty percent of CPOs and CPMs surveyed stated that they still use their e-procurement systems for purely transactional, not strategic, purposes.

The white paper highlights critical areas where maritime e-procurement will rapidly evolve, creating a more strategic approach to purchasing, which plays an important role in meeting one of the industry's biggest challenges: vessel optimization and maximizing the value of the asset for shipowners, operators and managers.

Blockchain will be embedded into future systems, which will solve the challenge of siloed data. Artificial intelligence and machine learning will solve the problem of the current lack of standardization for product descriptors.

HUGIN AUVs for Ocean Infinity

Ocean Infinity has placed three separate orders for a total of five Kongsberg Maritime HUGIN AUV systems, increasing its inventory to 15. The AUVs are supplied with Kongsberg Maritime HISAS 1032 synthetic aperture sonar, giving Ocean Infinity a total of six HUGINs with the ability to deliver high-resolution imaging in its fleet.

The HUGIN AUVs produce a data set including HISAS imagery and bathymetry, EM2040 bathymetry, sub-bottom profiler data and color photographs.

UniSea to Increase Efficiency Of Business Processes

UniSea AS has been selected by Tidewater Inc. as its partner in the digitalizing and standardizing of Tidewater's business processes related to health, safety, environment and quality (HSEQ) and operations. The UniSea software suite will be implemented on all Tidewater vessels and in all offices.

Tidewater Inc. is supposedly soon to become the world's biggest

operator of offshore service vessels following its merger with Gulfmark Offshore, with 273 vessels and 25 offices worldwide.

Cargotec Invests in Digital

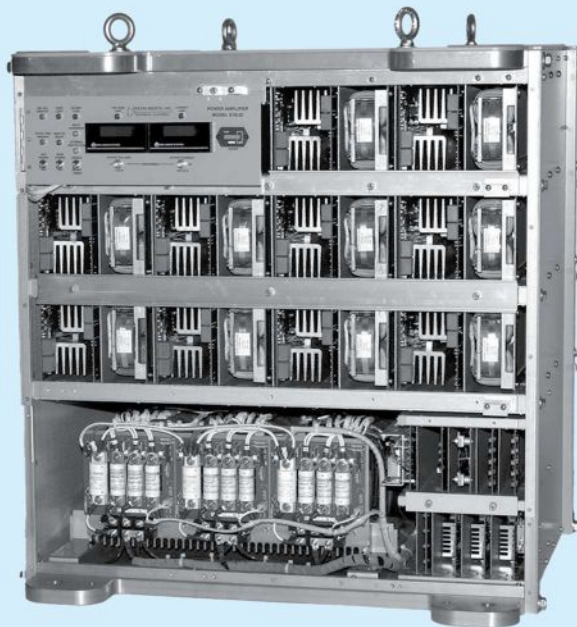
Cargotec will invest €32 million in accelerating the development of digital solutions to secure growth of new digital business. Part of this will be a new Digital Solutions Hub in Tampere, Finland, that will utilize

methodologies, technologies and data to develop digital solutions to all Cargotec business areas: Kalmar, Hiab and MacGregor. The new hub is another tangible step in Cargotec's strategy of becoming a global leader in intelligent cargo handling.

Tommi Pettersson, now in charge of Kalmar's software and automation development, will head the Digital Solutions Hub, to be fully operational by June 2019. **ST**

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TOTAL OCEAN MARKET COVERAGE 2019

JANUARY

Annual Review & Forecast / Buyers Guide/Directory

****Oceanography 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**, January 28-30,
New Orleans, LA

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- Navy Currents
- Ocean Business
- Ocean Engineering
- Ocean Research
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- 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*
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contracts

Kongsberg Maritime, Kongsberg, Norway, has selected one of the world's leading storage solutions companies as its battery partner and supplier of customized marine energy storage solutions and to contribute to a new generation of hybrid power solutions on autonomous and crewed vessel newbuilds. Leclanché.

Unique Group, Sharjah, United Arab Emirates, has entered into a cooperation agreement to provide corrosion control solutions to the Middle East market. Deepwater Corrosion Services Inc.

Enpro Subsea, Aberdeen, Scotland, reached a master services agreement (MSA) aimed at providing enhanced subsea architecture and smart standardization via its flow access module (FAM) technology. Kosmos Energy.

Optimarin, Sandnes, Norway, will supply seven of its USCG-approved ballast systems to Canada's largest ocean-going dry-bulk shipowning and chartering group. Five of the units will be fitted on existing vessels and two deliveries set for newbuilds. Fednav.

ChartCo, London, England, signed an agreement to market digital logbooks and software within the ChartCo OneOcean platform with a focus on reporting, monitoring, compliance and validation services. Klappir Green Solutions.

Damen Shipyards Group, Gorinchem, Netherlands, will deliver one Damen STu 1606 that will operate in the Mediterranean Sea in Toulon, France. Société de Remorquage et de Travaux Maritimes.

Korean Register, Busan, Korea, will provide enhanced IMO DCS (International Maritime Organization data collection system) services to the maritime industry. Swiss Climate EcoCare GmbH.

Fugro LADS Corp., Adelaide, Australia, will survey the Polynesian island country of Tuvalu, the world's fourth smallest nation. The survey will use airborne LiDAR bathymetry (ALB) technology for lagoon bathymetry and island topography. United Nations Development Programme.

Ocean Power Technologies Inc., Monroe Township, New Jersey, entered a long-term supply agreement for lithium-ion batteries for subsea battery solutions for its PowerBuoy products. NEC Energy Solutions.

DNV GL, Columbus, Ohio, is contracted to provide full-scale S-N* fatigue testing of large-diameter bolts and improve fatigue assessments of critical bolted connections by generating new test data. American Petroleum Institute. **ST**

meetings

February 4-6—EUROMARITIME, Marseille, France. anne-charlotte.micca@gican.asso.fr or www.euro-maritime.fr.

February 4-7—Gulf of Mexico Oil Spill & Ecosystem Science Conference, New Orleans, Louisiana. gulfconference@oceanleadership.org or <https://tinyurl.com/y998tjr6>.

February 5-7—Deepwater Operations and Topsides, Platforms & Hulls, Galveston, Texas. www.offshore-event.com/index.html.

February 5-7—Subsea Expo, Aberdeen, Scotland. rebecca.cox@bigpartnership.co.uk or www.subseaexpo.com/conference.

February 5-7—Underwater Intervention, New Orleans, Louisiana. 703-259-6118, ui@naylor.com or www.underwaterintervention.com.

February 25-27—Oceanology International Americas, San Diego, California. sara.andrade@reedexpo.co.uk or www.oceanologyinternationalamericas.com.

MARCH

March 5-7—Subsea Tieback, San Antonio, Texas. 713-963-6251, gailk@pennwell.com or www.subseatiebackforum.com.

March 5-7—World Ocean Summit, Abu Dhabi, United Arab Emirates. oceansummit@economist.com or www.woi.economist.com.

March 10-13—IEEE/OES Currents, Waves, Technology Measurement and Applications Workshop, San Diego, California. 508-289-2456, jrizoli@whoi.edu or cwtm2019.org.

March 13-15—World Congress on Maritime Heritage, Singapore. WCMH2019@worldexpress.com.sg.

March 18-21—U.S. HYDRO, Biloxi, Mississippi. 832-687-5570, melissa@thsoa.org or <https://thsoa.org/US-Hydro-2019>.

APRIL

April 1-3—Waterpower Week, Washington, D.C. 918-831-9560, andrea.harner@clarionevents.com or www.waterpowerweek.com.

April 2-4—MCE Deepwater Development, London, England. 281-491-5900, Bo.Howard@questoffshore.com or <https://mcedd.com>.

April 8-11—SubOptic, New Orleans, Louisiana. 703-444-0845, knielsen@stfevents.com or www.suboptic2019.com.

April 9-10—Intelligent Ships Symposium, Philadelphia, Pennsylvania. asnehq@navalengineers.org or www.navalengineers.org/Symposia/Intelligent-Ships-Symposium-2019.

April 9-11—Ocean Business, Southampton, England. +44 (0)1453 836363, hdavis@divcom.co.uk or www.oceanbusiness.com.

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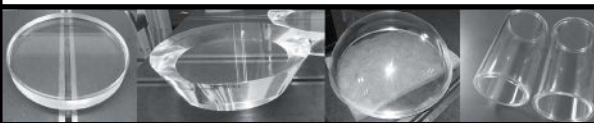
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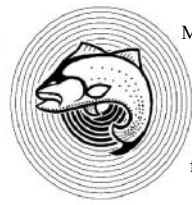


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From Shore to Store: Opportunity in Ocean Plastics—Rob Ianelli

Rob Ianelli is the CEO of Oceanworks Inc. He is a serial entrepreneur who has founded successful companies in the consumer product, marketing and sustainability industry. Passionate about pursuing market opportunities and transforming societal problems into compelling high-impact businesses, Ianelli has a keen understanding of how to create powerful results for customers, partners and the environment.



Every year the oceans are bearing an additional weight of 8 million metric tons of discarded plastic. That's close to one garbage truck per minute dumping its load into the sea. Even more mind-boggling is the fact that researchers have stipulated that without any immediate actions, there will be more plastic than fish in the ocean by 2050.

These startling figures have been syndicated across hundreds of media outlets and created a growing wave of interest in developing solutions. In fact, the issue of ocean plastic has been discussed as early as the mid 1970s with the National Academy of Sciences estimating that 14 billion pounds of garbage was being dumped into the ocean every year. That's more than 1.5 million pounds per hour.

A recent study released by the Ellen MacArthur Foundation noted that plastics production has grown 20 fold since 1964, reaching 311 million tons in 2014, and it is expected to double again in the next 20 years and almost quadruple by 2050, with no end in sight.

At a conference earlier this year, I had the pleasure of joining Sylvia Earle at a private dinner. She proclaimed, "The world thought the oceans were unbreakable," and the outcome we see now is simply the compounding result of this dangerous kind of antiquated thinking. Her thoughts echoed with me.

Something needs to change in how we approach the issues facing the ocean. Our company, Oceanworks, has done just that. Oceanworks is a private company, meaning we are not a nonprofit, NGO, working group or a think-tank. We differ from our peers only in that we have investors to account for and a forthcoming goal to establish our services into not only a repeatable process, but also a scalable global operation that massively impacts the collection and reutilization of verified ocean plastics into sustainable products.

Our journey with ocean plastics began in 2015, when I was optimistic that we would have the success we have now, but certainly unsure as to what the future entailed. Having become more educated on the ocean plastics issue, I wanted to do something about it. At that time, I had a robust sunglasses manufacturing program overseas supporting two eyewear brands I owned and operated. I decided the best way to immediately do something about ocean plastic was to make a pair of sunglasses from the material.

Jump ahead to June 8, 2016, World Oceans Day, when my team and I launched the world's first sunglasses made from recovered high-density polyethylene (HDPE) ocean plastic. We decided to use Kickstarter as a means to gauge the interest of consumers and leverage the press opportunities focused on the ocean. The ability to tell a story about a growing plastics problem and a definable solution with video, design and engineering proved insatiable to our backers. Norton Point, an eyewear brand, was fully funded in six days and went on to double our funding goal in 30 days.

Shortly thereafter, dozens of major consumer brand companies were contacting us. It became clear early on that the attention we were garnering was not directed toward what we made, but, more impor-

tantly, how we did it. We learned early on that major brands had two main requirements to address before incorporating ocean plastic into their products.

First, they required assurance that the material is truly ocean plastic. In response, we have developed a verified supply chain system to ensure chain of custody and origin of material.

Second, they wanted to know if the material(s) available would be suitable for the products that they wanted to make. Immediately we realized that we had to "de-risk" ocean plastics and work directly with brands' nominated suppliers and factories to troubleshoot the engineering modifications required for successful production.

We quickly realized that to become a successful private company in ocean plastics we needed to build as much value as possible. In the fall of 2018 we launched the world's first verified ocean plastic marketplace and also developed a correlating brand for consumers to recognize.

OceansMade is our brand uniting and creating value for ocean plastic collectors, processors, manufacturers, brands and consumers to come together around a single purpose: to clean up as much plastic from the oceans as possible. The products produced with material sourced from this marketplace will be adorned with the OceansMade logo, and consumers will have the confidence to know that what they are purchasing is verified from shore to store.

In summary, ocean plastics abound with possibilities. But we cannot tackle this alone. We all have a responsibility to act. Whether you are a citizen or a business, your support of our efforts will create a positive effect for our oceans and the future generations who depend on how we manage our resources today. **ST**

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www.oceanbusiness.com		www.underwaterintervention.com	

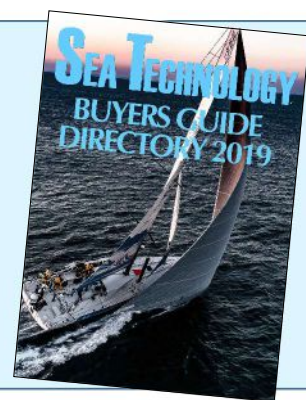
FRONT COVER:

Oceanworks Inc. CEO Rob Ianelli at Palisades Park, Santa Monica, California. He is wearing Norton Point sunglasses, a product made from ocean plastic. Oceanworks is a successful environmentally sustainable company that has created a pioneer marketplace for transforming ocean plastic waste into stylish consumer products.

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