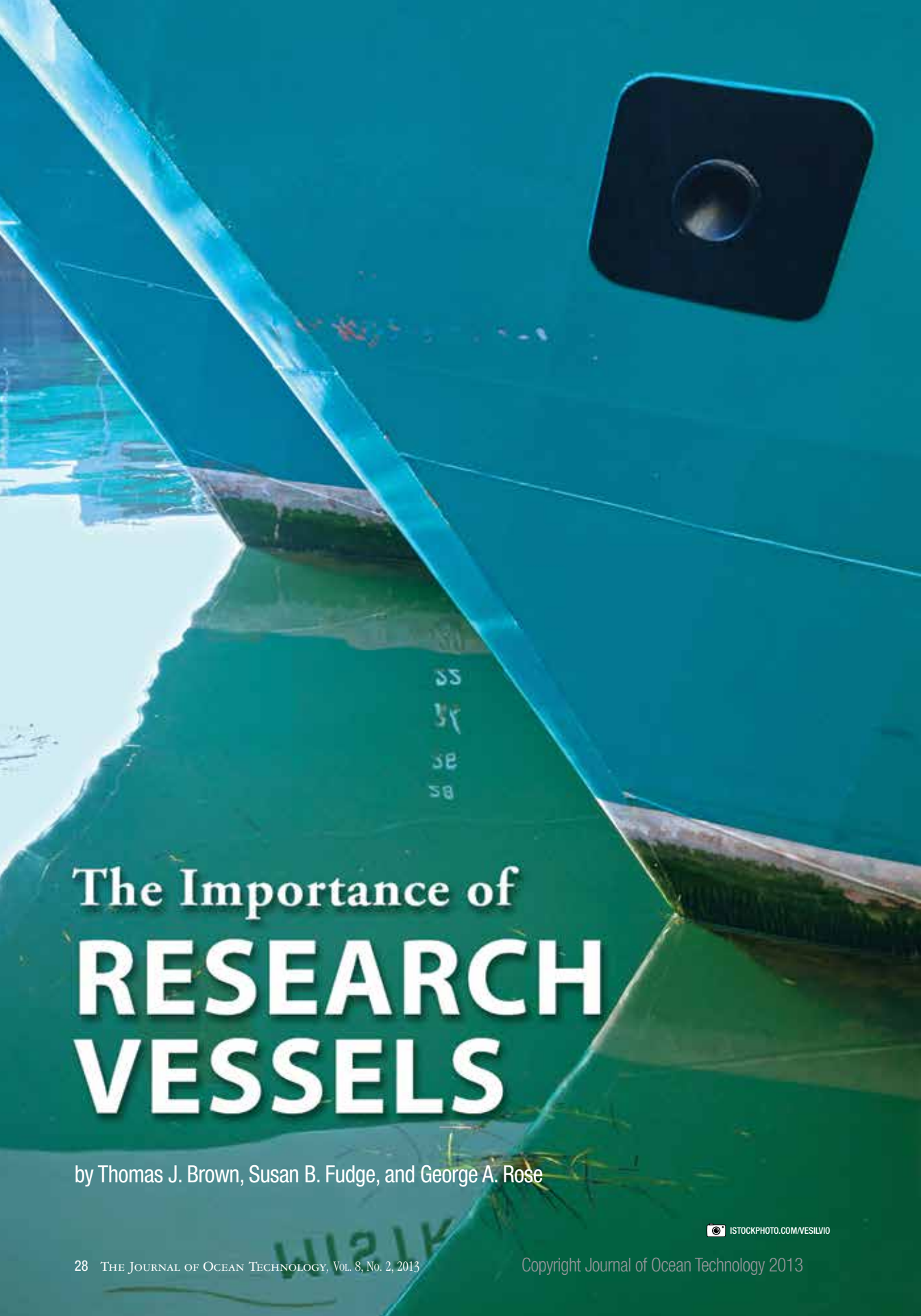

The Importance of RESEARCH VESSELS

by Thomas J. Brown, Susan B. Fudge, and George A. Rose

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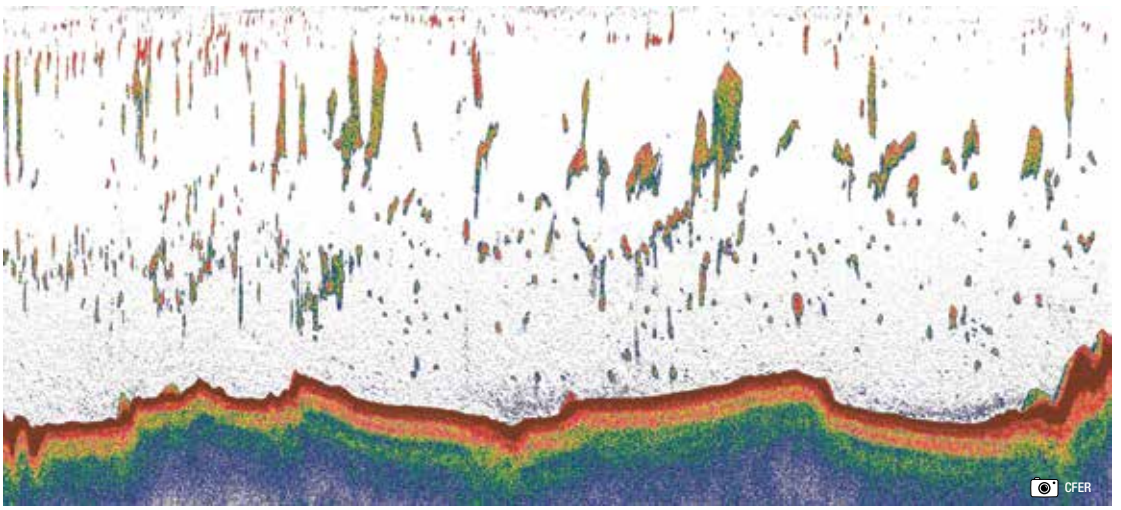
The ocean covers almost three-quarters of the Earth's surface – some have said the planet should be called Ocean and not Earth – and all life on Earth is linked to the sea. From our evolutionary roots to the present day, the human link to the ocean has been one of dependence. Oceans became transport highways, their natural resources harvested for food for subsistence and later commercial use, and more recently again for exploitation of nonrenewable resources such as oil and gas and perhaps, in the near future, undersea mining. As stewards of these vast resources, our record can easily be questioned. Tales of overfishing are well known, but perhaps of more importance, the oceans have become dumping sites for garbage and effluents, highlighted by the extensive trash patches in the Pacific Ocean and Sargasso Sea, where millions of tons of plastic and discarded refuse swirl in giant eddies. Lesser concentrations of the same stuff are present in all of the world's oceans.

The oceans are much more important to our future than is outer space, although budgets do not reflect this. We have been slow to acknowledge their importance and the interacting, potentially degrading effects of over fishing, resource exploration, pollution and climate change. It is surprising to note, especially given our dependence, that only 1% of our oceans are protected in some form from human use.[1] But times are changing. In the last 30 years or so we have begun to understand what human activity has been doing to the oceans.[2] Of particular concern, the opening Arctic Ocean covers approximately 30 million square kilometres and includes eight surrounding seas where natural resources are plentiful and much of the world's undiscovered petroleum reserves occur.[3] As temperatures rise, opportunities for new transportation routes, mineral resource development and fisheries will increase. Maintaining the integrity of these sensitive northern ecosystems will require a new level of research and much more effective international stewardship.

The lack of wise stewardship of our oceans comes with a cost. The oceans are critical to the Earth's carbon and water cycles, and to regulating climate and weather systems. The oceans host an estimated 250,000 species,[4] with phytoplankton producing half of the world's oxygen through photosynthesis. Over the past 200 years, escalating during the industrial revolution, carbon dioxide and other greenhouse gases have been pumped into the atmosphere. The result has been rapid warming of the oceans. Melting polar ice caps cause sea levels to rise. Weather patterns appear to be changing, with increased rainfall in some



Echogram of capelin from the May 2012 survey on the *Celtic Explorer*. Note that the resolution found in this echogram could not be achievable on a normal research vessel. The *Celtic Explorer* meets recommendations for radiated noise as per the ICES 209 Cooperative Research Report.

The Norwegian Institute of Marine Research's *G.O. Sars* is built to be super-quiet so as to have minimum impact on the sea and creatures being studied.

regions but drought in others. Super storms may become more frequent. Climate change will also have significant impacts on marine ecosystems and the economic and social systems that depend on them.[5] The oceans are becoming more acidic, impacting coral reefs and crustaceans dependent on less acidic seas. Species distribution and abundance, growth rates, reproductive potential and survival are all potential candidates for change,[6] with trophic and food web alterations affecting commercial fisheries in various ways, some predictable, some not. Sustaining productivity in world fisheries and conserving biodiversity in the world's oceans will require investment in research to assess the changes to come, and how best to deal with them.

So Why Do We Need Research Vessels?

The answer is really quite simple. If we accept that better knowledge about the state of the oceans is required to guide ocean policies,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then modern research vessels are mandatory. Years ago a research vessel might have been any boat from which scientists conducted research, but this no longer holds. The modern research vessel is a scientific lab designed to measure the ocean waters, plankton and fish communities and the seabed beneath. It is equipped with near as much technology as a space station (although much less expensive) and, unlike ships of old, is purpose-built to have minimum impact on the sea and creatures being studied. Many are built to be super-quiet so as not to disturb the fish they are measuring. These include research vessels such as the Irish Marine Institute's *Celtic Explorer*, or the Norwegian Institute of Marine Research's *G.O. Sars*, and other research vessels in countries as diverse as the United States of America, Russia, France, Japan, New Zealand, Spain, South Africa, Mexico and the United Kingdom. These vessels work year-round gathering information on the state of the oceans and fish stocks and conducting many other aspects of marine research. Without them, there would be virtually no monitoring of fish stocks, no mapping of the ocean, and little of the research required to manage fisheries and regulate human impacts on the ocean.

Although Dr. Robert Ballard's locating of the *Titanic* is well known, more mundane mapping of the seafloor and its structures (including shipwrecks) has become a major occupation of many vessels using multibeam sonar. It would be wrong to assume, nevertheless, that research vessels are the centrepieces of all ocean research. Other so-called 'vessels of opportunity' or commercial vessels are sometimes employed in research, and mooring systems and remote sensing from satellites enable time and space sensitive observations that research vessels cannot provide. But even in these cases, research vessels are often used in the work; for example, to calibrate commercial vessels or deploy moorings at exact locations. All in all, there are over 800 research vessels currently operating around the world, ranging in length from <40 metres to >70 metres. Unfortunately, the number of cruises has declined from approximately 1,700 in 2001 to 660 for 2010,[7] and many of these vessels are reaching the end of their normal service period. Their continued service and use of new technologies is essential to improving the state of our oceans.

Research conducted at sea and on research vessels also helps keep scientists in touch with the seas they study. Without that, there is a risk of becoming solely "keyboard scientists," who never experience or have direct contact with their objects of study, or, on a more personal

The Centre for Fisheries Ecosystems Research (CFER) team on the trawl deck of the RV *Celtic Explorer* during the 2012 Newfoundland and Labrador fisheries and oceanographic research survey. During this survey the CFER team collected 4,500 nm of acoustic data, numerous biological samples, and oceanographic data that has contributed to Canadian stock assessment processes and seven graduate student projects. This could not have been done without a research vessel with the capabilities of the *Celtic Explorer*.

level, feel the power of the sea or taste the salt on their lips. Good decisions often take more than knowledge, but acquired wisdom, with the latter being "a hard-won property, and one unlikely to be garnered at the keyboard."[8]

The Centre for Fisheries Ecosystems Research (CFER) at the Marine Institute of Memorial University sets itself apart in that we have implemented at-sea research and training as a centrepiece of opportunities for future scientists through the use of research vessels.[9]

In summary, learning to become better stewards of the ocean and to use its resources sustainably are among the largest international imperatives of the 21st century. We need to learn from and on the sea, and to do this we need research vessels.

PS ... could Captain Kirk have boldly gone where no one had gone before without the Starship Enterprise*? We think not!* ≈

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Thomas J. Brown holds a Bachelor of Science (Honours) in biology and a master's degree in fisheries resource management from Memorial University. After graduation, he obtained contractual employment as an aquaculture project officer with Fisheries and Oceans Canada, and went on to become Newfoundland operations manager for Tavel Limited, a dockside grading company. In October 2003, Mr. Brown accepted the position of Assistant Director of the Centre for Aquaculture and Seafood Development with the Fisheries and Marine Institute of Memorial University. In 2010 he played an integral role in the development and creation of the Centre for Fisheries Ecosystems Research at the Marine Institute and has since become Administrative Director of the Centre.

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George A. Rose has worked in the Newfoundland and Labrador fisheries for almost 30 years. He was the Natural Sciences and Engineering Research Council of Canada Chair of Fisheries Conservation at the Marine Institute prior to becoming Director of the Centre for Fisheries Ecosystems Research (CFER). Dr. Rose obtained his Doctor of Philosophy from McGill University focusing on the Labrador fisheries, a Master of Science from Laurentian University, and a Bachelor of Science (agriculture) in fisheries management from the University of Guelph. He has worked for provincial, federal and international fisheries organizations. Dr. Rose has published more than 100 papers on the North Atlantic fisheries, an award winning book on the Newfoundland and Labrador fisheries ecosystems, and is currently editor-in-chief of the international journal *Fisheries Research*.