OCEAN NETWORKS CANADA

ANNUAL REPORT APRIL 1 2012 - MARCH 31 2013

DISCOVER THE OCEAN. UNDERSTAND THE PLANET.

oceannetworks.ca

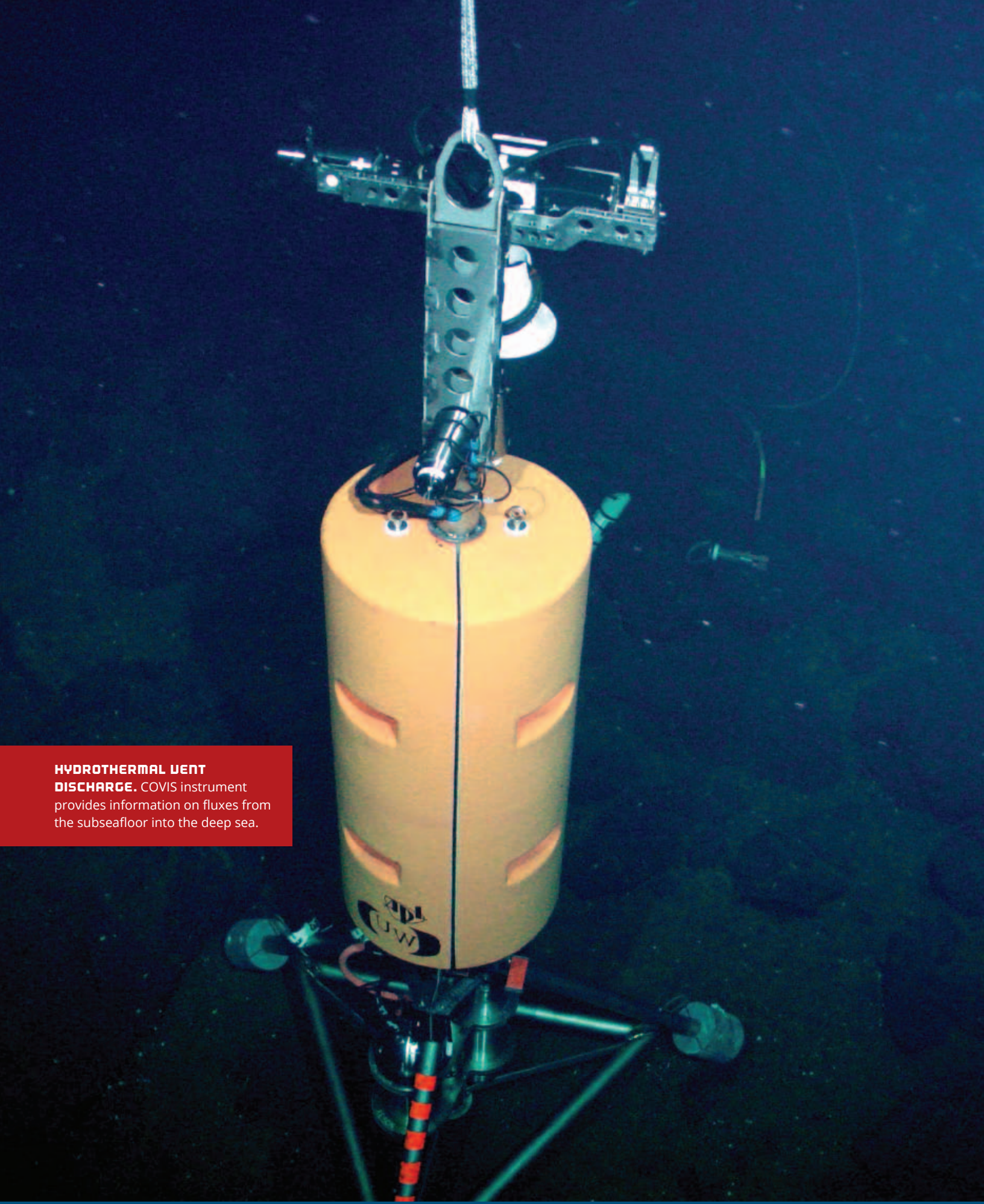
AN INITIATIVE OF University of Victoria

FRASER RIVER PLUME. During spring freshet, muddy silt-laden waters of the Fraser River form a front with salty, clear waters in the Salish Sea.

OCEAN NETWORKS CANADA

DISCOVER THE OCEAN. UNDERSTAND THE PLANET.

Annual Report
April 1 2012 - March 31 2013



HYDROTHERMAL VENT DISCHARGE. COVIS instrument provides information on fluxes from the subseafloor into the deep sea.

CONTENTS

THE OC

The ocean, covering more than 70% of Earth's surface, provides food and resources to mankind, moderates our climate, and is our major planetary life support system.

Ocean Networks Canada's focus is on observing our ocean planet to elicit new discoveries, understand its rich and diverse life–from bacteria to whales, study the dynamics of this vast world above and below the seafloor, and learn how Earth's climate change is impacting the ocean and, in turn, our lives.

Our mission is to enable ocean observatory research for the advancement of science and technology and for the benefit of Canada. Enabling this critical research also serves to generate sustainable solutions for managing food and energy so crucial for supporting society and the economy, and the multiple human uses of the ocean–from transportation to tourism to conservation. We are also committed to solutions consistent with maintaining the ocean's biodiversity and unique seascapes that will ensure a very long continuation of humankind on Earth.

The excellent research enabled by Ocean Networks Canada gives rise to commercially-driven innovations that deliver smart ocean solutions and places our industry partners in a globally competitive position.

Bottom node attracts marine life.

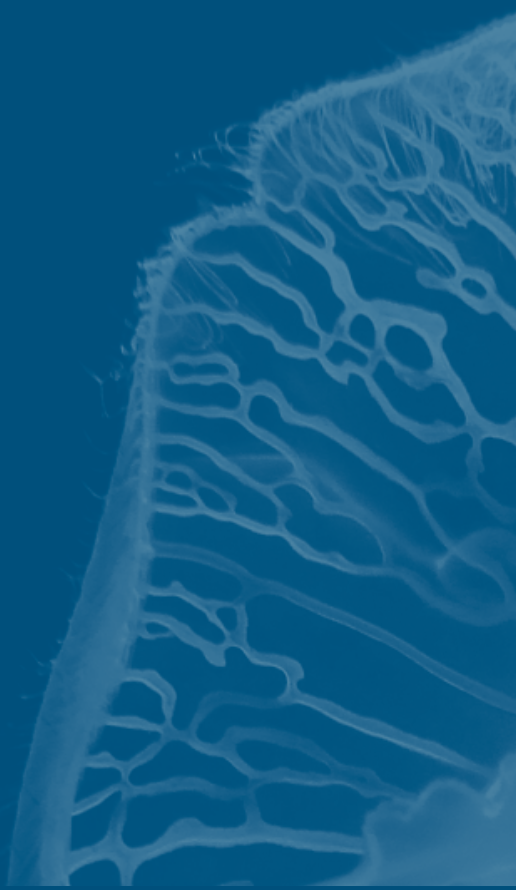
BOARD OF DIRECTORS' MESSAGE

Ocean Networks Canada (ONC) operates world-leading ocean observatories for the advancement of science and the benefit of Canada. The cabled observatories, NEPTUNE and VENUS, collect data on physical, chemical, biological, and geological aspects of the ocean over long time periods, supporting research on complex Earth processes in ways not previously possible. The creation of the observatories was funded largely by the Canada Foundation for Innovation (CFI) and the Province of British Columbia; operating and maintenance costs are being funded similarly, with the CFI contribution coming through the Major Science Initiatives (MSI) program.

An important aspect of all research, especially Canada's four large MSI facilities, is to explore opportunities for engagement beyond the research community itself, in particular relating to the commercialization of research results and of the unique technologies and infrastructure employed to obtain them. ONC is fortunate to have received special funding to address this challenge through the creation of the Ocean Networks Canada's Centre for Enterprise and Engagement (newly renamed the ONC Innovation Centre)—one of Canada's Centres of Excellence for Commercialization and Research.

This past year, Kate Moran's first as President and CEO, saw an expansion in ONC's observatories, including the creation of a mini-observatory in Cambridge Bay, Nunavut, as well as numerous technical demonstrations and other international and domestic outreach activities by the Innovation Centre. One of the most noteworthy undertakings for the year, however, was a rationalization of staff responsibilities and reporting relationships reflecting the greater degree of integration of NEPTUNE, VENUS and Innovation Centre activities. On behalf of the Board, I would like to acknowledge the significant contribution of Kate and her senior management team in undertaking this reorganization, and also the flexibility and commitment shown by all staff in adapting to the new organization and in working to make it better serve the needs of ONC's users and stakeholders.

A second major undertaking for the year was the development of a new strategic plan for the years 2013-18, reflecting the vision and needs of ONC's science communities as captured by our science and user committees and the International Science Advisory Board. The ONC Board would like to thank the participants in this process for all their hard work over the year.



Looking ahead to 2013-14, two major challenges for the Board and for ONC both relate to funding, with the Innovation Centre's support coming up for possible renewal and the contribution of the Province of British Columbia towards the operating costs of the observatories coming to an end. Planning has been underway on both fronts for several months.

In these brief remarks from the Board it is customary to close by offering congratulations and thanks to departing Board members, the President and CEO and the ONC senior management team, indeed to all ONC staff, for their respective contributions to the achievements of the past year. As well as reiterating these heartfelt words of thanks for 2012-13, I would also like to make special mention of the tremendous support that ONC has received from former UVic President David Turpin over the past seven years, indeed from before the organization was even created. Dave was the truest friend ONC ever had, and we wish him every success in the next phase of his career.

Andrew Bjerring
Chair, Ocean Networks Canada Board of Directors

PRESIDENT'S MESSAGE

Ocean Networks Canada has undergone some major transformations in the 2012/13 fiscal year. The year started with a major cheer when we learned of the success in our bid for the five-year Canada Foundation for Innovation Major Science Initiative (MSI) funding. This places ONC as one of only four MSI's in Canada to receive this award, which represents a new step forward for Canada–significant operations and maintenance funding that will keep Canada and British Columbia at the global forefront of ocean observing.

In June, after five dedicated and productive years at the helm of ONC, Martin Taylor stepped down to go back to his academic roots. Martin established one of the best and most robust governances for a research not-for-profit in the country. He set the course and steered us to success with the Canada Foundation for Innovation. All of us at ONC are sincerely thankful to Martin for his hardwork, generosity, kindness, and the steadfast direction he gave to us.

Martin turned the reins over to me in July, and I am honoured to be selected by the ONC Board to fill his shoes. I hope to continue to move ONC along the track of success that Martin began.

At the beginning of my tenure, I worked with the executive staff and the Board on a new organization for ONC that would bring together in synergistic divisions, the functions of VENUS and NEPTUNE. By the end of this year, we completed major aspects of the major change for which the details are described under Governance & Management in this report.

The spring and summer months were busy with successful shipboard expeditions to maintain both the VENUS and NEPTUNE observatories. A new approach to link the scientific and broader audiences to our exciting ocean adventures proved successful with the launch of the web portal "Wiring the Abyss 2012", which allowed anyone to view our at-sea operations live over the internet.

Scientists using both VENUS and NEPTUNE continue to demonstrate our unique research capabilities with 50 new publications ranging from the study of tsunamis to undersea landslides to gas hydrates to how life responds to low oxygen waters. We continue to support this multitude of disciplinary communities through one-on-one communication, new digital infrastructure data products (Oceans 2.0), topic-focused workshops, and at conferences.

Our reach was extended beyond the northeast Pacific this year with the installation of a mini-observatory in Cambridge Bay, Nunavut. This new arctic observatory includes some of our standard oceanographic sensors, but also an upward looking ice thickness profiler, provided by one of our industry partners.

But this year was not without its challenges. The second NEPTUNE operations and maintenance expedition was cancelled due to a major propulsion failure in the ship we were scheduled to use. This caused a major delay in servicing primary sensors at Endeavour. The VENUS Strait of Georgia array was shutdown by a failure at one of the nodes and remained out of commission for six months.

ONC's Innovation Centre showcased the Canadian marine industry at international trade shows, which opened up lucrative opportunities to them; engaged international partners who plan to use Canadian observatory technology to build new ocean observatories, established strong relationships with Canadian marine industry with the use of the observatories as technical demonstration platforms; and expanded ONC's education and public engagement reach with a new Ship2Shore program, ocean-related curricular materials, and partnerships with three aquaria located across the country.

All indications are that 2013/14 will be another good year for Ocean Networks Canada, ocean research, and expanding the broad range of users of these advanced observatories.

We are grateful for the generous support we continue to receive from the Canada Foundation for Innovation, Government of British Columbia, National Centres of Excellence, Natural Sciences and Engineering Research Council of Canada, Western Economic Diversification, and Canada's Advanced Research and Innovation Network.

Kate Moran
President & CEO

GOVERNANCE

ONC BOARD MANDATE

- facilitate research on current and future observatories;
- promote oceans-related research and enhance oceans-based research capacity at the University of Victoria and at the pan-Canadian partner universities;
- promote ocean-based public engagement and dissemination;
- cooperate with national and international research organizations with similar interests;
- promote the cooperation of academia, government and industry in ocean research;
- apply for grants and conduct fund-raising projects related to oceans observatory research;
- acquire and hold property, both real and personal, for the furtherance of the purposes of the Society; and
- conduct related activities that will promote the purposes of the Society

As steward of major subsea observatories that enables frontier research in ocean and earth sciences, ONC has developed, over time, a comprehensive governance and management system tailored to nurture and protect its assets, foster partnerships, and enhance the research outcomes and impacts.

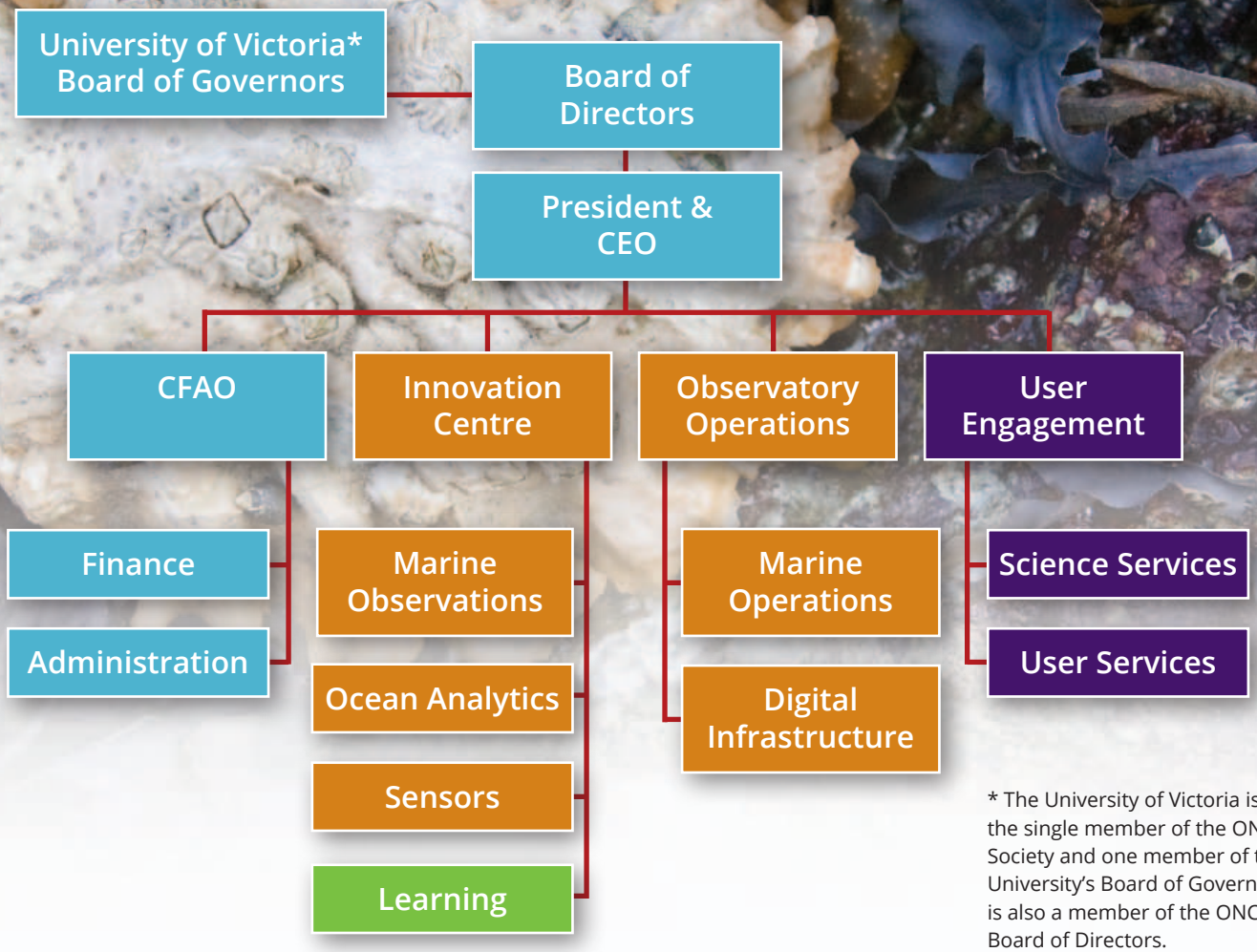
Recognizing the scale, scope, life-span, and international user community, ONC was created by the University of Victoria in 2007 as a not-for-profit society under the British Columbia Societies Act to provide dedicated governance and management of this world-leading ocean observatory.

As prescribed by the ONC Society by-laws and with Andrew Bjerring continuing as Chair, the Board of Directors met four times in this fiscal year, one of which was combined with a full day of strategic discussions.

The Board of Directors interacts with the University through a Joint Monitoring Committee (JMC). This Committee's mandate is to ensure sufficient communication between the University and ONC with respect to the operation of the VENUS and NEPTUNE. As usual, the JMC met quarterly where they reviewed ONC submissions to the University of Victoria Board of Governors, discussed new ways for ONC administration and finance to work together, and resolved issues that arose.

The International Science Advisory Board that advises the President on science strategy and international relationships, met in June and provided guidance on ONC's strategic and science plans as well as ways for ONC to collaborate internationally. NEPTUNE and VENUS have three advisory committees: NEPTUNE Science Planning; NEPTUNE Users; and VENUS Users Advisory. These committees met multiple times this year to provide user and scientific advice to ONC management.

GOVERNANCE AND MANAGEMENT STRUCTURE



* The University of Victoria is the single member of the ONC Society and one member of the University's Board of Governors is also a member of the ONC Board of Directors.

ONC BOARD OF DIRECTORS

- Andrew Bjerring, Board Chair
- Howard Brunt, University of Victoria
- Martha Crago, Dalhousie University
- David Fissel, ASL Environmental Sciences Inc.
- Louis Fortier, Laval University
- Bud Graham, Board Vice Chair
- Gayle Gorrill, University of Victoria
- Larry Mayer, University of New Hampshire
- Kate Moran, ONC President & CEO
- Christopher Loomis, Memorial University of Newfoundland
- Charles Randell, President & CEO, C-CORE
- Jim Roche, President & CEO, CANARIE, Stratford Managers Corp.
- Beverly Van Ruyven, University of Victoria Board of Governors
- David Vogt, University of British Columbia
- Wendy Watson-Wright, UNESCO-IOC
- Alan Winter, President & CEO, Genome British Columbia

MANAGEMENT

Management responsibility for ONC is vested with the ONC President and CEO. A new management structure was established this fiscal year that reflects the reorganization. The reorganization brings together the previously separate functions within VENUS and NEPTUNE under new Divisions: Finance and Administration, User Engagement, Observatory Operations, and Ocean Innovation.

In January, Verena Tunnicliffe stepped down from her leadership position as Director, VENUS. Verena played major leadership roles in the development of NEPTUNE and conceptualized, developed, brought funding to, built, and successfully operated ONC's VENUS observatory. Her vision, persistence, scientific excellence, and dedication not only to science, but also to her staff, made her one of the very few world leaders in cabled ocean observatories. We look forward to working with Verena as a leading ONC scientific participant.

Instruments deployed in a sealed Ocean Drilling Program borehole and connected to the NEPTUNE observatory collect continuous data.

ONC MANAGEMENT LEADERSHIP

Chief Scientist

DR. KEN DENMAN

Ken joined the ONC team in January 2011 to broaden and develop new collaborations with other scientists and organizations in Canada and internationally. His personal research addresses the effects of climate change on marine ecosystems and biogeochemical cycles.

For the previous 10 years Ken worked at the Canadian Centre for Climate Modelling and Analysis on campus, before that at the Institute of Ocean Sciences in Sidney BC, and before that at the Bedford Institution of Oceanography in Dartmouth, Nova Scotia. He was a Coordinating Lead Author in the Second (1996) and Fourth (2007) Intergovernmental Panel on Climate Change assessment reports, for which the IPCC shared the 2007 Nobel Peace Prize with Al Gore. He is an elected Fellow of the Royal Society of Canada, and in a previous life, he obtained a PhD in Physics and Oceanography from UBC.

Associate Director, Science Services

DR. RICHARD DEWEY

Dr. Richard Dewey holds a B.Sc. in Physics from the University of Victoria and a Ph.D. in Oceanography from the University of British Columbia. His research interests are coastal flows, mixing, turbulence, waves, and tides. He has conducted research throughout the Pacific from Japan to California, and along the B.C., Alaskan, and Arctic coasts.

In 2001, Richard co-authored the original proposal to CFI to design, build, and install the world's next generation of ocean observing systems in the coastal waters of British Columbia, a cabled observatory called VENUS. Since then Richard has been an integral member of the VENUS, and now ONC, management teams. Richard provides scientific leadership both on land and at sea, having been the Chief Scientist on nearly 30 VENUS and ONC maintenance and exploration cruises. Richard is also an Adjunct Professor in UVic's School of Earth and Ocean Sciences. As the Associate Director of Science for ONC, Richard coordinates and helps manage the user engagement activities and science support services for the research community.

Associate Director, Finance & Administration

FERN JOHNSON

Fern Johnson joined NEPTUNE Canada in October 2003. Previously, she held positions as the Controller of Greenlight Power Technologies Inc., the Director of Operations for the Victoria Christian Education Society and various other accounting positions in the public and private sectors. Fern is a Certified General Accountant with an MBA from Laurentian University with emphasis in strategic and effective organizational planning, awarded in 2010.

As the Associate Director, Finance and Administration at Ocean Networks Canada, Fern is a member of the operations executive committee with primary responsibility for the financial management of the organization, dealing extensively with UVic accounting and purchasing staff. This also includes financial reporting to ONC managers, which forms the basis for all financial reports submitted to the ONC Board, as well as ONC's funding agencies (Canada Foundation for Innovation, BC Knowledge Development Fund, Natural Sciences & Engineering Research Council of Canada, CANARIE, and BC Ministry of Advanced Education).

Director, User Engagement

DR. KIM JUNIPER

Dr. Juniper has been a Professor in the School of Earth and Ocean Sciences and the Department of Biology at the University of Victoria, and holder of the BC Leadership Chair in Ocean Ecosystems and Global Change since 2006. He came to UVic from the Université du Québec à Montréal where he was Professor of Biology and Director of the GEOTOP Research Centre. He received his BSc from the University of Alberta (1976) and a PhD from Canterbury University in Christchurch, New Zealand (1982).

The primary focus of his research has been the biogeochemistry and ecology of submarine hydrothermal systems. His interdisciplinary publications on deep-sea vents encompass the fields of microbial ecology, biomineralization and benthic ecology.

Kim previously served the NEPTUNE Canada project as Co-Chief Scientist in 2004-2006, and was President of the Canadian Scientific Submersible Facility from 2001 to 2011. He served as Associate Director of Science for NEPTUNE Canada previous to his current role.

Associate Director, Marine Operations

IAN KULIN

Ian Kulin joined NEPTUNE Canada in January 2012 as an Associate Director for NEPTUNE Canada. The engineering teams of NEPTUNE and VENUS merged in 2013 and his present position is directing Marine Operations. Work rolls for Ian include heading up the ONC facility at the Marine Technology Centre in Sidney, BC as well as the position of Chief Scientist / Expedition Leader on multiple expeditions and maintenance cruises on vessels such as the R/V *TG Thompson*, R/V *JP Tully* and D/V *JOIDES Resolution*. Ian is a graduate of Dalhousie University (TUNS) and a LEEDS Accredited Professional Engineer. He spent the previous five years at the University of Rhode Island Graduate School of Oceanography (GSO) as an engineer on Dr. Robert Ballard's E/V *Nautilus* team and as Project Manager on the Construction and Commissioning of the Inner Space Center at GSO. GSO work included all *Nautilus* vessel upgrades, maintenance and future planning as well as development of a new instrument package for the Integrated Ocean Drilling Program. Prior to working on the Ballard team Ian worked for over 17 years managing various engineering projects in more than ten countries on three continents.

Chief Finance and Administration Officer

DUC LE

Duc Le brings a distinguished career in senior financial and administrative positions across Canada to strengthen the executive team. He joins Ocean Networks Canada from the Parkland Regional Health Authority in Manitoba, where he held the position of VP Corporate Services and Chief Financial Officer since 2009.

Mr. Le has extensive experience collaborating with senior officials in government, universities, and the private sector. Previously, he played a senior administrative role with McMaster University, helping to grow research funding, academic programming and facilities construction. Additionally, as Director of Finance and Administration for a crown corporation, he guided the strategic financial objectives for two research parks affiliated with the universities of Saskatchewan and Regina.

A Certified Management Accountant, Duc holds a BSc in Engineering from the University of Montreal, and an MSc in Economics and Finance from Queen's University.

Director, ONC Innovation Centre

SCOTT MCLEAN

Scott McLean, a professional electrical engineer, brings over 21 years of ocean technology development experience to ONC from Halifax, where he worked for eight years as chief technology officer and vice-president of research and development at a high-tech oceanographic company. Scott's areas of expertise include sensor development, observing system design and sensor integration into observing systems.

From his experience in product development from concept through to creation, Scott has the proven ability to turn partnerships and technology transfers from Canadian and international groups into successful commercial products. Scott also serves as the Business Development Officer for Ocean Observing Technology.

President & CEO

DR. KATHRYN (KATE) MORAN

Dr. Kathryn (Kate) Moran joined the University of Victoria in September 2011 as a Professor in the Faculty of Earth and Ocean Sciences and as Director of NEPTUNE Canada. In July, 2012, she was promoted to the position of President & CEO, Ocean Networks Canada. Her previous appointment was Professor at the University of Rhode Island with a joint appointment in the Graduate School of Oceanography and the Department of Ocean Engineering. She also served as the Graduate School of Oceanography's Associate Dean, Research and Administration. From 2009 to 2011, Moran was seconded to the White House Office of Science and Technology Policy where she served as an Assistant Director and focused on Arctic, polar, ocean, the Deepwater Horizon oil spill, and climate policy issues.

Kate holds degrees from the University of Pittsburgh, the University of Rhode Island and Dalhousie University. Her research focuses on marine geotechnics and its application to the study of paleoceanography, tectonics and seafloor stability.

Associate Director, Digital Infrastructure

BENOÎT PIRENNE

Benoît Pirenne is Associate Director, Digital Infrastructure, at Ocean Networks Canada. He joined NEPTUNE Canada in October 2004 after having spent about 18 years at the European Southern Observatory (ESO), a leading organization for astronomical research where he assumed a number of scientific and technical (IT) positions in the area of data management.

Now at the University of Victoria, Benoît heads the Digital Infrastructure (DI) department that builds and operates "Oceans 2.0", the data management and archiving system for ONC. Oceans 2.0 comprises in the software and systems infrastructure necessary to link world-wide user communities to the NEPTUNE Canada and VENUS observatories.

Benoît holds a Masters degree in Computer Science from the University of Namur, Belgium (1986) and graduated in Computer Science from the Institut St-Laurent in Liège, Belgium in 1983.

Director, Observatory Operations

ADRIAN ROUND

A graduate of Royal Military College in Kingston, Ontario, with a BEng Electrical, Adrian Round, OMM, MSc completed a full career in the Canadian Navy. Over his 26 years in uniform, he served in a number of sea-going and shore command appointments including the Commanding Officer of HMCS ALGONQUIN and the Base Commander of Canadian Forces Base Esquimalt.

In 2002, Adrian retired from the Canadian Forces and in March 2003 joined the VENUS Project as the Project Manager. For 9 years he led the design, construction and operation of VENUS Coastal Network, an ocean observatory using fibre optic cables in the waters around Victoria. In January 2013 he assumed his current role as Director, Observatory Operations for ONC.

ONC COMMITTEE MEMBERS

INTERNATIONAL SCIENCE ADVISORY BOARD

Mark Abbott
Dean, College of Oceanic and Atmospheric Sciences at Oregon State University

Susan Avery
President and Director of Woods Hole Oceanographic Institution

Marcel Babin
Canada Excellence Research Chair in Remote Sensing of Canada's New Arctic Frontier, Université Laval

Kendra Daly
Associate Professor, College of Marine Science, University of South Florida

Bruce Howe
Research Professor at Ocean and Resources Engineering, University of Hawaii

David Martin
Associate Director and Principal Oceanographer, Advanced Physics Laboratory, University of Washington

Tim Moltmann
Director of Australia's Integrated Marine Observing System, University of Tasmania

Henry Ruhl
Project Manager, UK National Oceanography Centre

Kiyoshi Suyehiro
President, Integrated Ocean Drilling Program, Japan

Frank Vernon
Deputy Director, Ocean Observatory Initiative, Cyber-infrastructure Program, Scripps Institution of Oceanography, University of California San Diego

Bob Weller
Principal Investigator, Global and Coastal Scale Nodes, Ocean Observatory Initiative, Woods Hole Oceanographic Institution

NEPTUNE SCIENCE ADVISORY COMMITTEE

Susan Allen
Associate Professor Mesoscale Dynamics of Ocean and Atmosphere , University of British Columbia

James Boutillier
Research Biologist, Shellfish Section, Fisheries and Oceans Canada

David Farmer
Dean Emeritus, Graduate School of Oceanography, University of Rhode Island

John Hildebrand (chair)
Scripps Institution of Oceanography University of California San Diego

Debbie Ianson
Research Scientist, Ocean Climate Modelling , Fisheries and Oceans Canada

Sally Leys
Associate Professor and Canada Research Chair in Evolutionary Developmental Biology , University of Alberta

Anna Metaxas
Professor, Department of Oceanography , Dalhousie University

Garry Rogers
Head, Earthquake Hazards West, Geological Survey of Canada, Natural Resources Canada, Pacific Geoscience Centre

Peter Rona
Professor of Marine Geology and Geophysics Institute of Marine and Coastal Sciences and Department of Earth and Planetary Sciences, Rutgers University

Paul Snelgrove
Associate Professor; Canada Research Chair in Boreal & Cold Ocean Systems, Ocean Sciences Centre, Memorial University of Newfoundland

NEPTUNE USER COMMITTEE

David Butterfield
Scientist, Joint Institute for the Study of Atmosphere and Ocean University of Washington and NOAA Pacific Marine Ecology Laboratory

Ross Chapman
Professor Emeritus, School of Earth and Ocean Sciences University of Victoria

Earl Davis
Scientist, Geological Survey of Canada, Natural Resources Canada, Pacific Geoscience Centre

Nigel Edwards
Professor Emeritus, University of Toronto

John Ford
Scientist, Pacific Biological Station, Fisheries and Oceans Canada

Sally Leys (Chair)
Associate Professor and Canada Research Chair in Evolutionary Developmental Biology, University of Alberta

Tetjana Ross
Associate Professor, Department of Oceanography, Dalhousie University

Ron Tanasichuk
Research Biologist, Pelagics Section, Fisheries and Oceans Canada

Rick Thomson
Physical Oceanographer, Institute of Ocean Sciences

William Wilcock
Marine Geophysicist School of Oceanography, University of Washington

Together with the ONC Board of Directors, the total number of volunteer hours from the ONC Committee Members totaled 1600.

VENUS USERS ADVISORY COMMITTEE

Jay Cullen
Associate Professor, School of Earth and Ocean Sciences, University of Victoria

Alex Hay
Killam Professor of Oceanography, Dalhousie University

Gwyn Lintern
Scientist, Geological Survey of Canada, Natural Resources Canada, Pacific Geoscience Centre

Rich Pawlowicz (Chair)
Associate Professor, Physical Oceanography, University of British Columbia

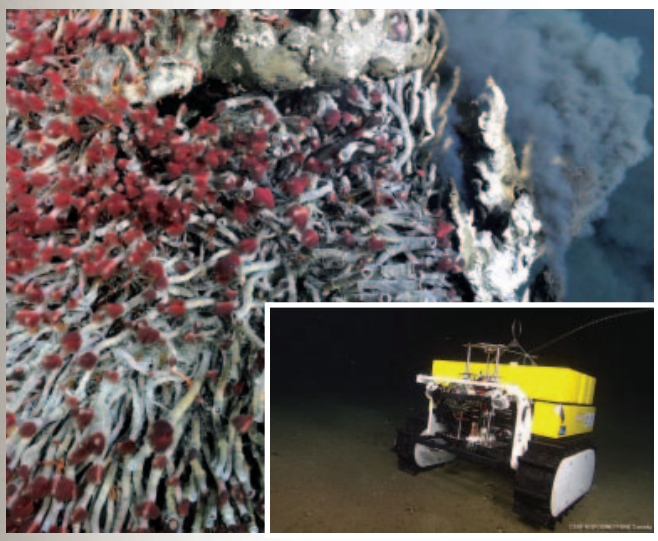
Angelica Peña
Scientist, Institute of Ocean Sciences, Fisheries and Oceans Canada

Mark Zacharias
Assistant Deputy Minister, BC Ministry of Environment

"We applaud Ocean Networks Canada for providing Canadians across the country with the opportunity to participate first-hand in ocean observations. The discoveries people will make while investigating the on-line data, images, video and acoustics will be a tremendous benefit to ocean science."

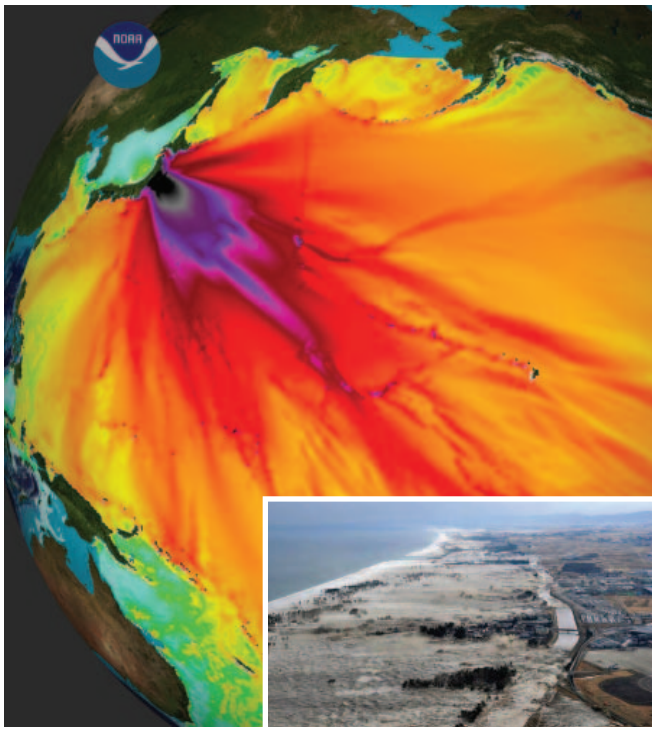
- John Nightingale, President, Vancouver Aquarium

RESEARCH HIGHLIGHTS



STUDIES OF GAS HYDRATE OUTCROPS WITH AN INTERNET-CONTROLLED BOTTOM CRAWLER

Instruments at an Ocean Networks Canada node in Barkley Canyon on the continental slope indicate high concentrations of gas hydrates at and beneath the subseafloor. If seawater temperatures warm, these hydrates will sublimate (transform from solid phase to gas), permitting methane—a potent greenhouse gas—to escape from the seafloor into the water column and potentially into the atmosphere. Data from Wally, an Internet-controlled seafloor crawler connected to the Barkley Canyon node by a 70 m tether, combined with current meter measurements, indicate that methane release increases when bottom currents strengthen, such as during storms, which may be increasing in frequency due to climate change.



TSUNAMI STUDIES

Bottom pressure recorders developed at the Natural Resources Canada Pacific Geoscience Centre are part of a tsunami array deployed on the NEPTUNE observatory that stretches from the deep ocean to the inner continental shelf. This real-time tsunami monitoring system captured signals from the September 2009 Samoan (Mw = 8.1), February 2010 Chilean (Mw = 8.8), and April 2011 Tōhoku (Mw = 9.0) earthquakes and tsunamis. Calculations allowed precise determination of tsunami wave speed, direction, and amplitude. The ability to assimilate open-ocean data from the cabled observatory into an operational tsunami forecast model makes it possible to provide updated wave time and height information that could help mitigate the impact of future tsunamis approaching the west coast of British Columbia.

SEDIMENT AND BENTHIC DYNAMICS

Time series of sonar scans of bottom sediment in Barkley Canyon, Saanich Inlet and the Strait of Georgia show depressions or pits and resuspension events that come and go over time scales of weeks to months. Camera images suggest that benthic flatfish form these pits. These flatfish and other bottom sea creatures can resuspend the surface sediments, completely turning over the surface layer within 100 days. Observations demonstrate that animals are important contributors to sediment mixing (bioturbation), which liberates nutrients back into the water column where they can support plankton growth. Tidally forced resuspension and transport at the base of the Fraser River Delta is critical for the redistribution of seasonal deposits from the sediment laden freshet. Continued long-term monitoring will enhance understanding of the response of benthic and water column ecosystems to changes in near-bottom turbulence and bed-stress.

ECOSYSTEM FUNCTION

Marine sediment ecosystems cover more of Earth than all other habitats combined, contributing significantly to global nutrient cycles, carbon and oxygen budgets, pollutant dynamics, and fisheries production (seafloor species comprise $2.5 billion of the $3 billion in total export value of Canadian fisheries). Ocean Networks Canada benthic ecology research combines camera observations and interactive sampling with sediment traps and data from multiple sensors collecting uninterrupted measurements of temperature, oxygen, and nitrate. Results from Saanich Inlet show that taxon richness (a measure of biodiversity) correlates with oxygen concentration, indicating that, as hypoxia (low oxygen) increases, low diversity, hypoxia-tolerant species of low commercial significance will dominate benthic communities on the continental shelf.

MARINE MAMMALS

Underwater sound from human activities affects the physiology and behavior of marine fauna. Ocean Networks Canada employs hydrophones to assess the large-scale acoustic ecology in the Strait of Georgia, near the mouth of the Fraser River, and on the NEPTUNE array off the west coast of Vancouver Island. Several whale species have been detected through recognition of their distinctive acoustic signals, including Orca, Grey, Humpback, and one interpreted to be an endangered North Pacific right whale, although there has been no visual confirmation. Ocean Networks Canada is participating in an International Quiet Ocean Experiment to establish marine soundscapes and compare underwater noise levels in a variety of oceanic environments to learn what levels can be tolerated by large mammals and how adverse levels of underwater noise affect their behaviour.

REAL-TIME VERTICAL PROFILING OF HYDROTHERMAL VENT TURBULENCE

Long time series are required to estimate heat, chemical, and biological fluxes from Earth's crust upward into the ocean via hydrothermal vents. The Cabled Observatory Vent Imaging System (COVIS) installed at NEPTUNE's Endeavour field node on the Juan de Fuca Ridge continuously measures backscatter intensity of suspended particles in black smoker plumes in three dimensions and diffuse flow from the seafloor. At this location, the ratio of upward fluxes from black smokers compared with diffuse flow is about 20 times larger than previous estimates, underlining the important contribution of black smokers to heat and materials fluxes into the ocean at seafloor-spreading centres.

DEEP-SEA FORENSIC INVESTIGATIONS

Knowing the time of death is of paramount value in any homicide investigation, but estimating elapsed time since death is difficult or even impossible after a body has been submerged in the ocean for a long time. In addition, marks on remains recovered from the ocean can easily be misinterpreted as wounds inflicted before or at the time of death, rather than as normal decay processes to a submerged carcass. Pig carcasses are commonly used as proxy for human remains in forensic research. VENUS underwater cameras are being used to study the decomposition of pig carcasses, lowered to the seafloor within both a protective cage and unprotected. Results reveal strong correlations between ocean chemistry conditions (e.g., ambient oxygen concentration) and macrofaunal scavenging (e.g., feeding by swarms of benthic amphipods) on rates of carcass degradation. This work is continuing, including the analysis of bone remains retrieved after months of in situ observations.

WIRING THE ABYSS 2012 EXPEDITION

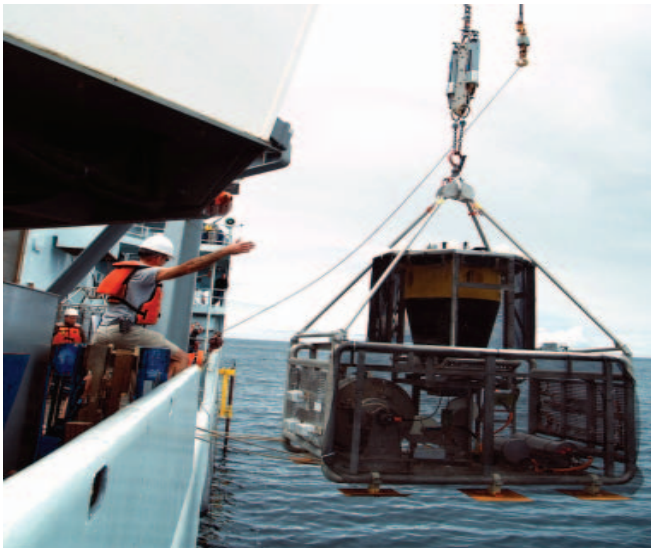
ONC conducted a total of 6 maintenance expeditions in FY12/13.

A variety of ship platforms and Remotely Operated Vehicle (ROV) systems were used to achieve the maintenance and operations goals of the NEPTUNE and VENUS observatories.

The expedition season commenced in July 2012 with a NEPTUNE maintenance cruise onboard R/V *Thomas G. Thompson* using the Canadian Scientific Submersible Facility's ROPOS ROV. Over a 29 day period, the Operations and Science teams conducted routine maintenance at all of the NEPTUNE science sites and deployed a new robotic crawler, the Vertical Profiler System and the first elements of a tsunami warning array.

August 2012 saw operations shift to a VENUS maintenance cruise onboard CCGS *Tully* with the ROPOS ROV. The VENUS Strait of Georgia array had suffered a major engineering failure at the beginning of August that forced a significant alteration to the planned expedition. The entire secondary infrastructure in the Strait of Georgia (SOG) was removed so that the main cable and nodes could be recovered. Science experiments planned for the Strait of Georgia were modified and deployed on the Saanich Inlet array.

A planned late September 2012 NEPTUNE maintenance cruise was cancelled when the R/V *Thomas G. Thompson* experienced a major engineering casualty and ONC was unable to locate a suitable replacement vessel to support the expedition.



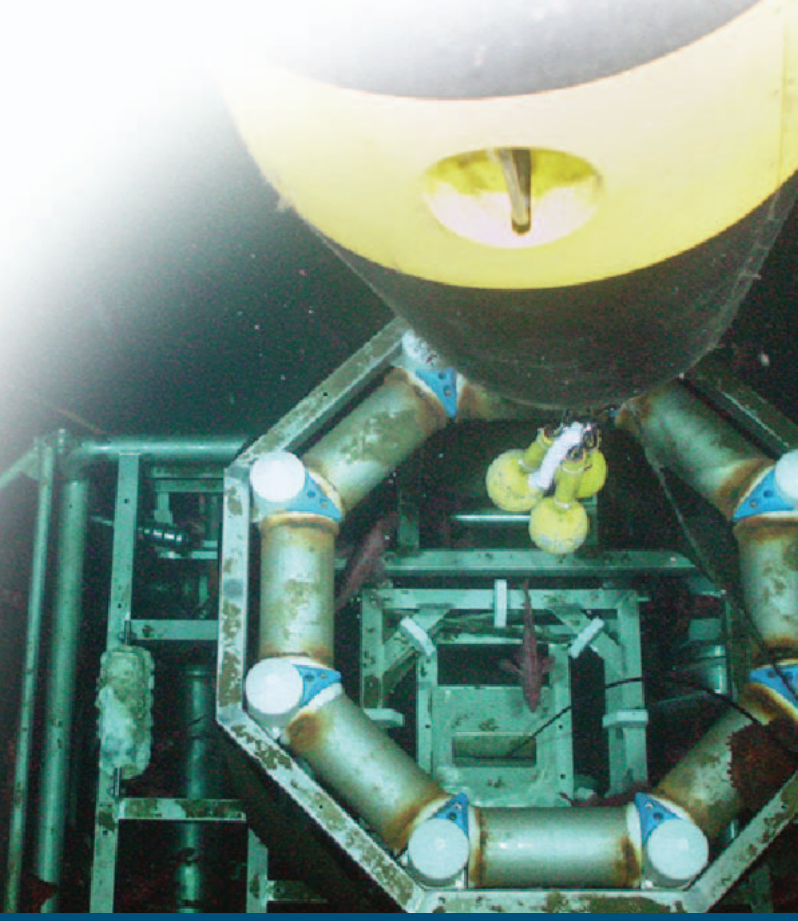
October 2012 saw the recovery of a 6 km fibre optic extension cable from the Strait of Georgia. The cable had been damaged on 4 July 2012 when an underwater event at the Fraser Delta tumbled the Delta Dynamics Laboratory platform over 200 m from its deployed position. Using the Island Tug and Barge Georgia Transporter, the cable was recovered from the seafloor and returned to the Marine Technology Centre for repairs.

November 2012 saw the completion of repairs to the NEPTUNE primary infrastructure using the Global Marine Systems' C/S *Wave Venture*. The replacement of a failed Branching Unit at the Folger Node had been started in 2011 but poor weather had prevented its completion. The Global Marine Systems Limited C/S *Wave Venture* completed the final splice and buried the cables, restoring the redundant ring architecture of the NEPTUNE observatory.

February 2013 saw the completion of the repairs to the VENUS SOG primary infrastructure using the C/S *Wave Venture*. Two node bases and 9 km of cable were recovered from the seafloor. Pressure vessels and wet-matable connectors on the node bases were replaced. The removable node pods were installed in the node bases and the array was redeployed and tested.

The Marine Operations team conducted a major test of the spare node in the newly completed test tank at the Marine Technology Centre. The test was a success and the spare node is now stored at the Marine Technology Centre.

March 2013 saw the reinstallation of the VENUS Strait of Georgia secondary infrastructure using CanPac Divers vessel *Oceanic Surveyor* and the Oceanic Explorer ROV. A variety of instrument platforms were deployed on the array and the science experiments that had been shifted to Saanich Inlet in August were recovered.



EXPANDING CAPABILITIES

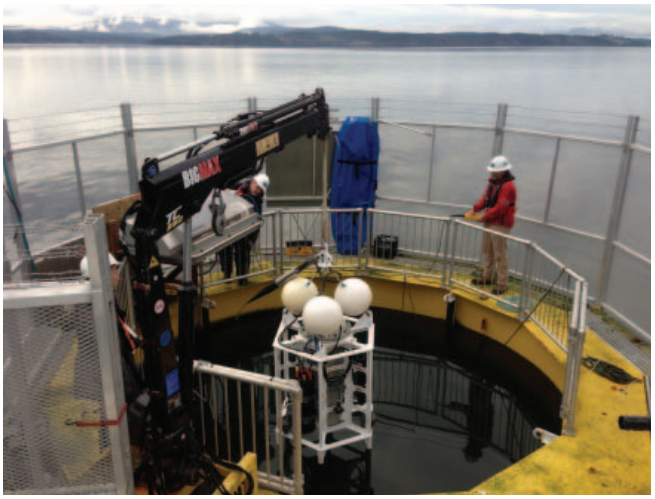
VENUS EXPANSION

ONC Operations and Science staff continued the implementation of the Canada Foundation for Innovation Leading Edge Fund expansion and upgrade of the VENUS observatory. Progress was made on a number of the instrument systems.

Two SeaSonde HF Oceanographic Radar systems were installed to monitor surface currents in the Strait of Georgia. These systems serve not only as a science research tool but can also supply valuable information to commercial marine operators and Federal government agencies.

Significant progress was made on the Buoy Vertical Profiler system. The MacArtney winch and the OceanWorks power and control systems were received and successfully integrated. The winch and control system were deployed for testing on the Ocean Technology Test Bed in Saanich Inlet. This allowed a realistic assessment of the system's performance and allowed the Digital Infrastructure team to test instrument control drivers in a deployment environment. The construction of the buoy was also completed and the fitting out process is continuing.

The first of the SeaKeeper shipboard instrumentation systems was installed in the British Columbia Ferry Corporation's M/V *Queen of Alberni*. During a planned dry-dock period, specialized hull fittings and a water sampling pod were placed on the hull of the vessel. Oceanographic and meteorological data are collected continuously as the vessel sails between Tsawwassen and Nanaimo and the resulting data are streamed to the data archive.



ONC INNOVATION CENTRE

As a follow-on to the FY09/10 substantial analysis of a large scale observing system in Cambridge Bay, the future site of Canada's High Arctic Research Station (CHARS), the Centre under the leadership of the Associate Director, Digital Infrastructure, successfully installed an ONC mini-observatory in Cambridge Bay in September.

The Innovation Centre supported Canada-Brazil relations for establishing collaborative development projects between the two countries along the theme of ocean observing. Of particular focus is establishing cabled ocean observing programs with the University of São Paulo and the Federal University of Rio de Janeiro.

The Centre provided consulting services to emerging ocean observing systems through its leveraging of the world leading ONC ocean observing technology and Canadian ocean technology industry. Proposals were submitted to EU and Asian projects that have over $10M in potential revenues to Canadian industry. Two priority projects, KIGAM in Korea and FORCE in Nova Scotia provided $427k in revenues in FY12-13 in their initial phases.

The Centre installed two industrial technology demonstration projects: pH and pCO2 sensors in Saanich Inlet for a one year evaluation. These measurements are critical for assessing the impact of ocean acidification in coastal waters. Should this evaluation prove that these Canadian sensors are stable, the companies will have a substantial head start in this growing global market.

IMPACT

SCIENTISTS & VISITORS

The number of active online users increased to almost 8000 this year and the number of data requests reached 21,500. Forty-five scientific contributions were published this year.

WEBSITE TRAFFIC

275,000

Visitor traffic to ONC's websites exceeded 275,000 this year, with just over 60% becoming returning users. These website visitors spent over 670 days accessing our websites.

180

COUNTRIES

Visitor locations were broadly distributed, with visits coming from 180 countries. The top ten countries were Canada, United States, Ukraine, Russia, China, United Kingdom, France, Germany, Spain and India.

1.6 MILLION VIEWS

You vimeo Tube

Our YouTube and Vimeo channels attracted over 1.6 million views with over 2.3 million minutes (1,650 days) spent by viewers watching Ocean Networks Canada video highlights. Top videos included *Sea Pig Slow Dance* (212,000 views), *Caged pig: Forensic experiment in the ocean* (343,000 views) and *Teen Spots Hagfish-Slurping Elephant Seal* (864,000 views).

SPENT

1,650 DAYS

35-64

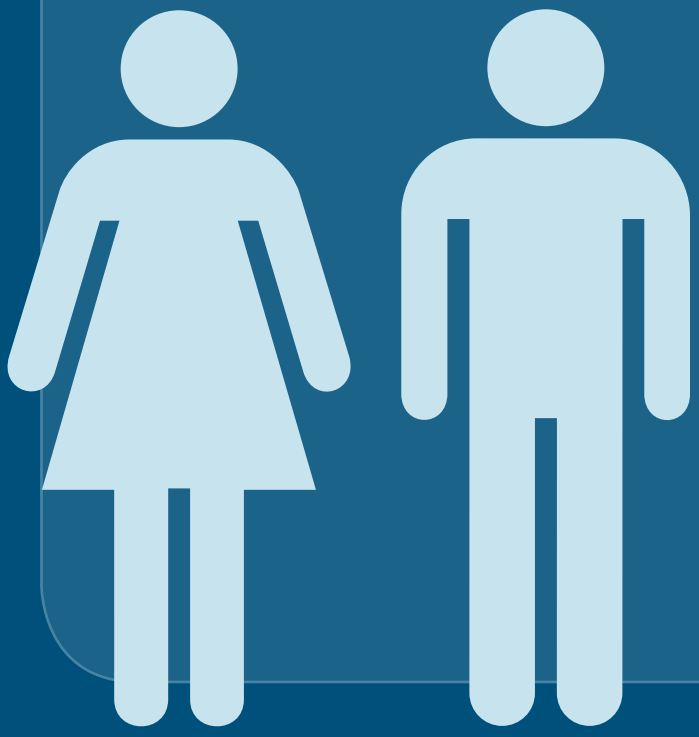
AGE RANGE OF VIEWERS

Surprisingly, the majority of viewers fell into the 35-64 age range, with over a third of views by 45-54 year olds. ONC's Flickr photo stream garnered over 65,000 views this year. Many of the 1000+ images on this channel found their way into publications and websites across the Internet.

OVER A THIRD

45-54

YEARS



65,000

flickr

VIEWS

MEDIA REACH

YOUNG CITIZEN SCIENTIST GRABS WORLD ATTENTION

A Ukrainian teenager who had never been to the ocean became fascinated with watching NEPTUNE live seafloor cameras. One day he observed something he thought might be unusual and reached out to us. We reached back...

and the resulting story of Kirill's hagfish-slurping seal was seen around the world. Ten seconds of video became a wonderful story about how everyone can be a scientist, no matter what your age, or background, or culture. Thank you Kirill, for your concern and your curiosity.

MEDIA COVERAGE

Ocean Networks Canada enjoyed consistent profile in traditional media coverage from Spring 2012 to 2013, generating over 300 stories in television, radio, newspapers, magazines and online publications.

The communications team worked strategically to integrate social media, traditional media and our most valuable tools – video, photographs and visuals – to share our technology, science and people with the world.

Working with the University of Victoria communications team media tips, news releases, pitches and advisories were prepared that put our news and opinions in front of the editors and producers and bloggers who decided what stories would reach their viewers, listeners and readers.

ONC is grateful to journalists locally, nationally and internationally for their interviews and interest. Some of these included:

- The Victoria Times Colonist, Vancouver Sun, Globe and Mail, and major dailies across Canada
- Macleans national weekly; Black Press regional papers from Nanaimo to Alberni; and Metro News
- CBC's The National, CTV news, Discovery Channel and Shaw TV
- CBC Radio Canada, The world at 6, On the Island; On the Coast; CKNW, CFAX, the Q, and National Public Radio.
- On the industry side: Sea Technology, Ocean Observing Systems and Subsea World News
- Our U Vic news networks: the Ring, Martlett, Radio CFUV and the Torch
- Online news organizations and blogs, including Yahoo and Huffington Post, phys.org; deepsea news, New Scientist and Radio Free Europe; and the Smithsonian blog.
- Science journals such as the esteemed American Geophysical Union's EOS newspaper.

The media shared ONC milestones such as: the BC Ferry system, our new electronic publications "The NEPTUNE Canada Marine Field Guide" and "An Invitation to Science", and our summer maintenance expedition on the R/V *Thompson*. Coast to coast coverage accompanied the installation of ONC's arctic mini-observatory at Cambridge Bay. Coastbuster—the new marine debris reporting app for Androids and iphones—made news from San Francisco to Anchorage and from Saskatchewan to Japan. Major news announcements including the CFI funding for operations and the Endeavour Hot Vents research expansion also made headlines.

And of course, there was the news emanating from Donetsk:

"Ukrainian Teen makes rare discovery on BC's ocean floor."

Kirill's hagfish discovery made headlines around the world. Starting with ONC's website and video story, news about this young citizen scientist intrigued people across North America, Europe and Asia. YouTube was flooded with viewers and Kirill's own channel went from tens of viewers to over 2.5 million.

Can you match some of the year's headlines with the year's accomplishments?

- The coldest darkest forensic lab on earth
- One of the Earth's Most Remarkable Places
- Ocean scientists work to improve our response to emergencies
- Deep-sea sensors to sound tsunami warning on Vancouver Island
- Batman of the deep blue sea
- Haida Gwaii quake monitored by NEPTUNE Canada
- Scientists study inlet's low oxygen
- Electronic guide offers rare glimpses of deep-sea life
- Procrastinate. Watch deep-sea videos. Help science
- Smartphone app aims to track debris from deadly Japanese tsunami
- Revealing pictures of the seafloor at Cambridge Bay
- Reducing underwater noise to help underwater marine life
- Canada's Ocean Networks humming along

Throughout the year, many different people represented our facility and observatories to the world's press. From our presidents Martin Taylor and Kate Moran; our directors, our Chief scientist Ken Denman and all our staff scientists, to our specialists and technicians and students. Thanks to all of you for sharing your "key messages" and passion.

VISITING SCIENTISTS

CHINA

Yan Li is Associate Director of the Department of Ocean Strategies and Planning, National Ocean Technology Center, State Oceanic Administration, People's Republic of China. In June 2012, she joined NEPTUNE as a visiting scholar, working with the Digital Infrastructure group. In her role as Associate Director, she helped secure over $12 million toward design and building of a test site in-situ for small scale wave and tidal current generator devices. Yan Li leads a staff of over 20 specialists and is responsible for 4 projects related to test and assessment technologies on ocean monitoring instruments and ocean energy generator devices in a tank and in the real environment.

CANADA

Dr. John Dower participated as a visiting scientist with Ocean Networks Canada in the spring and summer of 2012. His research focuses on the various ways in which interactions between biology and physics structure pelagic marine ecosystems. He has a focused research interested in the effect of physical variability on the ecology of (and interactions between) larval fish and zooplankton, and the ways in which variability in the physical environment regulates recruitment in marine fish populations. Some of his current research projects include: the population ecology of larval fish (in both coastal Newfoundland and the NE Pacific), the ecophysiology of overwintering copepods, the invasion biology of non-indigenous bivalves, and the role of Haida eddies in transporting larval fish to offshore seamounts in the NE Pacific.

SCIENTISTS AROUND THE GLOBE

ONC's current global distribution of research users of NEPTUNE and VENUS observatory data. Larger circle sizes represent a greater density of users.

LEARNING

SHIP2SHORE

The Ship2Shore educator program initiated in 2012 provides a unique opportunity for teachers to participate in ocean science and technology first hand aboard ONC maintenance expeditions and connect with students and educators back on shore.

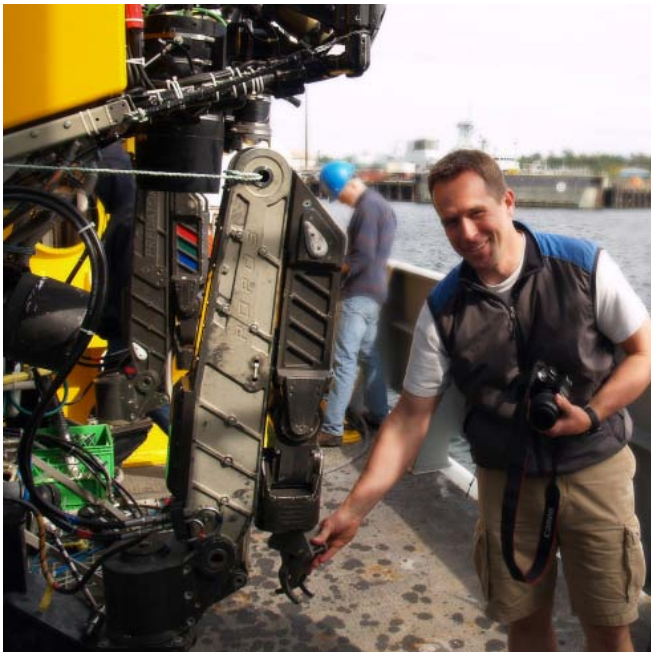
LEARNING RESOURCES

Learning resources were developed to support the growing need for ocean-focused teacher resources and to encourage educators to incorporate real-time science data into the classroom. ONC developed resources for both secondary and post-secondary levels that included data sets for professors at the University of Guelph and the University of British Columbia. Resources for teachers across Canada through partnership with Let's Talk Science were also developed.

Learning resources delivered by ONC in 2012/13 included lab exercises, lesson plans, and data sets, and also a totally new tool - classroom kits that focused on marine activities for children K-8.

STUDENTS

Power Up! was initiated this year and it provides graduate and undergraduate students, who study ocean science, with the opportunity to gain essential skills in communications. This one day event took students through workshops on resume building, networking and entrepreneurship and provided students with the oppotunity to practice those communication skills by "speed dating with industry." In these sessions they rubbed shoulders with members of the private, public and non-profit worlds.



"Great opportunity to understand marine field industry and how to enter it"
– Student

"Excellent networking event"
– Industry member

LEARNING

OCEAN SCIENCE SYMPOSIUM

Launched this year, the Ocean Science Symposium brought together 40 high school students with a passion for marine science and technology. Over the course of two days students learned about the diversity of marine science disciplines and partook in engaging and experimental learning and hands-on activities with expert oceanographers and 16 grad students.

PUBLIC

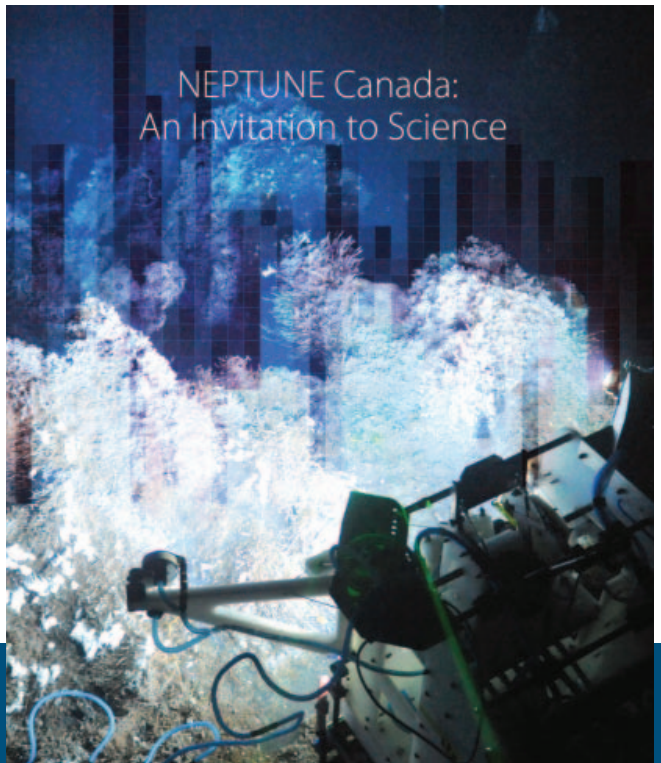
ONC's World Oceans Day celebration encouraged people of all ages to come out and learn how the ocean affects all of our lives and how we have an effect on the ocean. This festival, in partnership with the BC Maritime Museum, was a weekend of fun hands-on activities, a lively outdoor exhibition, and public speakers.

Activities included public talks by experts in the field, Ship2Shore live connection, hands on activities for kids, and a community fair with ocean information booths.

On the February 2013 Family Day Monday holiday, Kim Juniper, Benoît Pirenne, Allan Roberts and Yan Li along with coop students Kara Aschenbrenner and Jorge Conde travelled to Port Alberni for a community Open House at the NEPTUNE Port Alberni Shore Station. Over 300 townfolk turned up for demos, a tour, and updates on observatory developments.

IBOOKS

"Invitation to Science" iBook was launched. The interactive resource was designed to entice the interested public to immerse into the world of science and discovery on the NEPTUNE cabled observatory.



RECENT PUBLICATIONS

REFEREED JOURNAL PUBLICATIONS

2013

1. Barnes, C. R., Best, M. M. R., Johnson, F. R., Pautet, L., & Pirenne, B. (2013). Challenges, Benefits, and Opportunities in Installing and Operating Cabled Ocean Observatories: Perspectives From NEPTUNE Canada. *IEEE Journal of Oceanic Engineering*, 38(1): 144–157.
2. Crawford, W. R., & Peña, M. A. (2013). Declining Oxygen on the British Columbia Continental Shelf. *Atmosphere-Ocean*, 1–16.
3. Dinning, K. M., & Metaxas, A. (2013). Patterns in the abundance of hyperbenthic zooplankton and colonization of marine benthic invertebrates on the seafloor of Saanich Inlet, a seasonally hypoxic fjord. *Marine Ecology*, 34(1): 2–13.
4. Doya, C., Aguzzi, J., Pardo, M., Matabos, M., Company, J. B., Costa, C., Canals, M. (2013). Diel behavioral rhythms in sablefish (Anoplopoma fimbria) and other benthic species, as recorded by the Deep-sea cabled observatories in Barkley canyon (NEPTUNE-Canada). *Journal of Marine Systems*.
5. Fine, I. V., Kulikov, E. A., & Cherniawsky, J. Y. (2013). Japan's 2011 Tsunami: Characteristics of Wave Propagation from Observations and Numerical Modelling. *Pure and applied geophysics*, 170(6-8): 1295–1307. doi:10.1007/s00024-012-0555-8
6. Kim Juniper, S., Matabos, M., Mihaly, S., Ajayamohan, R. S., Gervais, F., & Bui, A. O. V. (2013). A year in Barkley Canyon: a time-series observatory study of mid-slope benthos and habitat dynamics using the NEPTUNE Canada network. *Deep Sea Research Part II: Topical Studies in Oceanography*.
7. Lapham, L., Wilson, R., Riedel, M., Paull, C. K., & Holmes, M. E. (2013). Temporal variability of in situ methane concentrations in gas hydrate-bearing sediments near Bullseye Vent, Northern Cascadia margin. *Geochemistry, Geophysics, Geosystems*.
8. Matabos, M., Bui, A. O. V., Mihály, S., Aguzzi, J., Juniper, S. K., & Ajayamohan, R. S. (2013). High-frequency study of epibenthic megafaunal community dynamics in Barkley canyon: A multi-disciplinary approach using the NEPTUNE Canada network. *Journal of Marine Systems*.
9. Merchant, N. D., Barton, T. R., Thompson, P. M., Pirotta, E., Dakin, D. T., & Dorocicz, J. (2013). Spectral probability density as a tool for ambient noise analysis. *The Journal of the Acoustical Society of America*, 133(4): EL262.
10. Mertens, K. N., Yamaguchi, A., Takano, Y., Pospelova, V., Head, M. J., Radi, T., Matsuoka, K. (2013). A New Heterotrophic Dinoflagellate from the Northeastern Pacific, Protoperidinium fukuyoi: Cyst-Theca Relationship, Phylogeny, Distribution and Ecology. *The Journal of eukaryotic microbiology*.
11. Purser, A., Thomsen, L., Barnes, C., Best, M., Chapman, R., Hofbauer, M., Wagner, H. (2013). Temporal and spatial benthic data collection via an internet operated Deep Sea Crawler. *Methods in Oceanography*.
12. Rabinovich, A. B., Candella, R. N., & Thomson, R. E. (2013). The open ocean energy decay of three recent trans-Pacific tsunamis. *Geophysical Research Letters*.
13. Sato, M., Dower, J., Dewey, R., & Kunze, E. (2013). Second-order seasonal variability in diel vertical migration timing of euphausiids in a coastal inlet. *Marine Ecology Progress Series*.
14. Xu, G., Jackson, D. R., Bemis, K. G., & Rona, P. A. (2013). Observations of the volume flux of a seafloor hydrothermal plume using an acoustic imaging sonar. *Geochemistry, Geophysics, Geosystems*.

2012

15. Aguzzi, J., Company, J. B., Sarda, F., Azzurro, E., Matabos, M., Juniper, S. K., Bahamon, N. (2012). Biorhythms challenge to deep-water stock and biodiversity assessments: cabled observatories video –solutions. (R. N. Gibson, R. J. A. Atkinson, J. D. M. Gordon, & R. N. Hughes, Eds.) *Oceanography and Marine Biology - An Annual Review*, 50: 235–286.
16. Ayranci, K., Lintern, D. G., Hill, P. R., & Dashtgard, S. E. (2012). Tide-supported gravity flows on the upper delta front, Fraser River delta, Canada. *Marine Geology*, 328: 166–170.
17. Bemis, K., Lowell, R., & Farough, A. (2012). Diffuse Flow On and Around Hydrothermal Vents at Mid-Ocean Ridges. *Oceanography*, 25(1): 182–191. doi:10.5670/oceanog.2012.16
18. Burd, B. J., & Thomson, R. E. (2012). Estimating Zooplankton Biomass Distribution in the Water Column Near the Endeavour Segment of Juan de Fuca Ridge Using Acoustic Backscatter and Concurrently Towed Nets. *Oceanography*, 25(1): 269–276. doi: 10.5670/oceanog.2012.25
19. Davis, E., & Heesemann, M. (2012). IODP Expedition 328: Early Results of Cascadia Subduction Zone ACORK Observatory. *Scientific Drilling*, 13(April): 12–18. doi:10.2204/iodp.sd.13.02.2011
20. Di Iorio, D., Lavelle, J. W., Rona, P. A., Bemis, K., Xu, G., Germanovich, L. N., Genc, G. (2012). Measurements and Models of Heat Flux and Plumes from Hydrothermal Discharges Near the Deep Seafloor. *Oceanography*, 25(1): 168–179.
21. Katz, T., Yahel, G., Reidenbach, M., Tunnicliffe, V., Herut, B., Crusius, J., Lazar, B. (2012). Resuspension by fish facilitates the transport and redistribution of coastal sediments. *Limnol. Oceanogr.*
22. Kelley, D. S., Carbotte, S. M., Caress, D. W., Clague, D. A., Delaney, J. R., Gill, J. B., Wilcock, W. S. D. (2012). Endeavour Segment of the Juan de Fuca Ridge: One of the Most Remarkable Places on Earth. *Oceanography*, 25(1): 44–61.
23. Matabos, M., Tunnicliffe, V., Juniper, S. K., & Dean, C. (2012). A year in hypoxia: epibenthic community responses to severe oxygen deficit at a subsea observatory in a coastal inlet. (M. Solan, Ed.)*PloS one*, 7(9): e45626.
24. Merchant, N. D., Blondel, P., Dakin, D. T., & Dorocicz, J. (2012). Averaging underwater noise levels for environmental assessment of shipping. *The Journal of the Acoustical Society of America*, 132(4): EL343–9.
25. Mertens, K. N., Yamaguchi, A., Kawami, H., Ribeiro, S., Leander, B. S., Price, A. M., Matsuoka, K. (2012). Archaeperidinium saanichi sp. nov.: A new species based on morphological variation of cyst and theca within the Archaeperidinium minutum Jörgensen 1912 species complex. *Marine Micropaleontology*, 96-97: 48–62.
26. Rabinovich, A. B., Thomson, R. E., & Fine, I. V. (2012). The 2010 Chilean Tsunami off the West Coast of Canada and the Northwest Coast of the United States. *Pure and Applied Geophysics*.
27. Robert, K., & Juniper, S. K. (2012). Surface-sediment bioturbation quantified with cameras on the NEPTUNE Canada cabled observatory. *Marine Ecology Progress Series*, 453: 137–149. doi:10.3354/meps09623
28. Snelgrove, P. V. R., Archambault, P., Juniper, S. K., Lawton, P., Metaxas, A., Pepin, P., Tunnicliffe, V. (2012). Canadian Healthy Oceans Network (CHONe): An Academic–Government Partnership to Develop Scientific Guidelines for Conservation and Sustainable Usage of Marine Biodiversity. *Fisheries*, 37(7): 296–304.

THESES AND BOOK CHAPTERS

2013

1. Favali, P., Beranzoli, L., Best, M. M. R., Delaney, J. R., De Santis, A., Edwards, A., & Suyehiro, K. (2013). Perspectives and long-term vision. In P. Favali, A. De Santis, & L. Beranzoli (Eds.), *Seafloor Observatories: A New Vision of the Earth from the Abyss*. Springer Praxis Books.

2012

2. Aguzzi, J., Company, J. B., Costa, C., Matabos, M., Azzurro, E., Mànuel, A., Priede, I. G. (2012). Challenges to the Assessment of Benthic Populations and Biodiversity as a Result of Rhythmic Behaviour: Video Solutions from Cabled Observatories. In R. N. Gibson, R. J. A. Atkinson, J. D. M. Gordon, & R. N. Hughes (Eds.), *Oceanography and Marine Biology: An Annual Review, Volume 50* (pp. 233–284). CRC Press.
3. Barnes, C., Best, M., Johnson, F., Phibbs, P., & Pirenne, P. (2012). The NEPTUNE Canada Project: installing the world's first regional cabled ocean observatory. In P. Favali, A. de Santis, & L. Beranzoli (Eds.), *Seafloor Observatories*. Springer-Praxis Geophysical Science Publishing.

4. Best, M. M. R., Barnes, C. R., Bornhold, B., & Juniper, K. (2012). Integrating continuous data from the coast to the abyss: A multidisciplinary view of the ocean in four dimensions. In P. Favali, A. de Santis, & L. Beranzoli (Eds.), *Seafloor Observatories: A New Vision of the Earth from the Abyss*. Chichester, U.K.: Springer-Praxis Publishing.

5. Gauthier, M. (2012). *Quantifying the impact of bottom trawling on soft-bottom megafauna communities using video and scanning-sonar data on the continental slope off Vancouver Island, British Columbia*. M.Sc. Earth and Ocean Sciences Thesis, University of Victoria, Canada.

6. Gebali, A. (2012). *Detection of salient events in large datasets of underwater video. M. A. Sc. Electrical and Computer Engineering Thesis*, University of Victoria, Canada.

7. Martonalti, B. (2012). *NEPTSim: Simulating NEPTUNE Canada using OMNeT++*. M. Sc. Computer Sciences Thesis, University of Victoria, Canada.

8. Matabos, M., Best, M., Blandin, J., Hoeberechts, M., Juniper, S. K., Pirenne, B., Varadaro, M. (2012). Seafloor Observatories. In M. Consalvey & M. Clark (Eds.), *Biological Sampling in the Deep Sea*. Wiley-Blackwell publishing.

9. Pirenne, B. (2012). The Role of Information Communication Technologies (ICT) for seafloor observatories: acquisition, archival, analysis, interoperability. In P. Favali, A. de Santis, & L. Beranzoli (Eds.), Seafloor Observatories: A New Vision of the Earth from the Abyss. Chichester, UK: Springer-Praxis Publishing.

10. Pulliat, I., Lanteri, N., Drogou, J. F., Blandin, J., Géli, L., Sarrazin, J., Léon, P. (2012). Open-Sea Observatories: A New Technology to Bring the Pulse of the Sea to Human Awareness. In M. Marcelli (Ed.), *Oceanography* (pp. 1–38). InTech.

CONFERENCE PAPERS

2013

1. Wanner, A., & Beer, R. (2013). Found Data: Generating Natural Looking Shapes by Appropriating Scientific Data. In *Computation Communication Aesthetics and X*. Bergamo: xcoax.org.

2012

2. Ewing, N., & Sen, G. (2012). Ship2Shore Marine Educators. In *Fall Meeting, AGU* (p. ED21B–0716). San Francisco: American Geophysical Union.

3. Heesemann, M., Mihaly, S. F., Scherwath, M., Hoeberechts, M., Matabos, M., Juniper, K., & Moran, K. (2012). Live Sensing of a Dynamic Ocean System with NEPTUNE Canada. In *Fall Meeting, AGU* (p. OS41C–1738). San Francisco: American Geophysical Union.

4. Rogers, G. C., Meldrum, R. D., Heesemann, M., Mulder, T. L., Brillon, C. D., & Cassidy, J. F. (2012). Progress on the NEPTUNE Canada Seismograph Network. In *Fall Meeting, AGU* (p. OS52A–04). San Francisco: American Geophysical Union.

5. Rona, P. A. (2012). Estimating Heat Transfer from Grotto Mound, NEPTUNE Canada Cabled Observatory, Juan de Fuca Ridge. In *Fall Meeting, AGU* (p. OS41C–1742). San Francisco: American Geophysical Union.

6. Scherwath, M., Spence, G., Riedel, M., & Heesemann, M. (2012). Gas Release Near Bullseye Vent - New Observations From NEPTUNE Canada's Seafloor Cable. In *Fall Meeting, AGU* (p. OS43A–1794). San Francisco: American Geophysical Union.

ABSTRACTS AND GENERAL REFERENCE

2013

1. Dummermuth, A., & Grosfeld, K. (2013, May 24). Climate change in the marine realm : an international summer school in the framework of the European Campus of Excellence. B*erichte zur Polar- und Meeresforschung = Reports on polar and marine research*. Alfred Wegener Institute for Polar and Marine Research.

2. Heesemann, M., Juniper, K., Hoeberechts, M., Matabos, M., Mihaly, S., Scherwath, M., & Dewey, R. (2013). Ocean Networks Canada: Live Sensing of a Dynamic Ocean System. In *Geophysical Research Abstracts* (Vol. 15, p. 6625). Geophysical Research Abstracts.

2012

3. Juanes, F., Rountree, R., & Pomerleau, C. (2012). The North East Pacific Time-Series Undersea Networked Experiments (NEPTUNE Canada): *A comparative study of sound production in two marine environments*. 2012 Meeting of the Canadian Acoustical Association.

4. Sirovic, A., Brandstatter, S., & Hildebrand, J. A. (2012). Fish recordings from NEPTUNE Canada. *The Journal of the Acoustical Society of America*, 132(3): 1916.

FINANCIALS

OCEAN NETWORKS CANADA
2012-13 SUMMARY COMBINED FINANCIAL INFORMATION

	Ocean Observatories	ONC Innovation Centre	In-kind Contributions	Combined
Revenue:				
Federal funding	$ 9,814,053	$ 1,684,418	$ 129,780	$ 11,628,251
Provincial funding	6,987,938		-	6,987,938
Miscellaneous	113,336	435,617	3,466,021	4,014,974
Amortization of deferred capital contributions	238,500	18,297	-	256,797
	17,153,827	2,138,332	3,595,801	22,887,960
Expenses:				
Personnel	5,378,900	1,146,890	381,196	6,906,986
Maintenance and repairs			-	-
Service contracts	644,059	168,201	-	812,260
Replacement parts subsea	5,831,397		-	5,831,397
Extraordinary maintenance	469,141		-	469,141
Minor upgrades	119,720	11,764	-	131,484
Shiptime/ROV	2,302,591		939,940	3,242,531
Other	105,961		-	105,961
Services	1,743,040	271,889	2,274,665	4,289,594
Supplies	42,724	21,662	-	64,386
General administration	439,447	218,444	-	657,891
Other	57,242	90,202	-	147,444
Total	17,134,220	1,929,053	3,595,801	22,659,073
Excess of revenue over expenses	**$ 19,607**	**$ 209,279**	**$ -**	**$ 228,887**

Notes to the Financial Information:

2012-13 marks the first year of the multi-year funding from the Canada Foundation for Innovation (CFI) under the Major Science Initiatives (MSI) Program. As a result, this is the first year that summary combined financial results are presented in this format in the ONC Annual Report. This financial information is unaudited. The audited financial information is available as set out below.

The first column represents the financial results of the operations and maintenance of the ONC ocean observatories, including corporate administration, user services and related activities. They are primarily funded by CFI and the BC government through grants to the University of Victoria. This financial information is not separately audited for ONC but is included in the audited consolidated financial statements of the University of Victoria. The audited financial statements of the University of Victoria are available at http://www.uvic.ca/vpfo/accounting/assets/docs/financial/uvicfinancialstatements/financial-statements-2012-13.pdf

The second column represents the financial results of the ONC Innovation Centre which is primarily funded by a grant from the Natural Sciences and Engineering Research Council (NSERC) under the Centres of Excellence for Commercialization and Research (CECR) Program. The audited financial statements for the Ocean Networks Canada Society are available at http://oceannetworks.ca/news/media-relations/downloads.

ONC received in-kind contributions from the University of Victoria ($629,196), BC Ferries ($682,500), and other organizations ($272,368) for materials and services provided at no cost to the ocean observatories. IBM Canada also provided in-kind contributions valued at $2,011,737 to the ONC Innovation Centre. In kind contributions are not recorded in the audited financial statements in accordance with the organization's adopted accounting policies.

OCEAN NETWORKS CANADA

CONTACT

Ocean Networks Canada
Technology Enterprise Facility (TEF)
University of Victoria
PO Box 1700 STN CSC
Victoria, BC V8W 2Y2 Canada
250.472.5400
info@oceannetworks.ca

Follow us on **Twitter** | Like us on **Facebook**

oceannetworks.ca

AN INITIATIVE OF University of Victoria