

**CANADIAN OCEAN SCIENCE NEWSLETTER  
LE BULLETIN CANADIEN DES SCIENCES DE L'OCÉAN**

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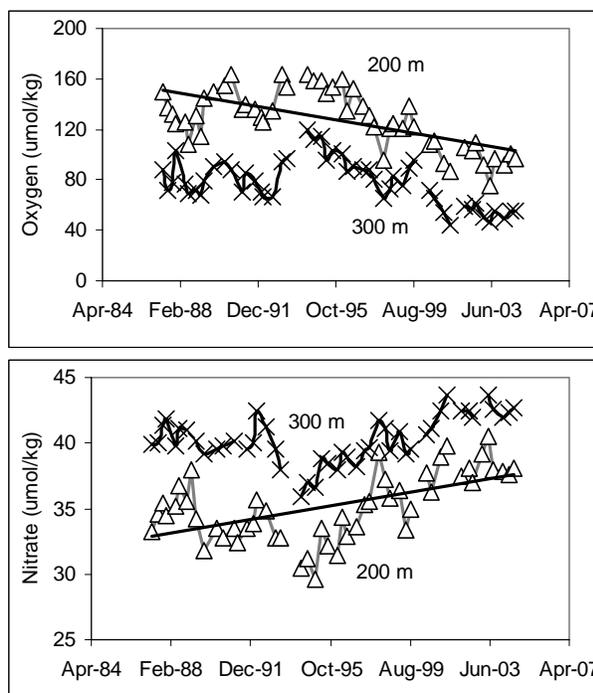
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## A trend towards lower oxygen levels in intermediate waters of the Subarctic NE Pacific

Report by Frank Whitney, [WhitneyF@pac.dfo-mpo.gc.ca](mailto:WhitneyF@pac.dfo-mpo.gc.ca)

Global warming is expected to reduce nutrient supply to the upper ocean. In a 1993 paper, Woods and Barkmann (*J. Plankton Research* 15) stated that the “enhanced greenhouse effect induces radiative forcing of the ocean, which diminishes the depth of winter convection, reducing the annual resupply of nutrients to the euphotic zone and therefore the annual primary production”. Since primary production is generally proportional to fish production (e.g. Iverson, 1990, *Limnology and Oceanography* 35), any reduction in nutrients will impact fish production and harvesting. Indeed, in the NE Pacific, we have observed a decline in nutrient supply, which has led to 17% less nitrate uptake in surface waters between the 1970s and the 1990s (Whitney and Freeland, 1999, *Deep-Sea Research II* 46).

Recent analyses of 17 years of chemical data collected at Ocean Station Papa (50 N, 145 W) indicate further effects of ocean stratification. Oxygen and nitrate data from standard sampling depths show distinct trends in the depth range from 100 to 300 m (adjacent figure). Oxygen at 200 m has declined at a rate of  $2.7 \mu\text{mol kg}^{-1} \text{y}^{-1}$ , whereas nitrate increased at  $0.27 \mu\text{mol kg}^{-1} \text{y}^{-1}$ . At this depth, there has been little change in salinity and only slight cooling occurred. These data suggest that reduced mixing during winter resulted in less ventilation (injection of oxygen from the atmosphere) of subsurface waters over time. Because waters are not being mixed towards the surface, they collect more nutrients through the remineralization of sinking organic waste.



In the open ocean, the decrease in oxygen content of seawater at 200 m depth from  $150 \mu\text{mol kg}^{-1}$  to  $<100 \mu\text{mol kg}^{-1}$  over our 17 year observation period may not cause much ecosystem disruption. However, these are the waters that eventually upwell onto the continental shelf along the Oregon to Alaska coast. In the past 3 summers, fish kills have been observed off Oregon as a result of low oxygen, nutrient rich waters being carried onto the shelf (Huyer, 2003, *Geophysical Research Letters* 30). Such low oxygen waters have not previously been observed in this region. Fish kills and loss of habitat to marine organisms may become more common place as surface ocean waters continue to stratify. In addition, many of the BC coastal inlets are replenished with oceanic waters that are drawn onto the coast during the upwelling season (July to September). Low oxygen levels in these waters could result in widespread disruptions of ecosystems in inlets that

have marginal oxygen levels at present. This includes coastal waters that are currently under stress because of increases in effluent discharge from growing human populations.

### **Gully Seismic Research Program**

Contact: Kenneth Lee, [LeeK@dfo-mpo.gc.ca](mailto:LeeK@dfo-mpo.gc.ca)

The northern bottlenose whale, considered endangered by the [Committee on the Status of Endangered Wildlife in Canada \(COSEWIC\)](#), inhabits the Gully Marine Protected Area (MPA) and adjacent marine canyons. Since whales rely upon sound for navigation, communication and echo-location of prey, there is concern that noise generated by the exploratory activities of the offshore oil and gas industry may stress this whale population. As the request for and issuance of new offshore exploratory licenses, with corresponding submission of proposals for seismic surveys, has intensified on the East Coast of Canada, there is now a public demand to review the situation.

In 2003, COOGER (Centre for Offshore Oil and Gas Environmental Research) coordinated acoustical and biological studies in conjunction with seismic exploration programs conducted by the private sector off the coast of Nova Scotia. The research program included a baseline survey of acoustic recordings and whale distributions in April 2003 within known whale habitat areas, including the Gully and adjacent canyons on the Scotian Shelf, before seismic shooting commenced. With the onset of seismic operations, recordings of whale vocalizations and direct visual surveys by marine mammal observers were repeated. In addition, ocean bottom seismometers were deployed to quantify seismic noise levels to validate mathematical models on sound transmission in water. These sound models are currently used in environmental risk assessments.

This project provides a unique opportunity to improve our scientific knowledge and capacity, and will allow regulators and industry to plan and prepare for future work in other areas. DFO research scientists from the Maurice Lamontagne Institute (Quebec), Northwest Atlantic Fisheries Centre (Newfoundland), Bedford Institute of Oceanography (Nova Scotia) and Institute of Ocean Sciences (British Columbia) have worked with collaborators from Université of Quebec at Rimouski and the offshore oil and gas industry to ensure the project's success.

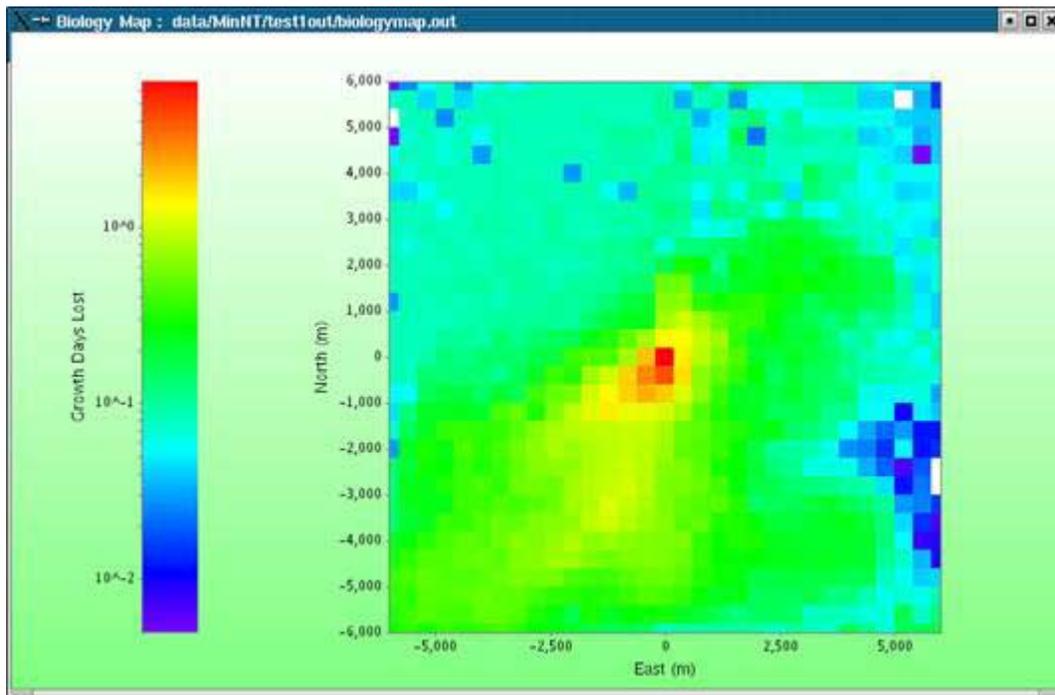
Presentations of the scientific results from this multi-disciplinary study were held in Halifax, Nova Scotia on October 4-5, 2004. The final Environmental Studies Research Funds (ESRF) report will be published by December 2004.

### **An Assessment Model for the Fate and Environmental Effects of Offshore Drilling Discharge**

Contact: Charles Hannah, [HannahC@mar.dfo-mpo.gc.ca](mailto:HannahC@mar.dfo-mpo.gc.ca)

The fate and potential environmental impacts of discharged drilling muds are ongoing issues for offshore petroleum operators, regulators, government agencies and environmentalists. Sound scientific assessments of the fate and impacts for different discharge scenarios can provide a

basis for prudent decisions that minimize adverse impacts. Dispersion models can be an effective tool in this process. The benthic boundary layer transport model, bblt, was developed to predict the transport and dispersion of suspended particulate drill waste in the benthic boundary layer. The latest version of bblt (Version 7.0) includes a graphical user interface (GUI) with integrated graphical output. The GUI is written in Java to enhance portability. Recent technical developments include a stress dependent settling velocity, explicit representation of the wave-current boundary layer, and a biological impacts module. As with previous releases, bblt v7 assumes a spatially homogeneous environment; horizontal variations in water depth, currents and bottom stress are ignored. The software can be downloaded from the web and installed on computers running either Linux or MS-Windows. The installation includes the source code for both the core bblt code and the GUI.



Recently, we estimated the potential number of growth days lost for scallops around the North Triumph site on Sable Island Bank as a result of drilling in the fall of 1999. The results suggest that the potential impact of drilling mud discharges on scallop growth is of the order of a few days of lost growth over spatial scales of a few kilometres.

The model and the documentation can be downloaded from:

[http://www.mar.dfo-mpo.gc.ca/science/ocean/coastal\\_hydrodynamics/WEBbbltgui/bbltgui.html](http://www.mar.dfo-mpo.gc.ca/science/ocean/coastal_hydrodynamics/WEBbbltgui/bbltgui.html)

The documentation has been published as a DFO technical report: Drozdowski, A., Hannah, C. G. and Tedford, T. 2004. bblt Version 7.0 User's Manual. Can. Tech. Rep. Hydrogr. Ocean Sci. 240: vi + 69 pp.

## **International Polar Year – time to get moving**

Report by Rob Macdonald, [MacdonaldRob@pac.dfo-mpo.gc.ca](mailto:MacdonaldRob@pac.dfo-mpo.gc.ca)

IPY (2007/08), as you will know from reading previous issues of this Newsletter, is an international programme sanctioned by ICSU (International Council for Science: <http://www.icsu.org/index.php>) and WMO (World Meteorological Organization: [www.wmo.int](http://www.wmo.int)) and focusing on both poles. The overall approach to planning this massive undertaking will be for each country to assemble its own sub-programme that fits comfortably within the overarching international scientific framework. In Canada, an IPY Canadian Steering Committee under the chair of Dr. Peter Johnson, an IPY Federal Working Group chaired by Dr. Barry Goodison and Ms. Bonnie Hrycyk, and an IPY National Secretariat at the University of Alberta have been created specifically to coordinate Canada's contributions to IPY. To plan a coherent programme will require adherence to an extraordinarily tight time line and, accordingly, Dr. David Hik, the executive director of the Secretariat (<http://www.ipy-api.ca>) has put out a call to prepare project pre-proposals for submission to the next Canadian Steering Committee's meeting in Edmonton on December 14-15, 2004. The primary purpose of that meeting will be to start to review IPY-Canada proposals and prepare a submission of what Canada's IPY programme will contribute to the IPY International Committee by mid-January. A formal call for pre-proposals (International and National foci) will be issued by the end of October. For the moment, the six international themes (listed below) will serve as guidelines, but the formal call will 'Canadianize' these themes. The Canadian Government has strongly committed to IPY and especially the inclusion of human and economic aspects into the science plan (see theme 6).

### The Themes

1. **Status:** to determine the present environmental status of polar regions
2. **Change:** to quantify, and understand, past and present natural environmental and social change in the polar regions; and to improve projections of future change
3. **Global Linkages:** to advance our understanding on all scales of the links and interactions between polar regions and the rest of the globe, and of the processes controlling these
4. **New Frontiers:** to investigate the frontiers of science in the polar regions
5. **Vantage Point:** to use the unique vantage point of the polar regions to develop and enhance observatories from the interior of the Earth to the Sun and the cosmos beyond
6. **Human Dimension:** to investigate the cultural, historical, and social processes that shape the sustainability of circumpolar human societies, and to identify their unique contributions to global cultural diversity and citizenship.

Further sources of information may be found at:

<http://www.polarcom.gc.ca> (Canadian Polar Commission)

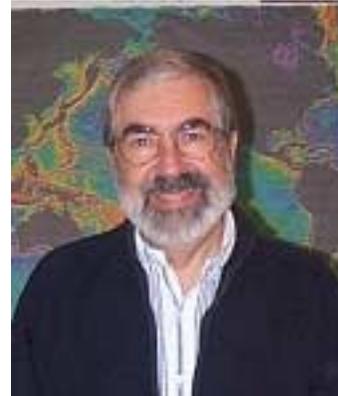
<http://www.arctic-council.org> (Arctic Council)

<http://www.ipy.org> (ICSU/WMO IPY Joint Committee)

<http://www.us-ipy.org> (United States IPY)

## Canadian Elected SCOR President.

Bjørn Sundby, Professor at Université du Québec à Rimouski (UQAR) and Adjunct Professor, Earth and Planetary Sciences, at McGill University, has been elected President of SCOR for the next four years. This is the first time in SCOR's history, which dates back to 1957, that a Canadian has been elected SCOR President. Professor Sundby earned a Ph.D. from the University of Bergen (Norway) and a Dr. Philos from the University of Bergen in 1987. His career in oceanography began in 1972 as a postdoctoral fellow at the Bedford Institute of Oceanography. He has been Professor of Oceanography at UQAR, Head of the Department of Chemical Oceanography and Marine Pollution at the Netherlands Institute of Oceanography, and Director of Physical and Chemical Sciences at the Maurice Lamontagne Institute, Canada. Since 1999, Prof. Sundby has been Professor of Oceanography at the Institut des Sciences de la Mer de Rimouski and Adjunct Professor at McGill University. Prof. Sundby's research focuses on redox chemistry, but is relevant to any element whose distribution in sediments is in some way related to the carbon cycle. His recent and ongoing projects include the use of a solid state voltammetric microelectrode to measure redox species directly in sediment porewater; recent changes in sediment chemistry in the deep Arctic Ocean basins as a result of global warming; hypoxia in the St. Lawrence estuary; the cycle of lead in the root zone of salt marsh sediments; the coupled geochemistry of manganese, nitrogen, and iodine in sediments; and geochemistry of cadmium, molybdenum, uranium, and rhenium in view of their use as tracers of redox conditions in paleo-sediments.



A Canadian 11-page report on the meeting (SCOR Annual Meeting) that elected Professor Sundby as its Chair may be found as the 3<sup>rd</sup> entry, Section B, at [www.cncscor.ca](http://www.cncscor.ca)

## New SCOR Working Groups

Two new Working Group proposals were approved subject to some clarifications identified at the 27th SCOR General Meeting held in Venice, Italy on September 27-30, 2004.

### *Working Group on Global Comparisons of Zooplankton Time Series*

This new SCOR Working Group will undertake a global-scale comparison of low frequency variability of marine zooplankton communities. This idea grew out of a workshop convened by Ian Perry (DFO/PBS) and Hal Batchelder during the recent “3rd International Zooplankton Production Symposium” (May 2003 in Gijon, Spain, co-sponsored by GLOBEC, PICES, ICES and the Spanish government). A summary paper from that workshop (Perry et al., in press) includes preliminary but provocative evidence for temporal coherence of zooplankton and climate variability in both the North Atlantic and the North Pacific. There was a strong consensus at the Gijon workshop that a more detailed and more global comparison of zooplankton time series would be timely, technically feasible, and

extremely useful. Such an analysis must be an international cooperative effort – the relevant data sets are in many places and have been collected by many independent nations and agencies. Expected activities and products include:

- Year 1: Summarize and evaluate methods, results, and questions arising from the zooplankton time series analyses that have been completed to date. For the proposed new comparative analyses, select and prioritize the set of regional time series, and the suite of variables from each time series that will be compared (e. g. total zooplankton biomass, major-group and/or species-level zooplankton taxonomic composition, phenology, and physical and biological environmental indices). Identify obstacles to pooled analyses (e. g. incomplete processing, differences in formatting, differences in resolution). Develop recommendations for data-exchange, and feasible enhancements of sample processing.
- Year 2: Begin comparative analyses. Evaluate sensitivity and specificity of data analysis (statistical) tools, and improve their availability and “user-friendliness”. Identify time scales and date intervals of particular interest. Post selected tools and data on a web or ftp site.
- Year 3: Complete comparative analyses of zooplankton and environmental time series, incorporating any new data that have become available during years 1-3. Identify synchronies (if any) in timing of fluctuations, and quantify correlation time and space scales. Prepare interpretive paper(s) for symposium presentation and publication. Prepare recommendations for “best practice” sampling and analysis methodologies

The Working Group will be Co-Chaired by David Mackas (Canada, DFO/IOS) and Hans Verheye (South Africa, Benguela)

### *Working Group to Investigate the Role of Viruses in Marine Ecosystems*

Understanding the role of viruses in oceanic carbon and nutrient cycling, food web processes and diversity is pivotal for assessing the stability of marine systems and their biogeochemical significance. This understanding is not only of scientific interest; it will also increase the predictability of the effects of global change on biogeochemical processes in the ocean. Moreover, quantitative data on the consequences of viral lysis are necessary to better understand the functioning of marine food webs. This will also facilitate the inclusion of viral effects into oceanic carbon models.

This working group will study the role of viruses in marine ecosystems over a period of four years, culminating in a final reports that: (1) summarize past results on virus-mediated mortality of eukaryotic plankton and prokaryotes and its impact on oceanic carbon and nutrient cycling, (2) coordinate data and international collaboration on the role of viruses in different water masses in particular in the open ocean and deep sea, and (3) assess the current methodological limitations and develop recommendations for techniques to quantify virus-mediated mortality of microorganisms (eukaryotes and prokaryotes), their impact on carbon and nutrient cycling, and methods for assessing diversity in viral communities. An important aspect of the working group will be to stimulate research to investigate viruses and viral-mediated processes in different water masses, since this promises a better understanding of the effect of viruses on biogeochemical cycles. The working group will also establish and maintain a Web site as forum that can be used by the ‘viral community’ for exchanging data,

ideas and future plans. The SCOR effort will culminate with an International Symposium that could include a published proceeding such as a special issue of Limnology and Oceanography or Deep-Sea Research. Curtis Suttle (UBC) is a proposed Member of the Working Group

### **Applications: Polar Continental Shelf Project (PCSP)**

The deadline for submitting applications to the PCSP is November 12, 2004. Only 2005 forms will be accepted. Handwritten applications or forms that have been altered will not be accepted. PCSP will no longer be sending hard copies of their application packages to clients. Principal investigators planning to conduct fieldwork in the Arctic are invited to apply for logistics support by submitting an [application form](#) to PCSP. See the list below to determine which forms you should submit. Depending on when and where you are conducting your operations, support may be available in the form of airplane or helicopter use, fuel caching, accommodation for your field party, loan of field or communication equipment, etc. Application details may be found at: [http://polar.nrcan.gc.ca/pcs\\_whatwedo/index\\_e.aspx?ArticleID=656](http://polar.nrcan.gc.ca/pcs_whatwedo/index_e.aspx?ArticleID=656)

### **Announcement of Opportunity: START Fellowship/Visiting Scientist Program**

Application deadline is December 1, 2004. Program details, application forms and information on required supporting documentation may be found at <http://www.start.org/> This program, funded by DGIS, the Netherlands, is designed to increase the number of developing country scientists who serve as active partners in global change research in START regional networks and in the Joint and Core Projects of the Earth System Science Partnership (IGBP, WCRP, IHDP, and DIVERSITAS). START Fellowships are offered at the graduate and post-graduate levels to young scientists from Africa, Asia, and Oceania. START fellows may work under senior mentors in leading laboratories or institutions in any part of the world, where research is conducted on relevant regional aspects of global change. Long-term collaboration between the individuals and institution involved is one important preferred outcome of the programme. The duration of these fellowships is ordinarily one or two semesters (i.e. typically 4-8 months).

A parallel activity, the START Visiting Scientist Award, allows more senior scientists from developing countries the opportunity to undertake short-term visits to major international laboratories to become acquainted with recent advances in research and develop long-term programmatic linkages and partnerships. The duration of these awards is usually 1-2 months.

Please note that START does not fund Latin American scientists, as this area is served by IAI.

### **New offshore oil & gas research newsletter online**

Contact: Rosalie Allen Jarvis, [AllenJarvisR@dfo-mpo.gc.ca](mailto:AllenJarvisR@dfo-mpo.gc.ca)

The Centre for Offshore Oil and Gas Environmental Research (COOGER) was established by Fisheries and Oceans Canada (DFO) to coordinate the department's nation-wide research into environmental and oceanographic impacts of offshore petroleum exploration, production and

transportation. In addition to descriptions of more than 25 scientific projects, the COOGER web site features a link to the latest issue of the “COOGER Update” newsletter. Please visit the COOGER web site at: [www.dfo-mpo.gc.ca/science/cooger-crepge/](http://www.dfo-mpo.gc.ca/science/cooger-crepge/)

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Previous newsletters may be found on the CNC/SCOR web site.  
Les bulletins antérieurs se retrouvent sur le site web du CNC/SCOR.

Newsletter #12 will be distributed on December 16, 2004. Please send contributions to [dick.stoddart@sympatico.ca](mailto:dick.stoddart@sympatico.ca)  
Bulletin #12 sera distribué le 16 decembre 2004. Veuillez faire parvenir vos contributions à [dick.stoddart@sympatico.ca](mailto:dick.stoddart@sympatico.ca)

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