

# Impact of Climate Change on Arctic Benthos

## Summary

### Project Leader(s)

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Life on the ocean floor is astonishingly diverse, but still very poorly known, especially in polar regions where ice cover has restricted sampling. Climate warming is driving a rapid transformation of polar ecosystems, and we urgently need to study the vulnerability of seafloor biodiversity to changes that are already underway. For instance, as wide areas of the Arctic are shifting from arctic to subarctic conditions, water temperatures are rising and ice cover is diminishing. Both of these factors will alter productivity patterns in the surface ocean and thus alter the delivery of organic matter to the seafloor. Major changes in food input will propagate throughout the benthic ecosystem, affecting biodiversity and ecosystem processes. Changes in ice cover are also likely to bring increased human economic activity to arctic seas, some of which (eg. bottom trawling) will directly impact seafloor ecosystems. In this context of potential widespread changes to deep-water benthic communities in the Arctic, we propose to establish benchmarks at biodiversity ‘hotspots’ - areas with a high number of species and abundance - and ‘coldspots’ where opposite conditions prevail. We anticipate that impacts of climate warming on the benthos will be amplified at these sentinel sites that represent extremes of benthic productivity and biodiversity. Hotspots are areas of concentrated utilization of surface productivity by the benthos, as a result of current patterns or direct sedimentation from above. Coldspots are, in turn, areas of the seafloor with a much-reduced food supply as a result of unfavorable horizontal transport or low overlying productivity. Knowledge resulting from our research efforts will enable us to better understand how the arctic benthos will be affected by climate-driven changes in oceanographic conditions and resource exploitation. We have a unique opportunity to document almost pristine conditions before the Arctic Ocean undergoes major changes. Specific objectives of this research program are therefore i) to describe and compare the biodiversity and secondary productivity of macro benthic and meiobenthic communities in areas of enhanced and reduced productivity and diversity (“hotspots” and “coldspots”, respectively), ii) to document the diversity and substratum-related abundances of megafauna as a baseline reference for future comparisons as Arctic conditions change, iii) to examine the role of biohermal structures in promoting the diversity of demersal species, iv) to test whether food-chain length changes with resource availability in response to climate ecosystem changes, v) to establish an ecological baseline through biological, chemical and geological signatures in sediment deposits, and finally vi) to identify features unique to regional hotspots. Overall, this research program will enhance our knowledge of the role of the benthos in the Arctic marine ecosystem and will help our partners to establish monitoring programs and conservation strategies to respond to the challenges of environmental change.

## People

### Network Investigators

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## **Partners**

BP Exploration Operating Company Ltd

Canadian Healthy Oceans Network (CHONE)

Imperial Oil Resources Ventures Limited

Parks Canada

Université du Québec à Rimouski

University of Plymouth

## **Publications**

### **Articles Published in Refereed Publications**

Archambault, A., Snelgrove, P.V.R., Fisher, J.A.D., Gagnon, J.M., Garbary, D.J., Harvey, M., Kenchington, E.L., Lesage, V., Lévesque, M., Lovejoy, C., Mackas, D.L., McKindsey, C.W., Nelson, J.R., Pepin, P., Piché, L. and Poulin, M., 2010, From Sea to Sea: Canada's Three Oceans of Biodiversity, PLoS ONE, v.5, no.8, e12182. doi:10.1371/journal.pone.0012182, Published

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- Link, H., Archambault, P. and Chaillou, G., 2010, First Views on a Second Glance: Benthic Functioning during Malina (2009) as Compared to 2008, Malina Plenary Meeting, Villefranche, France, 6-7/05/2010, Published
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- Link, H., Piepenburg, P. and Archambault, P., 2009, Spatial patterns of benthic carbon turnover in the Canadian Arctic in 2008: Indications of a decadal change in benthic ecosystem functioning., 2009 Arcticnet Annual Conference Proceeding, 56, Accepted
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- Roy, V., Archambault, P., Conlan, K. and Juniper, S.K., 2010, Scale-Dependence Relationships Between Benthic Biodiversity and Biogeophysical Variables on the Canadian Arctic Shelf, ArcticNet Annual Scientific Meeting, Ottawa, Canada, 14-17/12/2010, poster, Published

### **Specialized Publications**

- Robert, D., Lévesque, M. and Gagnon, J., 2010, Data from the Environment and Marine Resources Assessment of Imperial Oil/BP Exploration License Areas 446, 449 and 451 (Beaufort Sea), in the Summers of 2009 and 2010., Data report as part of the Environment & Marine Resources Component of the ArcticNet-BP-IOL Research Collaboration 2009-2011 Program, 70 p., Accepted
- Watkins, J., Archambault, P., Bortoluzzi, T., Conlan, K., Doidge, B., Fergusson, S., Gilchrist, G., Gill, M., Lovejoy, C., Michel, C., Nelson, J., Nickels, S., Poulin, M., Reist, J., Richardson, E., Robinson, C. and Stow, J., 2010, Arctic Marine Biodiversity Monitoring Plan, Marine Expert Monitoring Group, Draft 3 for caff board review, 153 p., Submitted