Biodiversity Monitoring Stations in the Davis-Baffin Division of the Eastern Arctic
Canadian Contributions to the Circumpolar Marine Biodiversity Monitoring Plan

E. Kenchington[1], L. Beazley[1], T. Siferd[2], M. Treble[2], J. Watkins[3], E. Baker[1], B. MacDonald[1], L. Anstey[1], C. Lirette[1], B. Rincon[1]

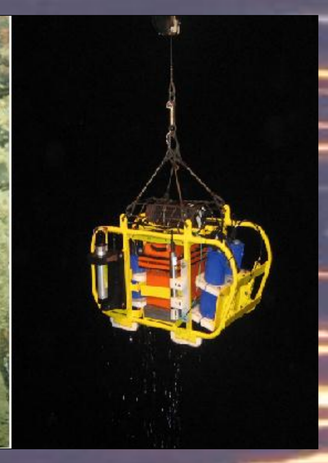
Fisheries and Oceans Canada

[1]Bedford Institute of Oceanography, Dartmouth, Nova Scotia; [2]Freshwater Institute, Winnipeg, Manitoba; [3]200 Kent Street, Ottawa, Ontario

BACKGROUND

Arctic waters are expected to show the first effects of climate change, including the effects of increasing sea water temperatures and ocean acidification. Baffin Bay and Davis Strait are key areas connecting the Arctic and the North Atlantic Oceans. The long-term time series from the NAFO (Northwest Atlantic Fisheries Organization) Standard Stations off West Greenland show that the observed warming of the North Atlantic Subpolar Gyre has had a tremendous impact on the West Greenland Shelf and off-slope waters (Stein 2010). The distribution of marine fauna in this area could be affected by climate change, including the expansion of ranges northward, and introduction of species (Vongraven 2009). Consequently it is critical to establish baseline data on benthic communities in this area in order to quantify future impacts of climate change. Fisheries and Oceans Canada has established 5 biodiversity monitoring sites in a fishery closure area following the Circumpolar Marine Biodiversity Monitoring Plan.

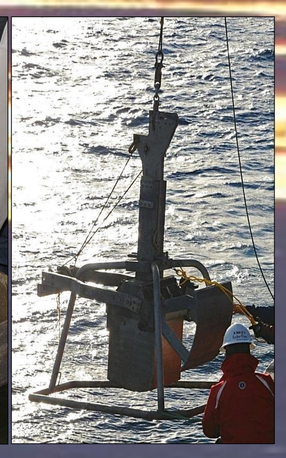
MEGAFAUNA



Benthic megafauna were sampled using a drop camera device (pictured above, right). Photos of the sea floor (pictured above left) were taken approximately every 10 m following transect lines running up-slope. Megafaunal abundance was recorded for all fauna greater than 1 cm.

Large foraminifera (such as *Rhizammina algaeformis*) visible on the sediment surface were qualitatively assessed from each photo based on whether they were absent/rare, sparse, moderate, or abundant.

MACROFAUNA



Macrofauna were sampled from sediment grab samples collected using a mega-box corer and Van Veen grab system deployed at the start or end of each camera station. Sediment samples were sieved into 0.95 cm, 1 mm, and 0.5 mm size fractions. Macrofauna specimens were identified to the lowest taxonomic classification possible.

All pan-Arctic species (i.e., ophiuroids, bivalves, snow crabs) were measured for size-frequency analysis.

MEIOFAUNA & MICROBES

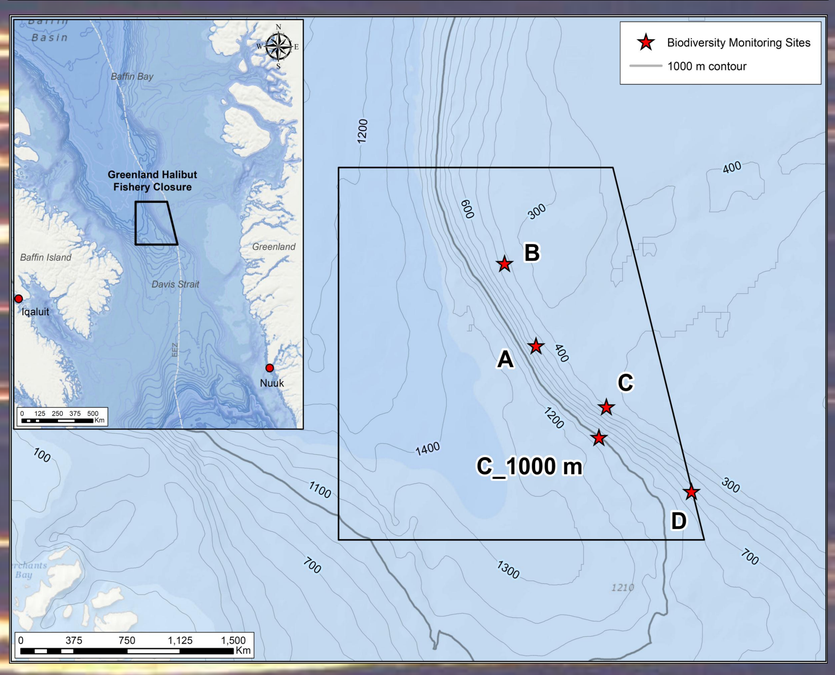
Meiofauna were collected from sediment subsamples collected from three Van Veen grabs per station. Seven sediment subsamples were collected from the top 1 cm of sediment using a modified 60 cc syringe. Samples were preserved in 3 ways: 1) formalin, to assess general meiofauna species composition and abundance, 2) ethanol, to assess foraminifera species composition and abundance, and 3) frozen, for DNA analysis of all meiofauna.

Sediment subsamples for microbes were also collected from the top 1 cm of each of 3 Van Veen grabs per station using a modified 10 cc syringe. Samples were frozen at -80˚C.

Priority Focal Ecosystem Components, Parameters, and Indicators Sampled at the Canadian Eastern Arctic Biodiversity Monitoring Sites - Following Gill et al. (2011) and Pomerleau et al. (2014)

Category	Focal Ecosystem Components	Key Parameters	Indicators
Benthic fauna & microbes	Macrofauna & Megafauna	Abundance, Biomass (wet weight), Species composition, Barcoding and other genomics	Community composition, Size-frequency distribution (for selected, mainly pan-Arctic species), Diversity indices (e.g., Shannon, Simpson), Distribution
Benthic fauna & microbes	Meiofauna & Microbes	Abundance, Biomass, Species composition, Barcoding and other genomics	Community composition and structure, Diversity indices (e.g., Shannon, Simpson), Distribution

Location of 5 marine biodiversity monitoring sites within the Greenland Halibut fishery closure (DFO 2007).



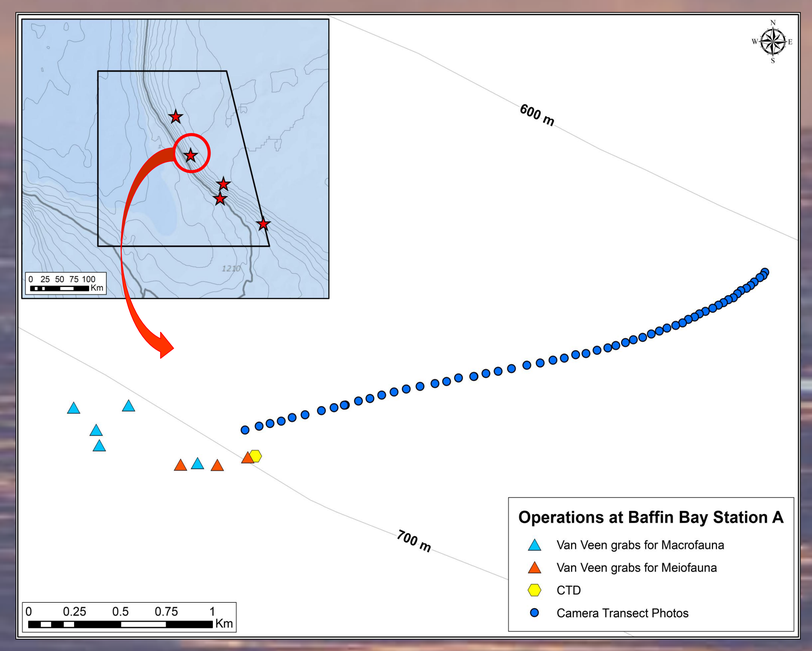
Summary of the camera operations conducted at 5 marine biodiversity monitoring sites in the Greenland Halibut fishery closure area (black box) for the collection of information on megafauna. CTDs and Van Veen Grab samples were conducted at each station for the collection of data on megafauna, meiofauna/microbes, and water column characteristics.

Station	Camera position (dd)		Depth (m)		Number of photos
	Start	End	Start	End	
A	67.7769/ -59.0593	67.7694/ -59.0850	593	705	58
B	67.9986/ -59.2658	67.9944/ -59.3086	404	457	74
C	67.6126/ -58.5469	67.6002/ -58.5708	229	482	102
C_1000 m	67.5297/ -58.6014	67.5436/ -58.5904	974	879	72
D	67.3829/ -57.9260	67.3707/ -57.9145	634	648	68

ACKNOWLEDGMENTS

This project was funded by the Canadian Department of Fisheries and Oceans International Governance Strategy Program. We thank Dr. Calvin Campbell (NRCan) for collaboration with the cruises and use of the camera and grabs, and the Captains and crews of the CCGS Larsen and CCGS Hudson.

Operations at the Baffin Bay Station A biodiversity monitoring site. Photographic transects were conducted to sample megafauna; Van Veen grabs for macrofauna and meiofauna/microbes, and CTDs for water column characteristics.



DNA BARCODING

DNA-based identifications using a portion of the cytochrome oxidase subunit I (COI) mitochondrial protein-coding gene have been employed across broad taxonomic ranges (Herbert et al. 2003) and provide an especially useful tool in cases where external morphology may not provide sufficient traits for full taxonomic resolution, especially in areas where the species are not well known. This approach has been popularly coined "DNA-barcoding". Unique or unknown specimens from each sampling station were targeted for DNA barcoding purposes. Each specimen was either subsampled for tissue, or the entire specimen was preserved in 95% ethanol. Genomic DNA was extracted using DNeasy®Tissue Kit (Qiagen), then PCR-amplified with one of several primer pairs to obtain a fragment of the mitochondrial cytochrome oxidase subunit I gene.

SPECIMEN PHOTOGRAPHS

An attempt was made to photograph all macrofaunal taxa identified from the grab samples. When possible these were taken at sea, prior to preservation, to capture natural colour.

CURRENT STATUS AND FUTURE PLANS

It is expected that all data from the 5 marine biodiversity monitoring sites will be extracted by April 2015. Additional camera transects and grab samples were taken in other parts of Davis Strait, and west of Resolution Island. Full sampling according to the CBMP protocols were undertaken at some of these locations. These may be analyzed in future depending upon funding. All data from the Greenland Halibut closure area sites will be made available through the Arctic Council Data Portal (Pomerleau et al. 2014).

REFERENCES

DFO. 2007. Development of a Closed Area in NAFO 0A to protect Narwhal Over-Wintering Grounds, including Deep-sea Corals. DFO Canadian Scientific Advisory Secretariat Science Response 2007/002.

Gill, M.J., K. Crane, R. Hindrum, and 18 others. 2011. Arctic Marine Biodiversity Monitoring Plan (CBMP-MARINE PLAN), CAFF Monitoring Series Report No.3, April 2011, CAFF International Secretariat, Akureyri, Iceland. ISBN 1. 978-9979-9778-7-2

Hebert, P.D.N., A. Cywinska, S.L. Ball, and J. R. deWaard. 2003. Biological identifications through DNA barcodes. Proceedings of the Royal Society Series B – Biological Sciences. 270:313–321.

Pomerleau, C, JM Watkins, P Archambault, and 12 others. 2014. Canadian Arctic Marine Biodiversity Plan 2014 - 2017. Canadian Component of the Conservation of Arctic Flora and Fauna's Circumpolar Biodiversity Monitoring Program,

Arctic Marine Biodiversity Monitoring Plan. CAFF Monitoring Report No. 13. CAFF International Secretariat, Akureyri Iceland. ISBN: 978-9935-431-34-9

Stein, M. 2010. The oceanographic work of the Institute of Sea Fisheries in Greenland Waters, 1952–2008. Journal of Applied Ichthyology, 26: 19–31.

Vongraven, D. 2009. Background Paper: Circumpolar Marine Biodiversity Monitoring Program Version 13. Artic Council, Marine Expert Monitoring Group, April 2009.

Fisheries and Oceans Canada | Pêches et Océans Canada