

GOVERNMENT OF CANADA PROGRAM FOR INTERNATIONAL POLAR YEAR (IPY)

**2007/08 PROGRESS REPORT
JANUARY 2008**

Global Warming and Arctic Marine Mammals (GWAMM)

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1. Summary:

GWAMM project has developed a Community-Based Monitoring network within the Hudson Bay region. The network consists of Inuit subsistence hunt collections focused on Arviat, Sanikiluaq, and Repulse Bay. Partnering with northerners provides samples collected from the marine environment with an emphasis on seals and whales. However, a reference collection of samples from the complete food web is being developed to build a model of trophic interactions from marine mammals down to nutrients and phytoplankton. GWAMM is also a network project that links to other marine mammal studies going on in the region including movement studies of polar bears, photo-identification of bowhead whales, tagging ringed seals, tracing beluga diets from chemicals, and tracking killer whale predation too name a few. Early results indicate that with declining sea ice, the marine ecosystem is shifting from a polar bear-seal system with Inuit hunters at the apex to one dominated by cetaceans with killer whales at the apex. This shift will eventually result in the loss of Inuit traditional subsistence culture. As a result, our project has the added goal to provide northerners with information required to adapt to a rapidly changing world where Arctic marine mammal populations are showing demographic strain due to polar warming.

2. Introduction:

The new-GWAMM project operates at a much smaller scale compared to the original application. The project is focused in the greater Hudson Bay region and supports the core activity of developing Community-based Monitoring using marine mammals as the focus. Marine mammal tissues and potential prey are being collected from Inuit subsistence hunts in three main communities: Arviat, Sanikiluaq, and Repulse Bay. The objectives are to engage northerners in ecosystem science, develop community sampling, enhance arctic science by distributing collected samples to Canadian research labs, model the Hudson Bay ecosystem, and conduct space-use research into polar bears, whales, and seals. As such the project is linked to other Canadian IPY projects: "Marine Birds", "Greenland Sharks", "PanArctic beluga", "Disease", and "Polar Bears" and internationally within the ESSAR and PAN-AME clusters.

The GWAMM project examines the effects of global warming on water-based mammals in the greater Hudson Bay region as well as the indirect effects on northerners whose well-being relies on subsistence hunting. Research will answer: How will marine mammals adapt to global warming – and what are the possibilities for future survival? What is the relationship between warming temperatures and the habitats of polar bears, seals, walrus, and whales? What are the potential effects of global warming on reproduction, and how many mammals will survive? What will be the effects of changes on northern communities and Inuit lifestyle? How can we reduce the effects of these changes and shelter northerners and animals into an uncertain future?

Several areas of mammal health and ecology were studied through community-based monitoring, including diet, diseases, and stress. Eventually genetic and population modeling methods will be used to understand change. In particular, we plan to quantify changes in diet of seals and whales, reproductive success, condition, survival, and ultimately model how they will respond to new marine mammal species invading their traditional environment. Will marine mammals acquire more diseases or become contaminated by pollutants; will this affect their health; and finally the quality of the foods eaten by Inuit? Knowing how polar ecosystems may change with global warming assist in developing strategies for conservation and species management. Northerners depend on these species as a food source and as an integral part of their unique culture. Research results will help Inuit communities adapt to changes to marine mammal distribution and abundance while preserving their cultural lifestyle.

3. Fieldwork 2007:

The primary emphasis of GWAMM research is community-based monitoring with the collection of marine mammal samples from subsistence hunts. However, GWAMM also includes a larger vision of providing information necessary to predict change and provide northerners with knowledge that will assist adaptation to global warming. Here, we have used IPY funding to create an umbrella group that can network and share resources collectively. Therefore, we provide a brief summary of all field work in Hudson Bay that was conducted within the GWAMM network even though IPY funding was only able to assist a small portion of this research.

3.1. Community-based monitoring

During the 2007/09 fiscal year, community-based monitoring took place in the northern communities of Arviat, Sanikiluaq, Repulse Bay, and Igloolik.

In Arviat and Sanikiluaq, sampling programs were set-up with the local Hunters and Trappers Organizations to have local hunters collect biological samples and information from ringed and bearded seals harvested during the community's subsistence harvest. In March, prior to the subsistence hunts, sampling kits were sent to the communities. The assembled kits contained equipment and information hunters required to perform collections in the field (Appendix 1). In Arviat, a local dedicated hunter, Frank Naturansugnik, was hired to coordinate the collections, and act as the community sampler of seals. In Sanikiluaq, the HTO Secretary Manager, Lucassie Arragutainaq, acted as the sampling coordinator for the community. During the 2007/08 season fifteen hunters participated in the collections in Arviat, and five in Sanikiluaq, collecting a total of thirty ringed and seven bearded seals in Arviat, and forty-nine ringed and three bearded seals in Sanikiluaq since May 15, 2007. Biological information gathered from each seal included species, sex, date and time of kill, hunter's name, location, GPS coordinates, and habitat, as well as measurements of total length, auxiliary girth, hip girth, fat depth at sternum, fat depth at hips, body weight, and sculp weight. Biological sample collections included lower jaw, muscle, kidney, stomach, intestines, blood, reproductive tract, blubber, and liver.

Several researchers and graduate students also visited communities to collect biological samples and information from marine mammals. In September 2007, Steven H. Ferguson (DFO), Sebastian Luque (PDF), and Jeff Higdson (PhD Student) visited the community of Sanikiluaq to conduct the satellite tagging field research on seals (see 3.6 *Satellite tagging of ringed seals on Belcher Islands*). During this field work the team, assisted by two local guides and their children, collected biological samples and information from seven ringed and two bearded seals harvested by the hunters. In addition to the biological information and samples generally collected from seals (see above), additional collections included: whiskers, claws, and hair which were frozen at -25° C, as well as small tissue (liver, muscle, skin and blubber) and blood samples that were frozen at -70° C in a cryogenic dryshipper with liquid nitrogen.

Two separate research teams visited the community of Arviat, Nunavut during the 2007/08 field season. Trish Kelley (PhD Student) and Lena Measures (DFO Research Scientist) from 8 to 29 August 2007 to collect biological samples and information from beluga whales; and Magaly Chambellant (PhD Student), Tara Bortoluzzi (Community-based monitoring coordinator), and Ashley Gade (MSc Student) from 22 to 28 October 2007 to collect similar samples and information from ringed and bearded seals.

During the beluga whale sample collections Frank Naturasungnik, a local hunter, was hired as a local guide to assist the researchers (Appendix 2). Biological samples and information were collected from two beluga whales, and samples included: liver, muscle, blubber, lower jaw, eyes, reproductive tract, lung, and intestine, as well as small tissue (liver, muscle, skin and blubber) and blood samples that were frozen at -70°C in a cryogenic dryshipper with liquid nitrogen. Biological information gathered included: species, sex, date and time of kill, hunter's name, location, GPS coordinates, and habitat, as well as measurements of total length, auxiliary girth, hip girth, fat depth at sternum, and fat depth at hips.

During the October visit to collect biological samples and information from ringed seals, a total of thirteen ringed seals were examined by the research crew. In addition to the biological samples usually collected (above) whiskers, claws, and hair were also collected and frozen at -25°C , as well as small tissue (liver, muscle, skin and blubber) and blood samples that were frozen at -70°C in a cryogenic dryshipper.

Sandie Black (DVM) visited Repulse Bay from 28 July to 4 August 2007, to collect samples and information from harvested and captured narwhal whales. Biological samples and information from three narwhal were collected including reproductive tracts frozen at -25°C , and small tissue (liver, muscle, skin and blubber) and blood samples frozen at -70°C in a cryogenic dryshipper. Biological information was also collected for each whale including sex, body length, tusk length, location, time of death, external skin conditions, and the condition of the internal organs.

Jeff Higdon (PhD student) conducted field work on bowhead whales from 23 June and 14 July 2007, in northern Foxe Basin near Igloodik, Nunavut. During his research he was able to collect biopsy samples (skin and blubber) from 46 live bowhead using standard cross-bow and biopsy tip techniques. (See section 3.12. *Photographic identification and biopsy sampling of bowhead whales*).

3.2. *Beluga whale acoustics*

In 2007, underwater beluga recordings were collected from four locations: Churchill (Manitoba), Moose Factory (Ontario), Eastmain (Quebec), and Repulse Bay (Nunavut).

Very little is known about belugas in James Bay; however they are considered a separate stock. Two researchers, Elly Chmelnitsky (MSc) and Lisa Loseto (PhD), travelled to Moose Factory, Ontario from June 1-9, to collect recordings from James Bay whales. Moose Factory is a Cree community on the Moose River about 25km from the mouth of James Bay (southwest). Twenty-three belugas were seen on a recognisance flight in James Bay about 10km off the mouth of the Moose River. Boat-based surveys were conducted along the Moose River with local guides, Jeff Isaac and Rick Rickard, however no belugas were seen from the boat and no calls were recorded. The Moose Factory Cree and MoCreebec communities indicated that belugas are sometimes seen in early to mid-May just after the ice break-up.

Hundreds to thousands of the western Hudson Bay stock of belugas are found in the Churchill River in July and August. Two researchers, Elly Chmelnitsky and Patricia Kelley, recorded beluga and associated behaviours from July 9-24. Seventeen hours of recordings were collected using a portable system from a boat. Collections were done with a local whale watch company, Sea North

Tours (owner Mike Macri) and with Emmelia Stainton (MSc, University of Manitoba). An autonomous recording device was also deployed with the help of Jack Batstone and staff at the Churchill Northern Studies Centre from July 20-August 26 in conjunction with the killer whale project. The autonomous device is designed to record belugas and killer whales, as well as other vocalizing marine mammals in the vicinity.

Beluga recordings were also collected in James Bay in August 2007. One researcher, Elly Chmelnitsky, collected recordings near Eastmain, Quebec in conjunction with a beluga satellite tagging project (Dr. Mike Hammill, DFO Mont-Joli, Quebec). The recordings were collected using a hydrophone tethered to shore. Although many hours of recordings were taken each day, only a handful of calls were recorded due to the low density of beluga in the area. Other people involved in the project were Samuel Turgeon (Technician, DFO, Mont-Joli), George Kudlu (Inuk from Wemindji, PQ), and Donald Gilpen (a Cree from Eastmain, PQ).

During boat-based surveys for killer whales in Repulse Bay, Nunavut, beluga recordings were collected opportunistically by researcher Jeff Higdon (August 20-31) and Elly Chmelnitsky (September 5-19). In Repulse Bay, approximately 10 hours of recordings were collected some of which contain beluga calls. Repulse Bay belugas are considered to be part of the western Hudson Bay stock.

3.3. *Killer whale research*

This research project was initiated to study killer whales in the Canadian Arctic as a collaboration with Universities (University of Manitoba), Federal government (Fisheries and Oceans Canada), Industry (Manitoba Hydro), Consulting Companies (North/South), and northern governments (Government of Nunavut, Nunavut Wildlife Management Board, Nunavut Tunngavik Incorporated).

Past killer whale sightings were put into a Geographic Information System (GIS) database. In 2007 sighting forms (Appendix 3) were faxed and mailed to all Nunavut communities (HTA/HTOs and Conservation Officers). During 2007, we have received sighting forms or observations from Arviat, Kugaaruk, Clyde River, Repulse Bay, Rankin Inlet, Clyde River, Pond Inlet, Churchill, southwest Hudson Bay, and central Hudson Strait. In 2007 Researchers visited Pond Inlet, Moose Factory, Eastmain, Cape Dorset, Arviat, Sanikiluaq, Igloodik, Repulse Bay, Pangnirtung, Churchill, and Iqaluit, and corresponded regularly with NTI in Rankin Inlet. In Repulse Bay researchers collected Inuit traditional knowledge and conducted boat-based surveys for killer whales. No killer whales were encountered in either August or September, but researchers collected data on abundance of other marine mammal species (killer whale prey items) and collected hydrophone recordings. In northern Foxe Basin bowhead whales were surveyed for killer whale rake marks on their tail flukes to examine the frequency of killer whale attacks and determine if killer whales are selecting certain age and sex classes of bowhead whales.

Six autonomous passive acoustic recording devices were deployed in the waters at the Seal River near Churchill, Manitoba and in Repulse Bay (2 recorders), Bellot Strait, Rankin Inlet, and Milne Inlet. Unfortunately the hydrophones in Repulse Bay, Rankin Inlet and Milne Inlet were lost due to unusual ice conditions and currently we cannot account for them. We are developing specialized mooring and location devices to minimize loss of recorders in 2008 deployments. Portable hydrophones and recorders were sent to the communities of Rankin Inlet and Arviat and also used by researchers in Churchill, Pond Inlet, and Repulse Bay. Researchers have started listening to the recordings for killer whale sounds.

Extensive efforts have been conducted to contact Northerners and northern scientists to gather additional sightings and establish a sighting network to ensure that killer whale sightings are reported in a timely manner. To date, partnerships in this sighting network have included marine mammal scientists, ecotourism operators, Hunters and Trappers Organizations (HTOs),

Government of Nunavut Conservation Officers (CO), Nunavut Tunngavik Incorporated (NTI), and northern residents. The sightings database currently contains 485 sighting records, ranging from the early 1800s to the present (2007). The database was used to produce a summary of knowledge on Arctic killer whales for DFO (Higdon, 2007) and also in a manuscript on relationships between killer whales and sea ice in the Hudson Bay region (Higdon and Ferguson, submitted).

A photographic database is also in development, which will allow the identification of individual killer whales. Photographs have been provided by scientists, professional photographers, and northern residents. As new photographs become available they will be added to this database, which will allow us to determine movements and abundance of killer whales in Nunavut waters.

A study on Inuit traditional knowledge of killer whales was initiated in Repulse Bay in 2007, with 17 hunters interviewed. This research is expanding with Arviat, Rankin Inlet, Igloolik, and Hall Beach being surveyed in March 2008 and Cape Dorset and Kimmirut between October 2008 and March 2009.

3.4. *Marine mammal whale focal follows*

In summer 2007 field research was conducted on killer whales in Repulse Bay (northwestern Hudson Bay). On August 5, 2007 two autonomous acoustic recorders (AURAL, Multi-Électronique, Rimouski, PQ) were deployed from a small boat with the assistance of local Inuit guides. After deployment Repulse Bay experienced unusually heavy multi-year ice conditions and both hydrophone stations were lost. For 2008 a different mooring system is being developed which will eliminate this problem (a weak link on the surface buoy, so that it will come loose from the system if dragged by ice, leaving the hydrophone in place).

Field work including boat-based marine mammal surveys, portable hydrophone recordings, and attempted killer whale focal follows was also conducted in Repulse Bay from 20-31 August and 5-19 September 2007). No killer whales were observed, but sightings of all other marine mammals (potential killer whale prey items) were recorded using a standard boat-based survey methodology in which direction and distance to all sightings and boat speed and bearing were recorded. Eight marine mammal species were recorded – three whales (narwhal, bowhead, and beluga), four pinnipeds (ringed, bearded, and harp seals and walrus), and polar bear. The most abundant marine mammal species recorded was ringed seal. Approximately 10 hours of portable hydrophone recordings were collected, and these are currently being analysed.

3.5. *Aerial survey of seals, polar bears, beluga in western Hudson Bay*

The first of two consecutive annual aerial surveys was conducted from May 25th to May 30th, 2007 by Steve Ferguson, Blair Dunn (Technician, DFO), and Magaly Chambellant (PhD) using Churchill, Manitoba as the base. To allow comparison with aerial surveys completed in the 1990's by Nick Lunn et al. (2000) in western Hudson Bay, the flying protocol was replicated: a Cessna 337 "Skymaster", chartered by Wildlife Observation Services, was used to fly 10 transects of 800m wide between Churchill, MB and Arviat, NU at 150m altitude and 260 km/h speed.

The ten survey lines represented a total of 3074.5 km, were flown in 11 hours and 20 minutes and covered an area of 2459.6 km² over western Hudson Bay. Marine mammals encountered during the survey were ringed seals (*Phoca hispida*), bearded seals (*Erignathus barbatus*), polar bears (*Ursus maritimus*) and beluga whales (*Delphinapterus leucas*) (Appendix 4).

Seal structures recorded were haul-out holes (352) and crashed lairs (40). Signs of recent polar bear kills (blood on the ice) were spotted 13 times including an observation of a polar bear

feeding on an adult seal. Ninety seven (97) tracks of polar bear on the ice were recorded, as well as 8 arctic fox (*Alopex lagopus*) tracks.

3.6. *Satellite tagging of ringed seals on Belcher Islands*

The purpose of the fieldwork was to (1) collect samples from seals (September at Split Island) and (2) capture and tag 8 ringed seals. We deployed 2 flipper (location only) and 8 time depth recorders (SPLASH) tags satellite transmitters on eight seals. The objective of the capture and tagging study was to understand ringed seal movements and foraging ecology in Hudson Bay. Basic biological information (e.g., condition and morphology) and samples from live and dead seals were also to be collected (see attached field report).

We chose Sanikiluaq, Nunavut to conduct this study because of the amount of information already available on ringed seals from a research program initiated in 2003 as part of Magaly Chambellant's PhD research program. Following the advice of the Hunters and Trappers Association (HTA) and previous experience we chose September to conduct the capture and tagging research.

The fieldwork in Sanikiluaq took place from the 4th to the 20th of September, 2007. The field team from Winnipeg included Steven Ferguson, Sebastian Luque, and Jeff Higdon. The community-led field team included Lucassie Ippak (lead guide), Johnassie Ippak (guide), and Johnny, Andrew, and Sam Willie Ippak (assistants). Following advice from the HTA (meeting held 5th September), we set up camp at Split Island at the same site as was chosen for 2006 field work. While camping on Split Island we were able to successfully catch 8 live seals in nets. We deployed all 10 satellite transmitters, including 2 seals with both SPLASH and flipper tags. All 8 live-caught seals were flipper tagged. In total 4 pups were tagged (2 female and 2 males), 3 juveniles (2 females and 1 male), and 1 adult (male). All the tags are remotely monitored via satellites, which record the hourly locations of the seals (Appendix 5). All captured seals were measured (length, girth, weight) and had samples taken that included hair, whisker, blood, and for adults a fat biopsy was taken. Two of the tagged seals were harvested by local hunters in December 2007 and January 2008.

The Inuit guides harvested 7 ringed seals and 2 bearded seals during the field trip from which we obtained body tissue samples and detailed morphometric measures. Information gathered from this scientific harvest will include testing for chemical signals in tissue to understand what ringed seals eat. The guides were paid for harvesting the seals and they used the meat for food and sold the skin as agreed to by consultation with the HTA. We collected small tissue samples that were frozen at -70° C in a cryogenic dryshipper with liquid nitrogen brought for this purpose. We also spun blood samples using a centrifuge to obtain serum which was also frozen.

3.7. *Polar bear research in Churchill and western Hudson Bay*

Andy Derocher and graduate students from University of Alberta conducted polar bear research in western Hudson Bay from the Churchill area north to Wager Bay. Research efforts included collaring polar bears and mark/recapture studies to collect information on polar bear population demographic parameters. GWAMM supported students include: Seth Cherry (PhD candidate) conducting research on polar bear habitat use in Hudson Bay; Sarah Medill (MSc candidate) looking at teeth as life-history recording structures in polar bears; and Peter Molnar (PhD candidate, co-supervised with Dr. Mark Lewis) working on modelling the energetics of polar bears.

3.8. *Polar bear research in southeastern Hudson Bay*

Marty Obbard conducted polar bear research along the Ontario coastline of Hudson Bay from 25 September – 16 October 2007 by live-captured 15 bears on Akimiski Island in James Bay and an additional 90 bears along the Ontario coast between Cape Henrietta Maria and the Manitoba border. All handled bears were weighed to continue our monitoring of body condition in this population. Information on litter size and morphometrics provided to Peter Molnar for his work on energy budget models for polar bears. The field crew deployed 9 Telonics GPS/satellite collars on females accompanied by yearlings—2 on Akimiski Island and 7 along the Ontario coast. Females accompanied by yearlings were targeted for collaring since they will return to the sea ice and mate in spring 2008. GPS/satellite collars provided 6 locations per day with small location error—these data will provide detailed information on the location of breeding areas. In addition, information on sites chosen for maternity dens will be obtained once the bears return to land in summer 2008. Mark/recapture survey has provided polar bear tissue samples to develop an indice of health (see Chronic Stress Research below #10). Fat biopsy samples were obtained for collaborative work on foraging patterns of southern Hudson Bay polar bears with Greg Thiemann.

3.9. *Contaminants in marine mammals*

Gary Stern and Steve Ferguson have a student examining contaminants, environment, and biology of ringed seals collected from Arviat. Ringed seals are an excellent candidate to study contaminants because they are abundant, circumpolar in distribution, harvested for Inuit subsistence, occur in subarctic and Arctic, and are an important food source for polar bear and indigenous northerners. Currently Ashley Gade (MSc student) is studying the effects of climate parameters, such as sea ice duration and ocean-atmosphere interactions have on contaminant concentrations in ringed seals by testing for seasonal variations in concentrations of mercury and organochlorines (OC). Ultimately, plans are to determine if or what distinguishing OC signatures exist between populations and to compare the overall contaminant patterns in several populations of ringed seals. Preliminary findings suggest that seals have lower mercury contaminant loads following a long open-water season. A possible explanation of this phenomenon may be a shift in prey availability. Ringed seals in this region are reported to consume fish during ice-covered months and invertebrates in the summer. Marine fish have greater mercury than invertebrates because they are at a higher trophic position. The stable isotope data will help test this hypothesis.

3.10. *Chronic stress research on marine mammals*

Research into wildlife health was facilitated by the collection of serum and liver samples using cryo shippers that kept the field collection samples at -70°C. The focus of this research supported by Matt Vijayan (University of Waterloo) and Marc Cattet and David Janz (University of Saskatchewan) is long-term physiological stress as important factors linking human-caused environmental change (e.g., global warming) that may impact wildlife population health. The premise is that with adverse population performance long-term physiological stress will result in impaired health of individual animals, including reduced growth, suppressed reproduction, and immune functions. Long-term stress biomarkers are being developed using proteins and genetic techniques adapted from human health research to detect and measure levels of stress-activated substances found in the blood serum, skin, and hair of different species collected using non-invasive methods.

3.11. *Disease and parasite research on marine mammals*

To study natural diseases requires the collecting of a variety of tissues from hunter-killed beluga, narwhal, and seals. Research Scientist (Lena Measures), veterinarian (Sandie Black), and a PhD graduate student (Trish Kelley) worked together with community hunters to collect tissues samples from whales and seals as part of a disease/health project. We provided a contract to the Arviat HTA to hire hunters as guides to assist the researchers in reaching the hunt in August 2007 and thereby gain access to beluga whales harvested by hunters. The researchers conducted the majority of sampling and brought their own equipment and supplies to collect the samples from the whales for the natural disease and genetics work. Researchers worked with a local hunter and paid him as a guide through the HTA for this work.

Researchers are analyzing the samples this winter to look at two bacteria, *Brucella* and *Helicobacter*, as well as examine other organs for parasitic roundworm infections in the lungs, stomach, intestine and head cavities around the ears. Some tissues were frozen or preserved with a fixative in the field for later examination in the laboratory. Some of the various organisms studied could affect the health of beluga populations while *Brucella* could possibly pose a health risk to human hunters and consumers.

Continued sample collections with the community during 2008 will require scientists working along side the hunters to collect the additional tissues needed for the natural disease and genetics work from the whales already being sampled for the other tissues and organs. The data gathered from this study will provide a greater understanding of beluga whale ecology and assist in conservation and management.

3.12. *Photographic identification and biopsy sampling of bowhead whales*

Field work on bowhead whales was carried out between 23 June and 14 July 2007, in northern Foxe Basin, Nunavut, based out of the hamlet of Igloolik. Jeff Higdon, University of Manitoba PhD graduate student, participated in the research with the assistance of local Inuit guides and assistants. Local help, in addition to logistical support, was provided by Igloolik Outdoor Adventures.

A total of 15 days of field studies were conducted. Whales were encountered on all 15 days, with the number of animals observed per day ranging from 3 to > 50. A total of 46 biopsy samples were collected which are being analysed for genetics, stable isotopes, fatty acids, and hormones. Over 17 GB of photographs were collected. These photos are currently being sorted into a database of individual whales. Approximately five different cow/calf pairs were encountered which assisted the main study goal to determine calving intervals. All females with calves had significant markings which will enable re-identification of these individuals in subsequent years.

3.13. *Hudson Bay ecosystem modelling*

A model for Hudson Bay that will evaluate the consequences of climate change has been initiated by Carie Hoover (PhD, University of British Columbia) and Tony Pitcher with plans to create an Ecosystem Evaluation Framework to characterize, evaluate, and assess the status of Hudson Bay by creating temporal and spatial simulation models tuned to available abundance data. Using the models they will investigate inter-species and fishery interactions, ecosystem function and alternative harvesting scenarios. Thereby, results can forecast ecosystem changes by altering biotic factors in the models that are affected by temperature increases.

Preliminary results include data mining for the Hudson Bay region. The main issue needed to be addressed is a general lack of information on abundance of lower trophic level species. Even though the marine mammal abundance estimates for the region are reasonable the levels of fish

and zooplankton necessary to sustain them have not been assessed. A general understanding of the ecosystem is necessary before attempting future projections to assess the effects of loss of sea ice on marine mammals.

Once the model has been fitted to data, researchers will test various climate scenarios by correlating temperature increases to ecosystem function, for example primary production and sea ice extent. Historical data will provide results to compare with present day ecosystem models and explore a range of climate change scenarios into the future. By building a mass balance model, gaps in data, as well as ecosystem structure will be identified. Modellers will estimate the proportions of lower trophic level species that would be required to sustain the current populations of top predators in the area. In addition past, current and future fishing and marine mammal harvest levels will be evaluated in relation to their impact on the ecosystem. The model will be fit to time series data, where available, and the potential for changes associated with increasing bowhead whale biomass and the discrepancy between western and eastern Hudson Bay ecosystems addressed.

IPY provided funding for the student to visit Winnipeg (Freshwater Institute) for a week in November. She was able to learn from local scientists and students working on Hudson Bay about the main issues and data sources. Three issues were highlighted during meetings with FWI scientists: (1) given the lack of knowledge of fish and zooplankton can the model work backwards from knowledge of top predator biomass and estimate lower trophic biomass; (2) what can be understood about ecosystem response to the drastic bowhead whale commercial harvest during the past and how will the current increasing bowhead population impact Hudson Bay into the future, particularly with global warming; and (3) can the model help to understand the striking differences observed in ecosystem biodiversity between eastern and western Hudson Bay?

3.14. *Arctic marine mammal Traditional Ecological Knowledge (TEK)*

Researchers (Kristin Westdal, MSc University of Manitoba) applied and obtained approval from the local Arviq Hunters and Trappers Organization, Nunavut Research Institute, and University of Manitoba Ethics Board to conduct interviews with hunters and elders on killer whale ecology. Killer whale interviews were conducted in conjunction with narwhal interviews in or near the community of Repulse Bay between 20 July and 13 August 2007. Participants were encouraged to speak specifically to predetermined questions while allowing for spontaneous and greater length coverage of a variety of related topics. An interpreter was used for the majority of interviews to translate questions and answers. Seventeen community members were interviewed and participants were drawn from a list of potential interviewees from the Arviq Hunters and Trappers Organization by the project interpreter, Marius Tungalik. One crucial finding of the interview was that killer whales that frequented the Repulse Bay region were marine mammal eaters and none were fish eaters. Killer whales tended to migrate in and out of Hudson Strait using Frozen Strait and were likely the same whales observed along the west coast of Hudson Bay (e.g., Arviat). The number of killer whales frequenting this area during recent summers was estimated from 12 to 500 with the majority saying fewer than 50 in total with considerable year-to-year variation.

The success of this interview project has led to 4 more communities being interviewed during winter 2008 and plans for an additional 4 communities in 2008/09.

3.15. *Narwhal research*

Researchers (Jack Orr, Pierre Richard, Kristin Westdal) led a successful capture effort in the Repulse Bay area by catching and instrumented (satellite-linked time-depth recorders) four narwhals (3 males, 1 female) in early August 2007. Whales were tracked for 3- 4 months with

evidence for a seasonal migration from their summering area in the Repulse Bay-Frozen Strait area to the eastern portion of Hudson Strait where they likely winter (Appendix). The results will add to findings from five tagged narwhals that were instrumented in August 2006. Another field capture season is planned for August 2008.

3.16. *GWAMM IPY Workshop*

During the 17th Biennial Conference on the Biology of Marine Mammals, sponsored by the Society for Marine Mammalogy, Steve Ferguson, Lisa Loseto, Trish Kelley, Elly Chmelnitsky, Magaly Chambellant chaired a Workshop on 28 November 2007. The Workshop was on the Canadian International Polar Year projects, Global Warming and Arctic Marine Mammals (GWAMM) and Circumpolar Flaw Lead (Team 5 Marine Mammals and Birds). Students and scientists presented on the results of the first year's field work and made plans for next year's field work, 2008/09. Over 20 people attended and participated in discussions and assessment of the past year's field work as well as assisting in planning next year's field work.

4. Results:

This is our first field season and therefore few results have been completed. Many of the samples derived from Community-Based Monitoring are currently being shipped to scientists and Universities for analyses. Preparation of samples, laboratory analyses, and final results will be worked on over the winter. Some preliminary findings from 2007 field work provide information that has the potential to impact the science for climate change adaptation as well as the health and well being of northerners: (1) contaminant work completed thus far indicates that contaminant levels are nonlinearly associated with the number of ice-free days and Arctic pressure; (2) movements of polar bears and ringed seals differ and likely habitat selection by each species relates to avoiding predation (seals) or increasing probability of predation (polar bears); (3) IQ results indicate that killer whales in Hudson Bay feed on marine mammals and not fish; (4) TEK surveys provide examples of local hunters reporting uncommon sightings of marine mammals that would not normally be seen in Hudson Bay (e.g., humpback whales, Greenland shark, harp seals); and (4) differences in trophic structure and response to changing sea ice conditions between eastern and western Hudson Bay.

5. Data Management:

IPY GWAMM Metadata gathered in the 2007/08 fiscal year includes:

- 1) Biological samples and information collected from thirty ringed seals and seven bearded seals in Arviat, Nunavut, during the annual 2007/08 subsistence harvest.
- 2) Biological samples and information collected from 90 ringed seals in Sanikiluaq, Nunavut, during the annual 2007/08 subsistence harvest.
- 3) Biological samples and information collected from seven ringed seals and two bearded seals in Sanikiluaq, Nunavut, September 9 to 17, 2007.
- 4) Biological samples and information collected from two beluga whales in Arviat, Nunavut, August 15 to 19, 2007.
- 5) Biological samples and information collected from four narwhal whales in Repulse Bay, Nunavut, July 28 to August 4, 2007.

- 6) Biological samples and information collected from 46 bowhead whales in Foxe Basin, Igloodik, Nunavut, June 23 to July 14, 2007.

See ArcticNet website (<http://www.arcticnet-ulaval.ca/>) for metadata set(s).

Methods used to manage and archive data and metadata:

To ensure quality assurance and control with all the data, all field researchers and students, as well as local dedicated hunters collecting the samples, are trained on proper and safe biological sample collection and handling techniques. Sampling protocols developed also require careful consideration of the hunting procedures used and logistical problems in transporting sampling equipment and materials to remote locations with unpredictable weather and environmental conditions. Compromises have been made to adapt the rigorous sampling procedures to standard hunting practices and thereby insure cooperation of hunters.

Once the completed sample kits are received at DFO Freshwater Institute (FWI) in Winnipeg, technicians provide verification to ensure the quality and accuracy of the biological samples and information collected. Information on the biological samples and their associated field datasheets are then entered into our electronic sample database (Microsoft Access) and the physical samples are stored in FWI archive freezers at -25°C (alarmed and monitored). Associated freezer and storage box numbers also recorded in the sample database. Data entry is double-checked for accuracy, and the computer database is backed-up daily. The master copy of the sample database is only accessible to the data manager, thereby ensuring quality control. Requests for access to the electronic dataset or the physical samples must contact the data manager. Metadata for IPY collections are in the process of being entered on the ArcticNet website (<http://www.arcticnet-ulaval.ca/>).

Analysis of all the biological samples (i.e. fatty acids, stable isotopes, stomach content analysis, genetics, contaminants, stress) is conducted at accredited facilities that use standardized methods with appropriate quality control protocols (e.g., fatty acids, stable isotopes, contaminants). Detailed records of all analyses performed on samples and results (tables and graphs) are recorded and linked within the sample database. The data manager, Tara Bortoluzzi, also oversees all phases of the data handling (sample collection, storage, analysis, etc) to ensure consistency, as well as quality assurance and control.

The biological samples and information gathered via GWAMM IPY will provide a reference library of the greater Hudson Bay marine ecosystem species for future studies of population genetics, pathology, specimen identity, and systematics. The project will establish a representative collection for future retrospective environmental quality analyses as a part of an effort to document long-term trends. Presently, the specimen inventory is relatively small. However, the careful procedure of collecting samples and the rigorous protocols that are followed from sampling to analysis will make this collection of great value for future analytical work on environmental change and marine mammals in the Arctic. The project emphasizes coordination with northerners as integral to collecting samples with the aim to transfer this knowledge and responsibility to northern communities in the future.

6. Training and Capacity Building:

IPY GWAMM, integrated with other associated research initiatives, involves the graduate research training of eleven highly qualified students; 4 MSc. students (Ashley Gade, Elly Chmelnitsky, Sarah Medill, and Kristin Westdal), and 7 PhD. students (Magaly Chambellant, Seth Cherry, Jeff Higdon, Carie Hoover, Trish Kelley, Peter Molnar). In addition, GWAMM has created two positions for postdoctoral researchers (Sebastian Luque and Tara Bortoluzzi), and laboratory and field training for two undergraduate students, one of which (Brent Young) is currently

completing his Honours thesis as a result of IPY GWAMM funding, and the other (Bonnie Gemmill) started her MSc. degree in January 2008.

A Fort Richmond Collegiate Grade 10 student, Beth Ferreira, also benefited from the IPY research, as she worked with project scientists and graduate students to use ringed seal samples collected as part of the GWAMM - IPY project to conduct a Science Experiment. She entered in the 2007 Provincial High School Science Fair Competition and was invited to compete in the Canada-Wide Science Fair, where she won First Prize for a project titled "*Mercury in *Phoca hispida* vibrissae: a non-invasive approach to contaminant analysis*". As a result of her achievements, Manitoba Hydro agreed to fund her continued science studies at the Freshwater Institute and she worked part time on a new science experiment. Her research dealt with non-invasive techniques to test seals for mercury contamination levels and feeding behaviour. She was invited to present her findings at a conference in Japan in October 2007 and is continuing her science studies at the FWI in 2008.

The success of GWAMM - IPY is also dependent on the involvement of northerners in all phases of the research. As a result, researchers work side-by-side with northerners, resulting in beneficial learning opportunities for both parties. For instance, during the seal tagging field research in Sanikiluaq in September 2007, two local hunters (Johnnassie and Lucassie Ippak) worked with researchers to place satellite tags and collect biological data from ringed and bearded seals. As a result of this work, Johnnassie and Lucassie have learned hands-on the scientific methods used to collection biological samples and information from arctic seals, as well as the monitoring techniques and equipment used in biological studies of this kind. With additional training, GWAMM anticipates that in 2009 the northerners will be able to conduct the field research independently, with DFO supplying the necessary equipment and supplies. Similar working relationships and training are also occurring in other northern communities, including Arviat, Repulse Bay, and Igloodik, Nunavut.

In many of the communities we are also actively working with the elementary and high schools to engage and inform students of the scientific work occurring in their community, as well as across the Canadian Arctic. For instance while in Arviat, Nunavut in October, 2007 Tara Bortoluzzi (community-based monitoring coordinator) and Ashley Gade (MSc Student) visited the John Annalukjuak high school to meet with teachers and students to talk with them about research occurring in their community. The teachers and students were very receptive to the visit and as a result formal presentations and student involvement in the research are planned for the 2008/09 field season. Frank Naturasungnik, the dedicated hunter hired in Arviat to coordinate seal samples collections from local hunters, also gave a presentation in October, 2007 to the local elementary school to show students how he examines and collects biological samples from seals for our research (Appendix 7).

Further, in Sanikiluaq in September 2007, Steve Ferguson met with the Principal of the Nuiyak School (K-12), John Jamieson, regarding student involvement in local research. The principal organized classroom involvement that included a science-based curriculum with a field component whereby students used fish nets (supplied by DFO) near their school to collect marine mammal prey species (i.e. fish and invertebrates). During the 2008/09 field season researchers plan to visit the school to present research finding to the students and continue an active collaboration with IPY research.

Wherever possible, we are also trying to hire local students from communities to help with field work activities. For instance in 2007, Jeff Higdon (PhD Student) employed two high school students, Nathan Parker and Tamareese Akittirq from Igloodik, Nunavut, as field assistants, to aid with boat-based marine mammal sightings, photography, focal follows, and biopsy sampling (Appendix 8).

During the 2007/08 field season, scientists and graduate students visited several northern communities to make presentations to local Hunters and Trappers Organizations (HTO/HTA)

regarding past research and present research proposals; Arviat (April and October 2007), Cape Dorset (May 2007), Igloodik (June 2007), Repulse Bay (July, August and September 2007), and Sanikiluaq (September 2007). Meetings provided opportunities for knowledge exchange with researchers, students, and northerners, to everyone's mutual benefit. Thus, graduate students were provided hands-on experience working in northern communities and were able to make contacts for future work, while northerners learned about current research initiatives occurring in their community and novel science ideas.

The GWAMM Freshwater Institute group also organized a full-day (December 6, 2007) tour of the Freshwater Institute laboratory facilities for an Inuk guide from Sanikiluaq. Johnnassie Ippak has participated in community-based monitoring and assisted as a hunter and guide for the past 3 years. During the tour we explained to him all of the analyses and results derived from the marine mammal samples that he has provided. This included: sorting, freezer storage, sub-sampling, data archiving, genetics, fatty acids, stable isotopes, and mercury detection. We also took him to visit to the Inuit art display at the Winnipeg Art Gallery.

7. Communication and Outreach:

GWAMM research built on existing northern expertise, provided additional training and work opportunities for northerners, and ensured a blending of scientific and traditional methods and knowledge in the delivery of the projects. For example, tagging projects included ringed seals (Belcher Islands) and narwhal whales (Repulse Bay) depended on the participation of the local community members (i.e., guides and field assistants) who were familiar with the animal behaviours and regional geography. Community field projects such as killer whale focal follows, community-based monitoring, and bowhead whale photo-id involved northern students whom assisted with field activities as part of a northern initiative.

For seal tagging on the Belcher Islands the two Inuit guides hired to assist with field work brought along 3 young family members and we paid the children a fee through the Hunters and Trappers Association for assistance. The community supported us in hiring school children as they considered learning from their parents and elders out on the land as more important education than attending school. The Hunters and Trappers Association requested that the young assistants be paid for helping so that they could learn the value of science and the value of knowledge of the land (e.g., guides). Having children in our field camp added a special positive ingredient to our research activities and they earned their pay by helping with a number of activities during tagging efforts including, sampling seals, immobilizing, painting seal heads, taking pictures, cleaning nets, and as observers who typically saw seals and wildlife before the adults. Thus, our project was able to expand community consultations outside of the community to field situations. Data from the satellite tags were transmitted back to schools in the community in real time on a web site thereby making results immediately available to the scientific community, media, northern communities, the public, and students and teachers (<http://www.umanitoba.ca/faculties/science/zoology/faculty/ferguson/belchers>).

This project offers an opportunity to involve northerners in planning, execution and analyses of marine mammal data and transmitting this data to the community through interviews, community meetings, and development of an internet site to provide real time mapping of marine mammal satellite locations. To ensure knowledge transfer we provided (1) an annual workshops meeting with presentations of research with partners and the general public during the 17th Biennial Conference of the Society for Marine Mammalogy (November 29-December 3, 2007) in Cape Town, South Africa; (2) annual progress and summary reports regarding research for distribution to northerners (attached); (3) posters on community-based monitoring were distributed in Sanikiluaq, Arviat, and Repulse Bay as well as presentation to the communities (e.g., HTO/HTA) by researchers in Cape Dorset (April 2007), Arviat (October 2007), Sanikiluaq (September 2007); (4) presentation of research at scientific conferences (see Section 6c); (5) publication of research in peer-reviewed publications (Section 6c); and (6) media (e.g., BBC Frozen Planet) spotlight on the research. For example, five posters on research related to GWAMM – IPY activities were

presented during the 17th Biennial Conference of the Society for Marine Mammalogy (November 29-December 3, 2007) in Cape Town, South Africa.

Communication to the public occurred through 10 media interviews in 2007. These included a series of phone and on-site interviews with British Broadcasting Company and their plans to film Frozen Planet. We met with Elizabeth White and Miles Barton in Cape Town, South Africa in November and Jeff Wilson in Winnipeg in January to discuss field work for 2008. Science North had a series of interviews in April 2007 on a special IPY project that will tour Canada. Interviews with newspapers occurred in January 2007 (Ottawa Citizen, France Press) on global warming effects and interviews with Globe and Mail, CanWest newspapers, and Aboriginal People Television Network occurred in December 2007 on tagging of marine mammals relative to NTI's request to stop intrusive research. Radio interviews included Philadelphia radio on mammal penis bones (baculum). CBC North interviewed on killer whales for radio play 30 Aug. 2007. Interviews of graduate students by the media were conducted by Merica Tremblay (CBC Radio Quebec) and Jean-Francois Bouchard (Montreal Gazette) in June 2007 on killer whale studies in Churchill.

8. Plans for 2008:

Planned activities for 2008 field season are similar to field events that occurred during 2007. Differences include replacing Cape Dorset as a Community-based monitoring site with Repulse Bay. Specific fieldwork plans for 2008/2009 include community-based seasonal sampling with arrangements for procuring DFO Science Licence to Collect and Hunters and Trappers Organization letters of support from Arviat, Sanikiluaq, and Repulse Bay for seal and whale sampling. In March 2008 community consultation will occur with a visit to Repulse Bay and in March we plan trips to Arviat, Rankin Inlet, Igloodik, and Hall Beach for community approval and Traditional Ecological Knowledge on killer whales. In April, polar bear research will be conducted in the Churchill area. In May community sampling trip will occur in Sanikiluaq for beluga whales. An aerial survey of western Hudson Bay is planned from Churchill at the end of May. At the end of June a bowhead whale photo-identification project will be carried out in Foxe Basin and includes bowhead biopsies and tagging. In July the killer whale and beluga acoustic research will commence with behavioural sampling in Churchill and the deployment of autonomous acoustic recorders in Churchill area and Repulse Bay. Also, in Repulse Bay in July and August narwhal whales will be captured and tagged, work with British Broadcasting Corporation on surveying for killer whales, and the first of two focal follow studies. During August in Arviat, beluga whales will be sampled through Community-based monitoring project as will narwhal from Repulse Bay. A possible bowhead hunt will be attended by GWAMM researchers to collect additional samples including cryogenically (-70°C) frozen samples and reproductive tracts. Near the end of August ringed seal tagging will take place in Sanikiluaq. In September polar bears will be captured in eastern and western Hudson Bay projects for collaring with GPS satellite instruments and mare/recapture studies to obtain condition and tissue samples. In October Arviat will be visited to collect seals and conduct a Traditional Ecological Knowledge study of ringed seals.

Planned community visit and presentations include: Arviat in March, July and October 2008, Rankin Inlet in March 2008, Sanikiluaq in May 2008 and August 2008, Repulse Bay in August 2008, Igloodik in March and June 2008, and Hall Beach in March 2008.

Laboratory and data analysis throughout the year include stable isotopes, fatty acids, contaminants (heavy metals and organochlorines), genetics, stress proteins and microarrays, disease, and analyses of telemetry data.

Appendices

General information: (required) **Number:** ARSQ-07-_____

Species: ringed seal / harbour/ranger seal / bearded seal _____
 Sex: Female / Male _____
 Age (skin/floppy) _____ Time _____
 Hunter's name: _____
 Location: _____
 GPS location: Lat _____ N Long _____ W
 Habitat: Ice edge / Ice / Open water _____

Measurements: (required)
 Total length _____ cm
 Girth: 1. pulling girth _____ cm Fat depth: at sternum: _____ cm
 2. hip girth _____ cm at ribs: _____ cm

Weights:
 Total body weight _____ kg Sculp (skin+fat) weight _____ kg

Sample list:
 Lower jaw (whole) _____ Liver (skinned) _____
 Flippers (one whole) _____ Stomach (in vial) _____
 Ovaries/testes (whole) _____ Muscle/meat (in vial) _____
 Muscle/meat (from the back, below ribs) _____ Blood (in vial) _____
 Intestines (whole) _____
 Blubber/skin (below arched, include some muscle and skin) _____

Comments: _____

Appendix 1: Example of field data sheets (front and back), which are sent to hunters in northern communities to record information on ringed and bearded seals they collect biological samples from for the community-based monitoring program.



Appendix 2: Picture of Magaly Chambellant, Ashley Gade and Frank Naturasungnik weighing a ringed seal as part of the community-based monitoring in Arviat, Nunavut on October 24, 2007.

The image shows two versions of a 'Killer Whale Sighting Form'. The left version is in Inuktitut, and the right version is in English. Both forms are designed for data collection on whale sightings. They include fields for:

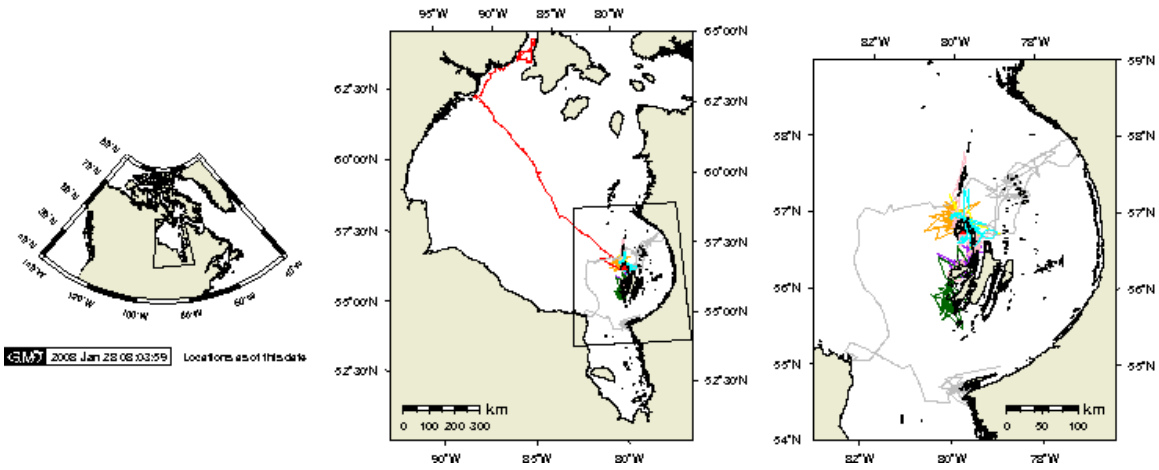
- Date and time of sighting
- Location and GPS coordinates
- Number of whales and their sex
- Activities (feeding, playing, swimming, etc.)
- Species identification (Orca, Minke whale, etc.)
- Observer information (name, address, phone)

 The forms also feature small illustrations of whales in various poses and species, such as breaching, playing, and swimming. The English version includes a note: 'Please use the back for any comments.'

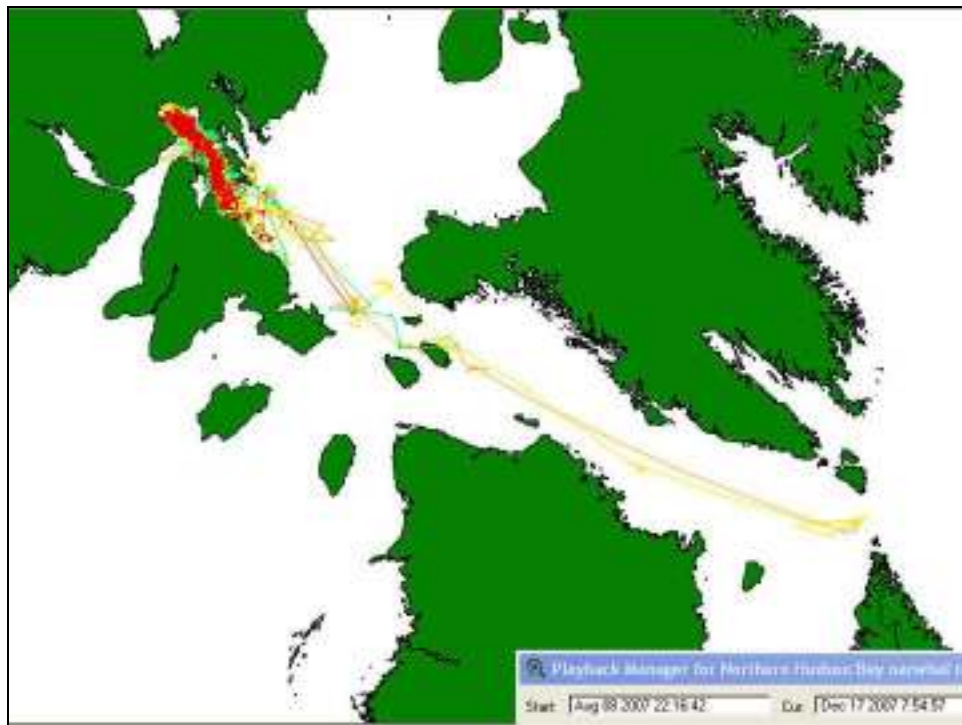
Appendix 3: Killer Whale sighting form, which was sent to northern communities to obtain information on sightings.

Line	Ringed seal			Bearded seal			Polar bear			Beluga whale		
	# ON	Dens.	# Total	# ON	Dens.	# Total	# ON	Dens.	# Total	# ON	Dens.	# Total
7	228	1.1774	249	6	0.0310	6	0	0.0000	0	1	0.0052	1
8	265	1.0026	276	1	0.0038	1	3	0.0113	3	18	0.0681	18
9	177	0.6708	204	3	0.0114	3	2	0.0076	2	22	0.0834	24
10	312	1.2047	345	1	0.0039	1	3	0.0116	4	6	0.0232	6
11	223	0.8601	261	2	0.0077	2	0	0.0000	0	1	0.0039	1
12	301	1.1563	336	0	0.0000	0	0	0.0000	0	1	0.0038	1
13	173	0.6852	186	1	0.0040	1	0	0.0000	0	8	0.0317	8
14	214	0.8592	253	1	0.0040	1	1	0.0040	1	7	0.0281	7
15	205	0.8757	228	2	0.0085	3	1	0.0043	2	16	0.0683	16
16	133	0.5949	173	2	0.0089	2	0	0.0000	0	2	0.0089	2
Total	2231	0.9071	2511	19	0.0077	20	10	0.0041	12	82	0.0333	84

Appendix 4: Number and density of marine mammals observed over the ten lines of the between Churchill, MB and Arviat, NU 26-29 May, 2007. #ON represents the number of animals seen on the 400m width of the transect for each side of the aircraft; #Total represents the total number of animals seen, whether they were on or beyond (off) the 400m width of the transect; 'Dens.' represents density and was calculated as the number of seals observed per line divided by the area covered by the 800m-wide transect on that line.



Appendix 5: Locations of 8 seals (as of 8 Jan. 2007) tagged during fieldwork in September 2007, on the Belcher Islands, Sanikiluaq, Nunavut.



Appendix 6: Movement of narwhal whales, tagged with satellite transmitters, over a four-month period from mid-August to mid-December, 2007. The narwhal were tagged in Repulse Bay, Nunavut.



Appendix 7: Photo of Frank Naturasungnik, the dedicated hunter hired in Arviat to coordinate seal samples collections from local hunters, giving a presentation to the local elementary school to show students how he examines and collects biological samples from seals (October, 2007).



Appendix 8: Photo of Jeff Higdon and his field assistant Tamareese Akittirq from Igloodik collecting photo identification information on bowhead whales in Foxe Basin, Igloodik (July 2007).