A monochromatic blue-toned photograph of an Arctic landscape. The foreground is filled with numerous icebergs of various sizes floating in a body of water. In the background, a range of snow-capped mountains stretches across the horizon under a cloudy sky. The overall scene is serene and cold.

Arctic Dinosaurs and Ecosystems 2007 Nunavut Expedition Proposal

Photo Credit: Hans Larsson

Nunavut 2007 - Expedition Summary

Locations:

Bylot Island and Baffin Island, Nunavut, Canada (72° 35' N, 77° 50' W).

Duration:

July 8th to July 27th, 2007 (2 ½ weeks)

Team Leaders:

Dr. Hans Larsson – assistant professor at McGill University, Montreal. Dr. Larsson has extensive field experience in Niger, Brazil, Morocco, Western Canada, and the Arctic.

Dr. Natalia Rybczynski – Research Scientist at the Canadian Museum of Nature. Dr. Rybczynski has extensive experience in Arctic fieldwork, having participated with 6 previous Arctic expeditions.

Objectives:

We will recover dinosaur and other animal remains from these localities, and assess their scientific value and climactic implications. These fossils will be prepared at the Redpath Museum and Canadian Museum of Nature and will be available for scientific study and potentially public viewing. We hope to further the study of Canadian palaeontology, specifically the study of past ecosystems, extinctions and the relationship to global climate. For more information, please refer to the attached expedition proposal.

Expected Weather:

Weather is highly variable in this region, with temperatures during the day varying between –20°C and +30°C. As well, due to the proximity of the Arctic Ocean, storms often come through the area, with high winds and rain or snow, posing a serious threat to poorly equipped expeditions.

Dangers:

Polar Bears are an ever-present threat, and this area is known to be a popular feeding ground for them. Extreme caution will have to be maintained at all times. Strict food storage procedures, mechanical alert systems (bear fence), chemical deterrents and if necessary firearms with less than lethal ammunition will be utilized in order to minimize this danger.

Finally the remoteness of the site poses another major danger. The only reliable method of transport in and out is by helicopter. This necessitates a degree of dependence on the equipment that we bring with us as well as training in medical and wilderness procedures.

Press and Photographic Potential:

Our previous expeditions have drawn considerable media attention from local and international sources including the BBC, CBC and Toronto Star. Due to the scientific nature of the expedition, all aspects will be thoroughly documented photographically. Please refer to the attached expedition proposal for photographs from previous expeditions.

Arctic Dinosaurs and Ecosystems 2007 Nunavut Expedition Proposal

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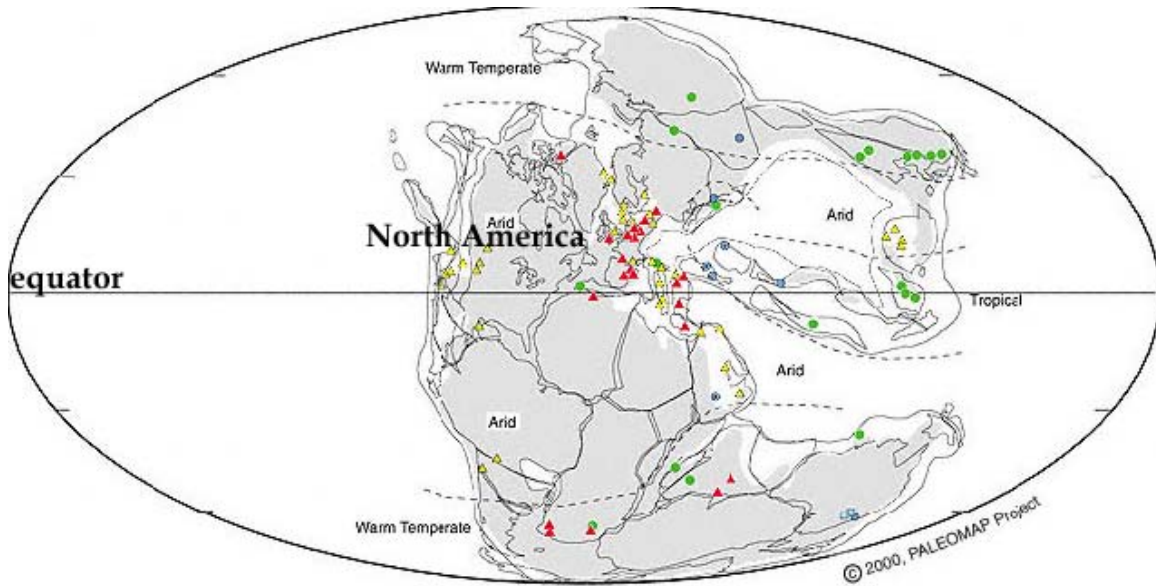
Summary

Our trip is primarily scientific in nature, and will be exploring various regions in the High Arctic for fossil remains of plants and animals. Our primary research goal is to learn more about global climate change and how it has changed in the past and may change in the future. Our party is made up of 6 members, all of whom have previous palaeontological field experience, and several of whom have previous Arctic experience. Our expedition will last for approximately one month, with most of the time spent actively hiking and searching for new fossil bearing localities. From July 8th to July 27th 2006, we will be traveling to Bylot and Baffin Islands in Nunavut, Canada. These locations are also above the Arctic Circle, and so we will be experiencing close to 24-hour daylight.

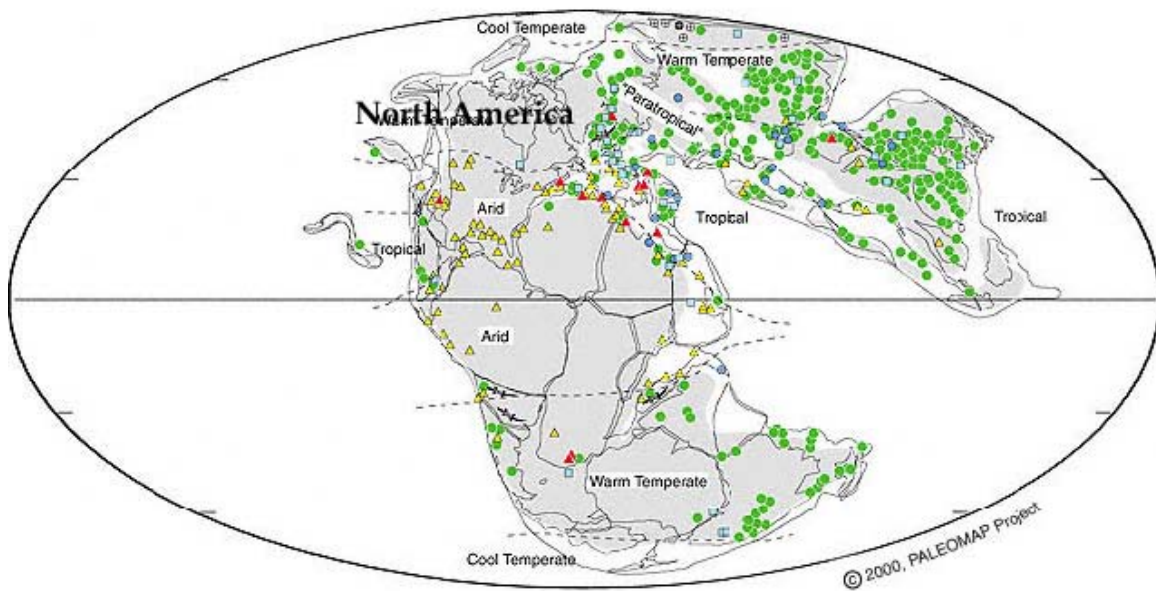
Introduction and Background

The Canadian Arctic is an extremely vast and relatively unexplored region in general, and especially in reference to paleontology. The existence of fossils in the region was first discovered in 1853, yet since this time, very little palaeontological exploration has been conducted (Tozer 1963; Ash and Basinger 1991). One of the most obvious reasons for this is the inaccessibility of the region and the short time period available each summer for expeditions. The Arctic holds great potential to increase our knowledge and understanding of the ancient world, in several respects. To date, much palaeontological work has been conducted in northern temperate regions, specifically southern Canada, the USA, and Europe. While the exploration of these regions has provided vital information about extinct ecosystems, little is known about extreme northern locations. Exploration of this region has the possibility for discovery of many new species unknown to science, as well as better understanding extinct ecosystems.

In the Mesozoic era (244 to 65 million years ago), the High Arctic was a very different place. At the beginning of the Triassic (248 to 206 million years ago) all the



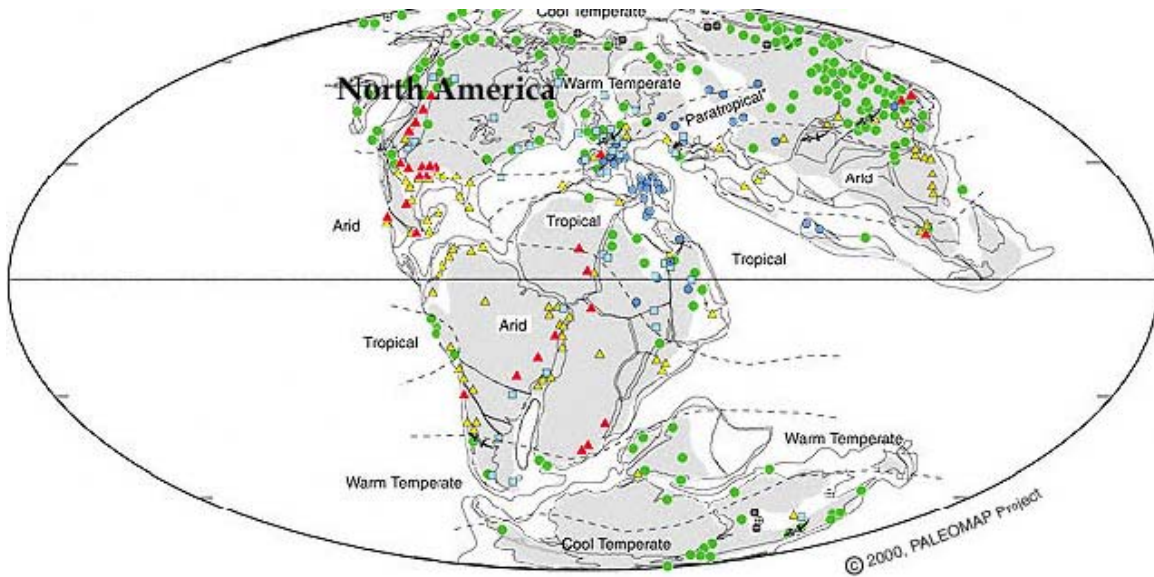
Lower Triassic - 240 million years ago



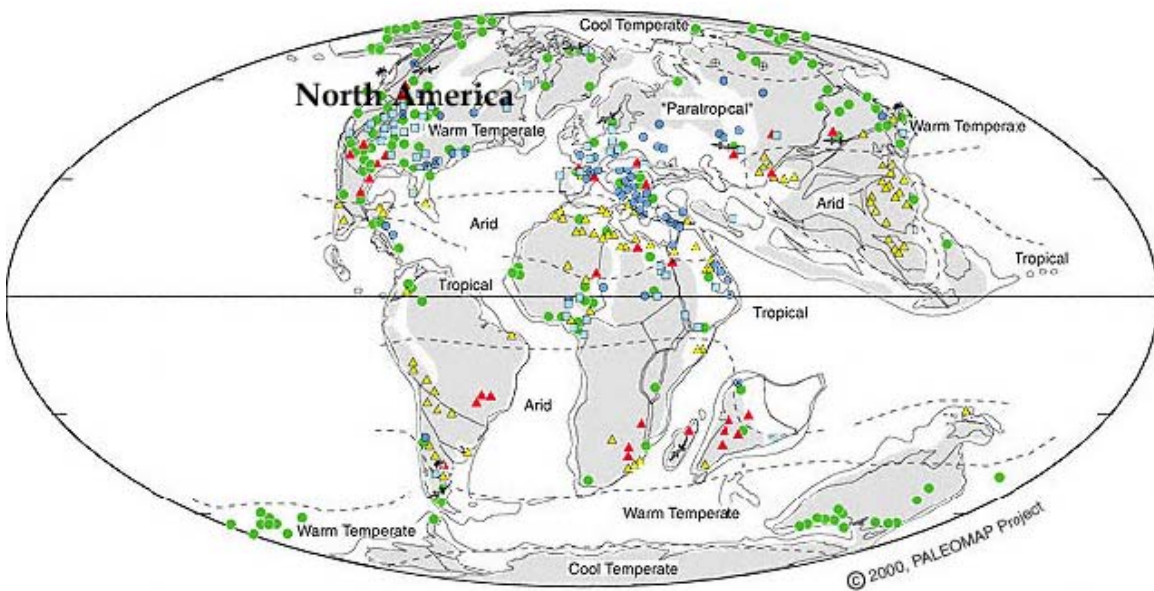
Lower Jurassic - 190 million years ago

Figure 1: Climate and continent positions during the Lower (Early) Triassic and Lower (Early) Jurassic. Note that during the Triassic North America was much closer to the equator than today, and that it was slowly drifting northwards during this time. Also, much of North America experienced hot, dry conditions during the Triassic, and the climate became gradually cooler and wetter by the Jurassic. Images adapted from www.scotese.com.

continents were assembled into a large super-continent near the equator called Pangaea. During this period, North America was moving from a position approximately 30 degrees further south than present to its current location (Fig. 1), leading to a major difference, especially in the northern latitudes, in both temperature and photoperiod (Ash and



Lower Cretaceous - 140 million years ago



Upper Cretaceous - 65 million years ago

Figure 2: Climate and continental position during the Cretaceous. Note that by the Lower (Early) Cretaceous North America was near its present day position, but that the climate was much warmer than today, especially at high latitudes. The temperature increased slightly into the Upper (Late) Cretaceous. Images adapted from www.scotese.com.

Basinger 1991). Much of the continent was experiencing very warm, dry conditions, much like those of the American southwest today. As time progressed, North America began to move further and further north. The Jurassic (200 to 144 million years ago; Fig. 1) saw the climate become cooler and wetter, especially in the Arctic. However, while it was cooling, the average temperatures were much higher than today, and regions that are year-round permafrost today probably never dipped below freezing during this time. We

know from some fragmentary evidence that at this time much of the Arctic Islands were part of a large, temperate rainforest, which probably supported a host of animals like lizards, amphibians and dinosaurs. During the Cretaceous (144 to 65 million years ago; fig 2) global temperatures probably reached a maximum, with regions in the Arctic possibly 20 to 30 degrees warmer on average compared to today, with abundant precipitation and very little frost (Wolfe and Upchurch 1987).

These warm temperatures gradually cooled off during most of the Tertiary (65 to 1.5 million years ago), yet still remained higher than today. During the Pliocene (5.3 to 1.8 million years ago) the temperatures were cooler than they had been 60 million years previous, but were still roughly 15°C warmer in Arctic regions than currently (Ballantyne et al. submitted).

Intended Study Sites

Our expedition seeks to expand our knowledge of ancient terrestrial ecosystems at times of dramatic climatic change. The research will explore rocks that record terrestrial fossils that lived at times preceding the climate changes. This data is vital to begin to assess how these terrestrial ecosystems changed in response to climatic changes, and how they may change in the future as the Earth experiences much warmer conditions due to human induced greenhouse gas production.

Our primary study sites for this expedition is Bylot Island, Nunavut. Bylot Island has been known for some time to have fossil localities. Previous expeditions by Larsson and Rybczynski have found diverse vertebrate fossil material including dinosaurs, birds and marine reptiles. However, previous expeditions' lack time, scope and focus on this productive locality. It is therefore our intention to thoroughly document the totality of fossils from this area of Bylot Island.

Our second intended study is a relatively unexplored area of Baffin Island, near Pond Inlet. This area's geology indicates that there is a good chance fossil material from the Mesozoic has been preserved. However, no palaeontological expedition has ever been mounted to examine this potentially important site.

Our ongoing group project is investigating in detail the biodiversity, productivity and provinciality in the Canadian Arctic during this time. Most of the data we have for the Arctic during this period comes from Alaska, Siberia and Greenland, while the number of fossils recovered from the Canada is extremely small. The main reason for this is not the lack of fossils in the area, but rather a lack of search effort, and so our goal is to change this.

By combining the data from productivity and diversity we hope to gain a more precise understanding of the ecological trends occurring across North America in the plant community at this time, such as provinciality and the floral response to long-term climatic changes on the order of millions of years. As well, questions about long-term changes in global temperatures at high latitudes can be examined.

Expedition Details

Group members – our group will be made up of 6 members:

Trip Leaders

Dr. Hans Larsson – Canada Research Chair in Vertebrate Palaeontology, McGill University, Montreal, Quebec

Dr. Larsson is an Associate Professor at McGill University, specializing in evolution of archosaurs (birds, crocodiles and dinosaurs). His research utilizes several different approaches, using developmental data from modern animals and using the fossil record to search for patterns in how these groups have evolved into their present state. His previous fieldwork includes expeditions to Africa, South America and Western Canada. He has participated in three previous expeditions to the Arctic, gaining valuable experience for operating in the region.

Dr. Natalia Rybczynski – Research Scientist, Canadian Museum of Nature, Ottawa, Ontario

Dr. Rybczynski is an expert on fossil mammals, especially rodents and their relatives. Much of her research has focused on the chewing apparatus of terrestrial herbivores, and comparisons between fossil mammals and reptiles. Interesting outcomes of her research has led to a new understanding of the functions and origins of woodcutting in beavers. Her interests also include evolution of Mesozoic and Cenozoic terrestrial communities in the Canadian Arctic. She has also participated in six previous Arctic expeditions, including five to the High Arctic, bringing a great deal of experience in organizing and coordinating our efforts in this harsh environment.

Team Members

Maria de Boef – McGill University, Montreal, Quebec

Maria is interested in bone histology and microstructure. By examining the bones of ancient animals, we can gain important insights into their behaviour and ecology. An important aspect of this trip for her is finding possible evidence for or against the theory that dinosaurs migrated, much as modern caribou in the region do today. This can be investigated by examining the growth patterns in ancient bones. She has participated in fieldwork in Western Canada as well as a previous expedition to the high arctic.

Alex Dececchi – McGill University, Montreal, Quebec

Alex is an MSc student studying changes in dinosaur limbs and their evolution into bird wings. Work in this region is important for him as the localities we are traveling contain important bird fossils as well as dinosaur fossils and so may yield important fossils for his studies. He has participated in previous fieldwork in Western Canada, Newfoundland and a previous expedition to the high arctic.

Luke Harrison – McGill University, Montreal, Quebec

Luke is an MSc student studying the evolution of development, with a specific focus on the fin to limb transition as well as the evolution of skeletal patterning changes. He done fieldwork in Western Canada for a number of years as well as Northern Ontario.

Matthew Vavrek – McGill University, Montreal, Quebec

Matthew is a Ph.D. student at McGill University, specializing in biodiversity and

productivity of ancient ecosystems. He is the team's plant expert, and is most interested in discovering the fossil flora of the area. He has spent several summers doing field research in Western Canada, Lebanon and the high arctic.

Travel Itinerary

We will be traveling by commercial aircraft from Montreal, Quebec and Ottawa, Ontario through Iqaluit, Nunavut on our way to our final commercial destination of Pond Inlet, Nunavut. From there, we will proceed by helicopter to our main locality on Bylot Island. Once on Bylot, we will prospect for new fossil sites as well as a thorough re-examination of known dinosaur fossil localities. Any and all fossil material will be carefully collected and packaged for the return journey. Several multi day trips, potentially involving glacier travel are planned to sites where geological data indicates a good probability of fossil bearing rocks. After approximately two weeks on Bylot, we will fly via helicopter back to Pond Inlet. Once there, we will embark on a multi day exploratory excursion in the immediate surrounds of Pond Inlet, whose rocks have a good potential for fossil material. Finally, we will fly back to Montreal via Ottawa with the collected material for preparation at both McGill University and the Canadian Museum of Nature.

Trip Preparation

Current preparations are underway for the summer. Funding for logistical support has been secured from the Polar Continental Shelf Project (PCSP), McGill University and the Canadian Museum of Nature. As well, several individuals have applied to the Northern Scientific Training program to support transport to the Arctic. Transport while we are in the Arctic has been arranged through the PCSP, and they will be providing us with communication support as well. Also, we have our own satellite phone should an emergency arise.

All necessary permits (Nunavut Palaeontologist Permit and National Park Permit) are in the final stages of approval. As well, all of the members on the team have at least a basic level of First Aid, and four members have training in Wilderness First Aid, with a special emphasis on Arctic and cold regions. As we will be in regions with polar bears, several members do have their firearms licenses to carry a shotgun, and two more will be completing a course before we leave to obtain one.

Environmental Impact

The Arctic may seem to some like a harsh, rugged place, but the ecosystems found there can be fragile. Our expedition will be sensitive to the local flora and fauna, as we will be concentrating our efforts and time on exposed rock surfaces. This is primarily because any attempt to prospect for fossils in areas covered by soil or vegetation is far too time consuming, as well as respecting the environment.

Photographic Potential

Our project is heavily dependant on high quality photography. We will be photographing all the localities that we will be exploring using several high quality cameras, as any material we publish on must be well documented. This means not only close in photographs of each specimen, but also wide-angle photos of the general outlay of the region the fossils were found in. This alone would be able to provide our sponsors with high quality photographs of a very remote region. As well, we will be photographing while we are moving from site to site, showing our group members wearing any sponsored gear in an extreme region with extreme climates.

Education and Outreach

In previous years, expedition members have given talks to widely different groups of individuals. Drs. Rybczynski and Larsson have both presented talks in the northern communities in which they were based, as well as public lectures in their home cities of Montreal and Ottawa. In addition to lectures intended for the general public, they have given several oriented towards a more scientific audience. As well, Matthew Vavrek has presented research on some of the fossils recovered from Axel Heiberg Island at a scientific conference. We are further investigating opportunities to present our research and findings to as broad an audience as possible, and would welcome any invitations from your organization to discuss our expeditions, both past and future, in any context. Please note that as our members do originate from several regions (Montreal and Ottawa) making us readily available in a number of major centers, and that several of our team members are bilingual (English/French).

Press Coverage And Publicity From Previous Expeditions

In previous years, our Arctic expeditions have garnered reasonable interest from major media outlets, such as CBC, BBC The Washington Post and The Toronto Star (see list at end of section). The hope is that with this expedition there is a much greater potential for finding even more and better preserved remains. This trip is also concerned with changes in biodiversity and what ecosystems were like in the high Arctic when there were high temperatures in the region, leading to a better understanding of long term climate change.

Manuscripts are also now being submitted to scholarly journals for publication on finds from previous years, as well as presentations (oral and poster) at many major scientific conferences. Any support for this project would be recognized in these articles and presentations.

Previous Press Coverage

CBC (http://www.cbc.ca/story/science/national/2004/10/19/dino_baffin041019.html)

BBC (http://www.bbc.co.uk/radio4/science/leadingedge_20040701.shtml)

Washington Post (<http://www.washingtonpost.com/ac2/wp-dyn/A40810-2004Oct17?language=printer>)

Science Daily (<http://www.sciencedaily.com/releases/2004/10/041018084253.htm>),

Alaska Science Outreach

(http://www.alaskascienceoutreach.com/index.php/science_seen/item/tyrannosaur_fossils_found_in_canadian_arctic/)

Toronto Star Article

(<http://pqasb.pqarchiver.com/thestar/access/1078818881.html?dids=1078818881:1078818881&FMT=ABS&FMTS=ABS:FT&date=Jul+18%2C+2006&author=Peter+Calamai&pub=Toronto+Star&edition=&startpage=A.03&desc=Sea+monsters+found+in+Arctic>)

Requested Items

As each region we will be visiting is hundreds of kilometers away from any permanent structures, we will be camping in tents for the entire trip. While PCSP has provided us with very durable tents, they are unable to provide sleeping bags. Each of us will require a sleeping bag rated to at least -15°C , as well as some type of resting pad, as the temperatures can drop very low, even during the middle of summer. As well, each person will need a full wind and rain proof breathable jacket and pants, as if poor weather strikes during the middle of the day we will have no way to immediately find shelter. The ground in the area is permafrost, and during the summer the upper layers melt while the lower, frozen layers prevent the water from draining away, making the ground soft and wet. This means that each person must have sturdy waterproof hiking and a pair of gaiters. During the prospecting phase, we will be backpack camping, and so a solid, large volume (80L+) backpack will be essential. A smaller size is not an option as we will not only be packing our gear and food, but also any fossils that we find along the way. Because we will be hiking for such prolonged periods over difficult terrain, everyone should have a set of hiking poles to aid them. GPS units are also very important, as we will be in regions without any trails and a very poorly known topology, so it is essential that we can accurately map our location at all times. Other minor but important items are also needed, such as warm, waterproof gloves and hats/toques, thermal underwear socks, sunglasses/ski goggles, watches, multi-tools/knives, binoculars and socks.

Summarized List of Items

Primary Items Required:

- Sleeping Bag (rated -15°C or better)
- Sleeping Pad
- Waterproof, Breathable Jacket/Pants
- Hiking Boots (waterproof) and Gaiters
- Frame Backpack (80L+)
- Hiking Poles
- GPS

Secondary Items Required:

- Waterproof Gloves and Hats
- Neck Warmers/Balaclavas
- Thermal Underwear
- Socks
- Sunglasses/Ski Goggles
- Watches
- Multi-tools (ie knives, etc)
- Binoculars

Further Information Online

International Polar Year Proposal - Pliocene Forest Communities of the Canadian High Arctic - A Time Capsule for Climate-change Research

(<http://www.ipy.org/development/eoi/proposal-details-print.php?id=320>)

International Polar Year Proposal - Cretaceous – Tertiary Vertebrate Faunal Transition

(<http://www.ipy.org/development/eoi/details.php?id=955>)

Larsson Lab website

(<http://www.redpath-staff.mcgill.ca/larsson/index.htm>)

First known fossil chewing reptile

(http://news.nationalgeographic.com/news/2001/06/0607_chewer.html)

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Budget

Funding Sources

Grant Name	Amount	Confirmed	Pending
NSERC (Larsson and Rybczynski)	\$5,000	X	
Canada Research Chairs (Larsson)	\$6,000		X
Northern Science Training Program (de Boef, Dececchi, Harrison and Vavrek)	\$4,000 X 4		X
Canadian Museum of Nature, internal funding (Rybczynski)	\$4,000	X	
Redpath Museum, internal funding (Larsson)	\$1,000	X	
Polar Continental Shelf Project (Larsson and Rybczynski)	\$72,000	X	

Total Estimated Grant Funding: \$104,000

Most of the funding for the trip has already been confirmed, including the most important and largest grant, that from the PCSP. PCSP is the governmental agency which co-ordinates the transportation, communications, accommodations, field equipment and related services for researchers within the Canadian Arctic. By having this confirmation, our travel plans are relatively set with no major further organizational problems while we will be in the Arctic. Most of the other grants are to help cover food and transportation costs to the Arctic.

Expenditures

Trip Expense	Cost/person	Total
Commercial plane tickets to Resolute, Nunavut	\$4,000 X 6	\$24,000
Air support in Nunavut		\$69,000
Equipment Rentals		\$8,000
Lodging/meals in Resolute	\$500 X 6	\$3,000
Meals while camping	\$500 X 6	\$3,000

Total Estimated Expenses: \$107,000

The largest expenditure by far will be air travel to and support in the Arctic. The cost to fly on commercial airlines to Resolute is approximately \$4000 per person, and while we are in the area helicopter and twin otter time is quite expensive. The other major costs are equipment rentals, which include tents and communication equipment, and food costs both while in Resolute and in the field.

Personal Gear Budget

Item	Cost
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Sleeping Bag (rated -15 ^o C or better)	\$300
Sleeping Pad	\$75
Waterproof, Breathable Jacket/Pants	\$500
Hiking Boots (waterproof) and Gaiters	\$250
Frame Backpack (80L+)	\$300
Hiking Poles	\$150
GPS	\$150
Waterproof Gloves and Hats	\$75
Neck Warmers/Balaclavas	\$40
Thermal Underwear/Socks	\$100
Sunglasses/Ski Goggles	\$100
Watches	\$100
Multi-tools (ie knives, etc)	\$80
Binoculars	\$100

Personal Gear Total: \$2320

While we obviously have a large budget for this expedition, what is not readily apparent is how the grant monies are awarded. All of the grants listed above are explicitly for logistical purposes, and are not allowed to be used for the purchase of personal equipment. Because many of our members are students our group is on a restricted budget, and so any possible donations of gear or any other support would be greatly appreciated.

Sample Images From Previous Expeditions



