FALL/WINTER 2006

MERIDIAN

IN THIS ISSUE

FOOD SAFETY AND FOOD SECURITY IN THE CANADIAN ARCTIC

Laurie H.M. Chan

Aboriginal communities in the Canadian North rely heavily on traditional food. Traditional food has been defined as locally obtained food, either from plants or animals, that is almost always culturally and geographically specific, is strongly linked to cultural values and identity, and is harvested sustainably. Traditional food has played an imperative role in the health of aboriginal people in Canada and remains a key component of the modern lifestyle of many Northern aboriginal communities.

An abundance of literature emphasizes the local nutritional importance of these foods at various levels of intake. Some of the key studies were done over the last 15 years by researchers at the Centre for Indigenous People's Nutrition and Environment (CINE) of McGill University, who conducted extensive dietary surveys in the Dene and Métis communities along the Mackenzie River in the Northwest Territories and in the Yukon, and with Inuit in Nunavut and Labrador. They found that the Dene and Métis consumed 101 traditional food species, with moose, caribou, whitefish, spruce hen and jackfish eaten most frequently. Caribou and moose meat were the main sources of energy and the essential nutrients protein, iron, zinc, copper and magnesium. Smaller mammals, fish, and birds were also shown to provide a large quantity of vital nutrients.

Inuit consumed the highest quantities of traditional foods among the indigenous communities in Northern Canada. The Inuit traditional food system includes over 300 species of marine and land mammals and birds, including caribou, ringed seal, narwhal, beluga, arctic char, polar bear, and berries. Traditional foods were the main dietary contributors of many nutrients, such as protein, omega 3, iron, zinc, copper, selenium and vitamin A.

In all three studies, it was found that a diet consisting of even small amounts of traditional food would provide a better composition of nutrients than a diet of only non-traditional (market) foods. The frequency of traditional food consumption was influenced by many different factors including availability of traditional food in the geographical area and the cost of market foods in the local store. Participants also reported that they would eat more traditional food if it were available.

An alarming trend is the general increase of market food: younger generations were found to be consuming less traditional food than their elders. This shift from traditional to market foods has meant an increased intake of carbohydrates and saturated fats, which could play a main role in an eventual increase in chronic diseases.

Food insecurity, or the unavailability

or inaccessibility of nutrient-dense and high-quality foods, is a crisis for the Canadian North. The Canadian Community Health Survey (2000–2001) showed food insecurity to be far more prevalent in all three territories than in any of the provinces, and significantly above the Canadian average. The problem is particularly severe among low and lower-middle income households in Nunavut: two-thirds (68%) of people in such households had at least one occasion in the previous year when they had insufficient food because of a lack of money. Barriers to food security are strongly rooted in poverty, inexperience with market food selection and preparation, and the absence of someone in the household capable of hunting. Food in the North is more expensive – it can be over three times the cost of food in the south – due to high distribution costs and low supply. Poverty restricts or cuts off access to nutritious but expensive market foods, which include nutrient-dense perishables shipped from the South, and also prevents participation in hunting for nutritious country food.

Young people, women, and the elderly have been identified as most vulnerable to food insecurity. Moreover, women and children consume the least traditional food within the household and are at highest risk of obesity and diabetes. In addition, the lack of a male head of household and, to a lesser extent, access to an income are significant in determining the consumption of traditional foods. Women and children are particularly vulnerable to food insecurity as they generally neither hunt nor have enough money to afford high quality market foods.

We conducted six focus group interviews in six Nunavut communities in 2003–2004 on food security issues. These revealed a high level of food insecurity and poor dietary quality. Income level, food choices and preferences, education, social structure and lifestyle changes, and social problems and traditional food accessibility and availability constituted the major barriers to food security. Those with the most difficulty obtaining traditional foods were families with low cash flow, families with no hunter, people with substance abuse and gambling problems, and elders who had to help support their children and grandchildren. The participants suggested the situation could be improved by providing resources for community hunts and community freezers; improving access to traditional food, especially for youth; developing programs that teach young people land skills so they can hunt for the community; and teaching youth and parents food preparation, including market and traditional foods. We have taken their advice and are now developing an intervention program with various communities in the North to promote the use of traditional foods to improve food security.

Community consultation meeting held in Repulse Bay, Nunavut. Photo: courtesy Laurie Chan.

While it is important to promote traditional food, the quality or safety of the food is another concern. Environmental contaminants such as organochlorines and heavy metals are found in the Arctic environment as a result of long-range atmospheric and oceanic transport and local mining activities. Potential health effects on indigenous peoples are a concern because humans are at the top of the food chain. Some of these pollutants are known to bioaccumulate, and animals at high trophic levels, such as fish and marine mammals, are important components of the traditional diet in the Arctic.

Both dietary exposure assessment and biomonitoring studies have shown that Inuit exposure to these pollutants is higher than the Canadian average. Initial results from an ongoing cohort study among the Inuit population of Nunavik have shown a decrease in birth size possibly related to increasing PCB concentrations. Ongoing studies related to this birth cohort study have also found a possible link between contaminants and immune deficits in Inuit infants.

With the implementation of the Stockholm Convention on Organic Pollutants and the active research and communication activities conducted under the federal Northern Contaminants Program, there is an increasing awareness of contaminant issues in the Canadian Arctic. Key among them is the balance of risks and benefits associated with eating traditional food. The current consensus appears to recognize the importance of maintaining or even promoting more use of traditional foods while actively improving the characterization of the health risk associated with contaminant exposure, through research.

Another threat to the traditional food system is the impact of climate change on the availability of food species. Climate change, with its potential for a variety of

both negative and positive impacts on human health, has been described as one of the most significant environmental challenges the world has ever faced. The Canadian Climate Centre has participated in numerous studies that investigate the potential impacts of climate warming. Conclusions from these studies identify the following impacts of climate change on resource management in the North: a change in precipitation, decrease in arctic sea ice, change in boreal forest stability, species composition, forest fires, and foraging difficulty for caribou, causing decrease or relocation of herds. Modelling studies have shown that climate change will cause permafrost thaw which creates the possibility of changes in land and water. The potential effects of these changes include a serious threat to food security and possibly to the survival of some of these cultures.

We conducted a participatory research project with two communities in the Yukon (Beaver Creek) and the Northwest Territories (Deh Gah Got'ie First Nation in Fort Providence) with the objective of documenting observations of changes in the local environment and their impacts on traditional food systems. We asked both specific and open-ended questions to gather information about the traditional food harvest, and conducted a qualitative analysis. The results showed that people from both communities are witnessing changes in climate that are affecting the traditional food harvest. To maintain an adequate supply of traditional food, community members have had to alter their harvest mechanisms. It is clear that a commitment to programs that will protect traditional food systems is necessary.

Caribou is an essential part of the Inuit diet. Apart from the meat, many other parts are edible, including the stomach contents and even the hooves. Caribou-skin clothing is unsurpassed for lightweight warmth in extreme cold. Photo: courtesy Laurie Chan.

Predicting how climate change will alter contaminant transport to the Canadian North in the global environment remains a challenge. It requires detailed knowledge of the physical and chemical properties of contaminants as well as understanding of environmental pathways and how they might respond to changes caused, for example, by altered atmospheric greenhouse gas composition. We presently lack this depth of understanding. However, it is well established that the dietary composition (*e.g.*, marine *vs.* terrestrial, fat *vs.* protein, old fish *vs.* young fish) can determine the amounts and kinds of contaminants ingested. Dietary changes can occur because of fluctuations in the populations of target species as discussed above (*e.g.,* beluga, bowhead whales, walrus, seals, bears, birds, fish, caribou, muskox) or by changes in access to the species. Shifting from lake trout to whitefish, for example, will decrease the intake of mercury whereas eating more marine mammals than land mammals will increase the intake of mercury and organochlorines. We are currently conducting various modelling exercises to project such changes. The research activities in this area require strong community support as well as collaboration with researchers from diverse disciplines. New paradigms are often required to integrate the newly generated information as well as translate them into policy. It is hoped that the information collected and the research results will help the communities increase their capability to develop adaptation plans and health promotion programs.

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UNDERSTANDING PERMAFROST–CLIMATE RELATIONS IN THE YUKON AND NORTHWEST TERRITORIES

Chris Burn

The National Sciences and Engineering Research Council of Canada (NSERC) Northern Chair program at Carleton University concerns permafrost in the Yukon and Northwest Territories. The program collaborates with several northern agencies. Formal partnerships have been established in the Yukon with the Village of Mayo, the First Nation of Na Cho Nyak Dun, Yukon Parks, and Yukon College, and in the Northwest Territories with Water Resources Division of the Department of Indian Affairs and Northern Development (DIAND), and Aurora Research Institute. W also have ongoing research with the Vuntut Gwitchin First Nation, the Western Arctic Field Unit of Parks Canada, and the City of Dawson. Our research program has been generously supported by the Polar Continental Shelf Project of Natural Resources Canada.

A large part of the program is devoted to capacity building in the North towards land and resource management, particularly to recognize the role of research in sustainable development. All our students engage local assistants for their fieldwork, and two of our present graduate students are northern residents. An important element of our program has been the residency of postdoctoral fellows at our partner institutions. Dr. Steve Kokelj spent his fellowship at Water Resources Division, DIAND, Yellowknife, and Dr. Jill Johnstone was at the Northern Research Institute, Yukon College. Steve has remained on the DIAND staff in Yellowknife and is engaged in permafrost research both in the Mackenzie Delta area and near Yellowknife. Jill has recently accepted a position as Assistant Professor of Biology at the University of Saskatchewan.

A primary focus of the research program is to improve understanding of permafrost–climate relations, so that we will be better able to predict the impact of climate change on permafrost terrain. There are few climate-change skeptics in the western Arctic and Yukon, where, since 1970, climate warming has become an accepted part of everyday life. At present, the noticeable effects in NWT include later openings and earlier closures of winter roads, while in Yukon northward range expansions of birds and mammals are commonly noticed. We have been working continuously in central Yukon since 1982, when the Carleton permafrost research group began fieldwork just outside Mayo under the supervision of Michael Smith. My wife and I met in Mayo, and so it has been a somewhat natural progression for us to return to the community each summer as a family. We have been welcomed warmly every year, and the students who have conducted their field work there have similarly enjoyed their sojourns in the Yukon. Our field data collection concentrates on monitoring changes in ground and lakewater temperatures, and examining systematic variations in ground conditions along natural gradients, such as hillslopes or following forest fires. Since 1987 we have conducted research in the western Arctic, in collaboration with Dr. Ross Mackay. Several of the field investigations we are involved with in the Mackenzie Delta area are at Garry Island, where Dr. Mackay established a research station in 1964, and at Illisarvik, the lake that he experimentally drained in 1978. At both sites we have obtained temperatures from permafrost which indicate that the ground in the Mackenzie Delta area has warmed by over 1.5°C since 1970, and we have collected similar data from Herschel Island, although conditions there are about 2°C cooler than near the delta.

I am particularly privileged to visit Garry Island and Illisarvik as well as Herschel Island on the Yukon coast. Garry Island and Illisarvik are near potential sites for gas development. Each year I look out over the ocean from these sites where, amidst the summer icebergs, belugas may be playing, and I listen to the croaking of the sandhill cranes, the calling of the loons, the squawking of disturbed ducks, or the mewing of a rough-legged hawk, and on Herschel I watch caribou grazing or a grizzly digging up ground squirrels. The northern wild lands are such a precious resource, increasingly altered by our activities – of which I am part – and I hope that we will be able to find ways to conserve our natural heritage while developing our resources for the benefit of all Canadians. That is the focus of our research program.

Several of the graduate student projects concern the factors governing permafrost conditions in the study area. Michael Palmer (M.Sc.) is looking at the variation in near-surface ground temperatures across tree line in the uplands between Inuvik and the western Arctic coast. In this area, snow conditions – ranging from the deep snow packs in the taiga to the shallow snow covers on the wind-blown tundra – are controlled by the vegetation structure. In winter

there is little difference in air temperatures between the tundra and the forest, but a great variation in ground temperatures, perhaps up to 10°C, due to the snow cover. Therefore, the response of permafrost near tree line to climate change will depend to a significant extent on the development and expansion of shrubs as the tree line advances northwards.

Similarly, Peter Morse (Ph.D.) is investigating the controls on permafrost conditions, including temperature and ground ice conditions, in the outer Mackenzie Delta. His work focuses on the importance of vegetation and topography in controlling snow depth, and their association with various soil materials. Both Michael and Peter are supported by Water Resources Division, DIAND, and their work is part of the government-sponsored science program in support of Northern energy development. A similar project to Peter's is being conducted in the Blackstone Uplands, at the southern end of the Dempster Highway, by Pascale Roy-Léveillée (M.Sc.). She is focusing on the physical controls of snow accumulation, in order to assist management of early winter snowmobile access in the area, and she is supported by the Yukon Department of Environment.

Related projects, but somewhat less directly applied to a specific pipeline proposal, are being conducted by Julian Kanigan (M.Sc.) and Thai-Nguyen Nguyen (M.Sc.), also in the Mackenzie Delta. Julian is creating an overview of the regional variations in ground temperature throughout the 65,000km^2 delta, principally south of tree line where there are few such data. Thai-Nguyen is tackling the curious determination in the most recent National Atlas of Canada (5th edition) that the permafrost in the Mackenzie Delta is discontinuous. His project involves substantial ground investigations, at representative sites that will be keyed to SPOT satellite images collected this year. He hopes to be able to estimate quantitatively the ground surface underlain by permafrost. Both Thai and Julian have been supported in the field by DIAND. In their cases, the importance of the research is to prepare for potential expansion of exploration and development activities into more of the Mackenzie Delta. In particular, a current issue for developers and regulators is the disposal of drilling waste in sumps (pits) which use permafrost as the containment medium. These research projects will help determine whether long-term containment of waste is likely in the relatively warm permafrost of the delta.

In the Slave province Kumari Karunaratne (Ph.D.) is undertaking a regional-scale project studying the variation in permafrost conditions across tree line at a spatial scale considerably greater than the 70-km transect of Michael Palmer. Kumari's project began at the Ekati diamond mine, where she has been supported to characterize the near-surface ground thermal regime in both natural and disturbed surfaces, and has expanded through the logistical support of DIAND to examine similar aspects at the abandoned Colomac site, and in the vicinity of Yellowknife. A principal objective is to examine the thermal regime in peatlands, which contain much of the ice-rich permafrost in the area, and compare this with conditions in mineral soil. The practical application of her work is in prediction of long-term freezing rates for containment structures, such as tailings ponds.

Over the years, most of our research has been based at Mayo. Early on in the Chair program several undergraduate projects were completed there, with the students living in the community for the summer. J.V. Clark School and the community campus of Yukon College have given us access to a workshop and the internet, thereby providing the critical infrastructure for academic fieldwork. The student projects focused on the thermal (Laurie MacGregor) and microclimatic (Aileen Profir) regime of Mayo Lake, the ground ice content of peatlands (Dan Shugar), and the relative rates of erosion by Stewart River of its banks at sites with and without permafrost (Karen Rowan). In addition to these investigations, Sheri Burke (M.Sc.) completed a study of the water balance of the Village sewage lagoon. The sewage lagoon was built in the early 1990s, but has never filled up. Instead, it has become a wetland which is one of the best local spots for bird watching! Sheri's research established that water was infiltrating out through the bottom of lagoon at close to the design rate, but the input to the structure was insufficient to fill it. Waste water was therefore not remaining in the lagoon as long as expected. The Village authorized the research, and the Council has subsequently begun to consider if and how the residence time of fluids in the infiltration cells might be increased.

In 2001, the community held a Central Yukon Climate Change Workshop to learn how climate change may affect the region and what might be done to prepare for potential impacts. As a result of the discussions, the community monitors a series of natural indicators in the changing environment, all of which are designed to build up a record of climate-change effects over the years, and may be cited as the community plan and regional land-use plans are updated. These research activities involve recording several annual events, such as the date of river break-up, but also include a monthly ground temperature monitoring program. When this program was established, we used the Village backhoe to excavate pits in dry gravel near the airport and

in the flood plain of the Mayo River, and in each we installed ground temperature sensors. Village staff read the sensors every month. As with many research projects, the data collected have served a purpose unforeseen when the program was established.

The flood plain of Mayo River, in its delta at the confluence with Stewart River, was altered in the early 1950s when a power dam was built on the Mayo River. The seasonal flooding regime has been changed, and several back channels are no longer flooded. These channels may have been over-wintering habitat for salmon yearlings during the year before they travel out to sea. The First Nation of Na Cho Nyak Dun has initiated a salmon habitat enhancement project in the flood plain to help conservation efforts for the Yukon salmon population. The intention was to excavate a back channel and lower it to the water table, thereby flooding it. The Yukon Water Board required assurance that the normally dry channel would be flooded, before the project could be approved. Ground temperature data that had been collected from near the site indicated that the heat flow in the gravel at the site was by convection due to flowing water, and so we were able to suggest that the necessary water source was available. Sure enough, as the channel was excavated, the water table was reached and the backwater filled to provide a suitable habitat.

The community-based research has also led to production of *Heart of the Yukon: a natural and cultural history of central Yukon,* a collaborative book published in full colour by the Village of Mayo. Conceived as a contribution to Mayo's centenary, the book is a collaboration between Mark O'Donoghue, the regional biologist for the Northern Tuchone region, Lyn Bleiler, President of the Mayo Historical Society, and me. Mark has written on the fauna and flora of the region, Lyn has written and coordinated the contributions about the cultural environment, and I have supplied material about the physical environment. We have several contributing authors, including the Lands Department of Na Cho Nyak Dun. The book is written for a general readership. Curiously, it is regional geography, a subdiscipline that is unfashionable in the academy, but of critical contemporary value as a background to environmental impact assessments. It is a principal part of our Northern Chair dedicated to assisting northerners to understand and appreciate the contribution that science may make towards understanding the local environment.

The four legs of the Northern Chair program are high-quality research, training of highly-qualified personnel, the development of partnerships, and the communication and promotion of northern research. I am grateful to NSERC for the vision of this broadly based program, and the support and collaboration of our northern partners. It is a great privilege to be welcomed, as if we were coming home, each time we travel North.

Chris Burn holds a National Sciences and Engineering Research Council of Canada Northern Research Chair at the Department of Geography and Environmental Studies, Carleton University.

NEW BOOKS

The Forgotten Labrador: Kegashka to Blanc-Sablon, by Cleophas Belvin. McGill-Queens University Press. 0773531513.

An intimate look at the lifestyle, living conditions, and activities of a people whose lives were shaped by the uncertainties of the seal, salmon, and cod fisheries.

The Forgotten Labrador recounts the history of a remarkable area of Canada – the Quebec part of the Labrador coast that extends eastward from Kegashka to Blanc Sablon.

Heart of the Yukon: a Natural and Cultural History of the Mayo Area, edited by Lyn Bleiler, Chris Burn and Mark O'Donoghue. Village of Mayo, 2006. ISBN 0-9780263-0-6.

Conceived as a contribution to Mayo's centenary, this collaborative book written for a general readership contains sections on the fauna and flora of the region, the cultural environment, and the physical environment.

Order from: Village of Mayo, Box 160, Mayo, Yukon Y0B 1M0 (mayo@northwestel.net).

NEW WEB SITE

The Labrador Inuit through Moravian Eyes

This site provides information on the 250-year relationship between Moravian missionaries and the Inuit of Labrador. This interaction led to the establishment of settlements for a formerly nomadic people, their conversion to Christianity and exposure to aspects of North American culture.
(//link. library.utoronto.ca/inuitmoravian/)

ASSESSING THE STATUS OF THE PEACE-ATHABASCA DELTA ECOSYSTEM: CHALLENGING THE PARADIGM FROM A PALEOENVIRONMENTAL PERSPECTIVE

Brent B. Wolfe, Roland I. Hall, and Thomas W.D. Edwards

An array of multidisciplinary studies have probed the hydrology and ecology of the Peace-Athabasca Delta (Alberta, Canada) over the past 35 years in efforts to identify and quantify the perceived negative effects of Peace River flow regulation. This includes paleoenvironmental investigations conducted over the past five years using state-of-the-art paleolimnological techniques. Contrary to expectations, reconstructions of hydrological and ecological conditions spanning the past ~300 years provide no compelling evidence to suggest that river flow regulation has had any discernable lasting effects on the delta. Rather, changes in the overall state of the northern Peace sector appear to be driven predominantly by local and regional climatologic variability at inter-annual to decadal time-scales, and by ongoing warming, drying and naturally declining Peace River discharge over the past century.

INTRODUCTION

We are conducting extensive multidisciplinary research to gain better understanding of past and present climate, hydrology, and ecology of the Peace-Athabasca Delta (PAD), Alberta, Canada, a highly productive northern boreal ecosystem of significant natural heritage (fig. 1). The aim of this research is to assess the impacts of both natural and anthropogenic factors, ranging from climatic variability and change to the influence of river flow regulation resulting from hydroelectric power generation at the headwaters of the Peace River since 1968. The latter is of particular interest because of the widespread belief that alteration of Peace River discharge has affected the frequency and magnitude of spring ice-jam flooding, which is considered to play an important role in the water balance of many basins that are perched above and disconnected from the complex channel network in the PAD (*e.g.,* see Prowse and Lalonde, 1996; Prowse and Conly, 1998, 2000). These basins and their extensive shorelines provide critical habitat for a variety of wildlife, including migratory waterfowl that utilize the delta as a critical stopover.

Concerns over potential linkages between regulation of the Peace River and the ecological integrity of the PAD developed many years ago, beginning with low levels on Lake Athabasca that occurred coincident with the 1968–1971 filling of the hydroelectric reservoir. This sparked the 1971, 18-month long *Peace-Athabasca Delta Project Group* study (PADPG, 1973) supported by the governments of Canada, Alberta and Saskatchewan, a $1.5 million environmental impact assessment of Peace River regulation on the PAD ecosystem. Results from this study led to the proposal of several structures to modify flow, and included construction of permanent rock-filled weirs on the Rivière des Rochers and Revillon Coupé channels to maintain the level of Lake Athabasca and promote flooding of perched basins. Although subsequent appraisals of these structures indicated that they failed to recharge the perched basins, major ice jam floods in 1972 and 1974 did replenish the higher elevated regions of the PAD. An extended dry period ensued from 1975 to 1995 in which there was no major flooding. Corresponding low water levels in perched basins during this period again led to another series of environmental studies, the *Peace-Athabasca Delta Technical Studies* (PADTS, 1996), which were also aimed, in part, at restoring perched basin water levels in the PAD. Investigations, however, suggested that increased temperatures during the ice-cover season, reduced snowpack depths, and changes in the intensity and duration of the pre-melt period may have also contributed to the apparent decline in flood frequency during the post-regulation period (Prowse and Conly, 1998; Prowse *et al.,* 2002). Thus, in these recent assessments, both reduced spring ice-jam flooding due to regulation on the Peace River and climate variability have been identified as drivers to what have been perceived to be unusually dry conditions and low lake levels in the PAD during much of the past 35 years. Rigorous scientific evaluations of these hypotheses have been hampered, however, because of the brevity of instrumental climatic and hydrologic records.

To address this shortcoming, we have performed a broad range of physical, biological and geochemical measurements on lake sediment cores retrieved from many basins in the PAD to reconstruct hydroecological conditions over the past several hundred years (fig. 1). These records were used to answer the following research questions: 1) What is the range of natural variability of hydroecological conditions in the delta, and how is that related to climatic variability, flood frequency and geomorphic change? 2) Does natural variability include multi-decadal periods without major flooding and low lake levels? 3) Has flow regulation had any perceptible (*i.e.*, directional) influence on hydroecological conditions in the delta?

This research recently culminated in a comprehensive technical report that detailed findings based on widespread sampling of surface waters from lakes, wetlands

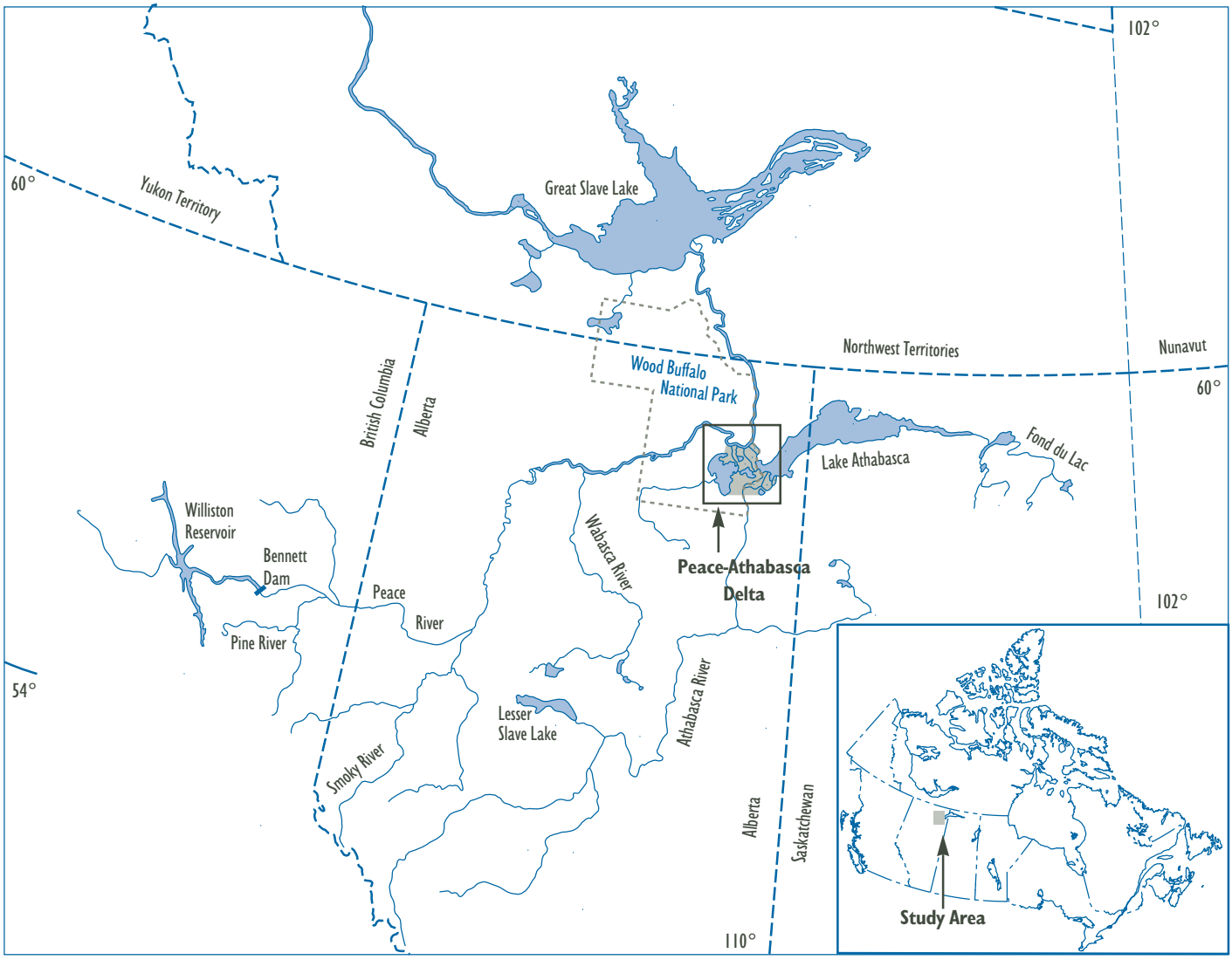


Figure 1
The Peace-Athabasca Delta (PAD), a World Heritage Site, is located in northern Alberta mostly within Wood Buffalo National Park. The WAC Bennett Dam was constructed in 1968 near the headwaters of the Peace River for hydroelectric production. Sediment cores have been obtained from several basins in the PAD to reconstruct hydroecological conditions over the past several centuries. Photo: Brent Wolfe.

and rivers for analysis of chemistry, nutrients, biota and water isotopes to characterize the range of modern hydrological and ecological conditions, in addition to the lake sediment stratigraphic analyses (Hall *et al.,* 2004). The multi-proxy lake sediment records, in particular, provided an unparalleled window into the recent natural history of the PAD and insight into its ongoing evolution. Highlights, as further described below, included exceptionally detailed reconstruction of local Peace River high-water flood frequency over the past ~300 years from analysis of laminated sediments of oxbow lakes (Wolfe *et al.,* 2006), while paleolimnological analyses at a more elevated site provided evidence for seasonal to periodic desiccation in response to drier climatic conditions and reduced flooding during the peak of the Little Ice Age in the 1700s (Wolfe *et al.,* 2005).

HIGHLIGHTS OF FINDINGS FROM LAKE SEDIMENT RECORDS

Peace River Flood Frequency: Evaluating the significance of extended periods without major ice-jam floods, such as the 1975–1995 interval, requires a long-term perspective on flood frequency. Although prior studies had generated a 180-year historical flood record from compilation of traditional knowledge and written documents (Timoney *et al.,* 1997) as part of the PADTS, the significance and magnitude of many of the flood events were questioned due to the high spatial variability of flooding and possible observer bias (Prowse and Conly, 2002).

Analyses of laminated sediments from two ~4m-deep oxbow lakes in the northern part of the PAD have provided the basis for additional and longer reconstructions of paleo-flood frequency (Wolfe *et al.,* 2006). These basins are located adjacent to major flood distributaries of the Peace River and are highly susceptible to the influx of river water and suspended sediment during high-water stages. Sediment core magnetic susceptibility measurements, supported by results from several other physical and geochemical analyses as well as stratigraphic correspondence with recently recorded high water events on the Peace River, provide proxy records of flood history spanning the past ~180 and ~300 years in these two basins. Results are in close agreement with the historical Peace River ice-jam flood record over the period of overlap (Timoney *et al.,* 1997; Wolfe *et al.,* 2006) and, furthermore, indicate that flood frequency has been highly variable over the past ~300 years but in decline for many decades beginning as early as the late 1800s based on the longer record from "Pete's Creek" (fig. 2). While the 1980s through to the early 1990s stands out as an interval absent of flooding, detailed multi-proxy analyses spanning the past ~50 and ~70 years on both oxbow lake sediment sequences fail to show substantial directional changes post-1968 that can be attributed to Peace River regulation (Wolfe *et al.,* 2006). In addition, the extended record from Pete's Creek indicates a much longer interval without major flooding occurred in the 1700s during the peak of the Little Ice Age (fig. 2), which also corresponds with an interval of low streamflow on the North Saskatchewan River (Case and MacDonald, 2003) as regional glacial advances in the Rocky Mountains led to increased storage and reduced meltwater supply to western Prairie rivers (Luckman, 2000).

Perched Basin Paleohydrology: In sharp contrast to the hydrological setting of Pete's Creek, "Spruce Island Lake" is an elevated, shallow (~1m), perched basin distant from major flood distributaries of the Peace River and outside the effect of all but the most extreme floods (fig. 2). Hence, water levels in Spruce Island Lake were expected to be very sensitive to former arid climatic conditions, and whose sediment record could be used to assess the significance of widespread low water levels observed in many perched basins during the 1980s and early 1990s.

Multi-proxy analyses of a sediment core from Spruce Island Lake have indeed been especially informative in placing the past 35 years of historical observation into a longer-term context. For example, results from oxygen isotope analyses of aquatic cellulose preserved in the sediment record, which provides insight into changes in the importance of lake evaporation, illustrate that intervals of both lesser and greater evaporation have occurred over the past ~300 years when compared to recent decades (Wolfe *et al.,* 2005; fig. 2). This included evidence for a period of prominent drought when the lake may have dried up at times during the 1700s, and is in strong agreement with the flood record from Pete's Creek (fig. 2) and other studies mentioned above. On the other hand, conditions of generally lesser evaporation dominated the 1800s prior to a long-term decline to more intermediate status that has characterized recent decades. Hence, average hydrological conditions since 1968 are well within the broad range of natural variability observed over the past ~300 years and no perceptible directional change is evident that can be associated with Peace River regulation.

Notably, multiple lines of evidence from our sediment core study indicate standing water has persisted in Spruce Island Lake for at least the past ~200 years, following the peak of the Little Ice Age during the 1700s (Wolfe *et al.,* 2005). This period spans several multi-decadal intervals without a major Peace River ice-jam flood, including the recent 21-year period (1975–1995) that post-dates Peace River regulation. Evidently, Spruce Island Lake has received sufficient direct precipitation and catchment runoff to offset evaporative loss at times of infrequent

flooding during the past ~200 years. This clearly underscores the important roles of local climate and catchment attributes in maintaining lake water levels and hydroecology. Based on our analyses, only during the exceptionally dry climate that prevailed during the peak of the Little Ice Age has Spruce Island Lake undergone seasonal to periodic desiccation.

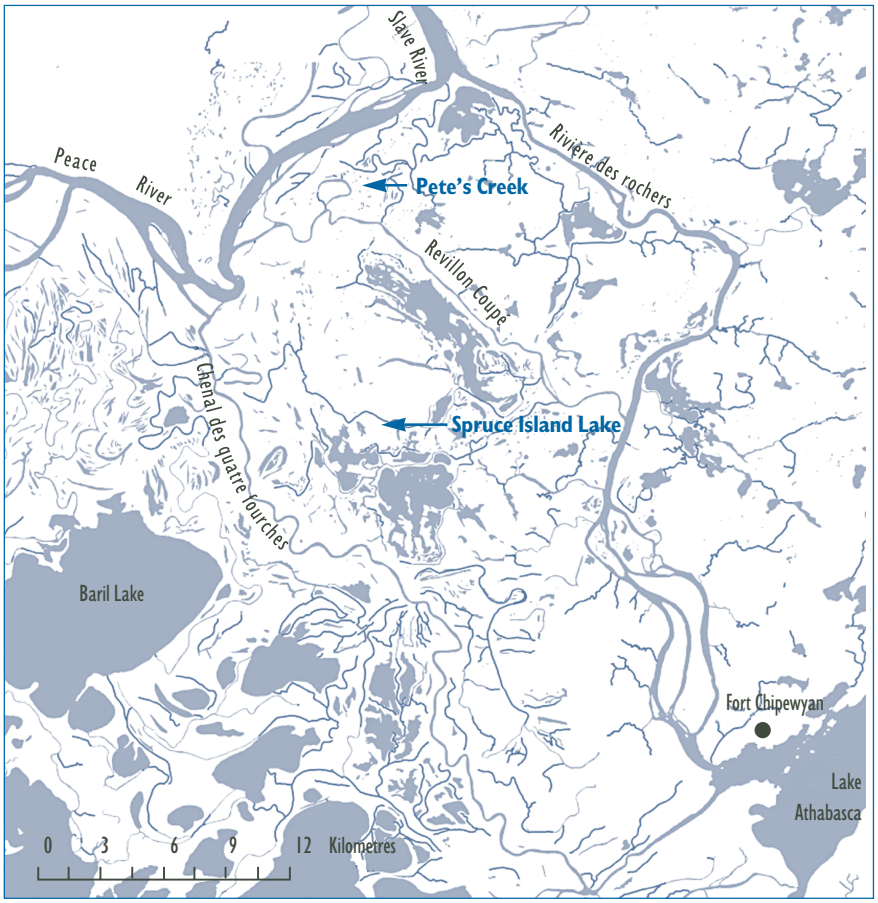
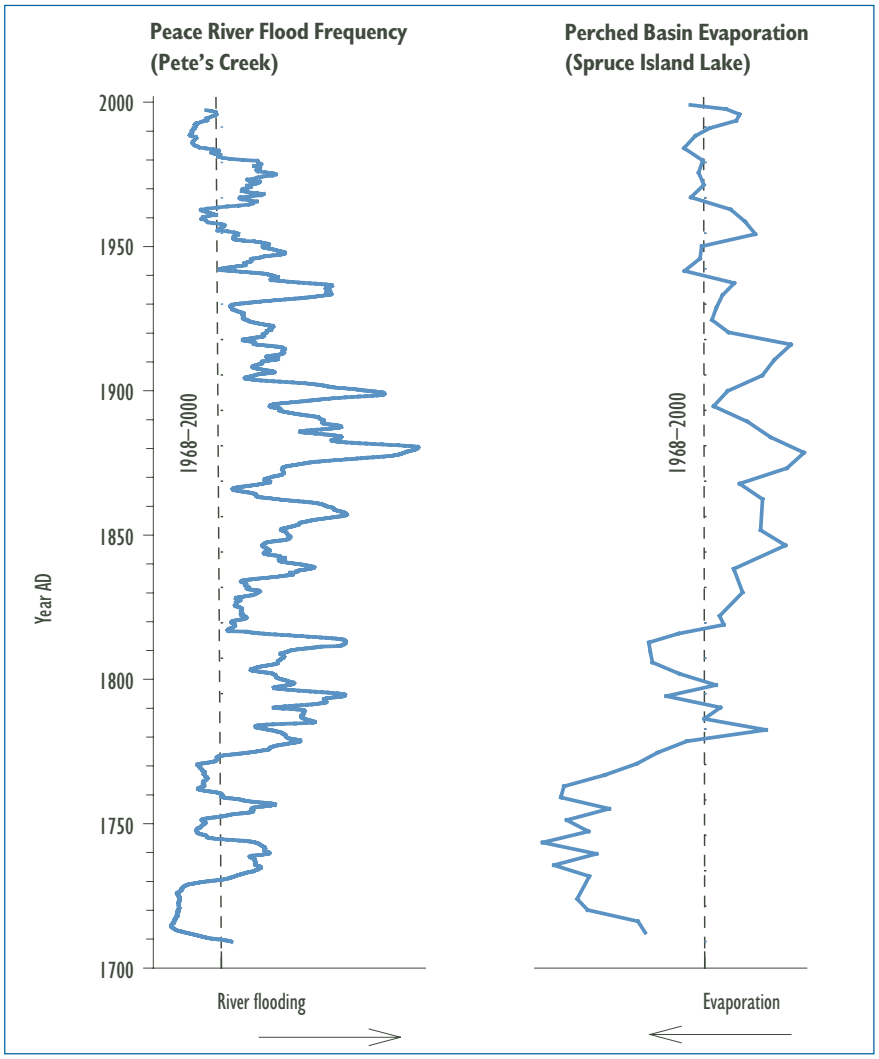


Figure 2
Examples of 300-year sediment records from lakes in the northern Peace sector of the PAD (left graph). Peace River flood frequency reconstructed from magnetic susceptibility measurements on a sediment core from "Pete's Creek", an oxbow lake adjacent to the Revillon Coupé (Wolfe *et al.*, 2006). The degree of river flooding increases to the right (right graph). Evaporation reconstructed from analysis of aquatic cellulose oxygen isotope composition on a sediment core from "Spruce Island Lake", an elevated perched basin (Wolfe *et al.*, 2005). The importance of evaporation increases to the left. Reconstructions are shown relative to 1968–2000 mean values. Photo: Brent Wolfe.



Spruce Island Lake

IMPLICATIONS AND FUTURE RESEARCH

The extended temporal perspective offered by proxy indicators in lacustrine sediments provides unique access into the range, variability and evolution of hydroecological conditions in the PAD. Our findings, some of which are highlighted above, have clear implications for ecosystem stewardship. Perhaps most fundamental is recognition that the PAD is a highly dynamic, northern, riparian ecosystem that responds sensitively to variability in climate and hydrology. Consequently, we recommend that the delta should not (and likely cannot) be managed to maintain it as a static system but rather within the context of ongoing and future climatic and hydrologic variability. While few would contest the observational evidence that environmental changes have recently occurred, our results indicate that these are not unprecedented and a trend towards drier conditions began several decades before onset of river regulation. Interestingly, it appears that the dominant human perception of 'normal' conditions in the PAD likely formed during the late 1800s and early 1900s when flood frequency and water levels (including Lake Athabasca) were anomalously high in response to elevated discharge of glacial meltwater in the Peace and Athabasca rivers at the conclusion of the Little Ice Age – a factor that may have contributed to the long-held paradigm that the delta is drying and dying by unnatural causes. Research efforts are now focused on extending our lake sediment histories beyond 1000 years to more fully capture the range of complex interactions between climate, hydrology, and ecology in the PAD, as well as in the Slave River Delta ecosystem downstream.

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Acknowledgements

We thank the many students and colleagues who have contributed to the Peace-Athabasca Delta Paleolimnology Project and are grateful for frequent discussions with G. MacDonald, D. Smith, J. Smol and T. Webb III. Support for this research was provided by BC Hydro, Wood Buffalo National Park and Department of Indian Affairs and Northern Development.

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EARLY FIELD EXPERIENCE IN THE NORTH: A FOUNDATION FOR NORTHERN SCIENCE CAREERS

Peter Johnson

The vast majority of Canadians have little knowledge of the North despite the fact that it comprises 60% of Canadian territory. Stereotypes from media and popular culture dominate a southern Canadian perception of the North. Canadian students in all disciplines must be made aware of the realities of the North because in many careers in government, industry or commerce northern issues may become part of their portfolios. While school age students can learn about the North from motivated teachers and specialized teaching tools (such as the proposed Royal Canadian Geographical Society–Students on Ice learning module, an International Polar Year project), for university students embarking on a northern science career an early introduction to the North *in the North* is essential.

For a long time in most southern federal bureaucracies a large proportion of staff

assigned to northern files had no northern experience. Land claims settlements and the devolution process have started to improve northern community representation in federal processes, but mid to senior levels of departments and agencies still have little northern experience and people with northern experience are frequently promoted out of a direct role in order to further their careers.

Most university administrations have no appreciation of the realities for the small percentage of their faculty members and graduate students who work in the North. We went through an exercise at the University of Ottawa a few years ago (which thankfully died quickly and painlessly) of drafting a manual for professors taking students into the field. This was done without consulting professors who actually went into the field. It included a recommendation to count the students before heading out into the field and to count them on return at the end of the day. It did not however give instructions as to what to do if there was a discrepancy. It also advised us to tell students to be careful where they put their feet when in mountainous terrain.

What is the value of a field experience in a student's training? Field work demonstrates to students that the Arctic is a homeland for people who have a different but equally valid (perhaps more valid) way of looking at society, culture and the environment. Talking about traditional knowledge may be valuable in raising awareness but living in the context of traditional knowledge' is far more important. Field work in general and northern field work in particular starts to develop an appreciation that not everything can be modelled in a computer, that real data is needed to validate models and provide input to development and planning policy, and that the rigidity of management models does not create the basis for decision making. It also demonstrates that obtaining real data is challenging.

On many occasions I have heard that a post-graduate student's first year of field work in the North has not achieved its objectives because the student was unfamiliar with field conditions. Occasionally students have not been able to function at all, resulting in delays for research programs. I still hear of cases of students arriving in the North with no introduction and no preparation. All too often problems derive from the field season being the first experience of the North. Unless a student is working with a large support team, such as is typical on the research icebreaker *CCGS Amundsen*, it can be a stressful situation.

I am convinced, after running a northern field course for over three decades, that an introduction to northern research through a field experience at the undergraduate level can be critical to a successful post-graduate career. Top grades are not in themselves an indicator of whether a student will develop into an excellent northern researcher. A northern researcher has to develop a number of skills in communication and consultation as well as in science.

Opportunities for exposure to northern research as an undergraduate student are limited. Over the years many students have gained crucial, focussed training by working as an assistant to a scientist or graduate student. An expanded ArcticNet as well as long term projects in biology, botany, and zoology have meant the continuation of this kind of opportunity. Another form of training, summer assistantships at Natural Resources Canada, has been seriously reduced, and many summer positions, especially under co-op programs, take place in an office or laboratory rather than in the field.

The reduction in opportunities for gaining field experience has usually been attributed to high costs in an era of static or shrinking budgets. Field work in the North is expensive, difficult logistically and can be disrupted or even cancelled for a season by inclement weather. While it is understandable that scientists should make the most of their research dollars by supporting graduate students, undergraduates and northern students must be attracted to, and given more opportunities to participate in, science training in the North.

There are few formal undergraduate field courses given regularly in the Canadian North. The Churchill Northern Studies Centre and the Kluane Lake Research Station of the Arctic Institute of North America have been used on a regular basis for academic field programs. Field schools have also been organized from other Canadian universities, such as the University of Guelph, and by a few American institutions. This contrasts with the wide range of regular course offerings at the University Centre in Svalbard, a unique partnership of Norwegian universities.

For 33 years I have organized an annual full-year credit geomorphology undergraduate field course in the North, sometimes in conjunction with research projects. For the last five years this has been supplemented by a half-year credit glaciology course at the ecotourism camp "Icefield Discovery", in the St. Elias Mountains. These courses provide not just academic training but also the experience of the environment, the necessity of teamwork, and exposure to other research conducted at the Kluane Lake Research Station. I might say that the last three may be as important as the first – for it is ultimately the enthusiasm of students which carries them forward in their careers.

Students who take northern field courses usually have to finance themselves. We have spoken for years about the difficulties of financing research in the North but it is even more difficult to support students on

courses. Universities provide little in the way of financial support despite the fact that there is minimal demand on registration fees apart from the keyboard work of entering the registration. Northern courses use no university space and no campus electricity. For a typical course at Kluane the cost to a University of Ottawa student would be $990 for registration and $1500 for logistics, plus the cost of transport to Whitehorse.

The support of courses has never been part of the mandate of the Northern Scientific Training Program (NSTP). NSTP has been fundamental to northern research by paying basic costs for post graduate students.

One of the problems has been that northern field courses, and actually even field courses in general, do not fit the model of the modern business-oriented university system. Standard minimum enrollment levels and class thresholds for assigning teaching assistants do not work in a field environment. Liability issues seem to have far more weight than the academic merit of a program. The risk of encountering a grizzly bear causes more concern than pedestrian crossings of busy streets on campus. Parents even seem happier to let their children go to Paris and London rather than to the "wilderness" of Yukon.

Stories abound about the incomprehension of realities of teaching in the field. I was once asked to state my contact hours for my course. As I feel fully responsible for the students for the duration of a field course

KLUANE LAKE FIELD COURSE IN 2006

The summer of 2006 was the 33rd successive year of the University of Ottawa Department of Geography Field Course in the Kluane Region. Thirteen students, nine who had already been on a Glaciology course at Icefield Discovery in the St. Elias Mountains, and four others, spent four weeks at the Kluane Lake Research Station of the Arctic Institute of North America. The objectives of the course are to introduce students to the North, to provide experience of northern research, and to provide a learning experience in one of the most beautiful regions of the world. Students worked as a team on the environment of Jenny Lake, a closed basin marl lake, and the hydrology of Silver Creek, a nival/glacierized basin. Small groups of students then developed their own mini-projects ranging from comparison of lake and pond environments along the Alaska Highway, to groundwater discharge and the formation of cemented beach materials, to surface water changes from spring source through a marsh into a swamp. Transects were taken south to Alaska across the Coast Ranges, demonstrating the dramatic vegetation zones of the region, and north to the thermokarst environments near the Donjek River. The latter also served as the opportunity for the group to get their "french fry fix" at Scully's Saloon in Kluane Wilderness Village.

For many students the exhilaration of a northern research northern field course inspires a career in polar research. Photo: Peter Johnson.

I replied 24 hours a day for 28 days – seven times the university norm. This caused some raised eyebrows. Some interesting equipment insurance issues emerged in the 1970s when I asked whether certain items were covered for field eventualities such as bear damage. The official response was "if the bear damages the equipment on site that is vandalism and is not covered; if the bear removes the equipment from site that is theft and you are covered". I have experienced delays while Purchasing has sought out cheaper equipment only to be confused by my subsequent request for 50km of extension cord. Computer equipment for teaching in laboratories at field stations often consists of the castoffs from the laboratory on campus.

How can we assess the success of field courses in directing the career choices of students? I can only quote statistics from my own field course. Thirty-five participants have gone on to post graduate studies on northern topics. Others have followed post graduate programs in different fields.

It would be a positive step to offer a course on northern research for all commencing post graduate students. A course could be sponsored by a program such as NSTP in collaboration with the Northern Research Institutes and northern communities. It should include for students from all disciplines:

- interaction with community elders;
- discussion of knowledge traditions;
- information on licensing processes and environmental requirements;
- discussion on communication and consultation;
- recognition of contribution by community members;
- capacity development;
- safety.

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REPORTS FROM THE ARCTIC SCIENCE SUMMIT WEEK

INTERNATIONAL ARCTIC SCIENCE COMMITTEE

Grant Ingram

The Arctic Science Summit Week (ASSW) is an initiative of the International Arctic Science Committee (IASC). A forum for discussion and collaboration, it provides an opportunity to hear about recent Arctic research in different countries and co-ordinate research and field activities.

Photo: GNWT

IASC is a non-governmental organization with a mandate to encourage and facilitate cooperative research in the Arctic region. Canada is one of 18 member countries. This representation provides a mechanism for two-way communication between Canadian scientists and the broader Arctic science community.

IASC is not a funding agency; rather, it assists with the development of projects by providing seed money for project planning, supporting travel costs of younger scientists, and facilitating cooperation in circumpolar Arctic research (a list of projects supported by IASC can be found at www.iasc.se). Over the past year, the IASC secretariat has moved from Oslo to Stockholm. The new Executive Secretary is Volker Rachold.

The annual meeting of IASC took place during the Arctic Science Summit Week in Potsdam, Germany, 23–30 March 2006. In a morning closed session, IASC held a vote on executive positions. Kristján Kristjánsson from Iceland was elected as the new President. Jackie Grebmeier from the USA and Dieter Fütterer from Germany were elected as Vice Presidents. In other news, the IASC Regional Board announced that Steven Bigras, from the Canadian Polar Commission, had been unanimously elected as its new Chair.

Discussion of the successful Second International Conference on Arctic Research Planning (ICARP II, www.icarp.dk), held in Copenhagen during November 2005, included plans for similar meetings in future. Although IASC was the main patron of ICARP II, the event was a partnership involving many organizations. Much of the time was spent discussing the Arctic aspects of International Polar Year 2007–2008 and ways to facilitate collaborative and co-ordinated research between individual countries' programs. Canadian researchers

participate in a number of major international Arctic programs that are linked to IASC, and will play significant and leading roles in numerous IPY activities.

Since IASC has the broadest mission of the various Arctic science organizations, it would logically be one of the leaders in helping develop implementation plans among the ICARP II partners. The Arctic Ocean Sciences Board has also played a central role in the ICARP II process to date and is expected to be an active partner in the implementation phase, especially on those projects dealing with marine sciences.

Future planning for IASC includes developing strategies to consult more widely amongst researchers and people living in the Arctic and to implement plans to encourage permanent developments and securing legacies after the IPY programs have ended. As the Canadian delegate to IASC, I would like to hear from you about how to strengthen the link between our science activities to Canada's Arctic population, input to Canada's needs for Arctic research, and examples of collaboration and communications that would promote a better understanding of the Arctic. Sustaining the momentum resulting from the IPY activities in the Canadian Arctic is essential.

The next Arctic Science Summit Week will be held from 14–21 March 2007 at Dartmouth College (New Hampshire, USA).

For more information please contact: Grant Ingram, Canadian delegate to the International Arctic Science Council, University of British Columbia (gingram@eos.ubc.ca).

INTERNATIONAL ARCTIC SCIENCE COMMITTEE REGIONAL BOARD

Steven Bigras

The International Arctic Science Committee (IASC) Regional Board, comprised of representatives from governmental scientific organisations in the eight arctic countries, ensures that IASC activities are consistent with the interests of those countries. The Chair is a member of the IASC Executive Committee.

At present the Regional Board is reviewing its terms of reference to make sure it is effective in dealing with current arctic issues. The Regional Board's current priorities are as follows:

- to improve the standing of arctic science among the residents of the Arctic;
- to provide support for access and permitting issues; and
- to maintain the link to the Arctic Council and work with national senior arctic officials.

During the Arctic Science Summit Week (ASSW) the Regional Board discussed issues closely aligned with the University of the Arctic and the Arctic Council dealing with cooperation among the ministers of science and the ministers of education, and rallying efforts to have research vessels excluded from the heavy tariffs applied to ships entering the Russian Exclusive Economic Zones in the Arctic during IPY 2007–2008.

For more information please contact: Steven Bigras, Chair International Arctic Science Committee Regional Board, Canadian Polar Commission (bigrass@polarcom.gc.ca).

Photo: GNWT

PACIFIC ARCTIC GROUP

Marty Bergmann

The Pacific Arctic Group (PAG) is comprised of institutes and individuals from all nations having a Pacific perspective on arctic science. Organized under the International Arctic Science Committee, the PAG serves as a Pacific Arctic regional partnership to plan, coordinate, and collaborate on science activities of mutual interest. Principal member nations include: US, China, Japan, Korea, Canada and Russia.

The discussions at Arctic Science Summit Week 2006 focused primarily on taking maximum advantage of upcoming activities during IPY as well as regular ongoing science activities to benefit the objectives of all countries involved in the area and fostering long-term relationships. By formalizing their management structure and terms of reference over the past year and organizing a formal process for receiving nominations

of representatives from member countries, the PAG will remain focused on the geographic region of interest yet will have the capacity to examine a broad range of activities and interests. New interests are being explored by the group, including increasing collaborations with Russia through the Nansen and Amundsen Basins Observational System (NABOS) and the Russia-American Long-term Census of the Arctic (RUSALCA) programs; partnering in atmospheric observations; sea ice measurements; and marine mammal studies.

Ship-based science opportunities exist with Canadian Coast Guard Vessels *CCGS Louis S. St-Laurent* and the *CCGS Sir Wilfrid Laurier* which both spend time in the Pacific Arctic Region. The *CCGS Amundsen* is also available for charter up to six months of the year. Opportunities exist on the Chinese vessel *R/V Xuelong* which will be in the Arctic in 2008 and 2009.

China, Japan, Russia, US, Canada and Sweden expect to be involved in ship-based studies in the PAG area during IPY. The PAG plans to meet in October 2006 in Shanghai, China in order to enhance international collaboration between member countries for IPY planning, data collection data synthesis.

For more information please contact: Marty Bergmann, Chair International Arctic Science Council Pacific Arctic Group, Department of Fisheries and Oceans (bergmannm @dfo-mpo. gc.ca).

ARCTIC OCEAN SCIENCES BOARD

Savithri (Savi) Narayanan

The Arctic Ocean Sciences Board (AOSB) meeting in 2006 brought together representative members of research and government institutions from 17 countries, Canada, China, Denmark, Finland, France, Germany, Iceland, Japan, Korea, The Netherlands, Norway, Poland, Russia, Sweden, Switzerland, the United Kingdom and the United States of America to report and discuss opportunities in Arctic Ocean multinational and multidisciplinary natural science and engineering research. AOSB is primarily a facilitator of Arctic Ocean science research across a wide range of disciplines including oceanography and marine geology. As an organization, it supports and encourages science-led international programs by offering planning, coordination and access to funding and logistics. Canada's new member on the AOSB is Dr. Savithri (Savi) Narayanan, Fisheries and Oceans Canada.

With the upcoming IPY, several of the organizations including AOSB are reviewing their roles and activities to take maximum benefit from the heightened profile of arctic science in the international research community. AOSB has existed for over 25 years, and has decided to project current focus on building potential synergies established prior to and during IPY.

The Integrated Arctic Ocean Observing System (iAOOS) program was approved and brought forward by the AOSB in 2005. The program will realize its full potential during the IPY period by building on the existing programs and on those new programs proposed under the IPY. Many countries, including Canada, have ongoing projects and planned projects under IPY linked to the iAOOS initiative. The AOSB will facilitate a management structure to run the iAOOS program.

It is worth noting that the International Conference on Arctic Research Planning (ICARP II) that was held in Copenhagen in November 2005 generated 12 research plans, three of which have a strong marine component. These include Working Group 4, Deep Central Basin of the Arctic Ocean; Working Group 5, Arctic Ocean Margins and Gateways; and Working Group 6, Arctic Shelf Seas. Canadian researchers with interest in these areas should examine the potential partnerships through involvement with the leads of these Working Groups. A workshop will be held in fall 2006 to begin the implementation process of the marine component of ICARP II.

For more information please contact: Savithri Narayanan, Canadian Representative to Arctic Ocean Sciences Board, Department of Fisheries and Oceans (narayanans @dfo-mpo. gc.ca).

FILM REVIEW

Susan Rowley

The Journals of Knud Rasmussen, directed by Zacharias Kunuk and Norman Cohn. 112 Minutes.

The film fades away and the credits begin to roll – the audience sits, uncertain how to react. Should we clap or stay quiet? In the end, most choose the quiet. The movie we have just experienced is *The Journals of Knud Rasmussen* by Zacharias Kunuk and Norman Cohn. It's a Monday night, the theatre is packed and this is the Vancouver premiere. Afterwards, I'm part of a panel answering audience questions.

Drum dance behind the scenes during filming, Photo: Isuma Distribution International, Oana Spinu.

The Journals of Knud Rasmussen is Zacharias Kunuk's personal eulogy of a time lost. In it he presents his vision of the Inuit transition from shamanism to Christianity. This is a nostalgic look at the past and the inexorable and inevitable encroachment of the outside world. The film is set during the visit to the Amitturmiut Inuit of Knud Rasmussen's Fifth Thule Expedition (1921–1924). All the characters are based on actual people.

The main characters in the film are: Ava, an aged shaman (played by Pakak Innuksuk), his wife Orulu (Neeve Irngaut Uttak), his daughter Apak (Leah Anguti-marik), his son Natar (Peter-Henry Arnatsiaq), his brother Ivaluarjuk (Abraham Ulayuruluk), Umik, a Christian played by Samueli Ammaq, his son, Nuqallaq (Natar Ungalaaq), and Fifth Thule Expedition members Knud Rasmussen (Jens Jørn Spottag), Peter Freuchen (Kim Bodnia) and Therkel Mathiassen (Jacob Cedergren).

Rasmussen, Freuchen, and Mathiassen, accompanied by their Greenlandic companions, arrived at Ava's camp in February 1922. Ava was a celebrated leader and shaman and he, his wife, and his brother shared their knowledge and life stories with Rasmussen. Several of the most moving passages in the movie have been taken from Rasmussen's accounts of these encounters recorded in *The Intellectual Culture of the Iglulik Eskimos* (1929).

Rasmussen leaves the group to travel to the west after arranging for Ava's son Natar to guide Mathiassen and Freuchen to Igloolik, a journey which will signal the beginning of the transition to Christianity. We watch as Ava and his family persevere through blizzards and rough ice and endure starvation as they struggle to bring Freuchen and Mathiassen safely to their destination.

When they finally reach Igloolik, they find Umik and his followers in a well-established camp. Umik was a shaman and leader who became a self-taught Christian. In the late 1800s, the Anglican missionary E.J. Peck translated parts of the Bible into Inuktitut using syllabics, a phonetic writing system. Umik had a copy of this Bible; for reasons that are unclear he chose to convert to Christianity and proselytize others. His was one of a number of self-taught parousial movements, which blended shamanism and Christianity, in the eastern Arctic (Blaisel, 1999). He used Christianity to enhance his leadership status within the community. The camps of his converts were easy to recognize: they sported a long pole with a white flag. When visitors arrived everyone would line up and shake hands with the new arrivals. Converts to Christianity would demonstrate their change in faith by breaking ritual food prohibitions, for instance by eating meat from the land (caribou) and meat from the sea (seal) on the same plate. These aspects of life at Umik's camp are carefully detailed in the film.

There were several Danes in the Vancouver audience who were confused by the film. Anyone expecting to be exposed to the journey of Knud Rasmussen on the Fifth Thule Expedition will be disappointed. This movie is not about the outsiders but rather about the impact of outside beliefs on the Inuit. The Danes in this movie are mere foils – serving to move the plot towards its inevitable conclusion. Therkel Mathiassen and Peter Freuchen act as unwitting spirit guides on this journey as Ava's family undergoes the transition from shamanism to Christianity. As a result the Danes, although well acted, are weakly and inaccurately portrayed. The most glaring commission is Peter Freuchen, who by 1922 had been married to a Greenlander for ten years, had two Greenlandic children and had little use for Christianity. The film depicts him as not speaking Inuktitut, not understanding Inuit culture, and rejecting Ava for the food security of the Christian Umik.

The audience also had questions about Umik's son Nuqallaq, whom Ava refers to as the murderer of a white man. In the movie he flirts with his old girlfriend Apak, taunts Ava and his old ways, and acts as the impetus pushing the group onwards to Igloolik. Nuqallaq did in fact kill a white man, Robert Janes, who was an independent trader in the Pond Inlet area. In the winter of 1920 the community felt Jane's unpredictable and threatening behaviour was endangering their safety. Nuqallaq acted as the executioner. In a prophetic moment in the movie, Ava tells Nuqallaq that the whites will not forget the murder of one of their own and that they will track him down. This is in fact what happened. In 1923 Nuqallaq was tried for murder and sentenced to serve ten years at Stony Mountain Penitentiary, in Manitoba. Within two years he contracted tuberculosis and for compassionate reasons was sent home, where he died within a few months, having infected several people with the disease. (Grant, 2002; Harper, 2005).

There are moments of brilliance in the film, particularly in the contrasting of the two belief systems. Several members of the audience noted the importance of song. We watch Inuit perform *pisiit,* their personal songs, and we hear the powerful words of Ava describing a time when he lost both a son and his spirit helpers, and gave up all hope, but a new song came into his mind and brought his spirits back.

> "*Once I lost a son, and felt that I could never again leave the spot where I had laid his body. I was like a mountain spirit, afraid of human kind. We stayed for a long time up inland, and my helping spirits forsook me, for they do not like live human beings to dwell upon any sorrow. But one day, the song about joy came to me all of itself and quite unexpectedly. I felt once more a longing for my fellow-men, my helping spirits returned to me, and I was myself once more.*" (Ava in Rasmussen, 1929:120)

The shaman Ava (Pakak Innuksuk). Photo: Isuma Distribution International, Oana Spinu.

Later we hear Umik's group singing Christian hymns. They are all singing words written by someone far away whom they have never met. In this context the hymns with their well-known tunes sound discordant to a southern audience, and they forcefully demonstrate the break between the old and the new ways.

Also clearly resonating with the audience were the strongly contrasting confession scenes. While expecting to see confession among the Christians, viewers were surprised to find it in Ava's group, where the transgressor, Apak, must confess out loud, and hence be shamed, in front of the entire community. She has had a miscarriage and kept this a secret because she does not wish to be burdened with the restrictions placed on women who have given birth or miscarried. It is her fault that the group has suffered harsh weather and privation. Meanwhile, among the Christians, prayers are said and sins forgiven without the need for public confession: no longer do people need to adhere to shamanism's ritual prohibitions.

Throughout the film we have seen Ava's daughter, who also has shamanic abilities, spending her nights using them to have sex with her dead husband. In the end she renounces this to take up Christianity. She has seen the changes coming and appears to choose the ways of Umik and Nuqallaq as opposed to those of her father and ancestors.

The film is an interesting blend of fact and fiction, and it is difficult for most viewers to discern one from the other. Perhaps this is irrelevant, for the work leaves a lasting impression on the audience. *The Journals of Knud Rasmussen* is a very personal journey taking us, in a sense, into the minds of the filmmakers. Throughout the film, Ava's spirit helper, dressed in fine fur garments, sits in the house, calmly awaiting the shaman's call. At the end we all feel the resignation on the face of Ava as he dismisses his spirits, and their disbelief at this abandonment. We feel the outside world arriving and the inevitability of the change. As the credits roll, the audience sits quietly taking in the simple act and the irredeemable change it signals.

Susan Rowley is Curator of Public Archaeology at the University of British Columbia's Museum of Anthropology and Assistant Professor, Department of Anthropology and Sociology. She is also a member of the Board of Directors of the Canadian Polar Commission.

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Arctic Frontiers Conference

January 21–26, 2007
Tromso, Norway
www.arctic-frontiers.com/

MERIDIAN
is published by the Canadian Polar Commission.

ISSN 1492-6245

Editor: John Bennett
Translation: Suzanne Rebetez
Design: Eiko Emori Inc.

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360 Albert Street
Ottawa, Ontario
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