Witness The
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Arctic Research at the University of Northern British Columbia

Established in 1994 with considerable public endorsement and enthusiasm, the University of Northern British Columbia (UNBC) has grown into one of Canada's premier small universities—just over 4,000 students attend the main campus in Prince George and four regional campuses throughout the province.

Today, UNBC offers 25 bachelor's programs, 14 master's programs, and 1 doctoral program in its two colleges—the College of Arts, Social, and Health Sciences and the College of Science and Management.

UNBC's internationally recognized academic and research programs prepare graduates in select areas of relevance to British Columbia, the north, and beyond. With over $100 million in total research funding to date, much of the university's research focuses on northern social, economic, environmental, and cultural issues. The university has established three priority research themes—natural resources and the environment; rural, remote, and northern health; and the sustainability of communities—which are all very relevant to residents of the north.

UNBC campuses offer access to river and forest research centers throughout the northern part of the province, which are ideally situated for both land and aquatic based research and university education. Other research infrastructure includes a national centre of aboriginal health, a forestry lab, and a landscape ecology research centre. UNBC strives to ensure that the community is part of the research process, information dissemination, and application of research results through partnerships with the private sector and public agencies—these alliances integrate research into management and keep research relevant and applicable to problems that require innovative solutions.

This insert highlights recent research activities at UNBC focused on arctic and high latitude issues.

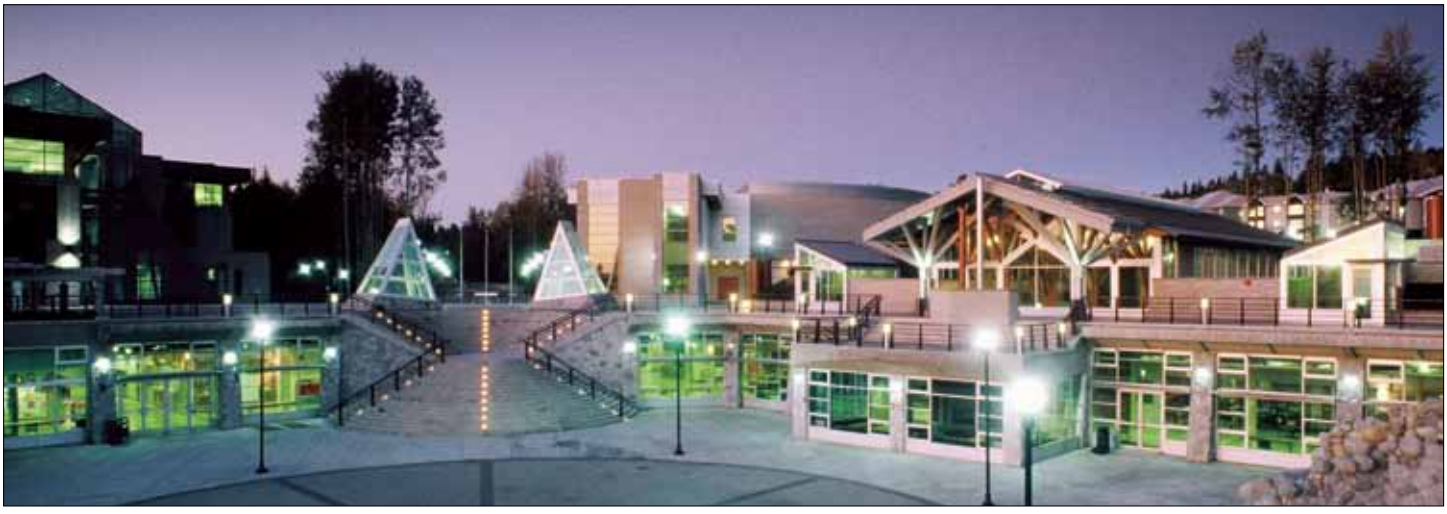
For more information, contact:

University of Northern British Columbia
Prince George Campus
3333 University Way
Prince George, BC V2N 4Z9
Canada

250-960-5555
sdery@unbc.ca
www.unbc.ca/

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

The UNBC Prince George campus, pictured below from the southwest, is uniquely positioned to be a showpiece for renewable energy. All of the core campus buildings are connected to each other and to a power plant by a utility corridor providing efficient distribution of heat and power. With $14.8 million in funding from the federal and provincial governments, the university is installing a biomass gasification system developed by Nexterra Energy, a BC company, which will provide heat to the connected buildings and offset an estimated 85% of current natural gas consumption. The project is expected to be implemented in 2009. Photo by: Bob Clarke.



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Ecosystem Science and Management Program

The Ecosystem Science and Management Program (www.unbc.ca/esm/) houses 30 faculty with interests in all aspects of ecosystem function, from the cellular and molecular scale to the organismal and landscape scale, and the role of humans in modifying these ecosystems.

Paul Sanborn and master's student Lesley Dampier are working with the Yukon Geological Survey to explore the relationships between soil development and glacial history in the central Yukon Plateau, near Carmacks, a small community in Yukon Territory. The eastern edge of their study area was overridden several times by the Cordilleran Ice Sheet. The retreat of the last glaciation occurred approximately 12,000 years ago, leaving the area ice free. At higher elevations, though, the western part of the study area may not have been glaciated since the early Pleistocene. Since soil age is determined by the amount of weathering that has occurred, the complex glacial history has created land surfaces with considerably different ages. Dampier's research examines soil chemical and mineralogical properties across this range of ages to look for systematic differences. Initial field and lab results show that the oldest upland surfaces have retained very few of the original glacial deposits. Soils are formed primarily of sandy materials produced by disintegration of the local granitic bedrock, which has been weathered into striking tower-like masses, or tors, that dot the ridge crests (see image this page). Dampier's research is co-supervised by Quaternary geologist John Clague of Simon Fraser University.

Lesley Dampier, a UNBC master's student, takes in the alpine vistas of the central Yukon Plateau. The weathered granitic outcrops, called tors, on the ridge crests are typical of areas that have escaped two or more of the most recent glaciations by the Cordilleran Ice Sheet. Photo by Paul Sanborn.

Scott Green's research focuses on the response of plant ecosystems to future climate change. He recently completed a project examining arctic tree growth and distribution in relation to underlying climatic and environmental conditions to clarify some of the primary determinants and mechanisms of response. Preliminary findings from projects by graduate students Cheryl Johnston-Scheutz and Sean Sweeney suggest that continuous daylight during the arctic growing season is an important environmental factor in genetic selection of primary adaptive traits in trees (such as growth cessation during winter, allocation of above versus below ground tissues, and photosynthetic versus non-photosynthetic tissues). Continuous daylight may also induce high water stress in trees, which is an important limitation in tree regeneration in a changing climate.

The majority of Green's fieldwork was conducted along the northern Dempster Highway corridor in the Yukon and Northwest Territories. Project activities brought him into regular contact with communities along the highway, and these encounters have expanded his research interests. Environmental changes in the far north threaten the sustainability of small communities that have little adaptive capacity and minimal resources to respond to change. He sees an urgent need to forge partnerships between northern communities, universities, governments, and industries and work toward facilitating the adaptation and long-term sustainability of these communities.

To address this challenge, Green, along with Art Fredeen and Paul Sanborn, both of UNBC, and Hardy Griesbauer at the British Columbia Ministry of Forests, recently entered into collaboration with researchers from the Yukon Forest Management Branch. Their project is funded by Indian and Northern Affairs Canada and will examine forest vulnerabilities and adaptive capacities in Yukon Territory. One unique aspect of their research is that it will integrate community and management policy interests at the beginning of the project to direct research objectives and methodologies.

Keith Egger and Darwyn Coxson are part of an International Polar Year project called Climate Change Impacts on Canadian Arctic Tundra Ecosystems: Interdisciplinary and Multi-scale Assessments, which is funded by the Natural Sciences and Engineering Research Council of Canada (NSERC). The aim of the research is to provide the first comprehensive assessment of the state of tundra ecosystems in Canada. The overall project is large, involving 47 researchers, 18 post-doctoral fellows, 12 Ph.D. students, 23 M.Sc. students, 47 undergraduate students, and 48 students at all levels from northern communities (see image on page 3).

The research is centered around the International Tundra Experiment (ITEX), a coordinated network of scientists and sites across the tundra biome established in 1990 to monitor long-term changes in terrestrial ecosystems and conduct warming and other environmental manipulations that test hypotheses related to effects of environmental variability and change on these ecosystems (see Witness Winter 2000/2001).

Egger and Coxson's research focuses on determining spatial and temporal variation in tundra soil processes that are important for carbon and nutrient transformation and production of trace gases. Tundra ecosystems are spatially patterned—in the high Arctic, typical patterns of vegetation and sediment created by frost action are

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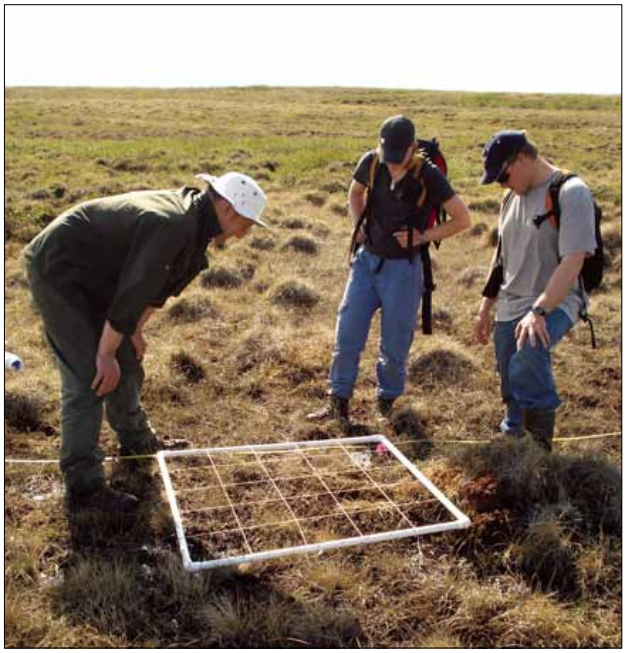
known as sorted nets, while in the sub- to mid-Arctic, more evenly distributed frost-churned soils are found. Understanding how these spatial patterns control carbon and nutrient flux is critical to successfully modeling future changes in tundra ecosystems. Egger is focusing on the geospatial dependence of fungal diversity linked to carbon and nutrient flux, and Coxson is studying the geospatial dependencies in lichen communities relating to their ability to fix atmospheric nitrogen.

Kathy Lewis and her graduate student Nayeemul Karim are studying the historic and predicted future impact of fire-climate interactions on lichen succession in the winter range area of the Bathurst caribou herd. The herd, which calves near Bathurst Inlet in Nunavut and is harvested by hunters in the Northwest Territories, has continued to decline in recent years. Northwest Territories Environment and Natural Resources estimates that herd numbers have fallen from nearly 350,000 in 1996 to under 130,000 in 2006. Concerned groups, including management agencies, ecologists, and aboriginal people, have been struggling to understand the reasons for the decline and to find ways to sustain the population.

A decreasing availability of lichens during the winter months may be one reason for the caribou population decline, and fire disturbance is a key driver of lichen succession in the caribou's wintering ground. Lewis and Karim are in the process of reconstructing the past 300 years of fire history and climatic variability. This information will enable them to characterize the plant succession of winter habitats in relation to fire regime and climate change and the process of lichen supply for caribou. Greater understanding of caribou population dynamics and management implications for conservation, land use planning, and strategic fire management will be useful for resource managers, ecologists, and northern aboriginal people.



Paul Grogan (at left), an ecologist from Queens University, collaborates with Darwyn Coxson on an IPY project called Climate Change Impacts on Canadian Arctic Tundra Ecosystems: Interdisciplinary and Multi-scale Assessments. In this picture, Grogan and students from UNBC and Queens University make plot based assessments of nitrogen fixing plants near Daring Lake. The site is located about 300 miles northeast of Yellowknife in the Northwest Territories. Photo by Darwyn Coxson.

Chris Johnson, graduate students Leslie Witter and Tara Barrier, and collaborators with the Government of the Northwest Territories (GNWT) are also studying the Bathurst herd—specifically, summer and winter range ecology and mechanisms that may have contributed to the current population decline. Witter is investigating the influence of biting and parasitic insects on caribou behavior and movement and Barrier is studying how habitat, fire history, snow, and predators influence the patch and landscape-scale selection strategies of caribou during winter. Their research is funded by NSERC, GNWT, and the Cumulative Impact Monitoring Program.

Outdoor Recreation and Tourism Management Program

The Outdoor Recreation and Tourism Management Program (www.unbc.ca/ortm) is within the College of Science and Management and has five faculty members.

Over the past four years, Pat Maher has established a diverse program of research on tourism in the polar regions. He recently worked with Parks Canada to study management issues associated with cruise ships in the national parks of Nunavut. The resulting technical report, Cruise Tourism in Auyuittuq, Sirmilik, and Quttinirpaaq National Parks, was published in 2008. Maher and colleagues from Vancouver Island University, Thompson Rivers University, and the College of the Rockies were recently funded by the Canadian Rural Secretariat to develop strategies that foster innovation in sustainable tourism in northern British Columbia.

Maher is also part of a three-year project called Climate Change and Tourism Change in Northern Communities: A Vulnerability and Resilience Assessment, which is funded by the Social Sciences and Humanities Research Council and will involve fieldwork in Nunavut, Nunavik, and Nunatsiavut from 2009 to 2012.

Maher helped found two research networks focused on tourism. The University of the Arctic Thematic Network on Northern Tourism addresses knowledge gaps about northern tourism through comparative, circumpolar research that builds baseline data and profiles. The International Polar Tourism Research Network generates, shares, and disseminates knowledge, resources, and perspectives on polar tourism and supports the development of international collaboration and cooperative relationships between members.

Maher was recently involved in co-editing two books—Polar Tourism: Human, Environmental and Governance Dimensions and Cruise Tourism in the Polar Regions: Promoting Environmental and Social Sustainability—both scheduled to be published in 2010.

Environmental Science and Engineering Program

The Environmental Science and Engineering Program (www.unbc.ca/ensc/index.html) has 13 faculty members—their research interests range from large-scale global climate to regional environmental issues.

Stephen Déry leads the Northern Hydrometeorology Group (NHG), which, with funding primarily from the NSERC, investigates the role of climate variability and change on the high-latitude and alpine water cycle. Most group members are graduate students within the Environmental Science and Engineering Program or research staff.

In collaboration with Marc Stieglitz (Georgia Institute of Technology) and Jessie Cherry (University of Alaska Fairbanks), Déry is developing a climatology of the Arctic Long-Term Ecological Research station at Toolik Lake (see Witness Volume 12, Number 2) and the North Slope of Alaska. Using data from about 20 meteorological stations, snow survey measurements, and global climate model output, the contemporary (1988–2004) and potential future (21st century) climate of the area is being established.

Déry also recently worked with Ross Brown (Ouranos) to develop an updated analysis on snowcover extent trends in the Northern Hemisphere. The results of this study show that the extent of the continental snowcover has decreased by about 9% and 3% in North America and Eurasia, respectively, from 1972 to 2006. The analysis also reveals that decreases in snowcover extent are amplified in northern continental regions during spring.

An extension of this work examines the ecological implications of a changing snowcover. Déry works with a team of researchers led by Nils Christian Stenseth at the University of Oslo to investigate the impacts of climate change on the state of the snowpack in the Yukon and other regions of Canada and how it may affect the ability of lynx to capture snowshoe hares in winter. Preliminary results show that changes in snowpack conditions, including hardness, have a direct impact on lynx's ability to capture prey.

NHG member Marco Hernandez-Henriquez contributes to an IPY project, Arctic Freshwater Systems, by providing updated discharge records for 45 major rivers in the Canadian Arctic, as well as information on recent trends and variability. Analysis of the interannual variability in the streamflow records has provided some of the first observational evidence of an intensifying hydrological cycle in the Canadian pan-Arctic.

Building on this project, Theodore Mlynowski has assembled and analyzed observational hydrometric data for about 90 Canadian rivers that have their outlets near the Arctic Ocean to assess the effectiveness of Canada's hydrological monitoring in the pan-Arctic.

Geography Program

Housed within the College of Science and Management, the Geography Program (www.unbc.ca/geography/index.html) has ten faculty.

Gail Fondahl is involved in a project under the aegis of the Sustainable Development Working Group of the Arctic Council to develop and then test a set of social indicators for tracking human development in the Arctic. The Arctic Social Indicators (ASI) project, which is a follow-up to the 2004 Arctic Human Development Report and involves over two dozen collaborators, is led by Joan Nymand Larsen of the Stefansson Arctic Institute and Peter Schweitzer of the University of Alaska Fairbanks. The team is modifying common indicators of human development (such as education, life expectancy, and material well-being) to reflect the arctic context and developing new indicators reflecting relationship to nature and cultural resilience as measures of domains arctic residents have indicated as critically important to their well-being. The ASI report will be published in late 2009; the indicators will then be tested and verified.

UNBC Institutes Advance Priority Research Themes

UNBC has prioritized three interdisciplinary research themes that either relate to existing areas of research strength or to areas where the university foresees significant future potential and is seeking to build research capacity: natural resources and the environment; rural, remote, and northern health; and the sustainability of communities. Institutes that advance these themes at UNBC include:

- The Natural Resources and Environmental Studies Institute (www.unbc.ca/nres/) promotes integrative research addressing natural resource systems and human uses of the environment. Most researchers within the institute are professors in the Ecosystem Science and Management, Environmental Science and Engineering, or Geography Programs. Many current research efforts within the institute focus on arctic issues.
- The Community Development Institute (CDI; www.unbc.ca/cdi/) supports the research, information, and development needs of rural and small town communities in northern BC. The institute serves as a resource for communities interested in making informed decisions in the face of environmental, social, and economic changes. Although the majority of CDI research focuses on regional issues, the institute is ideally positioned to coordinate broader research to understand and energize community development in the Arctic.

In addition to these institutes, the Northern Studies Program (www.unbc.ca/northernstudies/), a multi-disciplinary program of study within the College of Arts, Social, and Health Sciences, is also integral to the overall mandate of UNBC. The program draws upon the northern expertise of faculty with a wide array of backgrounds and exposes students to myriad issues facing northern BC, as well as northern regions around the world.