NUNAVUT WILDLIFE RESEARCH PERMIT APPLICATION

APPLICANT: Jeffery M. Saarela, PhD, Research Scientist

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Nunavut Water Board
MAR 2 9 2012
Public Registry

SPONSOR(S): n/a

FUNDING SOURCES: Canadian Museum of Nature; Polar Continental Shelf Program (PCSP) [support requested, notification expected by April 2012]

ADDITIONAL LICENCES REQUIRED: Katannilik Territorial Park permit [permission to work in the park]; Nunavut Territorial Parks Firearm Permit; Nunavut Water Board licence (submitted); Qikiqtani Inuit Association land use access licence (submitted).

PROJECT TITLE AND RATIONALE:

Flora of the Canadian Arctic

Species inventories and identifications are important for investigating the effects of global warming on arctic ecosystems. The composition and distribution of the Canadian Arctic flora is likely to experience a dramatic shift in the coming century in response to environmental change, but comprehensive present-day floristic data, necessary to track future change, is lacking for many Arctic regions. There are many gaps in current knowledge of the diversity and distribution of the Canadian Arctic flora. Some regions have never been explored botanically, and many remain poorly and incompletely studied. We are still discovering plant species new to science on the arctic islands (e.g., *Puccinellia banksiensis* Consaul), documenting many range extensions, and refining species circumscriptions. Accurate information on current distributions of species and robust identification tools are critical for understanding the impact of climate change on arctic plant species and plant communities. This project will provide comprehensive baseline data on arctic plants (taxonomy, distribution, ecology), with the goal of producing a complete Canadian Arctic Flora. It builds on our extensive, ongoing work on the arctic flora (see Publications in Appendix), and continues the strong, century-long tradition of arctic botany at the Canadian Museum of Nature (CMN), the only Canadian institution with major plant systematic research activities in the Arctic.

2012 Fieldwork in Nunavut

Southern Baffin Island is one region in the Canadian Arctic Archipelago that has received relatively little botanical attention to date, yet, being on the southern coast and close to the mainland, may be one of the first areas in the Arctic Islands to experience predicted changes associated with climate warming. We propose to focus our 2012 fieldwork on southern Baffin Island, in the Kimmirut area and to the east of Kimmirut along the Meta Incognita peninsula. This region is the most floristically diverse area of southern Baffin Island, yet its flora is documented fairly poorly. The majority of the collections from this area were made in the 1920s by J. Dewey Soper and M. O. Malte with imprecise collection localities, and no

comprehensive studies of the flora of the region have been conducted.
Several low arctic species known from the Kimmirut area, documented in the region by only one or a few plant collections, are not otherwise documented as occurring on Baffin Island (Aiken et al. 2007). Given its low arctic floristic affinities, we expect the flora of the region to be more diverse than is currently known.

We propose to study the flora in three main areas: (1) along the Soper River from Mount Joy to Kimmirut, (2) in the vicinity of Kimmirut (base camp at Taqaiqsirvik Territorial Park (Campground)), and (3) in the vicinity of a remote camp at the head of Barrier Inlet 60 km SE of Kimmirut. We will travel from Mount Joy to Kimmirut by canoe, camping along the way, and will undertake field research in the vicinities of each camp by foot. At the Barrier Inlet camp and in Kimmirut we will undertake field research by foot, and at remote and ecologically diverse sites reached by helicopter. Time permitting, we may spend a few days collecting plants in Iqaluit and vicinity prior to entering Katannilik Territorial Park.

We have been conducting comprehensive floristic studies in the Arctic since 2008, and have worked in three areas so far: (1) Southwestern Victoria Island, Nunavut (Nunavut Wildlife Research Permit number WL 2008-1039) in 2008; (2) Tuktut National Park of Canada and Paulatuk and vicinity, Northwest Territories, in 2009; and (3) Uluhaktok and Minto Inlet, Victoria Island, Northwest Territories, in 2010. These trips yielded over 3000 new vascular plant collections, substantially increasing knowledge of the floras of Victoria Island, the western Arctic Archipelago, the Canadian Arctic, and Canada.

TIME PERIOD: 28 June – 30 July 2012

LOCATION:

We propose to work in three main areas:

(1) 25-28 June 2012:
Iqaluit and vicinity.

(2) 28 June – 18 July 2012:
Katannilik Territorial Park, travelling by canoe along the Soper River from Mount Joy (N63.252347, W69.593031) to Kimmirut. In the park we will establish five to seven camps over a three week period.

(3) 18–25 July 2012:
A remote camp and vicinity at the head of Barrier Inlet 60 km SE of Kimmirut (N62.60611, W68.841389). We will explore the immediate area of this proposed area by foot (a radius of 3-5 km), and we will travel further from camp via helicopter. Helicopter sites will include the southern coast of Baffin Island and the higher elevation areas in the central Meta Incognito Peninsula.

(4) 25–30 July 2012:
Kimmirut and vicinity. We will explore the local area by foot (a radius of 3-5 km), and we will travel further from the community via helicopter, if helicopter support is available.

SPECIES:

Our goal in the field is to document plant biodiversity. We will study and document **all** vascular plant and bryophyte species that we encounter. We will also collect lichens and fungi, as time permits.

PROJECT LEADERS:

Dr. Jeffery M. Saarela, Research Scientist, Canadian Museum of Nature
Dr. Lynn J. Gillespie, Research Scientist, Canadian Museum of Nature

PROJECT PERSONNEL:

Jeffery M. Saarela, Ph.D., Canadian Museum of Nature
Lynn J. Gillespie, Ph.D., Canadian Museum of Nature
Roger D. Bull, M.Sc., Canadian Museum of Nature

Paul Sokoloff, M.Sc., Canadian Museum of Nature
Jennifer Doubt, M.Sc., Canadian Museum of Nature
One additional person (TBD)

OBJECTIVES: (Key expected results & Management implications)

Our overall goals are to gain a more complete understanding of the present state of the distribution and composition of the Canadian arctic flora, to expand the knowledge base for understanding the broad-scale impacts of environmental change on the arctic flora, and to develop a DNA-based identification system (DNA barcoding) for arctic plants. In 2011 we started a new project to produce the first Arctic Flora of Canada and Alaska, a flora that will treat all vascular plants in the entire Canadian Arctic and the North Slope of Alaska (http://arcticplants.myspecies.info/). All specimens that we collect in 2012 will be incorporated into the Arctic Flora, and new information about the diversity and distribution about the flora of southern Baffin Island (e.g., major range extensions, additions to the flora of the island, etc.) will be published in a peer-reviewed journal.

We are actively involved in the Polar Barcoding of Life initiative (POLAR-BOL), which is part of the broader International Barcode of Life Project (iBOL). We are leading efforts to produce DNA barcodes (a DNA-based identification system) for all Arctic plant species. By facilitating rapid identification for a diversity of scientists, this tool should have substantial implications for future understanding of the responses of plant species to environmental change. As of November 2011 we have produced DNA barcode data for two plastid gene regions from some 3000 specimens representing some 600 vascular plant taxa. During our 2012 fieldwork we will obtain silica gel-dried leaf samples for all of our collections; a subset of these (at least one representative of each species) will be incorporated into the barcode database. These collections will also contribute significantly to our growing CMN arctic plant tissue and DNA collection.

Management Implications: Our research will provide new and up-to-date information on plant diversity on southern Baffin Island, including in Katannilik Territorial Park. This information will be inform future land management related to plants in the region.

METHODS: (i.e. Details of capture, handling, and disposition – *be SPECIFIC*)

Plant Collecting Methods—We will document all vascular plants and bryophytes in the region by completing plant inventories of each of the main study areas, and will collect data on conservation status, ecology, distribution, and population variation as appropriate. All of these data will be useful for long-term monitoring of potential changes in species diversity in the future. Approximately 1000 vascular plant and 1000 bryophyte specimens will be collected, photographed, and studied. Collections will be deposited at the National Herbarium of Canada (Canadian Museum of Nature), and duplicate specimens will be distributed to national and international herbaria, all contributing to the permanent scientific record documenting the distributions of Arctic plant species in time and space.

We document plant biodiversity by exploring as many different habitats as possible, and spending time in each habitat to find all the different species that are present. We make collections of all the species at a site, with the aim of comprehensively documenting with voucher specimens the local plant diversity. We collect plants specimens using a plant press, the standard method that botanists have used for several centuries. Once collected, plant specimens are arranged into sheets of newspaper, placed between two pieces of cardboard, piled up, and tightened with two straps. The specimens are flattened and dry in the press; once dry they will last for centuries when stored in a herbarium (dried plant collection).

For each collection event we:

- Collect a few to several individuals of a species (depending on the size of an individual, and how common the species is locally). If a species is not common, we collect only enough material (i.e., enough for one or two herbarium sheets) to properly document its occurrence at the site. If a species is rare, we do not collect any specimens, and document its occurrence only with photographs.
- Record detailed notes on the location of the species, its local growing conditions, and other species that grow at the site. In a subset of instances we take photographs of

the species growing in its natural state.
- Preserve a small amount of leaf tissue in silica gel (a dessicant), which rapidly dries the genetic material in the leaf tissue in a way that is suitable for later study (e.g., DNA sequencing) in the molecular laboratory.

Transportation in the Field—Transportation to field camps and study sites will be provided by PCSP (twin otter and helicopter); transportation in the vicinity of each camp will be by foot. While in Katannilik Territorial Park we will travel an approximately 60 km stretch of the Soper River by canoe, over a three week period. During this period we will establish five to seven camps, spending an average of three days at each camp and exploring the flora around each camp site. We plan to have one camp at the head of Barrier Inlet for one week, and a final camp in Kimmirut at Taqaiqsirvik Territorial Park (Campground). Accommodation will be in small backpacking tents. No permanent or large temporary structures will be erected; impact will be minimal. All items associated with the project will be removed at the end of each camp stay.

COMMUNITY CONSULTATION PLAN:

Communities are consulted, in part, through this application process. We will work with personnel from Katannilik Territorial Park to establish a venue where we can share our work with the community of Kimmirut, when we are there. We have submitted a land use application to the Qikiqtani Inuit Association (including a short summary in English and Inuktitut), and we have submitted a water licence application which includes an short executive summary of our application in English and Inuktitut, which is shared with the community.

PROPOSED USE OF LOCAL KNOWLEDGE:

We hope to obtain some local knowledge about interesting plant areas in Katannilik Territorial Park by engaging with personnel that work for the park, or local individuals that may have knowledge of plants in the area.

OPPORTUNITIES FOR LOCAL PARTICIPATION:

In the Kimmirut area we would be interested in taking local people on field trips. There will likely be opportunity for our team to hire a wildlife monitor for the Barrier Inlet portion of a trip, which will take place on Inuit Owned Land.

TERMS & CONDITIONS:

This application is submitted and will be evaluated prior to issuance of a Research Permit or Collection Licence, as issued by the Department of Environment – Wildlife Management Division, Nunavut Territory. All submitted applications become the property of the Department of Environment– Wildlife Division and may not be returned to the applicant.

The application review process requires that copies be distributed to a number of reviewers. The contents of this application form may be subject to access under the Freedom of Information and Protection of Privacy Act.

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Principal Researcher's signature Date

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Additional Investigator's signature Date

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Additional Investigator's signature Date

All applications for Wildlife Research Permits should be submitted to:

Wildlife Research Section

Department of Environment
Box 209, Igloolik, NU, X0A 0L0

Tel: (867) 934-2178
Fax: (867) 934-2190
Email: wildlife_research@gov.nu.ca

Appendix – Arctic Publications and Presentations (since 2010)

Publications:

1. Saarela JM, Gillespie LJ, Consaul LL, Bull RD. 2012. Balsam poplar (Populus balsamifera; Salicaceae) beyond the treeline in the western Canadian mainland Arctic (Northwest Territories). Arctic, in press, accepted 10 June 2011.
2. Sokoloff, PC, Gillespie, LJ. 2011. Taxonomy of Fernald's Milkvetch - Astragalus robbinsii var. fernaldii (Fabaceae): molecular and morphological analyses support transfer to Astragalus eucosmus. Botany 90: 11-26.
3. Le Clerc-Blain, J., Starr, J.R., Bull, R.D. & Saarela, J.M. 2010. A regional approach to plant DNA barcoding provides high species resolution of sedges (Carex and Kobresia, Cyperaceae) in the Canadian Arctic Archipelago. Molecular Ecology Resources 10: 69-91.
4. Consaul, L.L., L.J. Gillespie, and M.J. Waterway. 2010. Evolution in North American Arctic Puccinellia (Poaceae) based on nuclear ribosomal spacers and chloroplast DNA sequences. American Journal of Botany 97: 324-336.
5. Consaul, L.L., L.J. Gillespie, and M.J. Waterway. 2010. Polyploid speciation and evolution in arctic Puccinellia (Poaceae: Puccinelliinae) – A review. In O. Seberg, G. Petersen, A.S. Barfod, J.I. Davis (editors), Diversity, phylogeny, and evolution in the monocotyledons. Aarhus University Press, Aarhus, Denmark. Pp. 645-662.
6. Saarela, J.M., L.J. Gillespie, L.L. Consaul, and R.D. Bull. 2010. The Vascular Plant Flora of Tuktut Nogait National Park of Canada and Vicinity, Northwest Territories. Report submitted to Parks Canada, April 2010 (and made available to the NWT government). 149 pages + 5 appendices. [Manuscript in preparation for submission to peer-reviewed journal, Phytotaxa].

Selected presentations:

1. Gillespie, LJ. 2011. Monitoring Red-Listed Arctic Plant Species. Conservation of Arctic Flora and Fauna (CAFF), Flora Group meeting. Akureryi, Iceland, Jan 31.
2. Gillespie, LJ. 2011. Flora of the Canadian Arctic: discoveries, DNA barcoding and a new flora project. Institut de Recherche en Biologie Végétale (IRBV), Université de Montréal, Feb 18.
3. Saarela, JM, LJ Gillespie, LL Consaul, RD Bull. 2011. New floristic discoveries and biodiversity of the western Canadian Arctic vascular plant flora. International Botanical Congress 2011, Melbourne, Australia, 17-29 July 2011.
4. Saarela, JM, LJ Gillespie, LL Consaul, JR Starr, RD Bull, PC Sokoloff. 2011. DNA barcoding the vascular plant flora of the Canadian Arctic. International Botanical Congress 2011, Melbourne, Australia, 17-29 July 2011.
5. Gillespie, L.J., J.M. Saarela, L.L. Consaul, RD Bull. 2010. Plant collecting by canoe: botanical explorations of Tuktut Nogait National Park and vicinity, Northwest Territories. 2010 SPNHC-CBA Joint Conference, Ottawa, ON, 31 May – 5 June
6. Saarela, J.M., L.J. Gillespie, R.D. Bull, B.N. Chouinard, P. Abraham, and J. Starr. 2010. DNA barcoding the vascular plant flora of the Canadian Arctic. Botany 2010: American Society of Plant Taxonomists / Botanical Society of America. Annual Meeting. August. Providence RI.
7. Aronsson, M., LJ Gillespie and S Ickert-Bond. 2011. Vascular plant Red List, Monitoring and Arctic Plant Portal. Conservation of Arctic Flora and Fauna (CAFF) biennial meeting. Akureryi, Iceland, Feb 2.
8. Gillespie, LJ. 2011. Flora of the Canadian Arctic: discoveries, DNA barcoding and a new flora project. Institut de Recherche en Biologie Végétale (IRBV), Université de Montréal, Feb 18.
9. Saarela, JM, LJ Gillespie, LL Consaul, RD Bull. 2011. New floristic discoveries and biodiversity of the western Canadian Arctic vascular plant flora. International Botanical Congress 2011, Melbourne, Australia, 17-29 July 2011. [e-poster] http://www.slideshare.net/jmsaarela/2011-saarela-et-al-ibc-2011-eposter-arctic-floristicsfinal
10. Saarela, JM, LJ Gillespie, LL Consaul, JR Starr, RD Bull, PC Sokoloff. 2011. DNA barcoding the vascular plant flora of the Canadian Arctic. International Botanical Congress 2011, Melbourne, Australia, 17-29 July 2011. http://www.slideshare.net/jmsaarela/2011-saarela-et-al-ibc-2011-eposter-dna-barcoding

11. Consaul LL, M Ip, D Charette, PM Catling, E Kattuk, S Kudluarok Jr, C Ekidlak, M Tsujimoto, N Doubleday. 2011. Traditional knowledge and botanical collections help to study climate change effects in the southern Arctic. Canadian Botanical Association, Annual Meeting. Halifax July 2011.
12. Abraham, P, BN Chouinard, JM Saarela, JR Starr. 2010. Plant DNA barcodes correctly identify all field collections of Carex and Kobresia (Cyperaceae) from the Canadian Arctic Archipelago. 2010 SPNHC-CBA Joint Conference, Ottawa, ON, 31 May – 5 June 2010.
13. Consaul, L.L., J.M. Saarela, L.J. Gillespie, and R.D. Bull, 2010. Vascular plant diversity in Canada's southern Arctic: new baseline data and significant floristic discoveries in Tuktut Nogait National Park and vicinity, Northwest Territories. 2010 SPNHC-CBA Joint Conference, Ottawa, ON, May31 –June 5 2010.
14. Consaul, L.L., J.M. Saarela, L.J. Gillespie, and R.D. Bull, 2010. Vascular plant diversity in Canada's southern Arctic: new baseline data and significant floristic discoveries in Tuktut Nogait National Park and vicinity, Northwest Territories. American Society of Plant Taxonomists / Botanical Society of America, Annual Meeting. July 31 - August 4. Providence RI.
15. Consaul, L.L., Morgan A. Ip, Paul M. Catling, Sarah Kudluarok, Lucy M. Tookalook, and Nancy C. Doubleday. 2010. Native orchids as bioindicators in the southern Arctic. Canadian Botanical Association Conference, Ottawa, Ontario, May 31–June 5, 2010.
16. Consaul, L.L. Flora of the Arctic, adaptations for harsh environments. Manotick Horticultural Society. March 8, 2010.
17. Doubleday, N.C., S.G. Donaldson, M. Ip, D. Charette, B. Grimwood, L. Consaul, and S. Kudluarok. Photos and Plants Through Time. IPY Early Results Workshop. Ottawa, Feb 16, 2010.
18. Gillespie, L.J., J.M. Saarela, L.L. Consaul, RD Bull. 2010. Plant collecting by canoe: botanical explorations of Tuktut Nogait National Park and vicinity, Northwest Territories. 2010 SPNHC-CBA Joint Conference, Ottawa, ON, 31 May – 5 June.
19. Saarela, J.M., L.J. Gillespie, L.L. Consaul, R.D. Bull, B.N. Chouinard, P. Abraham, J.R. Starr. 2010. DNA barcoding the vascular plant flora of the Canadian Arctic. 2010 SPNHC-CBA Joint Conference, Ottawa, ON, 31 May – 5 June.
20. Saarela, J.M., L.J. Gillespie, R.D. Bull, B.N. Chouinard, P. Abraham, and J. Starr. 2010. DNA barcoding the vascular plant flora of the Canadian Arctic. Botany 2010: American Society of Plant Taxonomists / Botanical Society of America. Annual Meeting. August. Providence RI.
21. Saarela, J.M. DNA barcoding Canadian plants: grasses, sedges, and the flora of the Canadian Arctic. Canadian Food Inspection Agency, 20 May 2010. [Invited seminar]
22. Sokoloff, P.C., Gillespie, L.J. 2010. Systematics and conservation of Fernald's Milkvetch: cpDNA, AFLPs and morphometric analyses do not support taxonomic recognition 2010 SPNHC-CBA Joint Conference, Ottawa, ON, 31 May – 5 June.

Public presentations:

1. Saarela, JM. 2011. Flora of the Canadian Arctic. Canadian Museum of Nature Annual General Meeting. 3 November 2011. Victoria Memorial Museum Building, Canadian Museum of Nature, Ottawa.
2. Gillespie, LJ. 2010. Canadian Arctic Flora: Botanical Research at the CMN. Ottawa Field Naturalists Club, VMMB, Ottawa, Dec 14.
3. Saarela, JM. 2011. Botany in arctic Canada: The latest chapter in a 200 year adventure. Floristic discoveries and biodiversity of the western Canadian Arctic vascular plant flora. Meeting of the Field Botanists of Ontario, Victoria Memorial Museum Building, Canadian Museum of Nature, 8 April 2011.
4. Saarela, JM. 2010. Flora of the Canadian Arctic. Canadian Museum of Nature Annual Volunteer Appreciation Luncheon. December 2010. Victoria Memorial Museum Building, Canadian Museum of Nature.
5. Sokoloff, P. 2011. A series of five blog posts on the Museum's nature.ca blog (one of five published as of 13 Oct 2011; text for all five posts is complete)