

Biodiversity of Canadian Arctic vascular plants and lichens: Field work, floristics and museum collections

Jeff Saarela, Lynn Gillespie, Paul Sokoloff,
Roger Bull & R. Troy McMullin



canadian museum of nature
nature
musée canadien de la nature

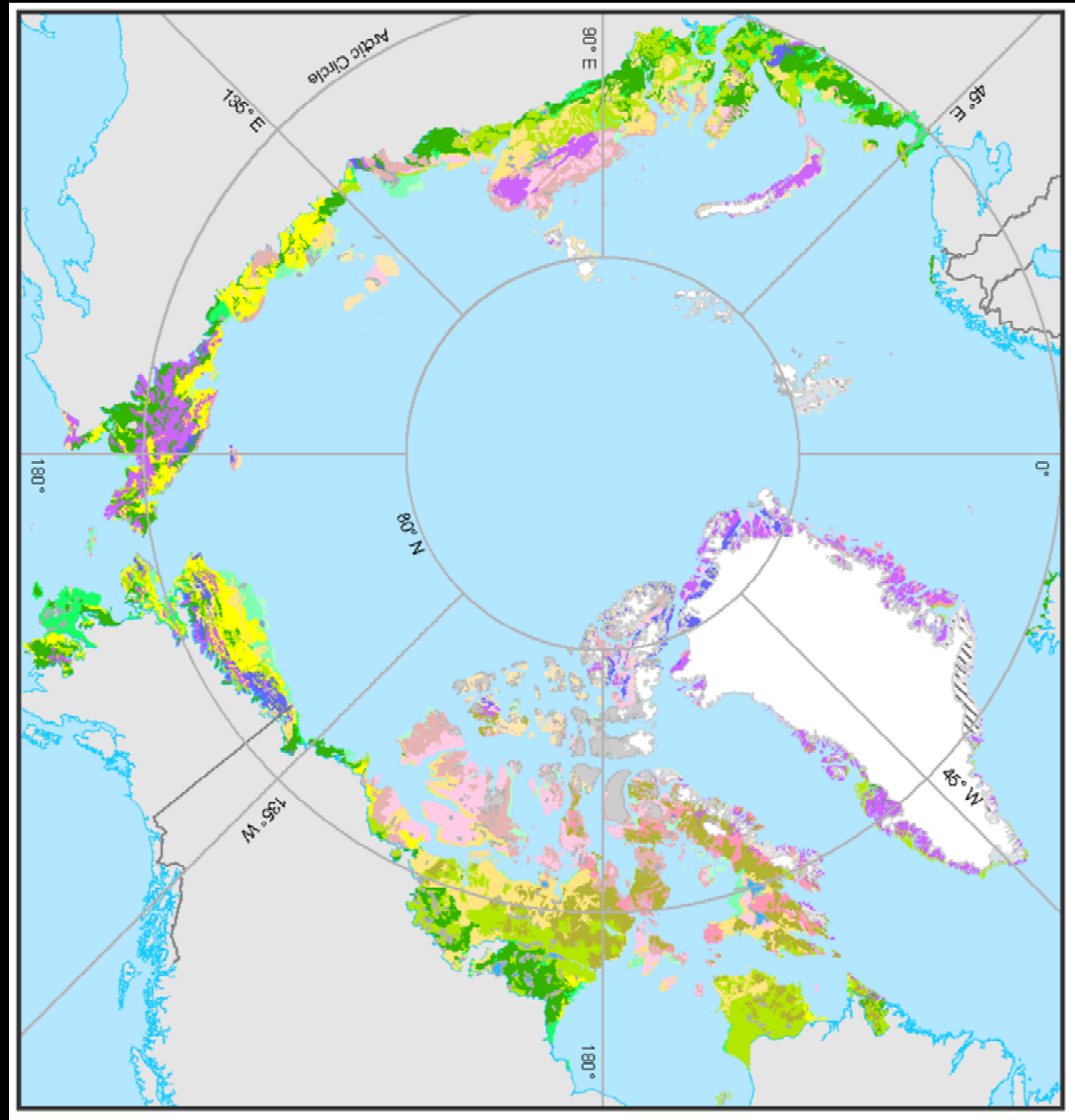
Centre for Arctic
Knowledge and Exploration

Global Arctic Flora - Vascular Plants

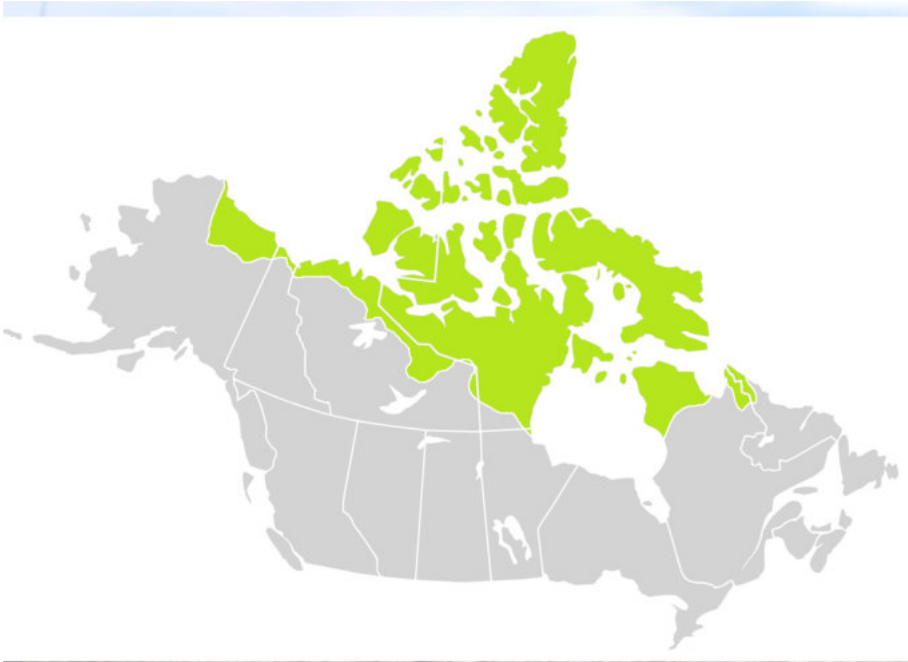
- 91 families
- 420 genera
- 2218 species



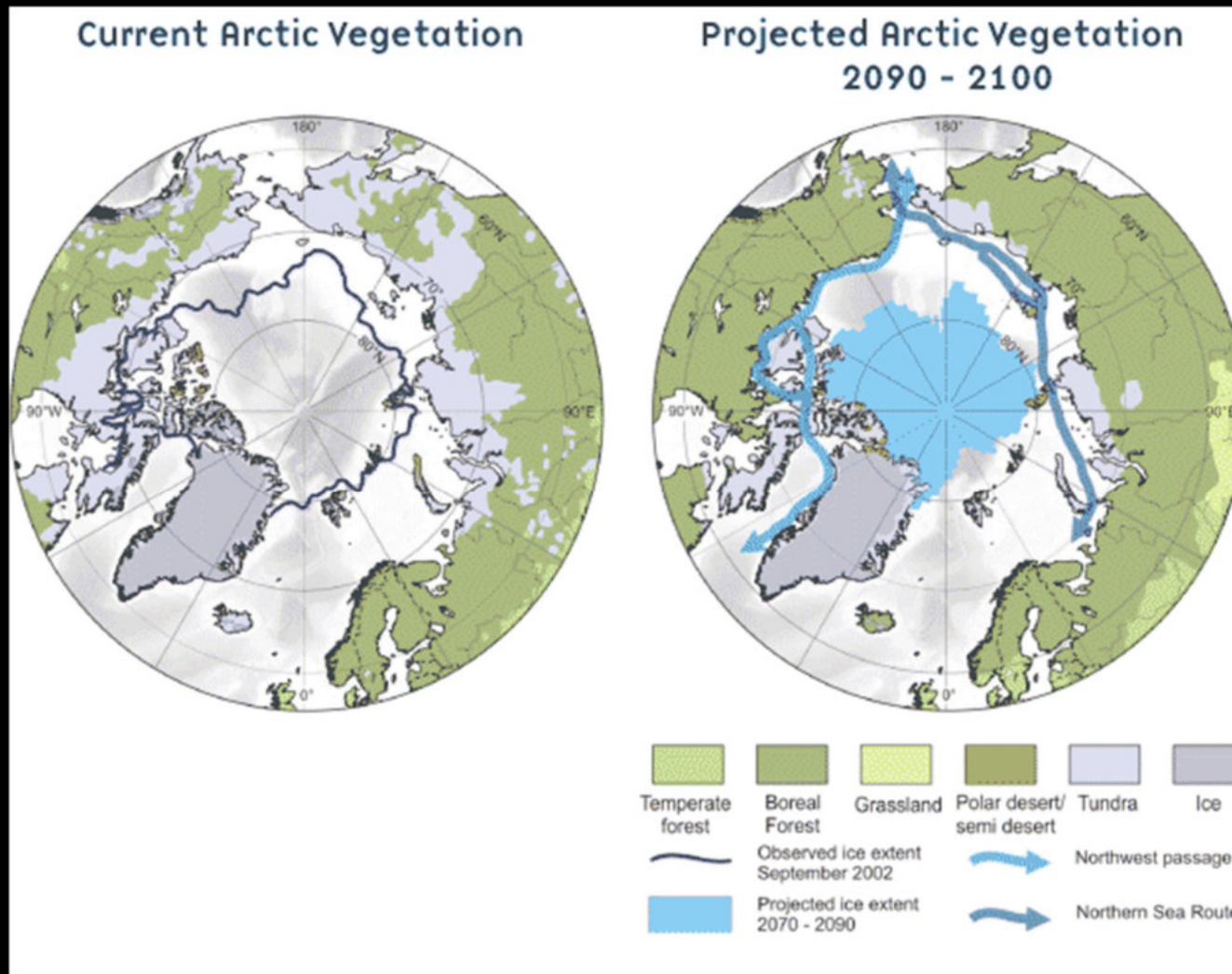
<http://nhm2.uio.no/paf/>



Canadian Arctic – ca. 800 species of vascular plants



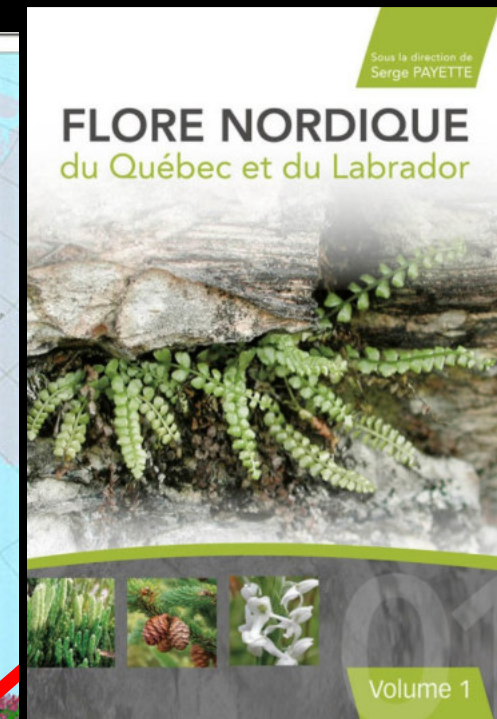
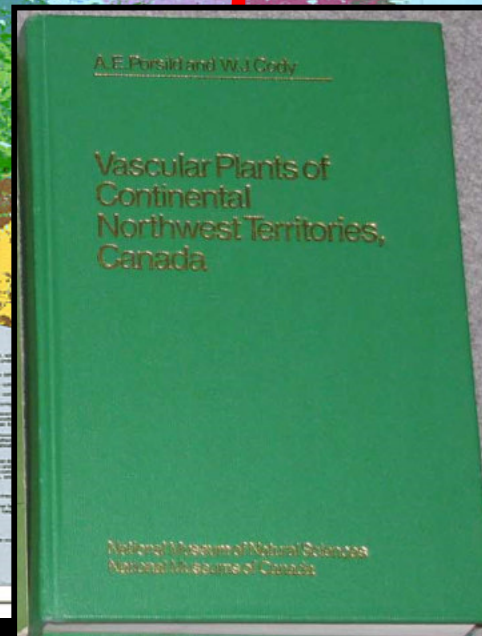
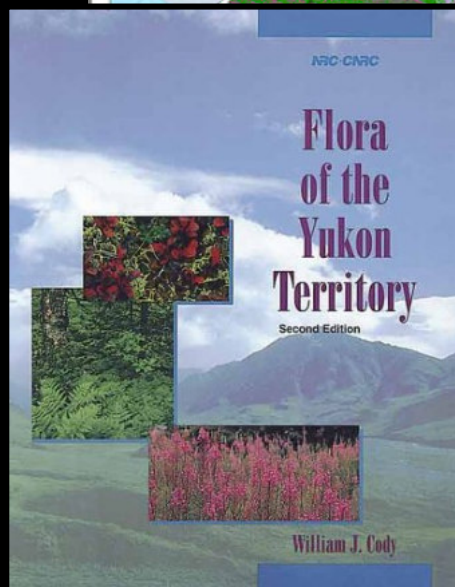
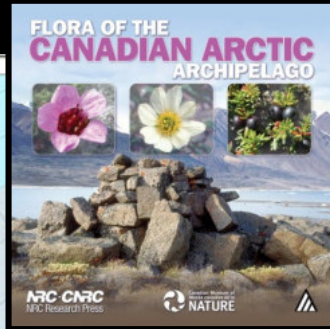
Why study Arctic plant biodiversity?



Source: British Antarctic Survey Mapping Unit

Changes in species and ecosystem distributions

Published Canadian Arctic Floristic Information



+ extensive primary literature

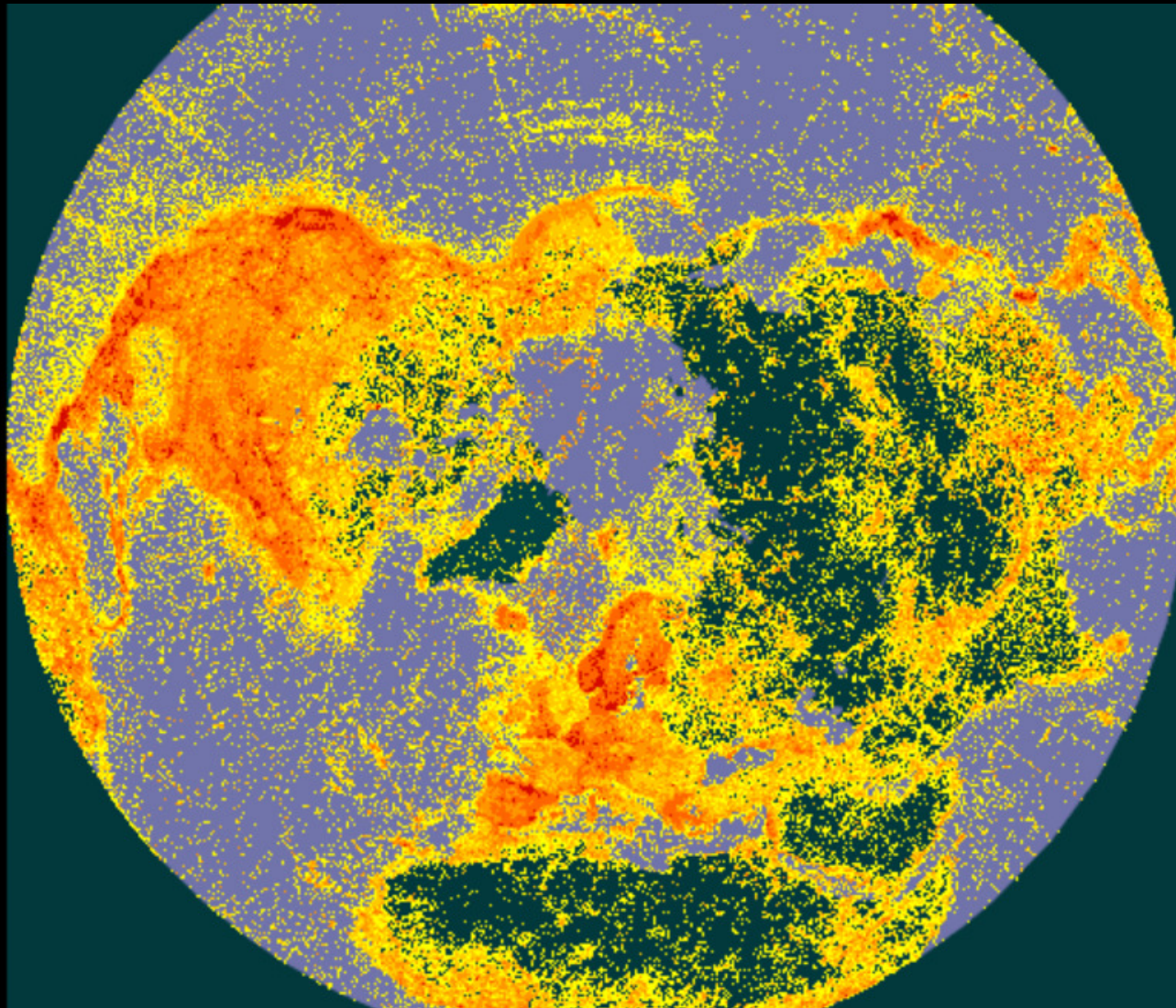
This biodiversity information is (or should be...) **specimen based**

Many unpublished records exist in collections
Names and taxonomic concepts change through time
Many Arctic taxa are difficult to identify...many misIDs.



National Herbarium of Canada (CAN)

The Arctic is poorly collected



All taxa
(plants,
animals,
fungi,
etc.)

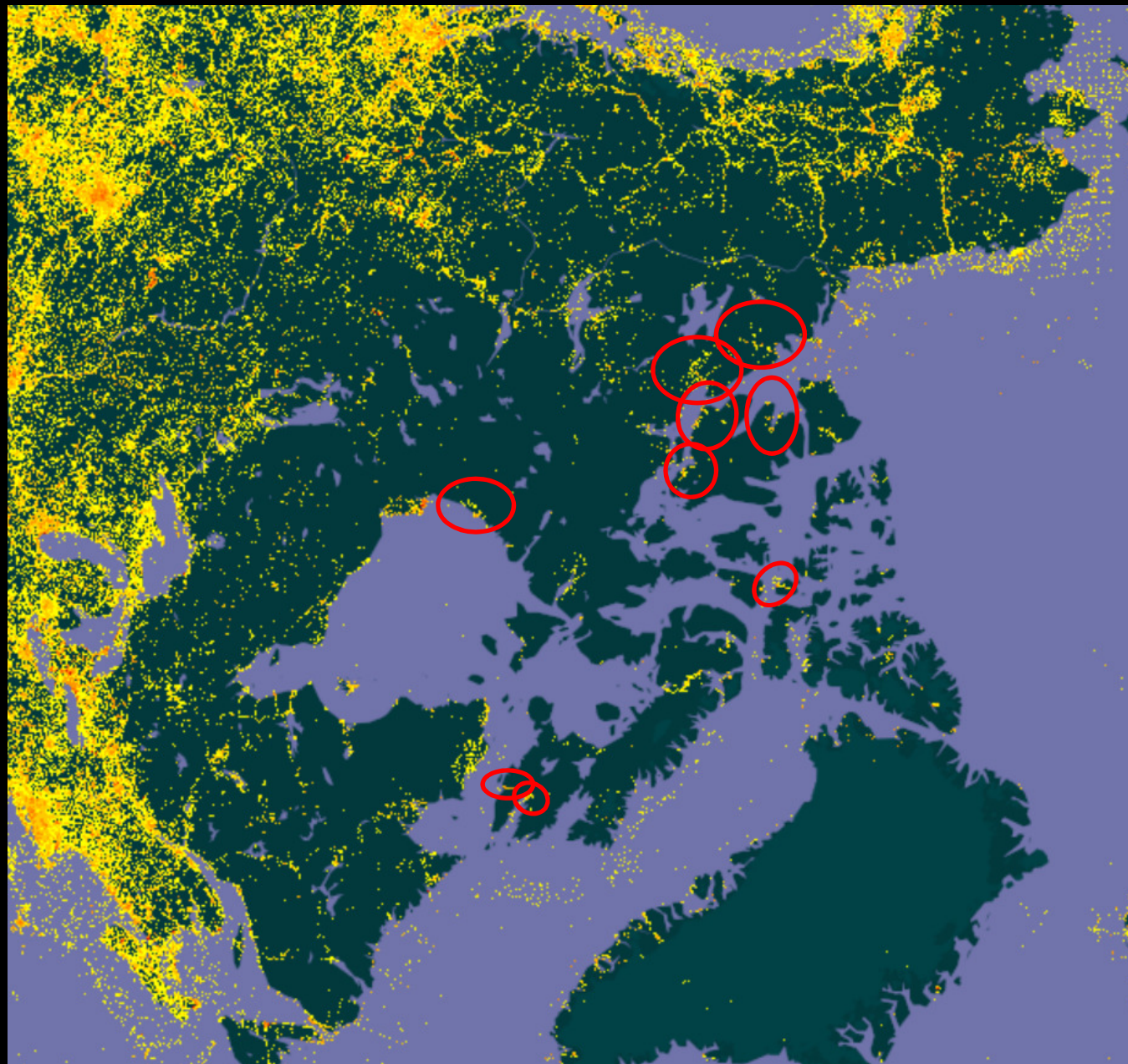
Global Biodiversity Information Facility (GBIF) –
Basis of Record: Preserved specimen

The Arctic is poorly collected

All taxa



Global Biodiversity Information Facility (GBIF) –
Basis of Record: Preserved specimen



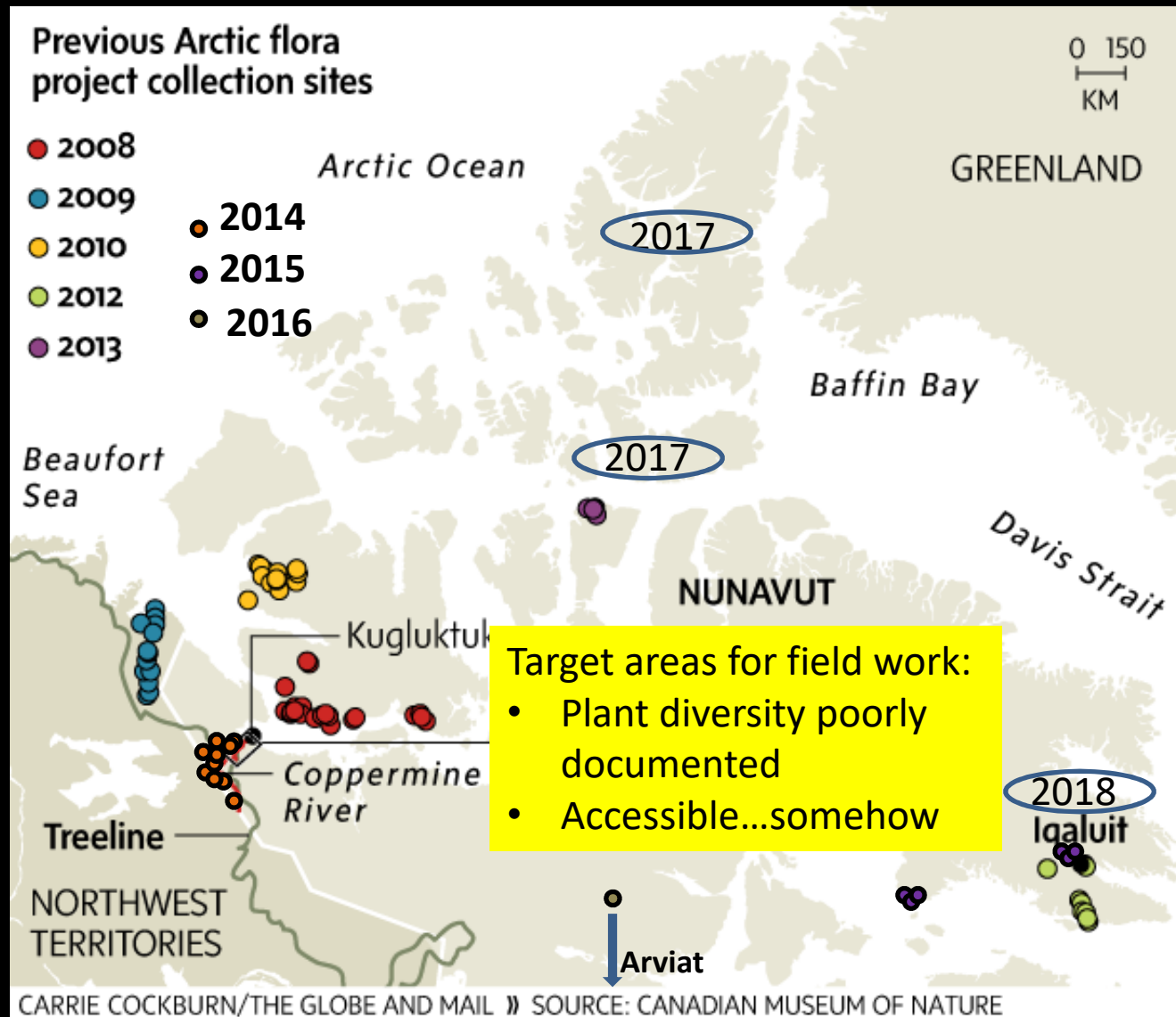
All taxa

1999-2018

○ Our (CMN)
plant
collections
since 2008

Global Biodiversity Information Facility (GBIF) –
Basis of Record: Preserved specimen

CMN Arctic Floristic Studies 2008-2018



Floristics

the study of the distribution, number, types, and relationships of plant species in an area or areas





CANADA C3

COAST TO COAST TO COAST
TROIS CÔTES • UN VOYAGE

A 23 000 km transect: new Arctic plant & lichen collections from the Canada C3 Expedition

Paul C. Sokoloff ⁽¹⁾, Mark S. Graham ⁽¹⁾, R. Troy McMullin ⁽¹⁾, Noel R. Alfonso ⁽¹⁾, Roger D. Bull ⁽¹⁾, Oluwayemisi K. Dare ⁽¹⁾, Jennifer Doubt ⁽¹⁾, Mark A. Edwards, Caroline H. Fox, Paul B. Hamilton ⁽¹⁾, Ed A. Hendrycks ⁽¹⁾, Lisa Kresky, Julie LaRoche, Rhiannon Moore, Paula C. Piilonen ⁽¹⁾, Vicki Sahanatien, Lianna Teeter, Man-Yin Tsang, Peter Van Buren, Michael Wong, Jeffery M. Saarela ⁽¹⁾

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Introduction

The Canada C3 expedition was a 150 day marine journey from Toronto, Ontario to Victoria, British Columbia by way of the Northwest Passage. Based on the icebreaker *Polar Prince*, this expedition brought together a diverse group of Canadians to explore Canada's Atlantic, Arctic and Pacific coasts while reflecting on the journey's core themes of Diversity and Inclusion, Reconciliation, Youth Engagement and the Environment. As a part of the expedition's scientific program, shipboard researchers and expedition participants opportunistically collected plants and lichens at stops along the journey to add new knowledge on the floristic diversity of Canada's three coastlines. These specimens are the botanical legacy of this awesome voyage, providing a snapshot of the species found along the expedition route during Canada's sesquicentennial year. Once deposited into the National Herbarium of Canada at the Canadian Museum of Nature, these specimens will serve as useful data for future researchers seeking to know more about the identity and distribution of Canadian Arctic plants and lichens. They contribute to ongoing research on Canadian Arctic vascular plant and lichen biodiversity at the Canadian Museum of Nature.

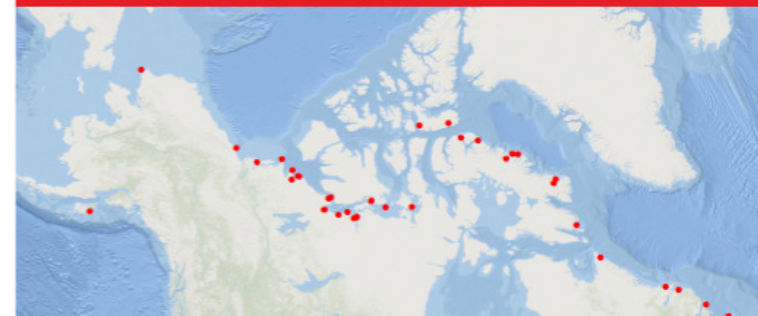
Sampling



Plant and lichen specimens were collected by expedition scientific staff, many of whom were non-botanists with various specialties, recruited from the Canadian Museum of Nature, various Government of Canada departments and agencies, NGO's and member institutions of the Alliance of Natural History Museums of Canada. On each leg, non-scientist participants assisted with the collection efforts on the land. Upon return to the ship after each landing, collections were sorted and processed (i.e., plants pressed and lichens dried) in the Bowhead Lab under the bow of the ship.



Polar Prince: This privately owned icebreaker was launched in 1958 and served in the Canadian Coast Guard until 1986. It was leased to the Students on Ice Foundation for the Canada C3 expedition.



See our poster

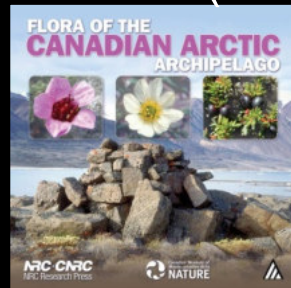
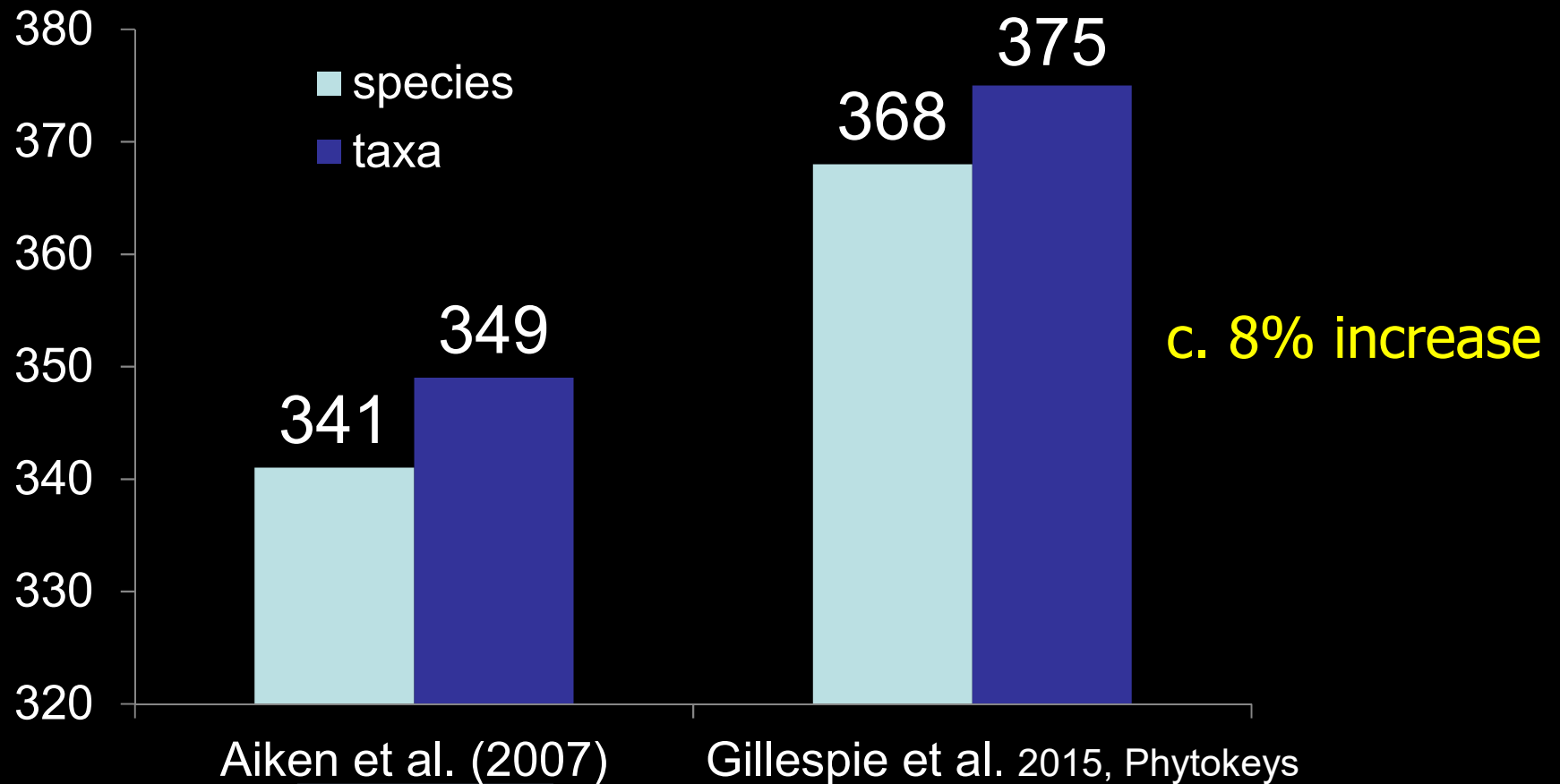
So far...over 10,000 new Canadian Arctic
plant collections; >~25,000 specimens



Tissue samples for genetic studies for
almost every collection



12 species and 3 families new to Canadian Arctic Archipelago



including new literature records, post-2007



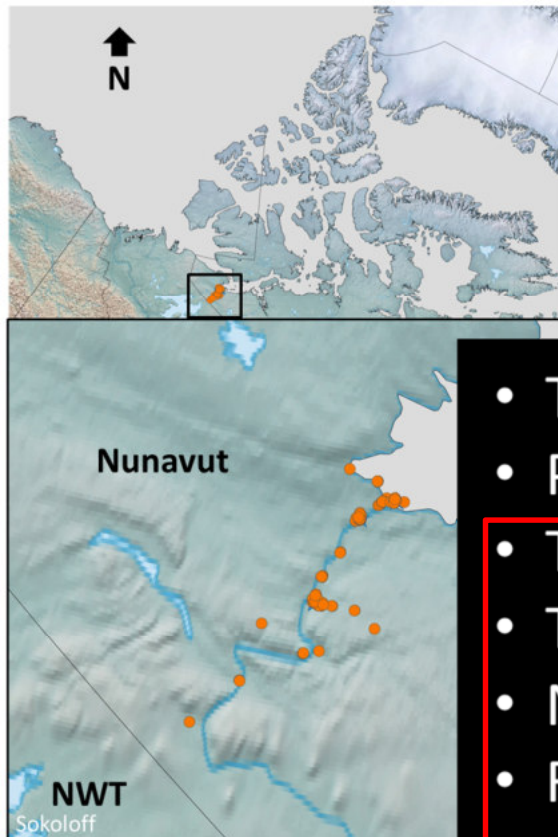
Vascular plant biodiversity of the lower Coppermine River valley and vicinity (Nunavut, Canada): an annotated checklist of an Arctic flora

Jeffery M. Saarela, Paul C. Sokoloff and Roger D. Bull

Botany Section and Centre for Arctic Knowledge & Exploration, Research and Collections,
Canadian Museum of Nature, Ottawa, ON, Canada

ABSTRACT

The Coppermine River in western Nunavut is one of Canada's great Arctic rivers, yet its vascular plant flora is poorly known. Here, we report the results of a floristic inventory of the lower Coppermine River valley and vicinity including Kivakuk.



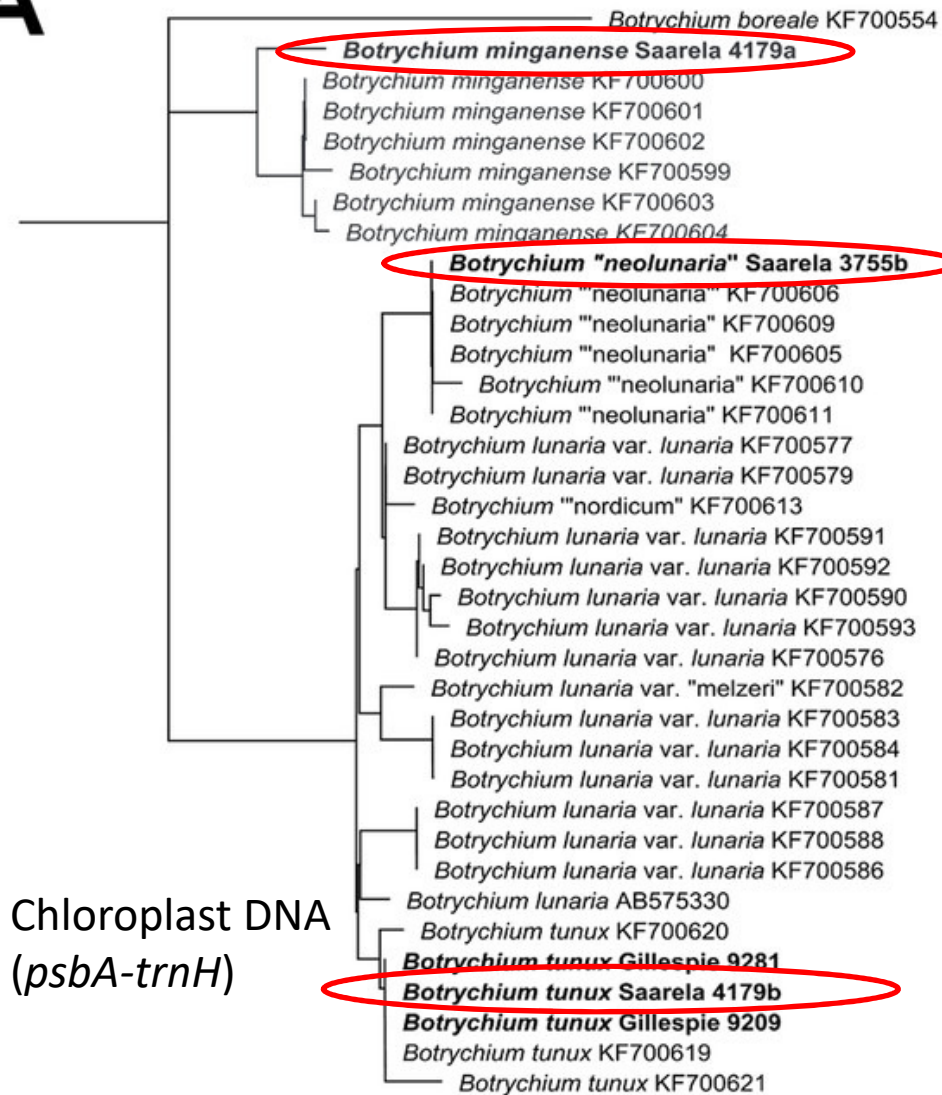
- Total taxa 311
- Previously recorded taxa 193 (62%)
- Taxa new to study area 119 (38%)
- Taxa new to Nunavut 13
- New taxa to mainland Nunavut 7
- Range extensions 54

Submitted 2 September 2016
Accepted 28 November 2016

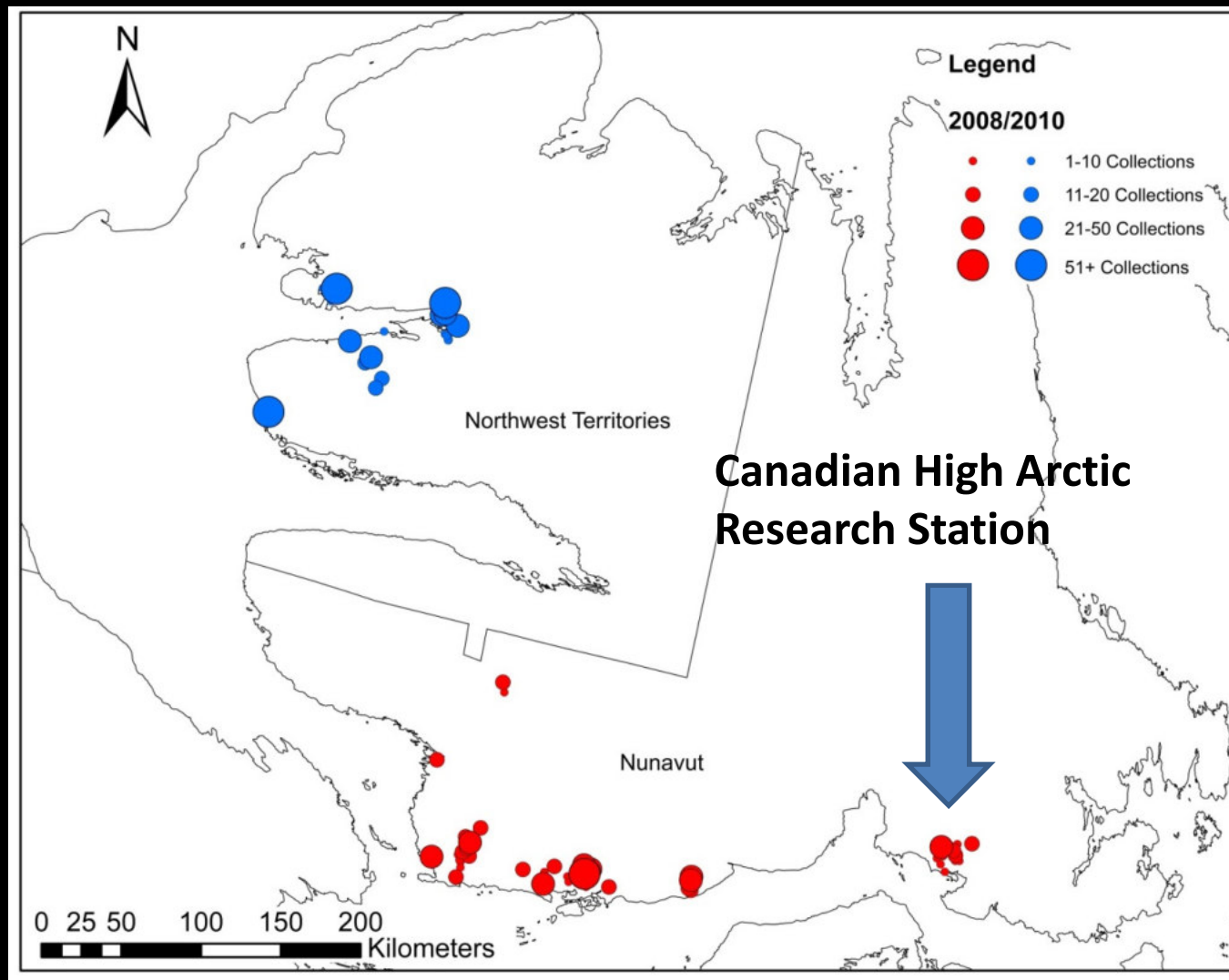
varieties) are newly recorded for Nunavut: *Grassia boreoalpina*, *Grassia capillaris*, *Draba lonchocarpa*, *Eremogone capillaris* subsp. *capillaris*, *Sabulina elegans*, *Eleocharis quinqueflora*, *Epilobium* cf. *anagallidifolium*, *Botrychium neolunaria*, *Botrychium tunneri*, *Eriogonum altaicum*, *Deschampsia cespitosa*, *Salix ovalifolia* var. *arctoditensis*, *Salix*

Botrychium tunux Stensvold & Farrar

A



Victoria Island – many areas previously poorly explored



Vascular Plants of Victoria Island – ca. 5400 unique collections, up to 2017



- c. 19 species new to the western CAA
- c. 30 species new to Victoria Island
- increased # of species from 231 to c. 261

Lichens of Arctic Canada



Lichenologist Dr. Troy McMullin joined the CMN in 2016

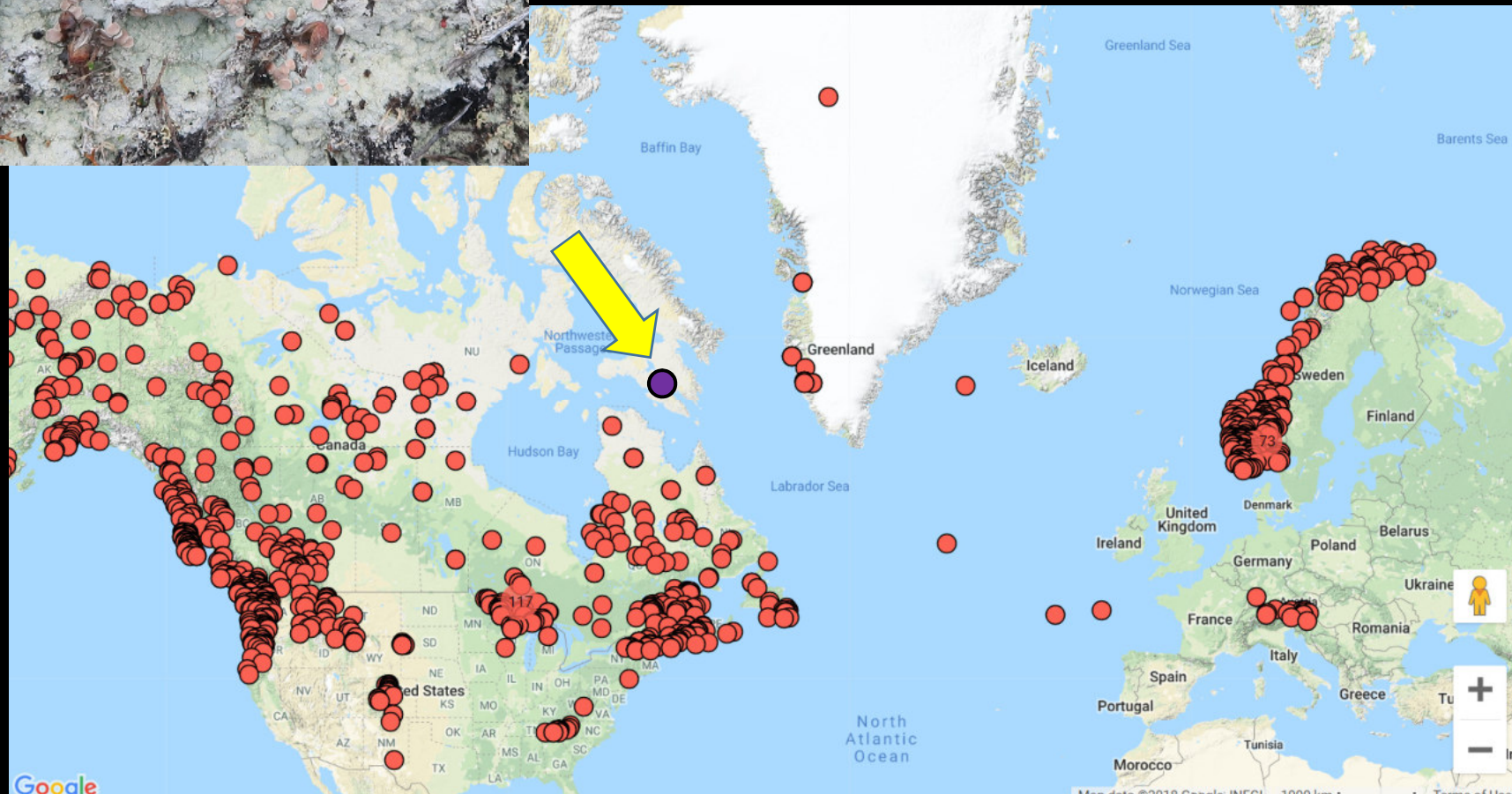
Long-term focus on documenting the lichen diversity of Nunavut, which is poorly known.

New Lichen Discoveries

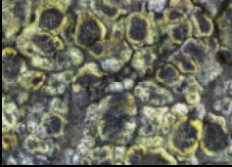


Icmadophila ericetorum (fairy puke lichen)

- first record for Canadian Arctic islands found in Iqaluit, 2018



New Lichen Discoveries



Acarospora schleicheri: first record for Nunavut and Arctic Canada found at Lake Hazen, Nunavut, 2017

- McMullin, R.T. 2018. *Opuscula Philolichenum* 17: 275-292



Megalaria jemtlandica: first Canadian (and second North American) record found in Arviat, Nunavut, 2016



Fulgensia desertorum: first record for Northwest Territories and Arctic Canada found at Cape Bathurst, Northwest Territories, 2017



Arctic digitization at the National Herbarium of Canada

a new project to digitize, georeference and image Arctic plant, moss and lichen specimens, according to global standards that facilitate collection data sharing and integration

Liberating Arctic botanical biodiversity data at the Canadian Museum of Nature



Jennifer C. Doubt, Lisa C. Gualtieri, Cassandra M. Robillard, Lyndsey A. Sharp, Paul C. Sokoloff, Jeffery M. Saarela

Botany Section and Centre for Arctic Knowledge and Exploration, Canadian Museum of Nature, Ottawa, ON, Canada. Contact: jdoubt@nature.ca

Introduction

Core to the polar research information spectrum are the millions of specimens in natural history collections. These specimens document the distribution of species in time and space, and often include additional ecological information, providing a wealth of biodiversity data. They also serve as vouchers for the datasets that underpin scientific conclusions, allowing future workers to confirm or revise identifications. Finally, these specimens are ongoing sources of new data – including genetic information – as they are continually re-used and re-interpreted in addressing new questions over the course of centuries.

Natural history museums face a massive challenge in databasing and imaging their collections, in order for them to be widely discovered, shared, used and reused in research and outreach. This challenge is commonly augmented by unprocessed specimen backlogs: specimens collected and stored, sometimes many decades ago, that have never been accessioned or prepared for long-term use, and that are essentially invisible to collection users, and unavailable for study.

In 2017, a philanthropic donation by the Sitka Foundation to the Canadian Museum of Nature (CMN), made possible the large scale digitization of Canadian Arctic (Yukon Territory, Northwest Territories, Nunavut) holdings.

National Herbarium of Canada

The National Herbarium of Canada, at the CMN, houses a growing collection of 1.25 million specimens of wild bryophytes, lichens, vascular plants and algae collected between 1766 and the present day. About 20% of the collection is databased so far. Staff estimate the Arctic portion (Canadian Arctic, as well as Alaska and Greenland) of the collection to represent about 100 000 specimens.

CMN scientists currently lead the collaborative production of an Arctic Flora of Canada and Alaska (<http://arcticplants.myspecies.info/>), continuing a tradition of Arctic botanical research and collection that dates to the earliest incarnations of the institution. Consequently, the National Herbarium of Canada provides a key international resource on Arctic plants over the past 200+ years.



Herbarium technician, Lyndsey Sharp (right) and student assistant Junyi Meng prepare a specimen

Student assistant Rachel Bergeron files specimens in the National Herbarium of Canada



Digitization Project Goals and Staff

With the understanding that available resources could not support full imaging and databasing for all Arctic holdings, project staff identified the need to, at minimum, make all specimen objects "discoverable" both by those who manage the collection and by those who use it. Accordingly, the following goals (in priority order) were set for digitizing Arctic herbarium specimens:

1. Capture specimen images and link them to complete or partial database records, and make them publicly available on the internet via the Global Biodiversity Information Facility (<https://www.gbif.org/>)

See
our
poster

As of 7 Oct 2018: 56,105 records
43,475 with images

Nunavut, Northwest
Territories, Yukon,
N Quebec

OCCURRENCE | 9 JULY 2014

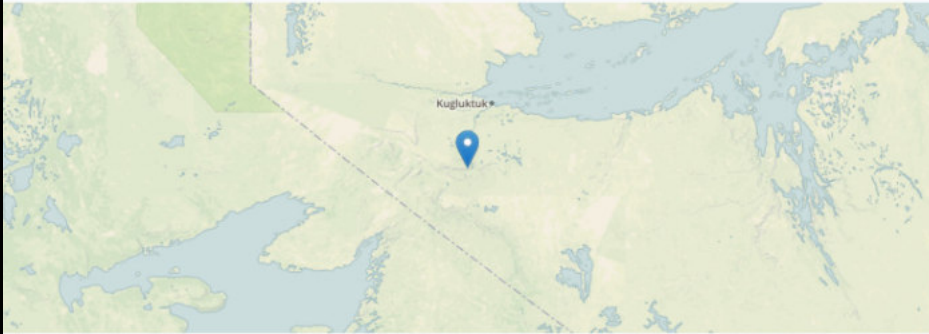
Botrychium tunux Stensvold & Farrar

Tunux' moonwort In English Collected in Canada

Plantae Tracheophyta Psilotopsida Ophioglossales Ophioglossaceae Botrychium

Species: *Botrychium tunux* Stensvold & Farrar
Location: Canada
Basis of record: Preserved specimen

Dataset: Canadian Museum of Nature Herbarium
Publisher: Canadian Museum of Nature



About the dataset

Records from the Canadian Museum of Nature Herbarium (The National Herbarium of Canada), including algae (CANA), bryophytes (CANM), lichens (CANL) and vascular plants (CAN). NOTE that geographical coordinates in the records are in some cases transcribed from specimen labels, whereas in others they have been derived by CMN staff from secondary sources (georeferencing). No GBIF field is available to differentiate records of each type. If you require this information, please contact CMN staff.

Record		Occurrence	
Basis of record	PRESERVED_SPECIMEN	Catalogue number	CAN 10014738
Collection code	CAN	Individual count	1
Collection ID	http://grbio.org/cool/4w1m-4a6d	Occurrence ID	d3a7b047-aea1-ea14-b49c-bd511fca261
Dataset ID	https://doi.org/10.15468/88qq3e	Preparations	dry
Dataset name	Vascular Plant	Record number	3755a
Institution code	CMN	Recorded by	Saarela, Jeffery M.; Sokoloff, Paul C.; Bull, Roger D.
Institution ID	http://biocol.org...col.org:col:34935		

Event		Taxon	
Day	9	Kingdom	Plantae
Month	7	Phylum	Tracheophyta



Backlog Arctic plant collections

Sylvia Edlund (1945-2014)

More than 5,500 Arctic collections: 1973-1991



Red – collecting sites of ca.
2000 specimens processed in
1980s

Blue – collecting sites of **ca.**
3000 specimens processed in
2018

National Biodiversity Cryobank of Canada



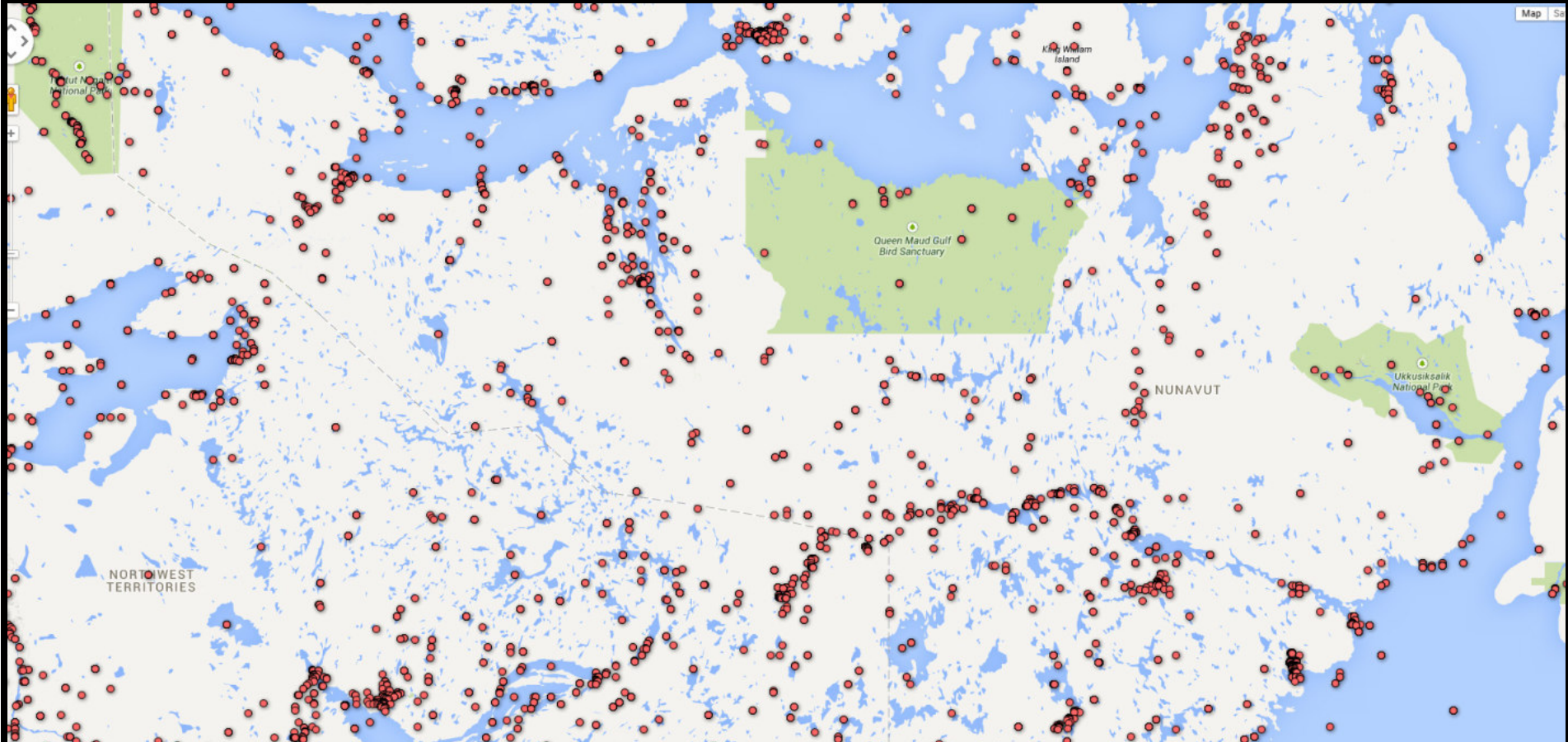
Mission of NBCC

- Provide excellent care for specimens
- Easy access for scientific use
- Open for tissue donations
- Samples from all taxonomic groups welcome

- At the Canadian Museum of Nature, Gatineau (Quebec), Canada
- Central repository in Canada of cryogenically-stored samples
- Now includes six -170°C freezers
- Maximum capacity of 200 000 samples at present



Continued collections-based documentation of Arctic biodiversity urgently needed



And digitization and mobilization of existing Arctic data in collections around the world

You can help document biodiversity



- Collect vouchers for all species in your study area, even the easy ones
- Deposit your vouchers in a public herbarium (universities, museums)
- Mention the vouchers and your publication and state where deposited

Make museum-quality collections in your study areas and deposit them in public collections



canadian museum of nature

nature

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