



Classification and Description of Vegetation Associations in Arctic Regions

Phase 2: Data Analysis and Classification

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Overview

The Canadian National Vegetation Committee is extending the Canadian National Vegetation Classification to include vegetation associations in Arctic regions. This project has several Phases. Phase 1 was completed in January 2010 (de Groot *et al.* 2010). This report covers Phase 2: Data Analysis and Classification.

There were 5 deliverables for Phase 2:

1. Expanded classification database, including additional plot data
2. Expanded Arctic vegetation tracking table with new data sources
3. Updated plot distribution map
4. Arctic vegetation classification to the plant association and sub-association rank
5. Final report

Phase 2 also included identifying and acquiring data for the classification of Subarctic vegetation. The process of acquiring and assessing the quality and usability of existing vegetation plot data from the Canadian and Alaskan Arctic and Subarctic followed the methods described in de Groot *et al.* (2010).

Arctic vegetation was classified into 48 plant associations in 4 orders and 23 plant associations in 3 habitat types.

Introduction

Phase 2 of the project Classification and Description of Vegetation Associations in Arctic Regions, included completing vegetation plot data acquisition for Arctic areas, the classification of this data into a hierarchy of vegetation associations, and the acquisition of vegetation plot data for Subarctic areas for a vegetation classification of the Subarctic. This report, gives details of this process.

Expanded Classification Database

The plot database from Phase 1 was expanded to include additional plots from both sub-Arctic and Arctic regions. The Subarctic plots were added in preparation of a Subarctic vegetation classification. The additional Arctic plots came from newly sourced data and from data that was identified but not obtained in Phase 1. As in Phase 1, documents were acquired from a number of different sources and in a variety of formats, including theses, reports, and private and government databases. Data was sourced through on-line data warehouses, contacting authors directly, published reports and papers, and by interlibrary loan of materials.

In Phase 2, data from 3,629 plots was added to the plot database. The majority of this data was obtained digitally. Additionally, data for over 1,300 plots has been obtained that has yet to be imported into the database, for a variety of reasons, such as waiting for plant species identification clarification from the authors.

Data Tracking Spreadsheet

Accompanying this report is a spreadsheet that lists all the potential data sources that were assessed during Phase 1 and 2. This spreadsheet provides details of the source, including whether it contained vegetation plot data, if this data was acquired, and if it was accepted into the database. This spreadsheet contains 428 entries, of which 60 have data that has been accepted into the plot database.

Plot Location Map

A map showing the location of all accepted plots and the Terrestrial Ecozone (Marshall 1999) and Floristic province (CAVM Team 2003) they are in was created (Map 1 and 2). The plots are generally well distributed across western and far northern portion of the Canadian Arctic, with some clustering in proximity to established research stations. Data from mainland Nunavut is lacking, but a working relationship with ecologists from this area who are working on a vegetation classification is being developed, and some plot data has been obtained but further work on plant identification is required before it can be used. Data is still lacking from Arctic portions of Quebec, but some data from Subarctic Quebec has been obtained, and a working relationship with ecologists from Subarctic Quebec who are working on a vegetation classification is being developed. Data from Torngat Mountains National Park in Arctic Labrador has been obtained, but required further work on plant species identification before it can be used.

Plot Database Status

The plot database now contains data from 9,646 plots. The distribution of the plots in was mapped and summarized where plot locations were available. The summary was done by Bioclimate Zone and Floristic Province (CAVM Team 2003) for plots in the Arctic and by Terrestrial Ecozone (Marshall 1999) for plots in the Subarctic, where floristic province mapping was unavailable (Table 1 and 2, Map 1 and 2).

Table 1. Number of plots by bioclimate zone or Terrestrial Ecozone

Bioclimate Zone or Terrestrial Ecozone	Number of plots
<i>Arctic plots (Bioclimate zone)</i>	
A - Herb	104
B - Prostrate Dwarf-shrub	164
C - Hemi-prostrate Dwarf-shrub	1,283
D - Erect Dwarf-shrub	678
E - Low shrub	2,533
<i>Subarctic plots (Terrestrial ecozone)</i>	
Hudson Plains	737
Taiga Cordillera	935
Taiga Plains	115
Taiga Shield	225
<i>Boreal plots¹ (Terrestrial ecozone)</i>	
Boreal Cordillera	1,314
Boreal Plains	1
Unassigned plots ²	1,557
Total number of plots in database	9,646

1 = Boreal plots were kept in the database as they were mostly from the high elevation Spruce-Willow-Birch Biogeoclimatic zone in British Columbia

2 = plots are unassigned if no location data was available or if they occur in Subarctic Alaska

Table 2. Number of plots by Floristic province

Floristic Province¹	Number of plots
Baffin-Labrador	152
Central Canada	1,043
Ellesmere - North Greenland	418
Northern Alaska	2,373
West Hudsonian	776
Total	4,762

1 = The Subarctic is not divided into Floristic provinces

Additional plots may become available through leads that have been identified but the data has not been obtained from the author. Additionally, some plot data has been obtained but we are waiting for clarification from the author on question about the data before it can be brought into the database.

Progress has also been made in collaborating with ecologists in provincial and territorial agencies in Nunavut and Quebec that are producing vegetation classifications for their jurisdictions.

VPro Metadata File

For each project acquired, a metadata file was created in VPro allowing details of the project to be permanently tied to individual plots. So, each plot can be tracked back to its source project, the author(s), the data collected and sample methods, and any changes made to the data.

Arctic Ecosystem Classification Summary

The Arctic data set was classified by table analysis in the Braun-Blanquet tradition with proposed units to reflect ecological and floristic differences. Floristic differences do not need to meet the strict requirement of characteristic species but often reflect relative dominance between common species.

The compiled data set was initially divided into physiognomic groups separating out treed, shrub, herb (tundra), and very low cover barrens types. The treed group was not analyzed further.

The physiognomic groups were initially divided into dominance groups to reduce the data set into more manageable analysis groups. The shrub group separated out into *Betula nana*, *Alnus viridis*, *Salix planifolia/pulchra*, *S. alaxensis*, *S. glauca*, and *S. lanata* groups.

Known common herb-layer ecological indicators for arctic ecosystems were used to further separate the shrub dominance types and to create analysis groups for tundra ecosystems. These include but were not limited to *Alopecurus alpinus*, *Arctagrostis latifolia*, *Carex aquatilis*, *C. bigelowii*, *Cassiope tetragona*, *Dryas integrifolia/octopetala*, *Empetrum nigrum*, *Eriophorum chamissonis/scheuchzeria*, *E. angustifolia*, *E. vaginatum*, *Equisetum arvense*, *Leymus mollis*, *Puccinellia* spp., and *Vaccinium uliginosum*. Secondary species that reflect variability in the broad groups were then identified and used to create initial association proposals. Georeferenced plots were overlaid with CAFF floral provinces and bioclimate subzones (CAVM 2003).

Prospective units were reviewed in the context of plot distribution across CAFF units to identify climate and biogeographic trends that might indicate regional differentiation. In addition, a survey of published units was reviewed to identify additional units or suggest further differentiation. This approach was particularly important for Barrens ecosystem where low cover and low species diversity challenge analysis in the office. In this group, published

Barrens units strongly guided association differentiation of this group.

Prospective Associations were organized into a classification hierarchy based primarily on common herb layer species groups that reflect common site conditions across bioclimate subzones.

Some species were grouped for purposes of the analysis. Species groupings were largely made on the basis of similar ecological requirements within a single genus but some broader groups were defined. This process was sometimes emphasized where species differentiation was likely difficult and variable among project datasets.

The Classification used 4129 plots and includes plots from all arctic bioclimate subzones, floral provinces, and the portions of the Subarctic. Not all data from adjacent areas of Alaska and the Subarctic and Alpine areas has been incorporated at this time.

The hierarchy and classification are broken into 7 main groupings. 4 Orders, which have specific floristic assemblages that defines them (see summary table 1). And, 3 Groups that represent “habitat types” and are more diverse floristically without a commonly shared species group.

These groupings, by order of plots in the dataset (commonality):

i) Order – *Dryas* – *Cassiope tetragona* (1144 plots)

- This Order occurs in Arctic zones B-E on dry to fresh, calcareous to weakly basic sites.

ii) Order – *Betula nana* – *Ledum* – *Vaccinium* (1132 plots)

- This Order occurs in the Subarctic and Arctic zones C-E on dry to very moist acidic sites

iii) Order – *Carex aquatilis* – *Eriophorum angustifolium* (776 plots)

- This Order occurs in all Arctic zones and represent very moist to wet sites fens and marshes. Includes some related but floristically distinct graminoid marsh types

iv) Order *Salix arctica* – *Alopecurus alpinus* – *Arctagrostis latifolia* (360 plots)

- This Order describes mesic to moist tundra in Arctic zones A-C largely from the eastern arctic.

v) Group – Barrens (419 plots)

- This group includes ecosystems of extreme climates with low vascular vegetation cover. Predominantly occurs in Arctic zones A and B but also at higher elevations or very exposed sites in other zones.

vi) Group Shorezone (154 plots).

- This group of ecosystems is floristically varied but represent saline ecosystems of beaches, estuaries, and the spray zone.

vii) Group Willow and Alder (144 plots)

- This group of ecosystems is mostly in the Subarctic and more discussion is required about the associations that have been defined. This group is floristically diverse and was not summarized in Table 3.

The classification presented with this report requires external review by Arctic vegetation ecologists before finalizing the classification; this is especially true of the associations in the habitat groups.

Not all plots in the Arctic portion of the database were included in the classification. This was due to some plots not fitting into the classification well, or issues of data quality upon closer examination during the classification process.

Table 3. Summary of plant species in six of the vegetation Orders/Groups¹

Species	Order Betunan - Ledum - Vaccini	Order Dryas - Casstet	Order Saliarc - Alopalp - Arctlat	Group Barrens	Order Carex aquatilis - Erioang	Group Shore zone	Common Name
Number of plots	1132	1144	360	419	776	154	
<i>Betula nana</i>	■■■■■				*		Scrub Birch
<i>Ledum</i> All	■■■■■						Labrador tea
<i>Cladina Stereocaulon</i>	■■■	*		*			<i>Cladina</i> & <i>Stereocaulon</i>
<i>Vaccinium uliginosum</i>	■■■	*					bog blueberry
<i>Cetraria</i>	■■■						<i>Cetraria nivalis/culcullata</i>
<i>Empetrum nigrum</i>	■■■						crowberry
<i>Vaccinium vitis-idaea</i>	■■■						Lingon berry
<i>Eriophorum vaginatum</i>	■■■■■	■■■					sheathed cotton-grass
<i>Salix reticulata</i>		■■■	*				net-veined willow
<i>Dryas</i> All		■■■■■	■■■	*			<i>Dryas</i> spp.
<i>Cassiope tetragona</i>	*	■■■■■					four-angled mountain-heather
<i>Salix arctica</i>		■■■	■■■■■	*	*		arctic willow
Moss species	*	*	■■■■■				moss
<i>Arctagrostis latifolia</i>		*	■■■■■				polargrass
<i>Luzula dry</i>		*	■■■	■■			<i>Luzula nivalis, confusa</i>
Lichen species		*	■■■				Lichen
<i>Alopecurus alpinus</i>			■■■	*			alpine meadow-foxtail
<i>Saxifraga oppositifolia</i>		*	■■	■■			purple mountain saxifrage
<i>Papaver</i> All		*	■	■			All Poppy species
<i>Eriophorum angustifolium</i>			*		■■■■■		narrow-leaved cotton-grass
<i>Carex</i> water					■■■■■		Large emergent sedges
<i>Polygonum viviparum</i>		*	■				alpine bistort
<i>Saxifraga</i> wet			■	*			<i>Saxifragas</i> of wet sites
<i>Juncus biglumis</i>			■				two-flowered rush
<i>Poa arctica</i>			■				arctic bluegrass
<i>Cardamine bellidifolia</i>			■				alpine bitter-cress
<i>Cerastium alpinum</i>			■				
<i>Draba alpina</i>			■				alpine draba
<i>Draba lactea</i>			■				milky draba
<i>Oxyria digyna</i>			■				mountain sorrel
<i>Saxifraga nivalis</i>			■				alpine saxifrage
<i>Stellaria longipes</i>			■				long-stalked starwort

¹ = the Willow and Alder group was not summarized

Interpretation of vegetation summary tables.

Species constancy is indicated by Bars and their colour and by Stars. Percent cover is indicated by the number of Bars. All values are the average cover of the species in all plots in the group/Association

Criteria for	Value
	% constancy
Minimum species constancy to include in summary	>=50
Black bar constancy	>=70
Gray bar constancy	>=50
Star constancy	>=25
	% cover
Six bar cover	>35
Five bar cover	18-35
Four bar cover	8-18
Three bar cover	3-8
Two bar cover	1-3
One bar cover	<1

References

- de Groot, A.J., I. Ronalds, R. Klassen and W. MacKenzie. 2010. Classification and description of vegetation association in Arctic regions - Phase 1: data acquisition and data entry. Bulkley Valley Centre for Natural Resource Research and Management, Smithers B.C. *for* Environment Yukon, Whitehorse, Yukon.
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