An International Arctic Vegetation Database

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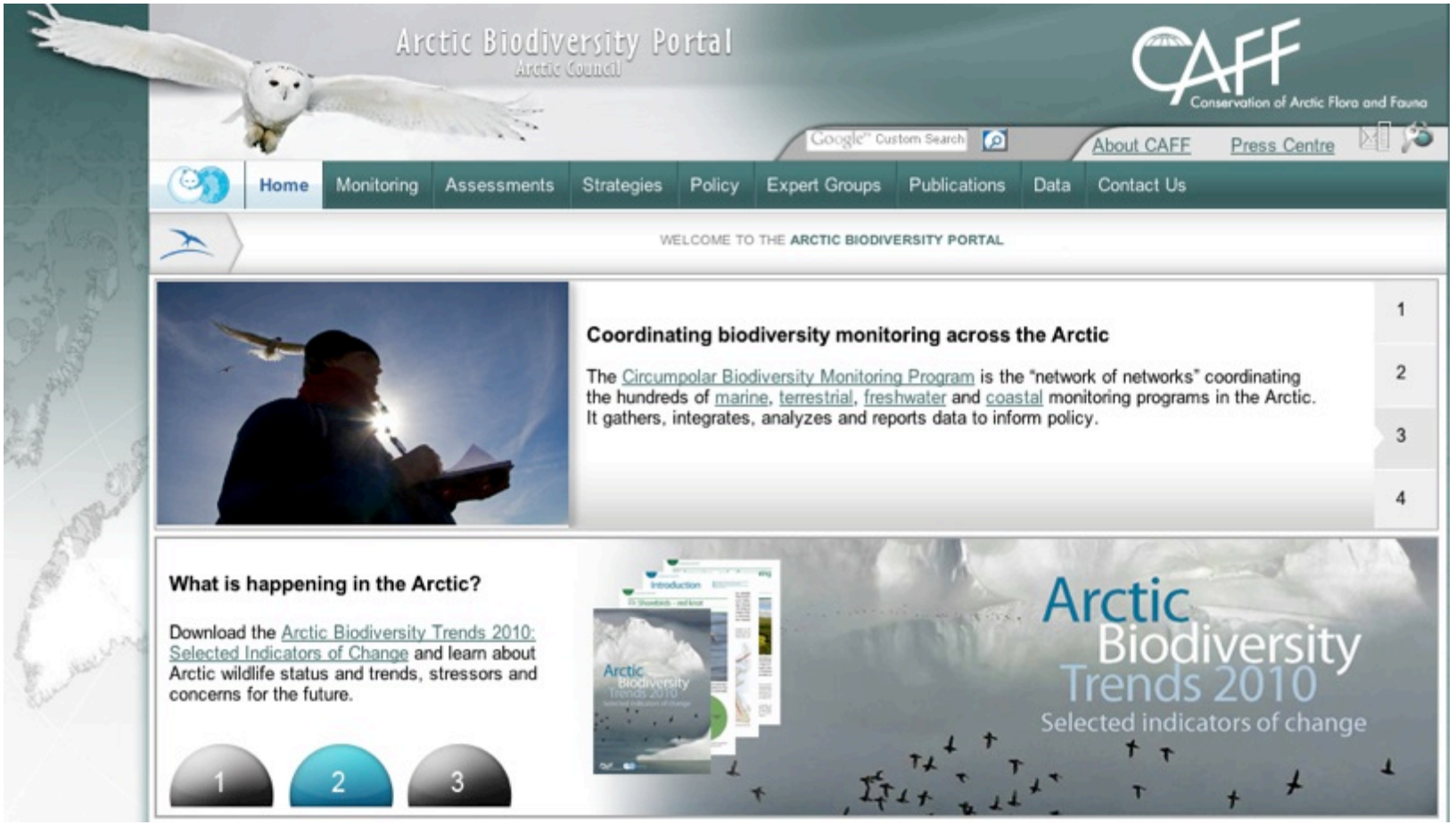
In memory of Boris Yurtsev (1932-2004) whose conception of circumpolar Arctic vegetation subdivisions is the framework for the IAVD.

European Vegetation Survey, 21st Workshop,, 24-27 May 2012

Overview of talk

- How the IAVD fits within the CAFF mandate
- History of the project
- Circumpolar Arctic Vegetation Map
- Conceptual framework for the project
- A proposal for creating the IAVD
- CAFF web-based data portal
- Funding
- Timeline

The IAVD is a project of the Conservation of Arctic Flora and Fauna (CAFF)

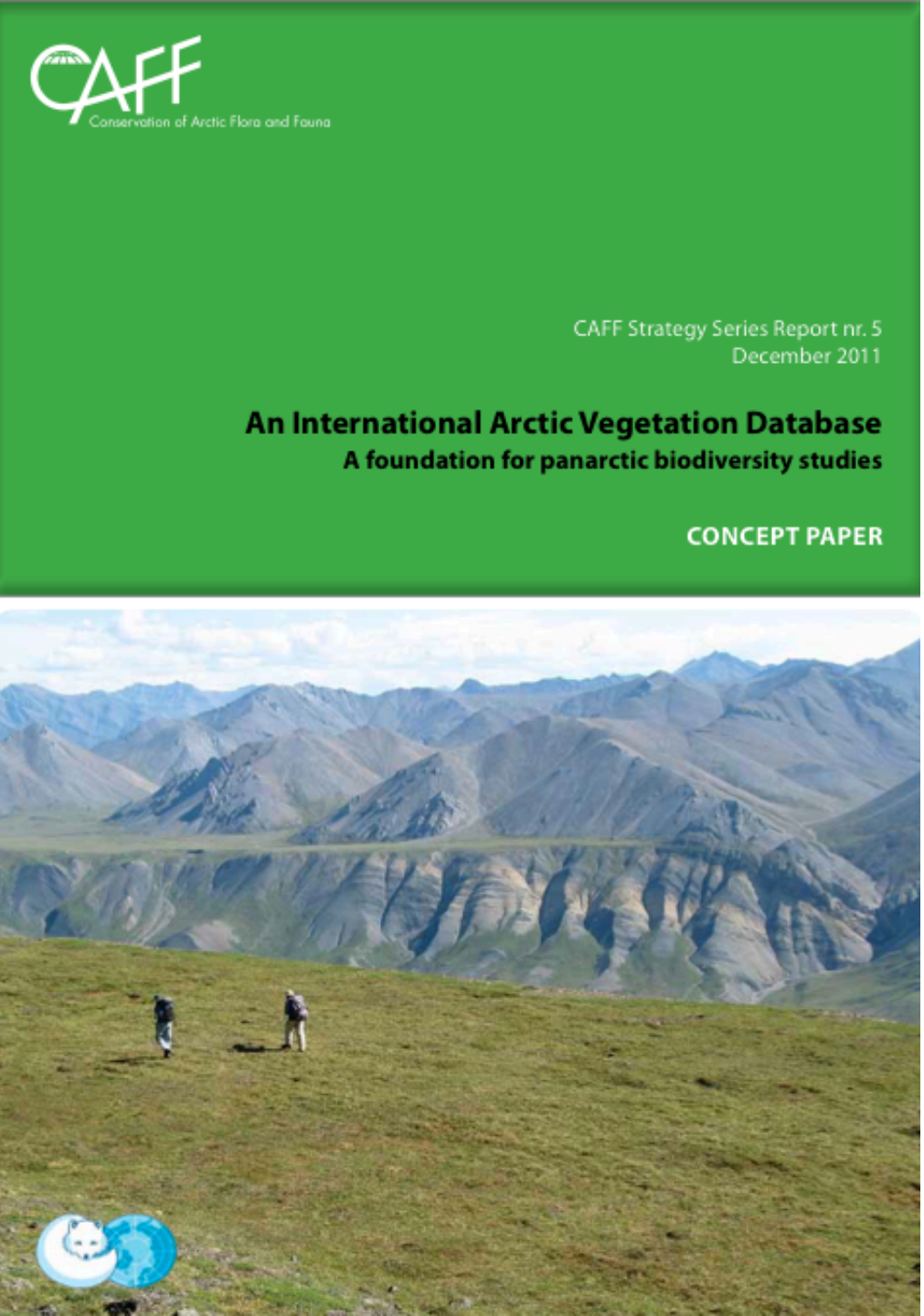


- **The biodiversity working group of the Arctic Council.**
- **Consists of representatives from each of the eight Arctic countries.**

How the IAVD fits within the CAFF mandate

Photo: M.K. Raynolds

- **CAFF promotes the following activities, all of which are central to the IAVD concept:**
  - **International opportunities to support the conservation needs of the biodiversity of arctic flora and vegetation;**
  - **Conservation partnerships within the Arctic and neighboring areas;**
  - **Research and education for conservation partnerships;**
  - **Exchange of published information and unpublished data concerning arctic flora and vegetation;**
  - **Development of cooperative botanical activities for the CAFF annual work plan.**
- **The IAVD has also applied for an endorsement by the International Arctic Research Committee and use of the IASC logo for promoting the project.**



International Arctic Vegetation Database

A unified web-based database containing as much of the Circumpolar Arctic relevé data as possible.

Walker, D.A. and Raynolds, M.K. 2011. CAFF Strategy Series No. 5.

International Arctic Vegetation Database

Ultimate goals:

1. **Panarctic vegetation classification using Braun-Blanquet approach**
2. **Prodromus (list) of Arctic plant communities with links to USNVC units.**
3. **Web portal with tables, descriptions, photos, maps of each plant community.**

Photo: D.A. Walker, Nuuk, Greenland

Why the Arctic?

Of all the global biomes, the Arctic Tundra Biome best lends itself to a unified international approach for managing its vegetation information.

Photo: D.A. Walker, Hayes I., Franz Josef Land, Russia

Why the Arctic?

Of all the global biomes, the Arctic Tundra Biome best lends itself to a unified international approach for managing its vegetation information.

- **The Arctic is floristically and vegetatively the most homogeneous of the global biomes.**
- **Its entire list of known vascular plants, bryophytes and lichens are documented in up-to-date checklists.**
- **It is already mapped at the global scale according to physiognomic categories (CAVM Team 2003), and it is the best described of all biomes.**
- **If successfully applied here, it would be a model for application to other global biomes.**

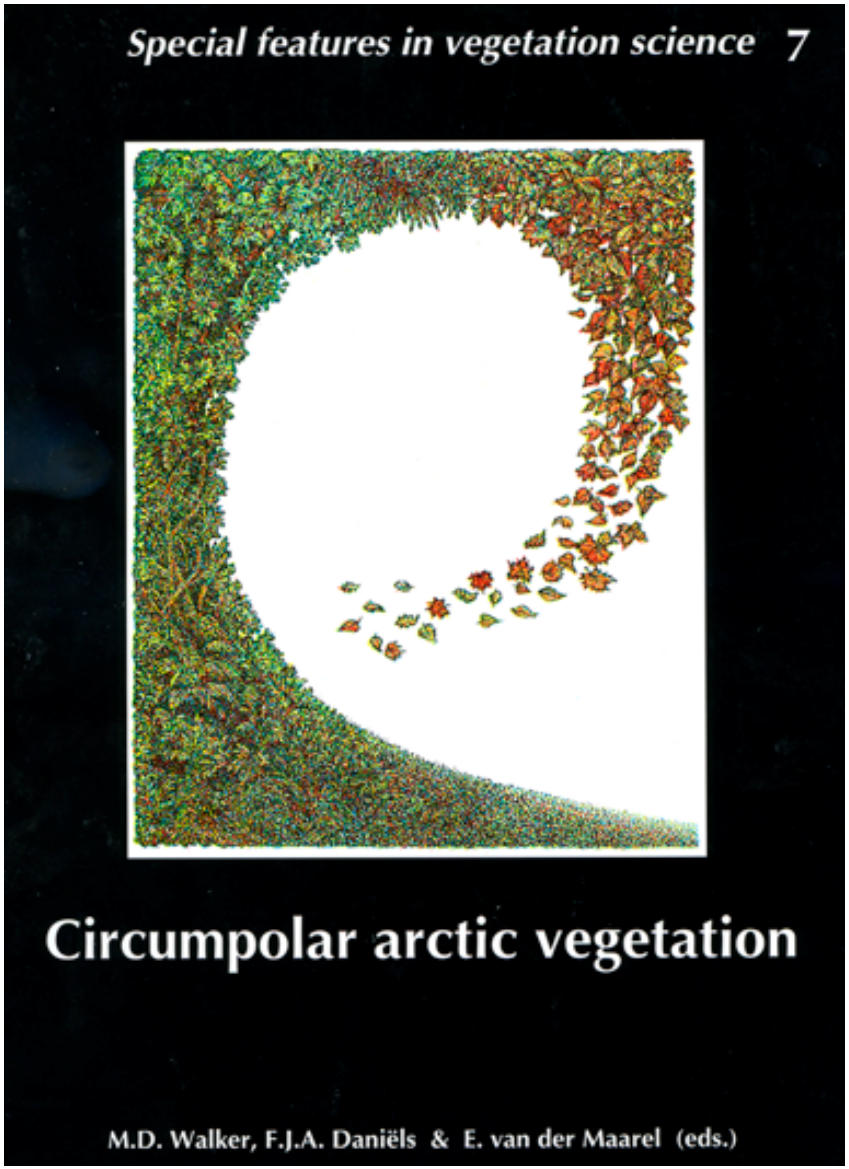
Photo: D.A. Walker, Hayes I., Franz Josef Land, Russia

Why now?

- **Global climate change has intensified efforts to inventory, classify and map the vegetation of the Arctic in much more detail than has been done previously.**
- **Nearly all Arctic plant community data are not presently organized in any easily accessible database and are difficult to locate and access.**
- **The amount of information in the Arctic (approximately 20,000 good relevés) makes it feasible to make such a database.**
- **Much of the information is in danger of being lost because of retirement or death of key investigators.**

Photo: D.A. Walker, Nuuk, Greenland

Origin: 1992 Boulder, Colorado Workshop



Circumpolar arctic vegetation: Introduction and perspectives

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Background

The circumpolar Arctic is a vast, remote area which experiences environmental change through both the indirect impacts of climate change and the more direct impacts of large-scale energy and industrial development and pollution. The vegetation of the Arctic is well-known only in a few relatively small regions near human settlements and areas of energy development; detailed studies of the composition and dynamics of plant communities are missing for many areas. Yet a synthesis is badly needed as we strive to understand the circumpolar Arctic as a single geo-ecosystem. To help meet this challenge, the High Latitude Ecosystems Directorate of the U.S. Man and the Biosphere Programme funded a workshop in March 1992 that brought together a large segment of the international vegetation research community dealing with the Arctic. The purpose of the workshop was to begin the task of completing a global synthesis of arctic vegetation. Ca. 30 lectures and posters were presented at the workshop. They treated general, phytogeographical aspects, local and regional vegetation-ecological descriptions, effects of human disturbance, challenges associated with mapping, geographic information systems, and remote sensing, and some ecophysiological aspects.

During 1992, manuscripts for a possible Special Feature in this journal were submitted. Due to communication problems, the reviewing and revision of many papers took a longer time than anticipated, but in the end we were able to include 13 papers. Together, they provide a broad overview of arctic vegetation, with a wide coverage of areas, from the Aleutian Islands over Alaska, Greenland, Svalbard, Kola, and Taymyr to Chukotka. Moreover, they make clear that vegetational variation can be convincingly linked to environmental variation. Finally, we learn how phytogeographical and local-ecological causes of floristic variation operate simultaneously in a complex way, which is unique and deviant from any other floristic kingdom in the world.

Special importance of arctic vegetation

Arctic ecosystems are of interest both for their inherent value as well as for their role in the global geosystem; ca. 15% of the world's carbon is estimated to be stored in boreal or arctic systems. General circulation models predict temperature increases in northern latitudes to be some of the most extreme (Mitchell et al. 1990). With low growing-season temperatures a change of only a few °C can lead to a several-fold increase in growing-degree days. Such changes may lead to (1) dramatic shifts in species distribution at many spatial scales, (2) movements of major boundaries, such as the treeline (Boreal-Low Arctic ecotone), and (3) local changes in snow cover and distribution along mesotopographic gradients, with important consequences to ecosystem function (M.D. Walker in press). Understanding and predicting how arctic ecosystems will respond to these impacts requires a global view of the region, but existing syntheses at that scale are very generalized (e.g. Aleksandrova 1980; Bliss & Matveyeva 1992). Global-scale research programs with foci or strong interests in the Arctic include the International Tundra Experiment, the U.S. Arctic System Science project, and the International Geosphere-Biosphere Program Global Change and Terrestrial Ecology core area. The success of these programs depend in part upon the existence of a common language for describing arctic ecosystems. Because the ecosystem must be characterized through the description of its plant communities, a multiple-scale, hierarchical system of classification is essential to all of these efforts (D.A. Walker & M.D. Walker 1991).

Arctic ecosystems largely belong to one biome, the tundra biome, with the polar desert biome represented beyond its northern boundary and with transitions towards boreal shrubland and forest at its southern boundary. Ca. 60% of the arctic vascular flora is in common throughout, increasing to as high as 90% in the northernmost regions. Other large biomes have substantial floristic differentiation among continents and are only

‘Boulder Resolution’ signed by 44 attendees at the workshop, 9 March 1992

“…Be it resolved that the international community of arctic vegetation scientists undertakes the the joint tasks of:

1. Creating a database of type relevé data, using the Panarctic Flora as a common taxonomical base;
2. Developing a comprehensive synthesis of phytosociological information through the publication of a Prodromus of arctic vegetation syntaxa; publication of a bibliography of arctic vegetation studies, and development of a revised syntaxonomical classification for the circumpolar region;
3. Compilation, editing and publishing an arctic circumpolar vegetation map depicting the distribution and boundaries of arctic vegetation north of the arctic tree line at a scale of 1:7,500,000 and legend that is acceptable and understood the the international community of plant scientists.

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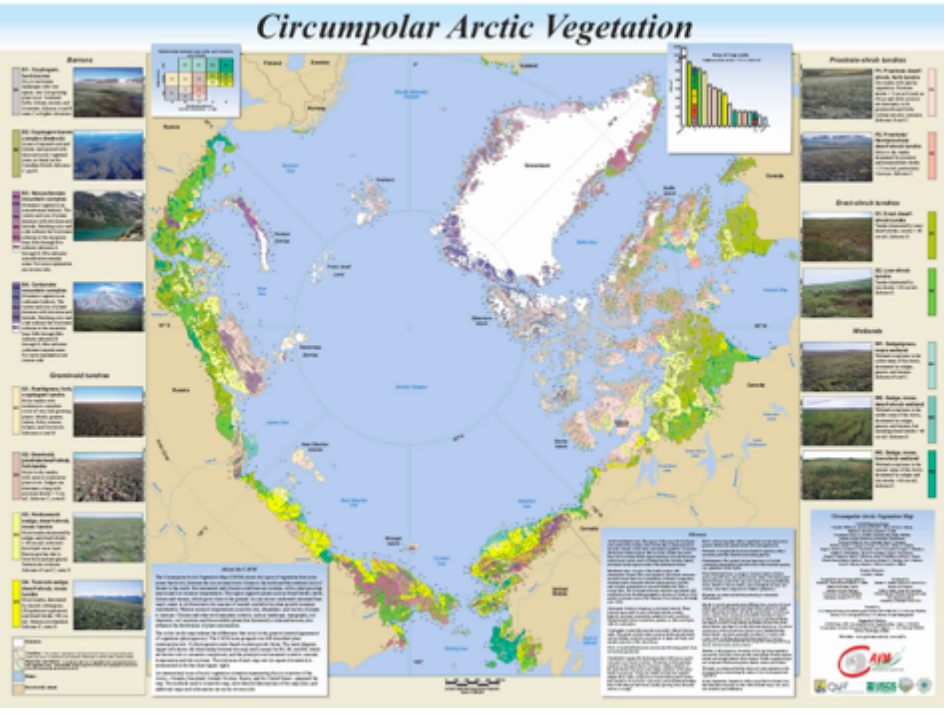
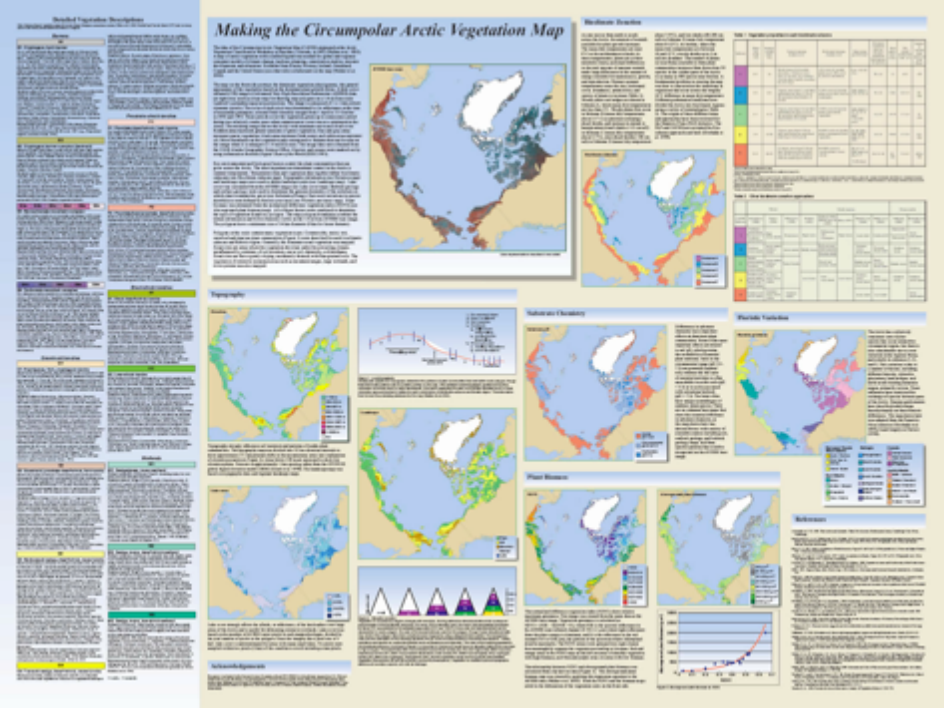


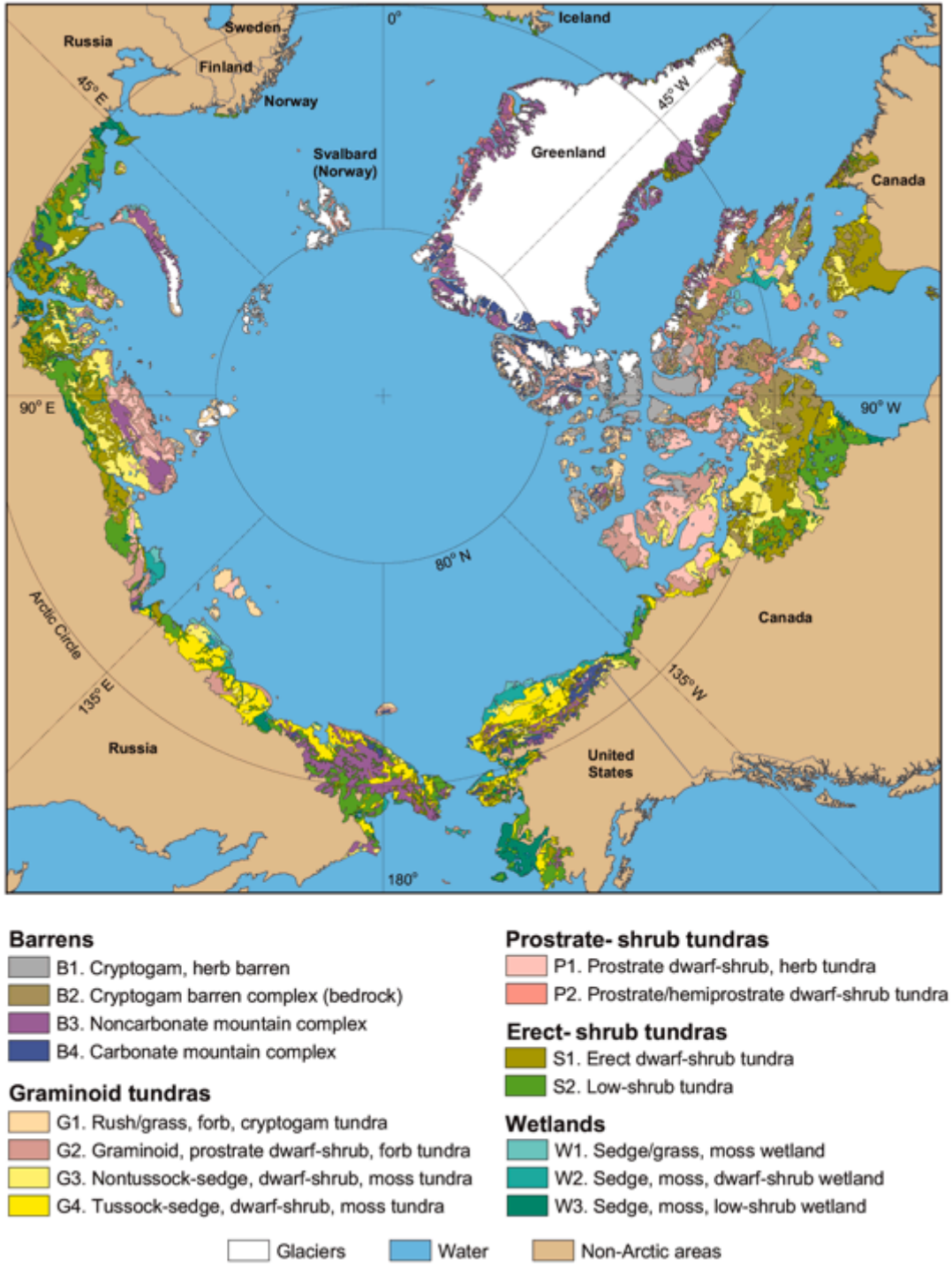


Circumpolar Arctic Vegetation Map (CAVM)

- Published as CAFF Map No. 1 in 2003.
- Methods and description in Walker et al. 2005. Jour. Veg. Sci., 16-267-282.
- GIS database includes maps of bioclimate subzones, floristic subprovinces, substrate pH, landscape types, topography, wetlands, NDVI/biomass.

The Arctic Tundra Bioclimate Zone

- Treeline is the southern boundary.
- Excludes regions that lack an Arctic climate or Arctic flora (e.g. Aleutian Islands, most of Iceland and alpine tundra outside the Arctic).

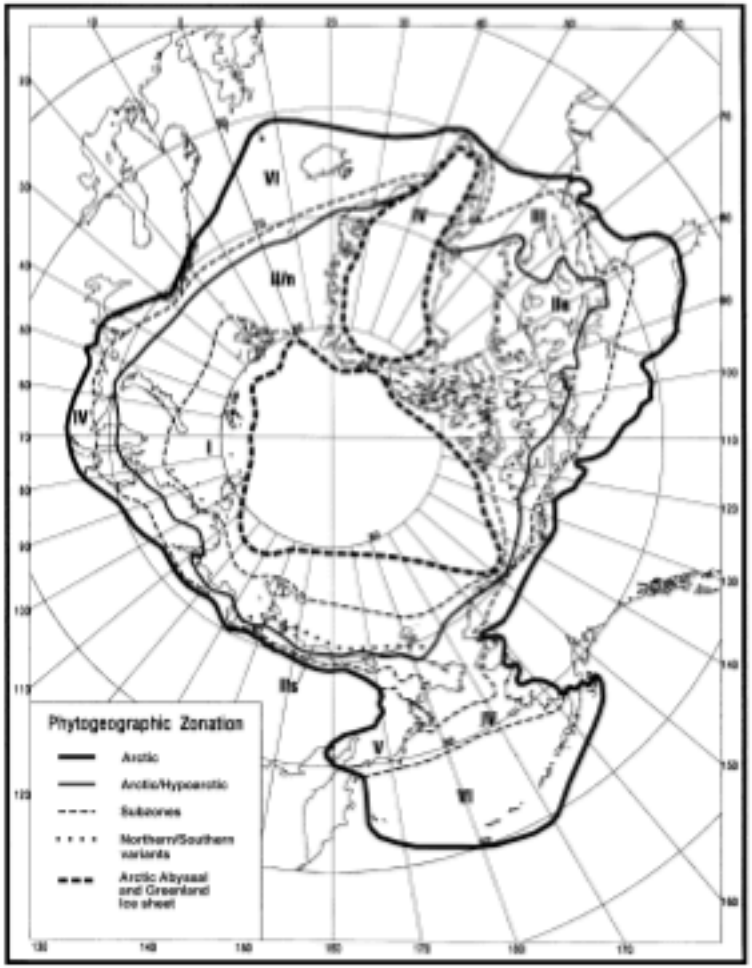


Russian phytogeographic framework

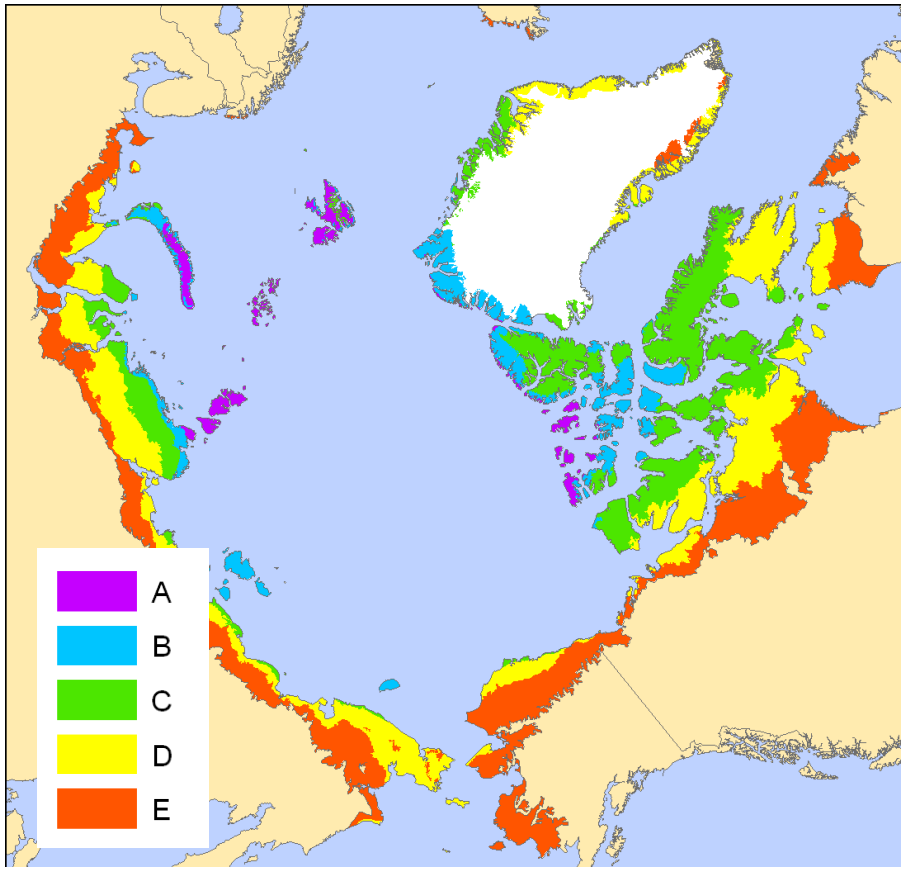
- **The CAVM followed the approach of Yurtsev (1978, 1994, 1995) and modified by Conservation of Arctic Flora and Fauna project (CAFF) (Elvebakk et al. 1999).**
- **Zonal subdivisions were first proposed in the 1930's (Gorodkov 1935) and later modified by Alexandrova, Tolmachev, Yurtsev, Andreev, Sochava, Chernov and Mateveeva and others.**
- **Zones are characterized by the vegetation and soil that best express the regional climate.**

B.A. Yurtsev (1932-2004)

Yurtsev's (1994) phytogeographic and floristic subdivisions of the Arctic



Yurtsev, B.A. 1994. *Journal of Vegetation Science.* Floristic division of the Arctic, 5: 765-776.



Arctic bioclimate subzones

Dominant plant growth forms on zonal sites in each subzone

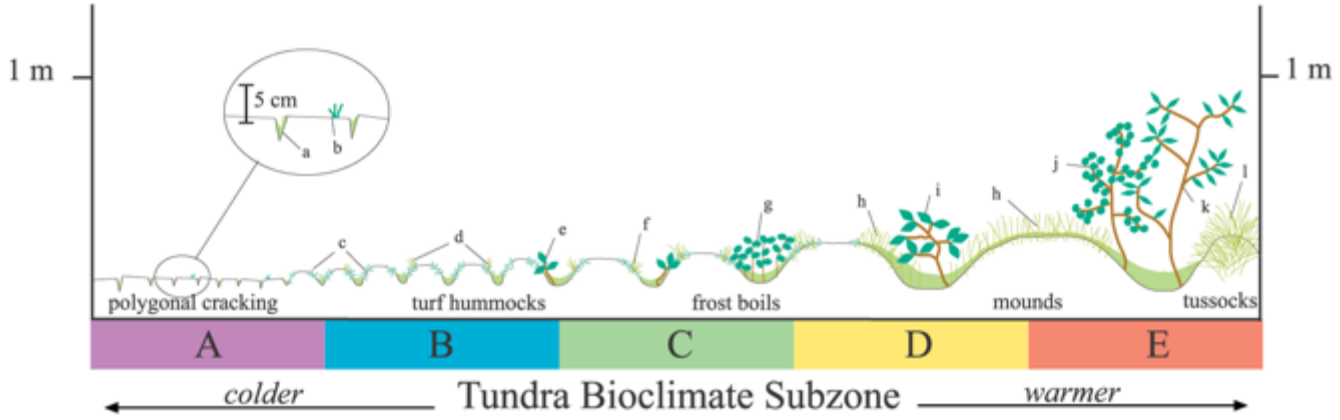
A – mosses, liverworts and lichens with some grasses and forbs

B – rushes and prostrate dwarf shrubs with mosses, liverworts and lichens

C – hemiprostrate and prostrate dwarf shrubs with bryophytes and lichens

D – sedges, erect and prostrated dwarf shrubs with bryophytes and lichens

E – tussock sedges, low and erect dwarf shrubs with bryophytes and lichens



1999 International CAVM Expedition to Canada

Goals:

- ***To determine if the Russian approach to zonation could be applied to North America.***
- ***To resolve the terminology conflicts that prevented unification of the Russian and North American approaches to classifying vegetation.***
- ***Introduce students to the Arctic.***

Photo: D.A. Walker, Eureka, Ellesmere, I. Canada, 1999

Panarctic Flora web site

Annotated Checklist of the Panarctic Flora (PAF) Vascular plants

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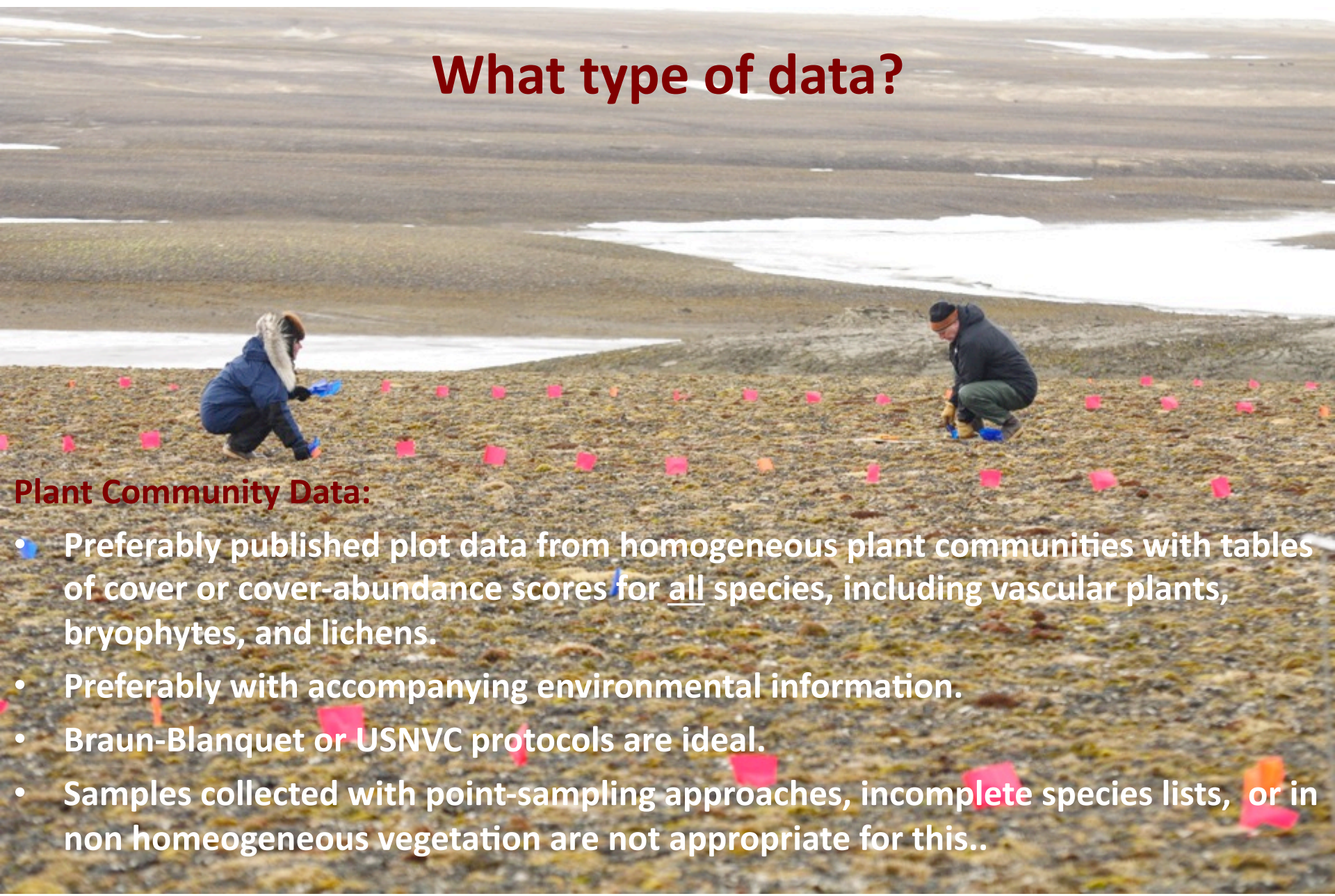
Species lists: a critical first piece

- *The Panarctic Flora*, (PAF) (Elven et al. 2011) for vascular plants.
- CAFF Arctic lichen checklist (Kristinsson et al. 2011).
- CAFF Arctic moss checklist (Belland 2012, unpublished).
- Liverwort list follows (Konstantinova et al. 2009).
- Synonyms from these and other lists will be included, following protocols developed for the SynBioSys vegetation information system of the European Vegetation Survey, http://www.synbiosys.alterra.nl/synbiosyseu/.
- Topic for discussion: Links to GBIF names.

Photo: D.A. Walker

What type of data?



Plant Community Data:

- Preferably published plot data from homogeneous plant communities with tables of cover or cover-abundance scores for all species, including vascular plants, bryophytes, and lichens.
- Preferably with accompanying environmental information.
- Braun-Blanquet or USNVC protocols are ideal.
- Samples collected with point-sampling approaches, incomplete species lists, or in non homeogeneous vegetation are not appropriate for this..

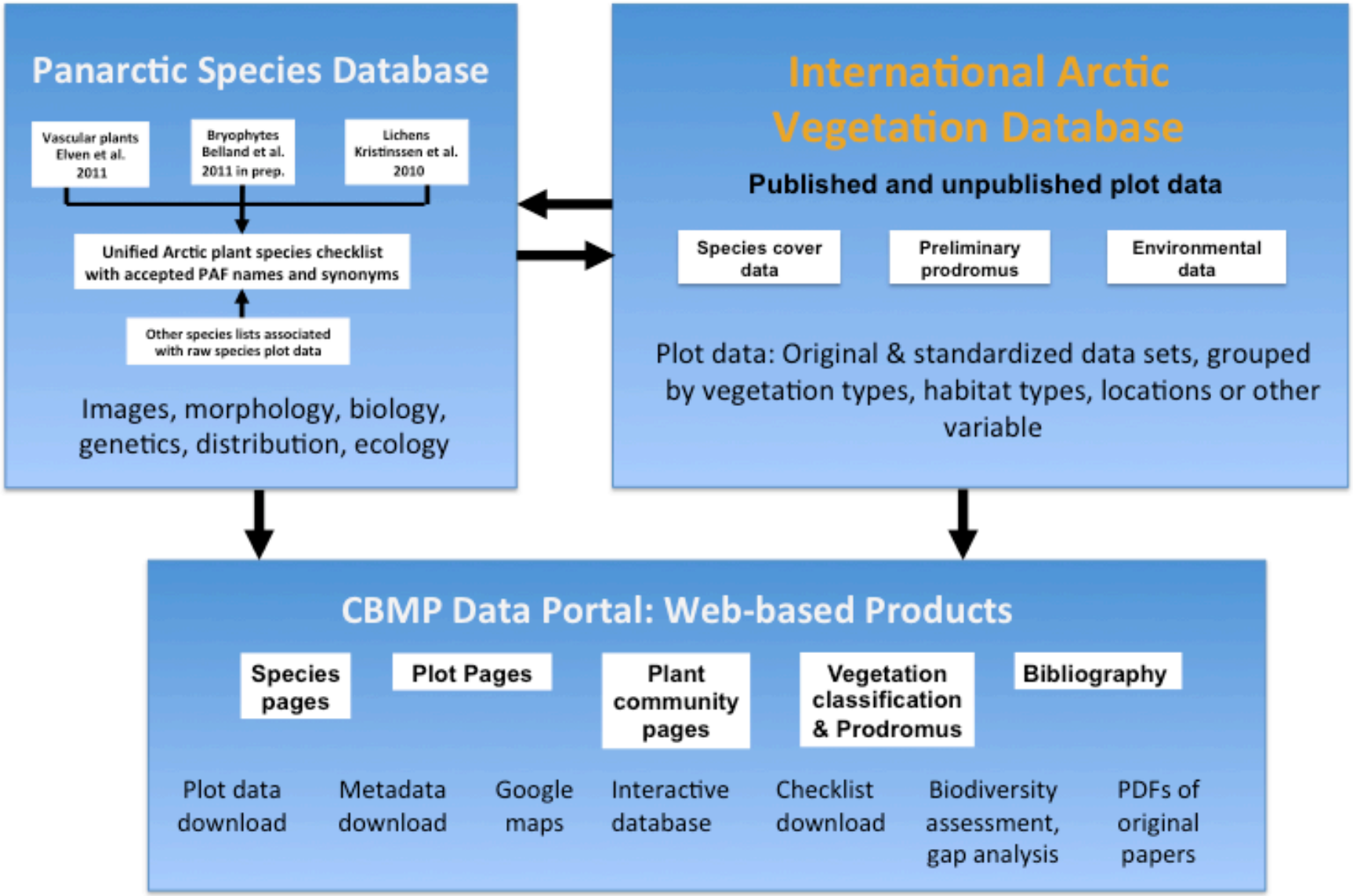
Photo: G. Matyshak , Hayes Island, Franz Josef Land, Russia

Need to harmonize North American and European vegetation sampling and classification approaches

Photo: Ina Timling,
moss-cushion community,
Hayes Island, Franz Josef Land, Russia

- **So much of the world is heavily invested in one or the other method (DeCaceras & Wiser 2011).**
- **The Arctic vegetation database would be constructed so that the date could be incorporated into either approach.**

Conceptual framework



CAFF Biodiversity Data Portal

- **Under development by CAFFs Circumpolar Biodiversity Monitoring Program (CBMP) in collaboration with the United Nations Environment Programme – World Conservation Monitoring Centre.**
- **Will access, integrate, analyze, and display biodiversity information from a multitude of stand-alone web servers.**

ARCTIC PLANT PORTAL

Symphyotrichum pygmaeum

(Lindl.) Brouillet & Selliah

Common Name: Pygmy Aster

Description:

Perennials 1.5–15 cm, cespitose. Stems 1–10+, decumbent to ascending (purple). Leaves firm, margins usually entire, apices obtuse to acute, blades spatulate, 5–19 × 2–4 mm. Peduncles densely villous to lanate distally, bracts 0. Involucres hemispherico-campanulate, 9–12.5 mm. Phyllaries in 3–4 series (dark purple), subequal, outer ± herbaceous, bases not indurate, margins herbaceous (outer) to narrowly scarious and erose proximally (inner), purple, villoso-ciliate in green portion.

Habitat:

River banks, terraces, and sand dunes

Conservation status:

G3, S2, sensitive, 16 populations in Canada, 5-6 discrete populations in Alaska.

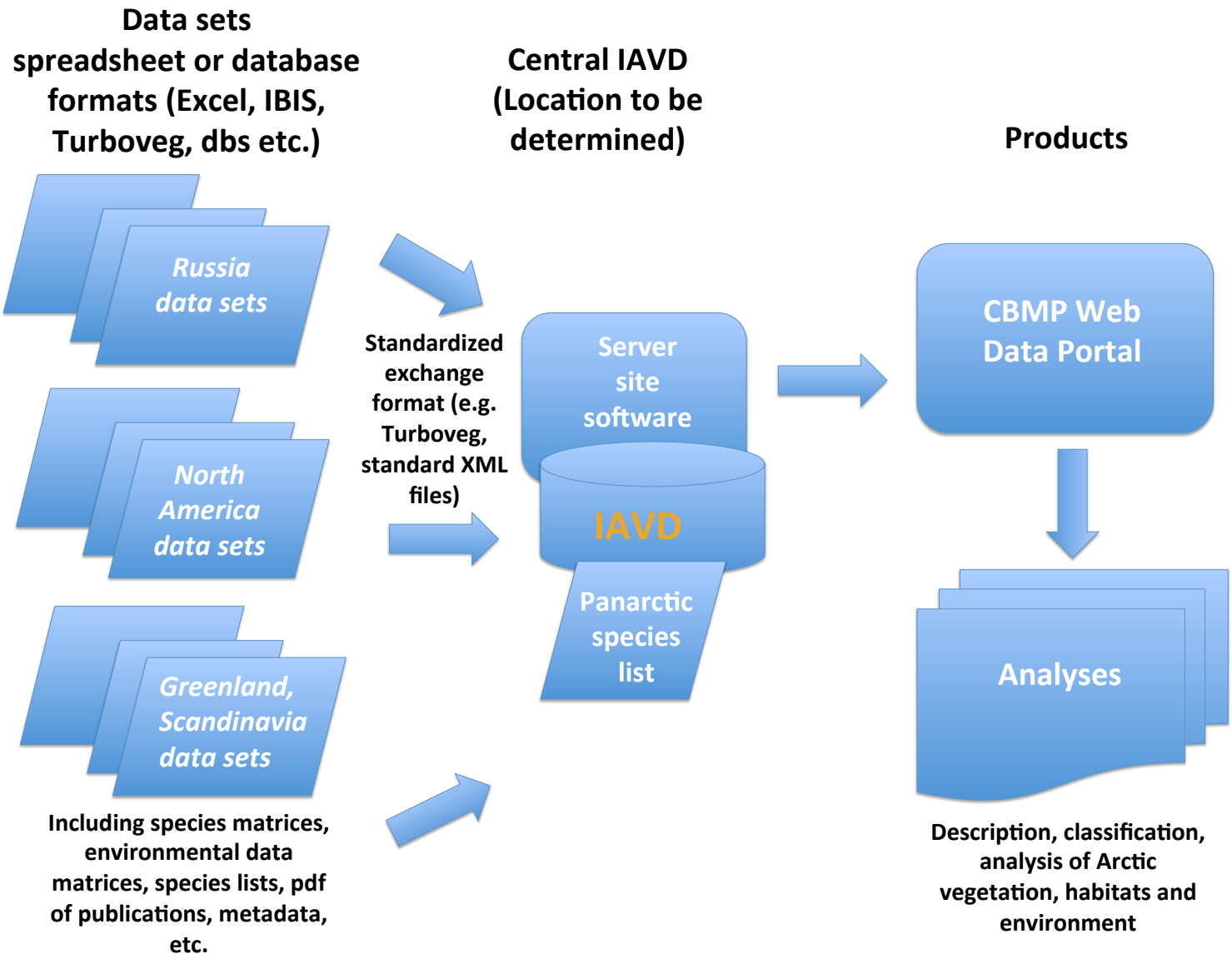
Notes:

Need to work out the kinks:

- **Turboveg database compatible with VegBank and IBIS (Russian database approach).**
- **How to handle environmental data?**
- **Prototypes for Greenland and Arctic Alaska.**
- **SynBioSys experience should provide a great deal of help.**

Photo: D.A. Walker

Data flow


Data sets
spreadsheet or database formats (Excel, IBIS, Turboveg, dbs etc.)
Central IAVD (Location to be determined)
Products
Russia data sets
North America data sets
Greenland, Scandinavia data sets
Including species matrices, environmental data matrices, species lists, pdf of publications, metadata, etc.
Standardized exchange format (e.g. Turboveg, standard XML files)
Server site software
IAVD
Panarctic species list
CBMP Web Data Portal
Analyses
Description, classification, analysis of Arctic vegetation, habitats and environment

Funding

- **Proposal will be written after the first organizing workshop.**
- **Will require funds from a variety of international agencies.**
- **Anticipated 5-6 year project. Anticipated items in the proposal:**
  - ***3-4 workshops for key investigators***
  - ***Full-time post-doc vegetation experts (Russia, North America, and Greenland/Scandinavia)***
  - ***Student assistants to help with data entry.***
  - ***Consulting to help to design the Turboveg and PostgreSQL databases.***
  - ***Web-site developer.***

Proposed Timeline

- **Year 1-2: Organizing workshop, Abisko, Sweden. Complete IAVD prototypes. Obtain funding.**
- **Year 2-4: Assemble data from literature sources at three main centers UAF (North America), Münster (Greenland and Scandinavia), and St. Petersburg (Russia). Build server site software. Build web pages for data portal.**
- **Year 5-6: Test and release the database.**

Photo: D.A. Walker. Nenets reindeer herder, Yamal Peninsula, Russia

Concluding statements

- The IAVD is supported by CAFF through the CFWG.
- The IAVD has roots extending back over 20 years in PAF and the CAVM.
- The CAVM provides a circumpolar framework for Arctic vegetation and the IAVD.
- The CBMP data portal will make the database available on-line.
- A conceptual framework for the IAVD, a realistic funding strategy and timeline are laid out in CAFF Strategy Report No. 5.
- Proposals are needed for making the IAVD a reality.

Photo: D.A. Walker. Franz Josef Land