The Arctic Vegetation Archive: History and goals for the workshop

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Overview of talk

- Milestones of the project
- Circumpolar Arctic Vegetation Map
- How the AVA fits within the CAFF mandate
- Conceptual framework for the project
- A proposal for creating the AVA
- CAFF web-based data portal
- Funding
- Timeline
- Reason for the name change from IAVD to AVA

Milestones

1992: The first International Arctic Vegetation Classification Workshop in Boulder, Colorado. Resolved to develop a database of arctic relevés and a prodromus of vegetation types for the Arctic. Several papers presented at the workshop reviewed the status of phytosociological research in the Arctic and were published in the *Journal of Vegetation Science* (Walker et al. 1994).

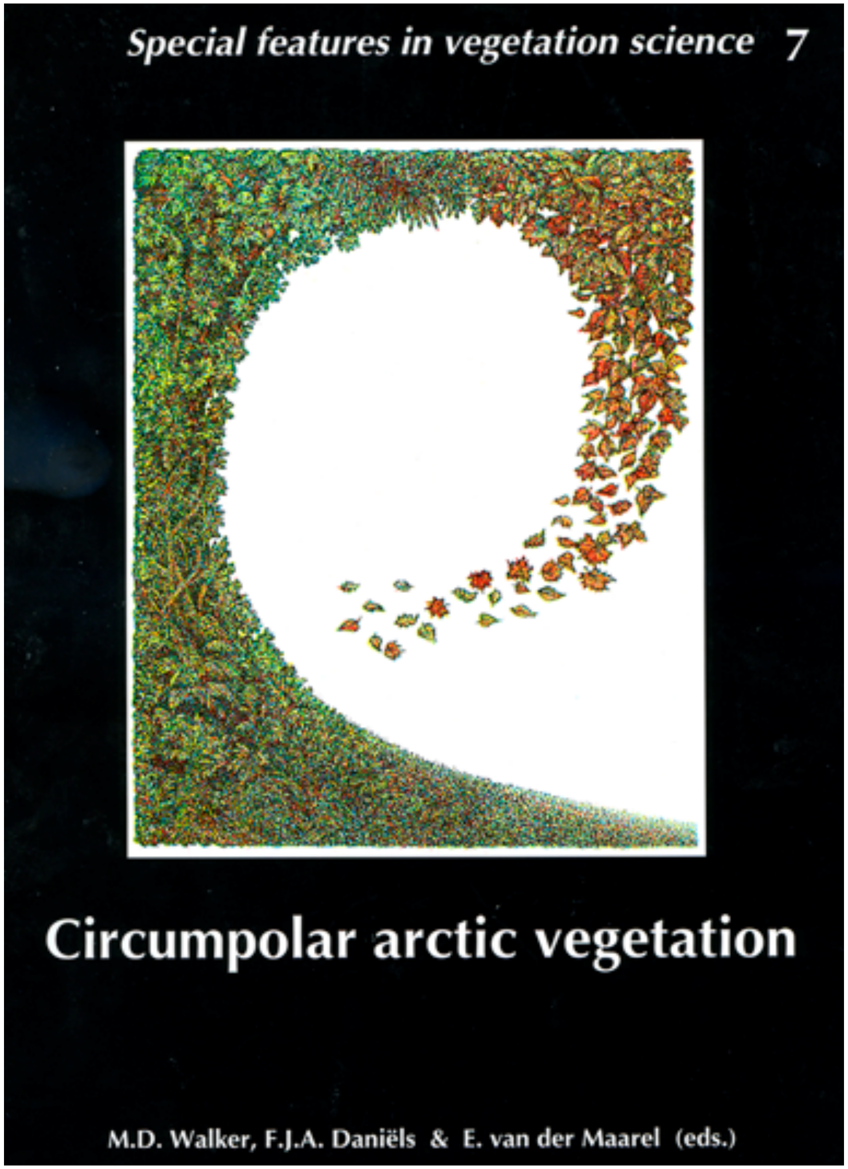
2003: The Circumpolar Arctic Vegetation Map published (CAVM Team 2003, Walker et al. 2005b). Helped to redefine the need for a vegetation classification for the Arctic. The attendees at the concluding workshop in Tromsø, June 2004 recommitted themselves to making the necessary database. Several contributions to the Tromsø workshop were published in *Phytocoenologia* (Daniels et al. 2005).

2011: CAFF and IASC endorsements of the IAVD (later changed to the Arctic Vegetation Archive). CAFF recognizes the project as an important part of its Arctic biodiveristy efforts and published the IAVD Concept Paper (Walker and Raynolds 2011).

2012: Two workshops sponsored by the Nordic Network on climate and Biodiversity (CBIO-NET). Helped to lay the foundation for the Krakow workshop and highlighted the application of the IAVD for modeling and predicting biodiversity trends based on patterns of plant distribution data that could be derived from an Arctic vegetation archive (Walker et al. 2013).

2013: Support from IASC, CAFF, and NASA LCLUC program made this workshop possible.

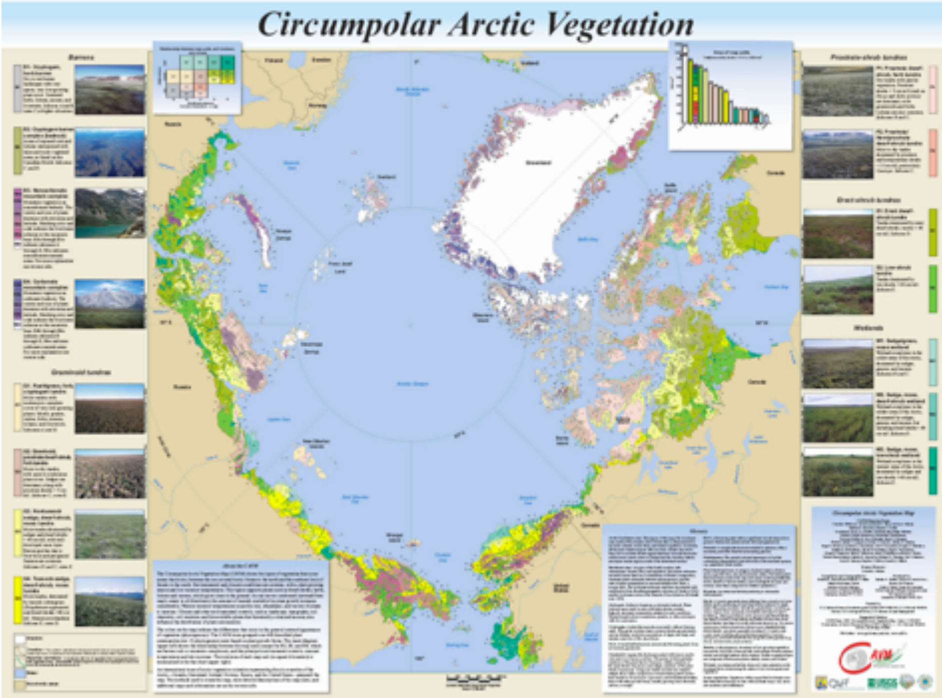
1992: Boulder, Colorado Workshop

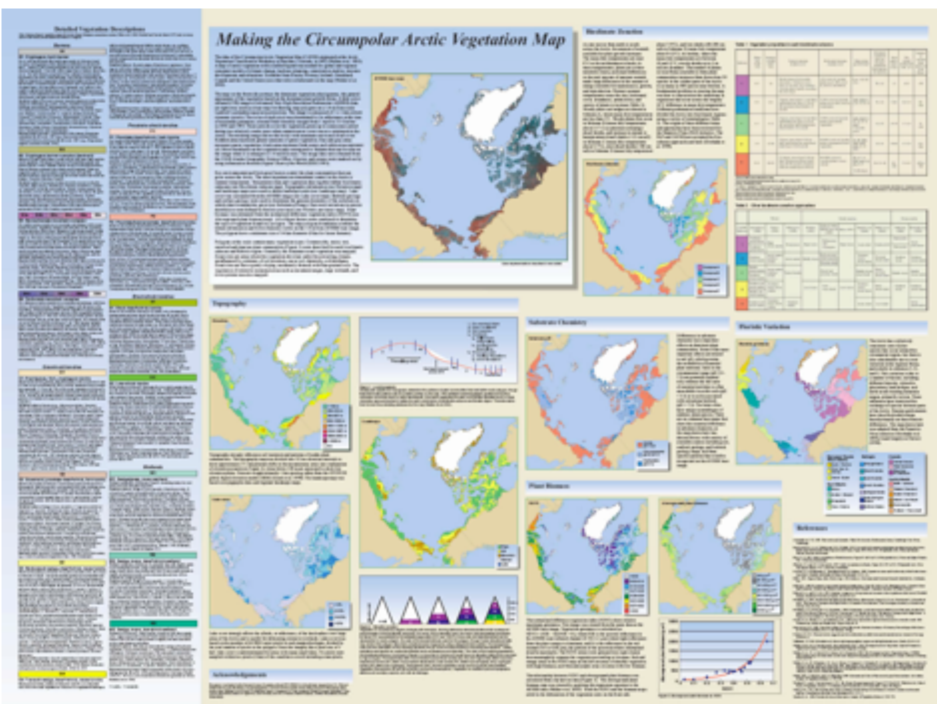


'Boulder Resolution' signed by 44 attendees at the workshop

"...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.



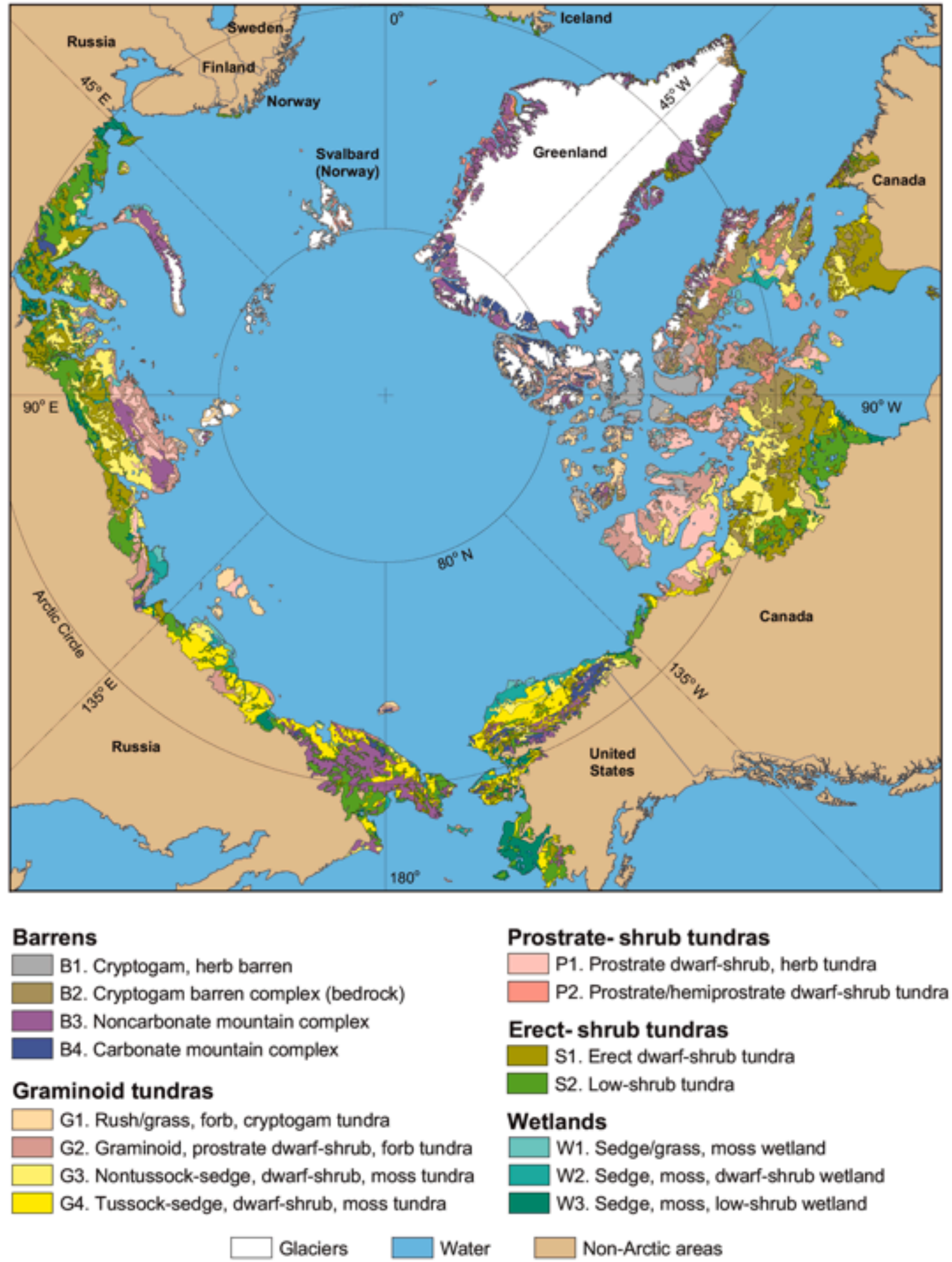


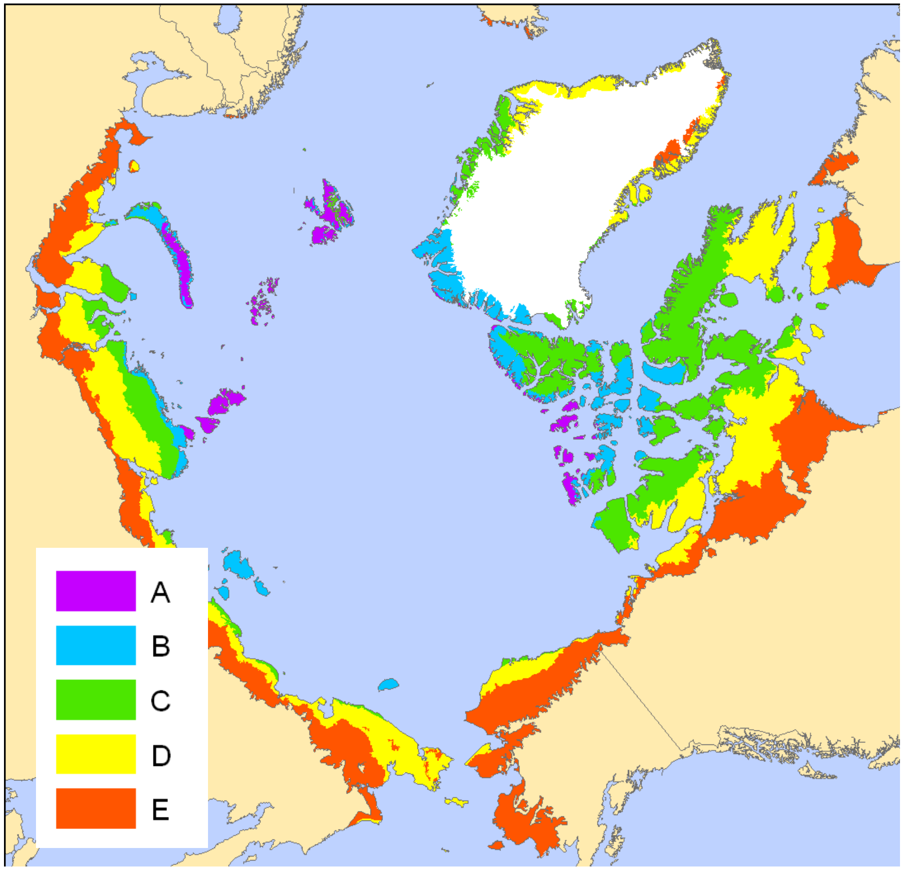
2003: Circumpolar Arctic Vegetation Map (CAVM)

- Methods and map described 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 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).

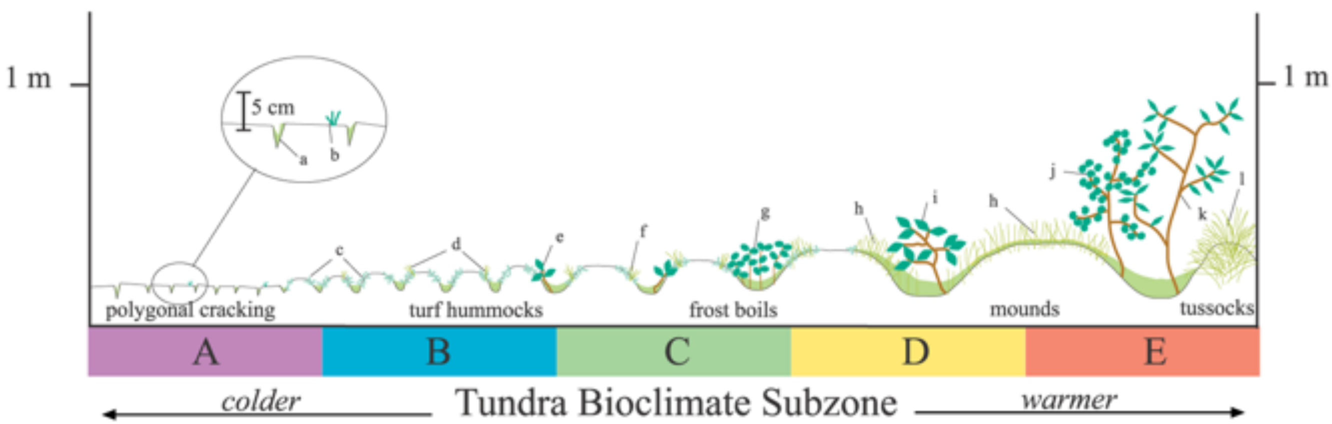




Arctic bioclimate subzones

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



Vegetation properties in each subzone

Subzone	Mean July Temp[1] (°C)	Summer warmth index[2] (°C)	Vertical structure of plant cover[3]	Horizontal structure of plant cover[3]	Major plant growth forms[4]	Dominant vegetation unit (see Detailed Vegetation Descriptions for species)	Total phyto-mass[5] ($t\ ha^{-1}$)	Net annual production[6] ($t\ ha^{-1}\ yr^{-1}$)	Number of vascular plant species in local floras[7]
A	0-3	<6	Mostly barren. In favorable microsites, 1 lichen or moss layer <2 cm tall, very scattered vascular plants hardly exceeding the moss layer	<5% cover of vascular plants, up to 40% cover by mosses and lichens	b, g, r, cf, of, ol, c	B1, G1	<3	<0.3	<50
B	3-5	6-9	2 layers, moss layer 1-3 cm thick and herbaceous layer, 5-10 cm tall, prostrate dwarf shrubs <5 cm tall	5-25% cover of vascular plants, up to 60% cover of cryptogams	npds, dpds, b, r, ns, cf, of, ol	P1, G1	5-20	0.2-1.9	50-100
C	5-7	9-12	2 layers, moss layer 3-5 cm thick and herbaceous layer 5-10 cm tall, prostrate and hemi-prostrate dwarf shrubs <15 cm tall	5-50% cover of vascular plants, open patchy vegetation	npds, dpds, b, ns, cf, of, ol, ehds* * in acidic areas	G2, P2	10-30	1.7-2.9	75-150
D	7-9	12-20	2 layers, moss layer 5-10 cm thick and herbaceous and dwarf-shrub layer 10-40 cm tall	50-80% cover of vascular plants, interrupted closed vegetation	ns, nb, npds, dpds, deds, neds, cf, of, ol, b	G3, S1	30-60	2.7-3.9	125-250
E	9-12	20-35	2-3 layers, moss layer 5-10 cm thick, herbaceous/ dwarf-shrub layer 20-50 cm tall, sometimes with low-shrub layer to 80 cm	80-100% cover of vascular plants, closed canopy	dls, ts*, ns, deds, neds, sb, nb, rl, ol *in Beringia	G4, S1, S2	50-100	3.3-4.3	200 to 500

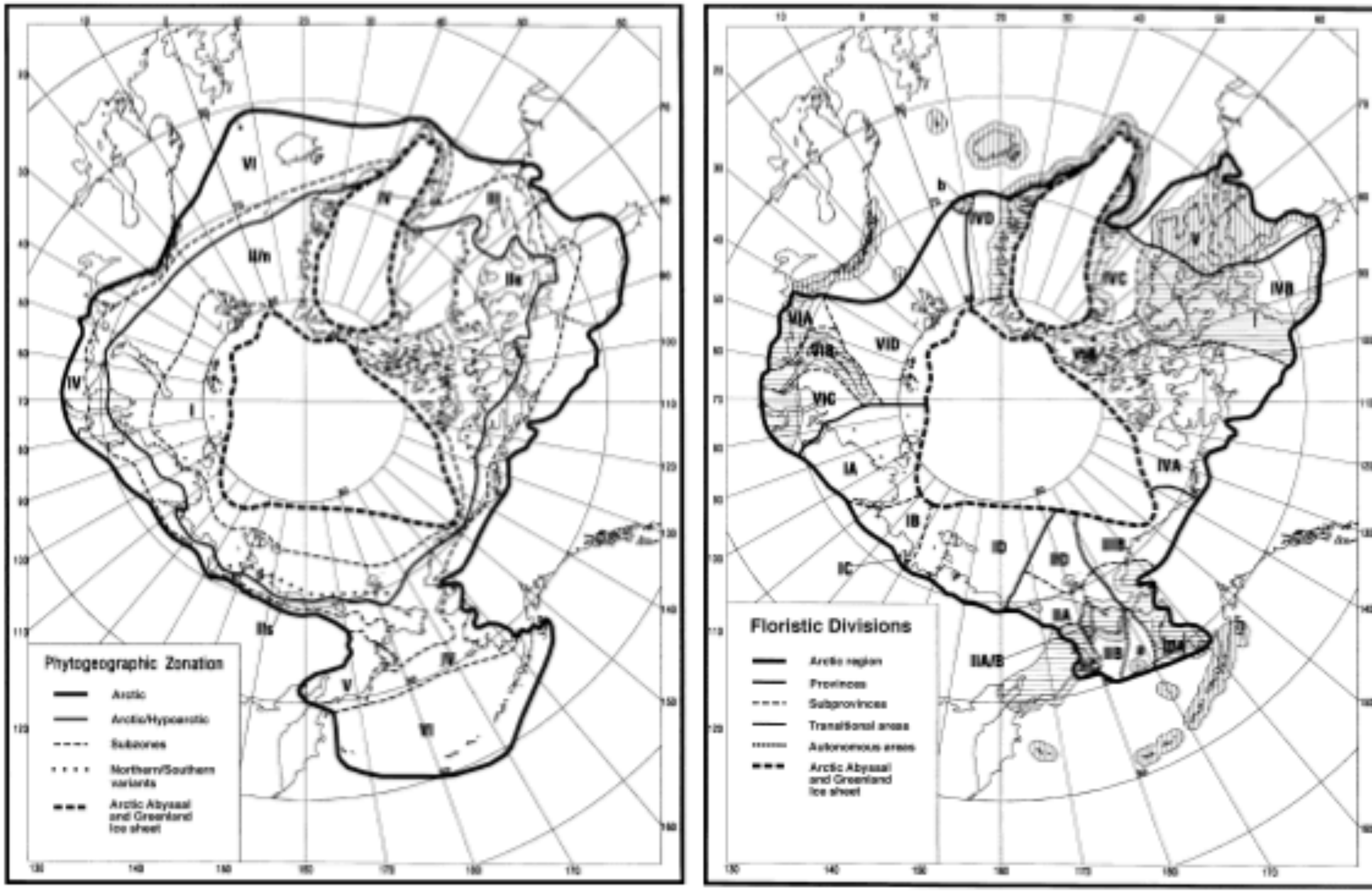
[1] based on Edlund (1996) and Matveyeva (1998).
[2] Sum of mean monthly temperatures greater than 0°C, modified from Young (1971).
[3] Chernov and Matveyeva (1997).
[4] b - barren; c - cryptogam; cf - cushion or rosette forb; deds - deciduous erect dwarf shrub; dls - deciduous low shrub; dpds - deciduous prostrate dwarf shrub; g - grass; ehds - evergreen hemiprostrate dwarf shrub; nb - nonsphagnoid bryophyte; neds - nondeciduous erect dwarf shrub; npds - nondeciduous prostrate dwarf shrub; ns - nontussock sedge; of - other forb; ol - other lichen; r - rush; rl - reindeer lichen; sb - sphagnoid bryophyte; ts - tussock sedge. Underlined codes are dominant.
[5] Based on Bazilevich, Tishkov and Vilcheck (1997), aboveground + belowground, live + dead.
[6] Based on Bazilevich, Tishkov and Vilcheck (1997), aboveground + belowground.
[7] Number of vascular species in local floras based mainly on Young (1971).

Russian zonal and 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 others) and modified by Alexandrova, 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.

Physiognomic units of the CAVM linked to plant communities: Sample vegetation unit description from the CAVM

Example:

B1. Cryptogam, herb barren (Figure 7a)

Dry to wet barren desert-like landscapes mainly in Subzone A and on some coarse-grained, often calcareous sediments in subzones B and C. Sparse (2-40%) horizontal plant cover, and very low vertical structure (generally <2 cm tall) with a single layer of plants where they occur. Dry herb barrens composed of few scattered vascular plants are present over much of the landscape. Snow-flush communities are often a conspicuous component, forming dark streaks on the otherwise barren lands, composed largely of bryophytes and cryptogamic crusts. In upland areas, vascular plant cover is generally very sparse (<2%), mainly scattered individual plants often in crevices between stones or small (< 50 cm diameter) cryoturbated polygons. Sedges (Cyperaceae), dwarf shrubs, and peaty mires are normally absent.

Dominant plants: The most common vascular plants are cushion forbs (*Papaver dahlianum* ssp. *polare, Draba, Potentilla hyparctica*[a], *Saxifraga oppositifolia*[n]) and graminoids (*Alopecurus alpinus, Deschampsia borealis/brevifolia, Poa abbreviata, Puccinellia angustata, Phippsia , Luzula nivalis*[a], *L. confusa*[a]), lichens (*Caloplaca, Lecanora, Ochrolechia, Pertusaria, Mycobilimbia, Collema, Thamnolia, Cetraria, Flavocetraria, Cetrariella, Stereocaulon*), mosses (*Racomitrium, Schistidium, Orthothecium*[n], *Ditrichum*[n], *Distichium*[n], *Encalypta, Pohlia, Bryum, Polytrichum*), liverworts (e.g., *Gymnomitrion, Cephaloziella*), and cyanobacteria.

Representative syntaxa: Communities of the classes *Thlaspietea rotundifolii* Br.-Bl. et al. 1947 (e.g. *Papaveretum dahliani* Hofm. 1968) and *Salicetea herbaceae* Br.-Bl. et al. 1947 (e.g. *Phippsietum algidae-concinnae* Nordh. 1943).

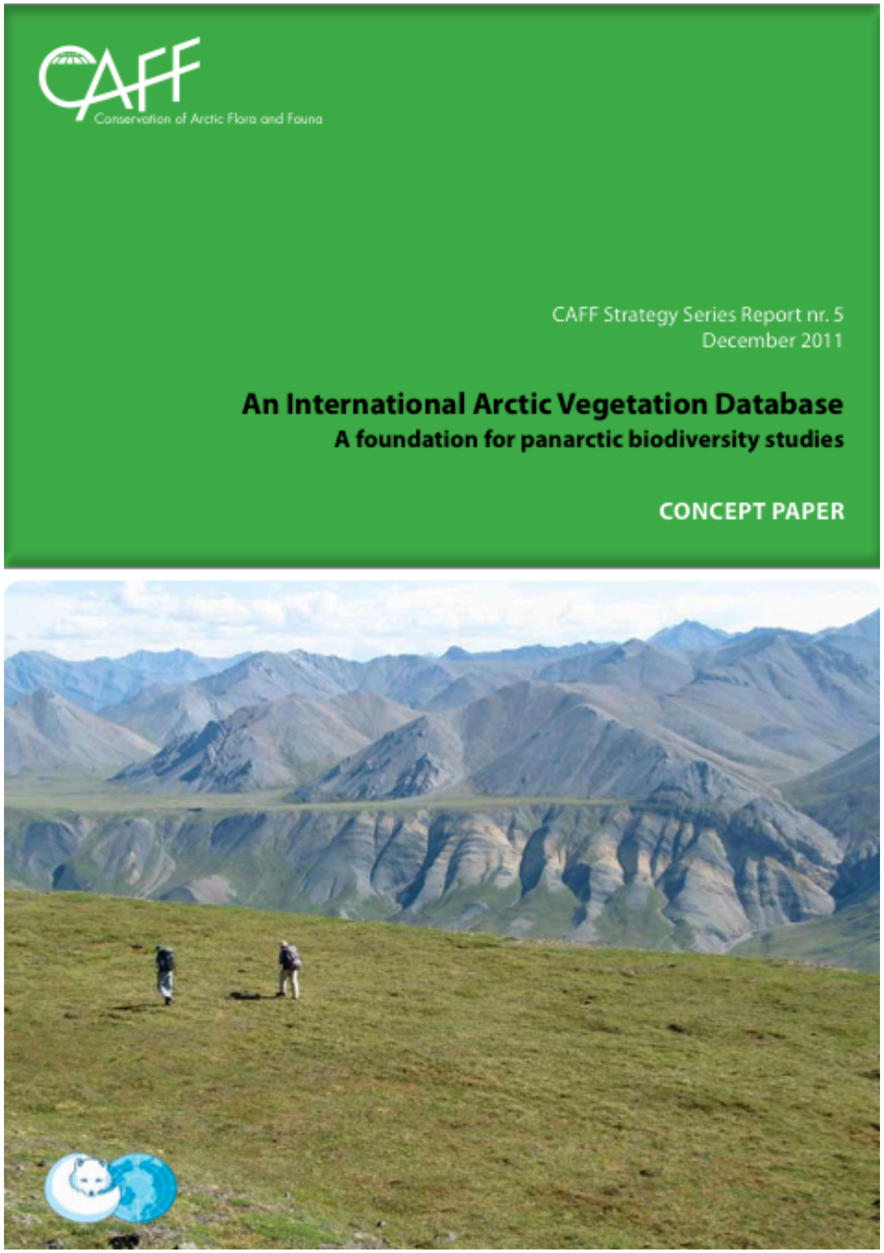
Proceedings from the concluding CAVM meeting in Tromsø, 2004

Classification and mapping of arctic vegetation

A tribute to Boris A. Yurtsev. A selection of contributions presented at the 2. Internat. Workshop on Circumpolar Vegetation Classification and Mapping, Tromso, Sommaroya, Norway, 2-6 June 2004

Ed.: Fred J.A. Daniels; Arve Elvebakk; Stephen S. Talbot; Donald A. Walker

2005. V , 375 pages, 205 figures, 135 tables, 24x16cm, 850 g
Language: English



2011: International Arctic Vegetation Database Concept Paper

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.

Need for a panarctic vegetation database

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.
- The amount of information in the Arctic (approximately 20,000 relevés) makes it feasible.
- Much of the information is in danger of being lost because of retirement or death of key investigators.
- No panarctic plant community data presently exists in an organized database.

Photo: D.A. Walker, Nuuk, Greenland

Why vegetation?

- Key integrator of many of the physical and biological attributes of ecosystems.
- Often used in environmental and biodiversity inventories, land-use planning, environmental management, and conservation evaluations.

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

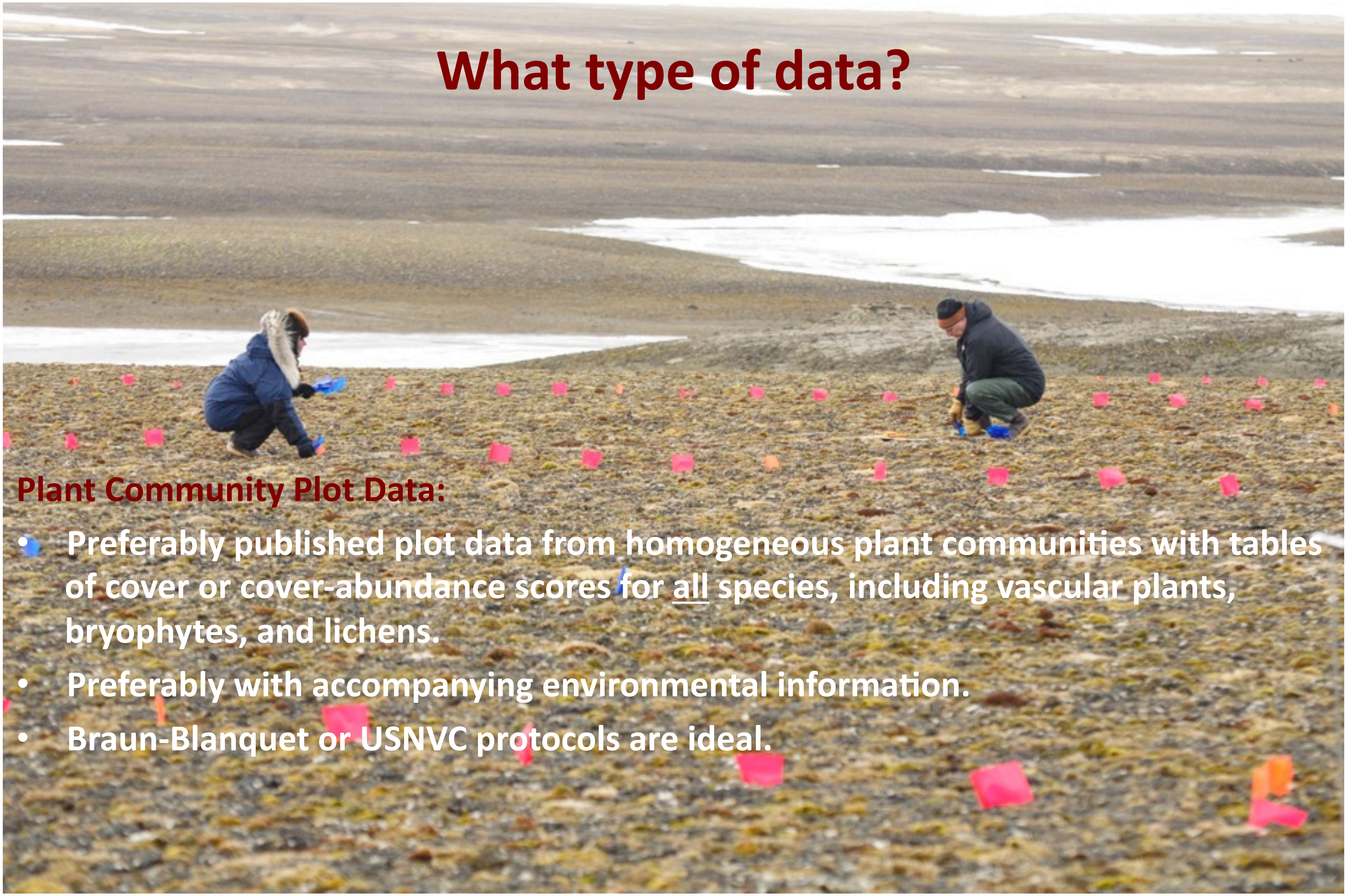
International Arctic Vegetation Database

Ultimate goals:

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

Photo: D.A. Walker, Nuuk, Greenland

What type of data?



Plant Community Plot 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.

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.**

North American and European approaches

The European approach:

- Tradition developed by Josias Braun-Blanquet (1928, 1964; Westhoff & van der Maarel 1978).
- Floristic-based approach: All levels of the classification hierarchy are based primarily on species composition
- Most widely used method of vegetation study in the Arctic, with many studies in Europe, Svalbard, Greenland, Russia, Canada, and the U.S.
- Has not gained wide acceptance in North America outside Arctic Alaska.

The American approach:

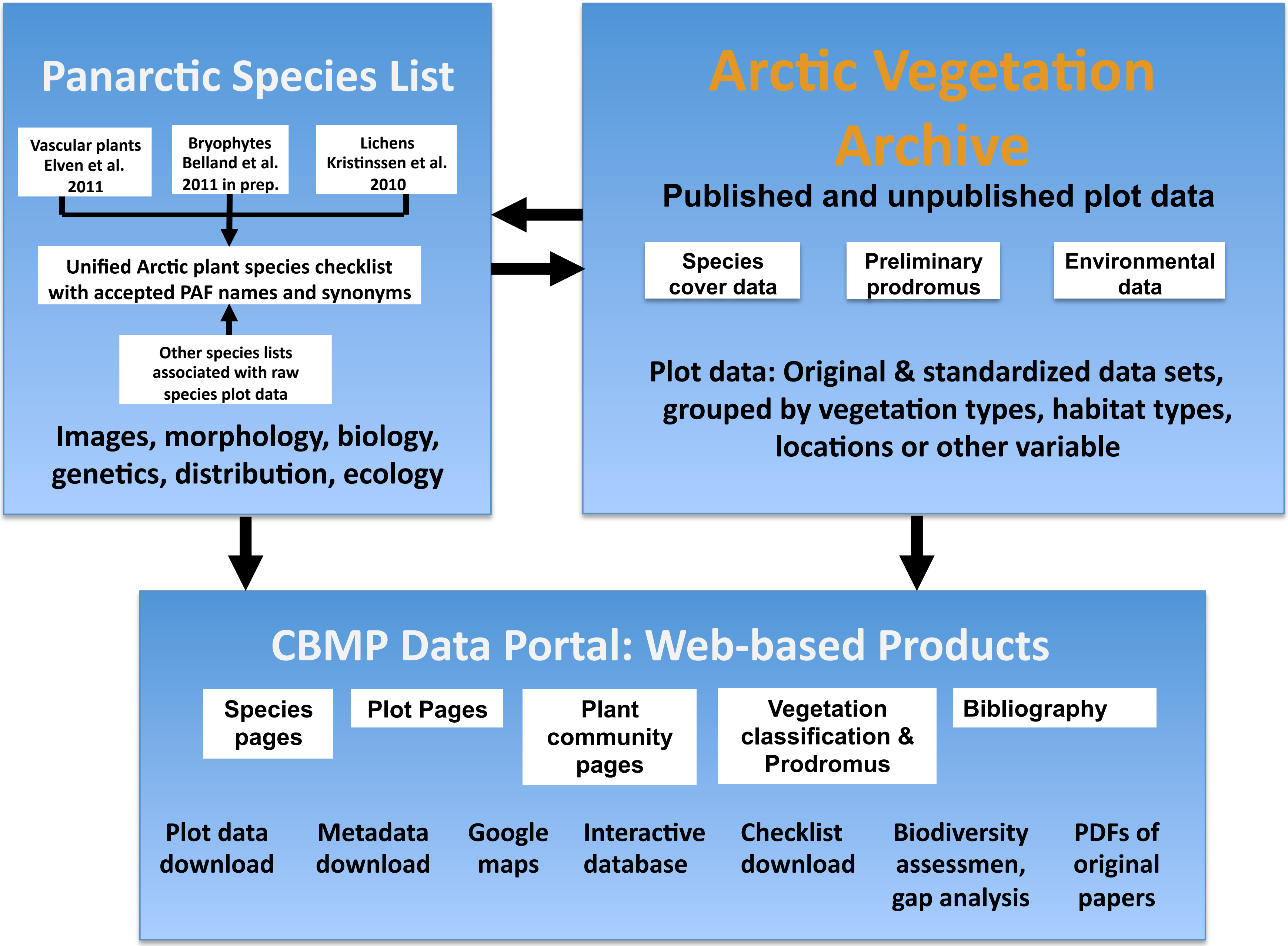
- Developed by The Nature Conservancy about 35 years ago. Eventually evolved into the U.S. National Vegetation Classification (USNVC) (Grossman et al. 1998, Jennings et al. 2009) and the Canada National Vegetation Classification (CNVC) (Ponomarenko & Alvo 2001).
- Uses floristic at the lowest level (association level) of classification and a variety of other criteria for higher-level units including vegetation and biogeographic criteria (Faber-Langendoen et al. 2009).
- Mandated by U.S. government agencies in the U.S. Several countries in the western hemisphere are using it to guide their national vegetation classifications, including Bolivia, Canada, Mexico and Venezuela (Faber-Langendoen et al. 2009).

How the AVA fits within the CAFF mandate

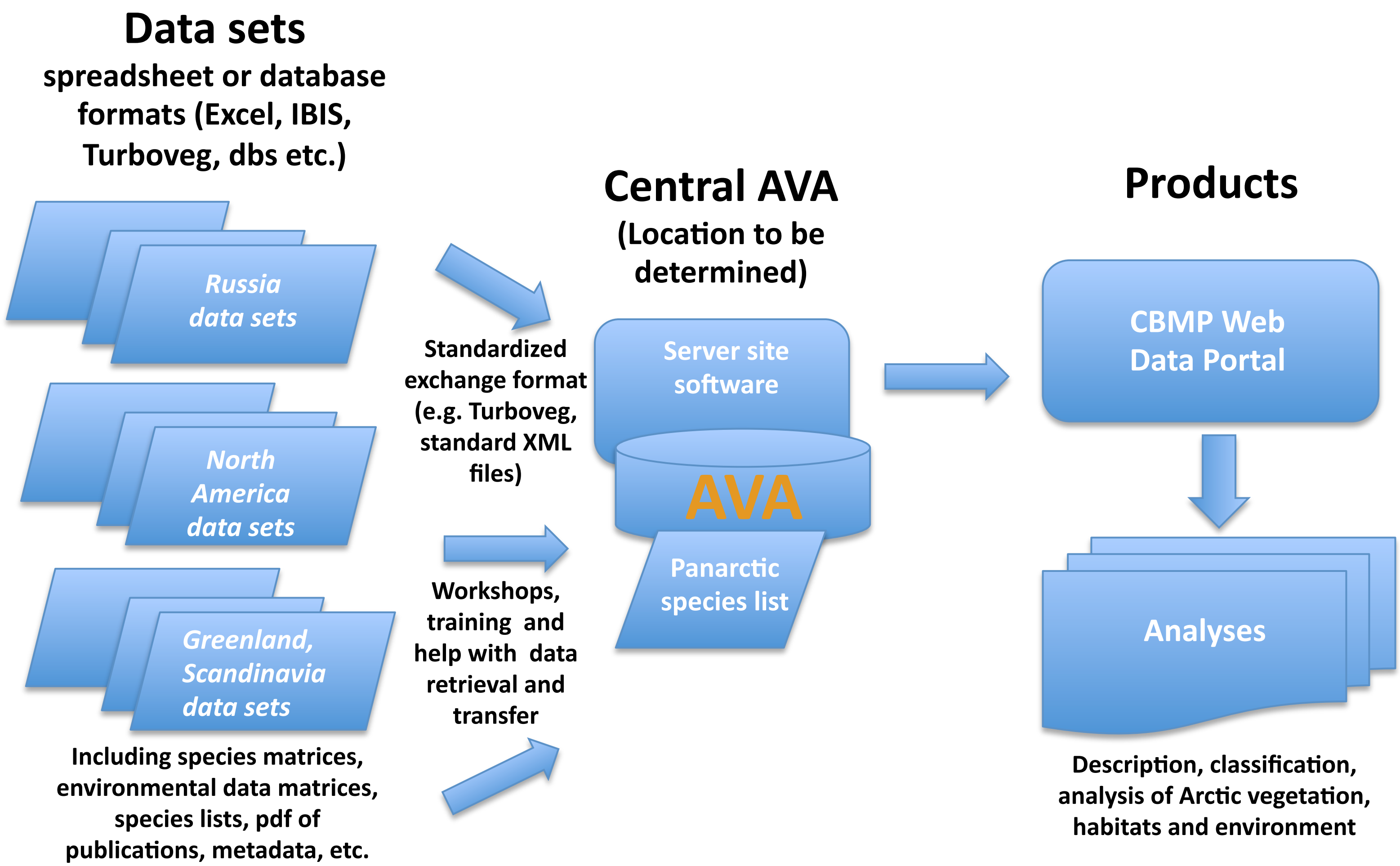
Photo: M.K. Raynolds

- The IAVD (now the AVA) concept was endorsed by CAFF and is a project of the CAFF Flora Working Group (CFG), which promotes the following activities:
  - 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.
- IASC also endorsed the project and allowed use of the IASC logo for promoting the project.

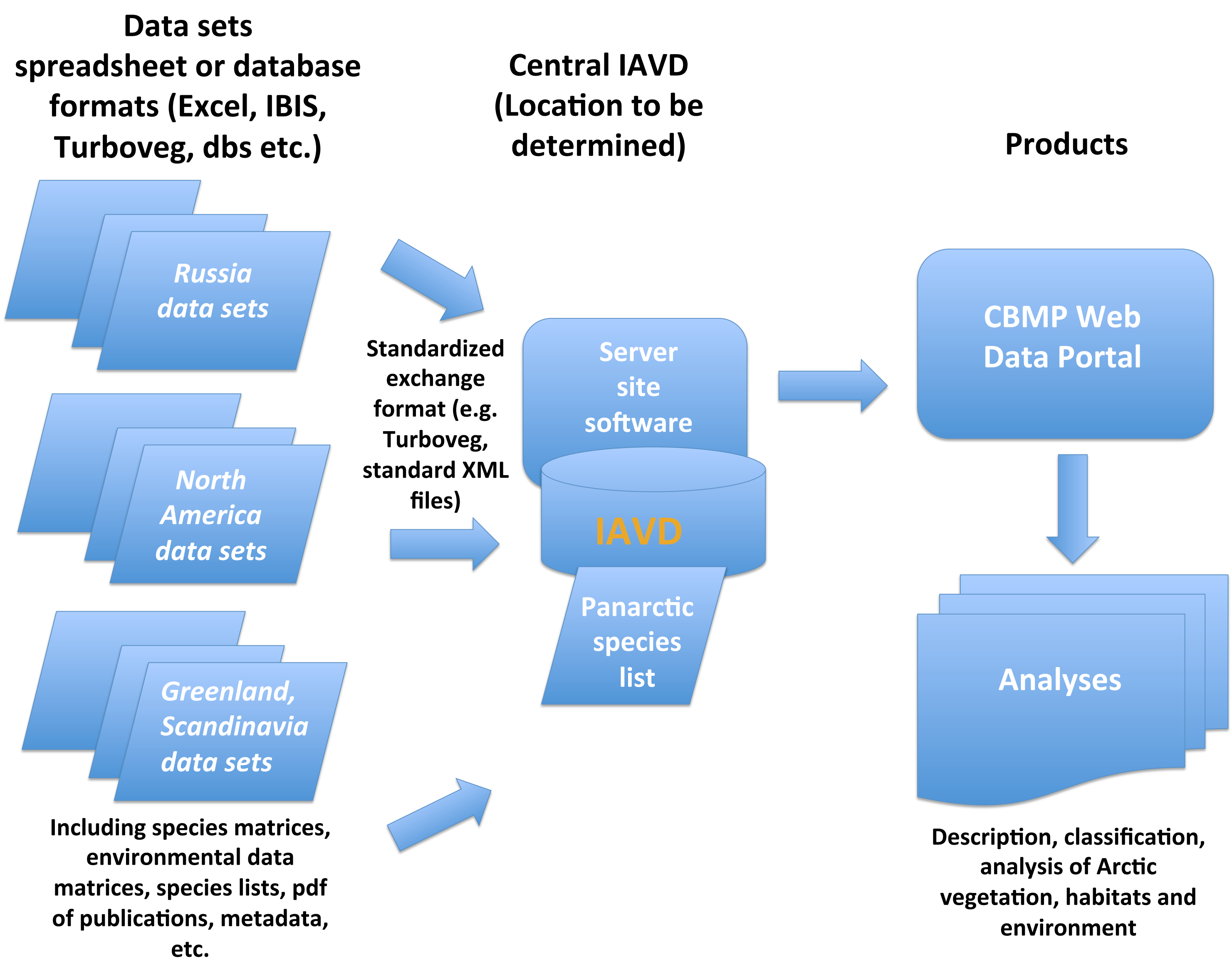
Conceptual framework



Possible model of data flow



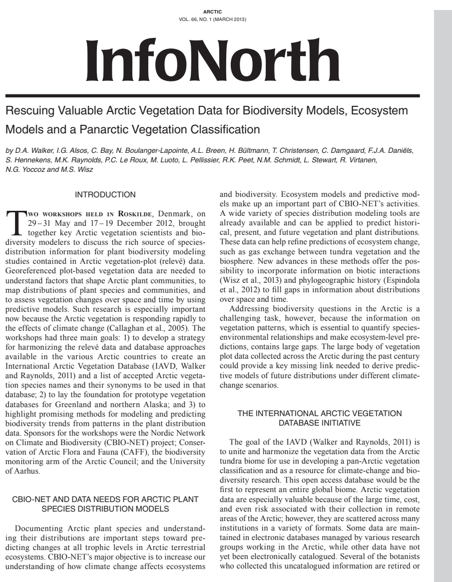
Conceptual possible data flow



CAFF Vegetation Web Portal

- Will be part of the CAFF Arctic Biodiversity Data Portal.
- Hierarchy of pages linking vegetation maps to vegetation unit descriptions, species pages, and vegetation plot data.

2012: CBIO-NET workshops, Roskilde, Denmark



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InfoNorth

Rescuing Valuable Arctic Vegetation Data for Biodiversity Models, Ecosystem Models and a Panarctic Vegetation Classification

by D.A. Walker, I.G. Alsos, C. Bay, N. Boulanger-Lapointe, A.L. Breen, H. Bültmann, T. Christensen, C. Damgaard, F.J.A. Daniëls, S. Hennekens, M.K. Raynolds, P.C. Le Roux, M. Luoto, L. Pellissier, R.K. Peet, N.M. Schmidt, L. Stewart, R. Virtanen, N.G. Yoccoz and M.S. Wisz

INTRODUCTION

Two workshops held in Roskilde, Denmark, on 29–31 May and 17–19 December 2012, brought together key Arctic vegetation scientists and biodiversity modelers to discuss the rich source of species-distribution information for plant biodiversity modeling studies contained in Arctic vegetation-plot (relevé) data. Georeferenced plot-based vegetation data are needed to understand factors that shape Arctic plant communities, to map distributions of plant species and communities, and to assess vegetation changes over space and time by using predictive models. Such research is especially important now because the Arctic vegetation is responding rapidly to the effects of climate change (Callaghan et al., 2005). The workshops had three main goals: 1) to develop a strategy for harmonizing the relevé data and database approaches available in the various Arctic countries to create an International Arctic Vegetation Database (IAVD, Walker and Raynolds, 2011) and a list of accepted Arctic vegetation species names and their synonyms to be used in that database; 2) to lay the foundation for prototype vegetation databases for Greenland and northern Alaska; and 3) to highlight promising methods for modeling and predicting biodiversity trends from patterns in the plant distribution data. Sponsors for the workshops were the Nordic Network on Climate and Biodiversity (CBIO-NET) project; Conservation of Arctic Flora and Fauna (CAFF), the biodiversity monitoring arm of the Arctic Council; and the University of Aarhus.

CBIO-NET AND DATA NEEDS FOR ARCTIC PLANT SPECIES DISTRIBUTION MODELS

Documenting Arctic plant species and understanding their distributions are important steps toward predicting changes at all trophic levels in Arctic terrestrial ecosystems. CBIO-NET's major objective is to increase our understanding of how climate change affects ecosystems and biodiversity. Ecosystem models and predictive models make up an important part of CBIO-NET's activities. A wide variety of species distribution modeling tools are already available and can be applied to predict historical, present, and future vegetation and plant distributions. These data can help refine predictions of ecosystem change, such as gas exchange between tundra vegetation and the biosphere. New advances in these methods offer the possibility to incorporate information on biotic interactions (Wisz et al., 2013) and phylogeographic history (Espindola et al., 2012) to fill gaps in information about distributions over space and time.

Addressing biodiversity questions in the Arctic is a challenging task, however, because the information on vegetation patterns, which is essential to quantify species-environmental relationships and make ecosystem-level predictions, contains large gaps. The large body of vegetation plot data collected across the Arctic during the past century could provide a key missing link needed to derive predictive models of future distributions under different climate-change scenarios.

THE INTERNATIONAL ARCTIC VEGETATION DATABASE INITIATIVE

The goal of the IAVD (Walker and Raynolds, 2011) is to unite and harmonize the vegetation data from the Arctic tundra biome for use in developing a pan-Arctic vegetation classification and as a resource for climate-change and biodiversity research. This open access database would be the first to represent an entire global biome. Arctic vegetation data are especially valuable because of the large time, cost, and even risk associated with their collection in remote areas of the Arctic; however, they are scattered across many institutions in a variety of formats. Some data are maintained in electronic databases managed by various research groups working in the Arctic, while other data have not yet been electronically catalogued. Several of the botanists who collected this uncatalogued information are retired or

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- **2 meetings at the Cromwell Roskilde, sponsored by the Nordic Network on Climate and Biodiversity (CBIO-NET) and Aarhus University highlighted the application of a vegetation archive for modeling and predicting biodiversity and helped to lay the foundation for the AVA.**
- **Resulted in InfoNorth article in *Arctic* (Walker et al. 2013).**

AVA elements resolved at the Roskilde meetings

- **Turboveg: for initial data entry.**
- **PASL: list of accepted species names for the AVA.**
- **GIVD: metadata archive.**
- **EVA: model archive and component thereof.**
- **Maximum compatibility with other vegetation database approaches (VegBank in the U.S, VPro in Canada and IBIS in Russia).**
  - **Alaska data will also be part of VegBank.**
  - **VegBank model may be a better approach for long-term archiving.**
  - **Need Vegetation data exchange**

Goals of the 2013 Kraków AVA meeting

- **Review the status of relevé data in each of the circumpolar countries.**
- **Unify the Arctic vegetation community behind an approach that is acceptable to all involved.**
- **Begin recruiting the people and resources necessary to complete the work.**

Photo: www.krakow.pl
http://krakow.pl/english/5666,artykul,krakow_advantages.html

Panarctic Species List (PASL) of accepted names: a critical first piece

- ***Combines several Arctic species lists into one that is foundation for the AVA (Raynolds et al. this workshop):***
- **Major topic for today: How to update and maintain the original lists and the PASL.**

Photo: D.A. Walker

Other critical elements

- How to make a Turboveg database compatible with VegBank, Vpro IBIS and EVA.
- Data exchange protocols.
- Storage of metadata.
- How to handle environmental data?
- Prototypes for Greenland and Arctic Alaska.
- Major topic for tomorrow.

Proposed Timeline

- Year 1-2: Organizing workshop, ASSW, Krakow, Poland. Complete IAVD prototypes. Obtain international funding.
- Year 2-4: Assemble data from literature sources at three main centers UAF (North America), Münster (Greenland and Scandinavia), and a to-be-determined site in 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

Funding

- Proposals after this workshop.
- Will require funds from a variety of international agencies.
- Anticipated 5-6 year project.

Concluding statements

- **The AVA was conceived 21 years ago to help consolidate the large amount of plot data from around the Arctic to aid in development of a circumpolar Arctic vegetation classification.**
- **The vision has recently been revitalized with the help of CAFF, IASC, and the CBIO-NET workshops and has the potential to contribute to a wide diversity of Arctic biodiversity, habitat, and ecosystem modeling efforts.**
- **The great challenge now is to develop a collaborative effort for funding.**

Photo: D.A. Walker. Franz Josef Land