

# **Boreal Tundra Vegetation of the North Atlantic and North Pacific Regions**

Anna Maria Fosaa<sup>1</sup>, Fred J. A. Daniëls<sup>2</sup>, Starri Heiðmarsson<sup>3</sup>,  
Ingibjörg S. Jónsdóttir<sup>4</sup> and Stephen S. Talbot<sup>5</sup>

<sup>1</sup>Natural History Museum, Faroe Islands, <sup>2</sup>University of Münster,  
Germany, <sup>3</sup>Icelandic Institute of Natural History, Iceland,  
<sup>4</sup>University of Iceland and UNIS, <sup>5</sup>U.S. Fish and Wildlife Service,  
Alaska, USA.

# Similarities between these areas

- (Almost) treeless neighbouring areas in an Arctic-Subarctic-Boreal climate gradient in the Northwest Atlantic and North Pacific Regions
- Similarities in flora, vegetation, ecosystems and land-use.
- Human impact comparatively strong
- The areas belong to the CAFF concern

# The area



# Faroe Islands

62°N, 7°W

Min February 4° C, max August 11 ° C

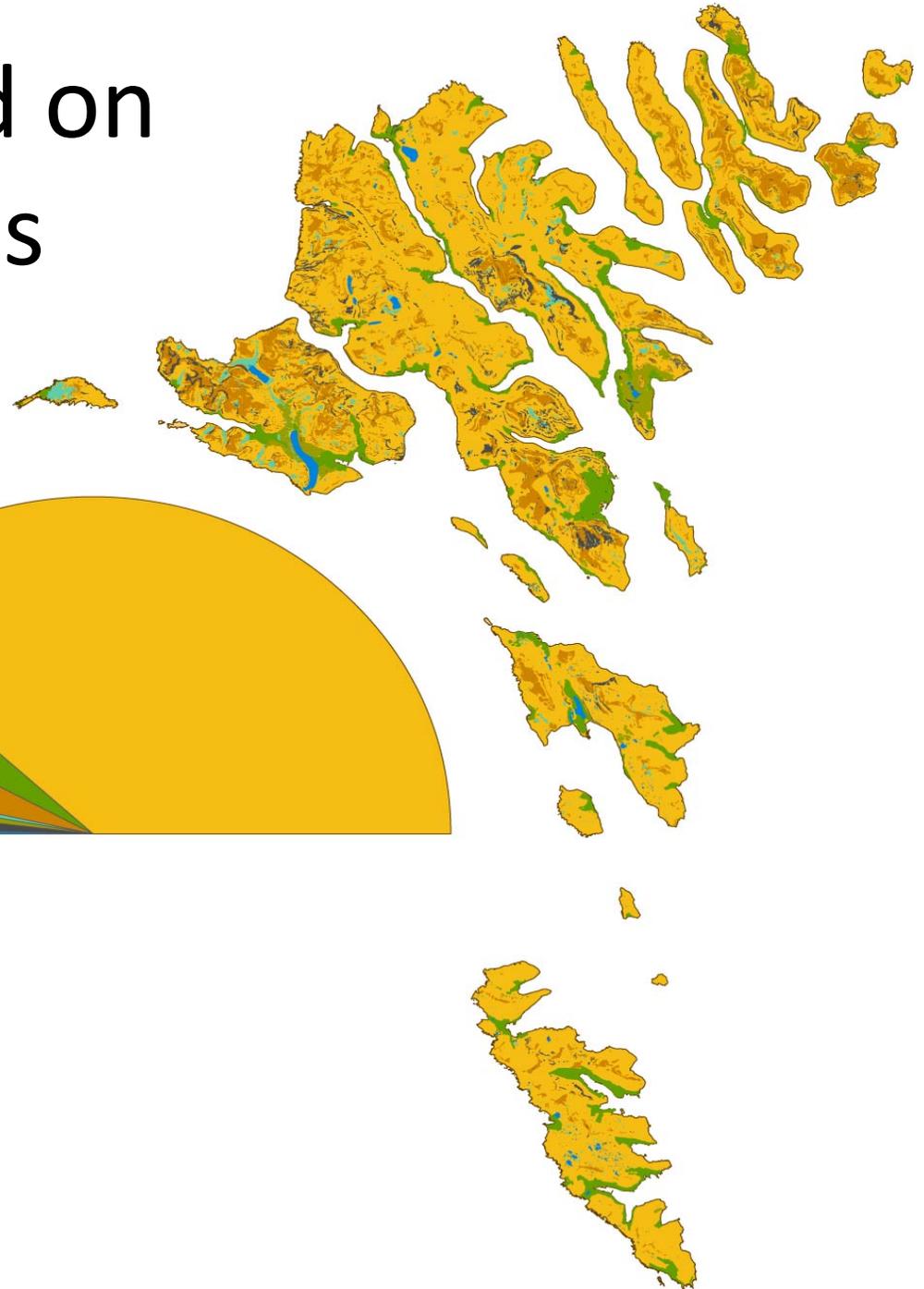
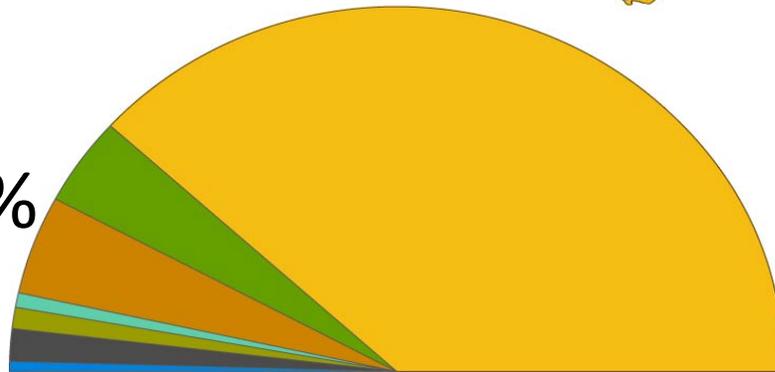
No trees since the last iceage (10.000-12.000 years ago)

Heavily grazed by sheep



# Vegetated land on Faroe Islands

- Grassland 76.5%
- Heath 1.9%
- Fell field 8.6%
- Mires 1.3%
- Lakes 0.9%
- Total area 1400 Km<sup>2</sup>



# Vegetation along altitudinal transects



Alpine area (400-882 m a.s.l.) with sparsely, vegetated fell-field, *Racomitrium* heath and *Salix herbacea* dominated vegetation



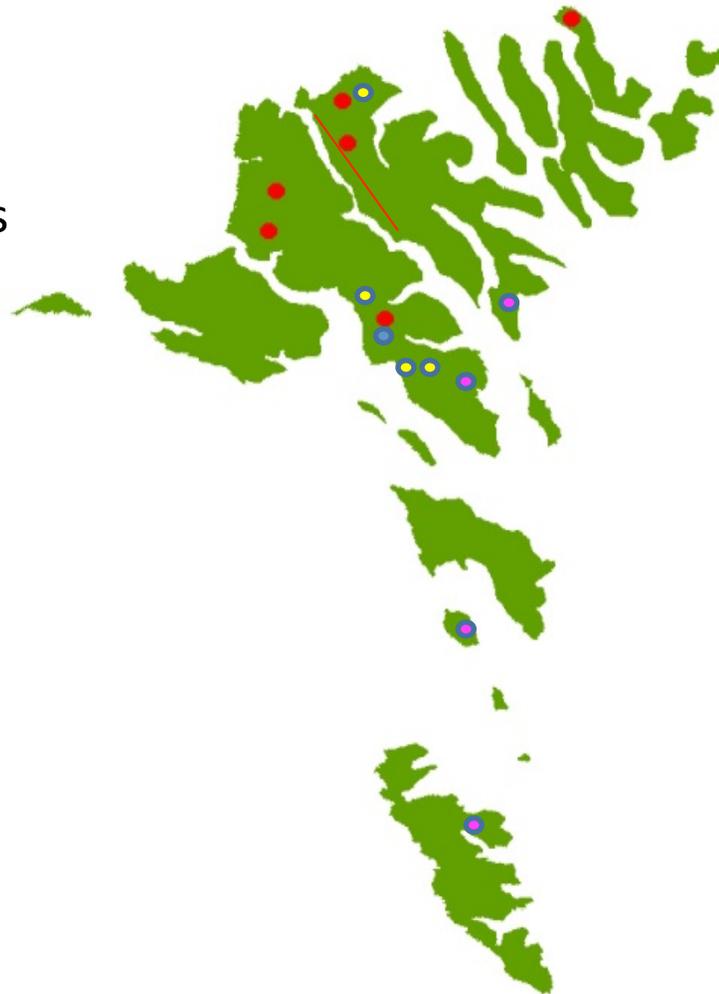
Low alpine area (200-400 m a.s.l.) with dry and moist grassland



Lowland area (0-200 m a.s.l.) with *Calluna vulgaris* and *Empetrum hermaphroditum* heathland

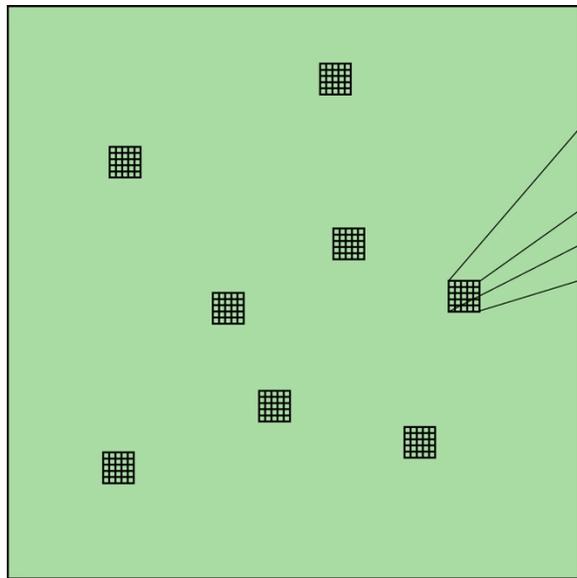
# Vegetation data available from the Faroe Islands

- — Monitored transects
- Monitored areas
- ITEX
- GLORIA



# Sampling design

Presence/absence  
of each species



10x10 m

8 randomly  
selected  
mesoplots 0.25 m<sup>2</sup>

## Sampled data

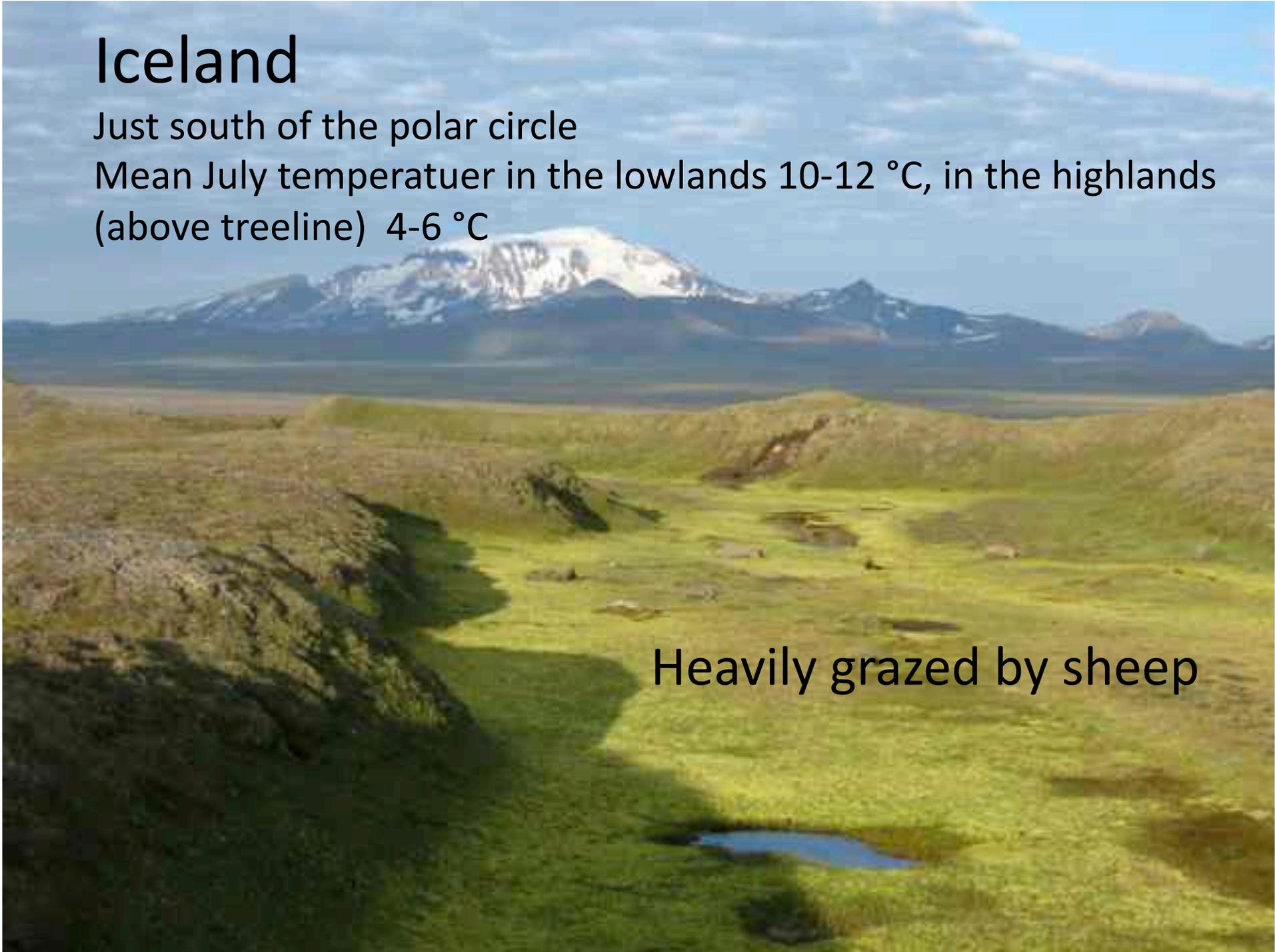
- Vascular plants
- mosses and lichens, partly
- Soil data
- Soil temperature
- Vegetation cover and height
- Soil depth

# Iceland

Just south of the polar circle

Mean July temperature in the lowlands 10-12 °C, in the highlands (above treeline) 4-6 °C

Heavily grazed by sheep



# (Potential) Mountain Birch treeline in Iceland

- *Betula pubescens* species limit (species present)
  - varies from less than 100 m above sea level at the northern and western most peninsulas up to 500 m in sheltered inland valleys.
- *B. pubescens* 2 m tree height-limit
  - varies from 0 m above sea level to 400 m (C. Wöll 2008)
- Above the treeline:
  - Low-arctic tundra / subarctic-alpine oceanic tundra with discontinuous permafrost.



# Vegetated land on Iceland / NDVI

- Total land area 103 000 Km<sup>2</sup>
- Extensive vegetation and soil erosion!
- Vegetated land ca 53 200 Km<sup>2</sup> (52%).
- there off 10-15 000 Km<sup>2</sup> poorly vegetated.
- Deserts 37 000 Km<sup>2</sup> (34%)
- Glaciers, lakes and rivers 14%.



<http://www.rala.is/desert/>

# Vegetation above the treeline along moisture gradients



- Dry moss-covered ridges or sparsely vegetated fell-fields / deserts
- Mesic moss and lichen rich dwarf-shrub heaths with *Betula nana* and *Salix* sp.
- Moist sedge-rush-herb meadows – with *Salix phylicifolia*, only if grazing protected (rare)
- *Carex-Eriophorum* dominated wetlands, palsa mires
- Snowbeds often characterised by *Sibbaldia procumbens*, *Gnaphalium procumbens* in addition to *Salix herbacea*

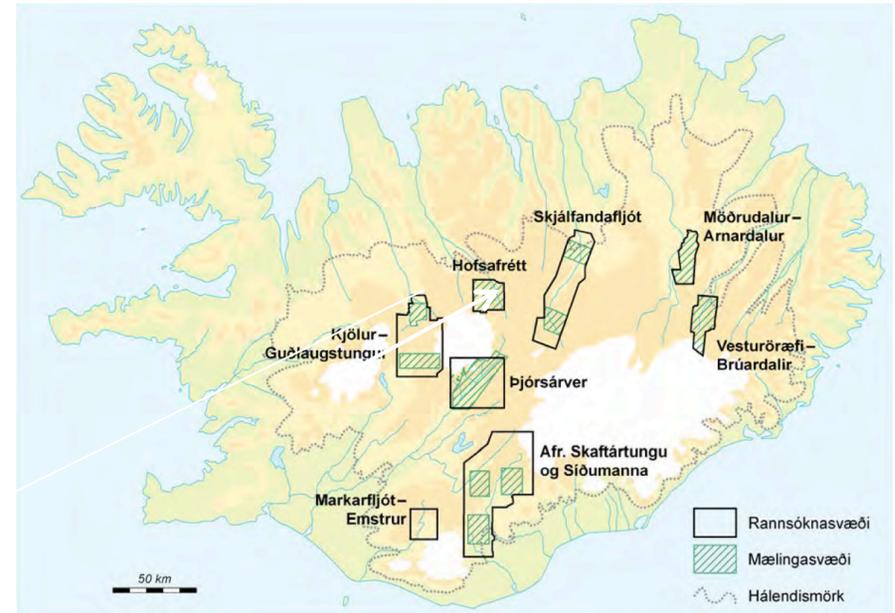
# Vegetation data available from the Icelandic Institute of Natural History

## Mapping of habitat types

393 transects – 200 m in length  
(random within „expected“ habitat  
type)

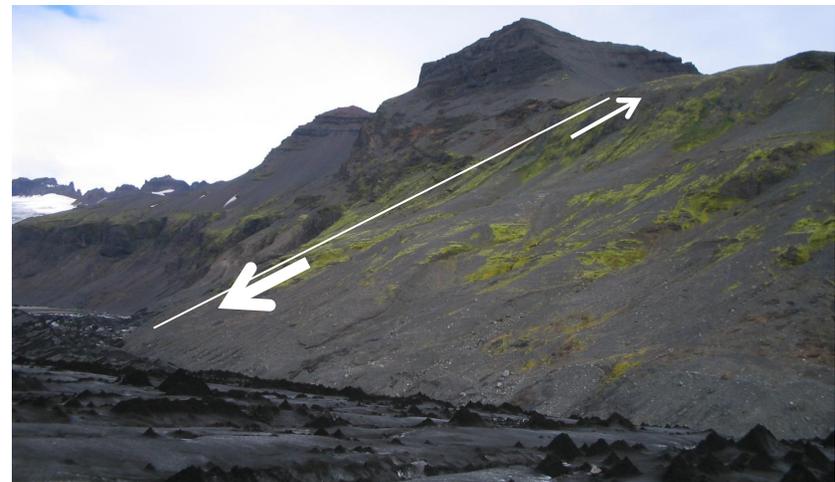
8 plots in each transect,  
100 x 33 cm

Vascular plants to each species,  
lichens and bryophytes partly  
several environmental  
parameters (soil PH, soil depth,  
slope etc.)



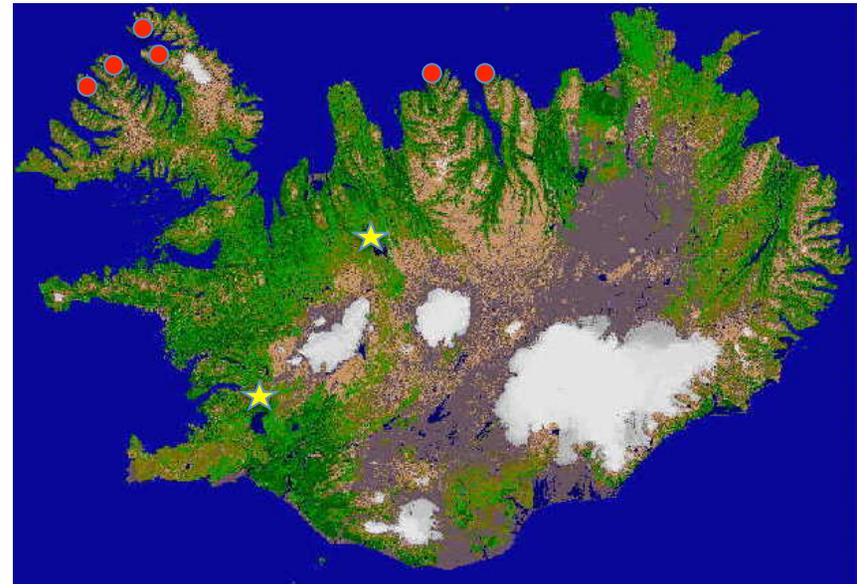
**Esjufjöll nunataks, SE-Iceland**  
**elevational transect 550 – 800 m**  
**18 permanent plots, 5 x 5 meters**

Began in 2006 presumed to  
be revisited every 5 years



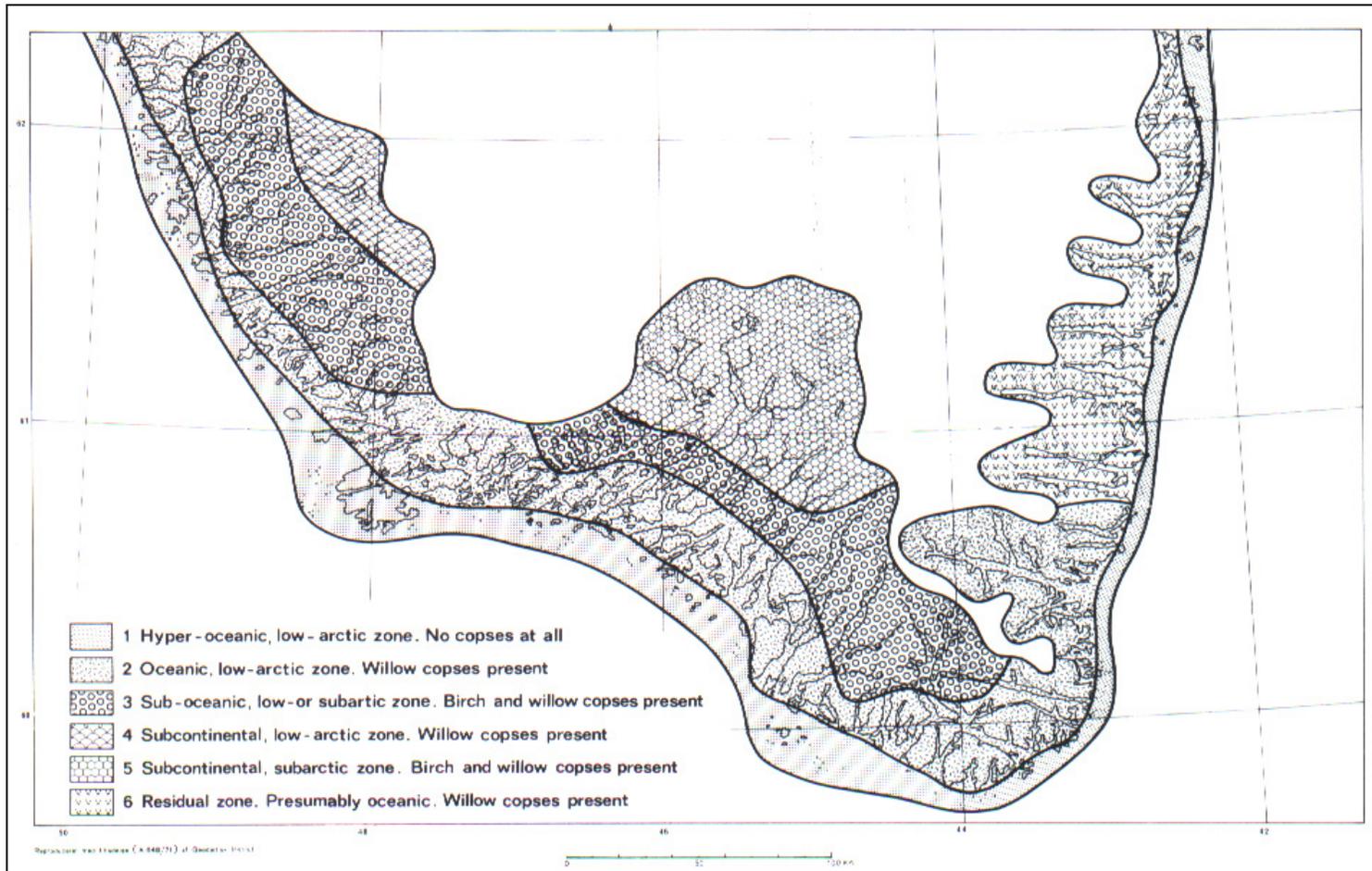
# Vegetation data available from Iceland

- University of Iceland (ISJ)
  - Species lists: vascular, bryophytes, lichens
  - Point intercept data – 450 plots (size 0.16 – 0.56 m<sup>2</sup>) in wet-dry highland (★) and low arctic (●) areas.
  - Abiotic data available
- Agricultural University of Iceland
  - Vegetation analysis with focus on vascular plants
  - several hundred plots in high- and lowlands.
- Soil Conservation Service
  - Vegetation analysis of restoration areas – several hundred plots.



- Classical (Central European) phytosociological studies
  - Thannheiser, coastal vegetation
  - Hövelmann Dwarf-shrub heath,
  - Hadac – moss heaths

# SW Greenland



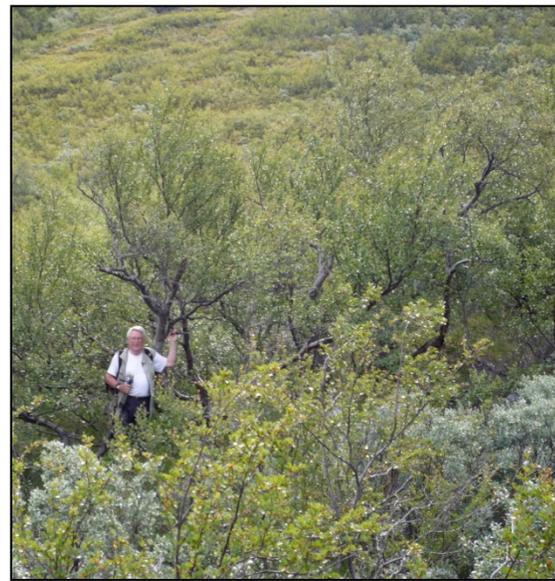
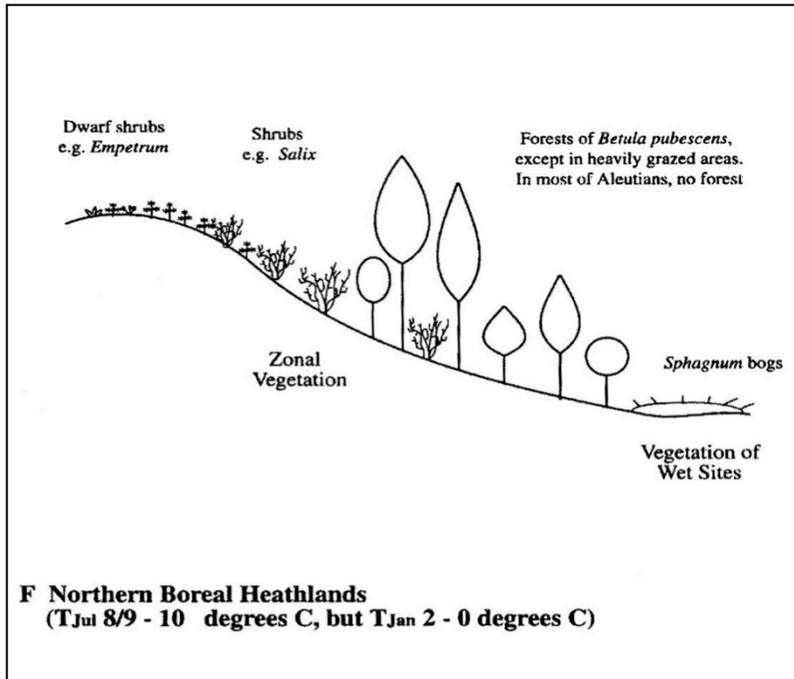
Feilberg 1984

**Subzones and alt. belts    D/d   nF   la(e/d) ma(c)**

| Bereich:<br>Höhen-Lage:<br>Wuchs-Zone:  | ozeanisch                      | sub-kontinentale                   |  |   | Syntaxa   |
|---|--------------------------------|------------------------------------|--|---|---|
|   | untere<br><i>Empetrum</i>      | untere<br><i>Betula-<br/>Elyna</i> | mittlere<br><i>Vaccinium-<br/>Cetraria</i> | obere<br><i>Dryas-<br/>Rhacomitrium</i> |   |
| A. Sommergrüne Gebüsche und Buschwälder:<br>Kraut-reiche Weiden-Gebüsche . . . . .                              | 2 <sup>0</sup> / <sub>0</sub>  | 8 <sup>0</sup> / <sub>0</sub>      | 3 <sup>0</sup> / <sub>0</sub>              | —                                       | A1. Betulo-Adenostyletea<br>A2. Loiseleurio-Vaccinieta<br>A3. Vaccinio-Piceetea |
| Zwergstrauch-reiche Weiden-Gebüsche . .   | 2 <sup>0</sup> / <sub>0</sub>  | 17 <sup>0</sup> / <sub>0</sub>     | 2 <sup>0</sup> / <sub>0</sub>              | —                                       |   |
| Birken-Buschwälder . . . . .  | —                              | 18 <sup>0</sup> / <sub>0</sub>     | —  | —                                       |   |
| B. Vorwiegend immergrüne Zwergstrauch-<br>Heiden:   |                                |                                    |  |   | B1. Loiseleurio-Vaccinieta  |
| <i>Empetrum</i> -Heiden, <i>Salix herbacea</i> -Subass.   | 6 <sup>0</sup> / <sub>0</sub>  | —                                  | —  | —                                       |   |
| <i>Empetrum</i> -Heiden, typische Ausbildung .  | 5 <sup>0</sup> / <sub>0</sub>  | —                                  | —  | —                                       |   |
| <i>Empetrum</i> -Heiden, <i>Cetraria</i> Subass.,<br><i>Deschampsia</i> -Var. . . . .                           | 32 <sup>0</sup> / <sub>0</sub> | —                                  | —  | —                                       |   |
| <i>Juncus trifidus</i> -Var. . . . .  | 16 <sup>0</sup> / <sub>0</sub> | —                                  | —  | —                                       |   |
| C. Vorwiegend sommer-grüne Zwergstrauch-<br>Heiden . . . . .  | —                              | 5 <sup>0</sup> / <sub>0</sub>      | 16 <sup>0</sup> / <sub>0</sub>             | 4 <sup>0</sup> / <sub>0</sub>           | C1. Loiseleurio-Vaccinieta  |
| D. <i>Alchemilla</i> -reiche Wiesen:<br><i>Alchemilla glomerulans</i> -Ran.- u. <i>Oxyria</i> -<br>Ass. . . . . | 2 <sup>0</sup> / <sub>0</sub>  | 3 <sup>0</sup> / <sub>0</sub>      | 5 <sup>0</sup> / <sub>0</sub>              | —                                       | D. Herb-rich Salicetea herbaceae  |
| <i>Alchemilla alpina</i> -Gesellschaften . . . . .  | 2 <sup>0</sup> / <sub>0</sub>  | 2 <sup>0</sup> / <sub>0</sub>      | —  | —                                       |   |
| E. Rasen mehr oder weniger trockener<br>Standorte:  |                                |                                    |  |   | E1. Juncetea trifidi<br>E2. Juncetea trifidi<br>E3. Carici-Kobresietea          |
| <i>Agrostis borealis</i> - <i>Rumex acetosella</i> -Verb.   | 1 <sup>0</sup> / <sub>0</sub>  | 10 <sup>0</sup> / <sub>0</sub>     | 5 <sup>0</sup> / <sub>0</sub>              | —                                       |   |
| <i>Juncus trifidus</i> - <i>Hierochloa orthantha</i> -Verb.<br>Fjell-Fluren und arktische Steppen . . . . .     | 11 <sup>0</sup> / <sub>0</sub> | —                                  | 1 <sup>0</sup> / <sub>0</sub>              | 3 <sup>0</sup> / <sub>0</sub>           |   |
| F. Moor- und Quellflur-Gesellschaften:<br>Acidiphile <i>Carex</i> -Moorgesellschaften . .                       | 11 <sup>0</sup> / <sub>0</sub> | +                                  | 6 <sup>0</sup> / <sub>0</sub>              | +                                       | F. Scheuchzerio-Caricetea/Montio-<br>Cardaminetea                               |
| Andere . . . . .  | 1 <sup>0</sup> / <sub>0</sub>  | 3 <sup>0</sup> / <sub>0</sub>      | 2 <sup>0</sup> / <sub>0</sub>              | 1 <sup>0</sup> / <sub>0</sub>           |   |
| G. Moos- und Flechten-Gesellschaften:<br><i>Rhacomitrium lanuginosum</i> -Gesellschaften                        | 1 <sup>0</sup> / <sub>0</sub>  | 2 <sup>0</sup> / <sub>0</sub>      | 3 <sup>0</sup> / <sub>0</sub>              | 11 <sup>0</sup> / <sub>0</sub>          | G1. Cladonia, Stereocaulon<br>G2. Rhacomitrium lanuginosum                      |
| <i>Cladonia-Stereocaulon</i> -Gesellschaften . .  | +                              | 2 <sup>0</sup> / <sub>0</sub>      | 30 <sup>0</sup> / <sub>0</sub>             | 3 <sup>0</sup> / <sub>0</sub>           |   |
| H. Schnee-boden-Gesellschaften (coll.) . . . .  | 2 <sup>0</sup> / <sub>0</sub>  | —                                  | 3 <sup>0</sup> / <sub>0</sub>              | 3 <sup>0</sup> / <sub>0</sub>           | H. Moss-rich Salicetea herbaceae  |
| I. Andere Pflanzengesellschaften . . . . .  | 2 <sup>0</sup> / <sub>0</sub>  | 10 <sup>0</sup> / <sub>0</sub>     | 2 <sup>0</sup> / <sub>0</sub>              | 1 <sup>0</sup> / <sub>0</sub>           |   |
| J. Nicht von Angiospermen und den unter<br>G. genannten Gesellschaften bewachsen<br>(± vegetationsfrei):        |                                |                                    |  |   | I, J. Varia   |
| Fels . . . . .  | 4 <sup>0</sup> / <sub>0</sub>  | 4 <sup>0</sup> / <sub>0</sub>      | 10 <sup>0</sup> / <sub>0</sub>             | 29 <sup>0</sup> / <sub>0</sub>          |   |
| Kies, Schotter usw. . . . .   | +                              | 4 <sup>0</sup> / <sub>0</sub>      | 3 <sup>0</sup> / <sub>0</sub>              | 28 <sup>0</sup> / <sub>0</sub>          |   |

After Knapp (1964)

<300m   <300   300-600   600-900



Subkontinental  
lowland near Narsarsuaq



Lowland Sheep farming Brattahlid



Upland Dryas-Racomitrium upland

# The vegetated land in Alaska Peninsula

- Boreal Relevés from Western Alaska
- •The vegetation is essentially treeless and comprises heaths, alpine tundra, meadows, deciduous thickets, and mires
- •Boreal tundra was sampled in the Alaska Peninsula/ Becharof National Wildlife Refuge (NWR), Aleutian Islands Subunit of the Alaska Maritime NWR, and Kodiak NWR: ca 1400 relevés
- • Arctic vegetation of Selawik NWR in NW Alaska: 159 relevés
- • Field studies of these areas are complete -- some are published -- some are works in progress
-

# Alaska Peninsula vegetation



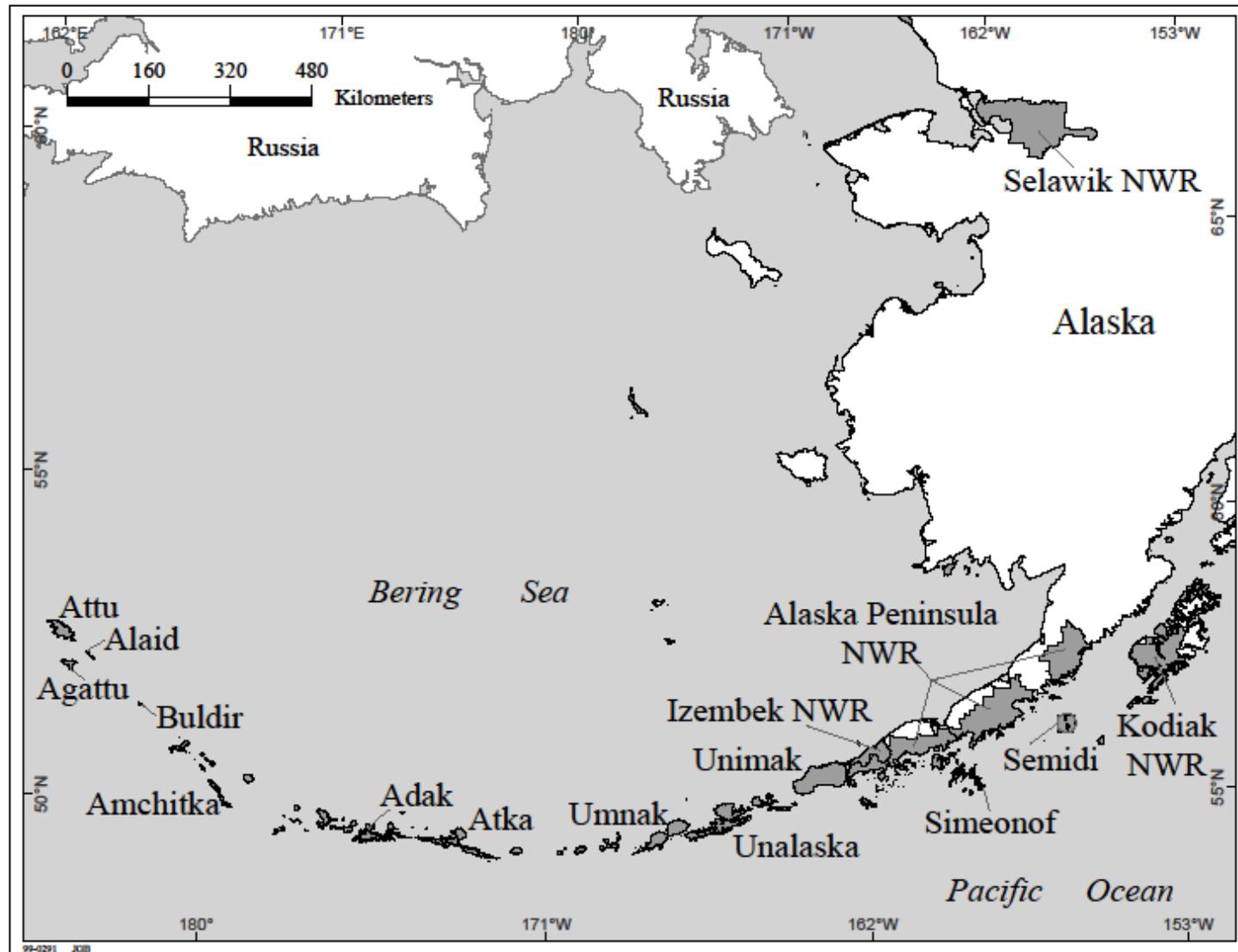
- Deciduous thickets of *Alnus* and *Salix*
- mesic meadows
- dwarf shrub (heaths and fellfields) vegetation

# The vegetation eastern Aleutian Islands



- I. Dry coastal meadows: *Honckenya peploides* beach meadow, *Leymus mollis* dune meadow
- II. Mesic meadows: *Athyrium filix-femina*-*Aconitum maximum* meadow, *Athyrium filix-femina*-*Calamagrostis nootkaensis* meadow, *Erigeron peregrinus*-*Thelypteris quelpaertensis* meadow
- III. Wet snowbed meadow: *Carex nigricans*
- IV. Heath: *Linnaea borealis*-*Empetrum nigrum* heath, *Phyllodoce aleutica* heath, *Vaccinium uliginosum*-*Thamnolia vermicularis* fellfield
- V. Mire: *Carex pluriflora*-*Plantago macrocarpa* mire
- VI. Deciduous shrub thicket: *Salix barclayi*-*Athyrium filix-femina* thicket

# "Location of Some Vegetation Studies in Western Alaska"



# Vegetation Methodology in Western Alaska"

- Relevés recorded according to Braun-Blanquet methods
- Relevé size: 25 m<sup>2</sup> for heaths, meadows, and mires; 100 m<sup>2</sup> for thickets; 400 m<sup>2</sup> for forests
- Site data recorded and soils analyzed in many releves for chemistry and texture

# How to include the region?

- Include all parts of the region inside the CAFF area
- Include only the alpine part of the region



Thank you for your attention!