

Assessing arctic flora composition in the Siberian treeline ecotone

Vegetation mapping, pollen analyses and
sedimentary DNA metabarcoding



Study site

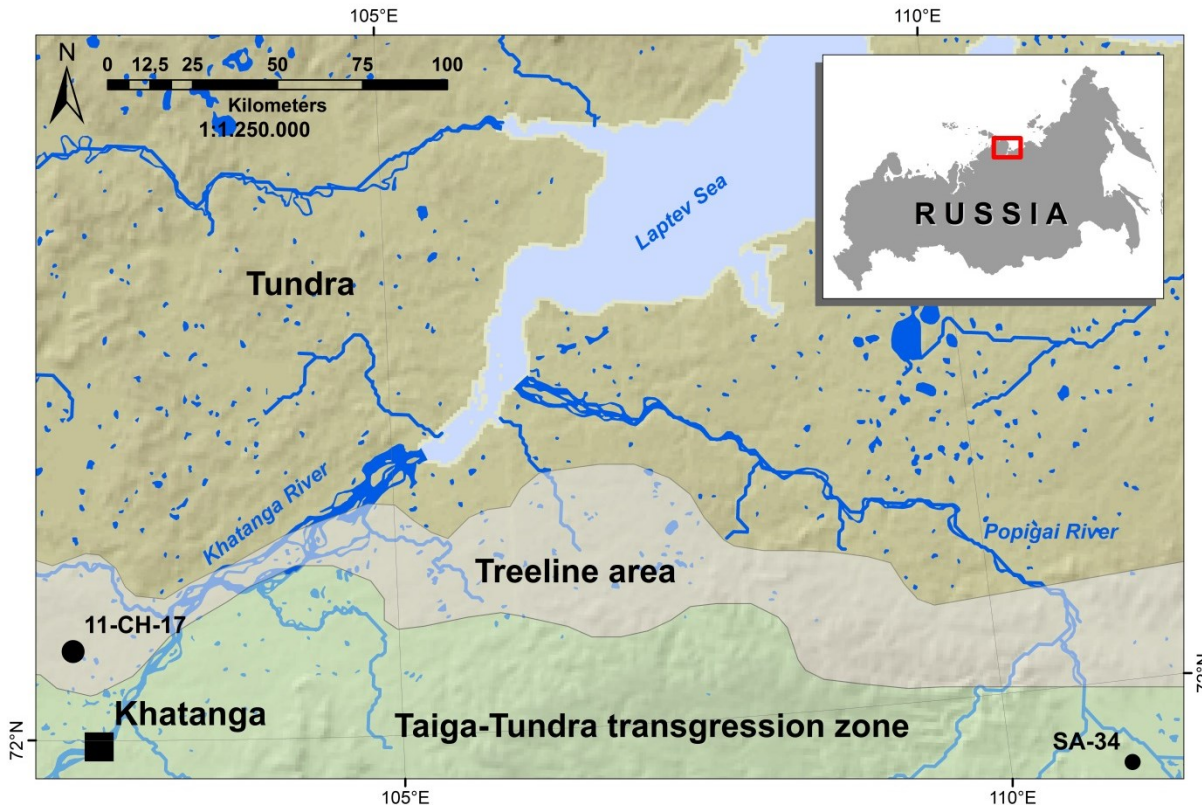


Fig.1: Location overview about the arctic treeline (grey), Taiga-Tundra transgression zone (green) and the coring site (red)

Coring campaigns since 2011:

- > 20 lakes (2011)
- > 30 lakes (2013)
- > 20 lakes (2014)

Transect study:

- Spanning approximately
- 360 km (north/south)
 - 300 km (west/east)



Fig.2: Impressions of vegetation cover, lake and fieldwork at the coring site

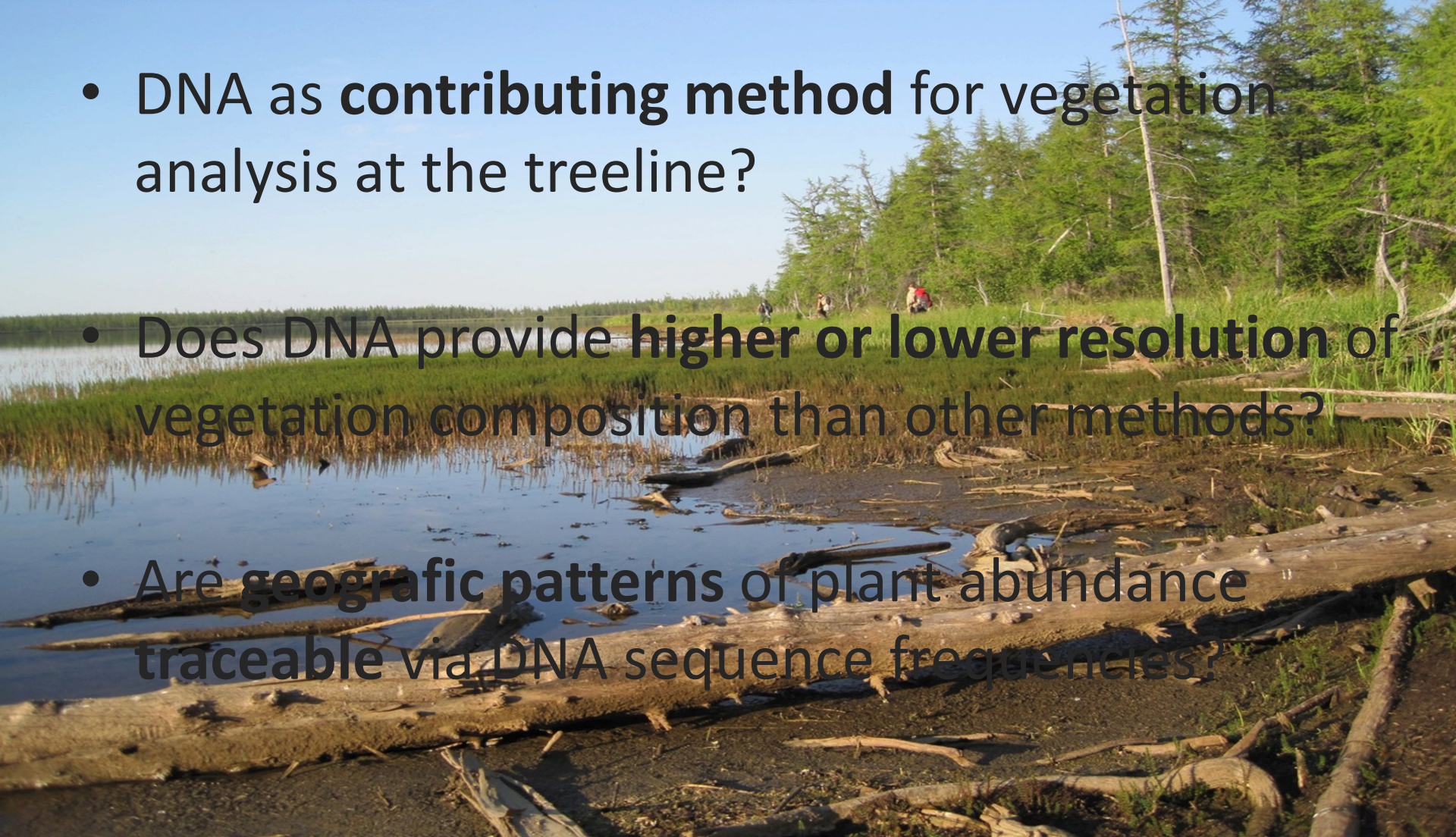
Aims/Objectives



1. Better understanding of siberian ecotone
 - Status quo of treeline vegetation
 - Fast changing Arctic (SERREZE et al. 2009)

2. Comparison of different vegetation assessment methods
 - Pollen records
 - Vegetation surveys
 - Genetics (metabarcoding)

Research questions

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- The background image shows a natural landscape with a body of water in the foreground, a muddy bank with fallen logs, and a dense forest of green trees in the background under a clear blue sky. Several people are visible in the distance on the grassy bank.
- DNA as **contributing method** for vegetation analysis at the treeline?
 - Does DNA provide **higher or lower resolution** of vegetation composition than other methods?
 - Are **geographic patterns** of plant abundance traceable via DNA sequence frequencies?

- Pollen counting
- Vegetation surveys
- Metabarcoding



Comparison of methods

	Pollen records	Vegetation survey	DNA analyses
Taxonomic level	Family, genus, species level	Species/genus (dependant from vegetation period)	Subspecies to family
Information provided	General floral composition	Floral composition	Cryptic vegetation, (quantity)
Temporal signal	present and past	Actual/recent status	Present and past
Spatial signal	Local and regional	Local	Local and regional
Resolution	High to raw	High to medium	High to medium

Advantages

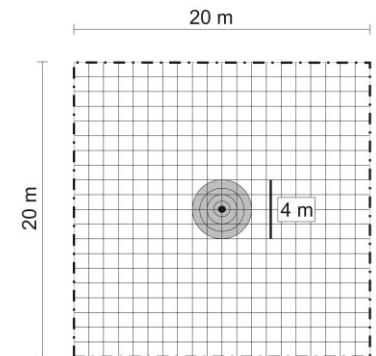
Pollen

- recent and past changes
- local and regional vegetation
- Long research tradition



Vegetation surveys

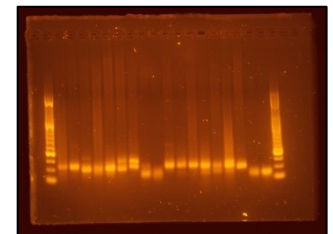
- reliable impression on coverage
- Directly comparable
- Well established



Field survey area = 400 m²

DNA metabarcoding

- Over-underestimations visible
- Assessability becomes „easier“



Disadvantages

Pollen

- Influenced by strength of pollen rain
- Pollen conservational grade
- Under-overestimation are common



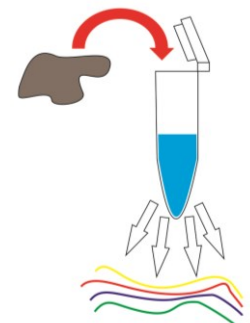
Vegetation surveys

- Biased by flowering season
- Level of identification
- Time consuming/difficult to maintain

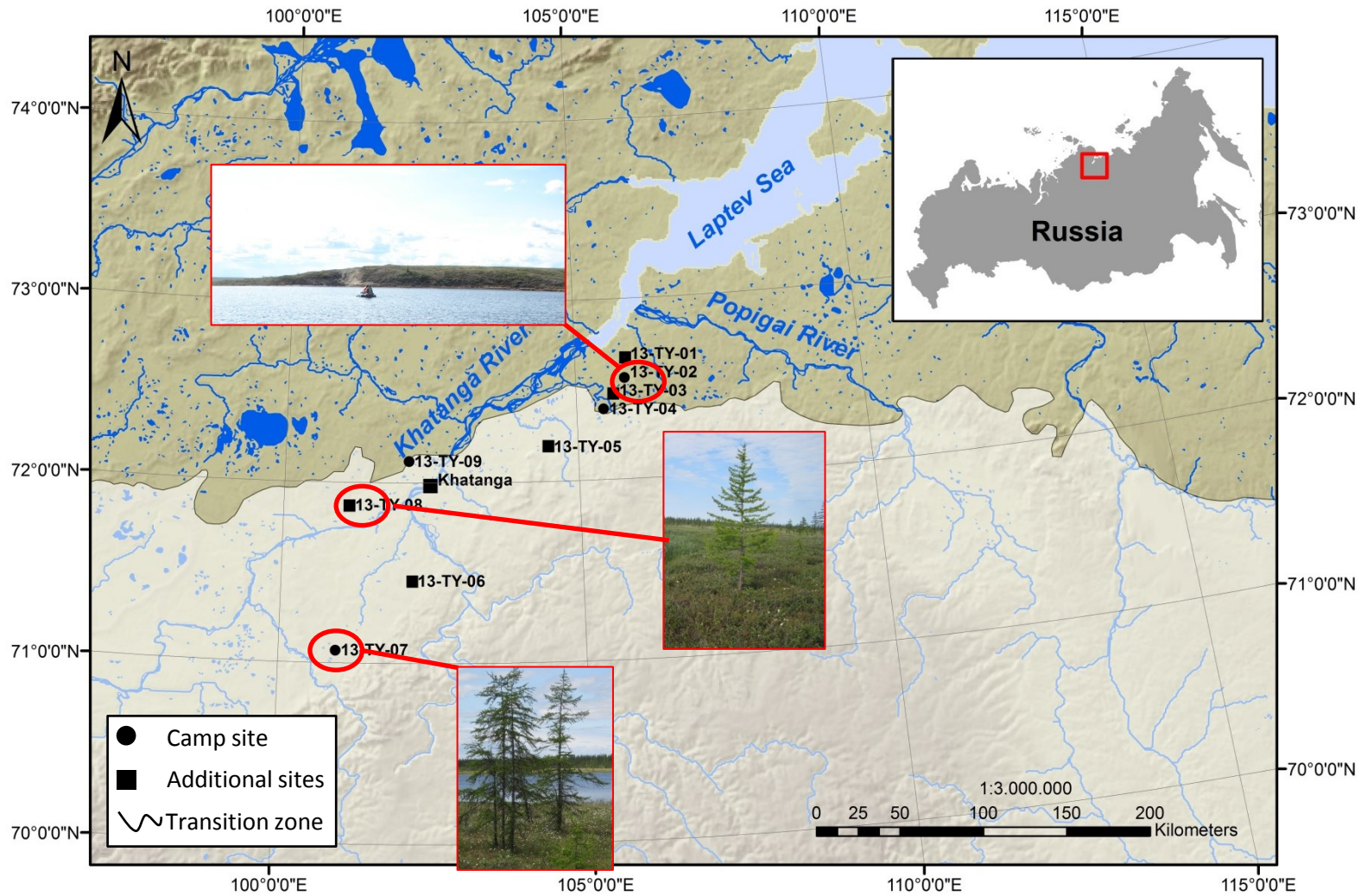


DNA metabarcoding

- False positive: contamination, base shifts
- Mistakes in the databases
- Origin of DNA sometimes vague



- **Metabarcoding:** molecular approach that can identify specific sequences of DNA (barcode)
 - provides information about:
 - quality and quantity
 - very high resolution
 - cryptic vegetation
 - over-/underestimation visible
 - assessability becomes easier

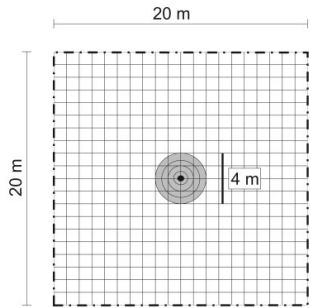


Preliminary DNA results

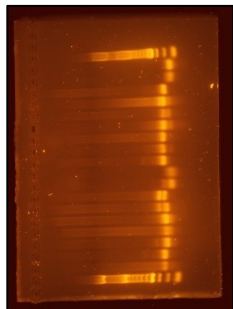
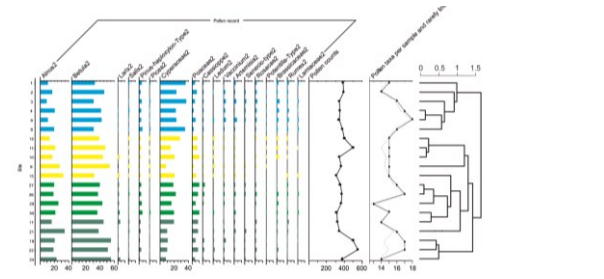
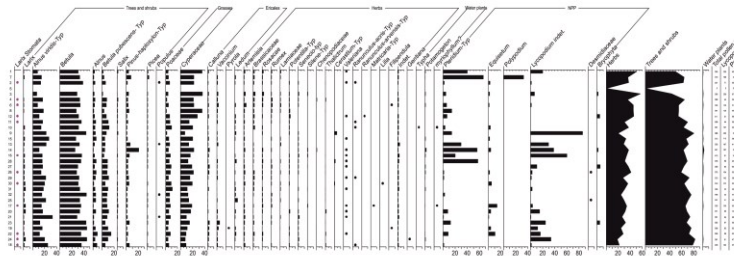
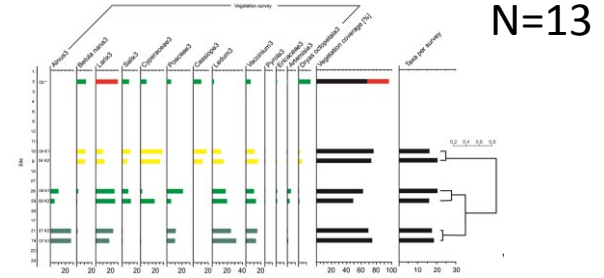
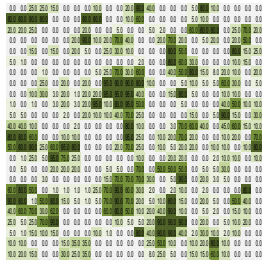
- 50 GB of data
 - 5026 unique sequences
 - 1902 = 95 % similarity to arctoboreal database database
 - 619 = 98 %
 - 243 = 100 %

Classification	Taxa sequences	Total sequences
Terrestrial	135	~ 5.9 Million
Aquatic	18	~ 1.2 Million
Bryophytes	19	~ 4200
Equisetaceae	6	~ 544,000

Comparison of analyses

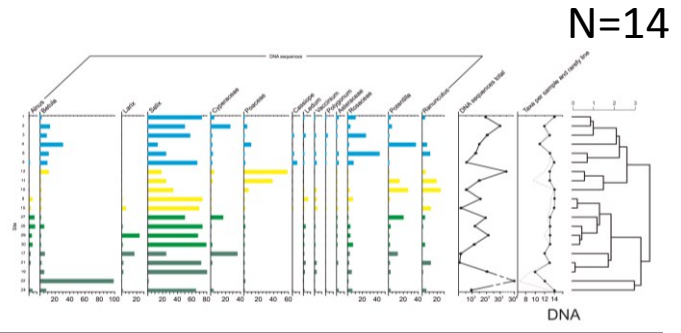


Field survey area = 400 m²

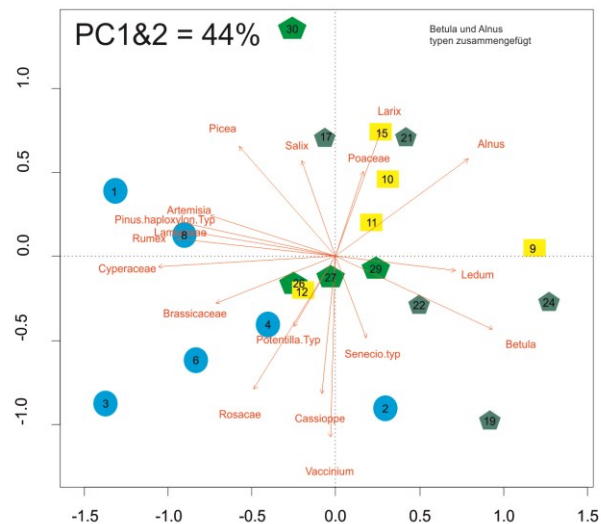


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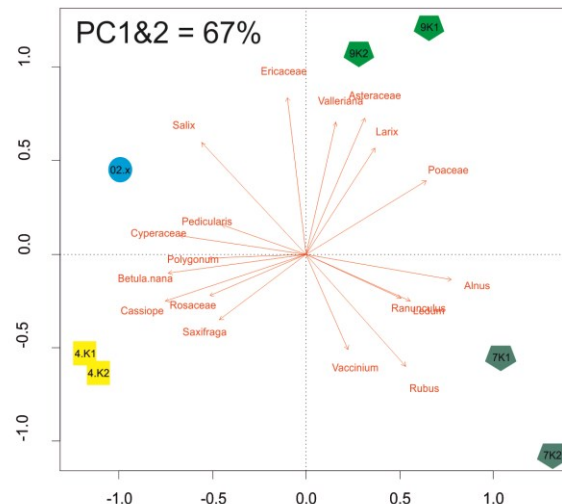
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Preliminary results

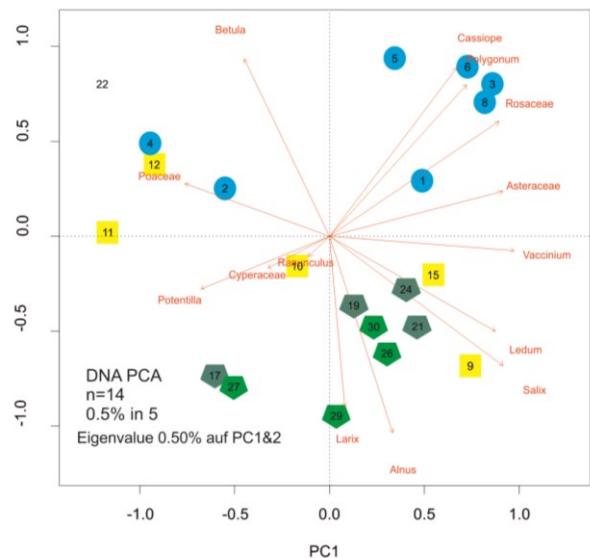


pollen



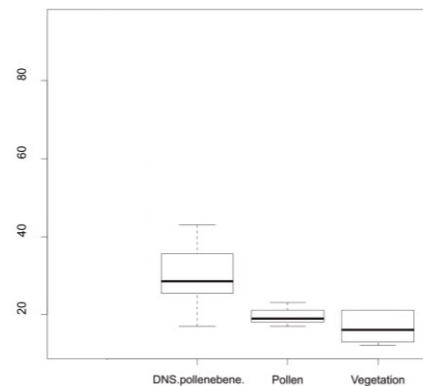
vegetation

- tundra
- tree tundra/treeline
- light taiga (zwei Farben, da 2 verschiedene sites)



DNA

Taxa diversity



Research questions / ideas

- DNA as contributing method? ✓

→ fast approach to trace vegetation diversity

- Does DNA provide higher or lower resolution? ✓

→ Higher resolution as in pollen or vegetation

- Are geographic patterns traceable? ✓

→ Gradients are well defined

Combination of methods provides reliable image of recent vegetation

What is next?



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Thank you for your attention!

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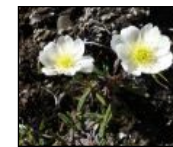
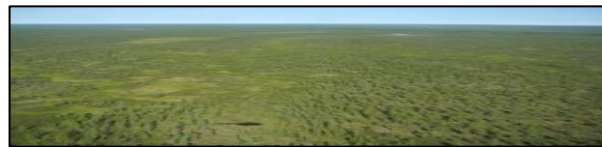
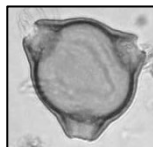


Also to all members of the expeditions in 2011 and 2013,
as well as everyone who helped to organize and made the project run



30.08.2014

Thank you



27.03.2015

AWI - Geotreff

