# NINA in the ECORESP-C project

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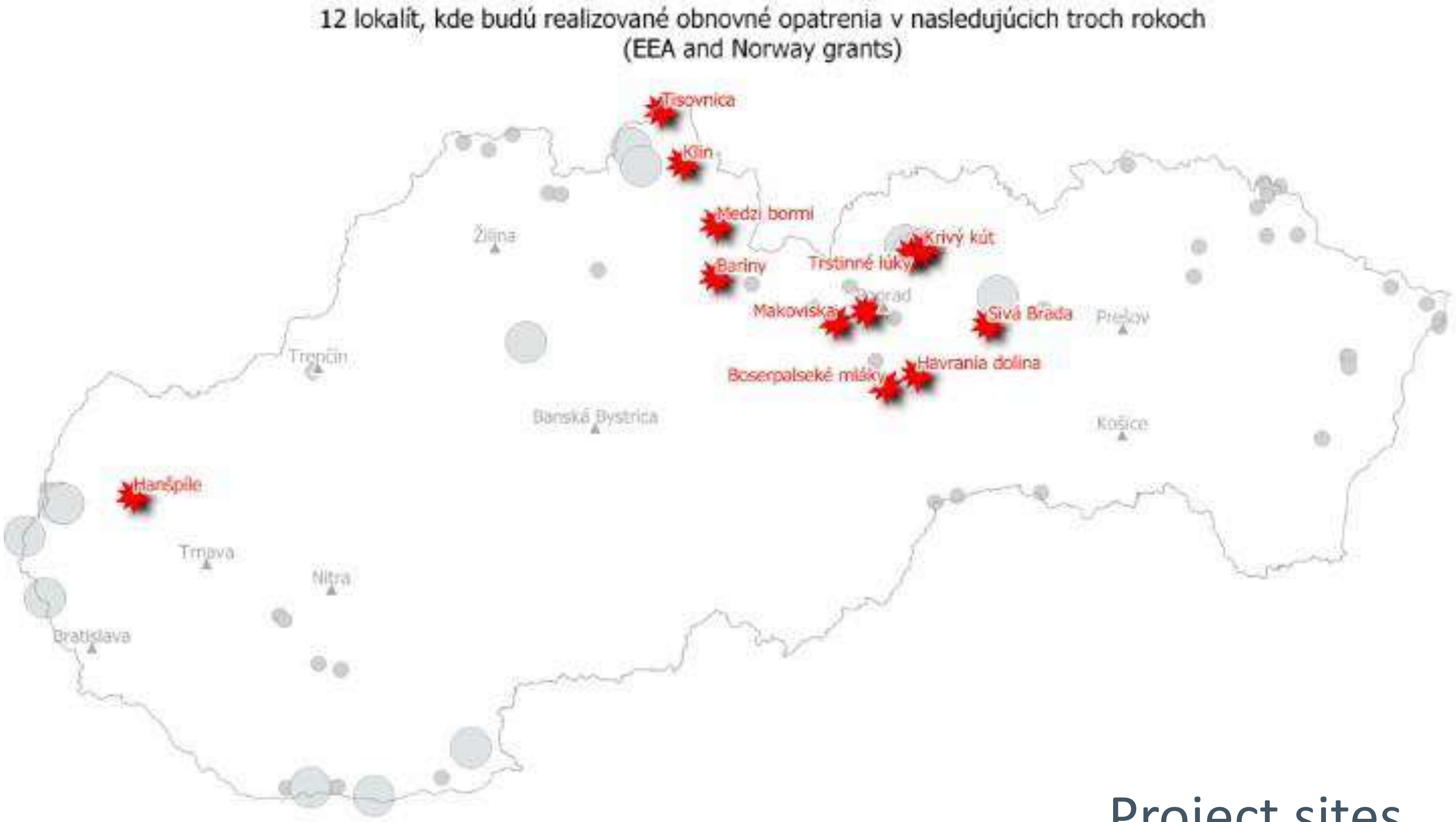
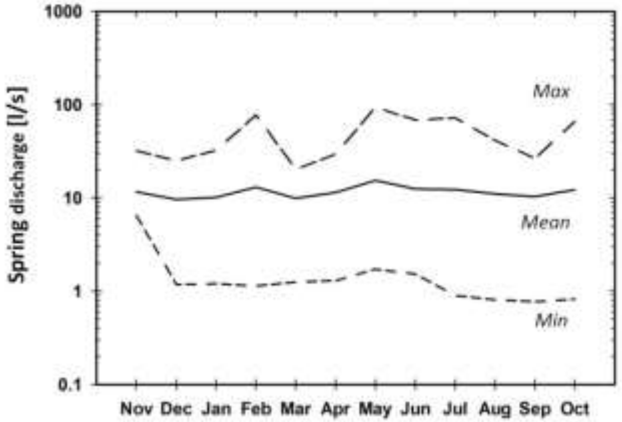
Norwegian Institute for Nature Research




# Project sites

## 1. Hydrological monitoring

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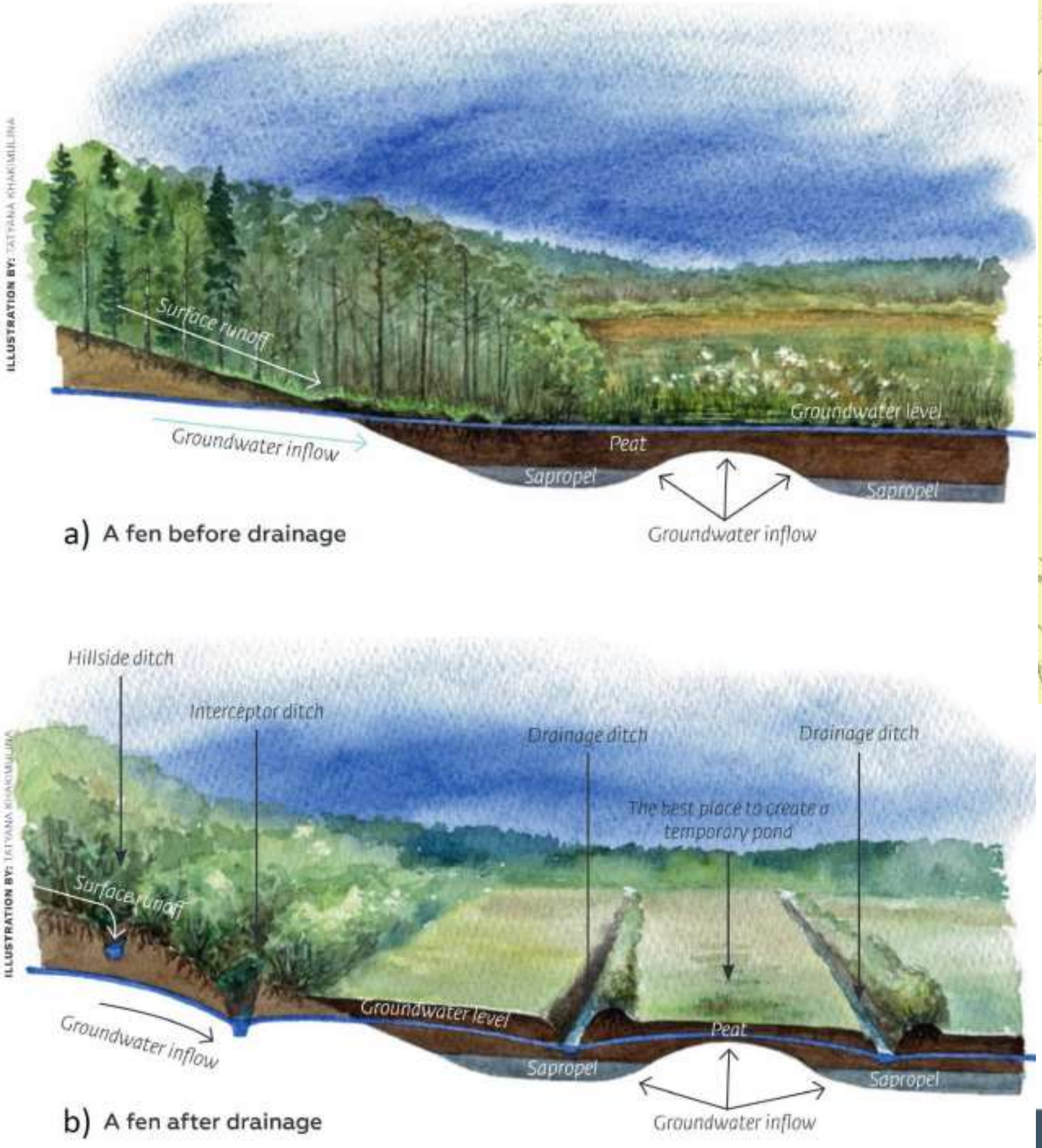


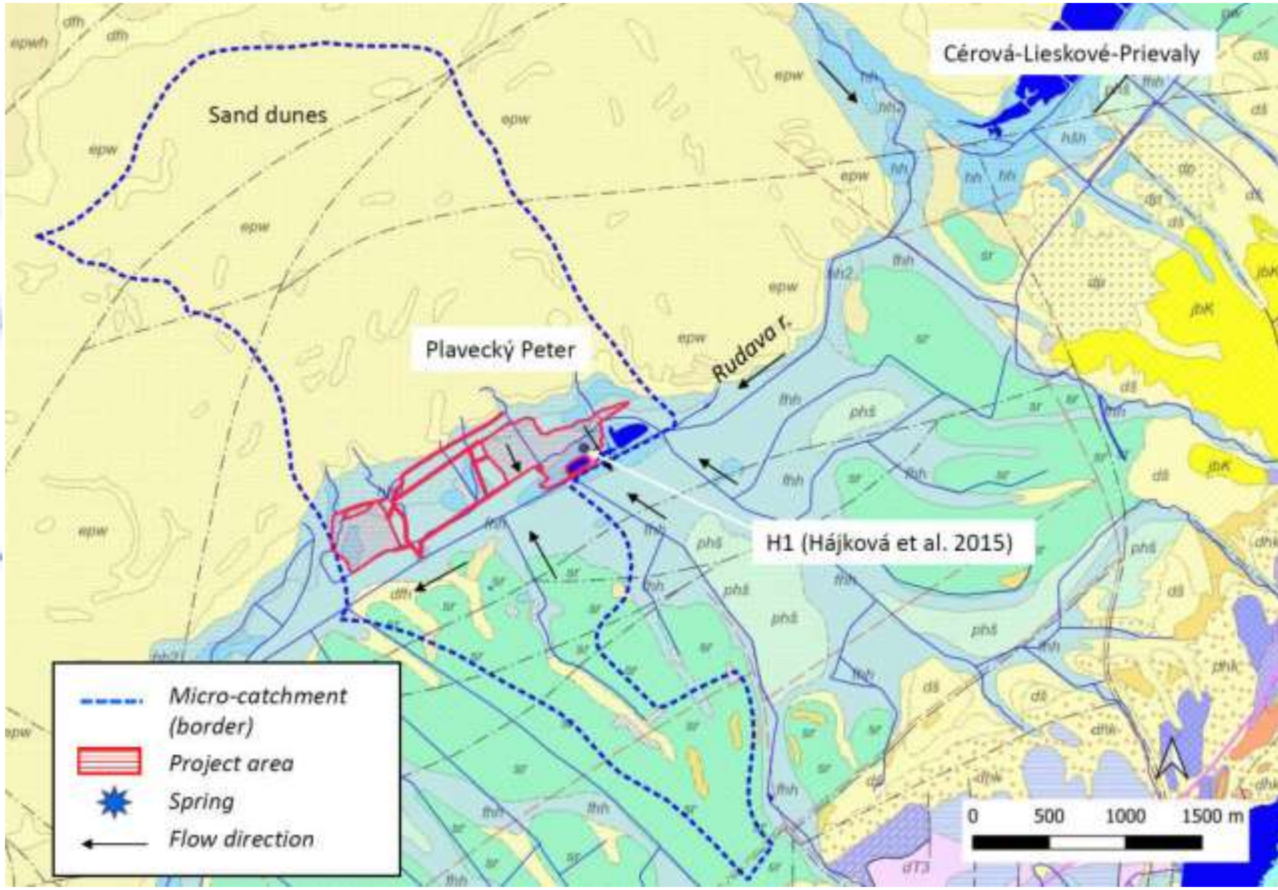


Geological situation at Hanšpile with hydrography and indication of surface flow directions

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Klinské rašelinisko

Largely drained, with encroachment of scrub

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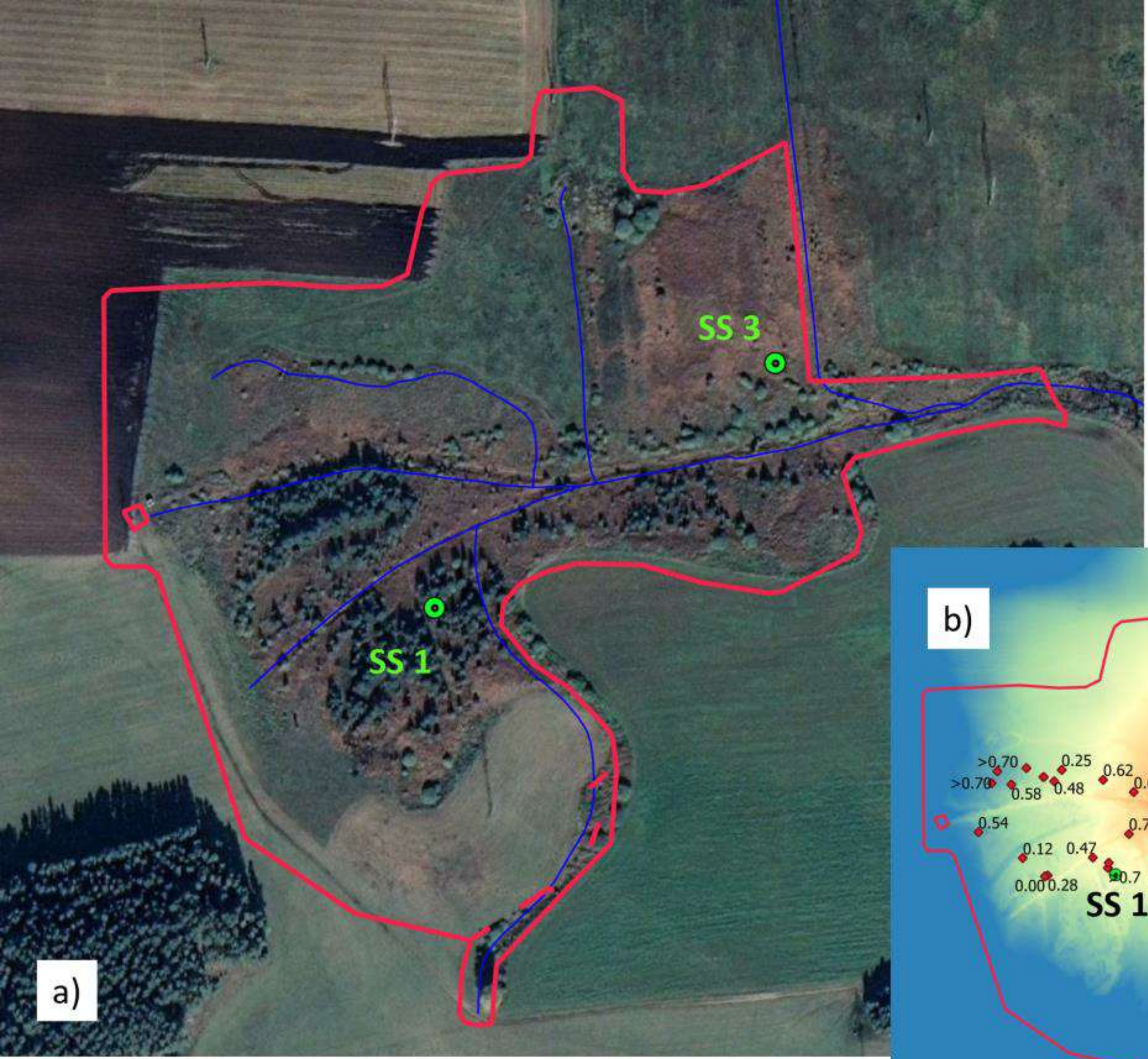


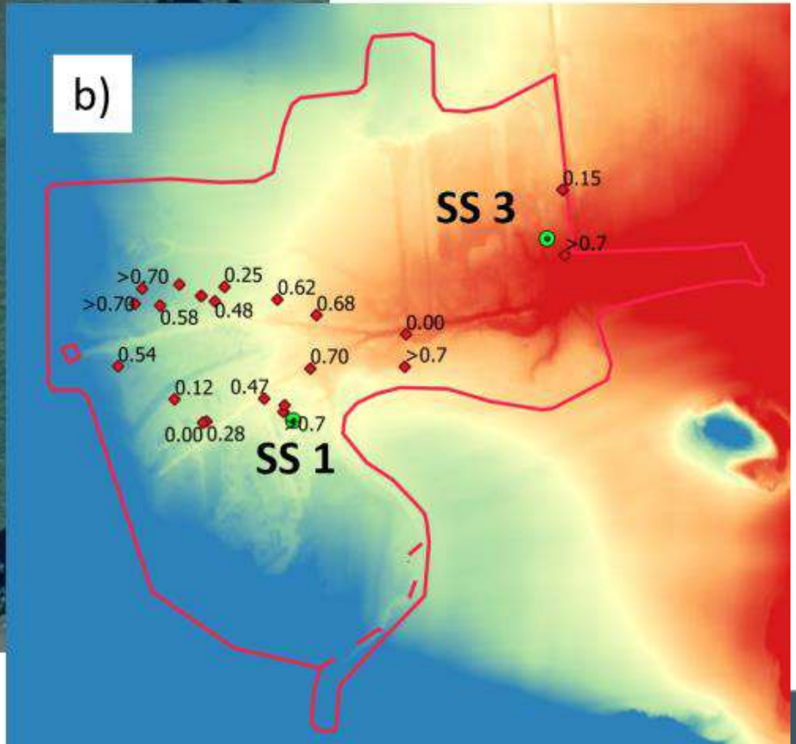


Spišskoteplické slatiny, northern site:

a) aerial image with suggested monitoring locations

b) Digital Terrain Model with observed peat thickness suggested monitoring locations.

Orthophoto: Google.

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**Table 4.21:** Summary of information about the area provided by DAPHNE (2022)

| Information | Description |
|---|---|
| Protection state | national nature reserve declared in 1979, protection level 4, part of the Natura 2000 system - territory of European importance with the designation SKUEV0105 Spišskopodhradské travertine. |
| EU Habitat types | 1340*, Lk6, , Lk10, Tr11 |
| Treasures | Carpathian travertine salt marshes (the unique largest and most preserved occurrence of this biotope in Slovakia) with endangered and rare plant species (*S. parviflora*) |
| Impacts in the past | – Abandoning the management of wetlands as meadows for the last 50 years lintensification of agricultural production in the catchment area of the wetland<br>– Construction of a parking lot |
| Effect of impacts | – Changes in the chemistry of the inflowing waters<br>– Transformation of unique communities of salt marshes and fens with unique and rare plant species into vegetation-poor reed monocultures<br>– Unsatisfactory state of wetlands in terms of biological diversity in most areas |
| Current state | – Reed encroachment<br>– Swamp meadows have completely disappeared from the territory. |
| Previous measures | – Mowing of degraded salt marshes twice a year for 15 years (0.5 ha)<br>– Chemical parameters studies 2019-20; 20 points across site monitored for chemicals associated with eutrophication |
| Main project goals | – Improve the condition of the priority biotope Carpathian travertine salt marshes, including critically endangered and rare plant species (*S. parviflora*); expand size of 'pristine patch' |
| Suggested measures | – Improvement of the hydrological regime, aiming to reduce the eutrophication by means of measures in the wetland and in its marginal zone (a) Realization of buffer zones (grass strips, 2 ha) to eliminate nutrient runoff from the fields, b) Realization of a 250 m long clay barricade in the edge zone of the wetland on the other side of the road to block seepage<br>– Removal of the asphalt parking lot on an area of 869 $m^2$<br>– Mulching/Mowing and removal of biomass (7.32 ha) |

Example of results from hydrological work, including suggested managment measures.

Site: Sivá Brada

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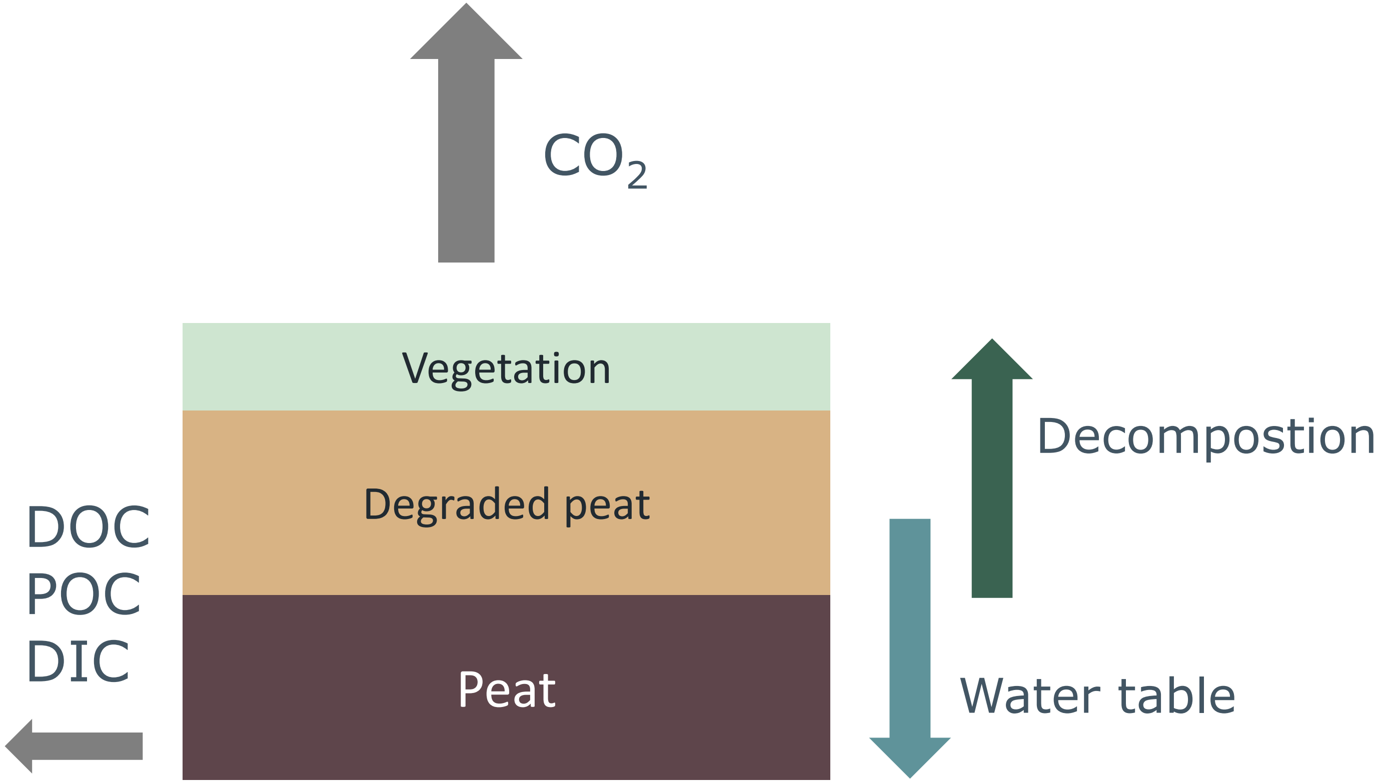
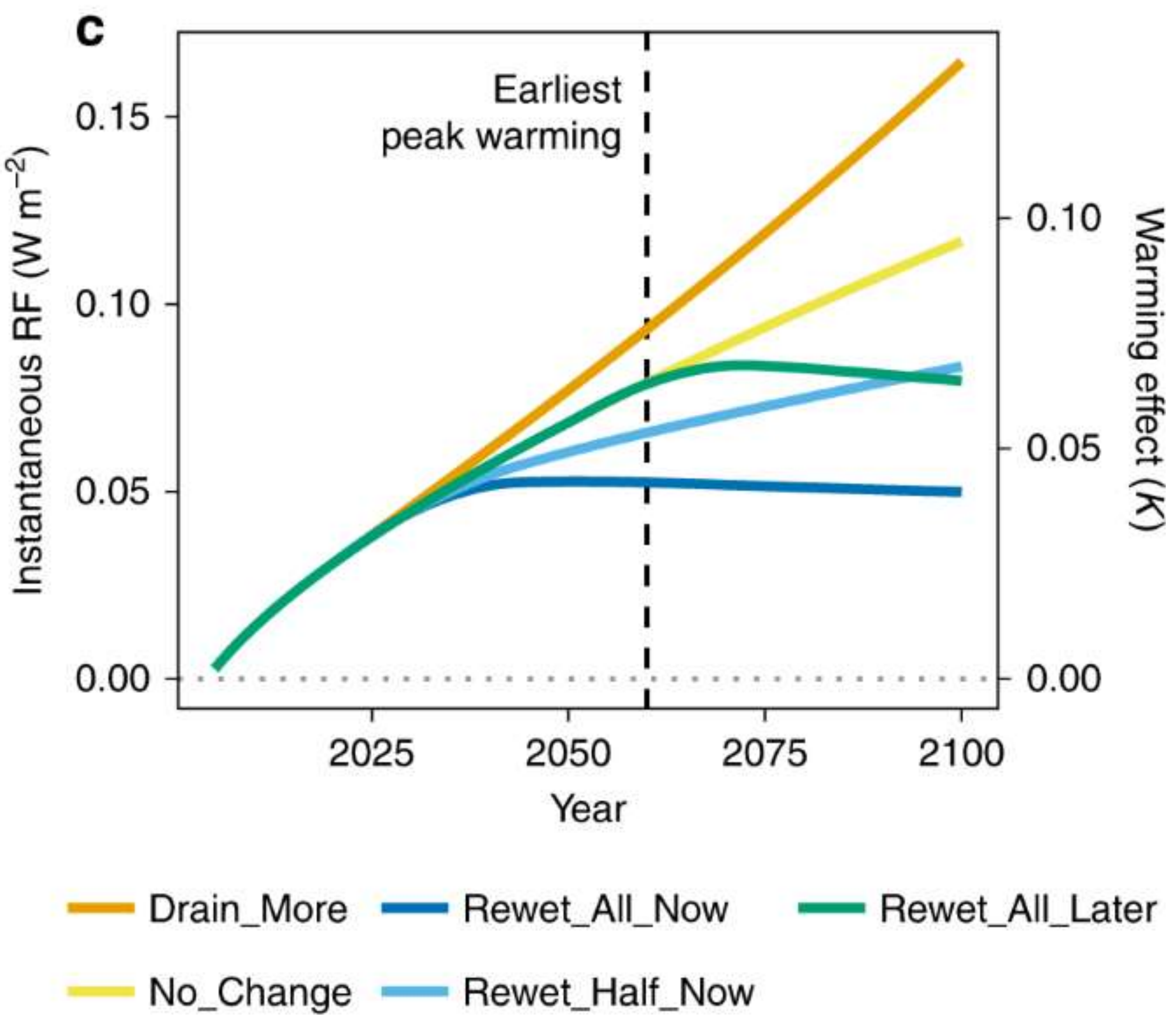
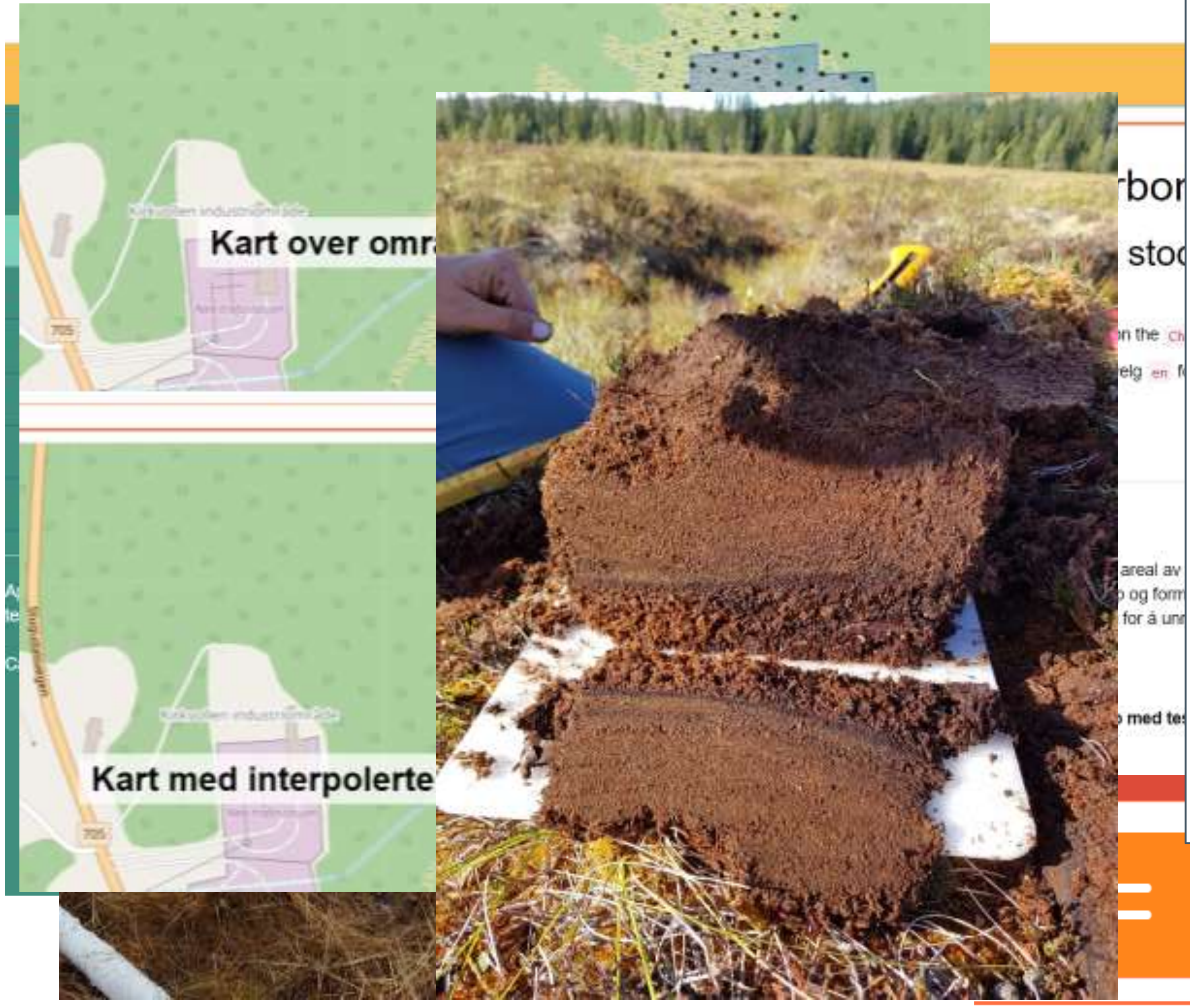
# 2. Carbon stocks



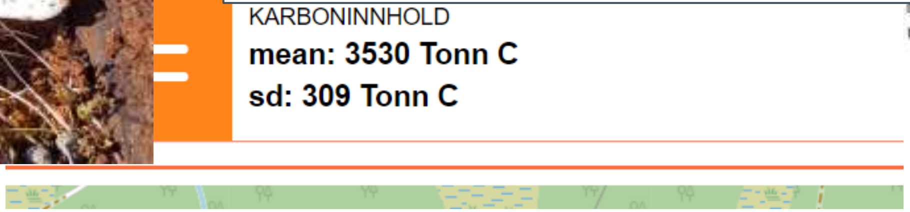
Günther et al. 2020



# https://carbonviewer.nina.no/



- Calculate carbon stocks in peatlands
- User collects data on area and peat depths
- CarbonViewer calculates volume
- Database of peat properties built in

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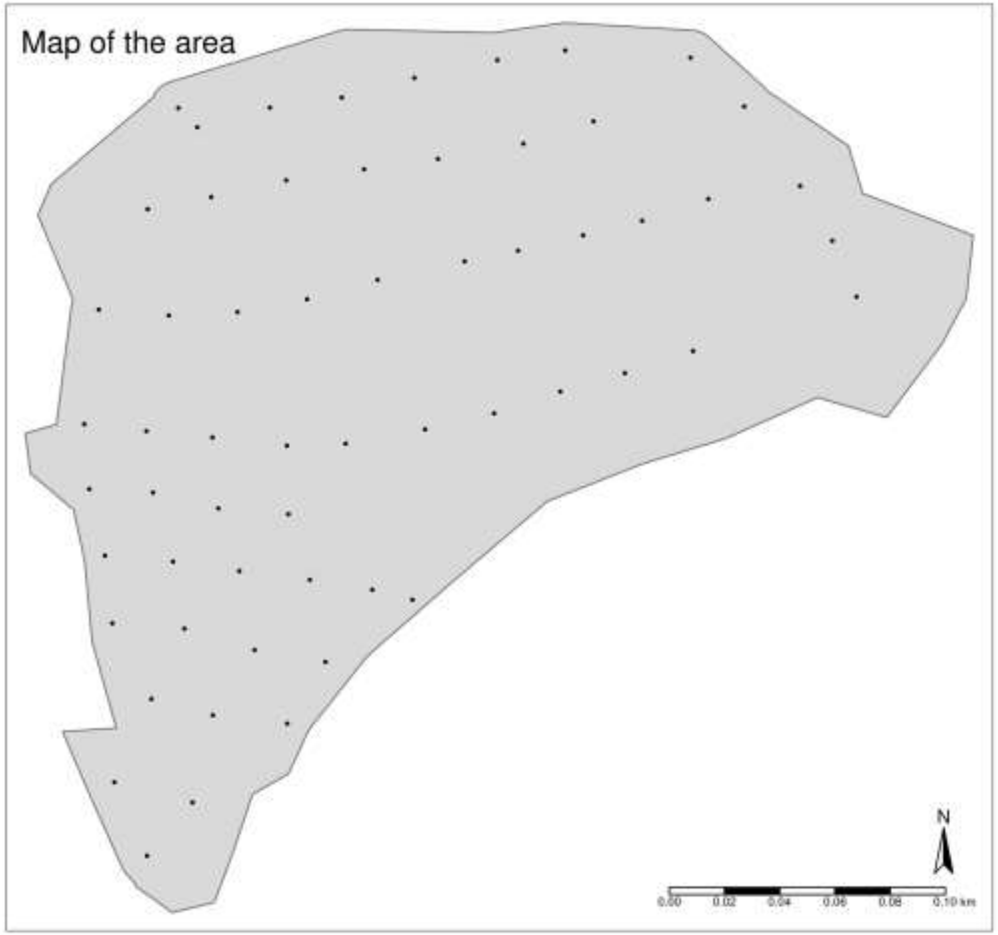
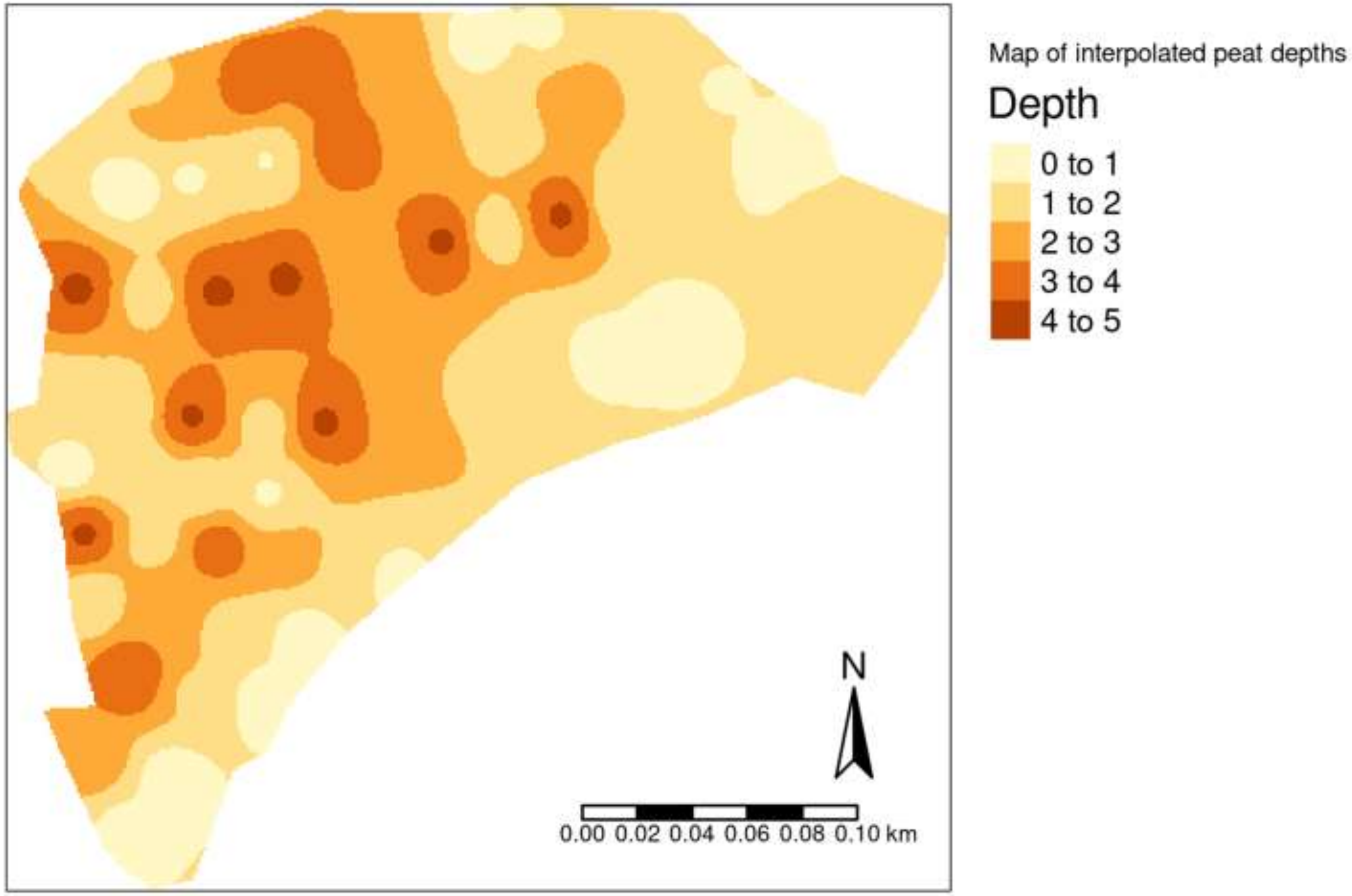
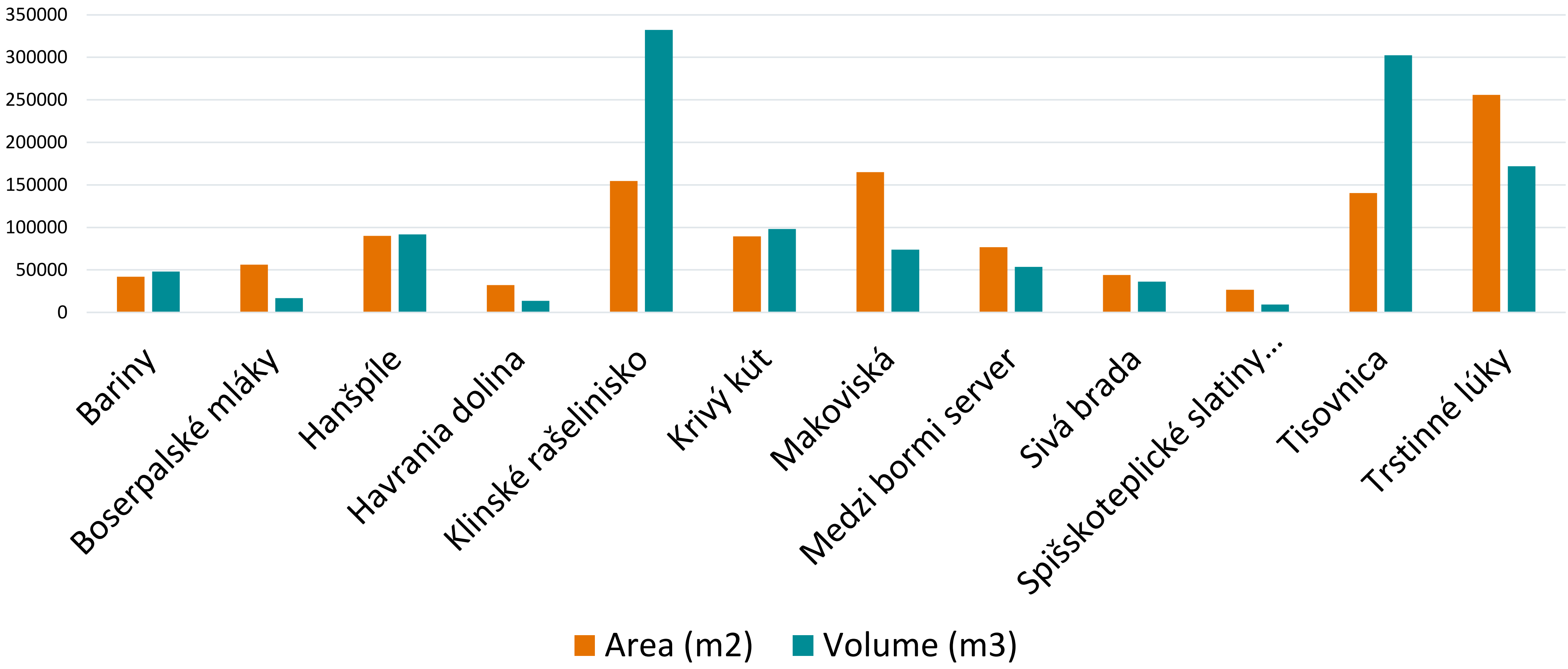



Carbon stock in the bog at Klinské rašelinisko

- 6719 tonn C using Loisel et al. (2014)
- 7458 tonn C using our samples

# Area and volume of peat at study sites



# Total carbon stocks at study sites

72 915 tons of C = 267 598 tons of $CO_2$

*Carbon properties based on Loisel et al. 2014

6.1 tonnes $CO_2$
(Global Carbon Budget 2023)

→ Carbon stocks in ECORESP-C study sites =

Emissons of
43 868 people

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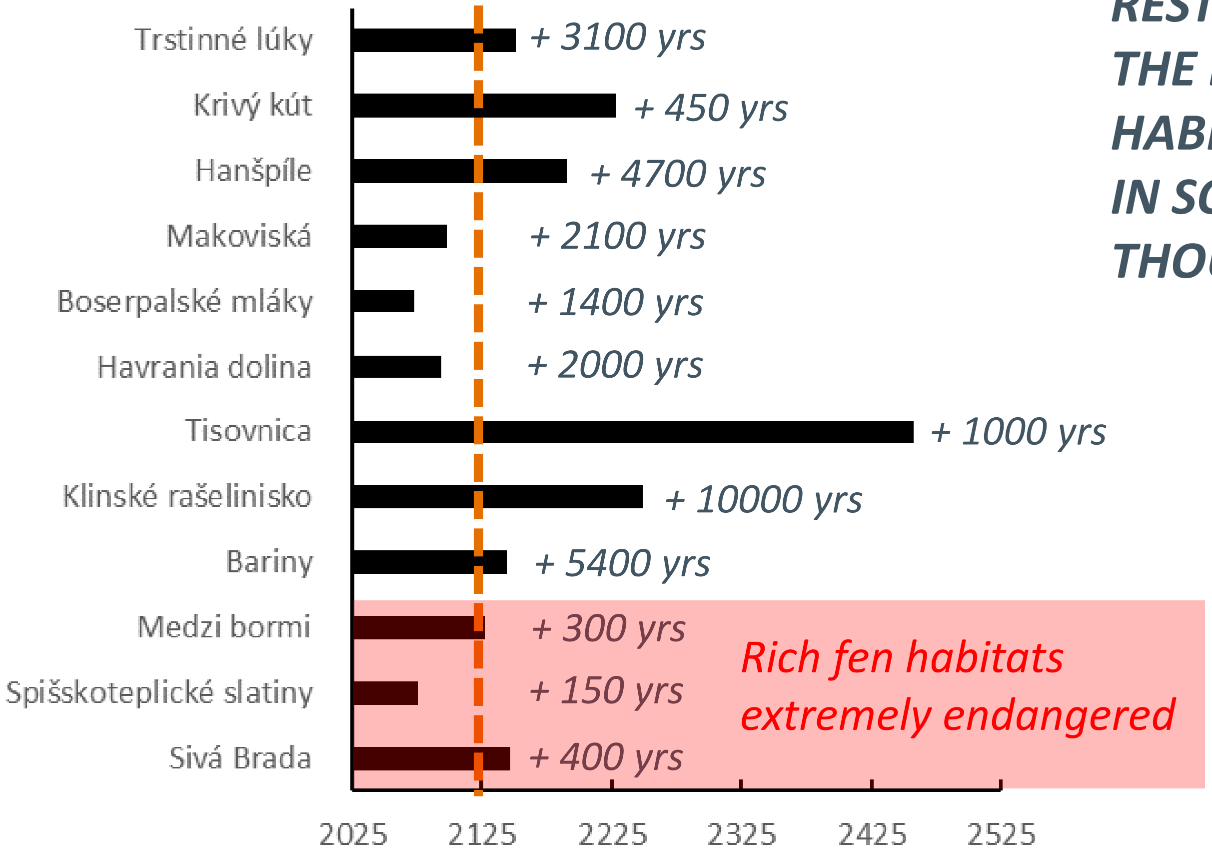
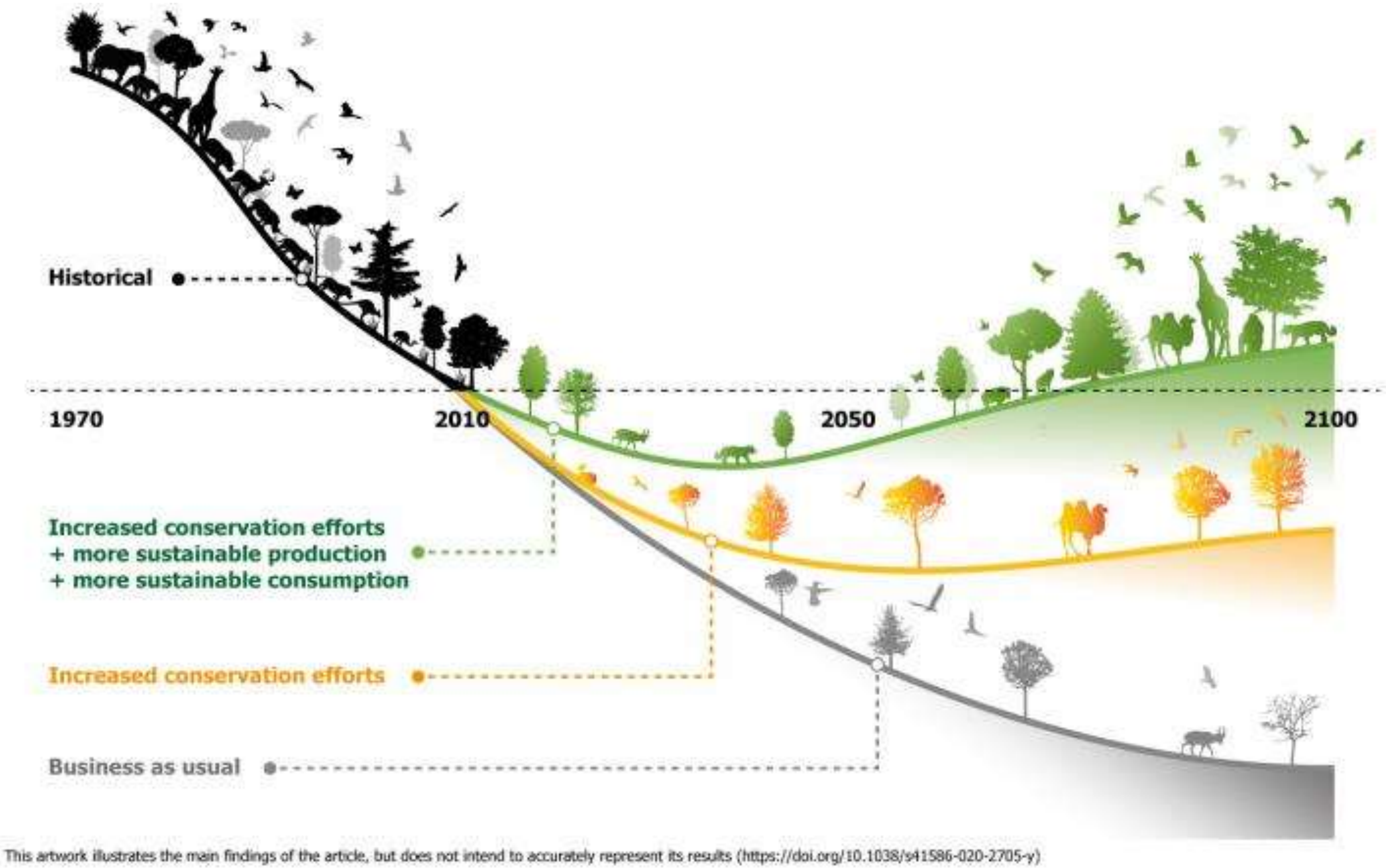
# Rapid loss of peatland habitats (2) – Extended lifetime by restoration




***RESTORATION MAY EXTEND THE LIFETIME OF PEATLAND HABITATS BY HUNDREDS, IN SOME CASES EVEN THOUSANDS OF YEARS***

Theoretical time for complete loss of C stock calculated with C densities measured *in situ* in ECORESP project and IPCC tier 1 emission factors for drained and restored peatlands of temperate climate zone.

# 3. Monitoring and biodiversity




Leclère et al. 2020 Nature

# Biodiversity Assessment - Introduction

- Species diversity as measure of biodiversity

- Biodiversity conservation
  - Preserve species assemblages characteristic of each habitat.

- **Goal**: to make a baseline inventory of species present in Slovakian degraded peatlands and compare it with the restored Belianske Lúky:

  - fungi, earthworms, aquatic invertebrates, and amphibians.

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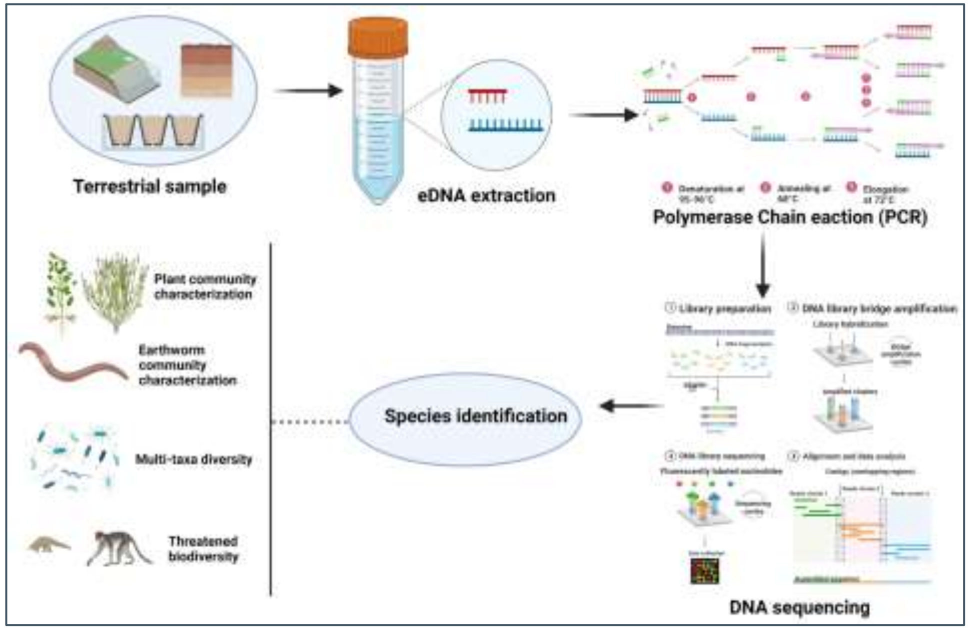
# Biodiversity Assessment - Why eDNA?

**eDNA metabarcoding**: taxonomic identification of a community without previous sorting/isolation of organisms

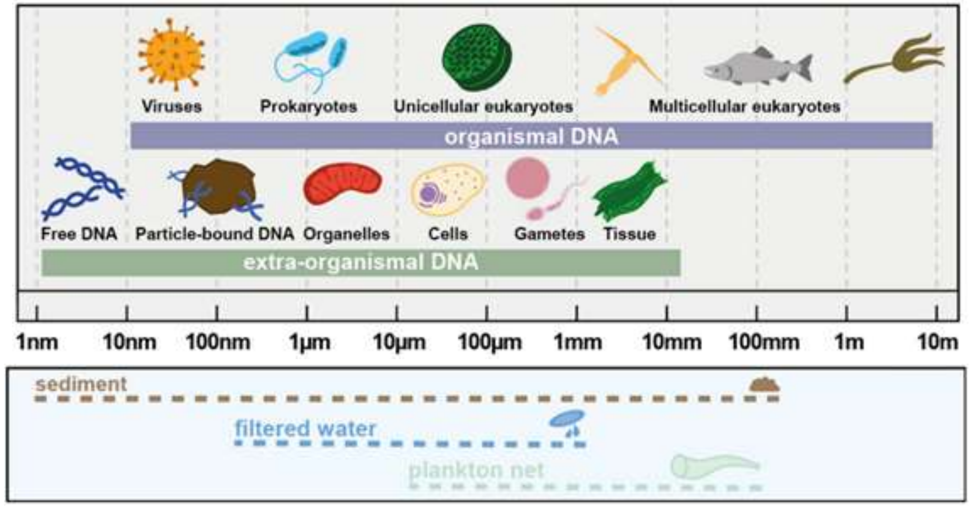
## Metabarcoding workflow




Hassan, S., et al. (2022)

## environmental DNA

Rodriguez-Ezpeleta, N., et al. (2021)




eDNA provides a baseline quantification of biodiversity at each site with a standardised methodology which may be repeated exactly in the post-restoration period.

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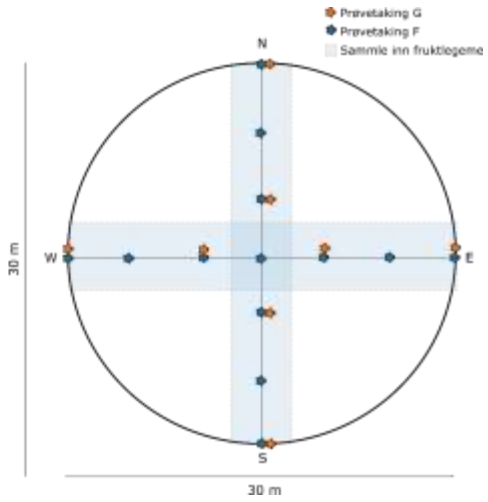
# Sampling design

8 sites: 1 restored fen + 7 pending to be restored

2-3 microhabitats per site

2 types of samples: water and soil


SOIL




WATER

Photo by
Rastislav Lasak

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# Sample processing & Data Analysis

| | Soil samples | Water samples |
|---|---|---|
| Total samples | 21 | 25 (22 + 3 negatives) |
| Volume | ~100 mL soil -> 10g | 0.5L - 2.5L |
| DNA Extraction | FastDNA Spin Kit | Kit |
| PCR - Targets | Fungi -> fITS7/ITS4 | Amphibians |
| | Earthworms | Insects |
| Sequencing | NovaSeq | NovaSeq |
| Bioinformatics | Dada2 | Dada2 |

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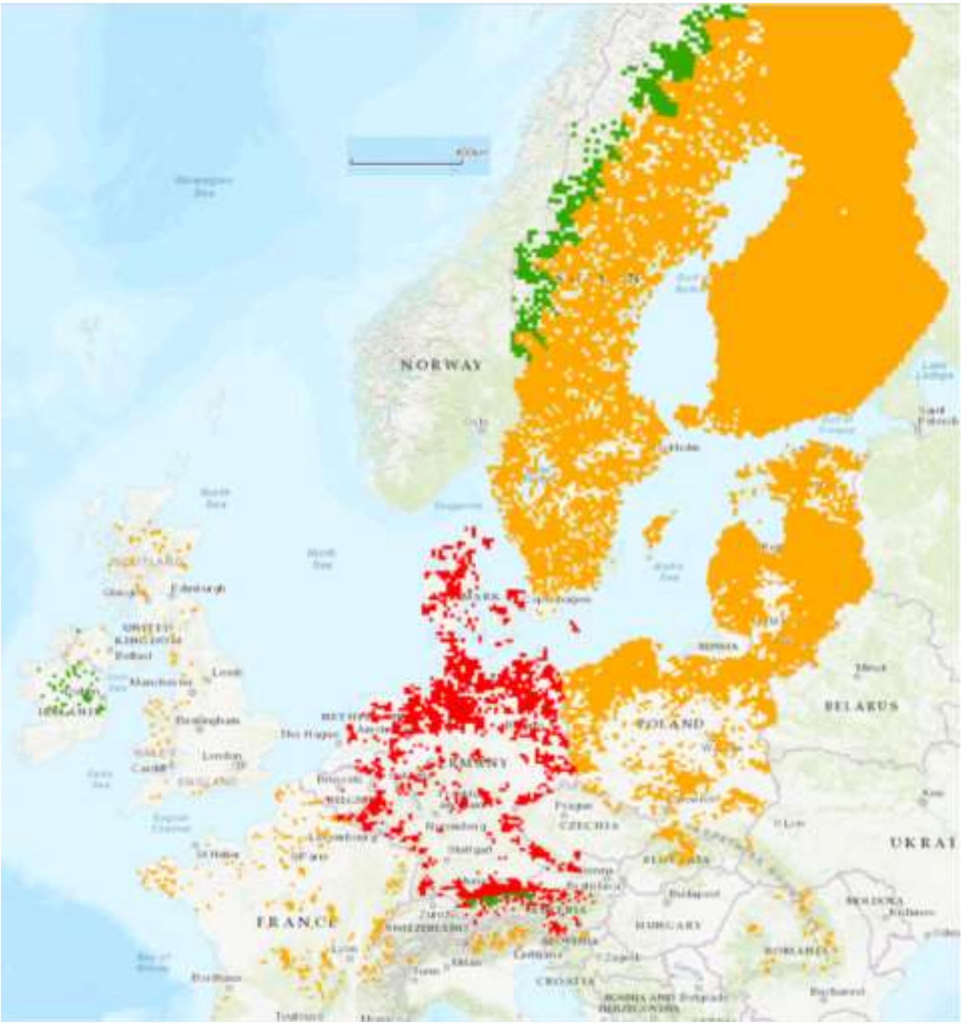
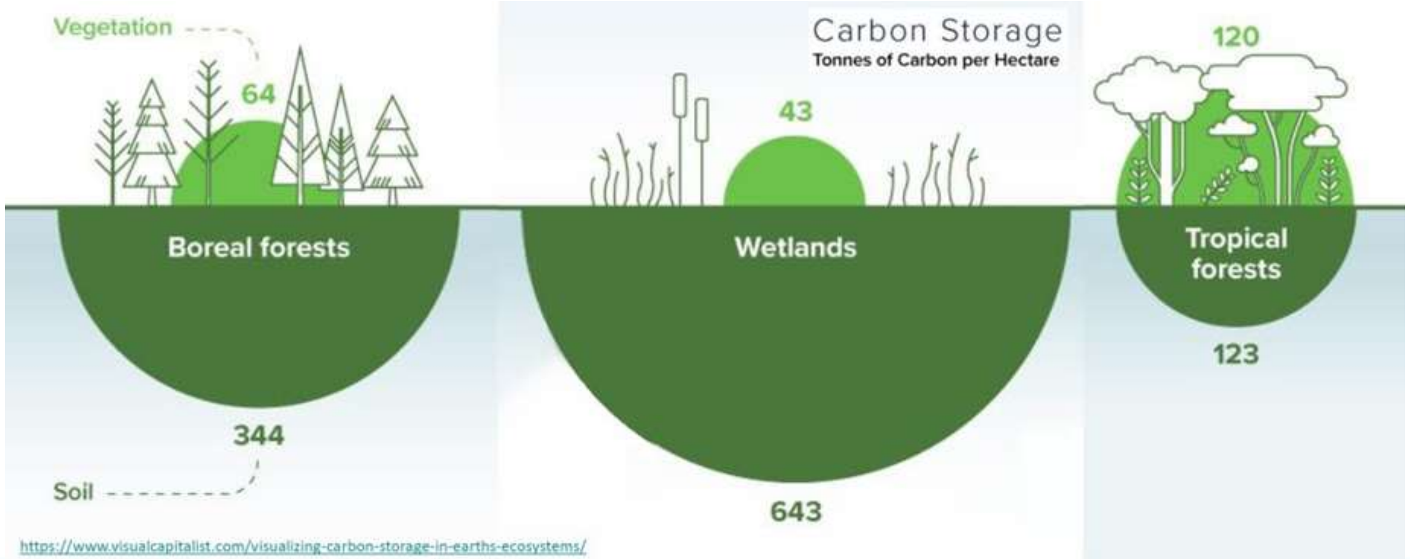
# 4. Bog woodland management: insights from Scandinavia




*Designated Bog woodland (91D0) habitat in the European Union and United Kingdom, 2013-2018, indicating habitat status.*

*Green indicates 'Good' condition; orange 'Poor' condition and red 'Bad' condition.*



Bog and bog woodland under restoration at Brattås Nature reserve in Norway. Restoring the natural levels flow of water at the site is almost always the primary requirement for restoration.

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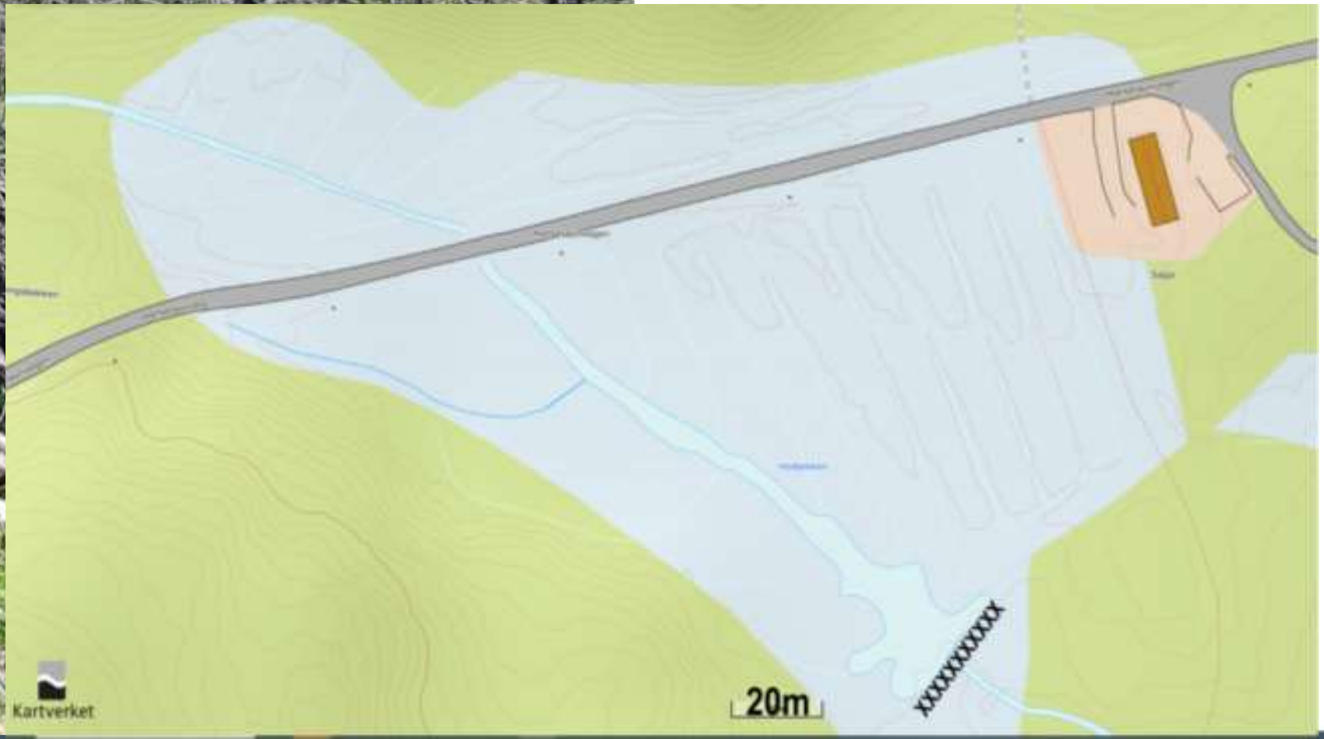
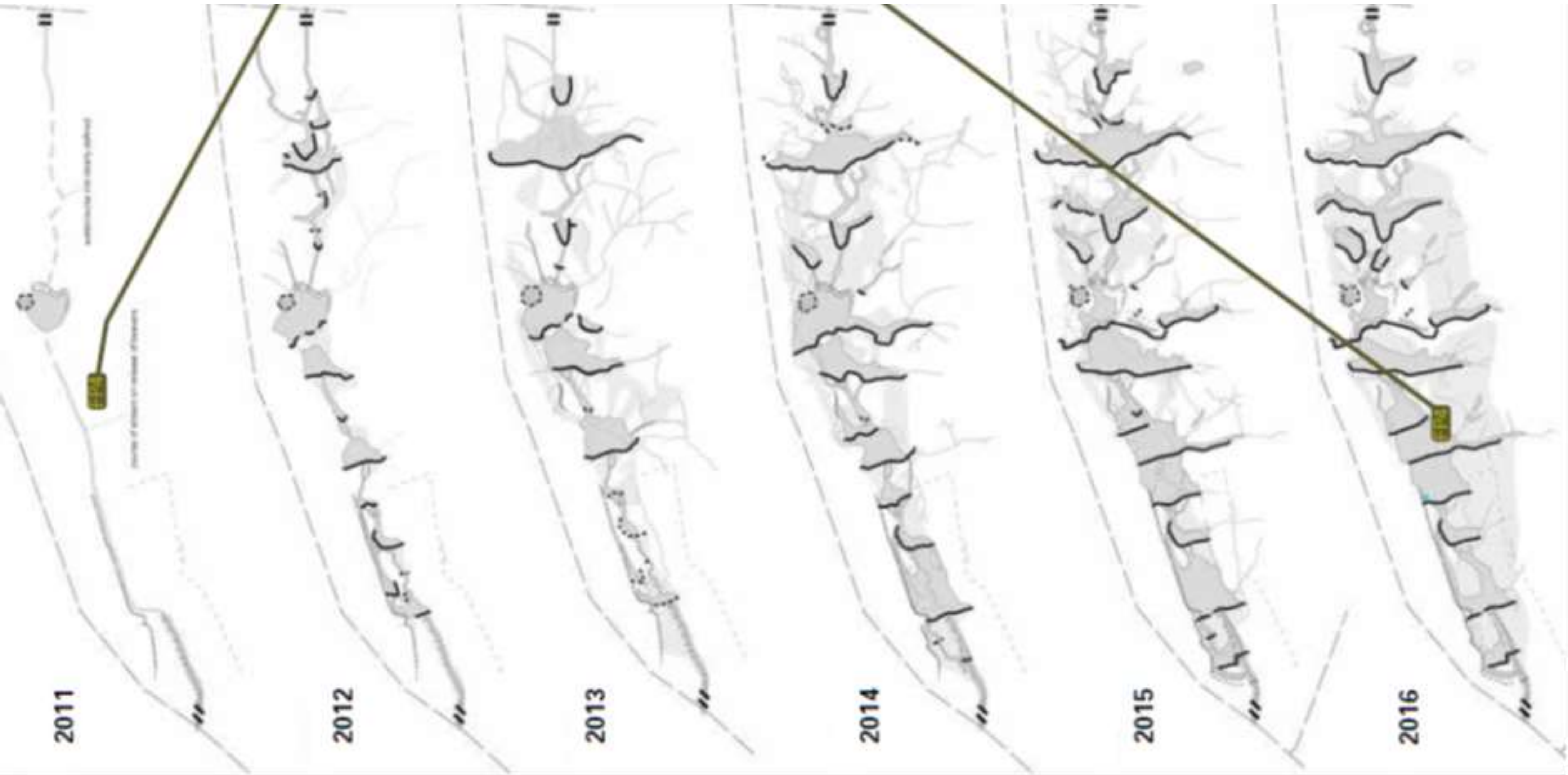
…increasingly often with help from nature!

Beaver dam on a ditched and canalised stream in drained forest bog, Trondheim Bymarka, Norway.



Trstinné Lúky,
Slovakia




Development of a small stream converted to a drainage ditch, often dry in summer, into a complex restored bog woodland, as a result of beaver activity. Grey indicates surface water, black beaver dams. Source: Devon Wildlife Trust 2017.

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Lundarsøyla, SW Norway. Former bog woodland dried out by Drainage ditches. There are no beavers in the area as yet…

…but their effects can be mimicked by building artifical dams from local materials, in this case unwanted invasive dry-ground tree species as the frame, infilled with wet peat

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Lundarsøyla restored – note small dam, now overgrown, in lower picture.

Natural water flows across the site have been restored, the bog woodland and its Sphagnum understory reestablished, and peat formation resumed.

# Summary

- NINAs work in the project falls into four main areas, hydrology; carbon emissions/sequestration; biodiversity; and bog woodland managment.
- The hydrological work has provided future managment suggestions at each site
- The carbon work has mapped the peat depths at all sites and estimated the quantity of the carbon stock. Overall the sites store carbon equivalent to the emissions of 43 868 people. The wok also indicated how much longer carbon storage can be prolonged at each site by restoration measures (centuries to millennia, depending on the site).
- The biodiversity work has used modern eDNA methods to establish a clear baseline with a standard, quantifiable methodology. Changes over time following restoration can be directly compared with pre-restoration conditions by repeating the work and comparing with the baseline.
- Bog woodland management experience in Scandinavia indicates the primary importance of restoring natural water flow regimes at a site. Often this is now done ‘naturally’ by the expanding beaver population. Their damming activities can be mimicked in places that beavers have not yet colonised.

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