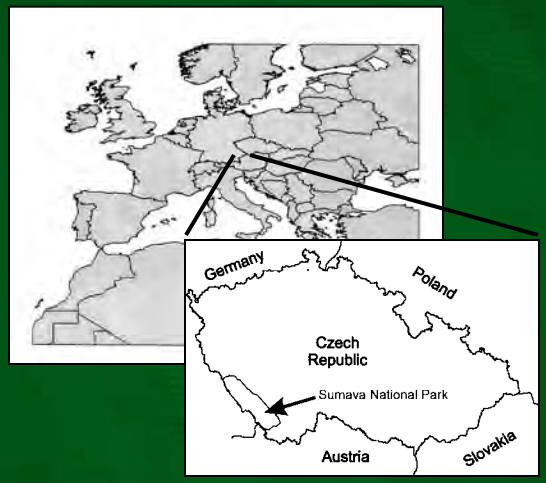
Mire conservation and restoration

in the Sumava National Park

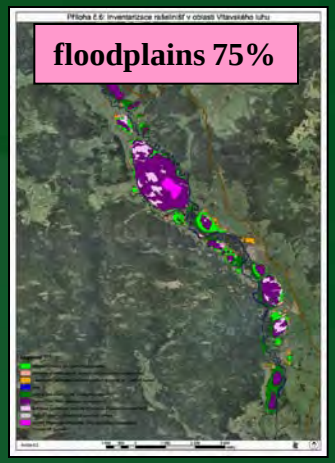
Ivana Bufková

Sumava National Park
ivana.bufkova@npsumava.cz

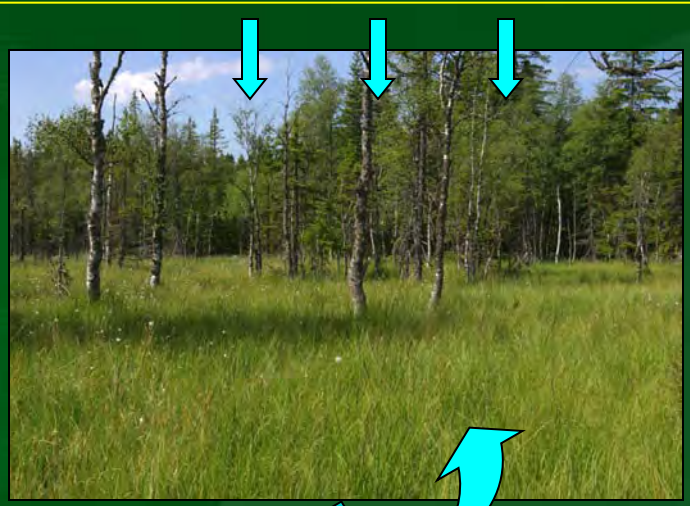
Sumava National Park



ŠUMAVA NATIONAL PARK (70 000 ha)	Area (ha)	% NP area
Mires	6 566	10 %
Other wetlands	14 930	21 %
All wetlands - total	20 536	31 %

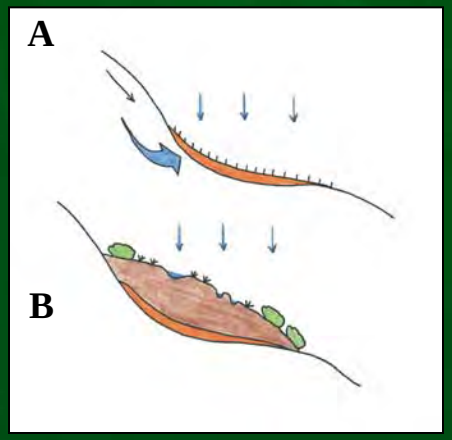


A/ MINEROTROPHIC MIRES - supplied by groundwater

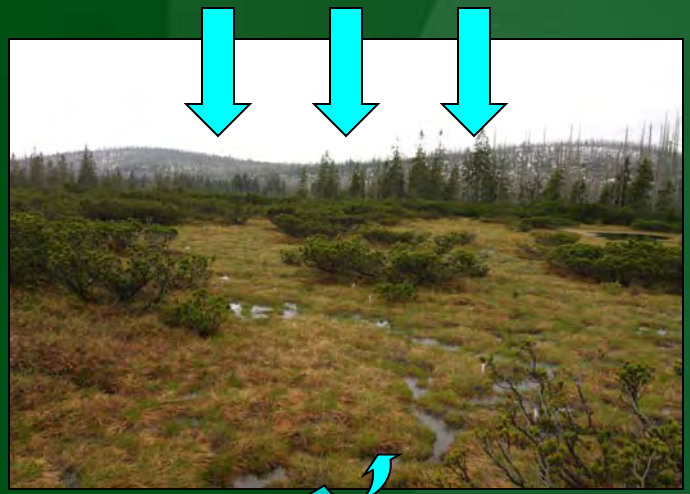


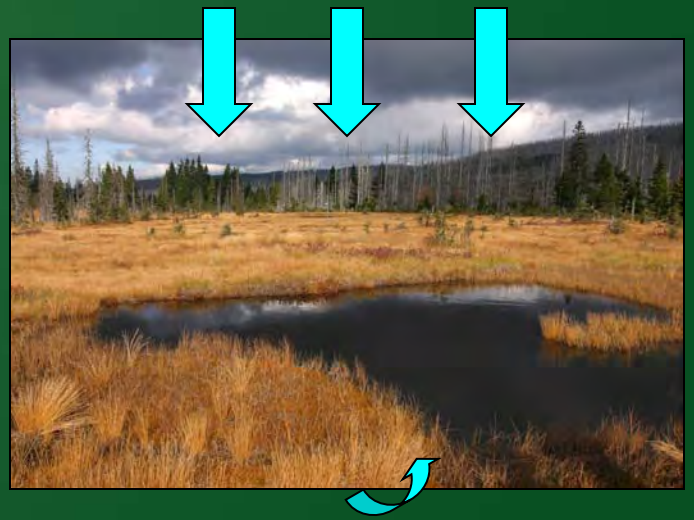
- shallow peat layer
- higher pH
- oligo- to mezotrophic
- **spruce mires, birch mires, poor fens, mire meadows**

transitional mires are in between



B/ OMBROTROPHIC MIRES (bogs) - supplied by rainwater





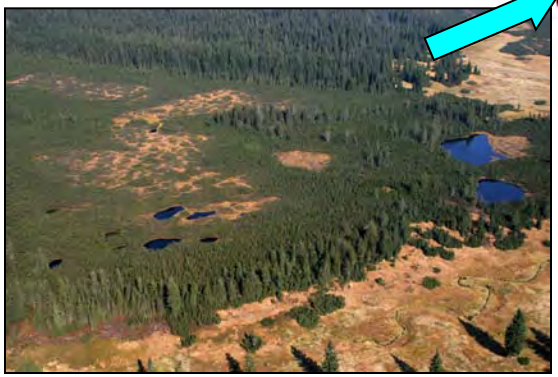
- deep peat layer (3-8 m)
- low pH
- dystro- to oligotrophic
- **raised bogs**

Distribution of mires in the Sumava NP

valley raised bogs
with bog pine forest

minerotrophic mires

(mainly spruce mires and poor fens)



upland mountain raised bogs

valley raised bogs

- **more than 6000 ha of mires**
- **in altitudes 700-1200m a.s.l.**

1990 – Ramsar Site Sumavska raseliniste peatlands

Mires (NP total)		**6 566 ha**	**10 %**
	bogs	**1 587**	**2 %**
	minerotrophic mires	**4 982**	**8 %**

Mires as landscape phenomenon

memory of Ice Age
- relic habitats and species

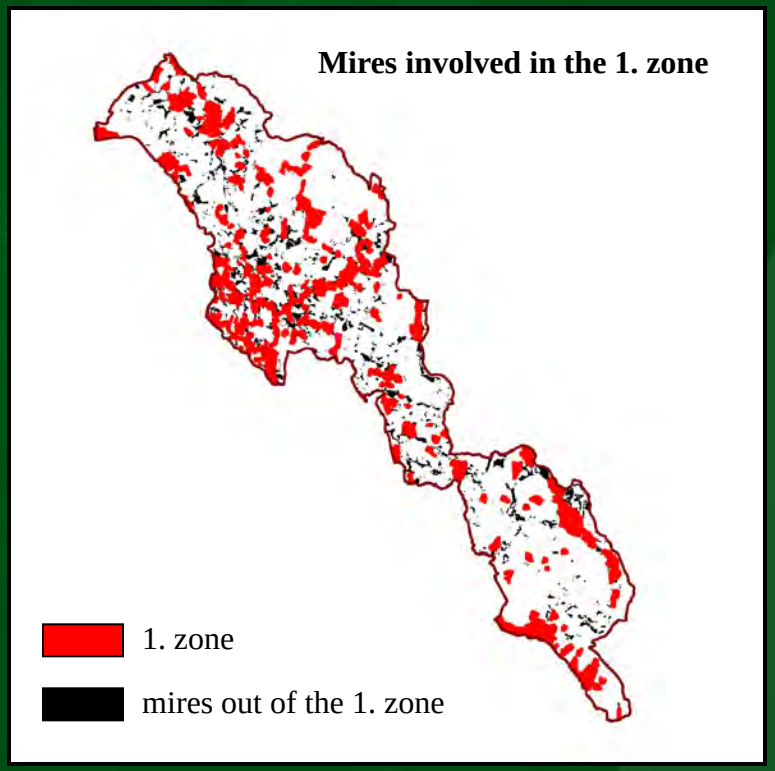
- rare species and communities
- islands of northern nature

→ biodiversity

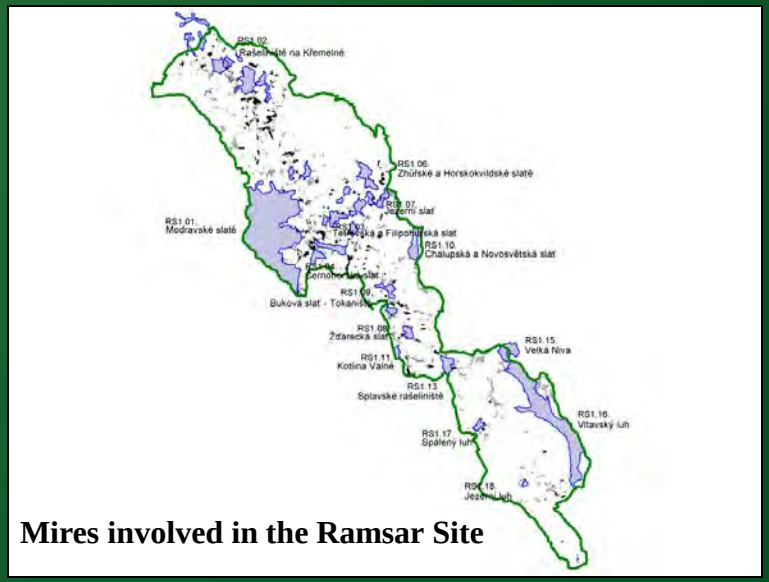
- water retention in landscape
- supply of groundwater sources

- local climatic condition
- enhancement of short water cycle in the landscape
- carbon storage

Mires and current zonation of the Sumava NP



Mire type	NP (total ha)	1.zone (ha)	mires within 1. zone (%)
Bogs	1706	1500	88%
Spruce mires	1548	932	60%
Poor fens and meadow mires	958	437	46%



Mires involved in the Ramsar Site

Mires - different management approach

Primary mire ecosystems

raised bogs
bog woodland
transitional mires

Non-intervention management

with initial re-wetting of drained sites

Disturbed mires

(all types)

Restoration
(starting phase)

Secondary mire ecosystems

meadow mires

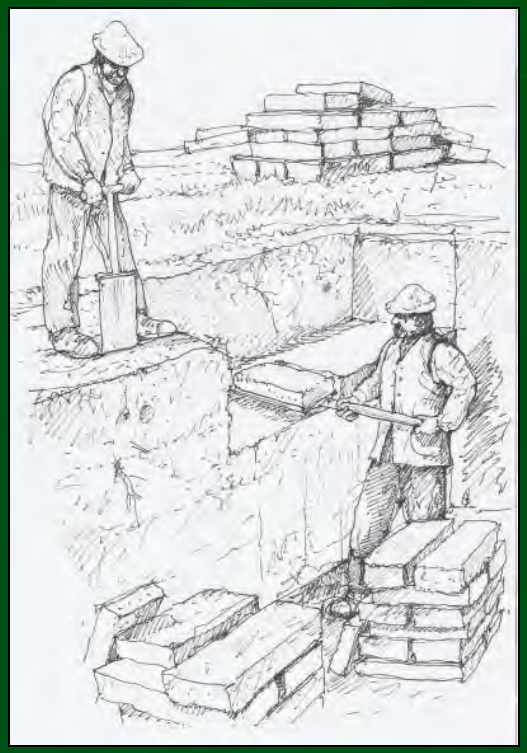
Active management

including initial re-wetting of drained sites

Use of mires – anthropogenic impacts

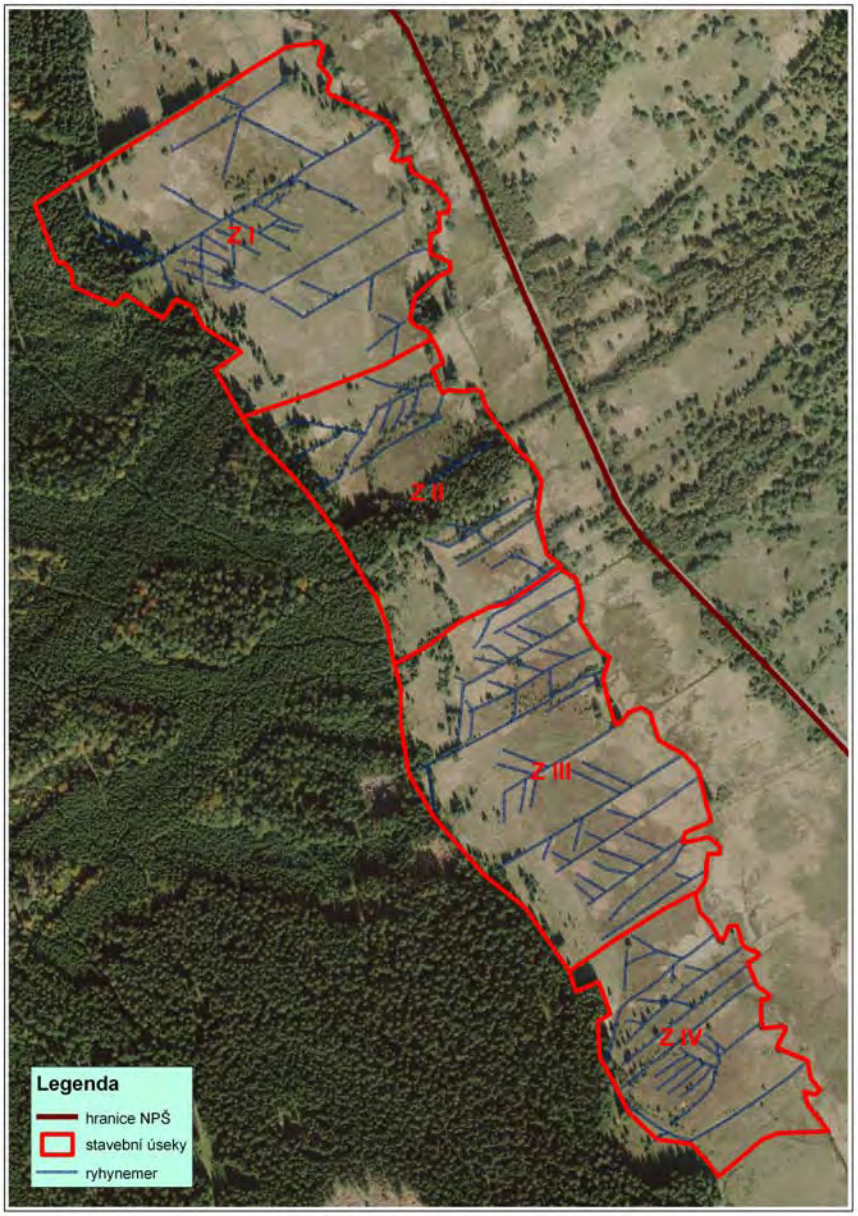
- peat cutting
- agriculture use – grasslands, pastures
- forestry
- accessibility, infrastructure
- water reservoirs, dams
- stream regulation

- hydrology - drainage
- eutrophication
- mechanical disturbances
- imisions
- lost of biodiversity

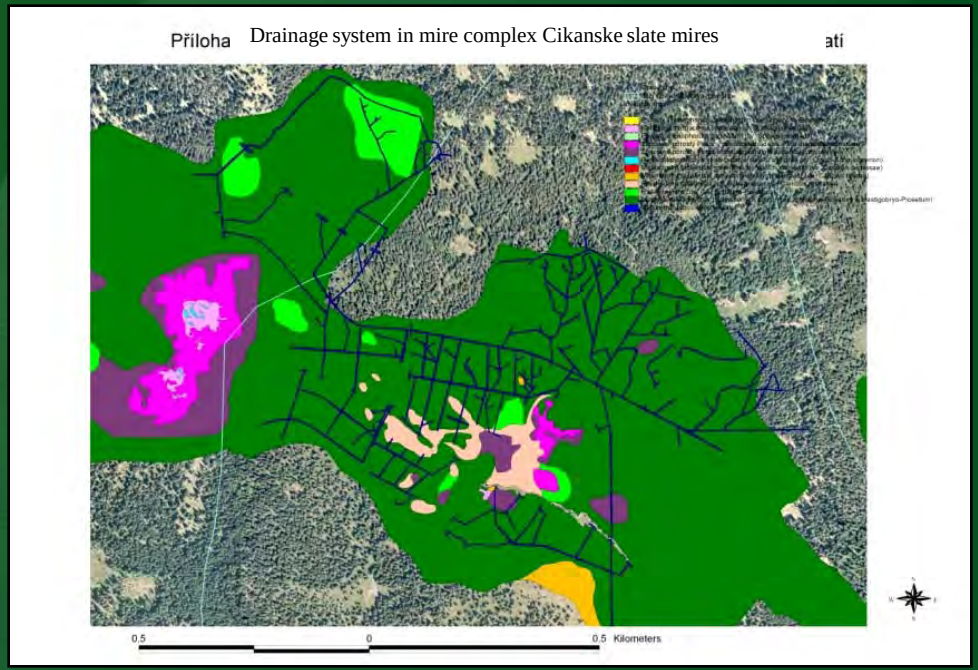


Past drainage

- **more than 70% of mires influenced by drainage** (mire survey 2004-2005)
- 2 periods (19th century, 60-80ś of the 20th century)
- predominantly surface drainage
- scale of degradation changes



Obr. 1: Rozčlenění zájmového území na stavební úseky



Mire Restoration Programme

- since 1999
- primarily focused on disturbed hydrology

Primary objectives:

1. **Re-establishment of natural hydrology**
2. **Enhancement peat-forming processes**
3. **Mitigate or stop biodiversity losses**
4. **Involvement of people into mire conservation**

General approach

RE-WETTING

- from upstream sites downstream
- entire „hydrological units“
- priority statement - criteria

TARGET WATER TABLE CONCEPT

Detailed objectives:

1. raising water table
2. re-establishing of natural flows of water in mires
3. reducing of water losses

Restoration method - blocking and infilling of ditches

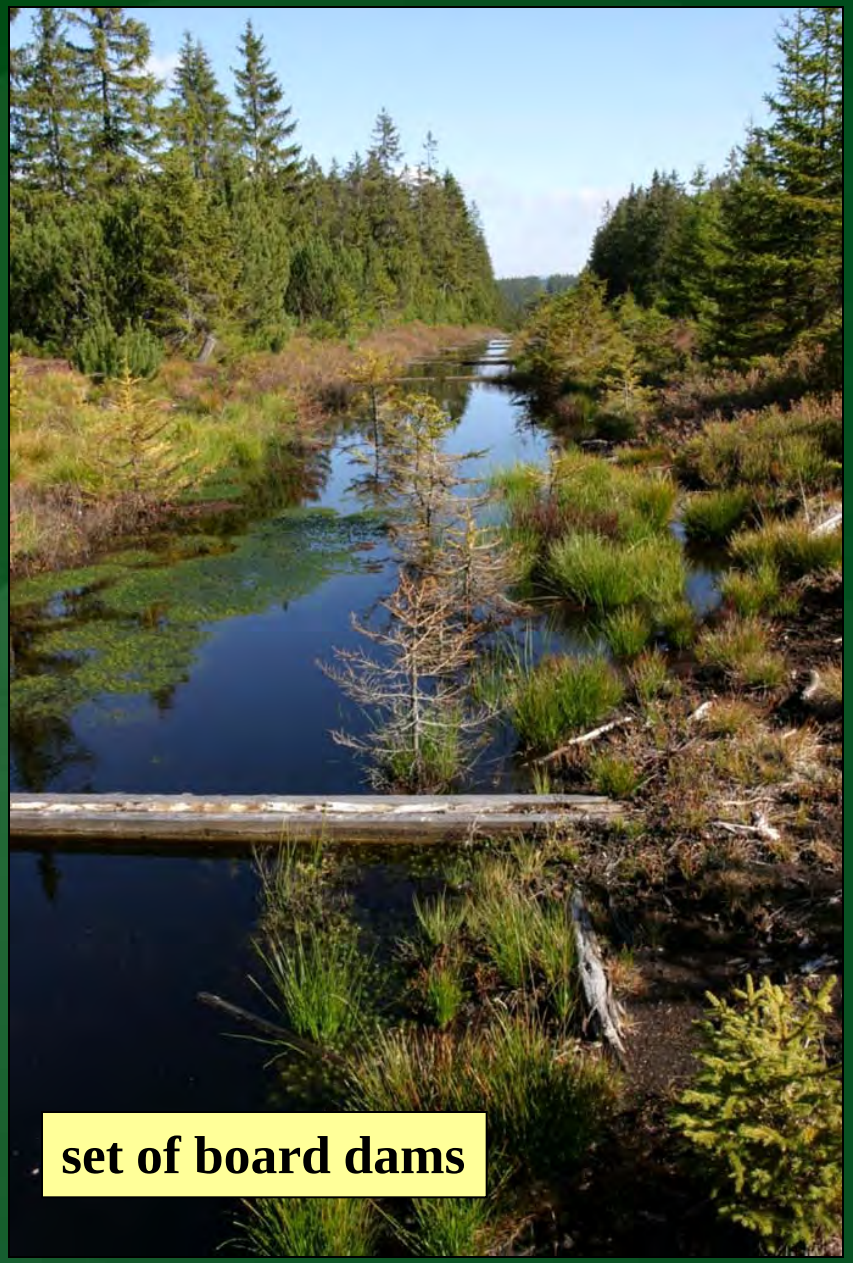
❑ **cascade of board dams + ditch infilling**

WHY??

➢ **Specific features of mountain mires:**

- small-scale mires
- lack of peat for daming and infilling
- sloping gradient – frequent erosion
- hardly accessable sites

TARGET WATER TABLE CONCEPT

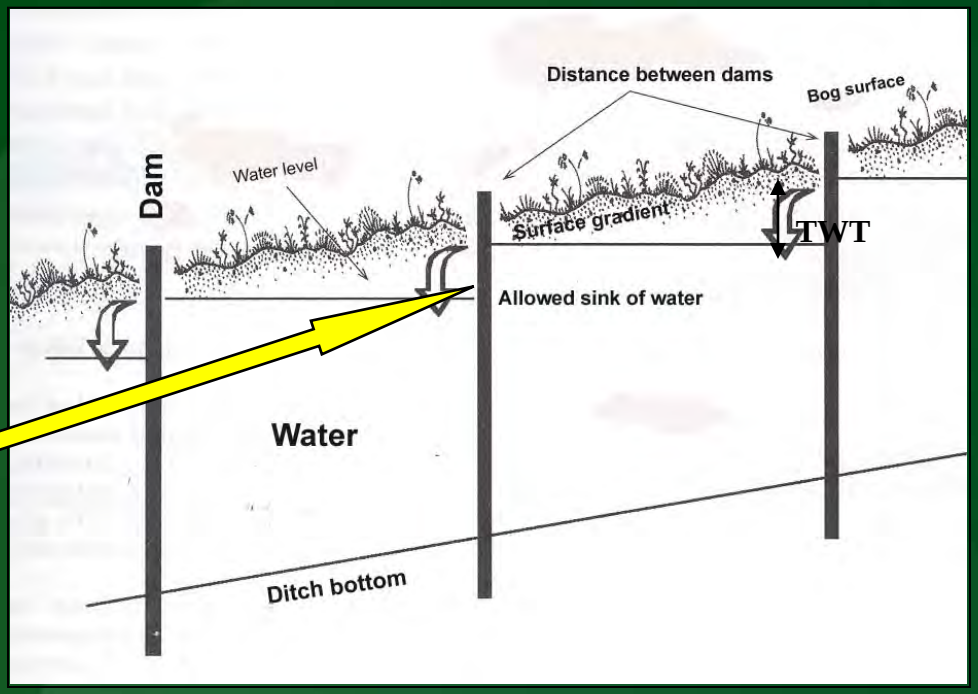


set of board dams

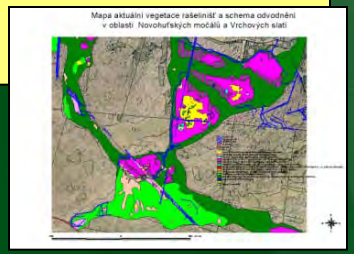
Target water table concept (TWT)

Mountain mires – sloping surface
➡ dam cascades

TWT is a concept for judging dam number and distribution



- **TWT** corresponds to **natural** water table in distinct mire types
- **TWT** = maximum sink of water level in front of the dam
- **mire/vegetation type** determining **TWT** and **surface gradient** are key variables to judge dam distribution



Infilling of ditches - enhanced terrestrialisation

➢ **spontaneous**

(20-30%)

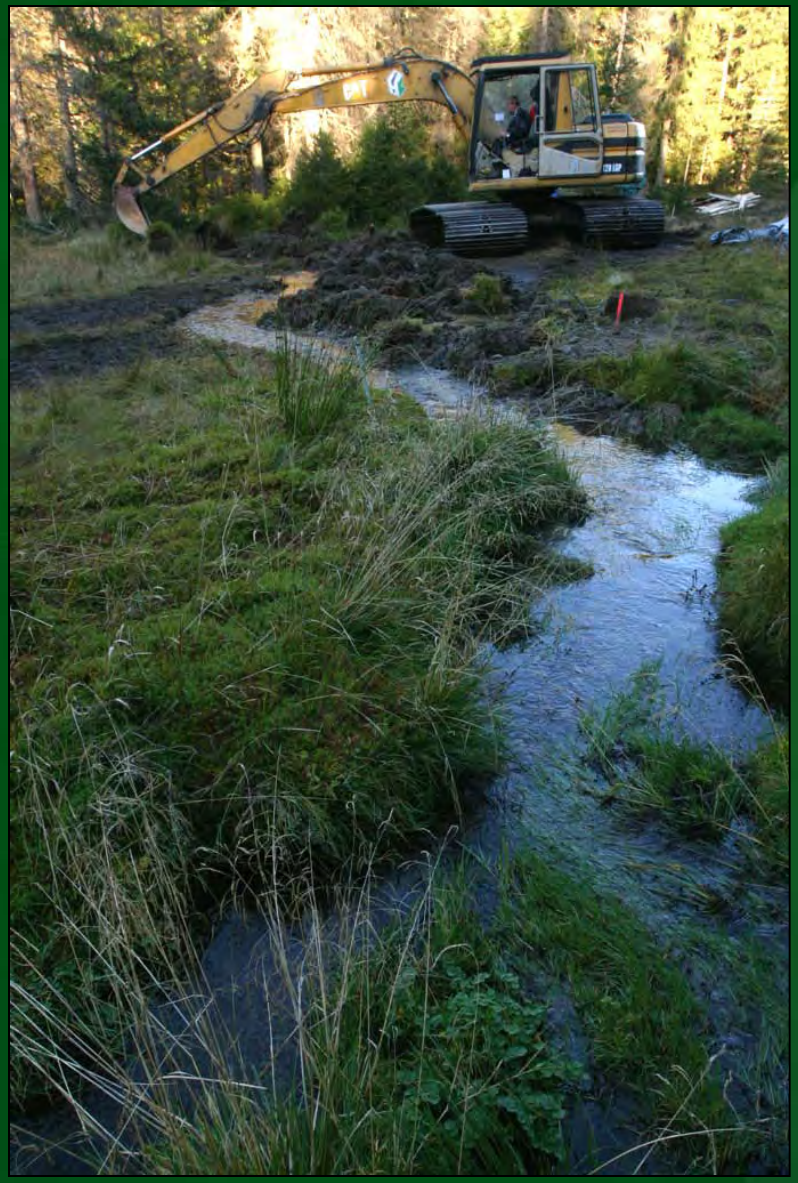
- **shallow ditches**
- **good light condition**

➢ **enhanced**

- **refilling of pools between dams** by woody material, peat, *Sphagnum* clusters

Gradual disappearing of ditches from landscape

Re-establishment of natural water flows !!!

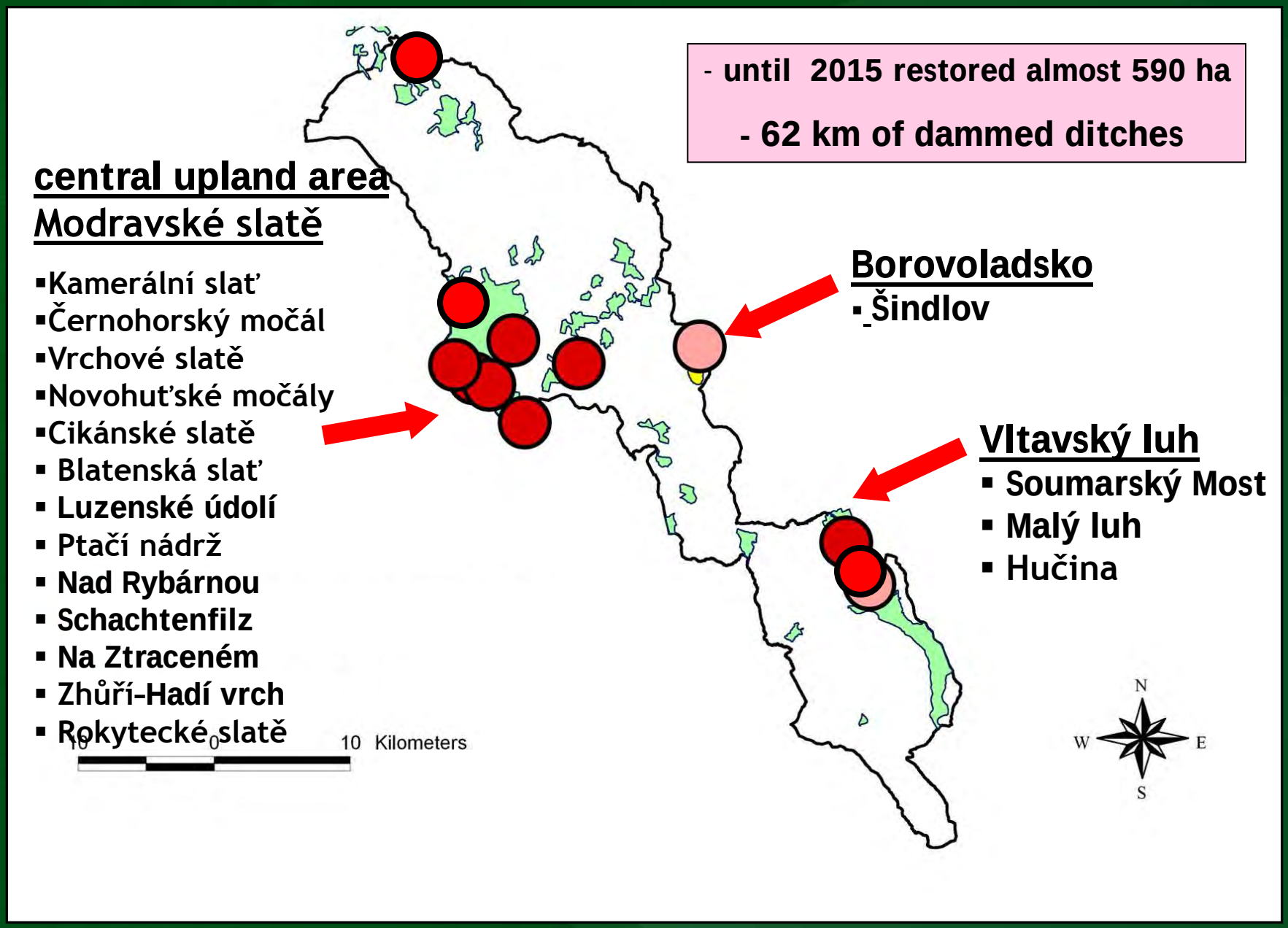


- to divert water onto the mire

  (respecting the earlier flows)
- small and shallow feeder ditches

- **<u>restoration of original capillar streams!</u>**

Implemented restoration projects until 2014



Case studies: Sloping raised bogs and spruce mires – upland

Case studies: Steep sloping spruce mires – upland area

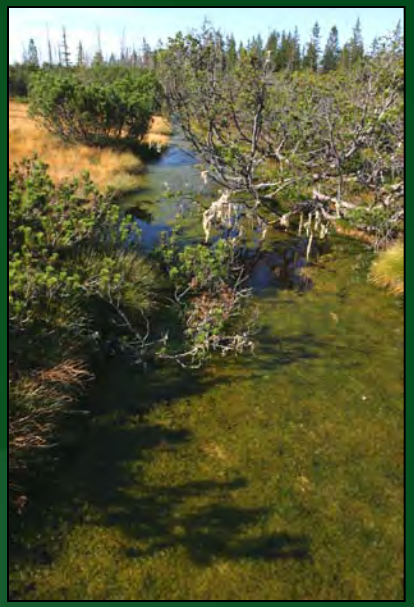
ČERNOHORSKÝ MOČÁL MIRE – II. phase

- along former „Iron curtain“
- no TWT rules
- **to stop large erosion**
- 80 ha, ditches ca 1,8 km
- ditch-digging spoil available
- 2013-2014 damming by excavators
- restoring of capillar streams
- 115 000 EUR (100m ditch = ca 1500 EUR)

Rewetted raised bogs - upland area

Schachtenfilz 1 year after

Kameral bog 6 years after

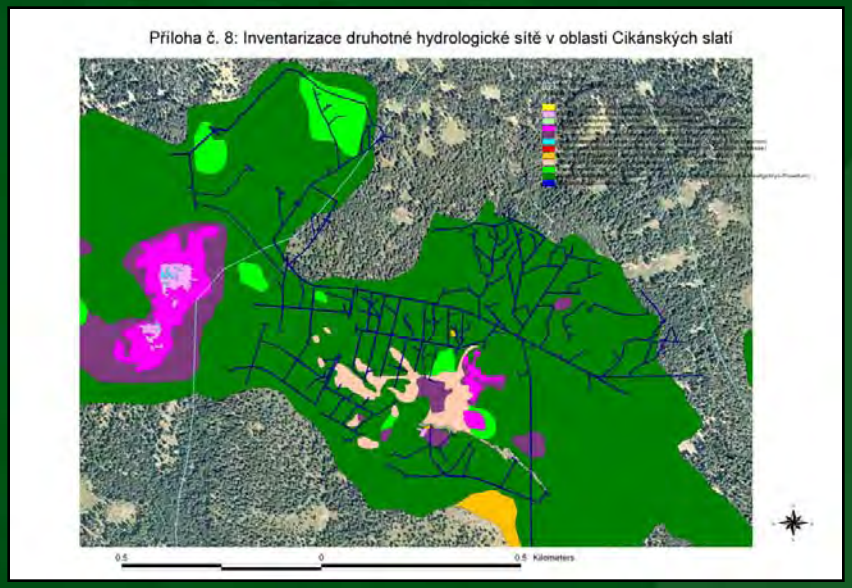


Kameral bog 14 years after

Novohuťský bog 7 years after

Březnické bogs 6 years after

Spruce mires – upland area




Listera cordata

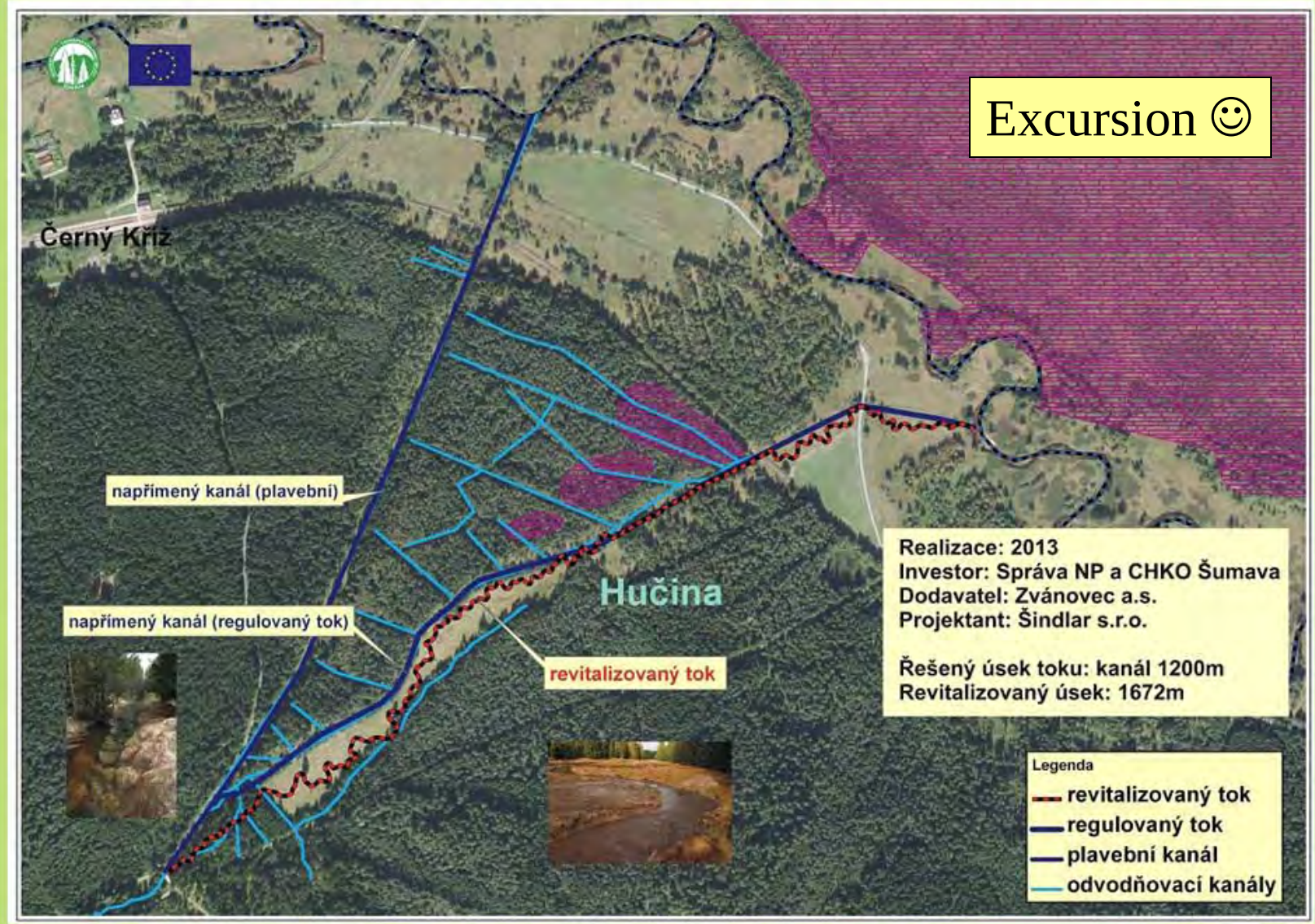

1 year after


9 years after

Floodplain sedge mires

MALÝ LUH MIRE

Restoration of valley mire together with mountain stream - HUČINA



Restoration of industrially cut peatbog

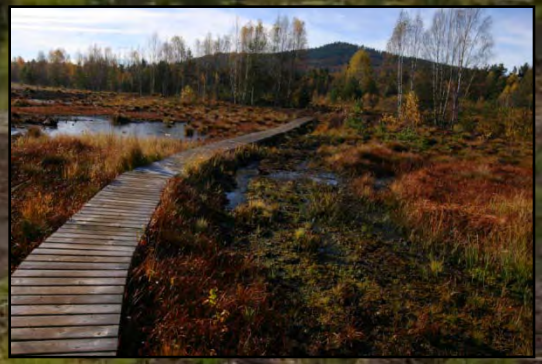
Soumarský Most

Excursion ☺

total area: 70ha
mire type: valley raised bog with bog pine forest
implementation: 1999-2006

Restoration measures:

- damming of ditches
- forming of shallow surface depressions
- mulch material from adjacent sedge meadows to enhance recolonisation of bare peat layers and reduce evaporation



Project implementation – subcontracts (national or EU funds, NP budget)

Manual work without heavy machines

- unaccessable sites
- vulnerable habitats

Limited use of heavy machines - excavators

- only accessable sites
- highly degraded

- transport of materials
- dam instalation and infilling

Involvement of public - „People for mires“

Involvement of people in mire restoration

- visitors of the Sumava NP, local people, NGOs, students,
- private companies since 2011

- **Weeks for mires (since 2005, mainly NGOs)**
- **Days for mires** (regularly since 2008)

Implemented restoration projects until 2014

Site	Area (ha)	Number of dams	Length of the dammed ditches (km)	Year	Costs (Cz)	Financial sources
Kamerální slať	3,2		0,7	1999, 2004	98 000	National Park budget
Novohuťské močály	56,5	346	3,4	2003 - 2004	779 962	National Park budget
Vrchové slatě + Malá slať	26,5	286	3,9	2003 - 2004	300 741	National Park budget
Cikánské slatě	121,8	1336	14,5	2003 - 2006	1 523 360	National Park budget
Malý luh	37,5	211	1,4	2004	112 186	National Park budget
Chalupská slať - Šindlov	25,6		1,8	2004	328 876	National Park budget
Blatenské slatě I + II	40,6	264	2,9	2005 - 2006	457 682	National Park budget
Luzenské svahy I -Luzenská slať - Březnické slatě	14,8		4,5	2004 - 2006	1 053 056	National Park budget
Hučina	17,4	221	2,8	2005	246 327	National Park budget
Biskupská slať	1,1	-	0,3	2005	61 156	National Park budget
Ptačí nádrž	7,8			2006 - 2007	326 257	National Park budget
Černohorský močál - I etapa	23,1	148	1,6	2006 - 2011	344 550	National Park budget
Na Ztraceném	17,1	223	1,9	2009	711 108	National Park budget
Schachtenfilz	5,4	203	1,2	2008	621 745	National Park budget
Nad Rybárnou	5,3	135	1,2	2008	549 765	National Park budget
Pod Prameny Vltavy	16	300		2006	646 000	national funds
Soumarský Most	55	500	9	2003 - 2004	3 985 000	national funds
Hučina	12,4	221	1,2	2013	1 900 000	EU funds (Operational Programme)
Černohorský močál - II etapa	67	596	2,1	2013-2014	3 226 666	EU funds (Operational Programme)
Rašeliniště na Zhůřském potoce	31	1285	7,4	2014	6 507 933	EU funds (Operational Programme)
SUMA	**585,1**	**6275**	**61,8**		**23 780 370**	

area: 590 ha
blocked ditches: 62 km
restored streams: ca 2,3 km

ca 850 000 EUR

Mire research and monitoring

- coordinated with the Mire Restoration Programme

Project: „Ecology of drained mires and possibilities for restoration“
supported by the Czech Ministry of the Environment (VaV SP/2d1/113/07) in 2005-2010

MAIN GOALS:

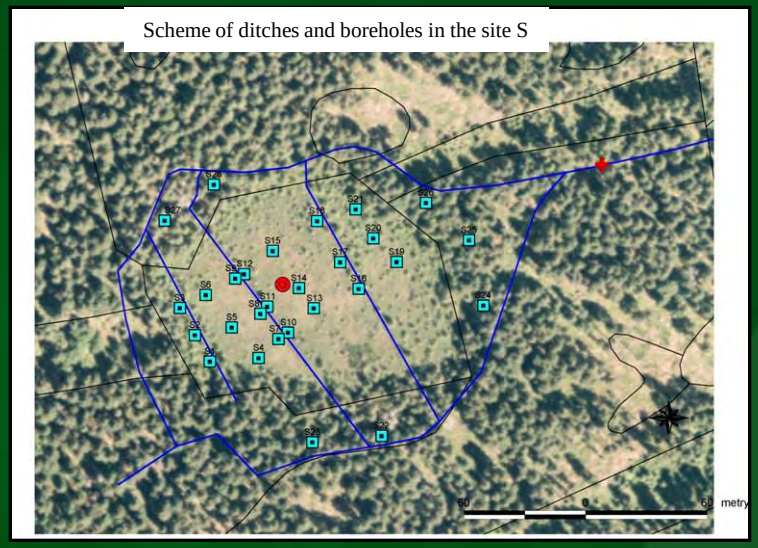
- ❑ **to study degradation changes in mires with disturbed hydrology**
- ❑ **to evaluate the success of restoration**

What is response of mires to restoration?

- how restoration influences mire hydrology, hydrochemistry and microclimate condition?
- how it can influence water quality and runoff in the concerned catchment area?
- is restarting of peat-forming processes possible?
- how it is reflected in biodiversity?
- are there different responses between distinct mire types?

Were implemented restoration measures successful?

Methods - monitoring design



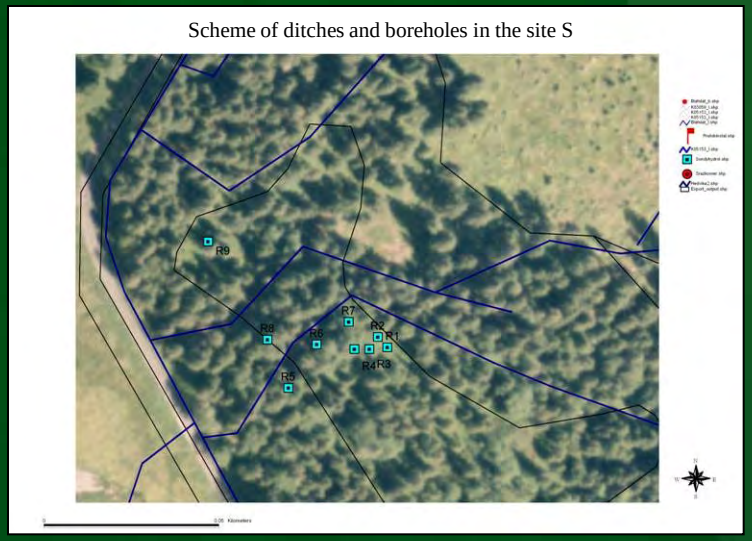
drained

intact

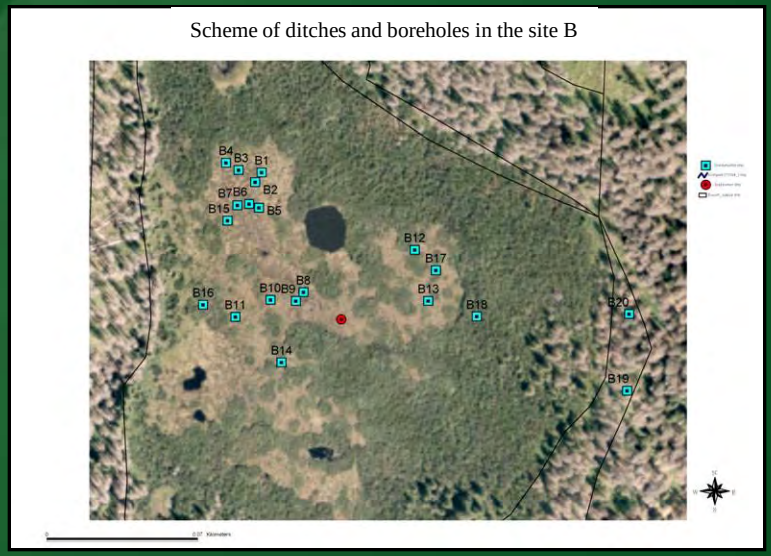
before restoration
(3 years)
after restoration

habitats: - ombrotrophic peatbogs
- spruce mires
since 2007 – poor sedge fens

2008 – restoration of drained sites



Nad Rybárnou – heavy drained



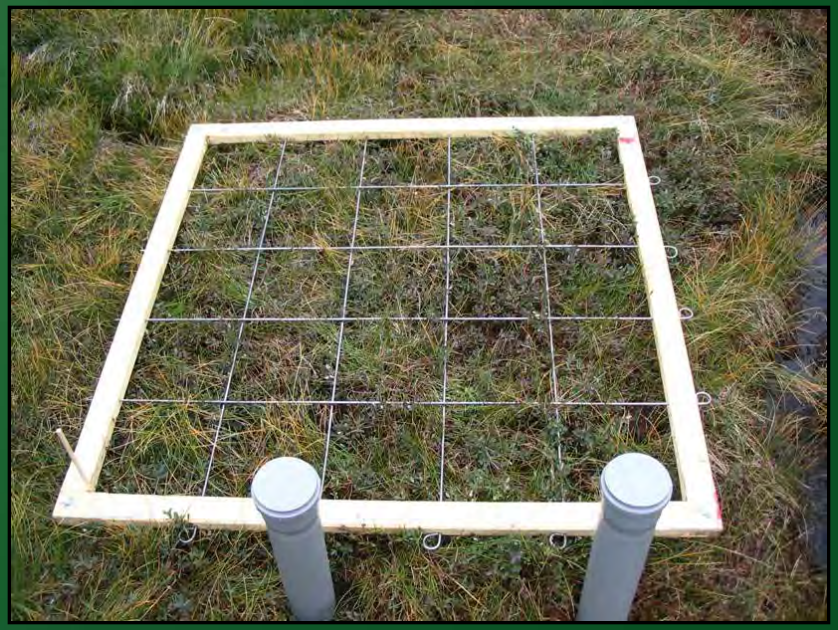
Blatenská slať - intact

Environmental variables measured

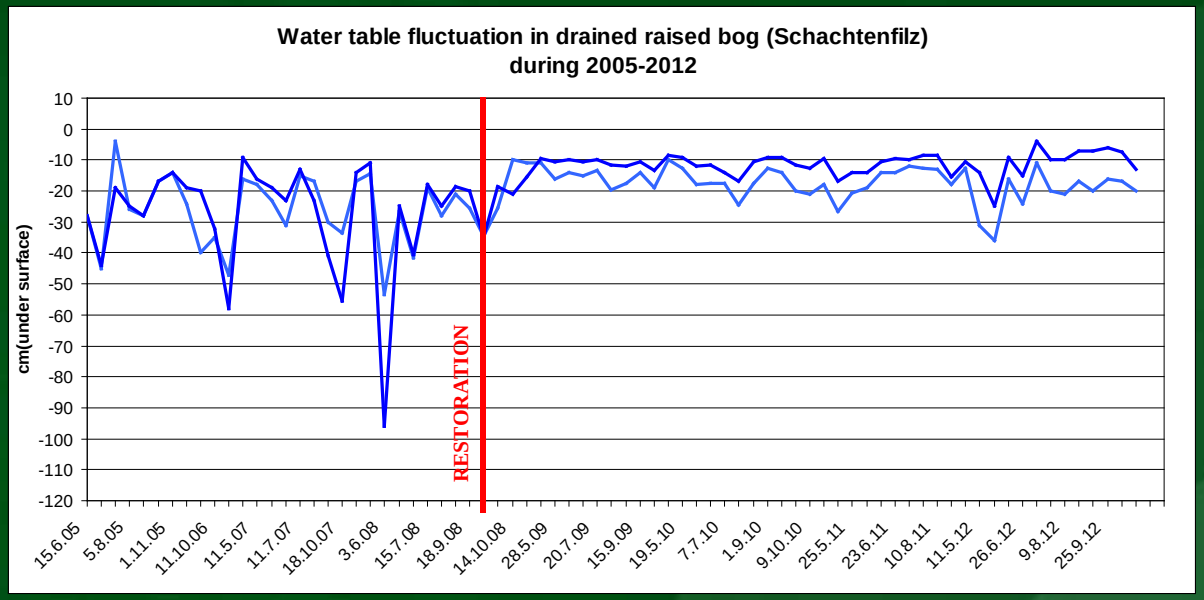
- permanent plots (98) with associated water wells were established to characterise different mire sites

❑ monitored variables:

- **water table**
- **runoff**
- **water chemistry** (pH, conductivity, DOC, SO4, NO3, NH4, PO4, Ca, Mg, Al, Fe - monthly)
- **precipitation**
- **microclimate** (air temperature and humidity)
- **vegetation** (1x1m permanent plots)



Positive effect of restoration on hydrology

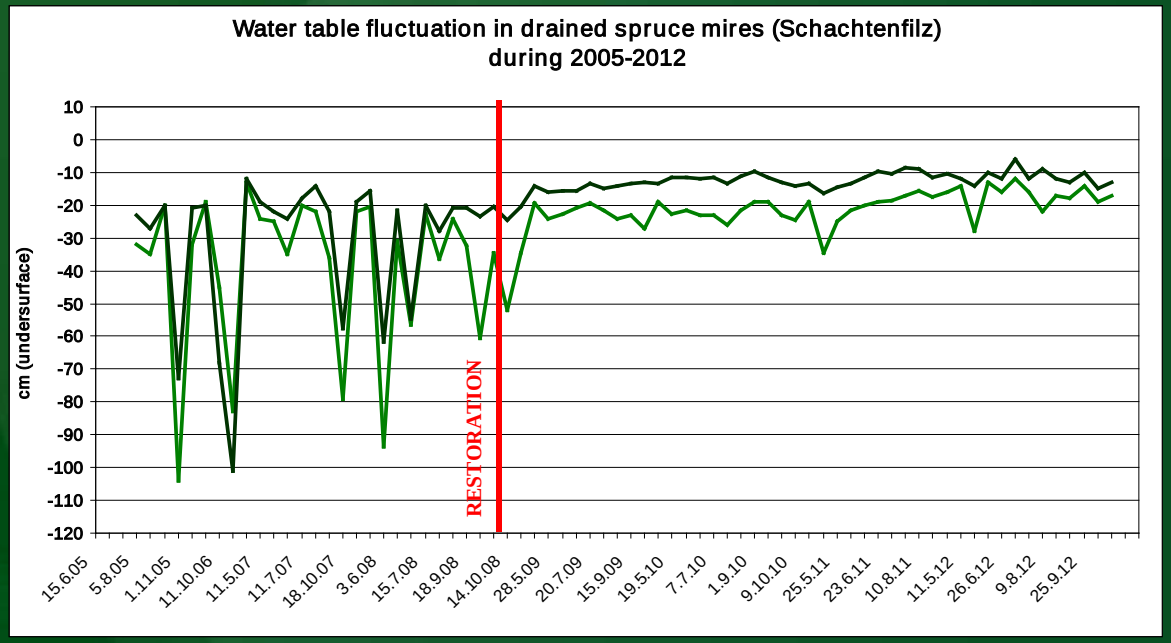


OMROTROPHIC BOGS
– groundwater independent

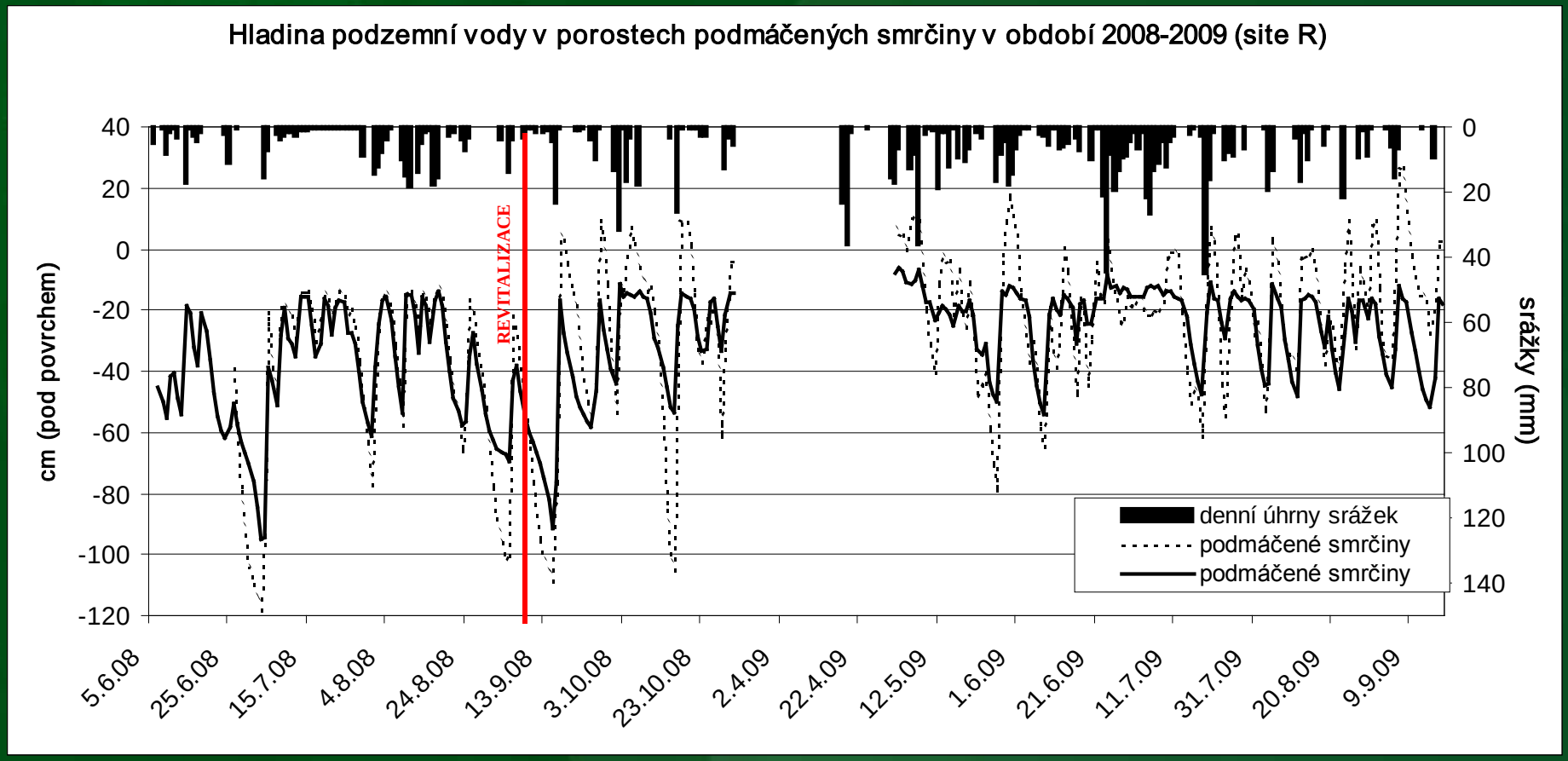
- immediate quick response
- water table raised up
- amplitude of WT fluctuation decreased

MINEROTROPHIC MIRES
– groundwater dependent

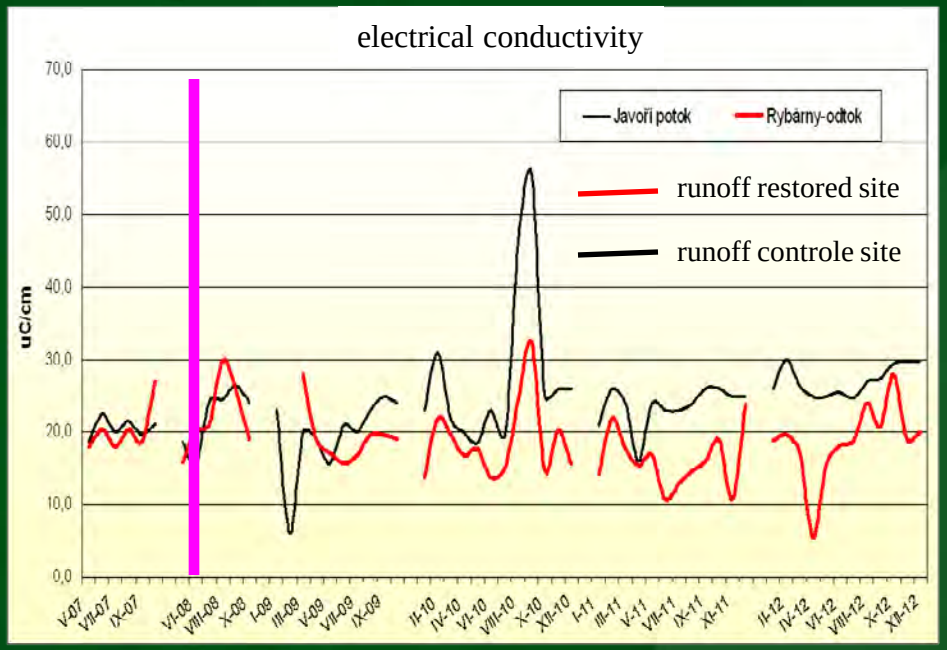
- response similar to raised bog

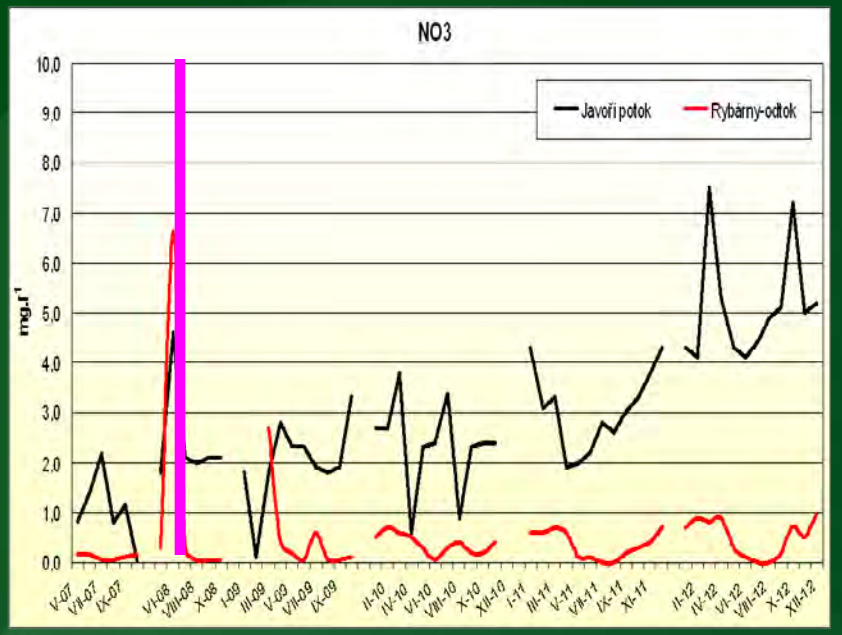


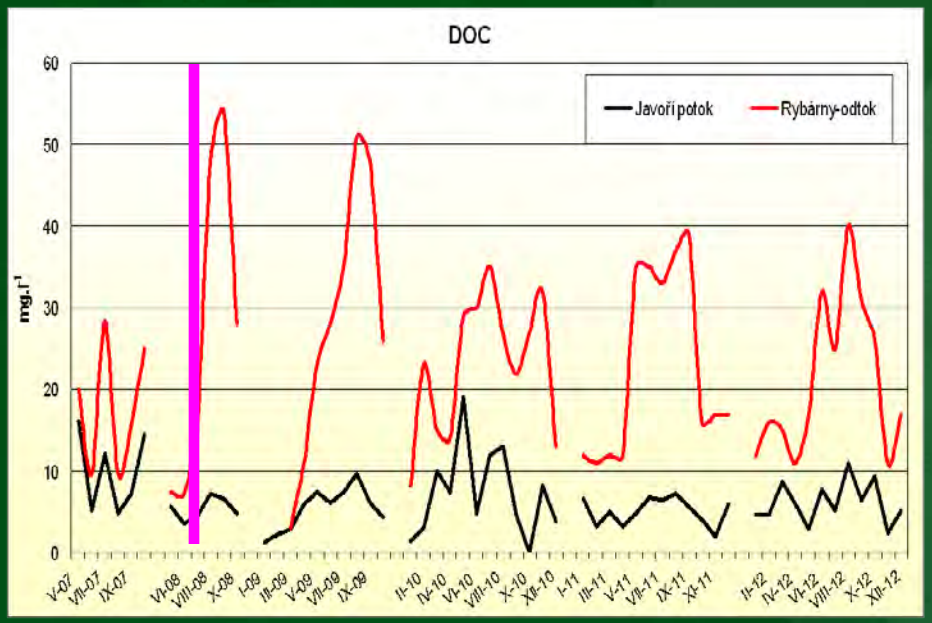
Water table position in drained wet forests (Sch) before and after restoration

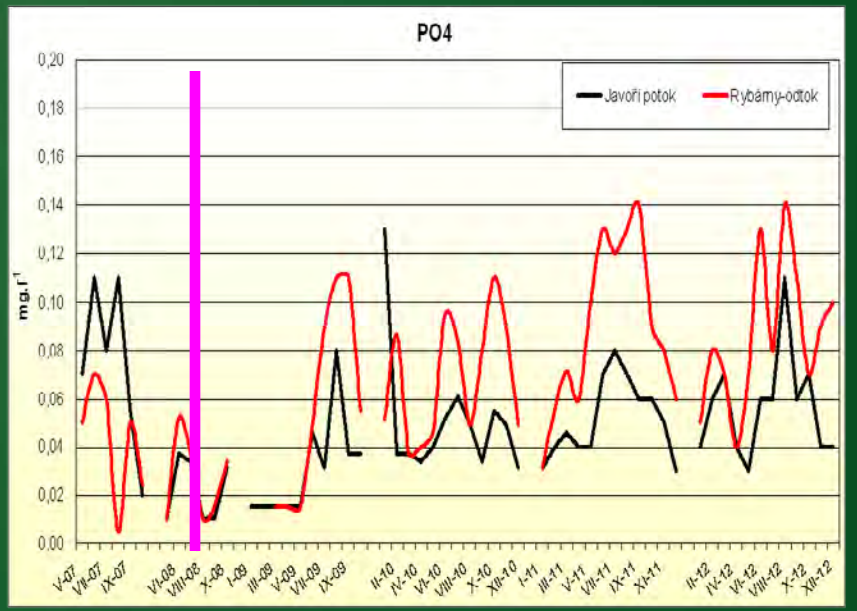


Water quality in the restored catchments

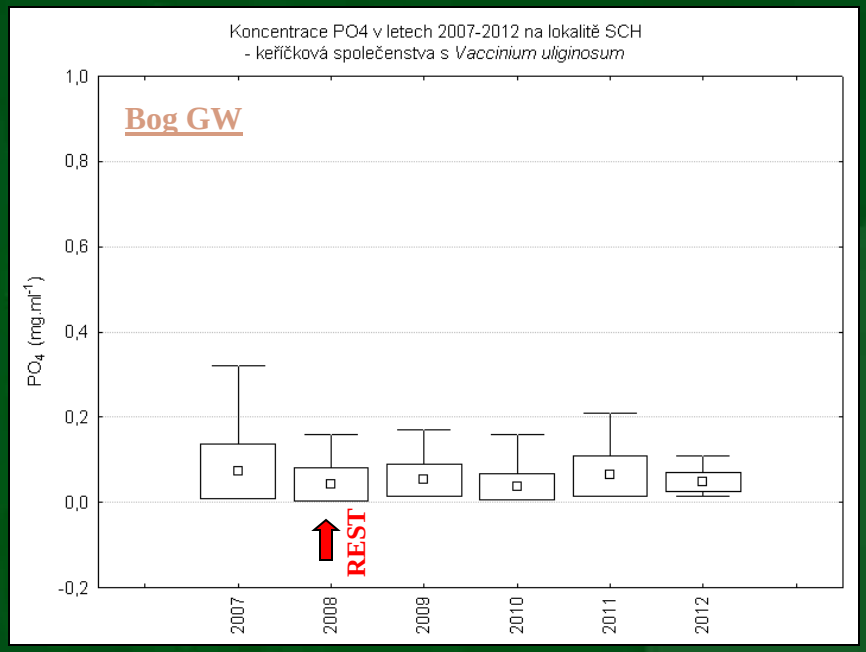


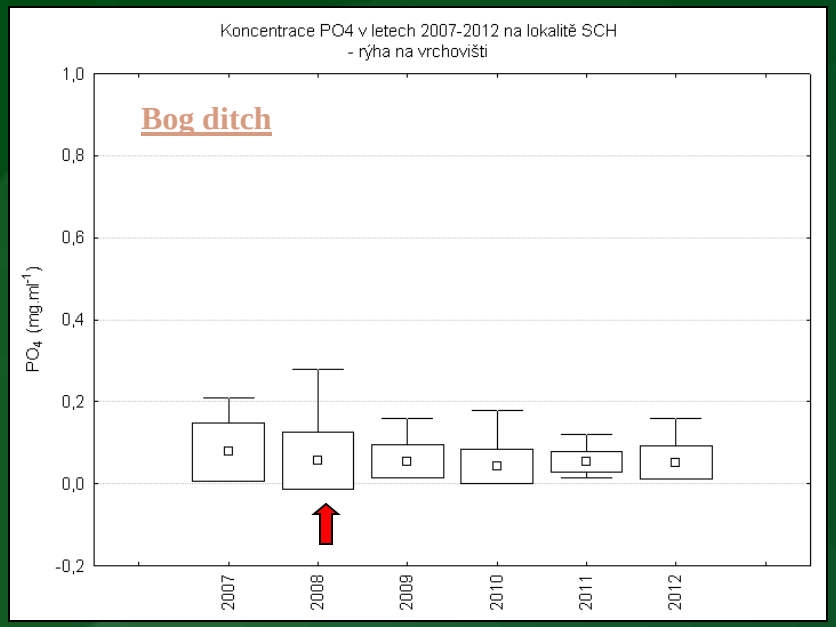




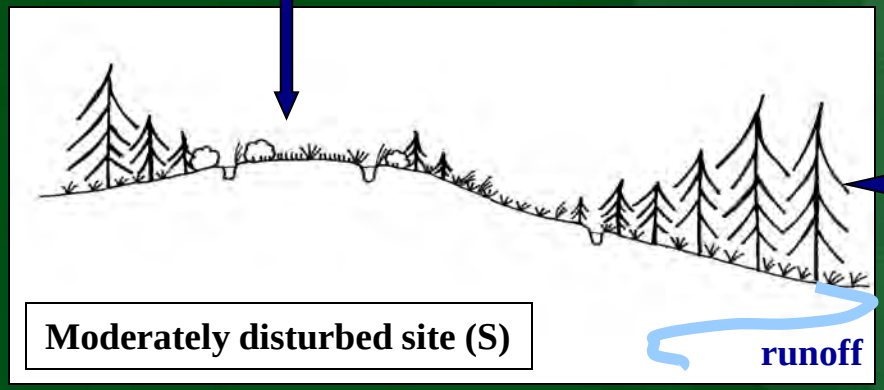


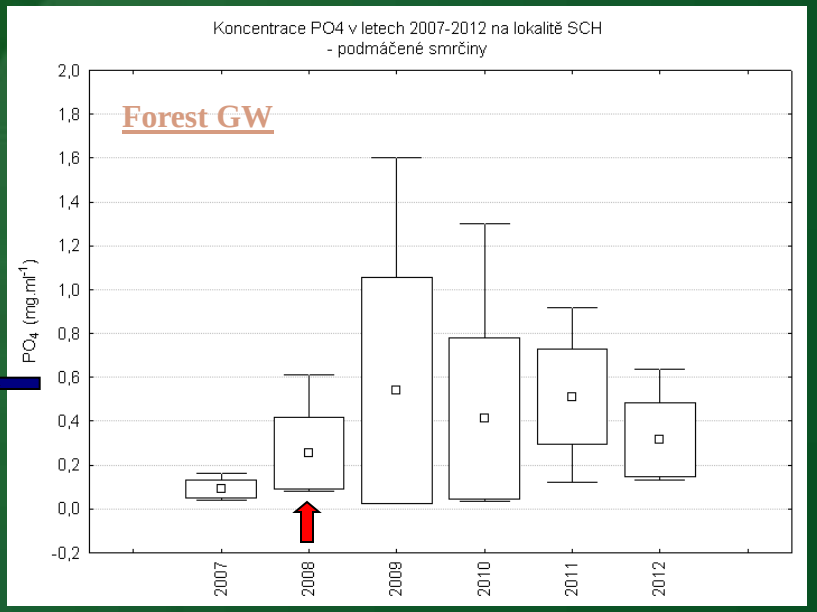
Hydrochemistry response of different mire types - PO4





Similar response found for Al, Fe, NH4





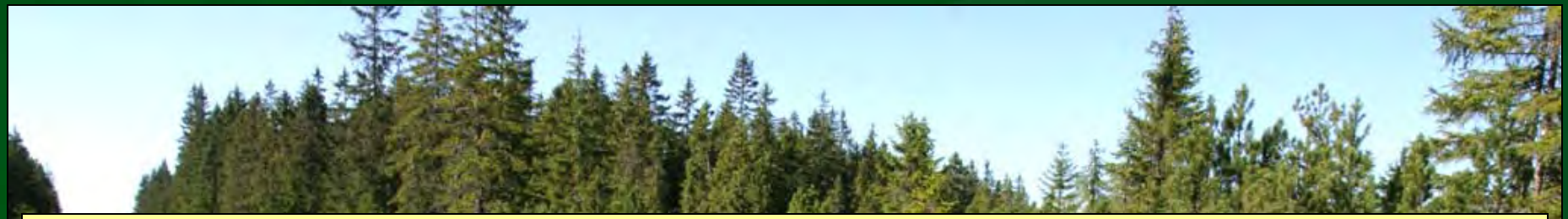
Positive effect of reatoration on mire vegetation


Re-developed hollow 2012

- spontaneous re-development of **wet** surface features (hollows) 4 years after restoration
- re-development of mire-forming vegetation – proportion of *Sphagnum* mosses
- rare species – *Listera cordata* – 2008 (50 palnts), 2012 (ca 400 platnts)


Summer 2012

Conclusions



- **target water table** concept – appropriate for restoration of sloping mountain mires
- **positive effect of restoration on hydrology –** similar response in different mire types
  - raised up WT, reduced fluctuation
- **hydrochemistry** response is different for distinct mire types:
  - **hydrochemistry response was much pronounced in minerotrophic mires (especially spruce mires)**
- **water quality is highly influenced by proportion of distinct mire types restored in the catchment**
- **early and long-term responses of mires are different**
- **about 82% of restoration measures could be assessed as succesful**

Thank you for your attention

František Stíbal
Eva Zelenková
Jan Mokrý
Miroslav Mäntl
Eva Loskotová

Aknowledgement:
Andrea Kučerová
Ladislav Rektoris
Jan Pokorný


Landscape without wetlands
is
landscape without
water