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Wetland restoration

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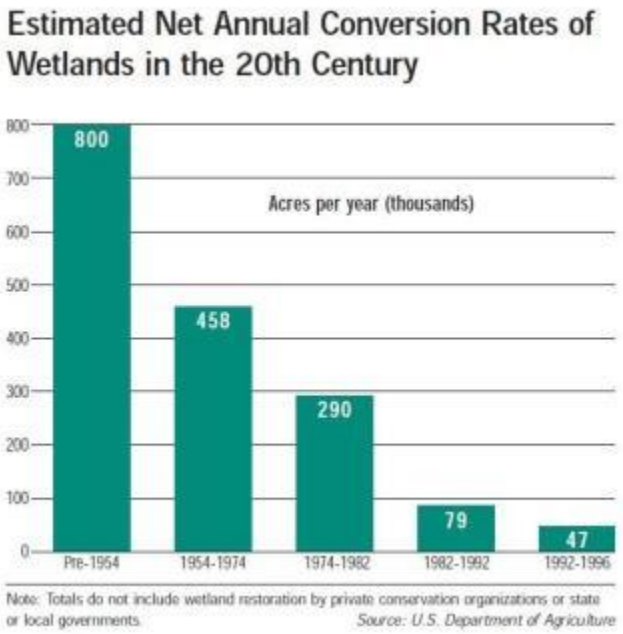
Wetland management

- Human activities have influence wetlands for centuries with varying degrees of impact
- Wetlands mostly drained for agriculture and forestry purposes
- Destruction of wetlands (river regulation, dam construction, urbanization, infrastructure development peat extraction…)
- Construction of artificial wetlands

Wetland losses

- About 50% of the world´s wetlands lost
- Area of peatland reduced 10-20%
- e.g. global wetland extent declined by 6% between 1993 and 2007
- currently wetland loss the greatest in the tropics and sub-tropics (population growth, agricultural expansion, plantation development)
- Wetland losses slowed down

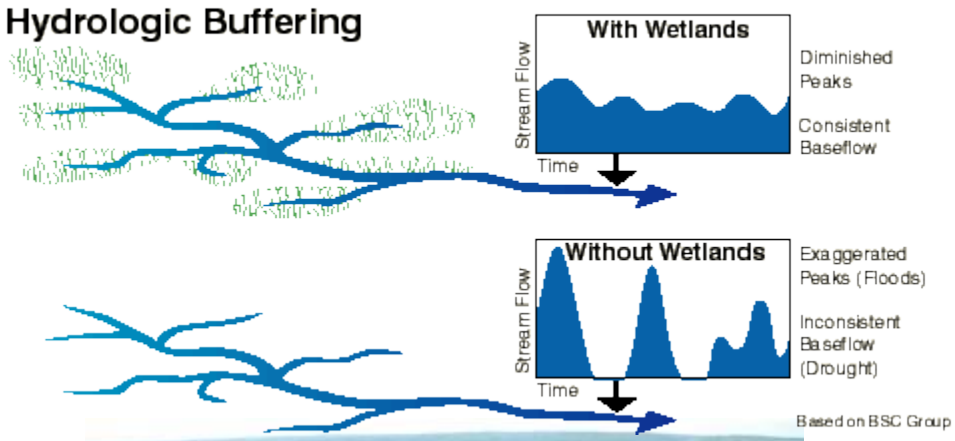
  in Europe and North America



Reasons for wetlands protection and restoration

Loss and degradation of wetlands led to a decline of important goods and services:

- Water quality
- Erosion and flood control
- C sink
- Nutrient sink or trap
- High biological production
- Biodiversity and landscape heterogeneity
- Habitat for wetland species
- Recreation



Ramsar convention

- The Convention on Wetlands of International Importance, especially as a waterfowl habitat
- an international treaty for the **conservation and sustainable utilization of wetlands**, to stop loss of wetlands, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.

Ramsar

Restoration

- **Restoration – active approach,** returning a degraded wetland or former wetland to a pre-existing condition or as close to that condition as is possible

- **restoration aims**: to revitalize a self-sustaining naturally functioning wetland ecosystem

- **first step of restoration**:

  restoration of hydrology

Basic restoration decision manual

Restoration is the process of bringing something back what you have lost - you have to know:

1. what you would like to have back (which functions)
2. whether it is possible to get it back (degree of disturbances)
3. what you have to do to get it back (methods and techniques of restoration, technical feasibility)

→ **Aim and Priorities**

- Another things you have to take in to account:

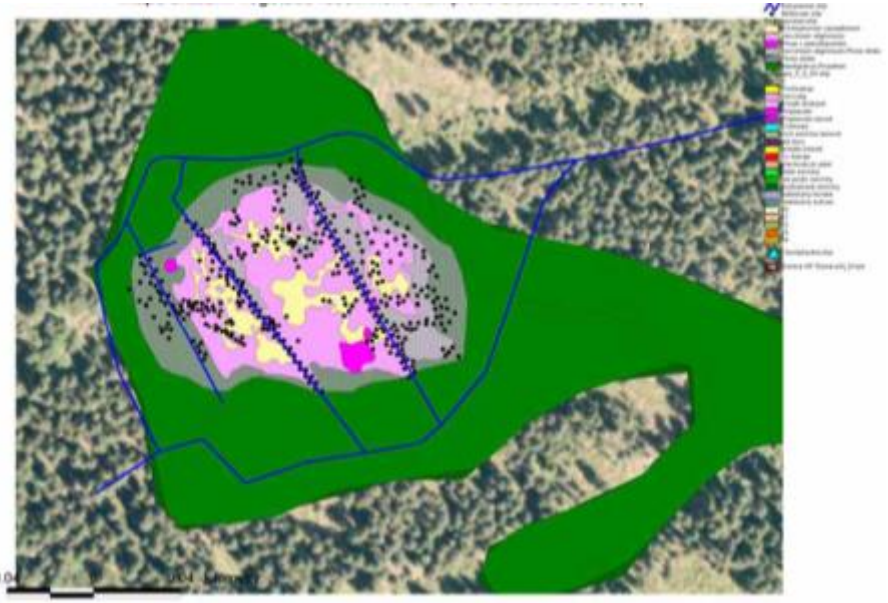
  area, costs, owner, accessibility, side-effects,...

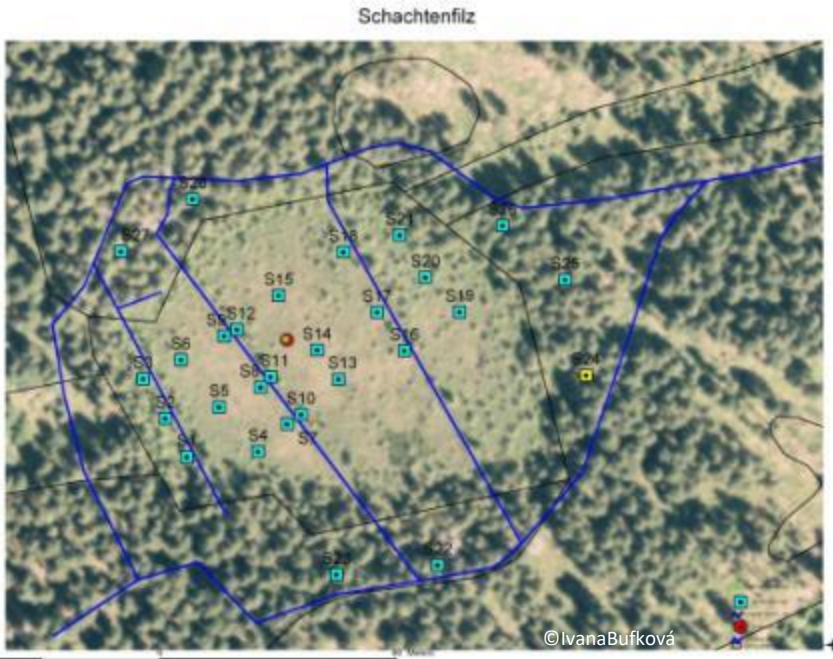
1st Example – drained mountain bog

1st Example – pristine mountain bog

Before restoration

- Detail site study – map of vegetation, map of drainage system, topography, hydrology, ….
- Start with the monitoring (WT, vegetation, chemistry, outflow, soil properties, key species,….)
- Reference sites

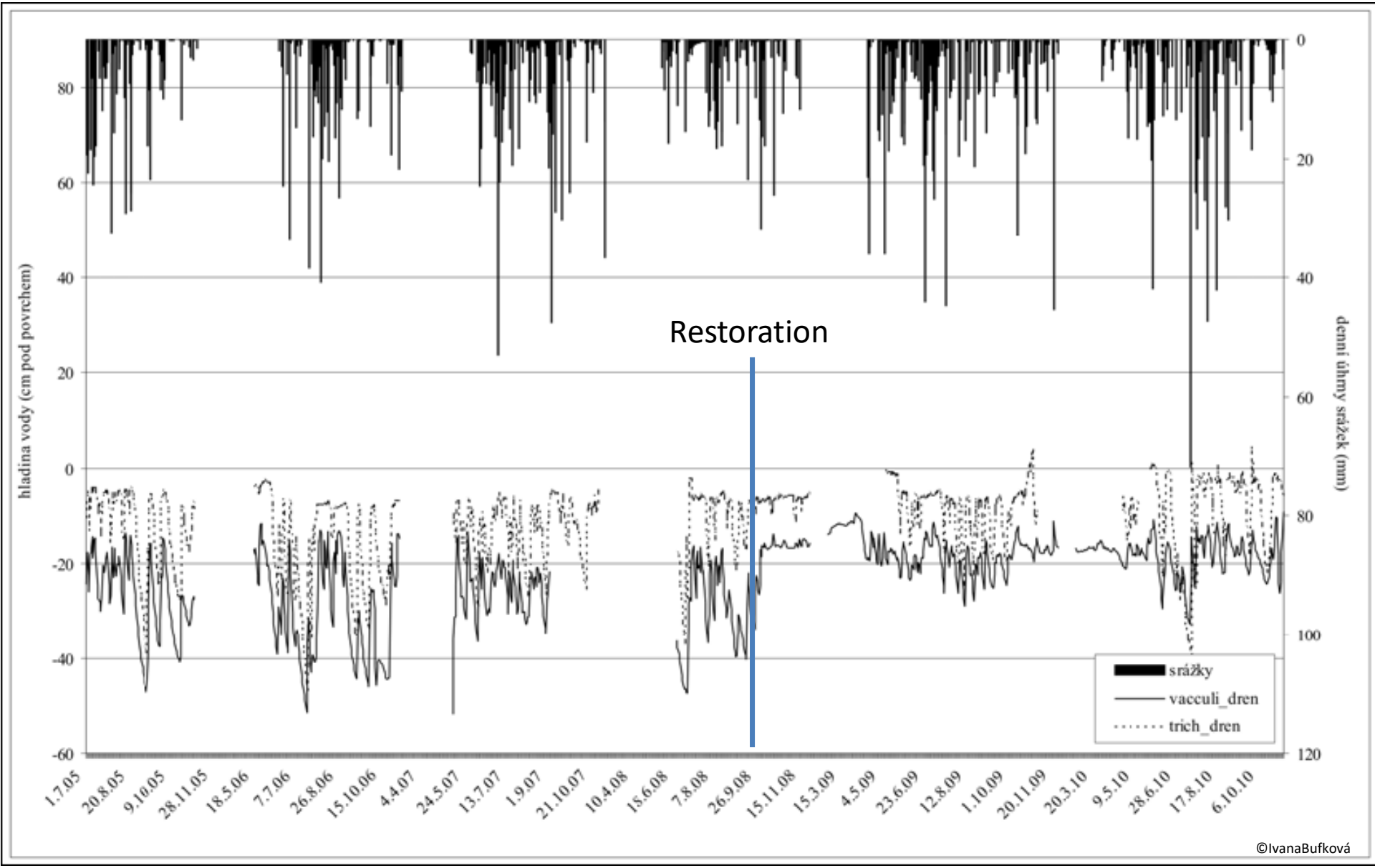




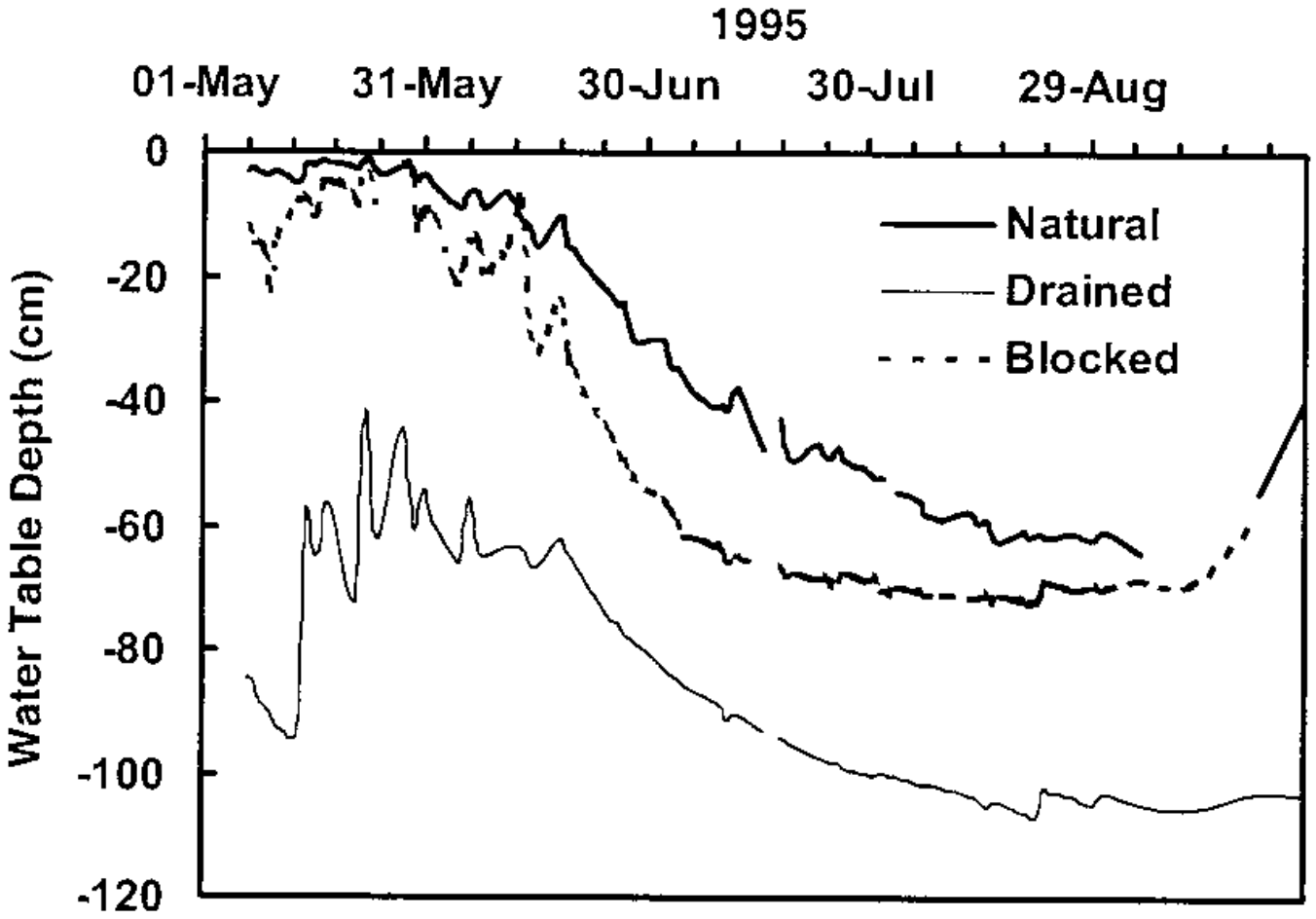
Restoration

- Main aim – increase and stabilize water table, restore the original hydrological regime
- Target water table
- Instalation of dams
- Monitoring
- Evaluation of restoration

WT fluctuation

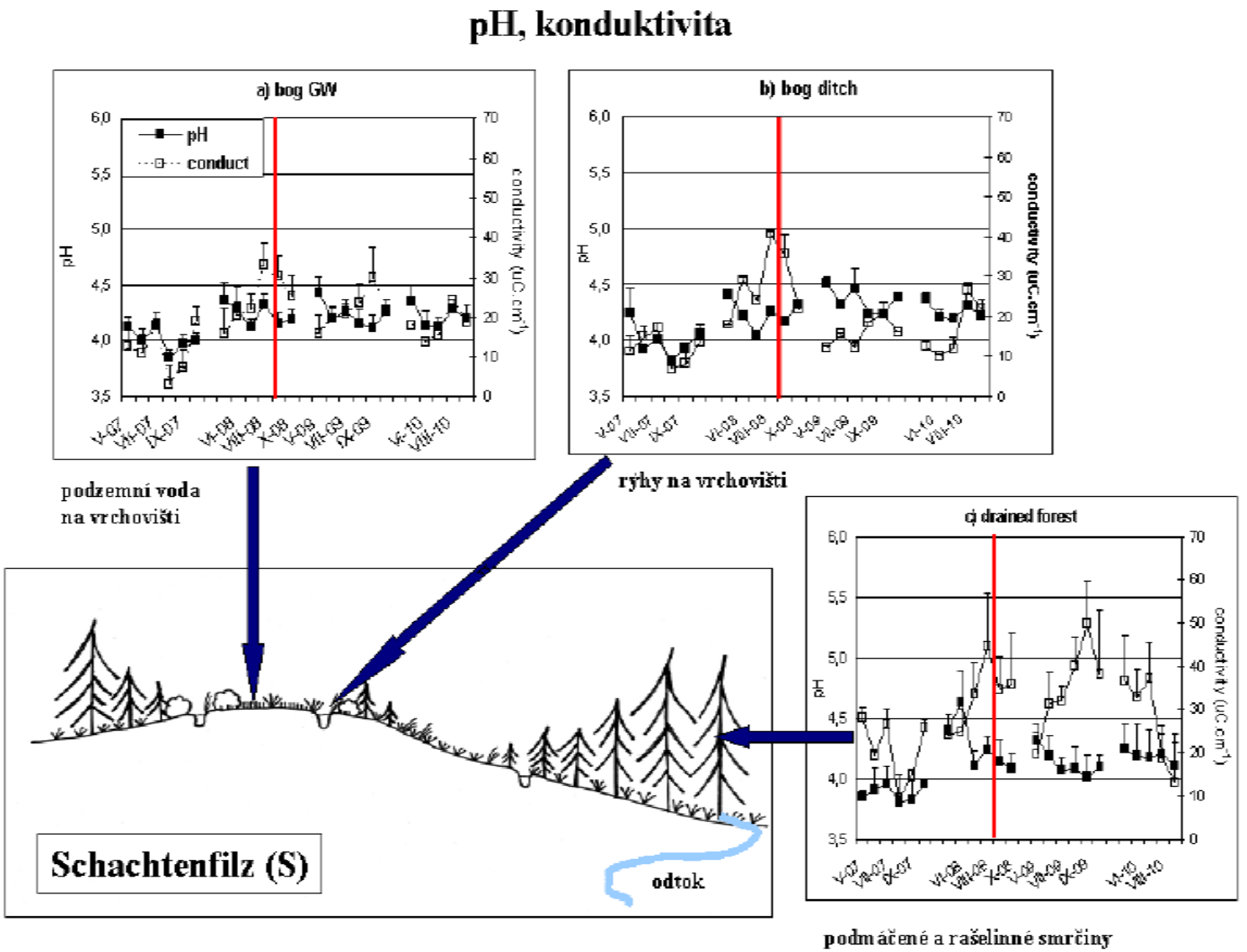


Effect of restoration on water table



Price et al. 2003

pH and conductivity of water on restored site



Before and after restoration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Before and after restoration

Spruce swamp forests


pristine


©Zuzana Urbanová


drained


restored

Risks of wetlands management

Drainage

- Disturbance of hydrology
- faster decomposition of OM and subsidence
- hydraulic properties of soil
- Erosion and nutrient loss
- soil and water chemistry
- vegetation structure
- microbial community and their functioning
- C fluxes and C accumulation

Restoration

- X
- decomposition of dead org. material
- X
- Leaching of nutrients
- X
- Dramatic changes in vegetation and microbial community structure
- C losses

The process of restoration of original functions will take few years or decades till vegetation and microb. community is established

2nd example – restoration of cut-away peatland

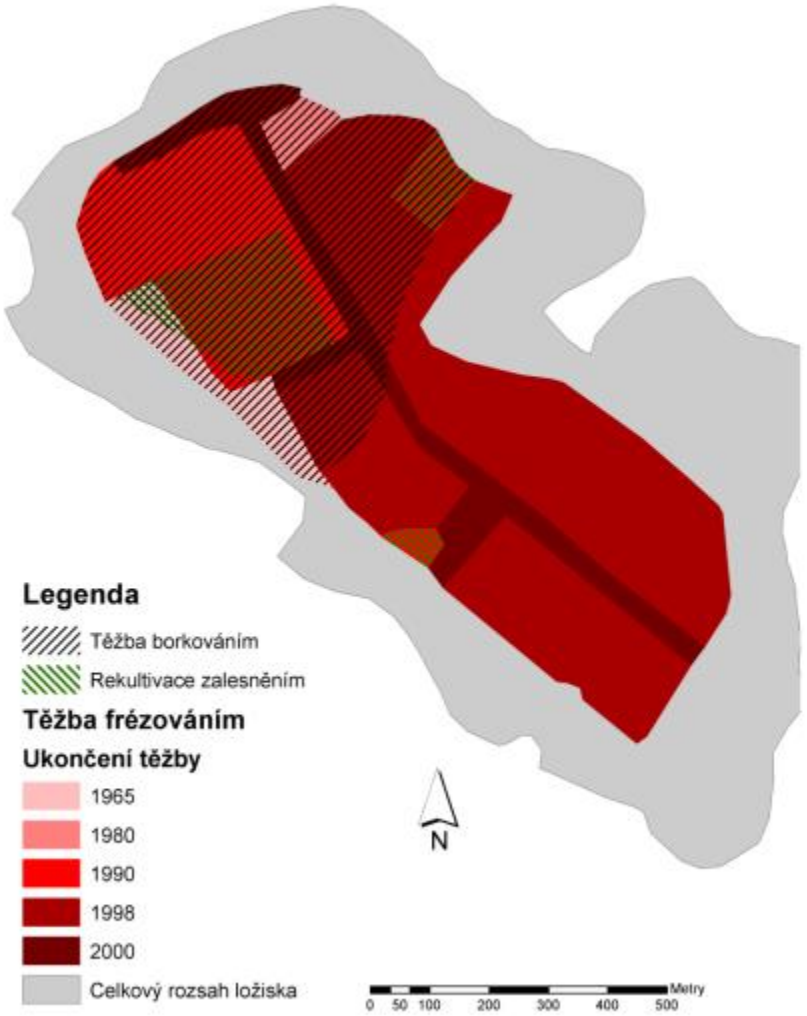
- peat harvesting by milling
- vegetation is totally removed
- very effective drainage

harsh hydrological and microclimatic conditions for naturall revegetation


Detail KM
Souřadnice
1952
500 m
https://kontaminace.cenia.cz/
snímky poskytl VGHMÚř Dobruška, © MO ČR 2009
spolufinancovaném Evropskou unií - Fondem so

Potential original shape of the valley raised bog before mining

Initial state before restoration



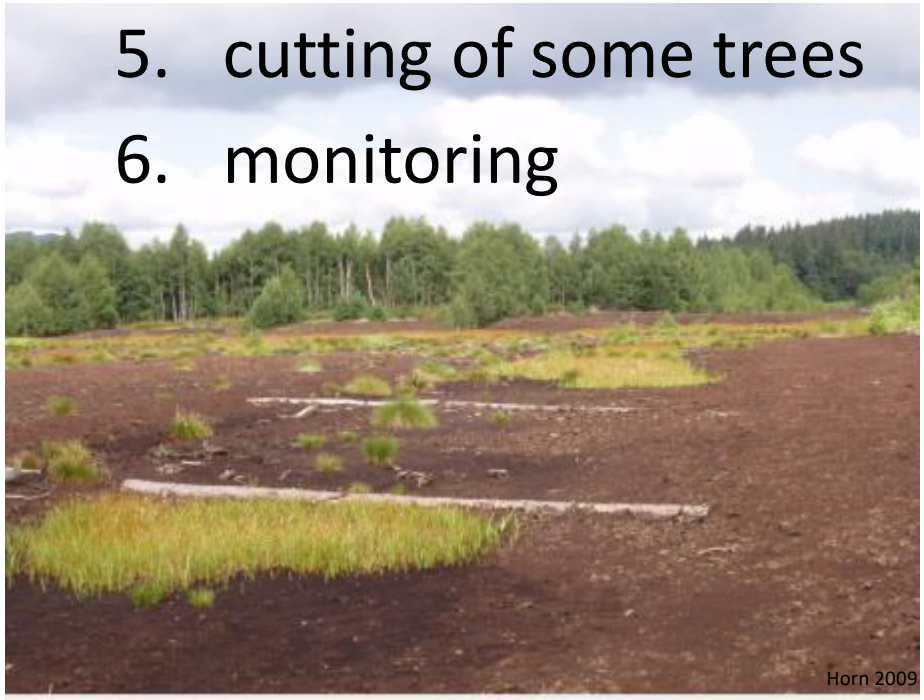
https://mapy.cz/ ; Horn 2009

Before restoration

Horn 2009

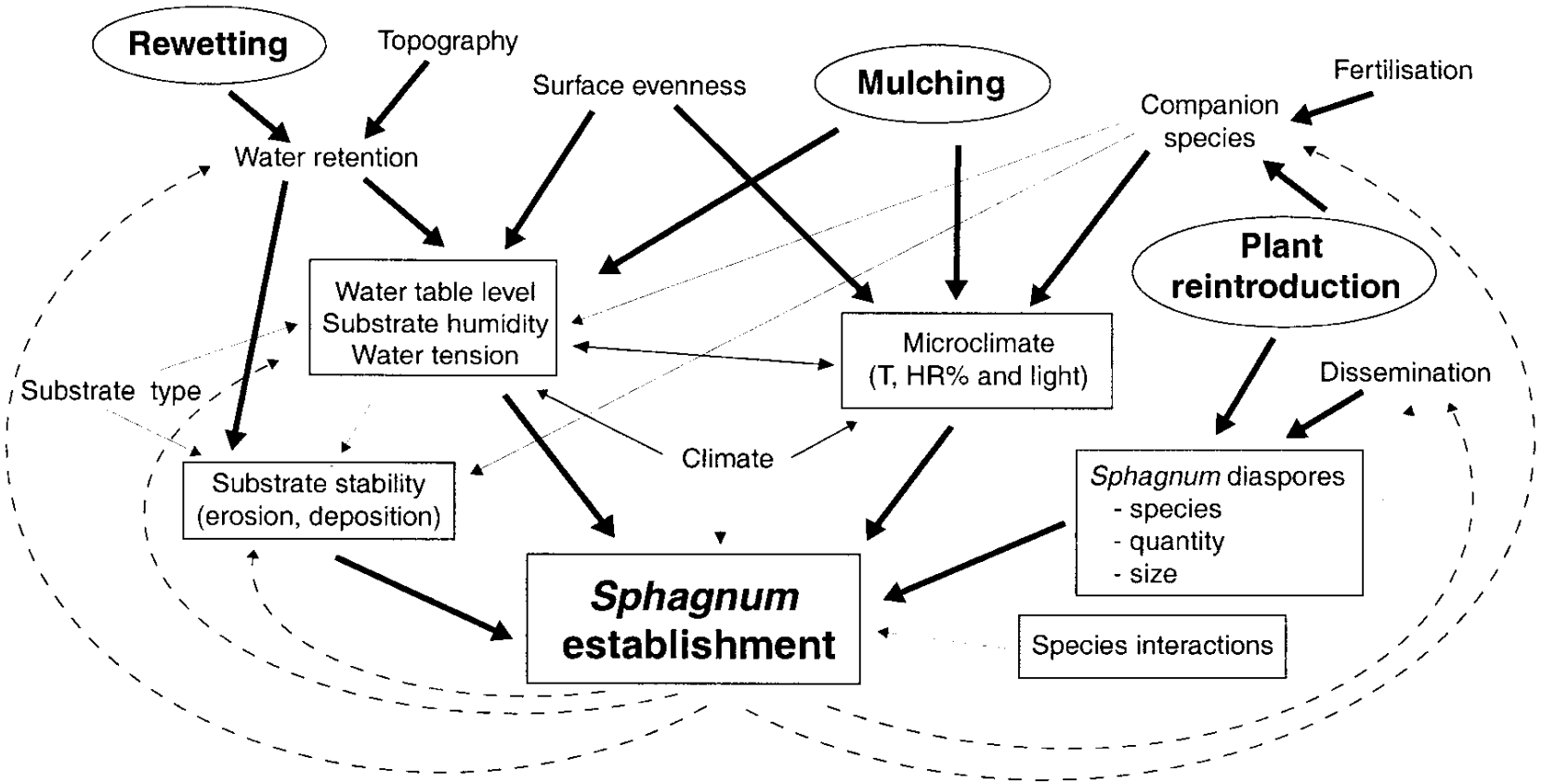
Restoration

1. Blocking and filling of drainage ditches
2. shallow depressions – surface heterogeneity
3. anti-erosion measure
4. spreading of mulch
5. cutting of some trees
6. monitoring


Horn 2009


Horn 2009

The interaction of restoration techniques in the re-establishment of *Sphagnum* mosses on mined raised bogs

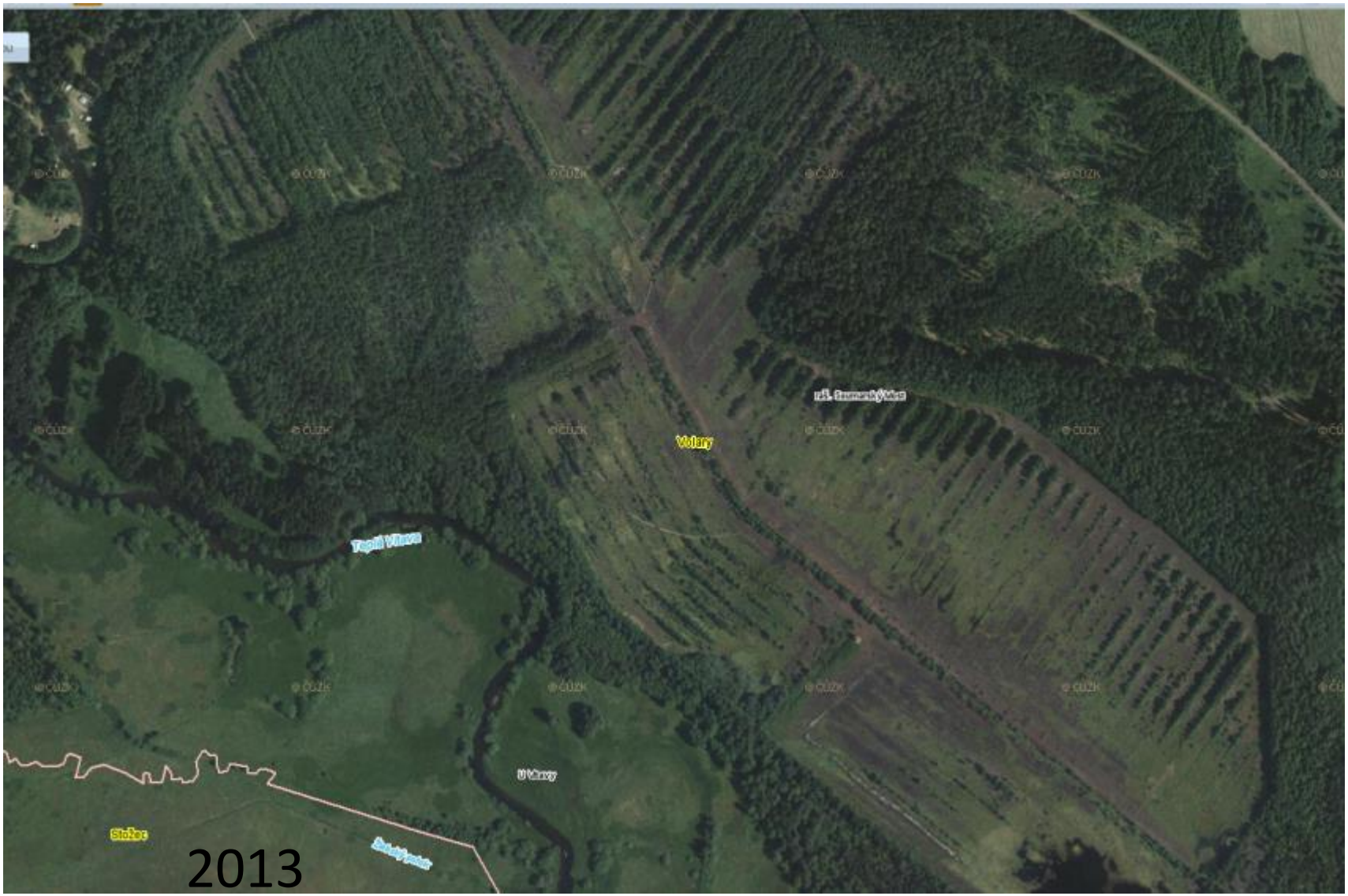


(in Gorham et al. 2003)

Changes following restoration

https://mapy.cz/

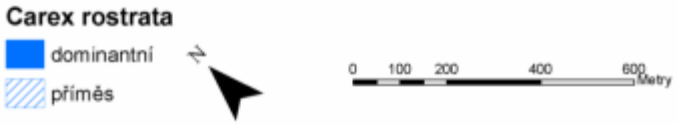
https://mapy.cz/

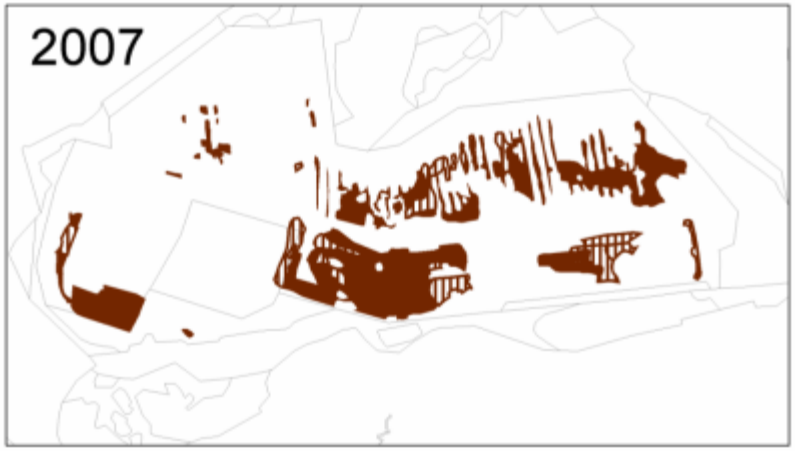


https://mapy.cz/

Vegetation spreading

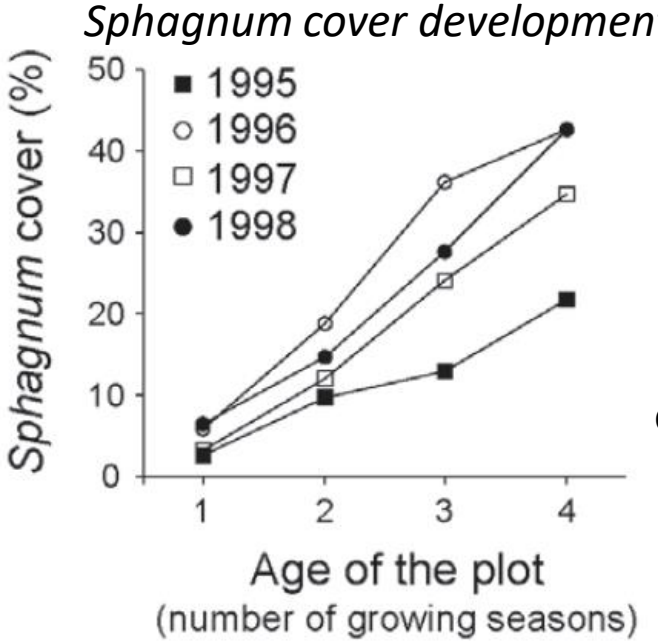
Eriophorum vaginatum in 2000 and 2007



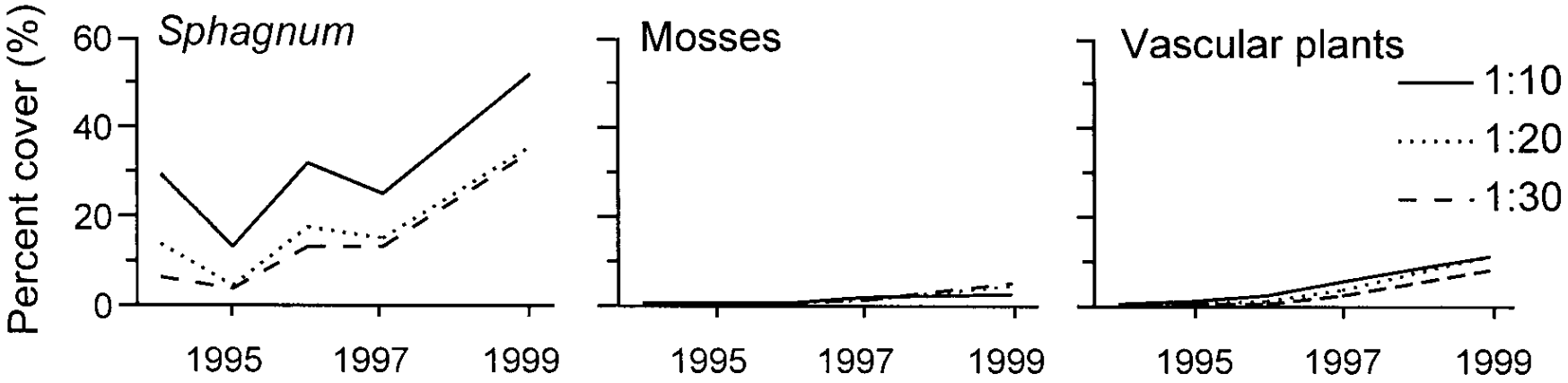


Horn 2009

Evolution of vegetation cover



Chirino et al. 2006



Evolution of percent cover of *Sphagnum,* other mosses and vascular plants from 1994 to 1999

Rochefort et al. 2003

Current state 10 and more years after restoration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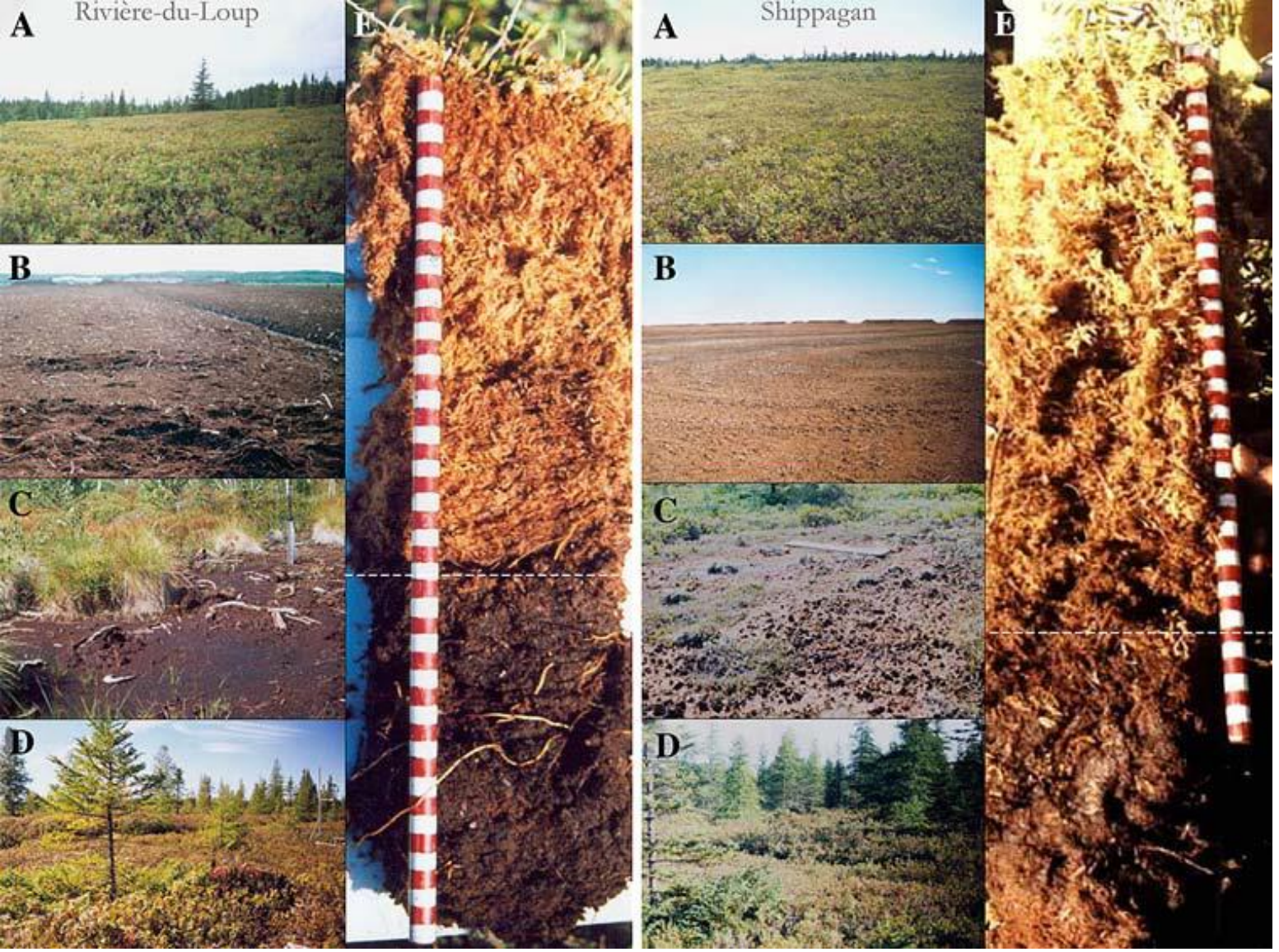


A. Natural bog

B. Mined site

C. mined sites, 30 years abandoned

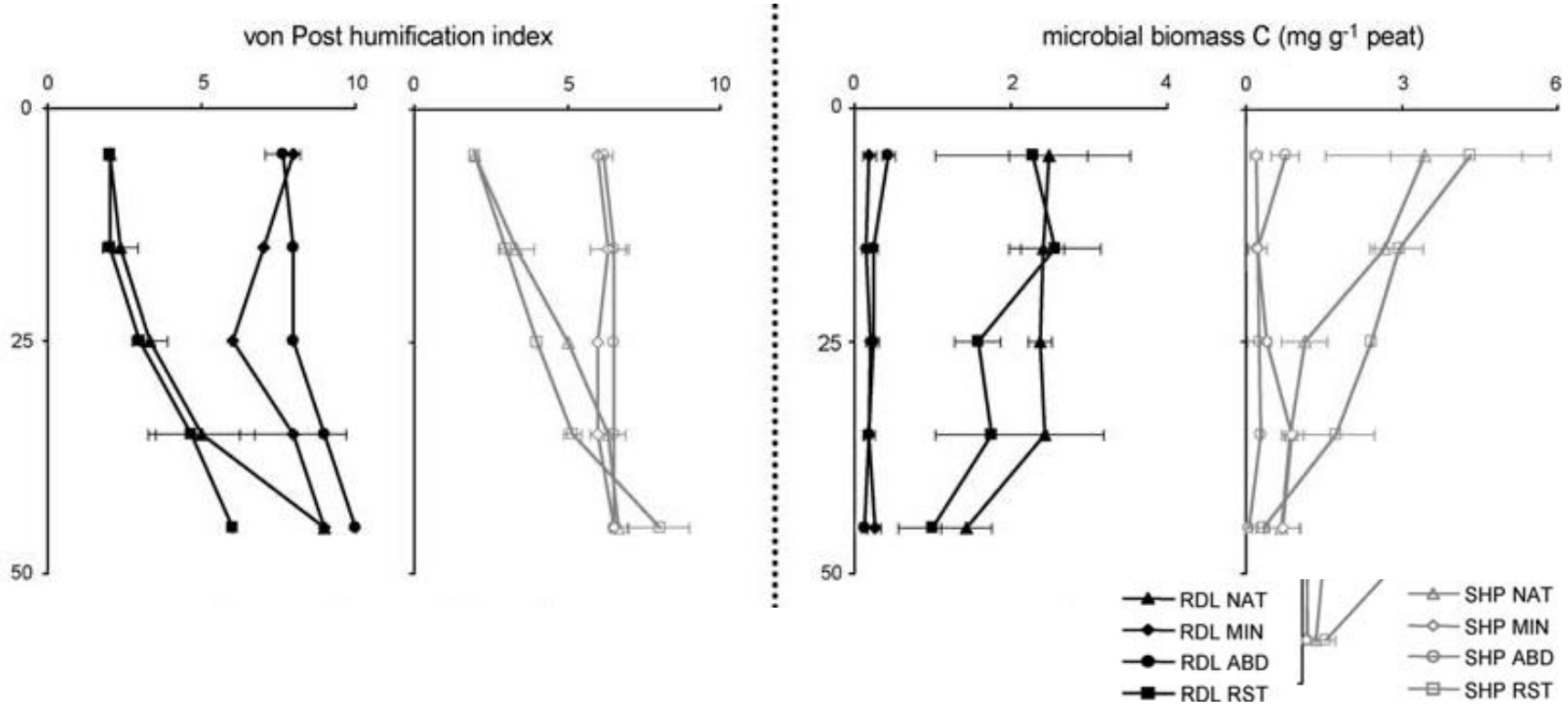
D. Mined sites, actively re-flooded and restored, 30 years

E. The peat profiles cut away from hummocks in the restored sites with dotted line marking the previous surface after mining.

(Basiliko et al. 2007)

Regeneration of peat properties and microbial community

von Post humification index, microbial biomass C



active accumulation of peat = regeneration

(Basiliko et al. 2007)

3rd example – stream/river restoration

- intensive stream regulation in past

  decrease of water retention capacity

  faster outflow

  decrease of biodiversity and heterogeneity

  decrease water quality

http://strednicechy.ochranaprirody.cz/pece-o-vodni-rezim-krajiny/revitalizace-vodnich-toku/

https://mapy.cz/

Stream restoration

- set of activities that help improve the environmental health of a river or stream
- aim to restore the natural state and functioning of the river system (support of biodiversity, recreation, flood management and landscape development)
- achieving a self-sustaining, functional flow regime in the stream system that does not require periodic human intervention
- number of sequential steps (planning, designing, funding, constructing, monitoring)

http://www.ecmost.cz/clanky.php?page=revitalizace_voda; http://enviregion.pf.ujep.cz/inter_uc/2st/main.php?kap=a7p&iddata=050

Restoration techniques

1. modification of stream channel (chanel shape,profile, microtopography, meanders)

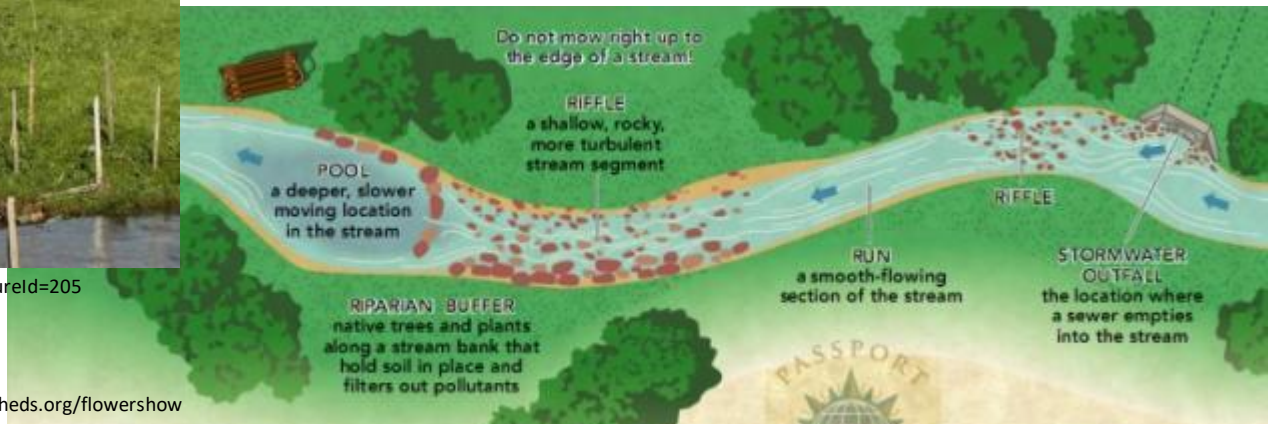
http://www.koaliceproreky.cz/temata/revitalizace-vodnich-toku/

https://lesycr.cz/sprava-vodnich-toku-a-bystrin/revitalizace-vodnich-toku/

Restoration techniques

1. modification of stream channel (chanel shape,profile, microtopography, meanders)
2. support natural erosion/accumulation

http://www.dotace.nature.cz/galerie-oparteni/?arrangementId=39&pictureId=205



http://www.phillywatersheds.org/flowershow

Restoration techniques

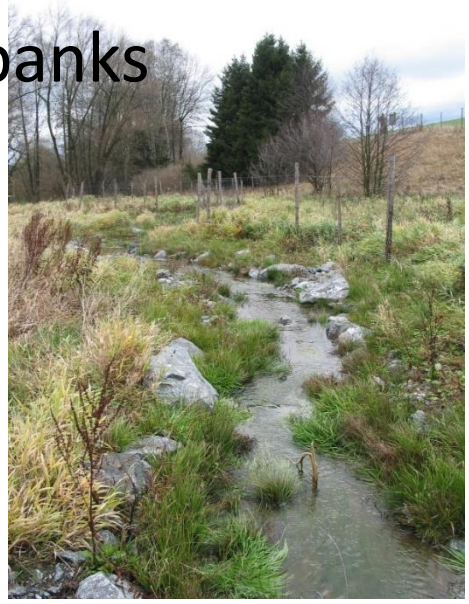
1. modification of stream channel (chanel shape,profile, microtopography, meanders)
2. support natural erosion/accumulation
3. removing of barriers/ reintroduction of large woody debris, boulders

http://vodnihospodarstvi.cz/revitalizace-litovickeho-potoka/

Restoration techniques

1. modification of stream channel (chanel shape,profile, microtopography, meanders)
2. support natural erosion/accumulation
3. removing of barriers/ reintroduction of large woody debris, boulders
4. stabilization of stream banks

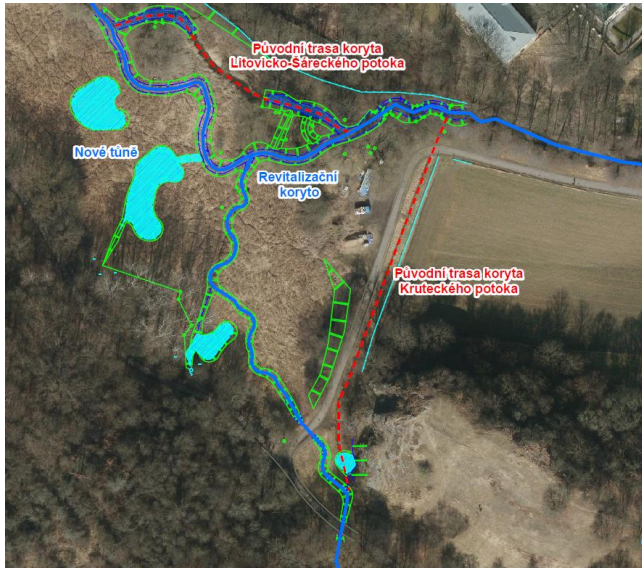
http://strednicechy.ochranaprirody.cz/pece-o-vodni-rezim-krajiny/revitalizace-vodnich-toku/



https://arnika.org/revitalizacni-projekty-v-cr

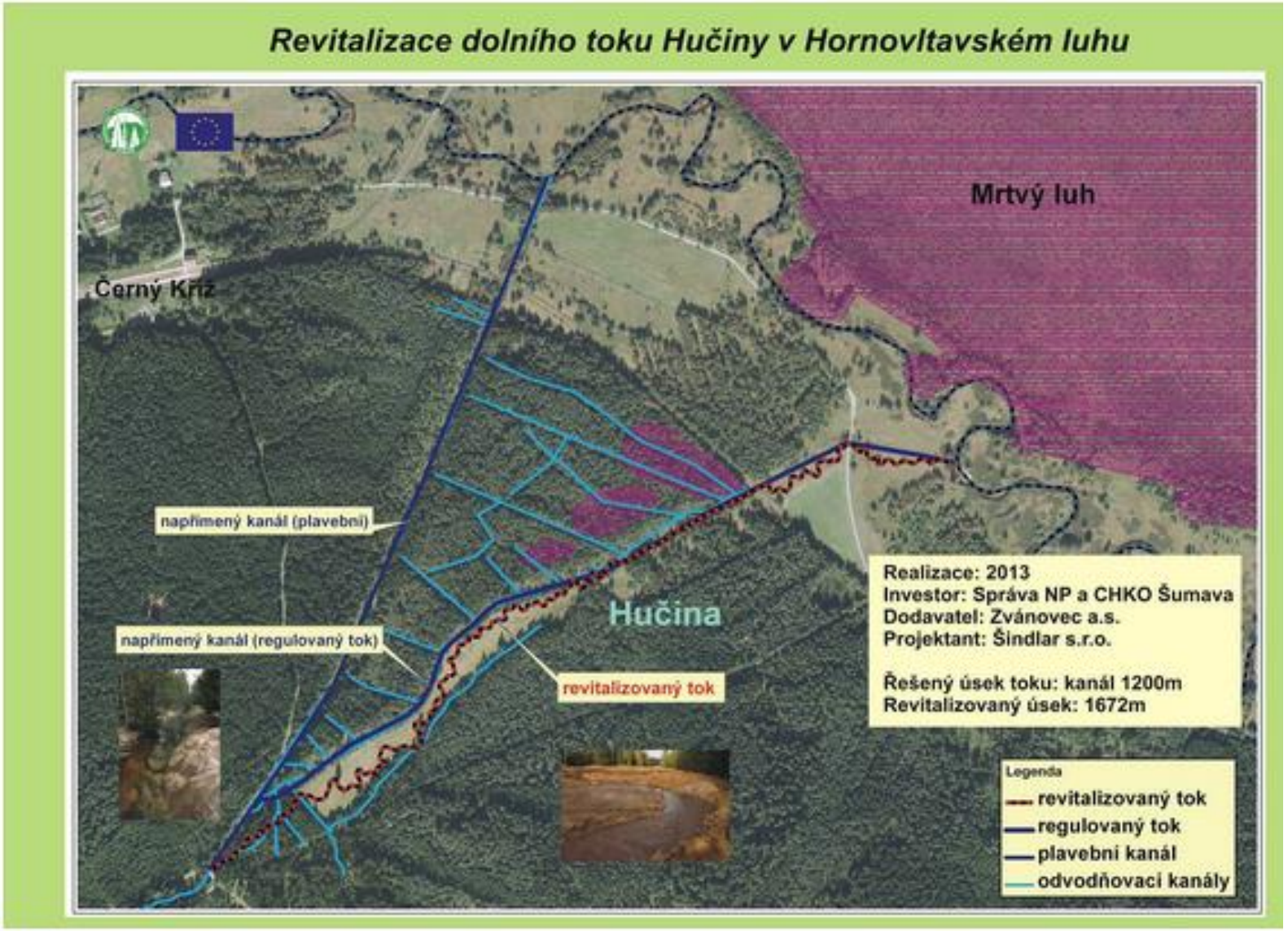
Restoration techniques

1. modification of stream channel (chanel shape,profile, microtopography, cross sections, meanders)
2. support natural erosion/accumulation
3. removing of barriers/ reintroduction of large woody debris, boulders
4. stabilization of stream banks
5. channel capacity



http://www.praha-priroda.cz/vodni-plochy-a-potoky/vodni-toky/litovicko-sarecky-potok/revitalizace-a-opravy-na-litovicko-sareckem-potoce/revitalizace-v-lokalite-jeneralka/

Example of small stream restoration



Obr. 1: Situační mapka revitalizovaného úseku Hučiny (autor I.Bufková)

Before restoration

Obr.2: Regulované koryto Hučiny (foto I.Bufková)

After restoration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