Interactions between Human Activities and the Structure and Functioning of Wetland Ecosystems

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Crucial question:

What is the "wise use of wetlands" postulated by the Ramsar Convention?

- **Wise use = sustainable management = long-term maintenance of wetland ecosystem services**
- **Examples discussed:**
- **I. Fishponds and their reed-dominated littoral zones (= reed belts formed by helophytes)**
- **II. Mires (= bogs and fens)**
- **III. Wet grasslands in inundation areas of fishponds and in floodplains**
- **IV. General evaluation: wetland functioning as the basis of wetland ecosystem services**

I. Fishponds and their reed-dominated littoral zones

Production ecology of fishponds and their littoral zones. Studied within the IBP (1965-74) and UNESCO´s MaB program (since 1976)

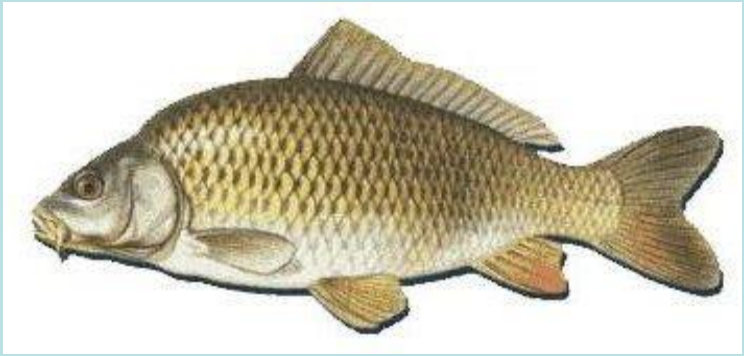
Reed decline in fishpond and lake littoral zones. Studied within two EUREED EU Projects (1993 - 1998)

WHAT IS A FISHPOND ?

An artifical shallow water reservoir used for fish production, with the possibility of a complete and periodical drawdown.

MAIN FISH SPECIES REARED IN CENTRAL EUROPEAN FISHPONDS:

Common carp (*Cyprinus carpio*) 88 %
(17 000 tons per year in the C.R.)
Grass carp (*Ctenopharyngodon idella*) plus
Silver carp (*Hypophthalmichthys molitrix*) 4 %
Tench (*Tinca tinca*) 1 %
Pike (*Esox lucius*)
Pikeperch (*Sander lucioperca = Stizostedion l.)*
Catfish *(Silurus glanis)*



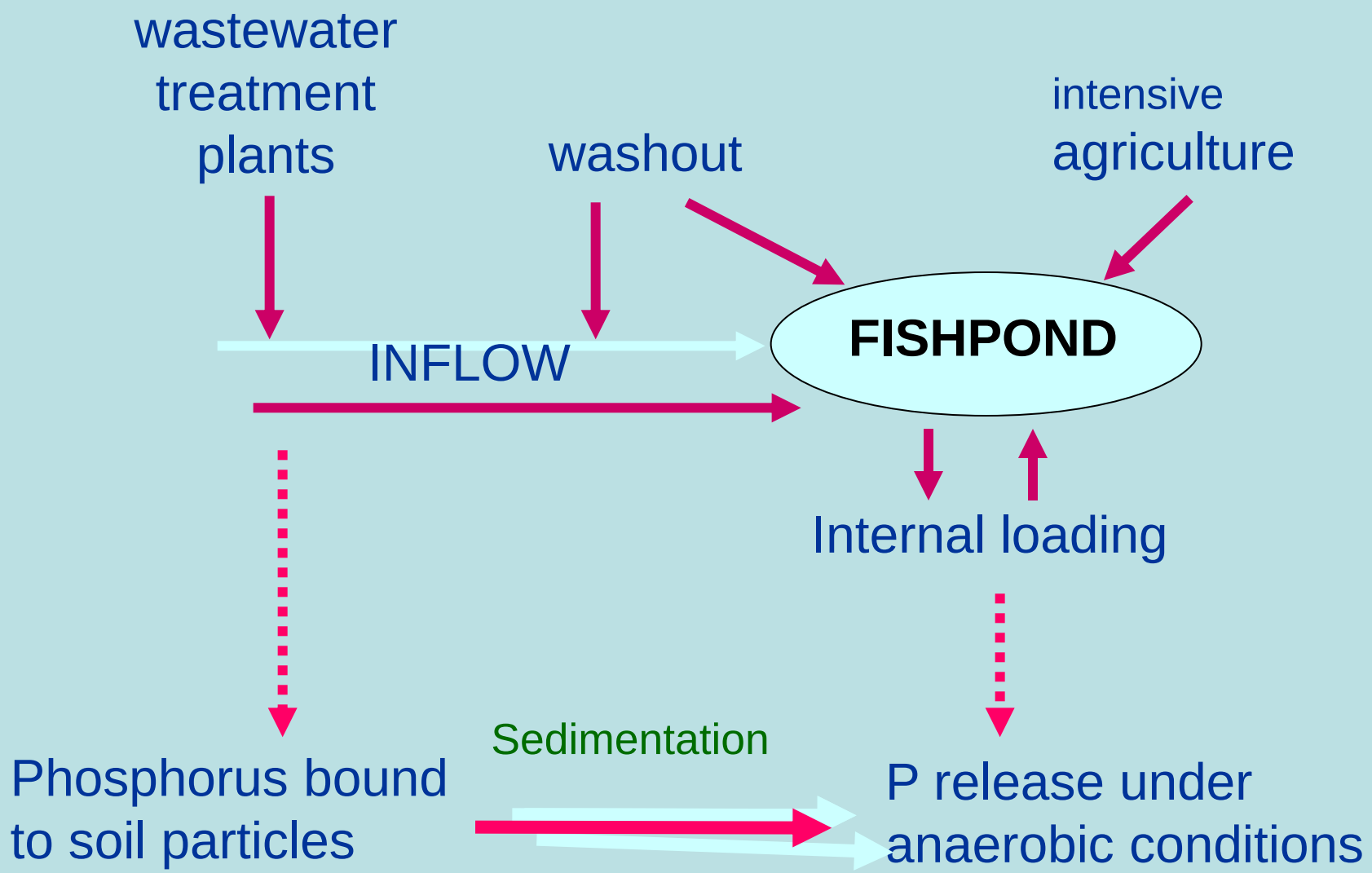
Common carp – market size about 40 cm

FISH HARVEST

DEVELOPMENT OF FISHPOND MANAGEMENT in the present Czech Republic

Period	Area *thous. ha*	Production *Kg.ha^{-1}*
12th cent.	unknown	
14th cent.	75	40
16th cent.	180	40
18th cent.	79	30
1850	35	25
1924	44	81
1956	50	137
1965	50	210
1975	51	328
1985	52	393
1995	52	423

HYPER-EUTROPHY OF FISHPONDS



Water bloom of *Microcystis* (Cyanobacteria) (Opatovický fishpond, August 19, 2002)

BIODIVERSITY DECLINE IN FISHPONDS

Increased intensity of fish farming
=
Biodiversity decline

Plants of clean water → Ruderal plants

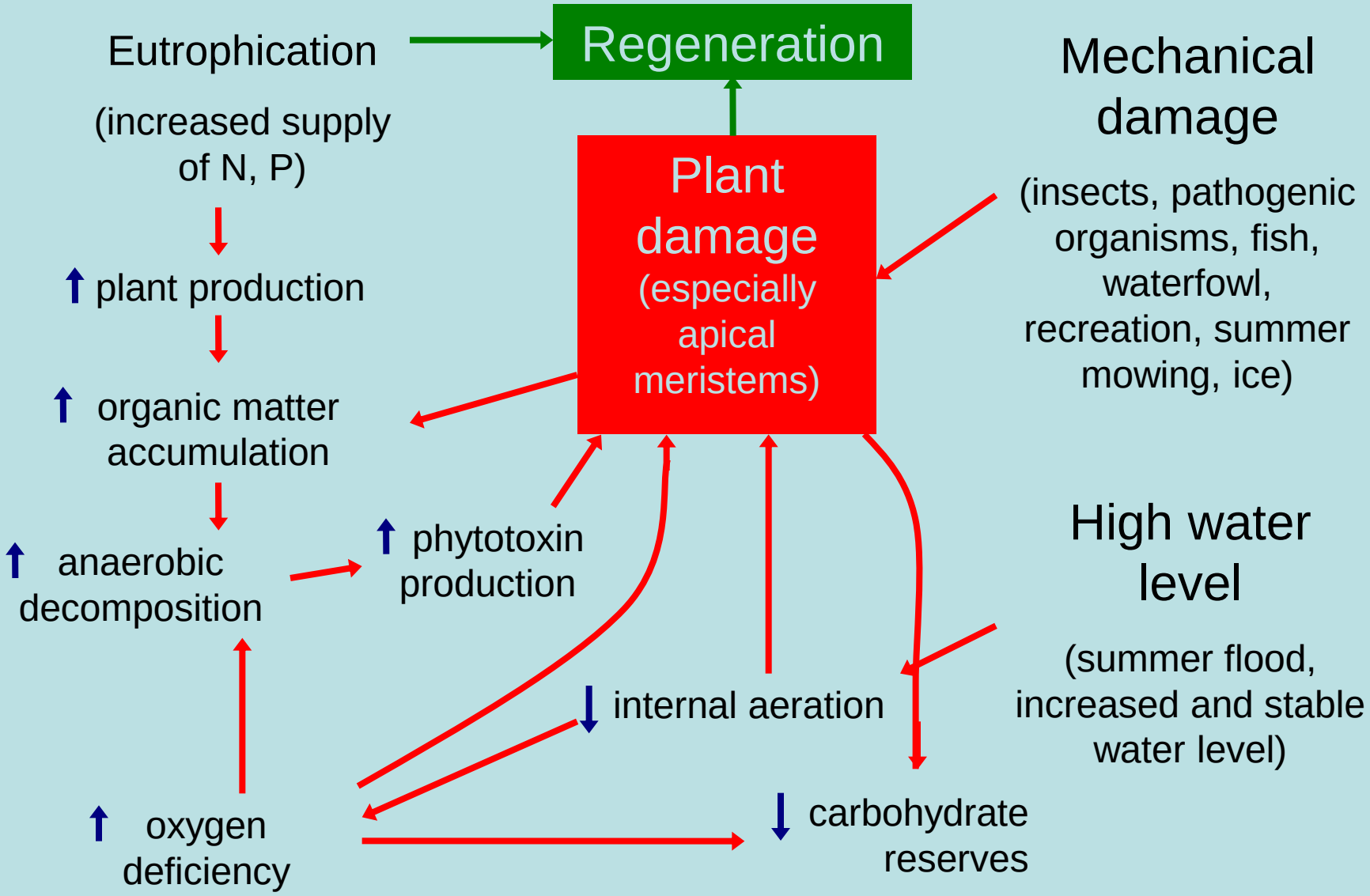
High fish feeding pressure → Benthos decline

Decline of bird species richness

Reed decline in hyper-eutrophic habitats

Littoral of Rožmberk fishpond (western shore), South Bohemia, Czech Republic

Factors affecting reed decline



Properties of flooded soils

Flooding of soil pores:

↓

1. **Oxygen deficiency**
2. **Toxic products of microbial metabolism:**

- Reduced iron and manganese,
- Hydrogen sulphide
- Organic acids, etc.

Reed root systems in:

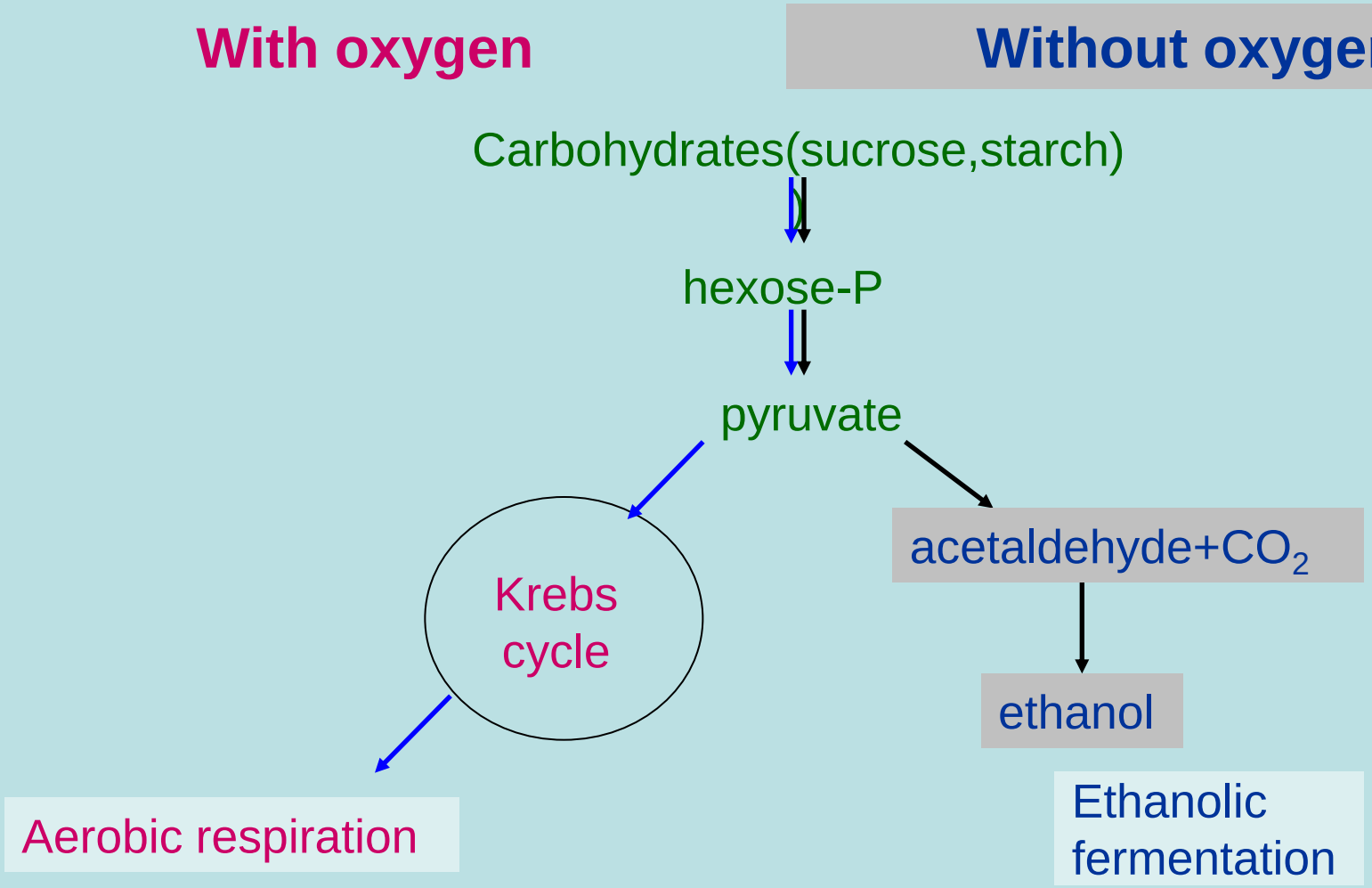
Oligotrophic habitat

Photo A. Soukup

Hyper-eutrophic habitat

Photo A. Soukup

Metabolic pathways:



Reserve carbohydrates - essential for survival under anoxic or anaerobic conditions

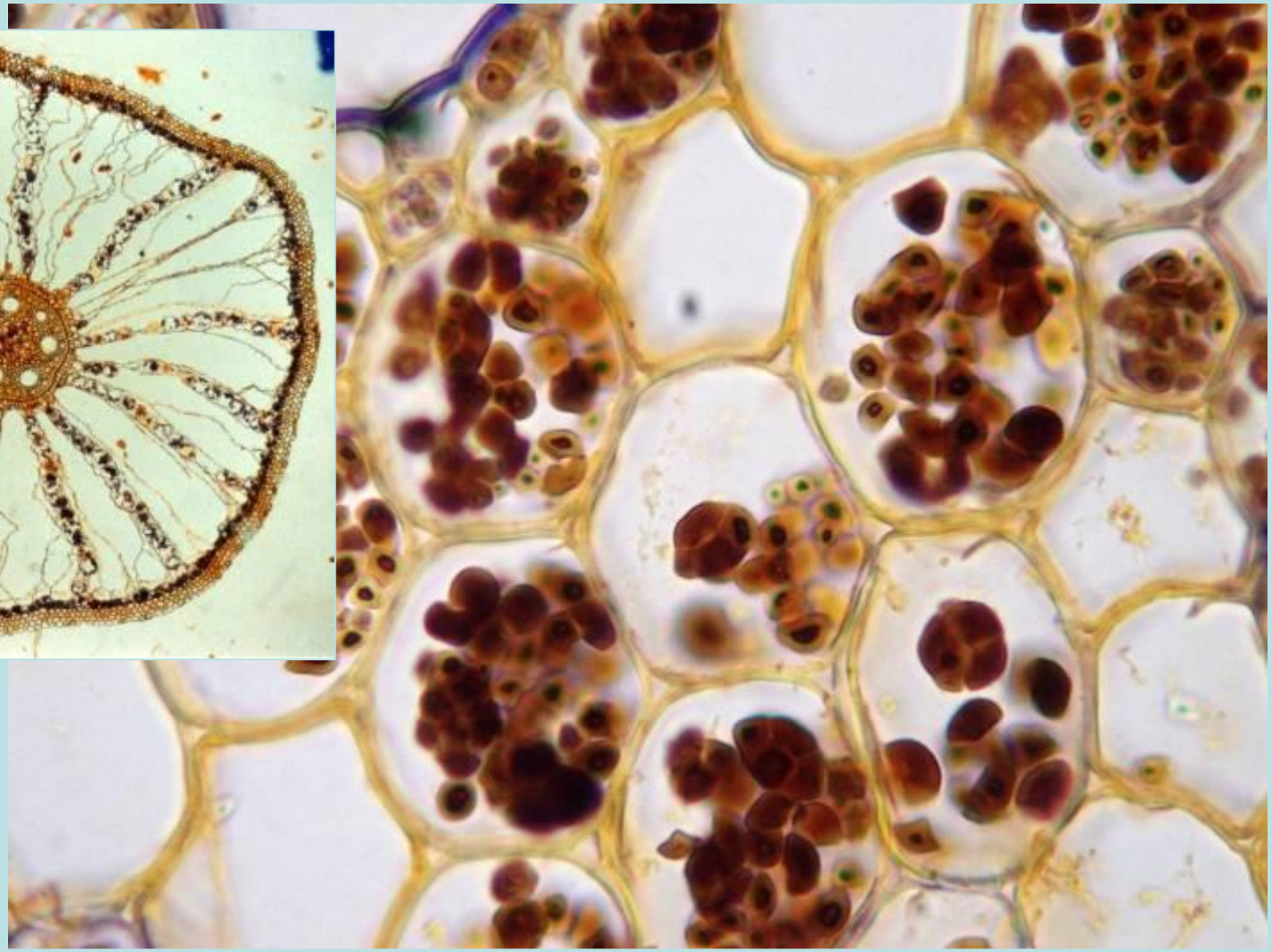
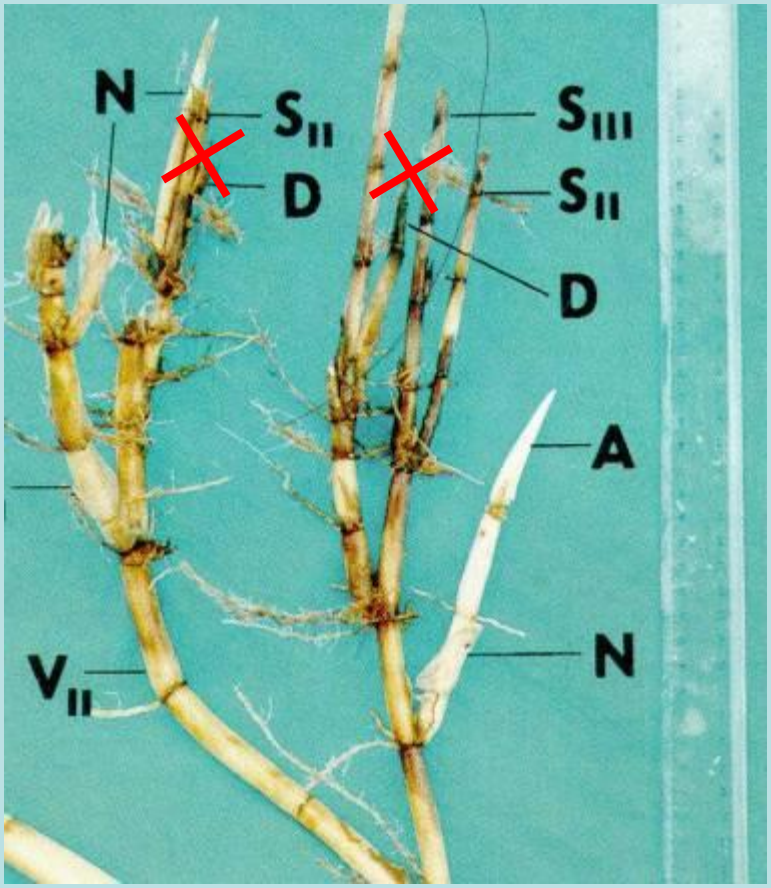


Photo A.Pecháčková

The weakest point:
damaged apical meristems



Management supporting the growth of reed stands in fishpond littoral zones:

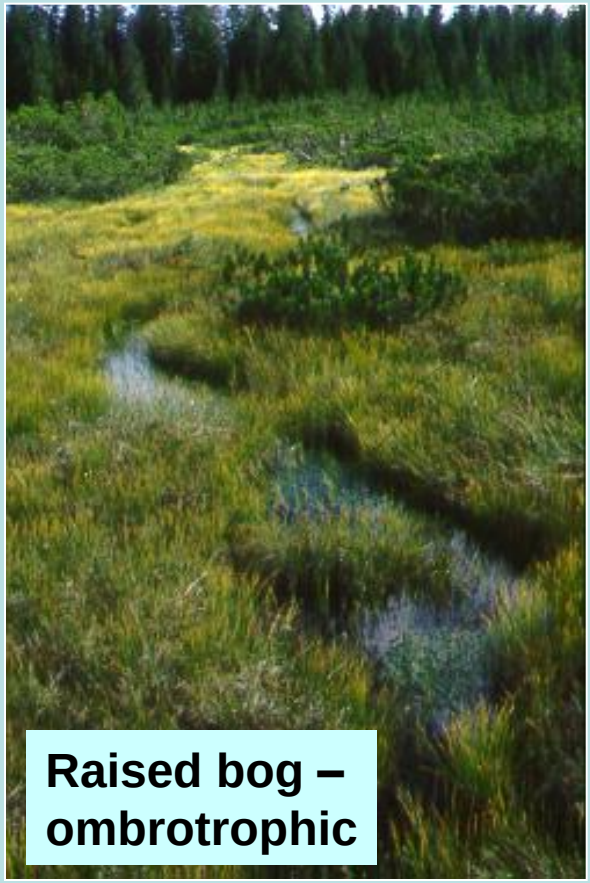
- **Partial drawdown at any time(= smaller risk of oxygen deficiency)**
- **Complete drawdown in the growing season (= substrate oxidation)**
- **Lower fish stock density (= smaller mechanical damage)**
- **Mechanical protection (fence) (= smaller mechanical damage)**
- **Winter cutting (= less substrate for decomposition, better light penetration in spring)**
- **Reduced runoff from surrounding agricultural land**

  (= reduced eutrophication)

II. Mires

<u>Specific features:</u> Impermeable subsoil, hence water-logging, incomplete decomposition of organic materials and peat formation.

Main types of Central European mires:



Raised bog – ombrotrophic

Transition mire – combined water supply

Fen - minerotrophic

Photos: A. Kučerová

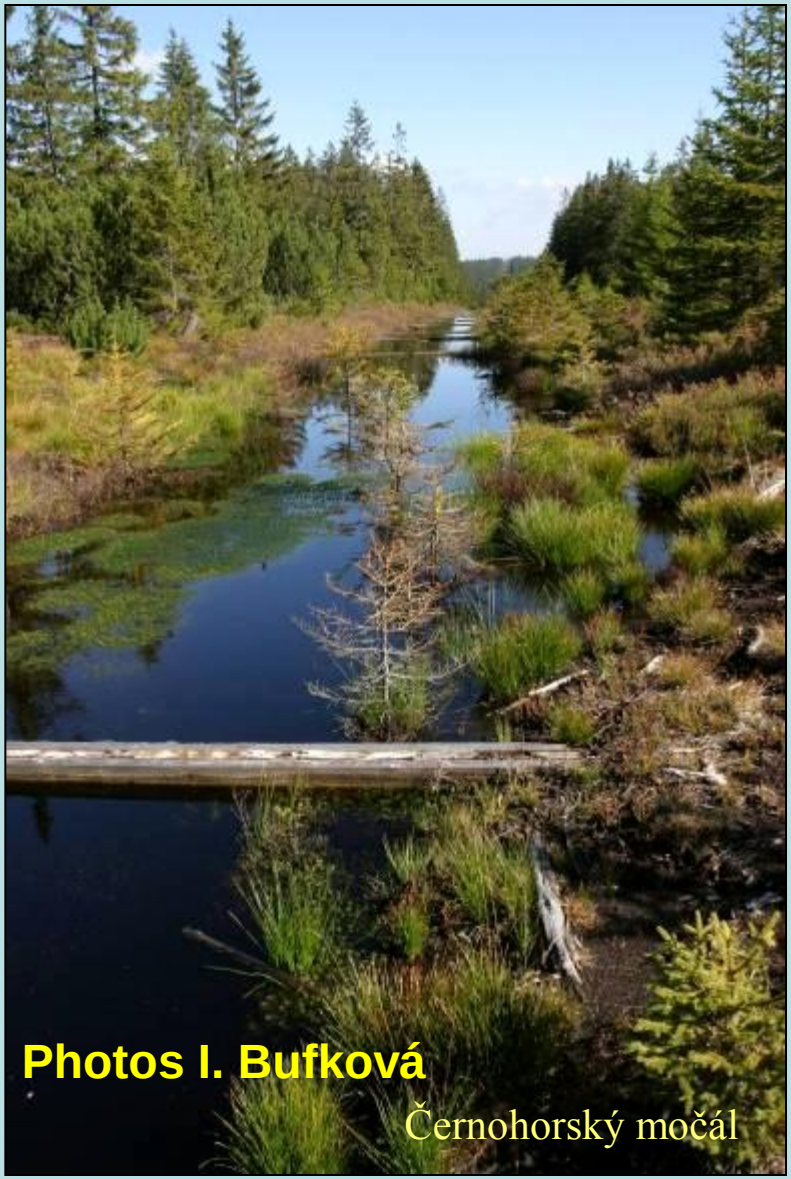

Spontaneously regenerating bog after peat extraction in the traditional way – excavation of peat bricks by hand
Photo J. Ševčík

Program of mire restoration within the “Šumava Mires“ Ramsar site, Czech Rep.

- **CONCEPT OF TARGET WATER LEVEL:**
- **lifting and stabilization of water table at the ± original level**
- **retardation of surface discharge**
- **water retention during dry periods**

Blatenská slať

Gentle performance without heavy machinery



Photos I. Bufková

Černohorský močál

III. Wet grassland: marginal wetland ecosystem in inundation areas of fishponds and in river floodplains

Ecological studies since 1976 (MaB projects)

“Wet Meadows“ near Třeboň, LTER site:

Aboveground biomass and production

Inter-annual variation of seasonal maximum aboveground biomass

in the “Wet Meadows“ sedge-grass marsh

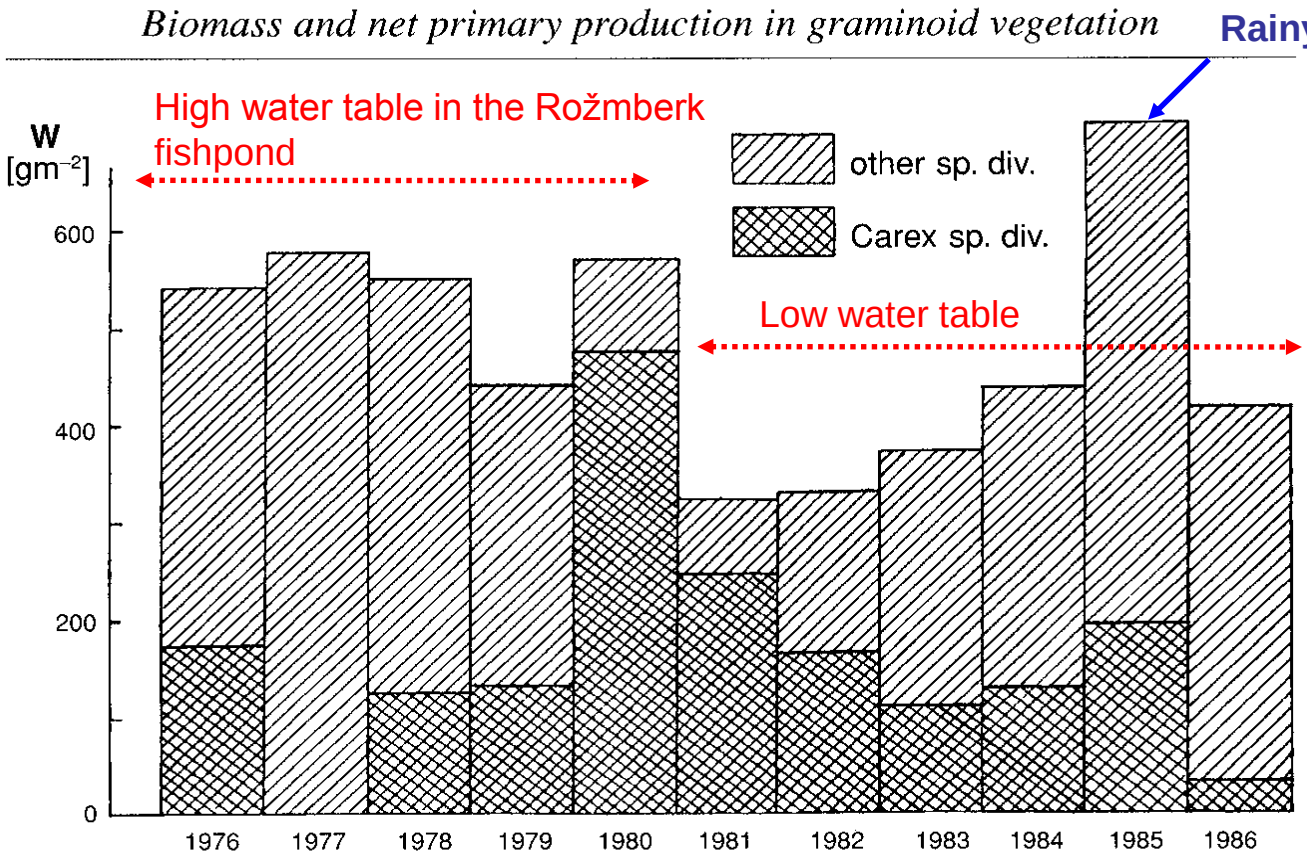


Figure 21.2 Seasonal maximum aboveground biomass, W (g m^{-2} of dry mass) in an unmown stand of a sedge–grass community of the association *Caricetum gracilis* in the Wet Meadows in 11 successive years. The biomass of *Carex* spp. is shown separately, other species are predominantly *Calamagrostis canescens*

Wetlands Hydrology: human interference with it should be cautious, because

wetlands play an important role in local, regional and global water budgets and hydrological cycles, especially:

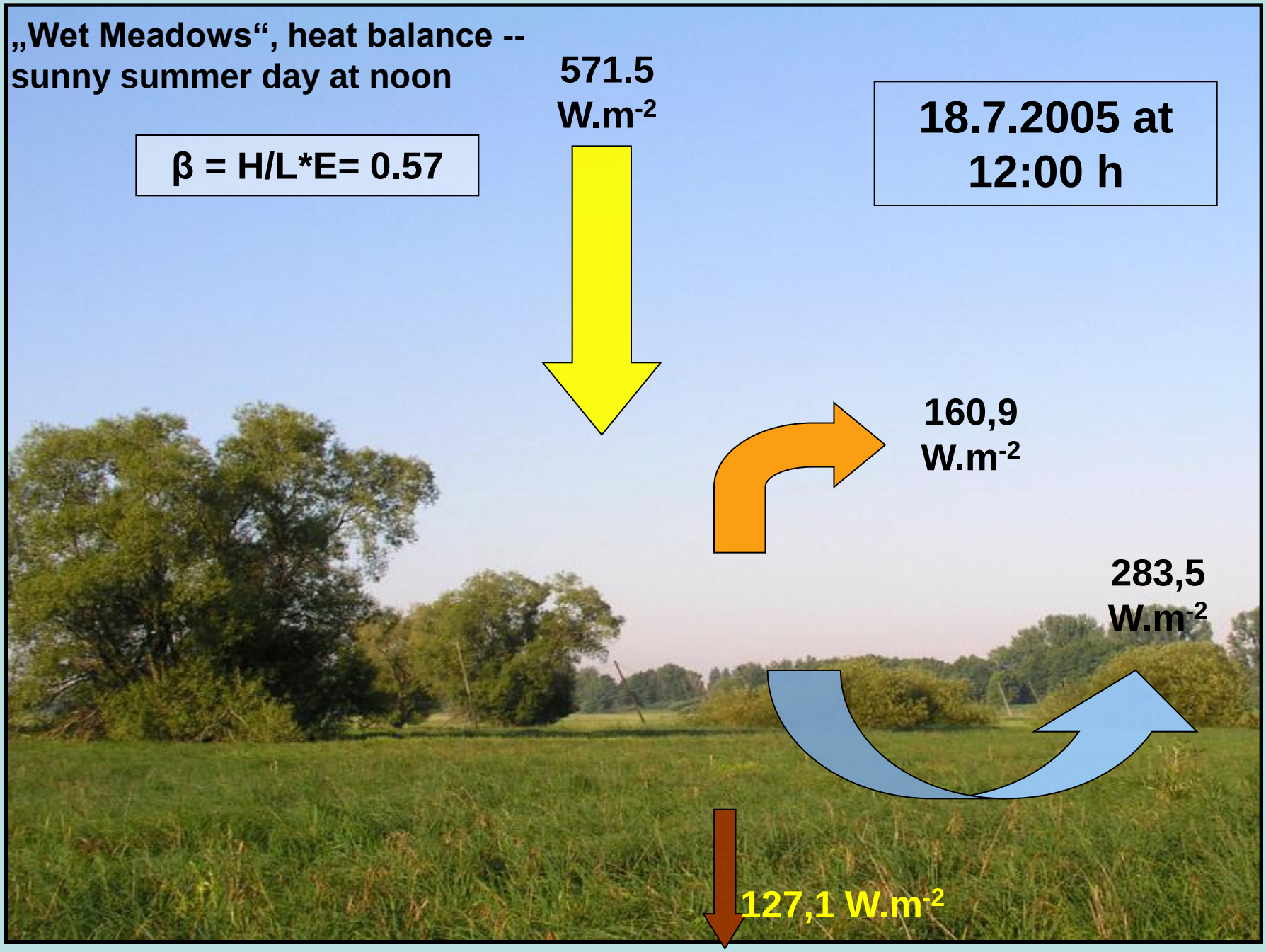
- **Evapotranspiration of wetlands is nature's powerful air-conditioning tool.**
- **Water retention in wetlands slows down water discharge from catchments and damps water-level fluctuations in both standing and running waters.**

A relatively undisturbed floodplain peforms these roles very well !

Photo D. Pithart: Lužnice River floodplain in the TBBR

Severely modified watercourses and floodplains lose these beneficial functions

Restoration of a more (near-)natural state of such a floodplain is impossible without great and costly investments


„Wet Meadows“, heat balance --
sunny summer day at noon
β = H/L*E= 0.57
571.5
W.m-2
18.7.2005 at
12:00 h
160,9
W.m-2
283,5
W.m-2
127,1 W.m-2

Important role of wetlands:

NATURAL FLOOD CONTROL

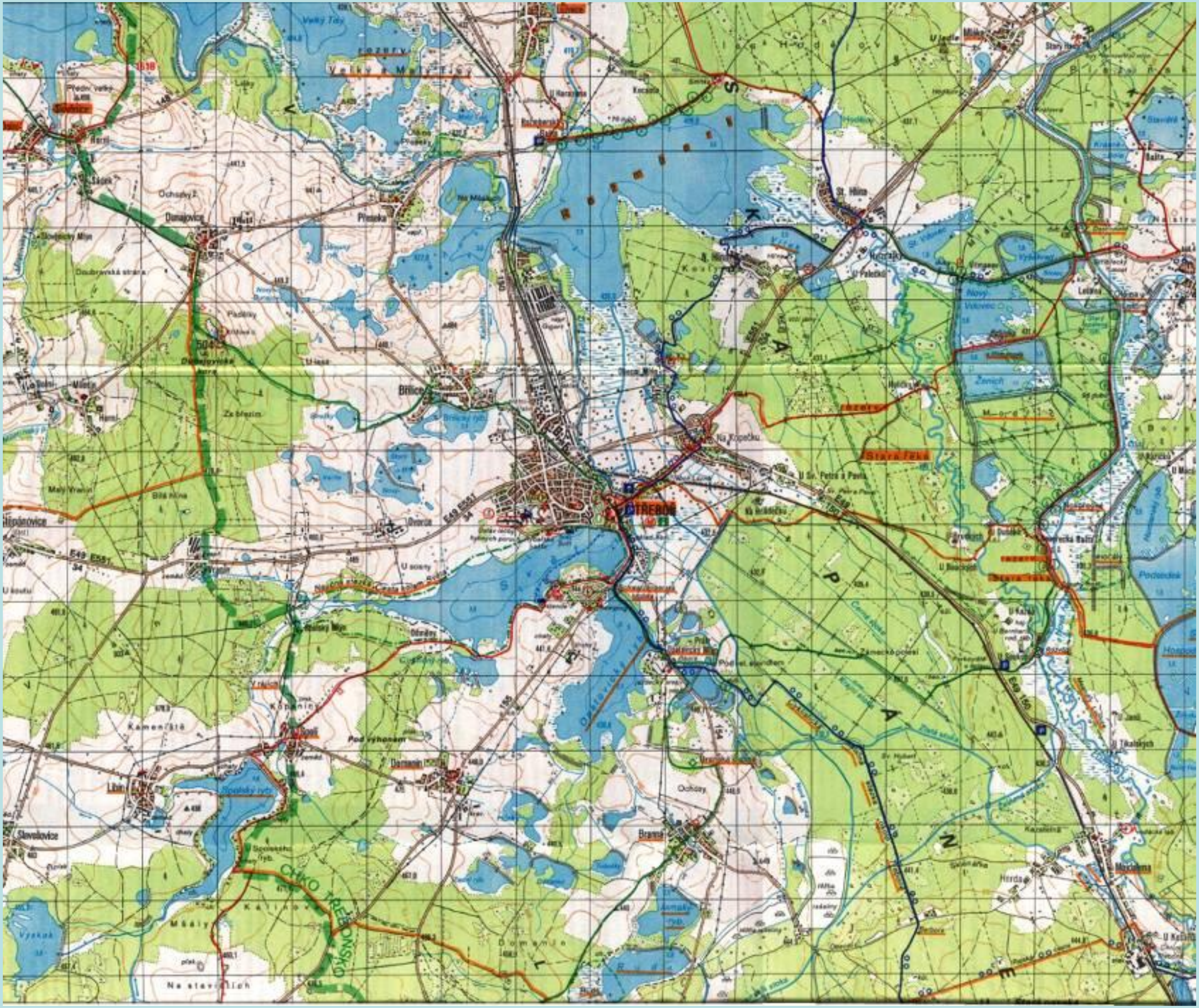
- **Slowing down of run-off, infiltration**
- **Storage capacity for water in the catchment (fishponds, alluvial forests,wet meadows, mires, etc.)**
- **Reduced and delayed water discharge, transformation of flood wave and protection of regions situated downstream**

Water retention in floodplains of rivers and in fishponds, incl. wet grassland:

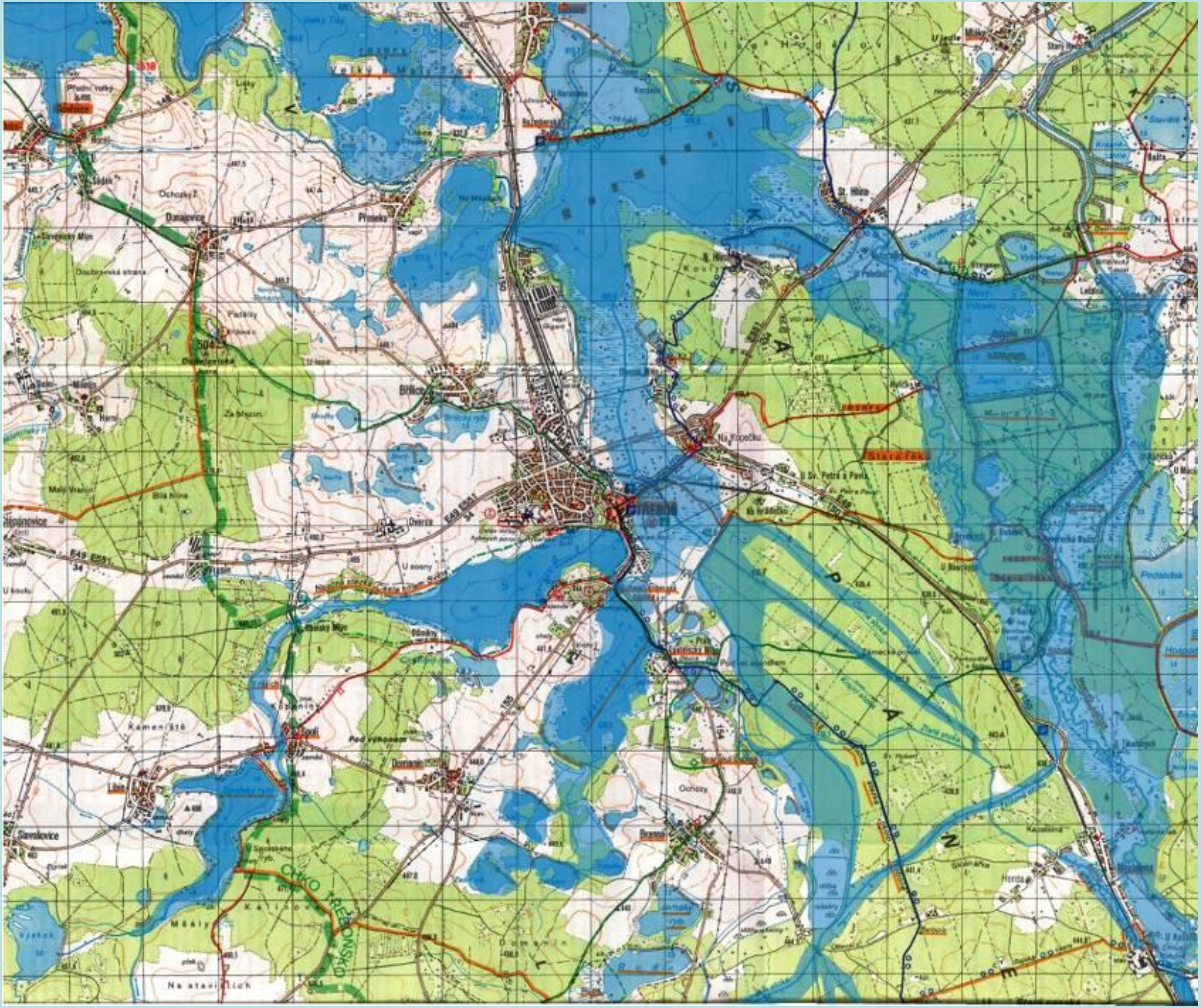
Summer flood in August 2009, similar to that of August 2002: see next two slides:

Photo: J. Dušek

2010/08/09

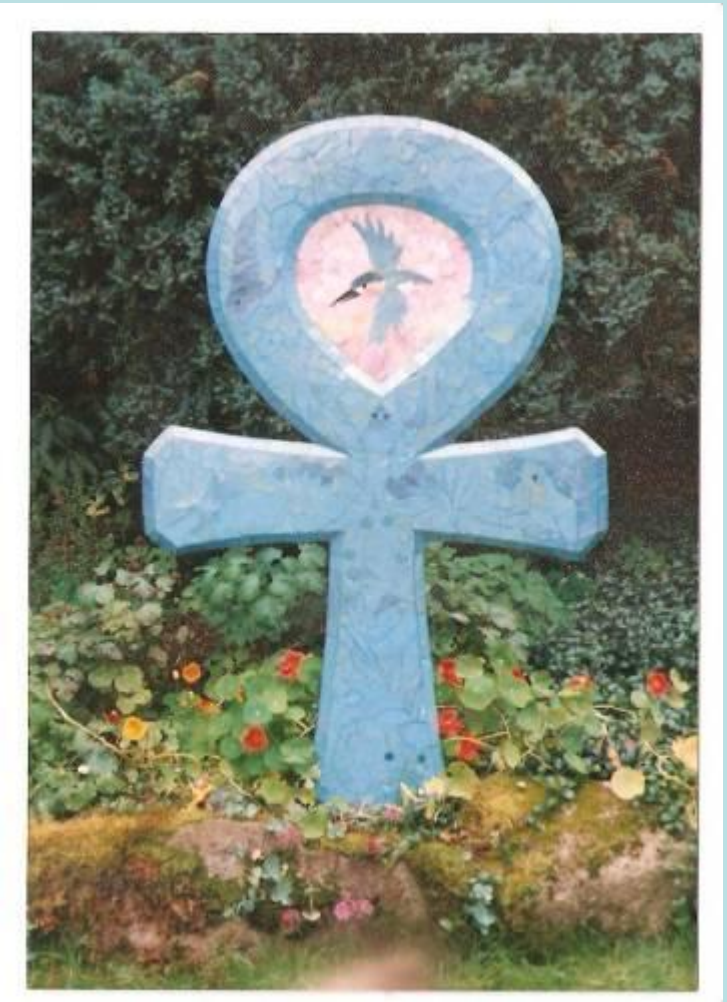


TŘEBOŇ
Dunajovice
Břilice
Přeseka
Domanín
Branná
Libín
Spolský ryb.
Na Kopečku
U Sv. Petra a Pavla
Stará řeka
Kamenitá
Pod výhonem
Ochozy
CHKO TŘEBOŇSKO



Na Kopečku
U Sv. Petra a Pavla
Stará řeka
CHKO TŘEBOŇSKO

IV. Question: Wise (=sustainable) use and management of wetlands?

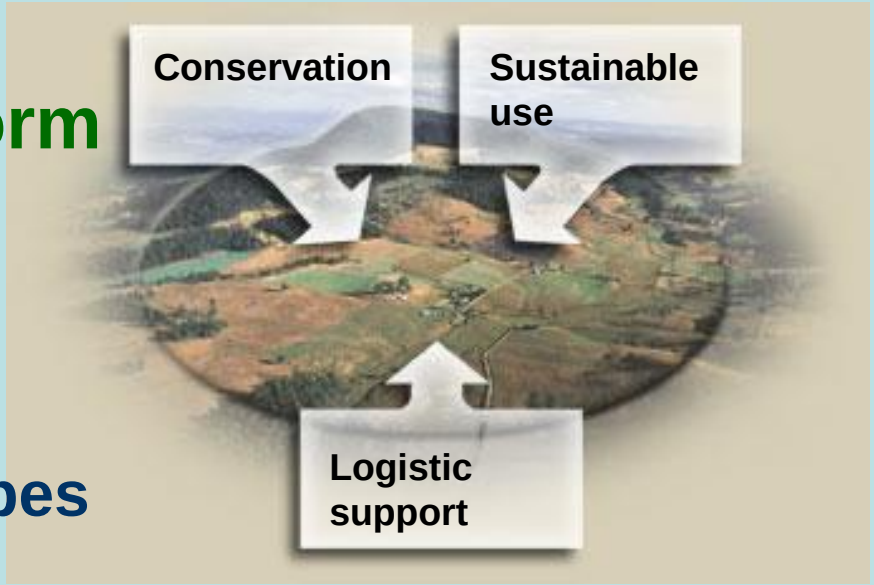


Akh - symbol of MaB, mosaic by J. Vydra

Answer:

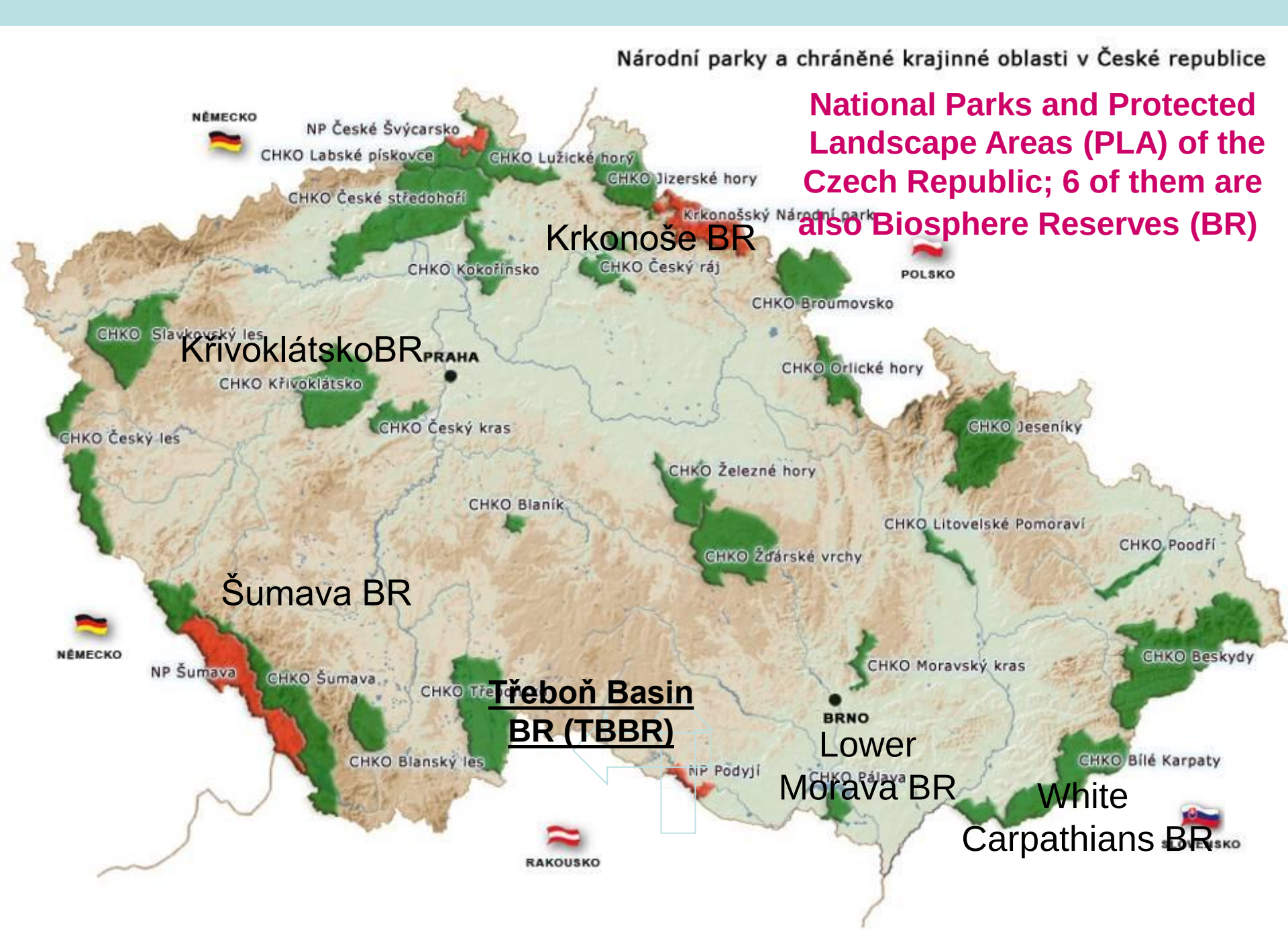
Application of the Biosphere Reserves Concept, introduced by and forming part of UNESCO's Man and Biosphere (MaB) Program (started in 1970)

Biosphere Reserves



Biosphere reserves perform three main roles:

- **Conservation *in situ* of natural and semi-natural ecosystems and landscapes**
- **Demonstration areas for ecologically and socio-culturally sustainable use; and**
- **Logistic support for research, monitoring, education, training and information exchange**


Národní parky a chráněné krajinné oblasti v České republice
National Parks and Protected Landscape Areas (PLA) of the Czech Republic; 6 of them are also Biosphere Reserves (BR)
NĚMECKO
NP České Švýcarsko
CHKO Labské pískovce
CHKO Lužické hory
CHKO Jizerské hory
CHKO České středohoří
Krkonošský Národní park
Krkonoše BR
CHKO Kokořínsko
CHKO Český ráj
POLSKO
CHKO Broumovsko
CHKO Slavkovský les
KřivoklátskoBR
PRAHA
CHKO Křivoklátsko
CHKO Orlické hory
CHKO Jeseníky
CHKO Český kras
CHKO Český les
CHKO Železné hory
CHKO Blaník
CHKO Litovelské Pomoraví
CHKO Poodří
CHKO Žďárské vrchy
Šumava BR
NĚMECKO
NP Šumava
CHKO Šumava
CHKO Moravský kras
CHKO Beskydy
Třeboň Basin BR (TBBR)
BRNO
Lower Morava BR
CHKO Blanský les
NP Podyjí
CHKO Pálava
CHKO Bílé Karpaty
White Carpathians BR
RAKOUSKO

Ecosystem services of three main TBBR wetland types: fishponds, mires and floodplains

- “Ecosystem Services“ is an anthropocentric concept which can be understood and correctly explained only within the context of natural processes and the possible human impact on them.
- This concept should never be misused against nature, e.g., in the name of short-term profit.
- Only healthy structure and functioning of wetland ecosystems provide a basis for their sustainable ecosystems services.

The role of wetlands with respect to the nature conservation function of the TBBR and "wise use" of its two Ramsar Sites (RS)

FUNCTION of the Biosfere Reserve (Trebon Basin)	Wetland 1 **FISHPONDS**	Wetland 2 **MIRES** (bogs, fens)	Wetland 3 **RIVERINE** (floodplain)
NATURE CONSER-VATION Biodiversity Habitats, Species ….	BR Core area 8 nat. reserves Ramsar site potential NATURA 2000 *Coelanthus subtilis Haliaeetus albicilla, Sterna hirundo, Luscinia svecica,* migratory birds, *Lutra lutra*	BR Core area 10 nat. reserves Ramsar site potential NATURA 2000 priority peatbog habitats, *Liparis loeselii,* Invertebrates (glacial relics, endemites)	BR Core area 11nat. reserves (p.Ramsar site) potential NATURA 2000 priority riverine habitats, molluscs, fishes, dragonflies, *Lutra lutra*

Negative impacts on and threats to wetlands in the TBBR and its two RS: "Třeboň Fishponds" and "T. Mires"

Trebon Basin Biosphere Reserve	Wetland 1 **FISHPONDS**	Wetland 2 **MIRES** (bogs, fens)	Wetland 3 **RIVERINE** (floodplain)
NEGATIVE IMPACTS, THREATS	**High-intensity fish-farming with Carp stock** (eutrophication, destruction of littoral stands, reduction of food sources)	**Large-scale extraction of peat for agricultural purposes** (habitat destruction, drainage)	**Large-scale extraction of sand and gravel** (habitat destruction, ground water table alter.) Decline of farming

Use of the BR concept - TBBR example, conclusions:

- The Třeboň Basin Biosphere Reserve (TBBR) implements successfully its three main functions with respect to wetlands and other ecosystems:
- Conservation of valuable both (semi)natural and human-made wetlands, esp. those declared as wetlands of international importance by the Ramsar Convention

Photo: J.Ševčík

Use of the BR concept - TBBR example, conclusions, continued.:

- Logistics incl. research, environmental education, support to "wise" use of wetlands.
- Sustainable use and development: public relations, contacts with stakeholders – esp. compromises with the fisheries, coordination with requirements of the local authorities, NGO´s, inhabitants and visitors.
- *The BR makes effective use of the fundamental ideas and documents of the MaB program: Statutary Framework of BR´s, Seville Strategy for BR´s (1995), and Madrid Declaration (2008) .*

Photo: J.Ševčík


Final message:
a landscape without
wetlands is
a landscape without water!
Photo I. Bufková

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- **Other sources.**

Thanks for the use of their photographs and other information and valuable assistance

Thank you for your attention!

Photo J. Ševčík