

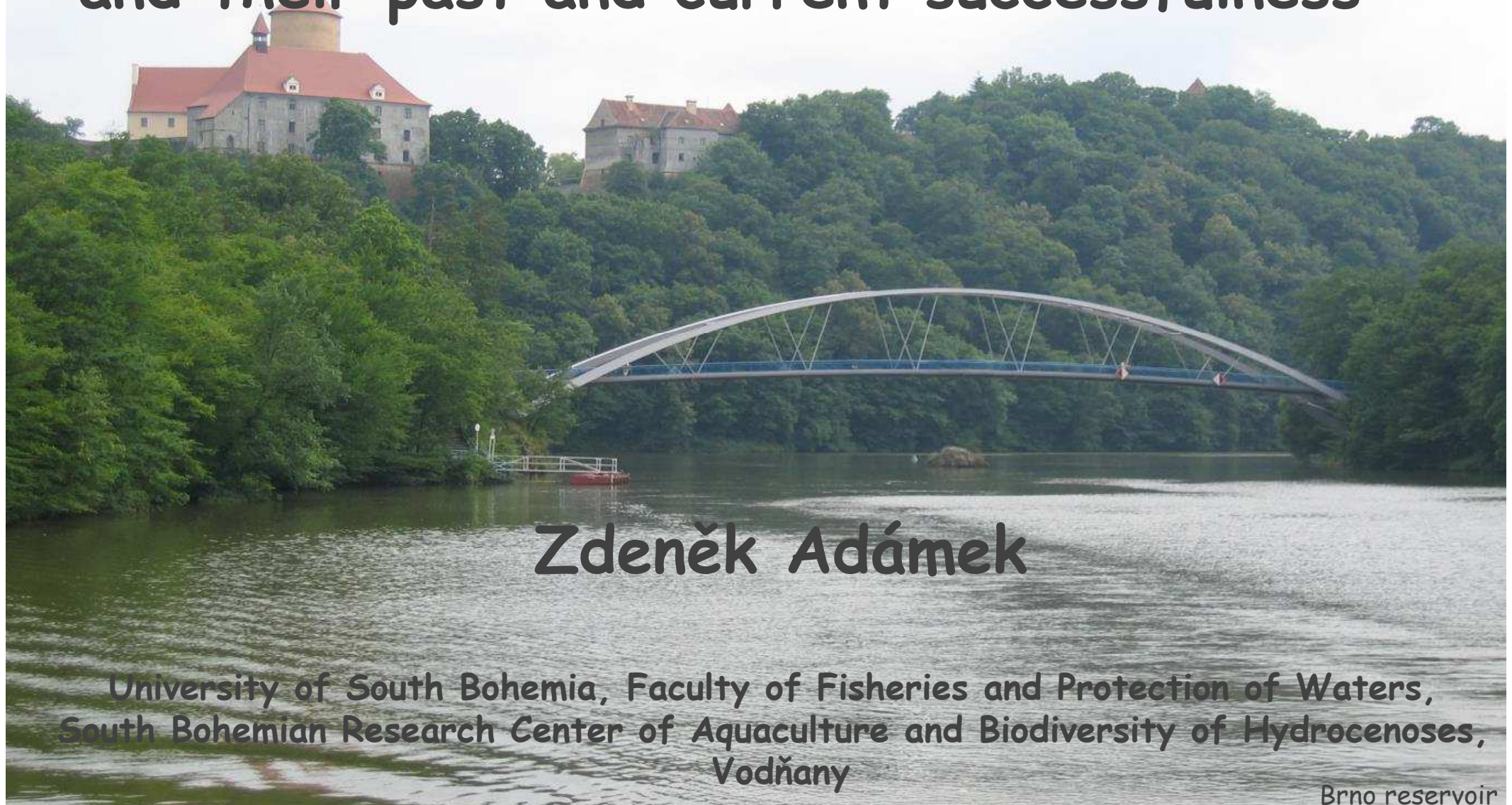


FACULTY OF FISHERIES & PROTECTION OF WATERS

UNIVERSITY OF SOUTH BOHEMIA IN ČESKÉ BUDĚJOVICE



Biomanipulation measures on Czech reservoirs and their past and current successfulness



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Vodňany

Brno reservoir



Brno reservoir

Czech reservoirs

- water management facilities
 - water retention
 - flood prevention
- drinking water supplies
- hydropower use
- recreation sites incl. angling
- BUT
- suffering from heavy eutrophication





However,

the majority of Czech reservoirs is supplied with high nutrient loading - particularly with nitrogen and PHOSPHORUS, inducing



the deterioration of water quality and strong summer occurrence of bluegreen algae (Cyanobacteria) blooms of *Microcystis* and *Aphanizomenon* in particular



Brno reservoir

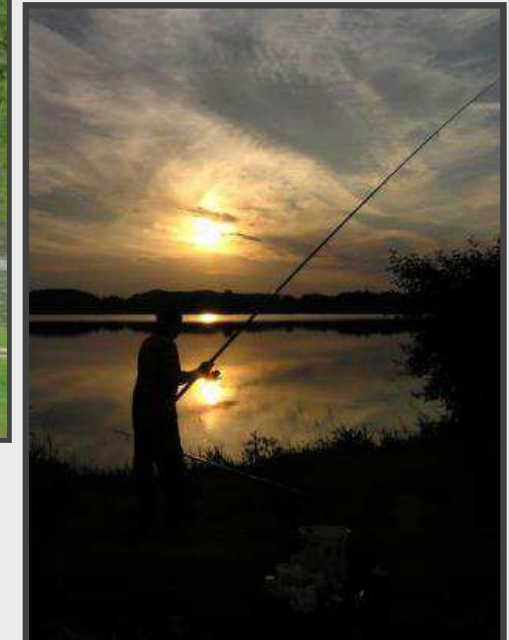


Important sites of recreation

- Czech reservoirs are heavily exploited for recreational purposes (leisure time activities, angling, swimming) and water sports during both summer (sailing, water-skiing, boating, rowing, wind-surfing) and winter (skating, cross-country skiing, ice fishing)



Brno reservoir



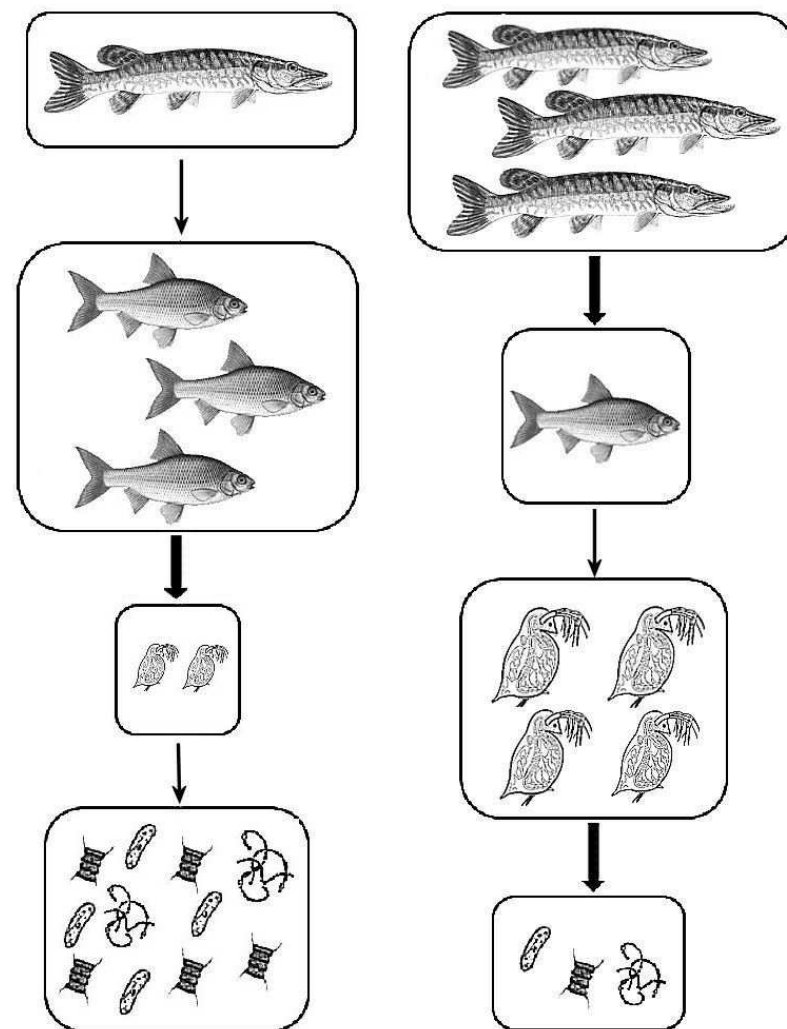


Since early 1980, all reservoirs which serve as the raw drinking water supplies are subject to so called „controlled fish stocking” based on „top-down” approach.

HOWEVER,
the „controlled fish stock” is understood by the river authorities in a quite simplified way, just as a regular release of piscivorous fish, mostly as a ~ 5cm fry.

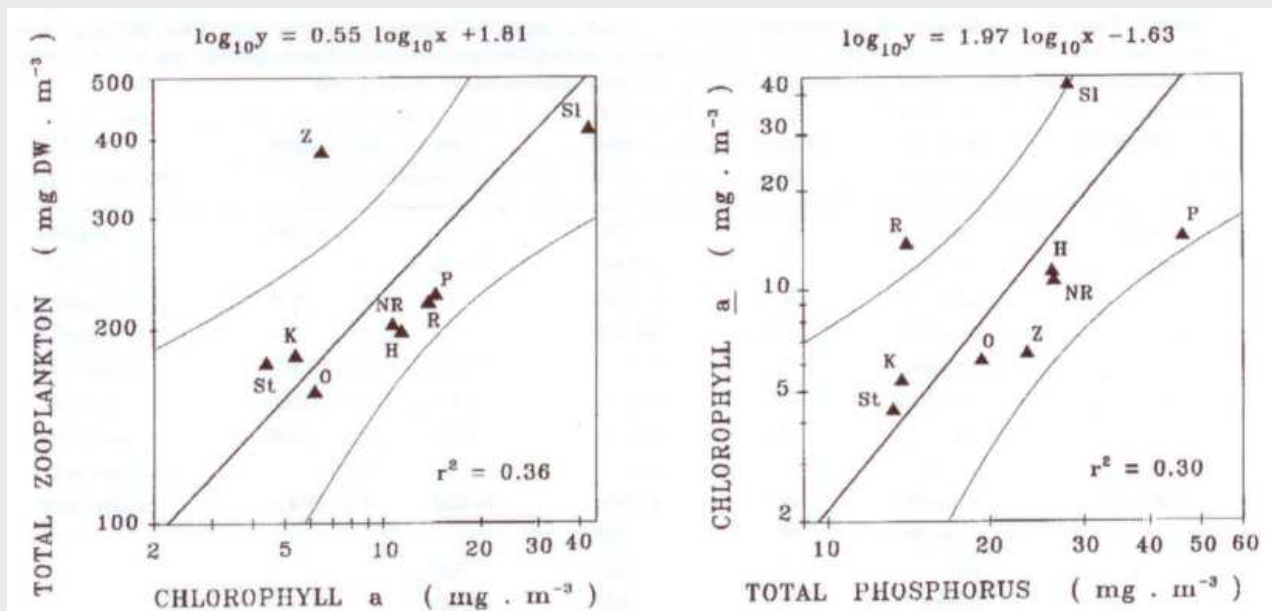
THUS,
as regularly proved, these measures do not bring results as expected.

WHY?

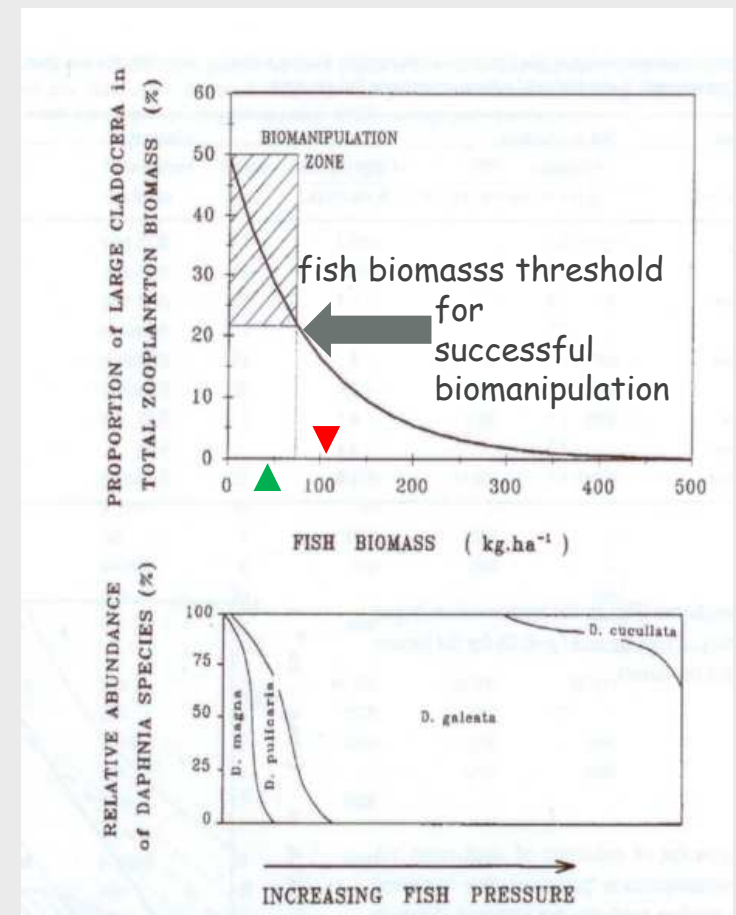




The relationship of chlorophyll-*a* level - TP, and of zooplankton biomass - chlorophyll-*a* was found to be positive on Czech „biomanipulated“ reservoirs and did not differ from those which have not been subject to biomanipulation



(Seda J., Hejzlar J., Kubecka J., 2000: Trophic structure of nine Czech reservoirs regularly stocked with piscivorous fish. *Hydrobiologia*, 429: 141-149)





**External NUTRIENT LOADING
is of extraordinary importance
for the biomanipulation successfulness**

**Threshold value of yearly external phosphorus loading and
concentration for the applicability of biomanipulation measures:**

0.6 – 0.8 g TP per m² (Benndorf et al., 2002)

**20–50 mg.m⁻³ (Jeppesen a Sammalkorpi, 2002)
in deep stratified reservoirs**

**max. 2 g TP per m² (Jeppesen et al., 1990)
100–250 mg.m⁻³ (Jeppesen a Sammalkorpi, 2002)
in shallow reservoirs**



The success of biomanipulation efforts on Czech (and other) reservoirs is limited by heavy P loading which makes the appropriate application of top-down control low effective

To succeed, the biomanipulation measures must be a part of more complex processes, namely

REVITALISATION



Possible principal steps of a successful revitalisation project are:

- a) preventive anti-erosive and anti-flooding arrangements in the reservoir water catchment area
 - b) construction of efficient water treatment plants in the reservoir water catchment area
 - c) phosphorus precipitation on the inlet
 - d) reservoir draining, at least partial
 - e) liming of the dry bottom
 - f) sediment removal, at least limited
 - g) nutrients and cyanobacteria precipitation
 - h) aeration of the hypolimnion and destratification
 - i) reduction of planktivorous and benthivorous fish (roach and bream in particular) biomass, preferably during spawning
 - j) biomanipulation (top-down) measures - increased predatory fish stocking
 - k) cyanobacterial biomass harvesting from the water surface
- external loading reduction
- internal loading reduction
- management measures



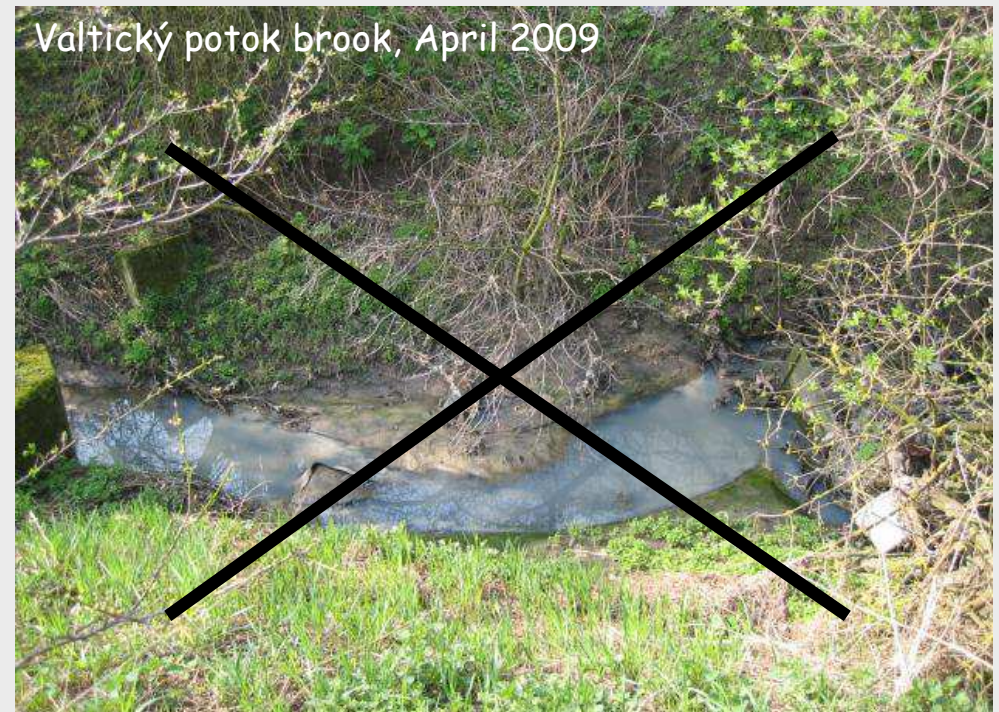
Ad a) preventive anti-erosive and anti-flooding arrangements in the reservoir river basin



Problems associated with soil and nutrients (fertilizers) flushing and subsequent deposition in water reservoirs

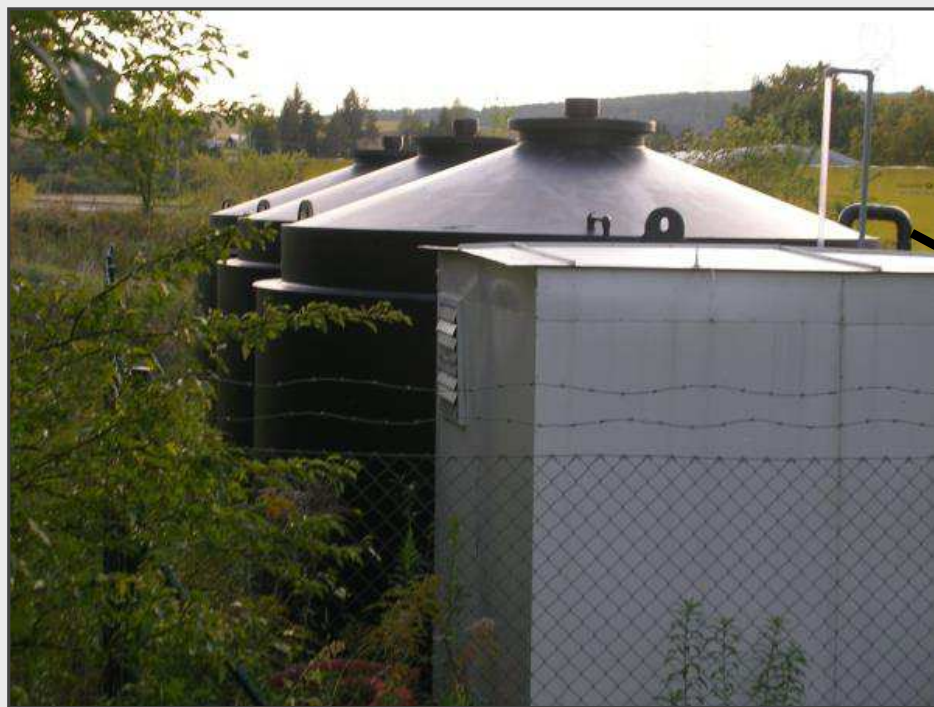


Ad b) construction of efficient water treatment plants in the reservoir river basin and elimination of small illegal discharges





Ad c) phosphorus precipitation in the inlet [$41\% \text{Fe}_2(\text{SO}_4)_3$ - PIX113]



River Svatka, September 2012

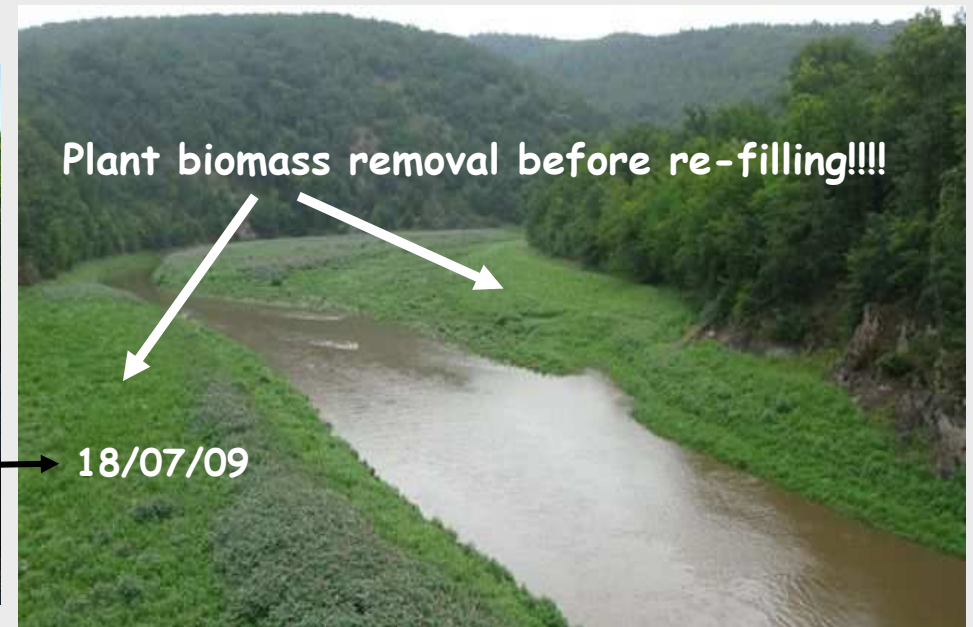


Ad d) (partial) reservoir draining

9 m decline
259 ha \Rightarrow 78 ha



26/04/09



18/07/09



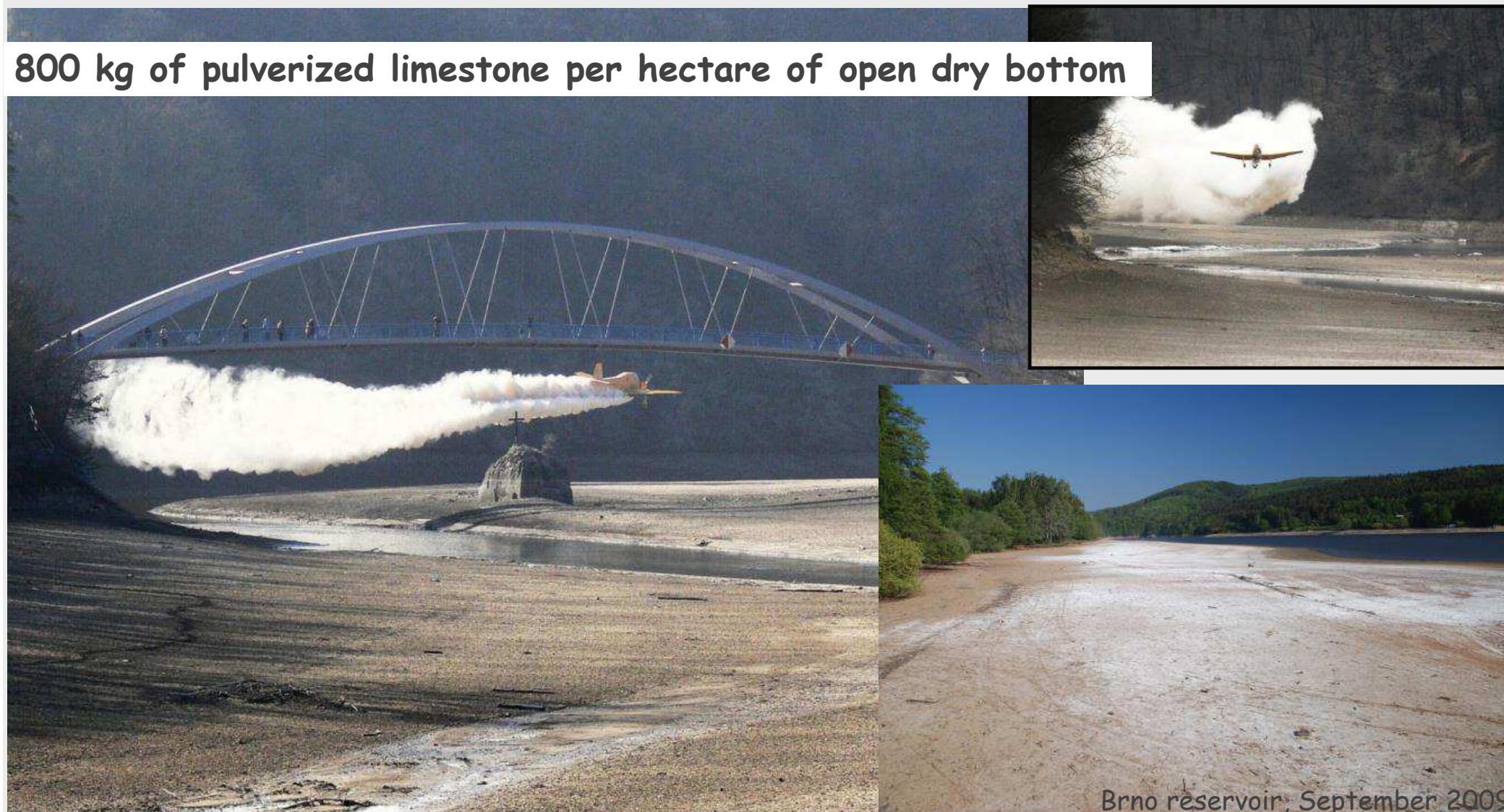
sediment thickness 2-3.5 m

Brno reservoir, May 2009



Ad e) liming of uncovered dry bottom

800 kg of pulverized limestone per hectare of open dry bottom



Brno reservoir, September 2009





Ad f) (partial) sediment removal



Brno reservoir, February 2010

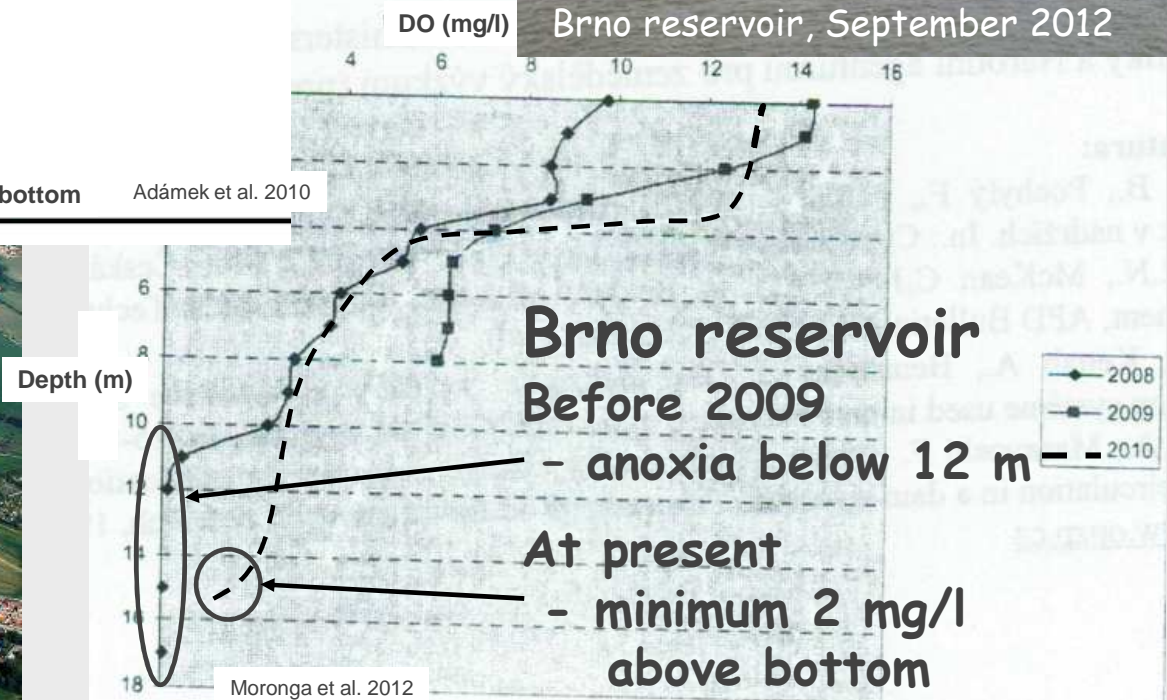
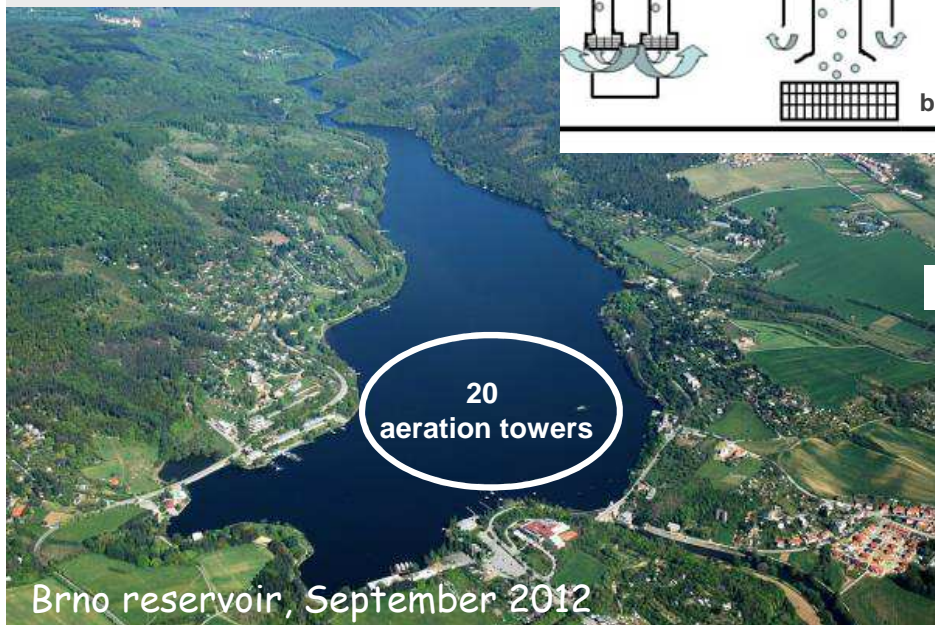
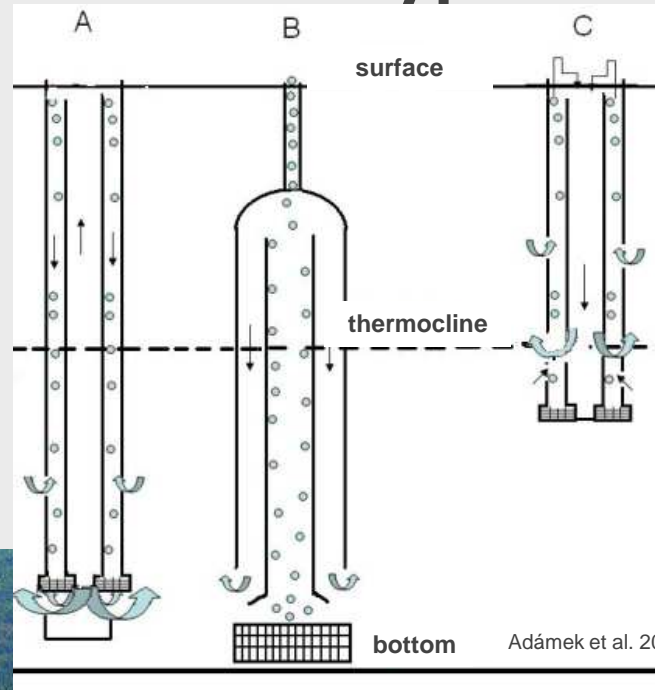
Štěpánek pond, August 2006





Ad h) aeration of the hypolimnion and destratification

Avoiding anoxic conditions in the hypolimnion is crucial for the elimination of sediment P release





Ad i) reduction of planktivorous and benthivorous fish (roach and bream in particular) biomass during spawning



River Morava, August 2007



Brno reservoir, May 2009



Hlohovecký pond, May 2006

Herbivorous fish often forgotten!!!!

.... including water level manipulation – drying of deposited eggs

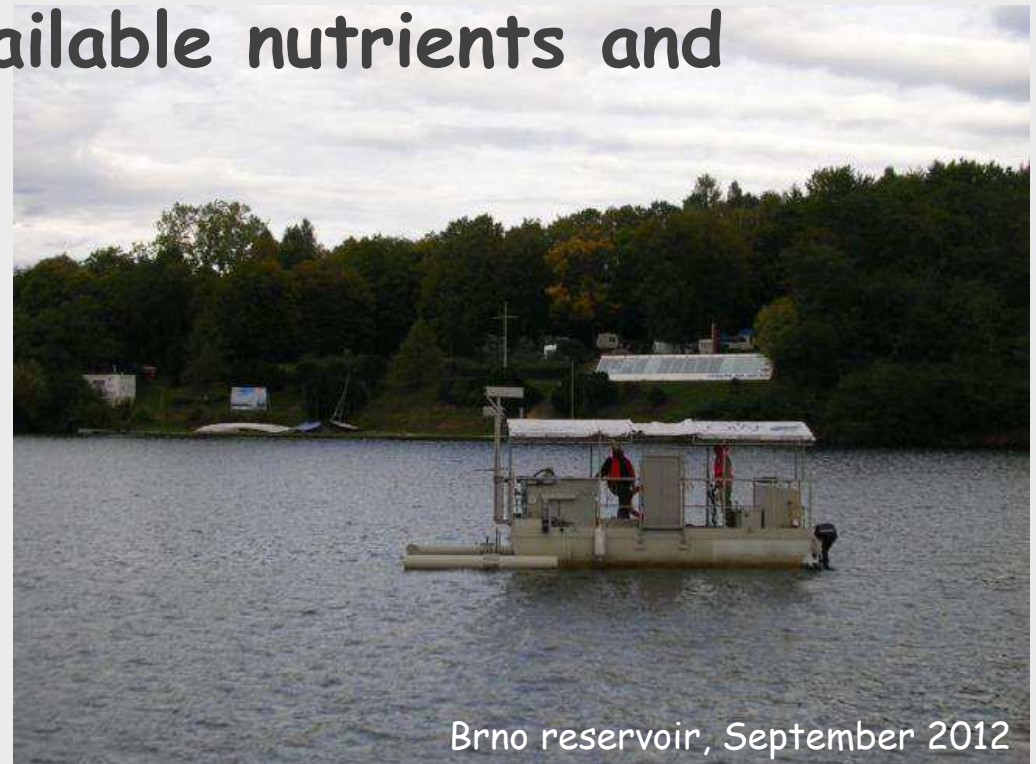




Ad j) top-down control measures - increased predatory fish stocking

Ad k) cyanobacterial biomass harvesting from the water surface

Ad g) precipitation of available nutrients and cyanobacteria from the water column (polyaluminiumchloride - PAX)



special harvesting and application boat

Brno reservoir, September 2012



HOWEVER,

it must be kept in mind, that the best effectiveness of foodweb manipulations may be obtained after reduction of external P loading below a certain threshold.



IN TURN,
if revitalisation of eutrophied lakes is not accompanied by appropriate fisheries management, the combined forces of zooplanktivory and high P recycling by dense stocks of planktivorous and benthivorous fish may hold the water in a eutrophic stage, even if external P loading has been significantly reduced.



Thanks for your attention!

Brno reservoir, September 2012



Economic value of ponds and lakes and their sustainable use

Form: Seminar and study visits

Date: 14-16 May 2013, Vodňany, Czech Rep

Project: LakeAdmin - Regional administration
of lake restoration initiatives

Programme: INTERREG IVC

Contact: jkolecek@frov.jcu.cz

Rožmberk pond, photo L.Hlásek