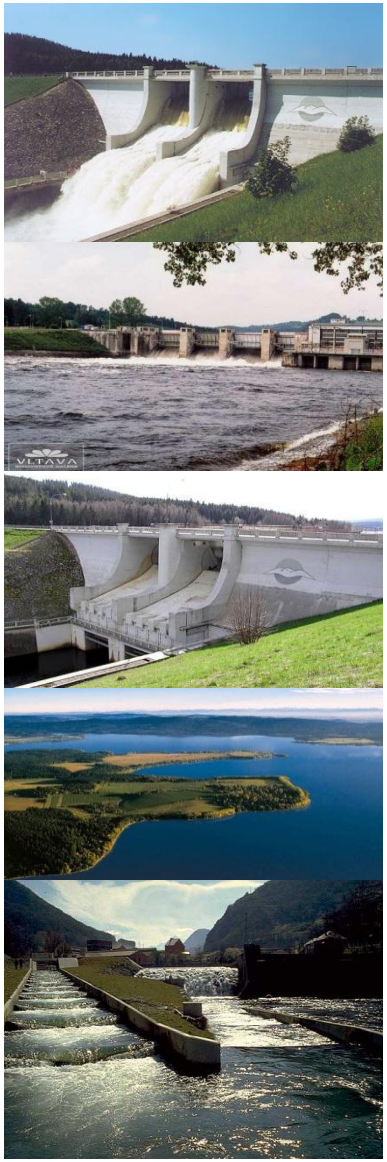
Hydropower impacts on fish

VÚV TGM

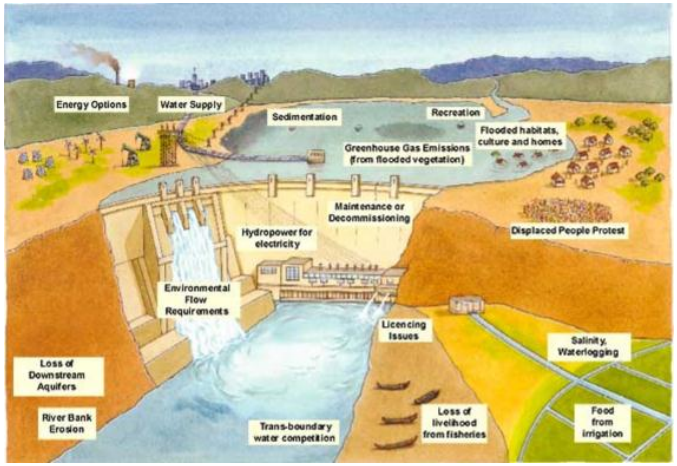
Jiri Musil

HYDROPOWER IMPACTS – HABITAT CHANGES



Functional exchange pathways of matter, energy and organisms (Ward and Standford, 1995)

vs



- productivity
- dynamics
- aquatic communities

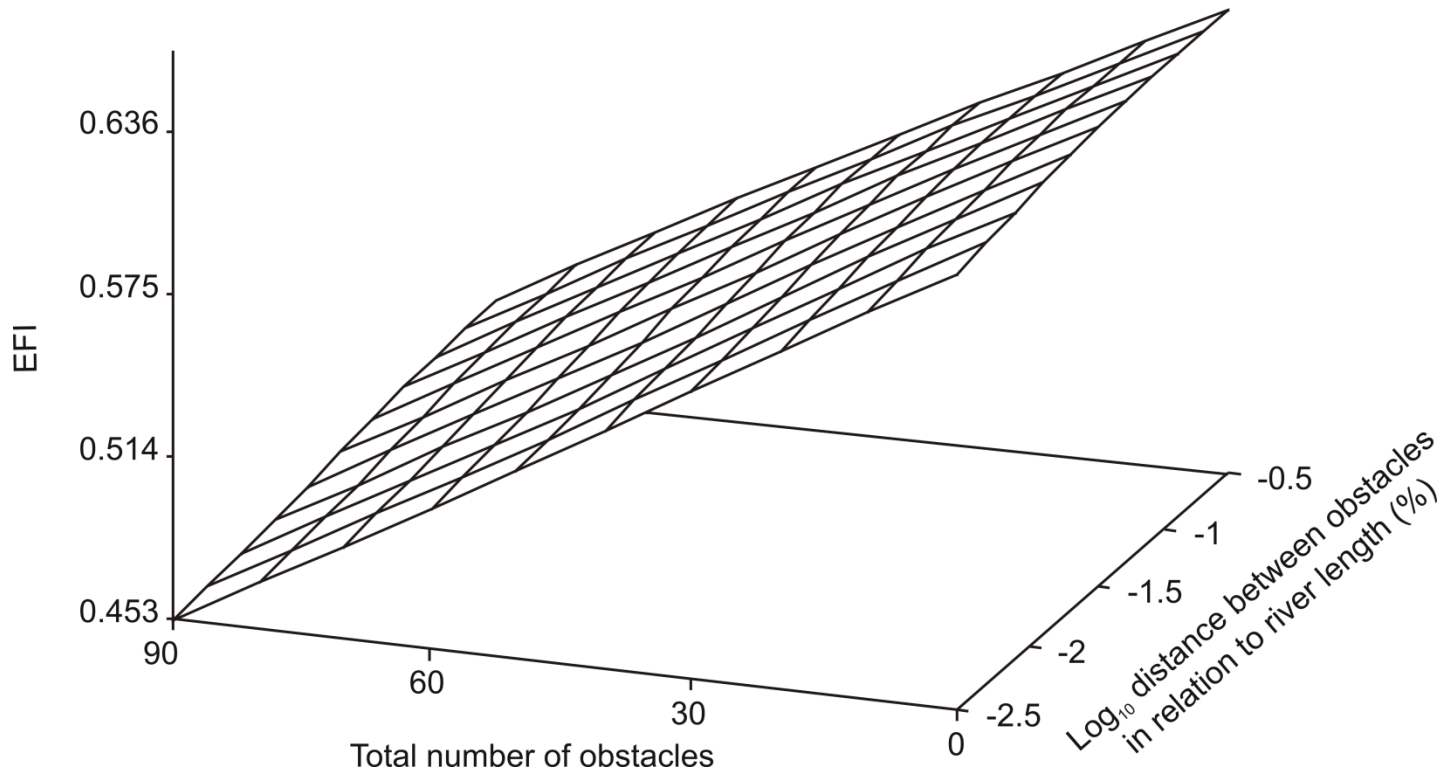
Ecosystem processes
Ecosystem structure

Biodiversity loss
(e.g. Cowx et al., 2002)

In Europe, > 74% of river systems are strongly affected (Nilsson et al., 2005)

FREE MIGRATION AS A PREREQUISITE TO IMPROVE ECOLOGICAL STATUS

Fig. 1. The relationship between river ecological status and the number of migration barriers.



Musil et al., 2012 (*Ecological Indicators*)

HYDROPOWER IMPACTS VS FISH MIGRATION

- **species distribution (diadromous fishes)**
- **availability of vital habitats**
- **timing of migration (reproduction success)**
- **izolation in space (genetic variability)**
- **conpensatory migration (climate change…)**
- **fish injuries and/or mortality**

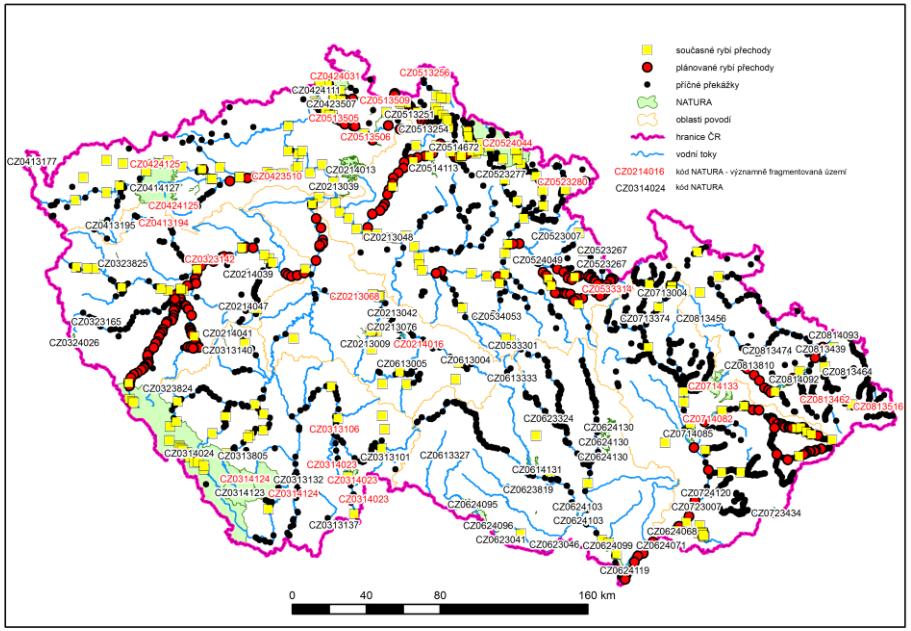
⇩

Viability and stability of population

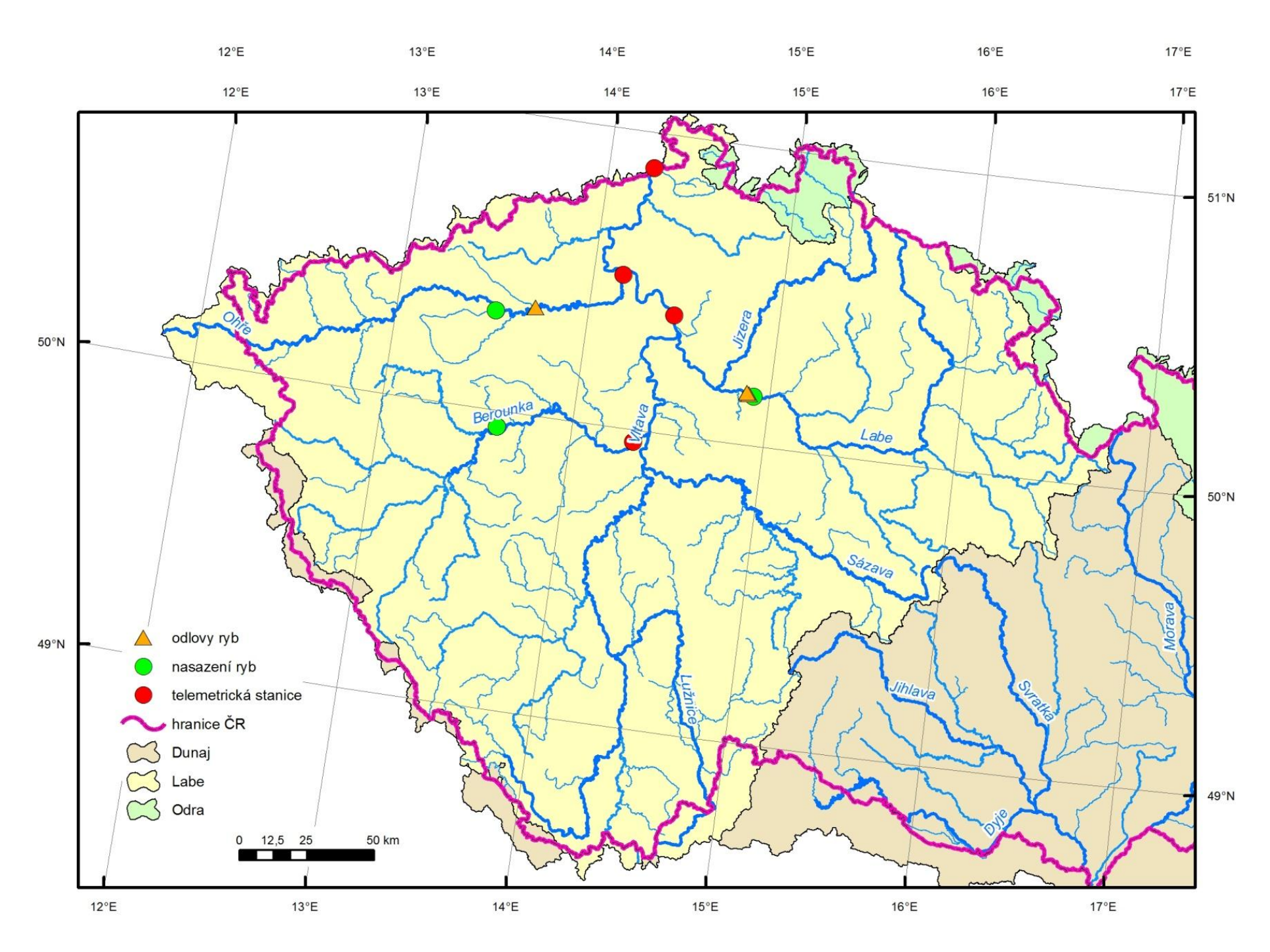
CASE STUDY I – Cummulative mortality of eel in the Czech Republic (*Anguilla anguilla* L.)

22.9.2007 EN Official Journal of the European Union L 248/17

COUNCIL REGULATION (EC) No 1100/2007
of 18 September 2007
establishing measures for the recovery of the stock of European eel

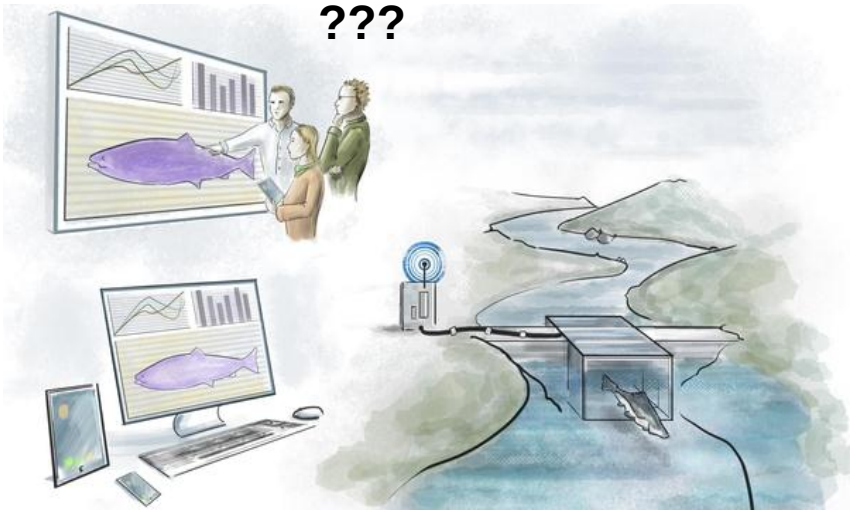


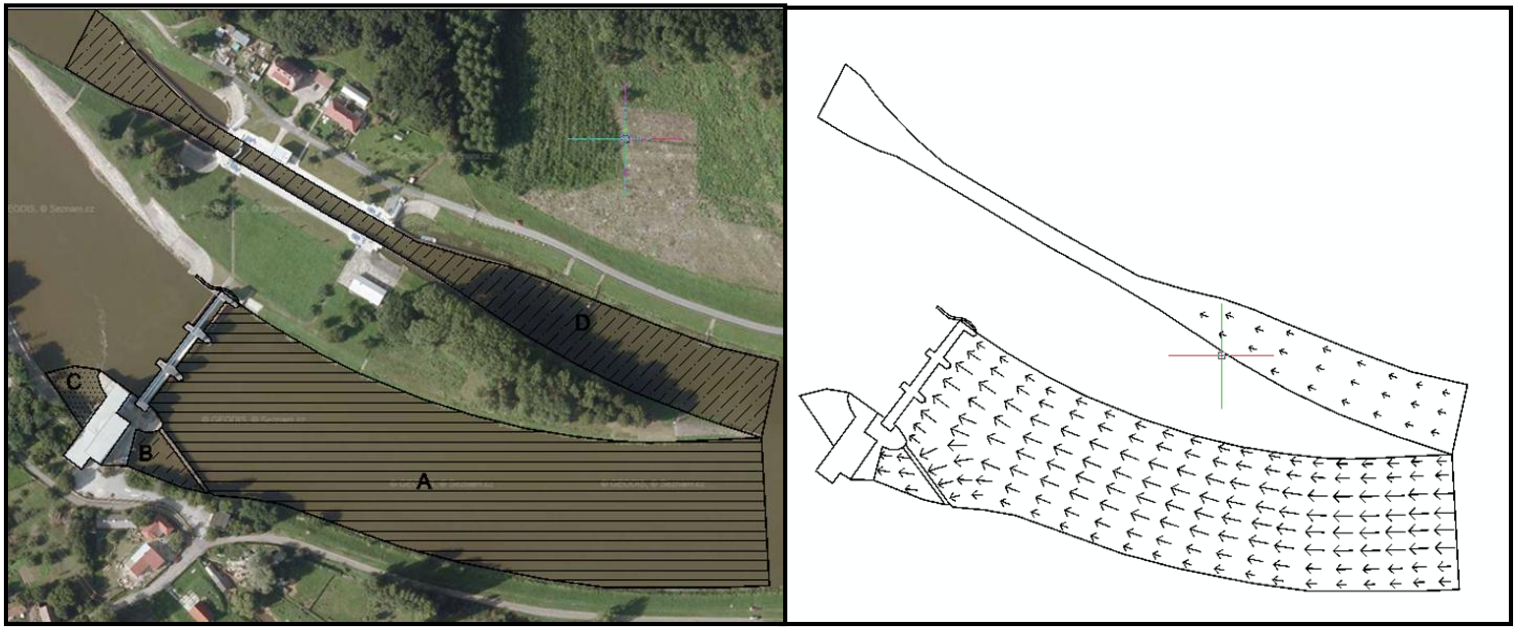
Barteková et al. (in review) (*Ecology of Freshwater Fish*)


12°E
13°E
14°E
15°E
16°E
17°E
51°N
50°N
49°N
Ohře
Jizera
Berounka
Vltava
Labe
Sázava
Lužnice
Jihlava
Svratka
Dyje
Morava
odlovy ryb
nasazení ryb
telemetrická stanice
hranice ČR
Dunaj
Labe
Odra
0 12,5 25 50 km

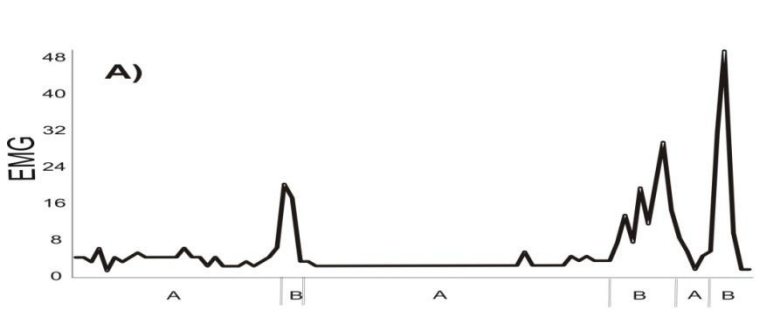
River basin	No. tagged individuals	Migration success (%)
Berounka	20	20
Ohře	18	16.7
Labe	19	20
total	**57**	**12.5**

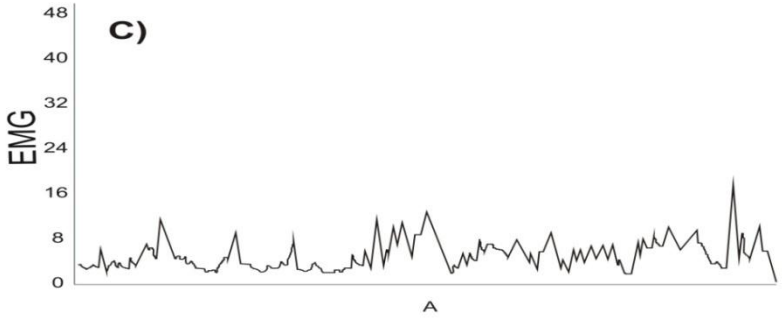
CASE STUDY II – when eel met hydropower plant (migration route, turbine mortality and behavioral aspects of migration)





$$\frac{\partial q_x}{\partial t}+\frac{\partial}{\partial x}\cdot\left(\beta\cdot\frac{q_x^2}{h}+\frac{1}{2}\cdot g\cdot h^2\right)+\frac{\partial}{\partial y}\cdot\left(\beta\cdot\frac{q_x\cdot q_y}{h}\right)+g\cdot h\cdot\frac{\partial z}{\partial x}+\frac{h}{\rho}\cdot\frac{\partial p_a}{\partial x}-\alpha\cdot q_y+\frac{1}{\rho}\cdot\left[\tau_{0x}-\tau_{px}-\frac{\partial\left(h\cdot\tau_{xx}\right)}{\partial x}-\frac{\partial\left(h\cdot\tau_{xy}\right)}{\partial y}\right]=0$$





Musil et al. (in press) (*River Research and Applications*)

WHAT MEASURES ARE MOST ADEQUATE?

- Behavioural screens (louvers, electric curtains, subsonic devices, stroboscope light, etc.) expose a selective efficiency, i.e. the efficiency depends on the fish species and the local conditions.
- A high efficiency can be expected for fine screens (10 mm).
- Fish friendly turbines are available.
- Currently the design of fish protection means has to be based on a target species.
- There is a big lack of knowledge on the behaviour of fishes in front of screens, bypass intakes, turbines.

Environment Agency

Environment Agency Fish Pass Manual

Document – GEHO 0910 BTBP-E-E

Band 4

Guntram Ebel

Fischschutz und Fischabstieg an Wasserkraftanlagen

Handbuch Rechen- und Bypasssysteme

Ingenieurbiologische Grundlagen
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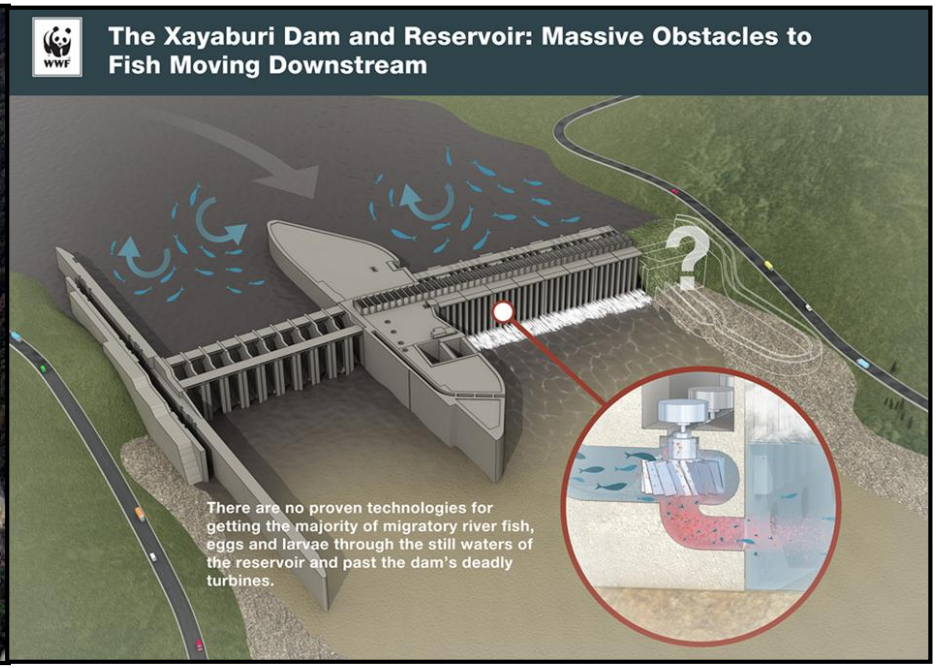
Mitteilungen aus dem Büro für Gewässerökologie und Fischereibiologie

icpdr iksd
International Commission for the Protection of the Danube River
Internationale Kommission zum Schutz der Donau

Measures for ensuring fish migration at transversal structures

Technical paper

Thank you for your attention



Štěchovice reservoir (Elbe river basin)