Fischwanderung in genutzten Gewässern
Herausforderungen und Lösungen
Biel, CH, 30.-31.10.2014

www.boku.ac.at/hfa

BOKU - University of Natural Resources and Applied Life Sciences
Department of Water, Atmosphere and Environment

Innovative Lösungen zur Fischgängigkeit in Österreich

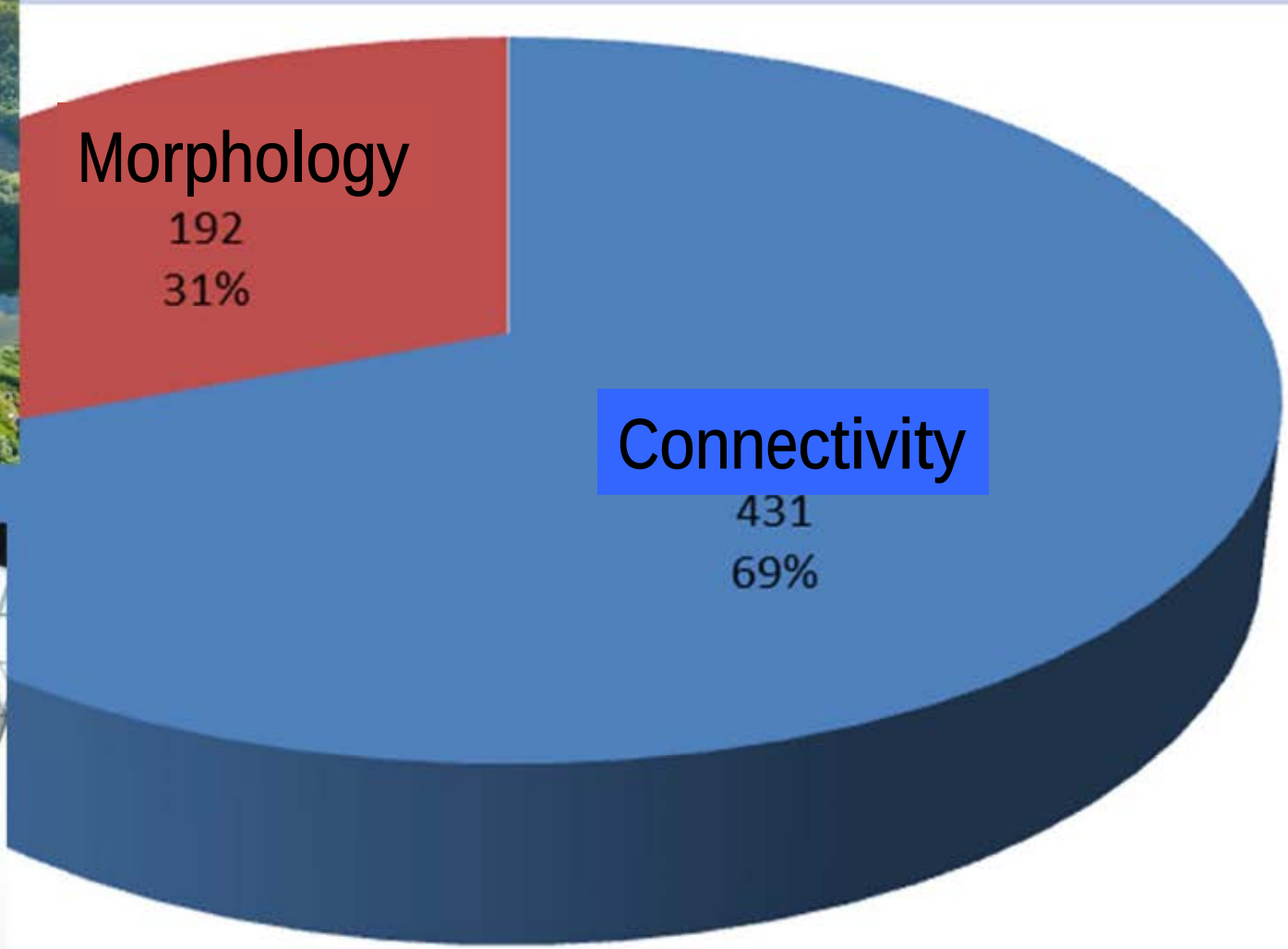
S. Schmutz, G. Unfer, B. Zeiringer

Institute of Hydrobiology and Aquatic Ecosystem Management
Department of Water, Atmosphere and Environment
BOKU - University of Natural Resources and Applied Life Sciences,
Vienna, AUSTRIA

Funding for WFD measures in Austria

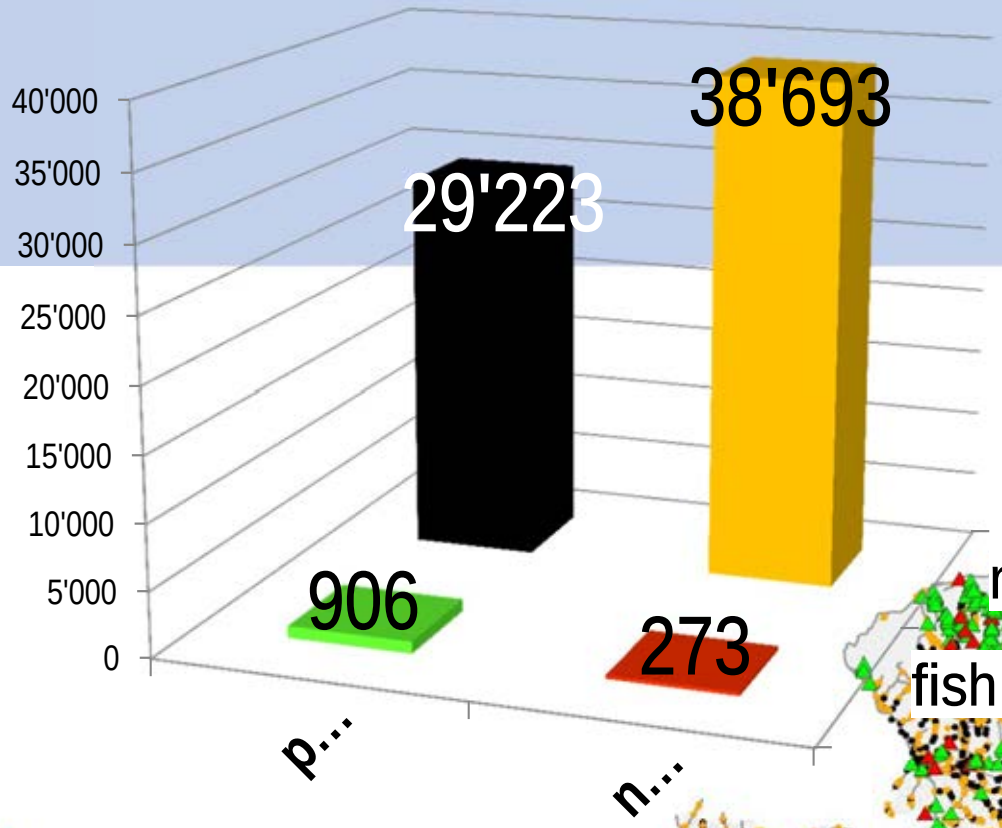
www.boku.ac.at/hfa

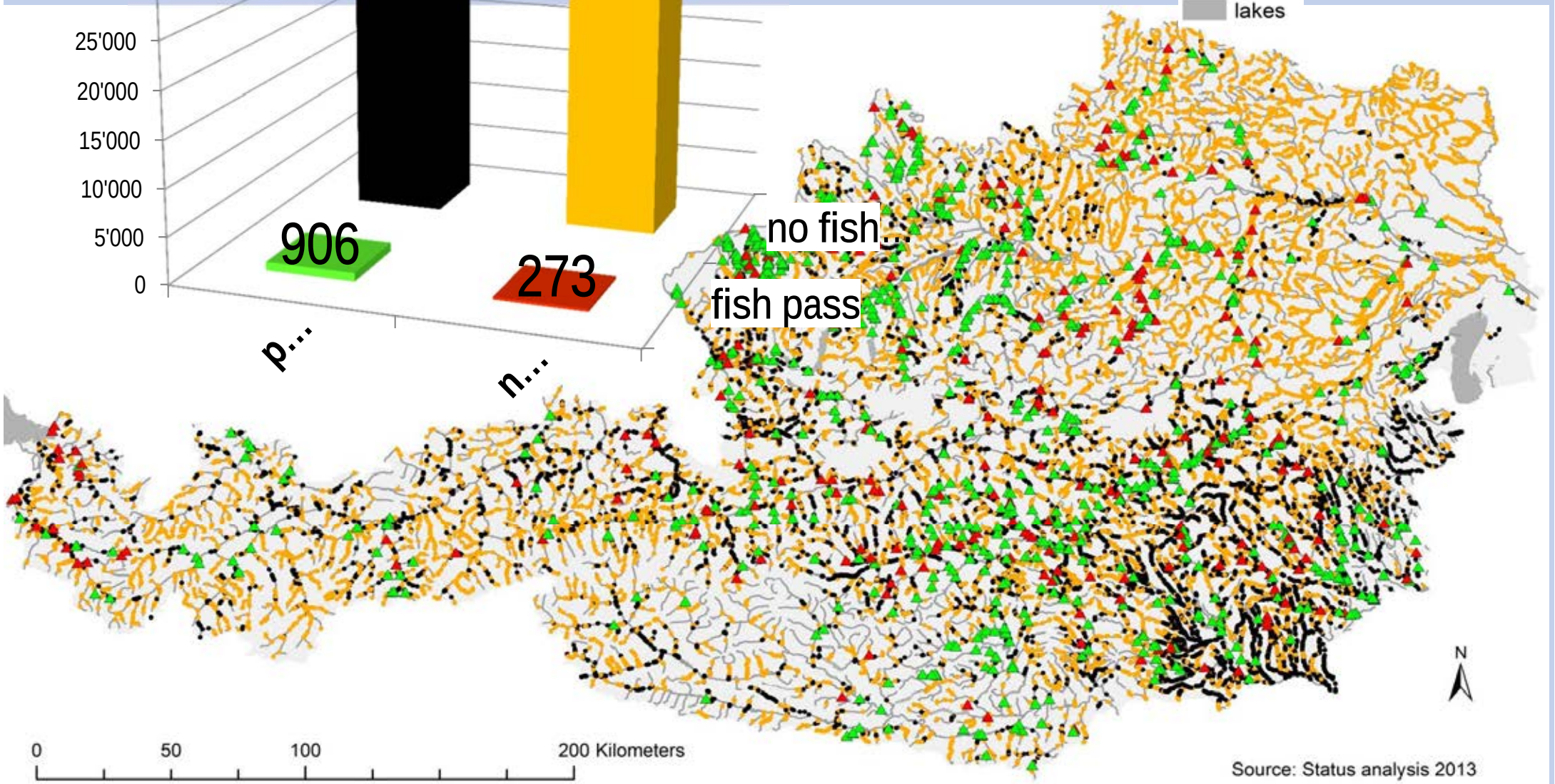
140 mio. Euro



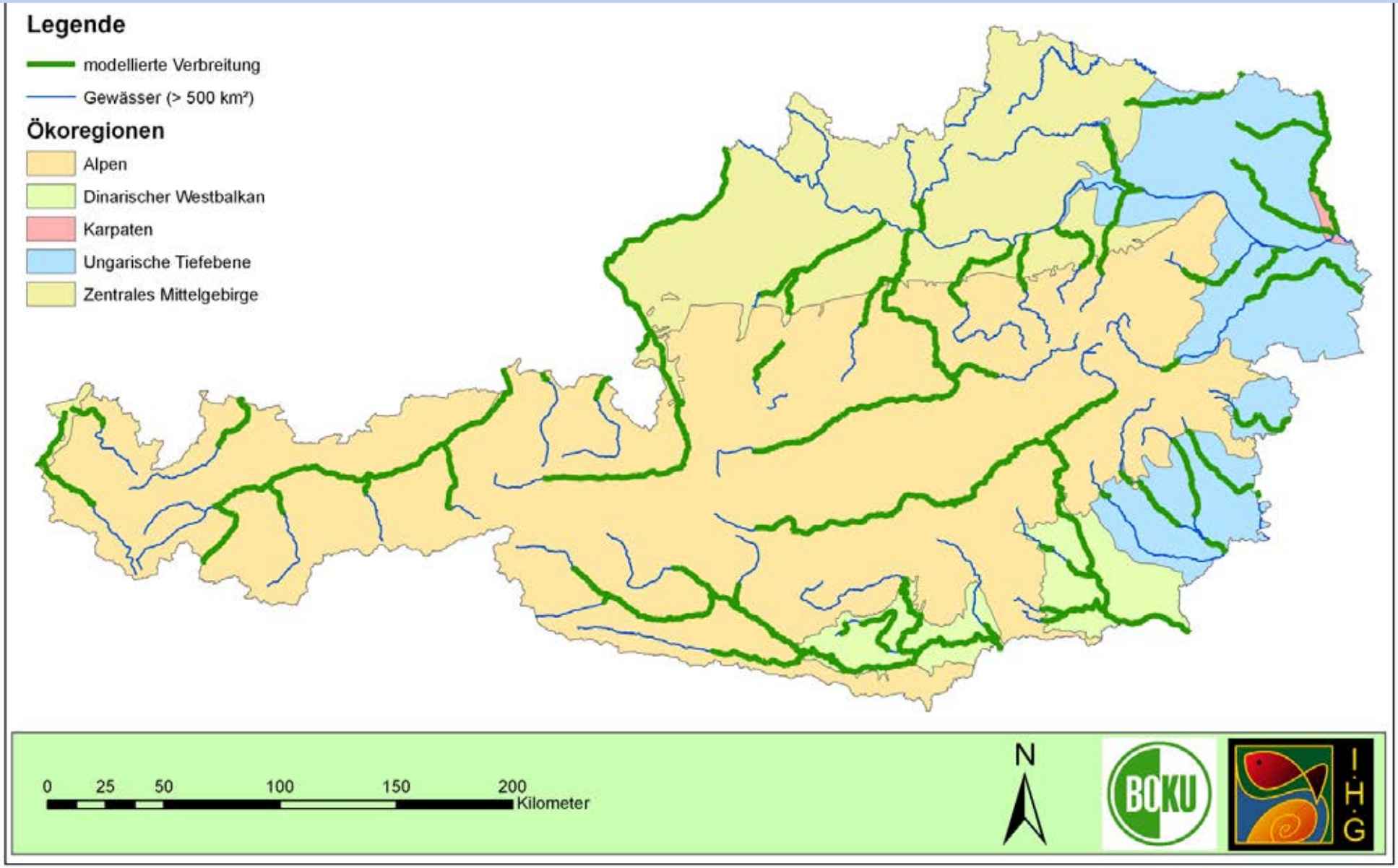
Barriers and fish passes in Austria

www.boku.ac.at/hfa

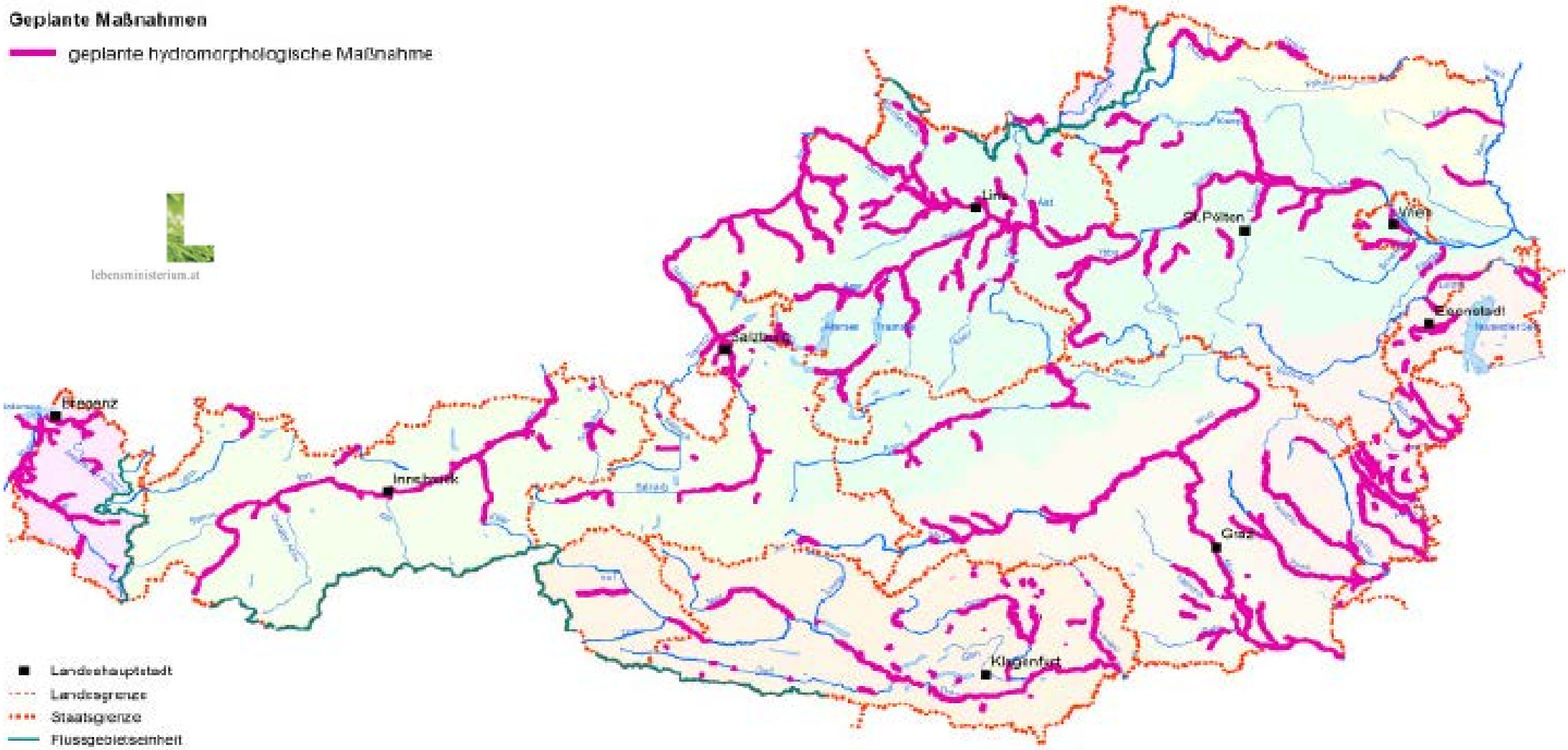




Modelled distribution of Danube salmon

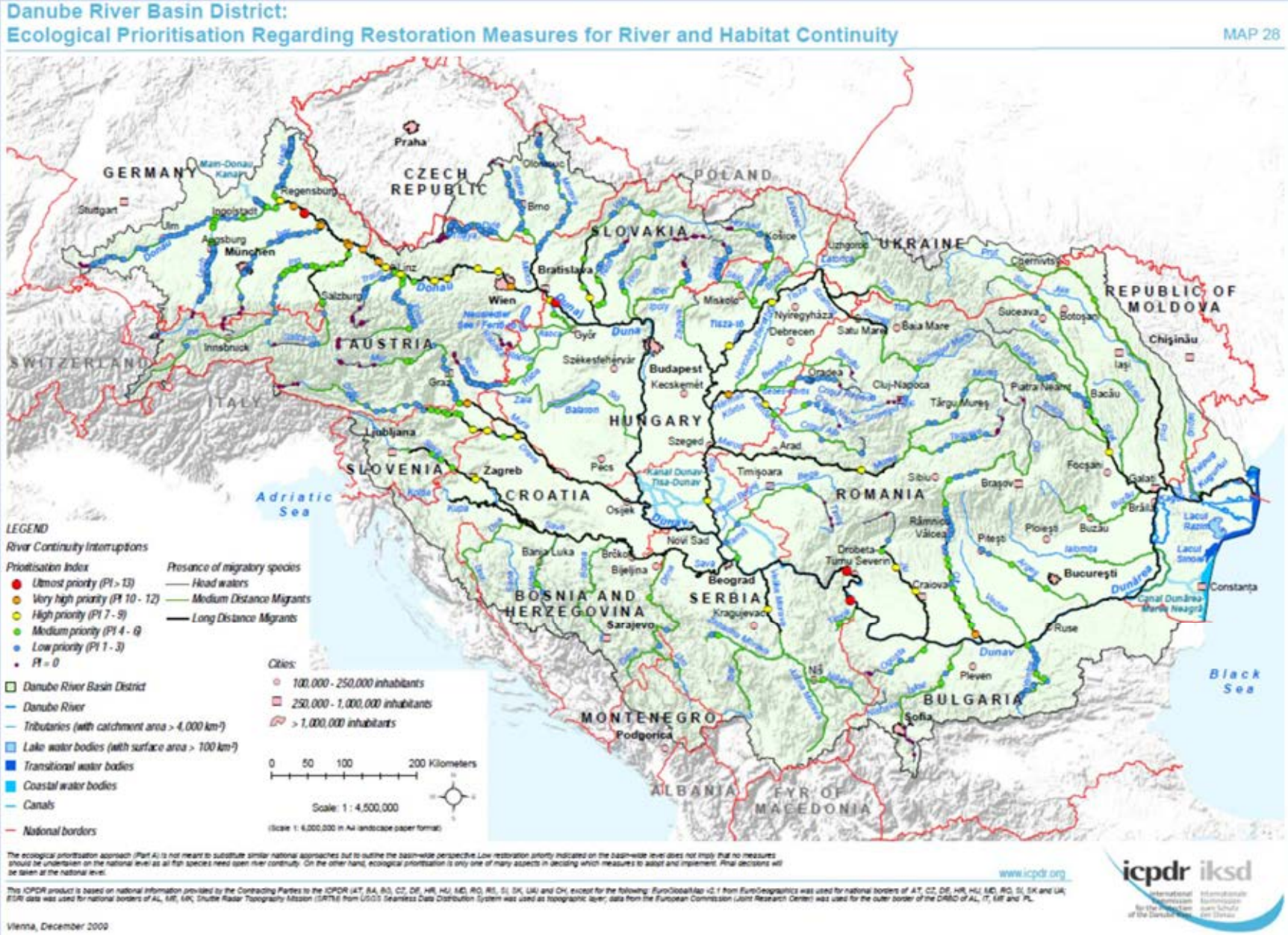


Priority rivers

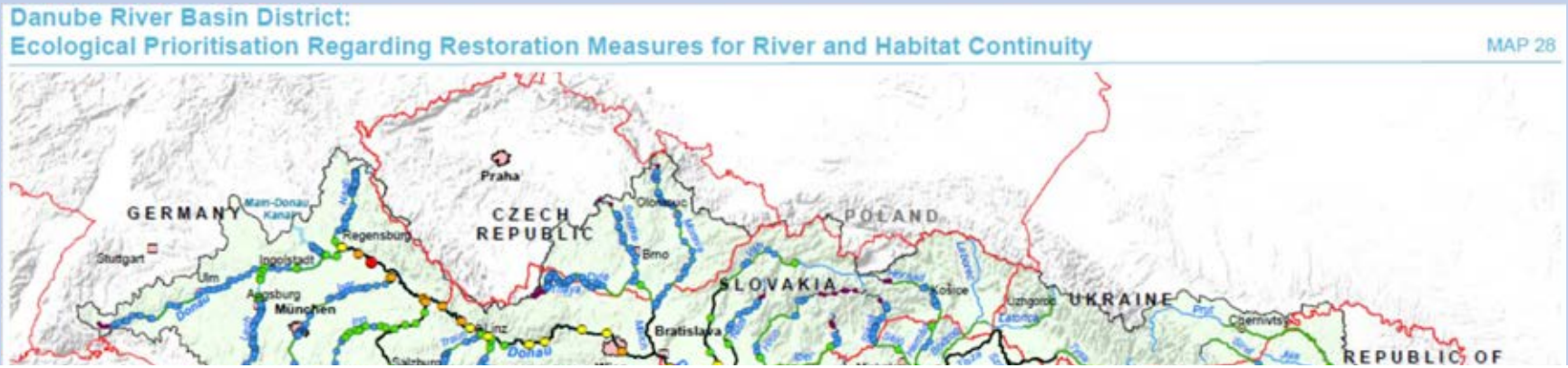


Danube River Basin Management Plan
Prioritisation of continuity restoration

www.boku.ac.at/hfa



Danube River Basin Management Plan
Prioritisation of continuity restoration



Prioritisation Index (PI)

PI = Fish region x (1 + first obstacles upstream + distance from mouth + reconnected habitat + protected site)

Austrian fish pass guideline

http://www.bmlfuw.gv.at/wasser/wasser-oesterreich/plan_gewaesser_ngp/massnahmenprogramme/leitfaden_fah.html

Austrian fish pass guidline

Objectives

- Support for planning
- To guarantee high functionality
- If applied properly **good ecological status or potential can be expected** in terms of continuity
- **For special cases individual solutions are required** (e.g. artificial waters, very small streams, existing weirs without optimal location for entrance)

Fish passes - Types

- Aufgelöste Sohlrampe
- Rock ramp

- Gewässertypisches Umgehungsgerinne
- Nature-like bypass-channel

Fish passes - Types

- Naturnaher Beckenpass bzw. Tümpelpass
- Nature-like pool and weir fish pass

- Schlitzpass
- Vertical slot fish pass

Construction and assessment criteria

- Size und hydraulic calculations
  - According to fish species, fish size and river type
- Finding of the entrance
  - Depending on fish species, migratory behaviour
  - River type and size, location of the entrance, attraction flow, water level fluctuations, connection to bottom
- Passability of the fish pass
  - Fish species with the biggest size, maximum swimming capacity
  - Channel slope, pool dimension, slot width, flow velocity and pattern, minimum depth, rough bottom substrate, energy dissipation
- Operation and maintenance
  - Operating time, maintenance

Dimension criteria

- Pool size
  - Length 3 x length of maximum fish length
  - Width 2 x length of maximum fish length
- Pool depth
  - Vertical slot fish pass: 60 cm (Upper trout region) up to 75 cm (grayling) or 85 cm (Danube salmon)
  - Nature like pool pass: 60-140 cm depending on river type
- Minimum depth at crest between pools
  - 2-3 x height of fish, mind. 20 cm
- Rough bottom substrate
  - Layer of 10-30 cm with rough stones (vertical slot fish pass)

Dimension criteria

	Maximal height differencen among pools	Slot width	Energy-dissipation
Epirhithral	20 cm	15 cm (20 cm)	160 W/m^3
Metarhithral	18 cm	15-25 cm (Äsche)	140 W/m^3
Hyporhithral	15 cm	25-35 cm (Huchen)	120 W/m^3
Epipotamal	10-13 cm	20-40 cm (Wels)	100 W/m^3
Metapotamal	8 cm	50 cm (Wels)	80 W/m^3

Attraction flow

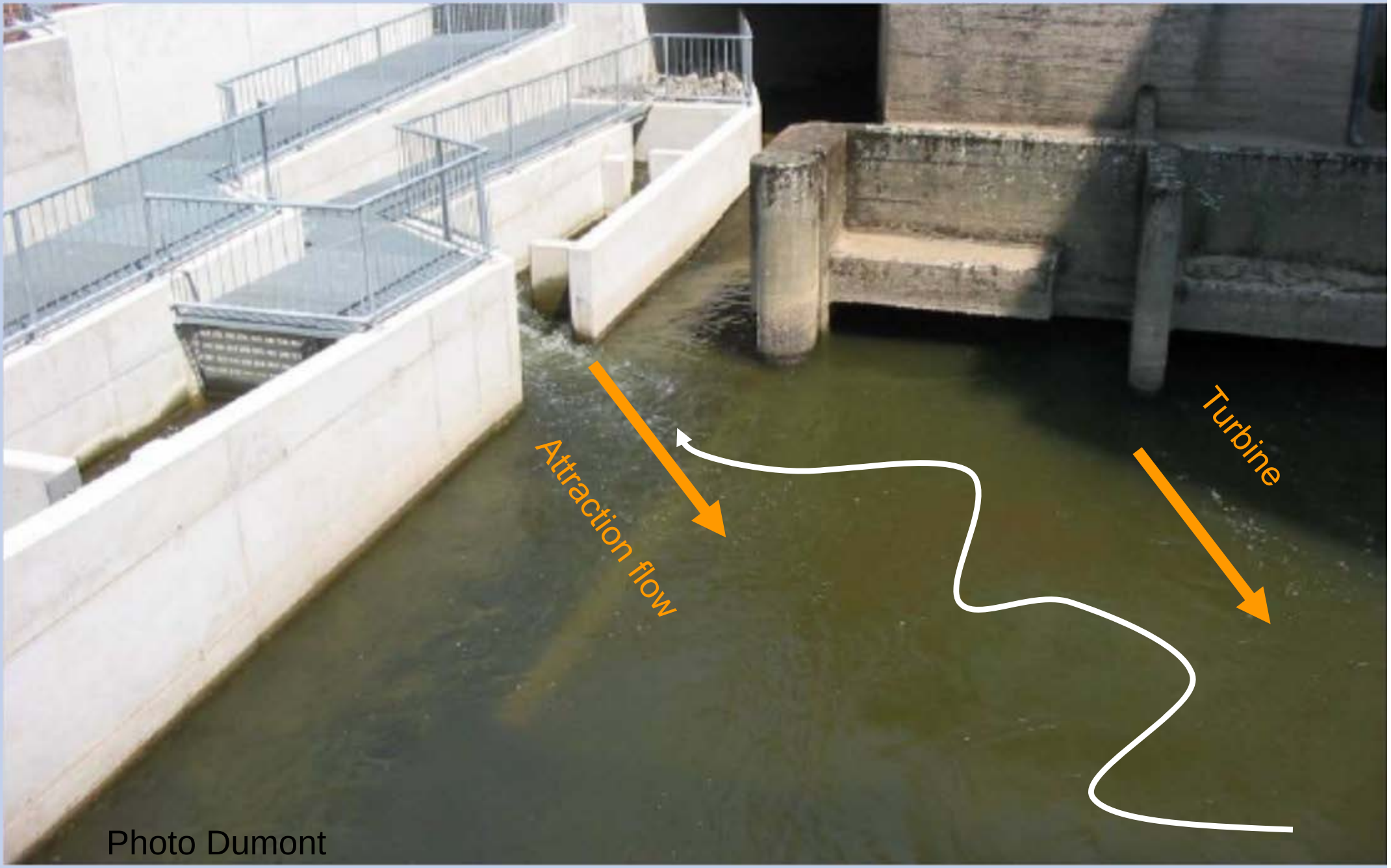


Photo Dumont

Attraction flow

- Location
  - Entrance should be located within the migratory corridor
- Attraction flow
  - 1-5 % of concurrent flow
    - In small rivers guaranteed by fish pass flow
    - In large rivers additional attraction flow required at entrance
- Connection to river bottom

Attraction flow

Low flow

High flow

Without additional attraction flow fish cannot find the entrance

Maintenance

Examples

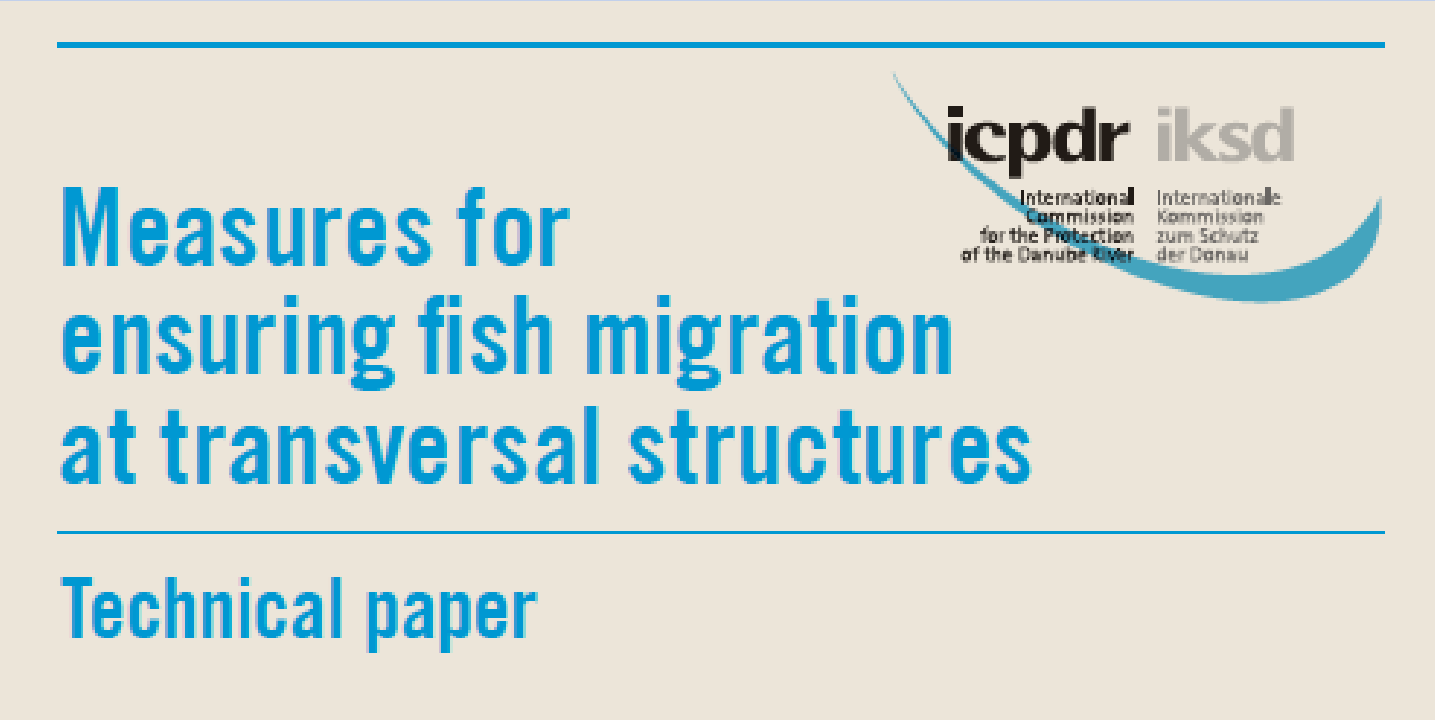
VERBUND (since 2000)

- New
  - Leoben
  - Werfen/Pfarrwerfen
  - Hieflau
- Pilot projects
  - Melk
  - Dionysen
  - Mixnitz
  - Spielfeld
  - Peggau
  - Villach

Harreiter 2009

Literature

- https://www.icpdr.org/main/practical-advice-building-fish-migration-aids



Downstream solutions

Austrian wide collaborative project

How to get fish downstream?

- Spill flow
  - Efficiency? Mortality? Injuries? Depending on species, fish size and type of spill flow
- Turbines
  - Mortality? Injuries? Depending on species, fish size and type of turbine
- Via upstream fish passes
  - Efficiency?
- Via downstream fish passes
  - Efficiency? Depending on species, fish size and type fish pass

Planned case studies

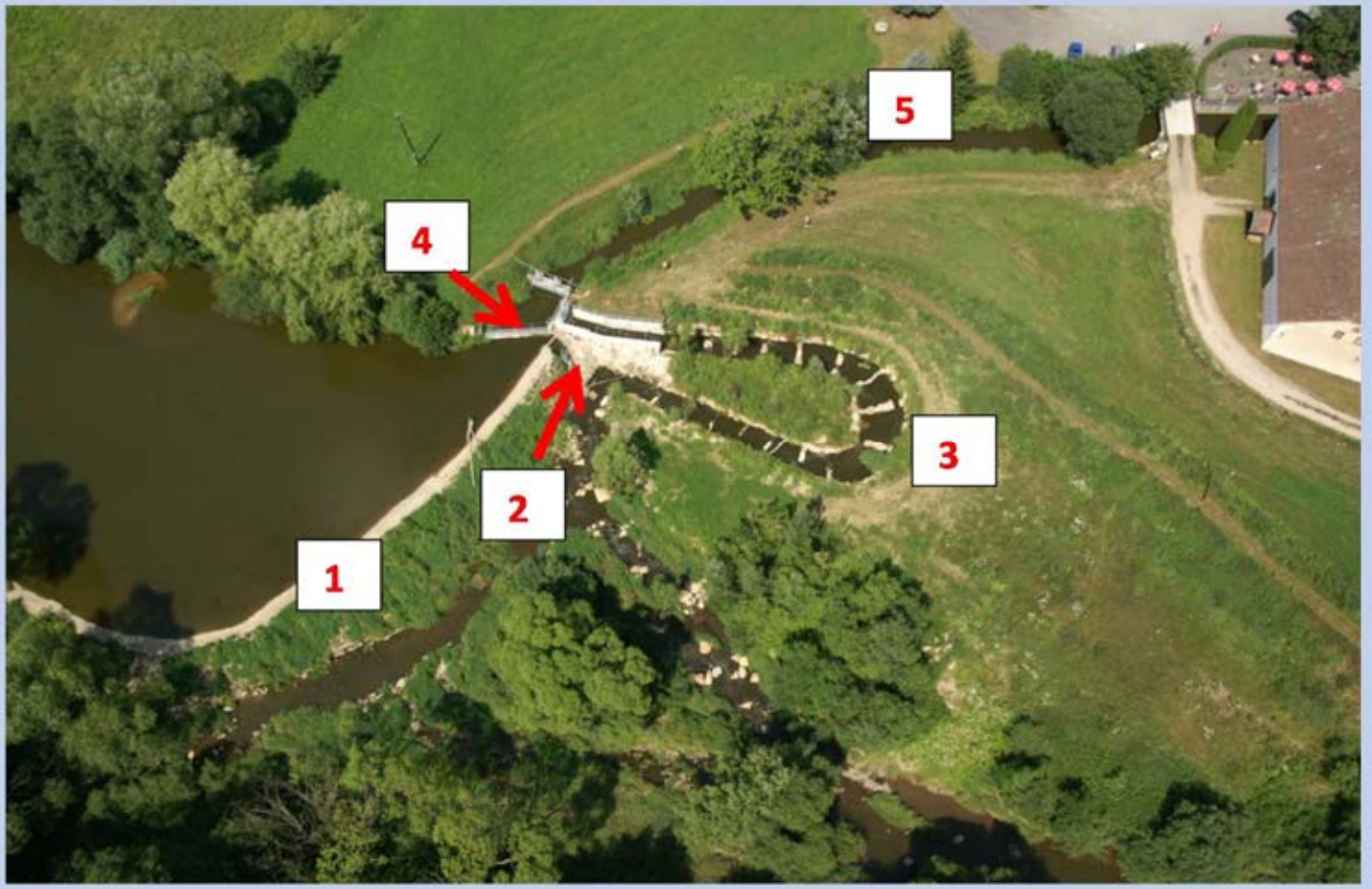
- Murau
- Thaya
- Mondseeache
- Antiesen/Mühlheimer Ache
- Salzburg Fritzbach
- Behavioural experiments Lunz/HyTEC

Thaya - Riedmühle

1. **Weir**
2. **Minimum flow channel**
3. **Fish pass**
4. **Guiding wall –**
5. **Diversion channel**

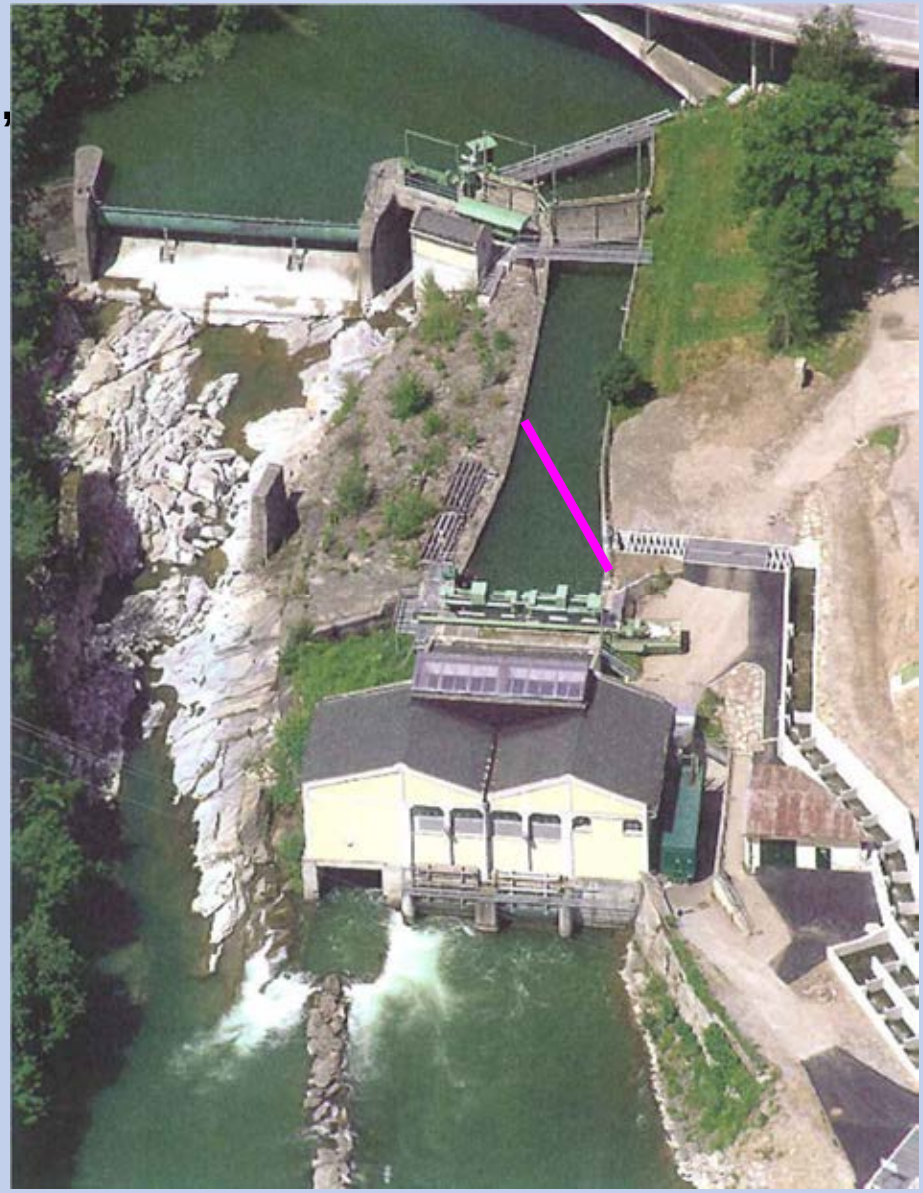
Is the guiding wall effective

Are fish guided to the upstream fish pass?



Murau – Mura river

- **>6700 fish monitored during upstream migration, >60% grayling**
- **>370 fish monitored during downstream migration, >40% brown trout**



Topic:

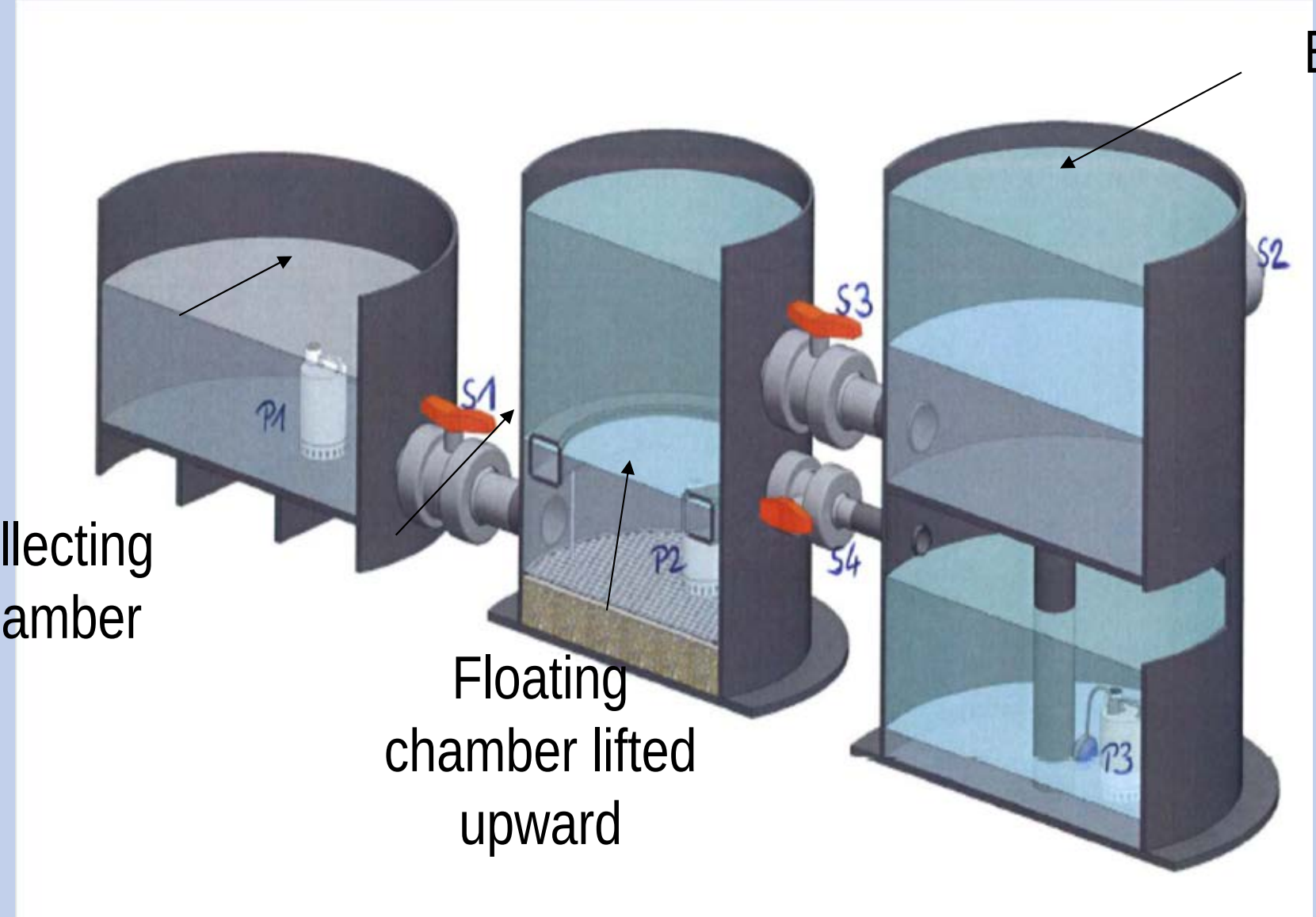
Design and efficiency of planned guiding fence

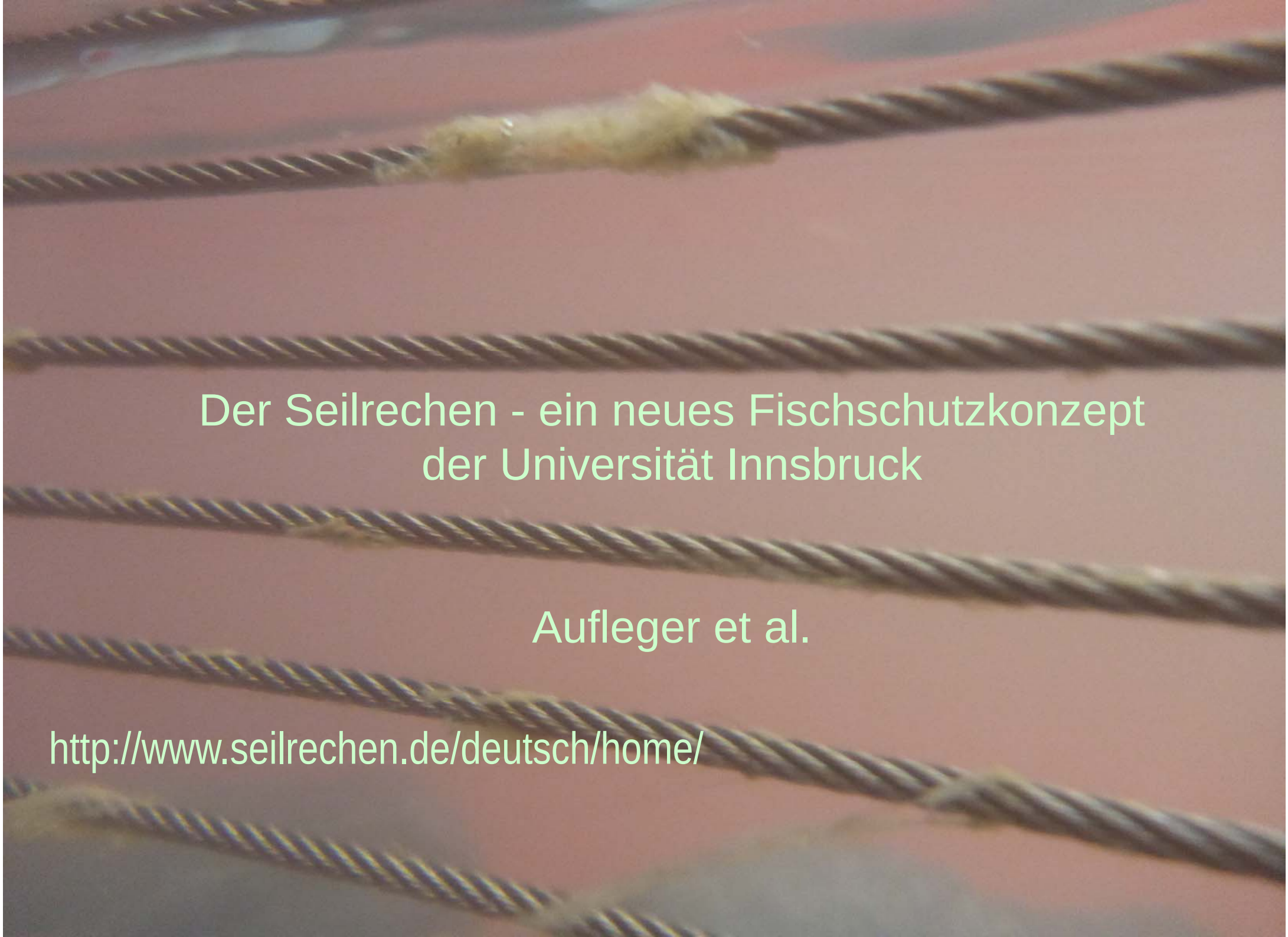
Innovative solutions

Innovative Fish-lift-lock-system

www.boku.ac.at/hfa

Der Wasserwirt, Bernhard Monai, http://www.der-wasserwirt.at





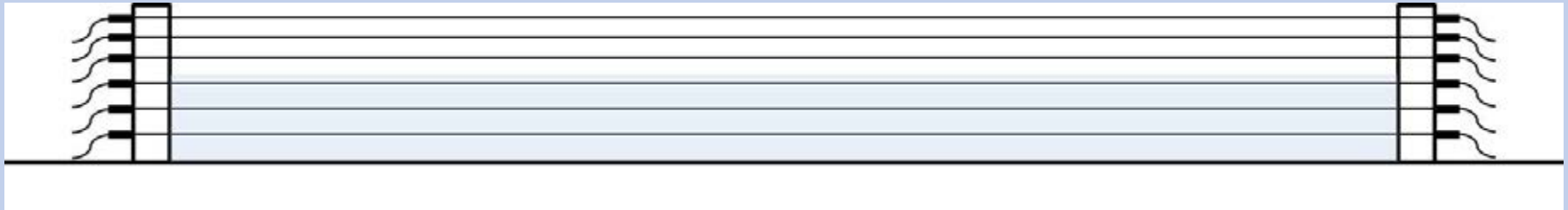
Der Seilrechen - ein neues Fischschutzkonzept der Universität Innsbruck

Aufleger et al.

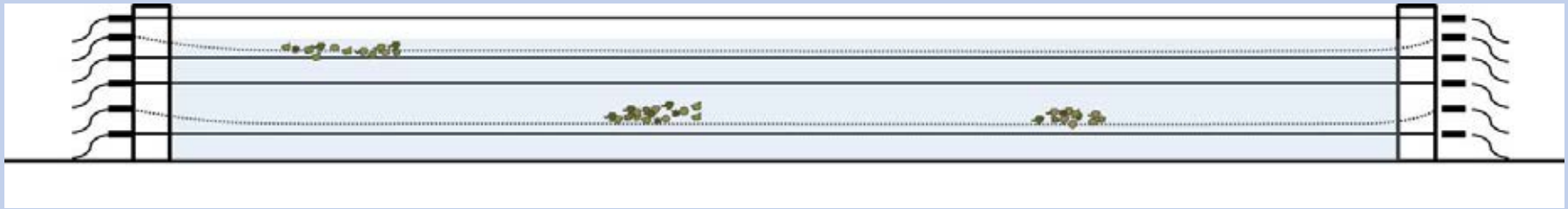
http://www.seilrechen.de/deutsch/home/

Seilrechen

Normal mode of operation

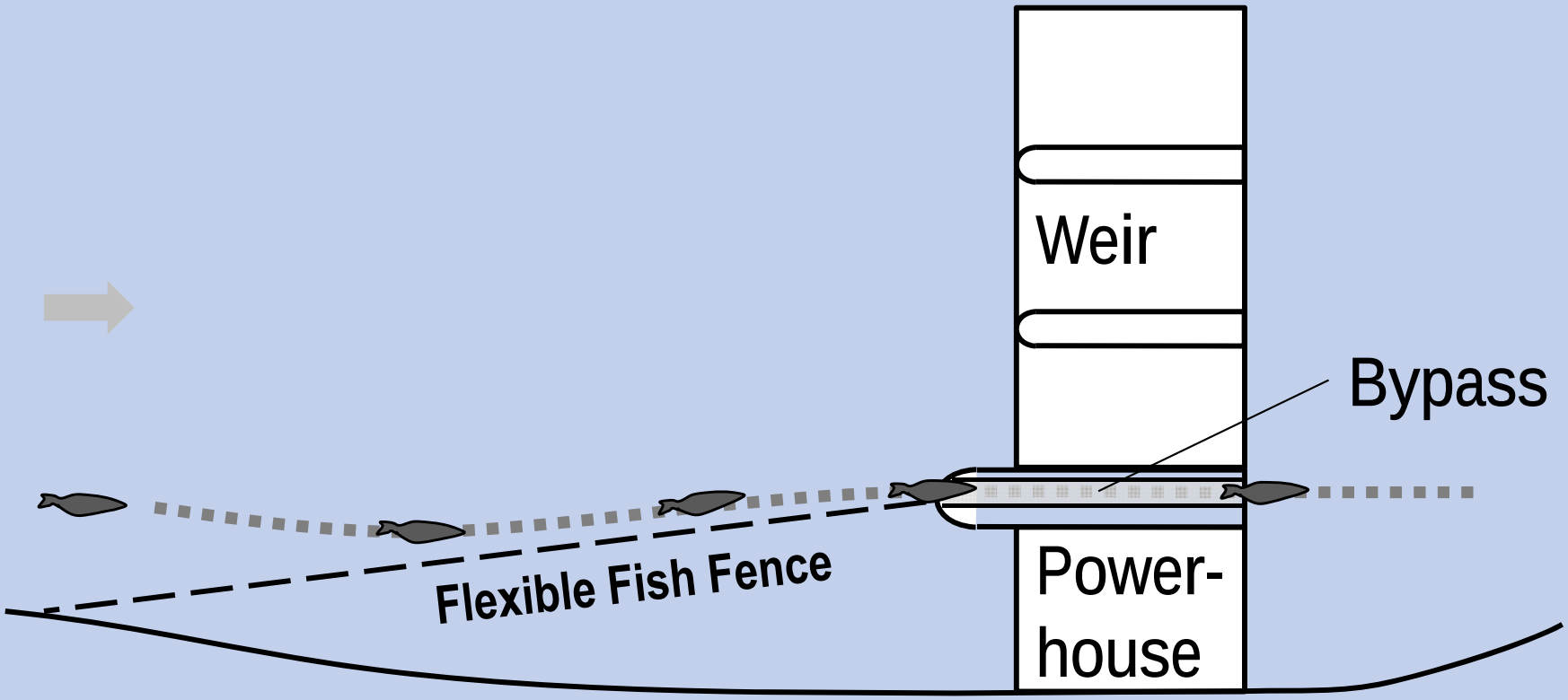


Relaxation of individual cables to mobilize local cloggings



Operation at higher discharges

Plan view Seilrechen



Ergebnisse Verlegungsversuche - Holz

http://www.zek.at/hydro/news/uni-innsbruck-entwickelt-seilrechen/

„HYDROCONNECT“ - „Albrecht fishLift inside“

www.boku.ac.at/hfa

- ΔH = 3,15m
- AØ = 1,4m IØ = 0,8m
- Q = 200 l/s
- 20 U/min
- Power >4kW

Video – Upstream

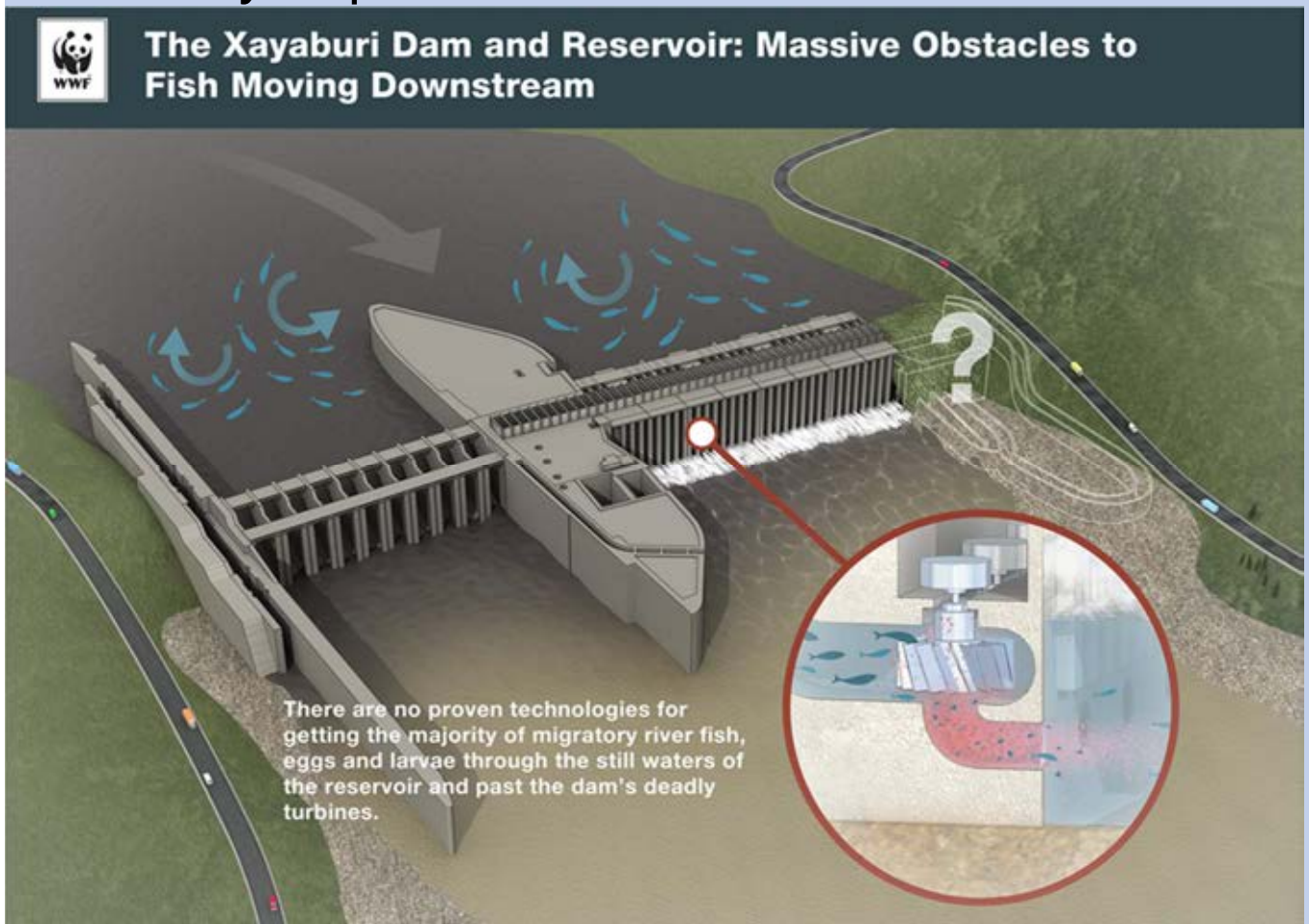
Video – Downstream

Dead ends?

Mekong river

www.boku.ac.at/hfa

- Xylem Inc has won a US$19.6 million contract to provide custom-made **Flygt pumps** to help fish navigate the Xayaburi run-of-river hydropower dam in Lao PDR

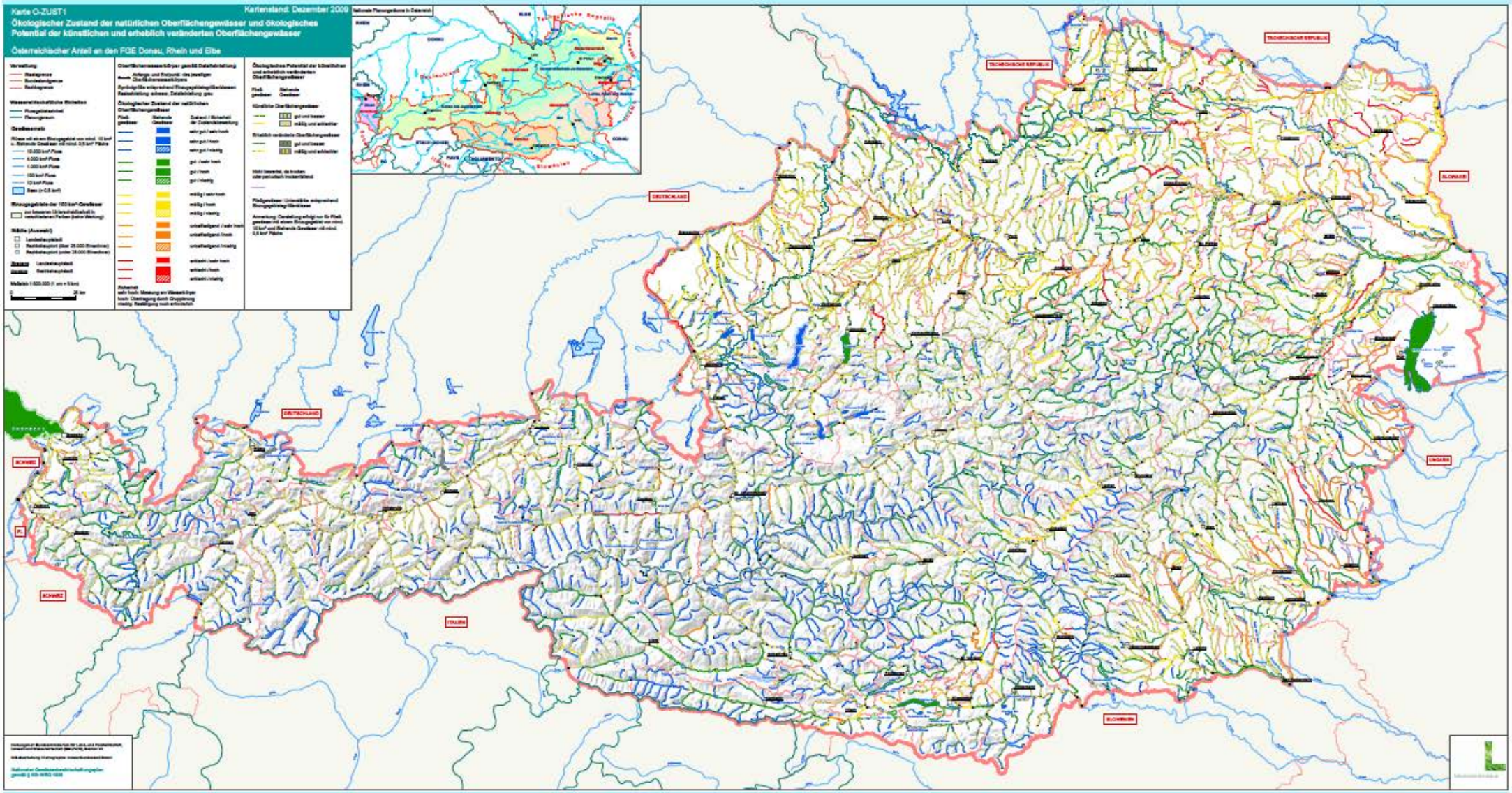


Are pumps the solution?

Do we achieve the good ecological status after having restored continuity?

Ecological status of Austrian rivers

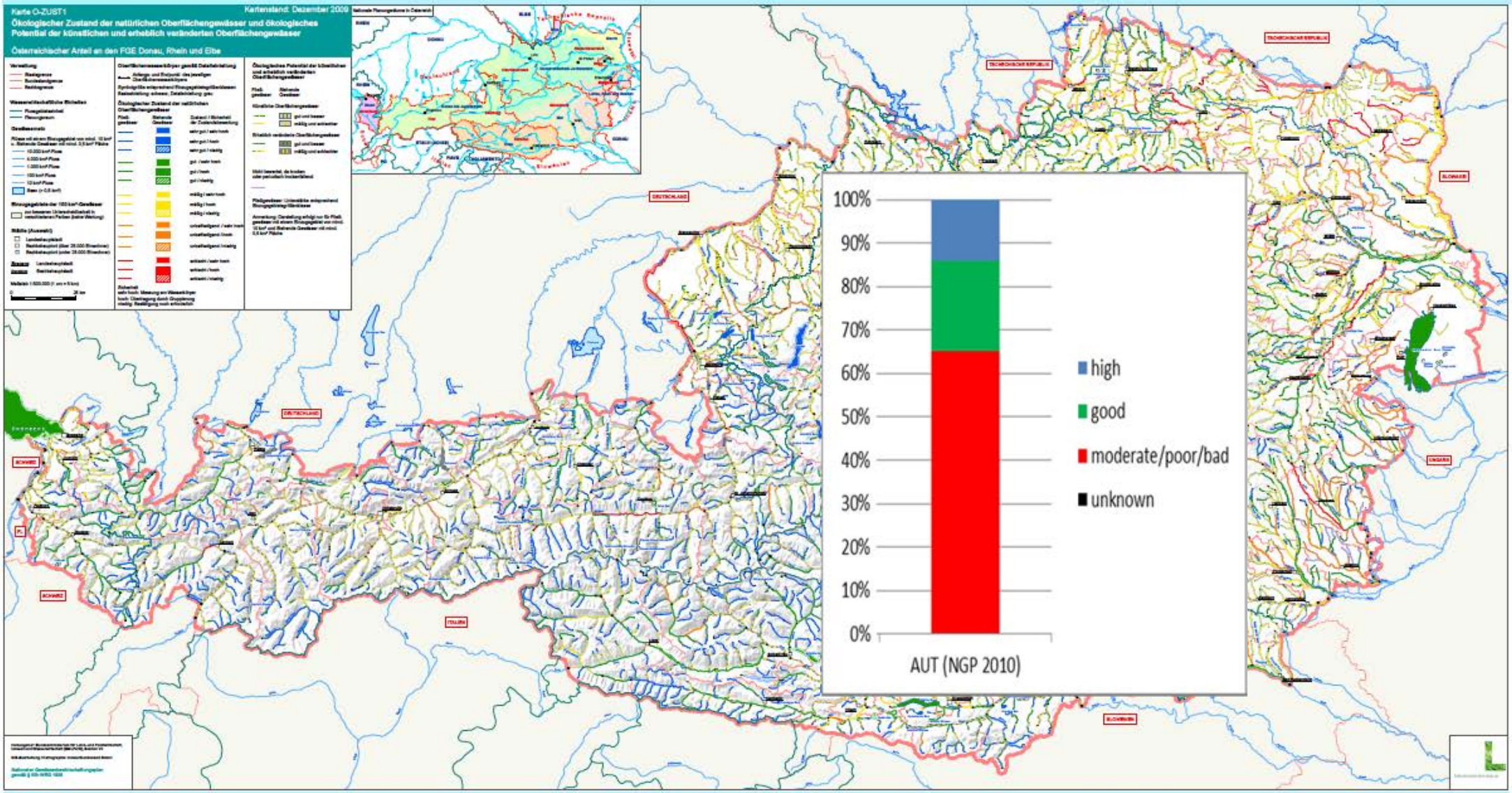
www.boku.ac.at/hfa



Data source: RBMP 2009

Ecological status of Austrian rivers

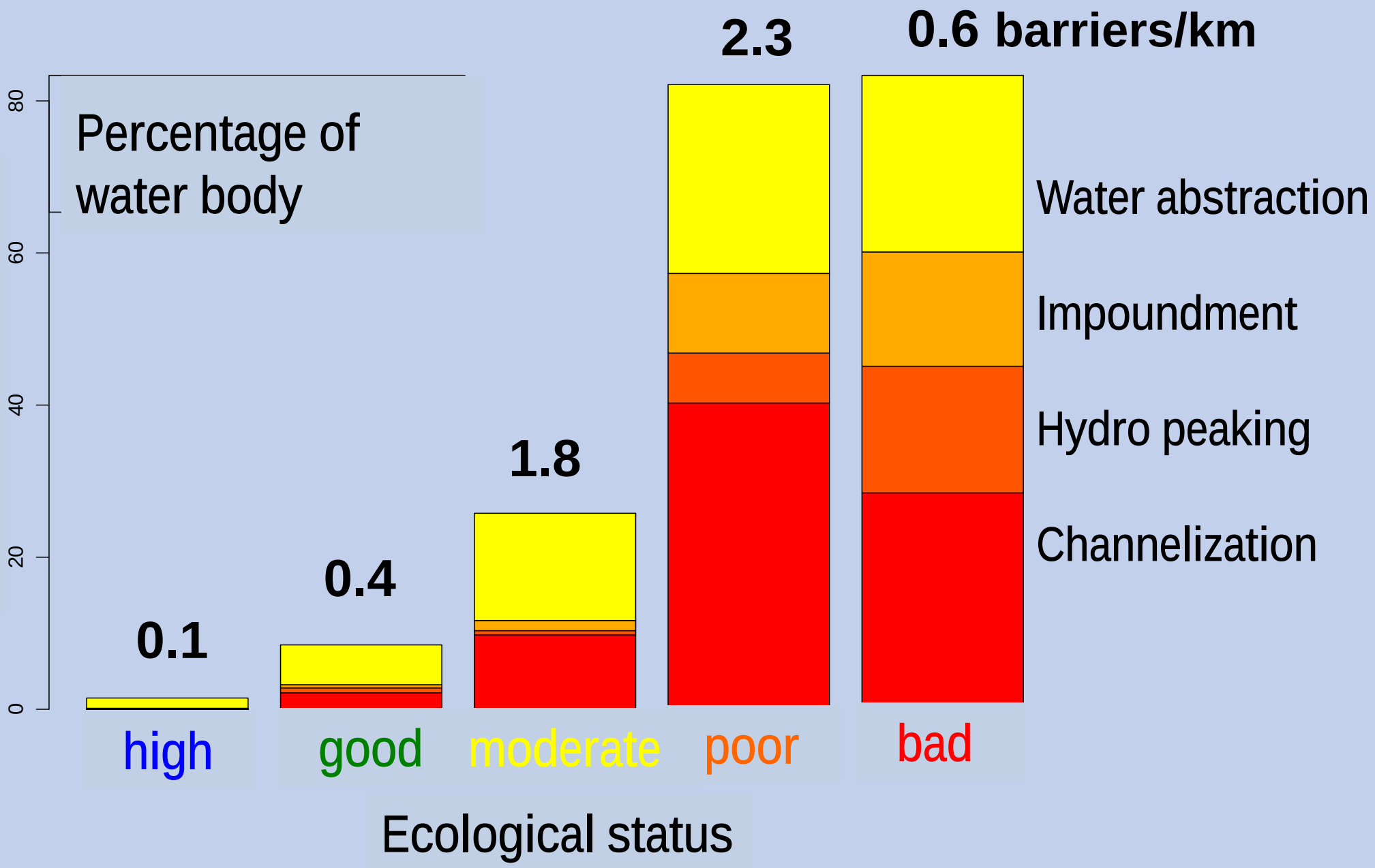
www.boku.ac.at/hfa



Data source: RBMP 2009

Multiple pressures in Austrian rivers

www.boku.ac.at/hfa

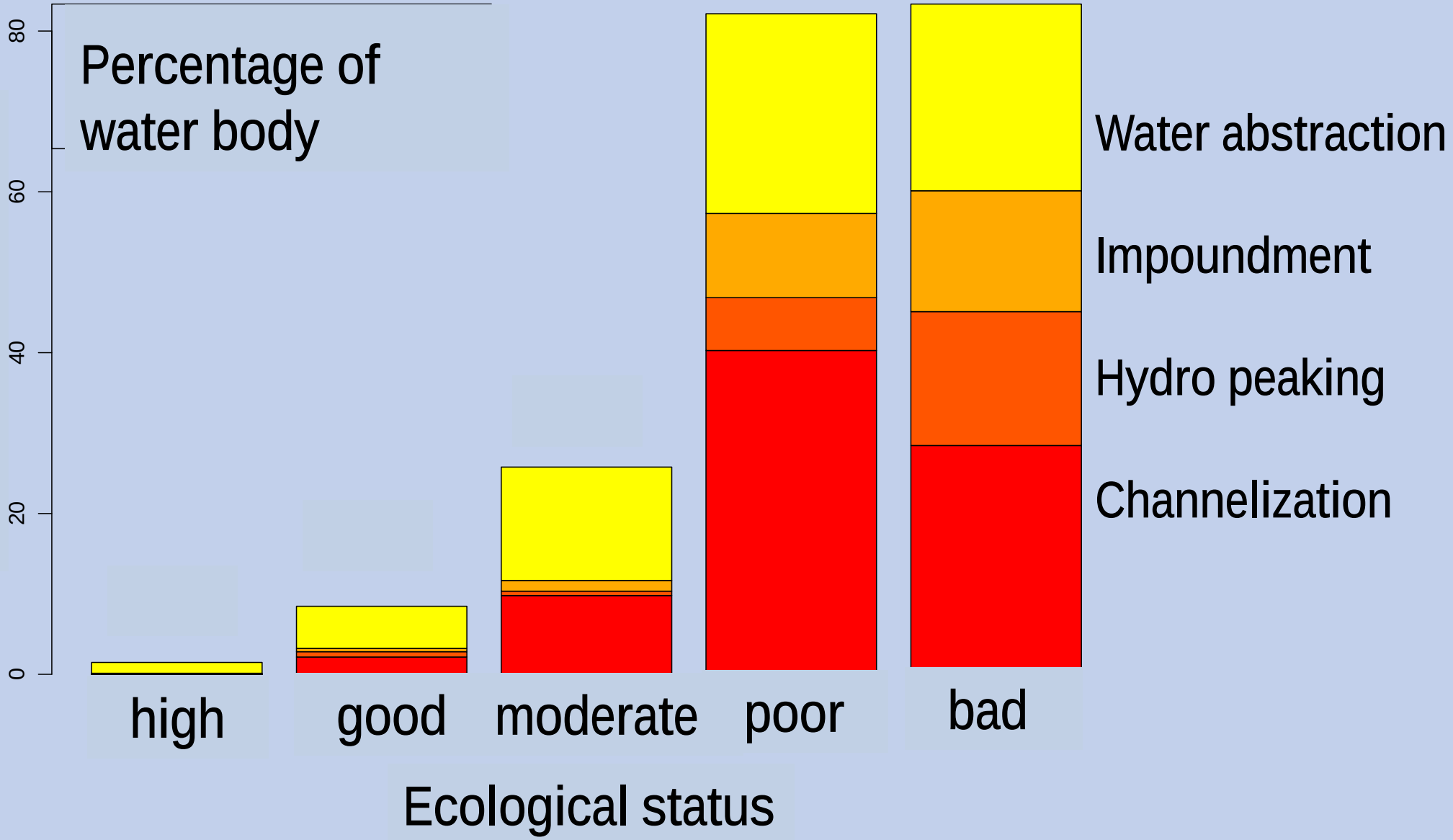


Data source: RBMP 2009

Multiple pressures in Austrian rivers

www.boku.ac.at/hfa

Without continuity interruptions



Data source: RBMP 2009

SUMMARY

- Restoration of **continuity** disruptions are the main objectives of river restoration in Austria
- Research in Austria focuses on **potamodromous** species
- Downstream fish passage is still an **unsolved** problem
- **Innovative** solutions are required
- Additional restoration efforts covering the **hydromorphological** dimension of river systems are necessary in order to achieve the good ecological status (potential) according to the WFD