

The role of fish passage in achieving „Good Ecological Status“



www.boku.ac.at/hfa

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

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

140 mio. Euro



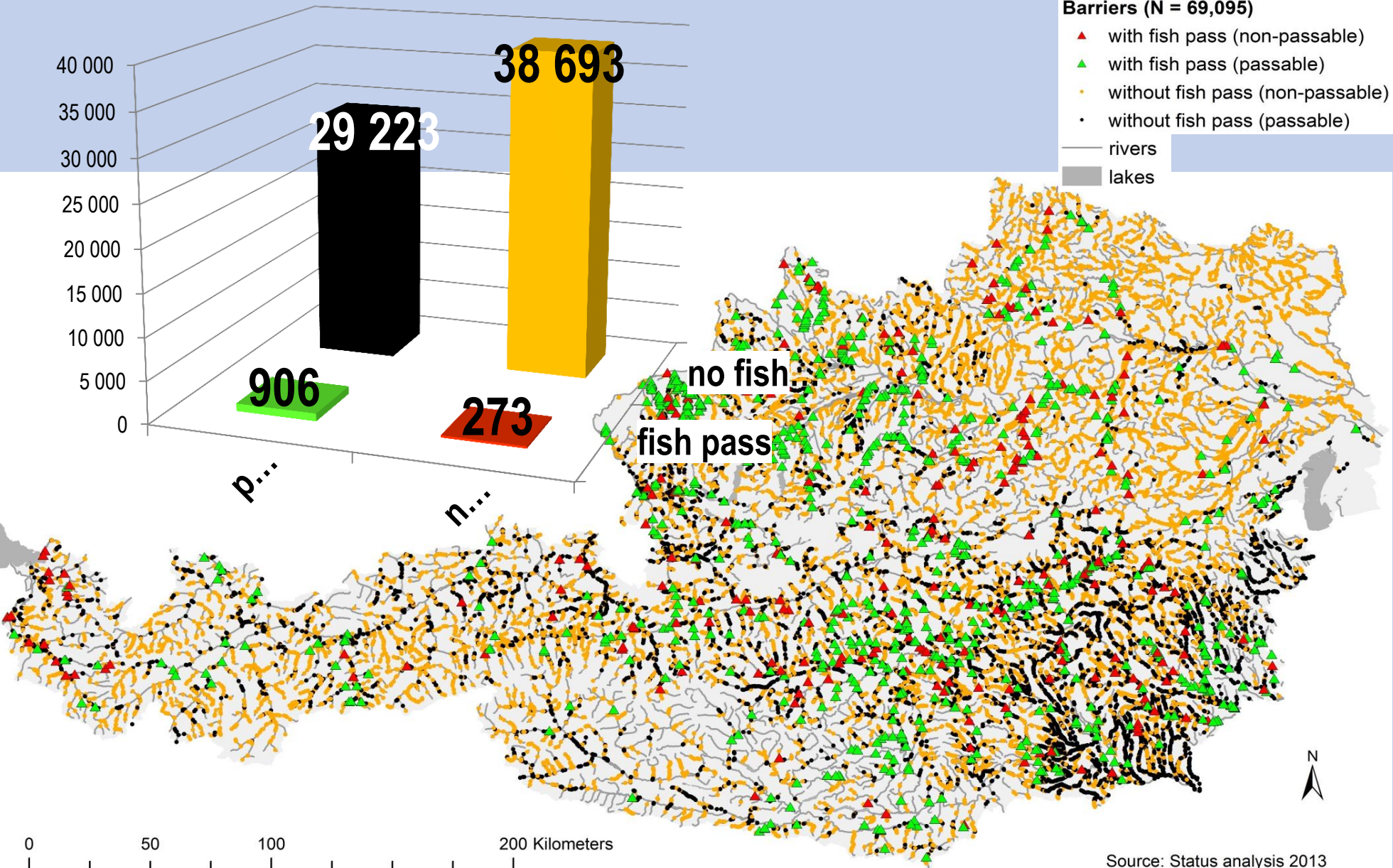
Morphology

192
31%

Connectivity

431
69%

Barriers and fish passes in Austria



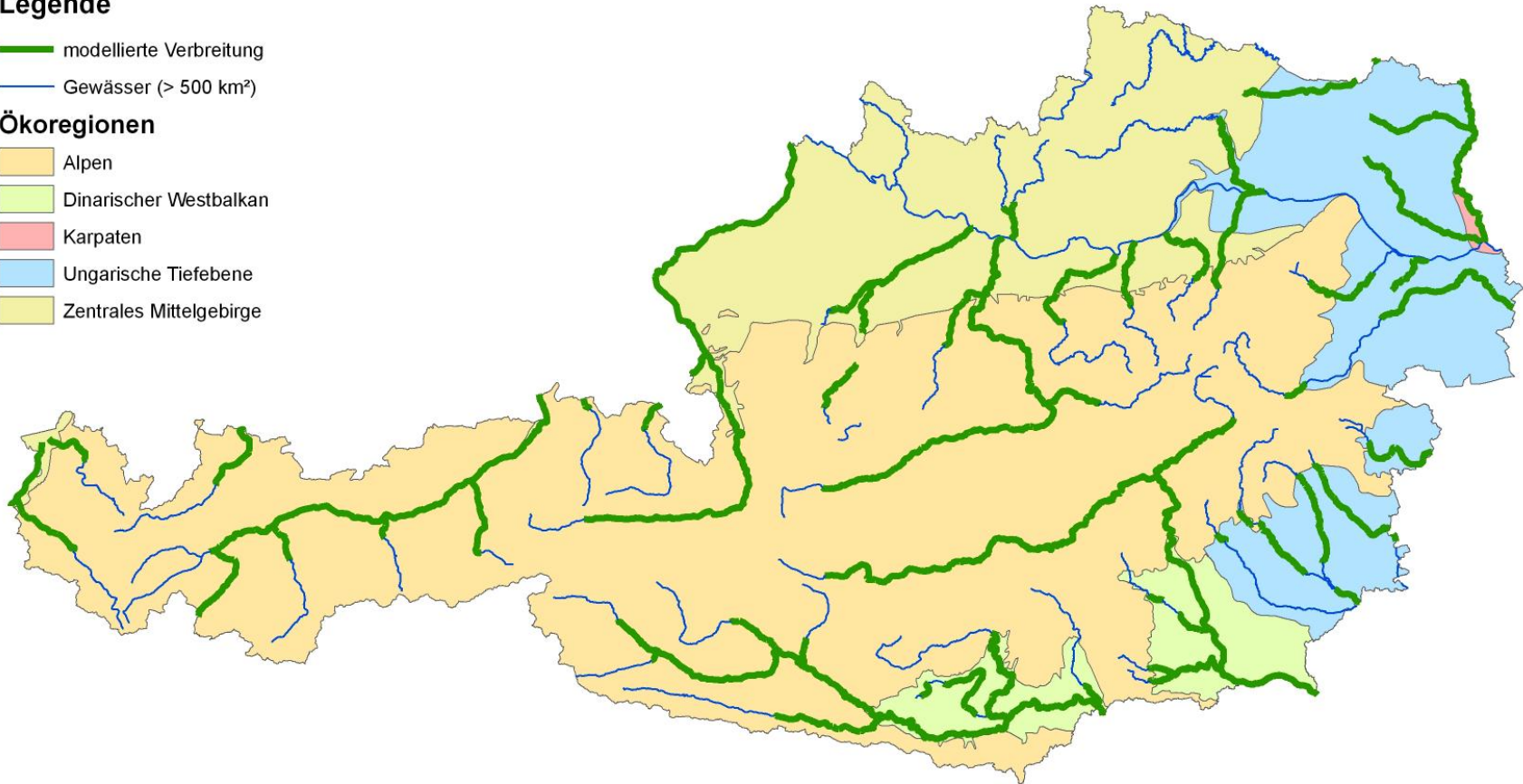
Modelled distribution of Danube salmon

Legende

- modellierte Verbreitung
- Gewässer (> 500 km²)

Ökoregionen

- Alpen
- Dinarischer Westbalkan
- Karpaten
- Ungarische Tiefebene
- Zentrales Mittelgebirge



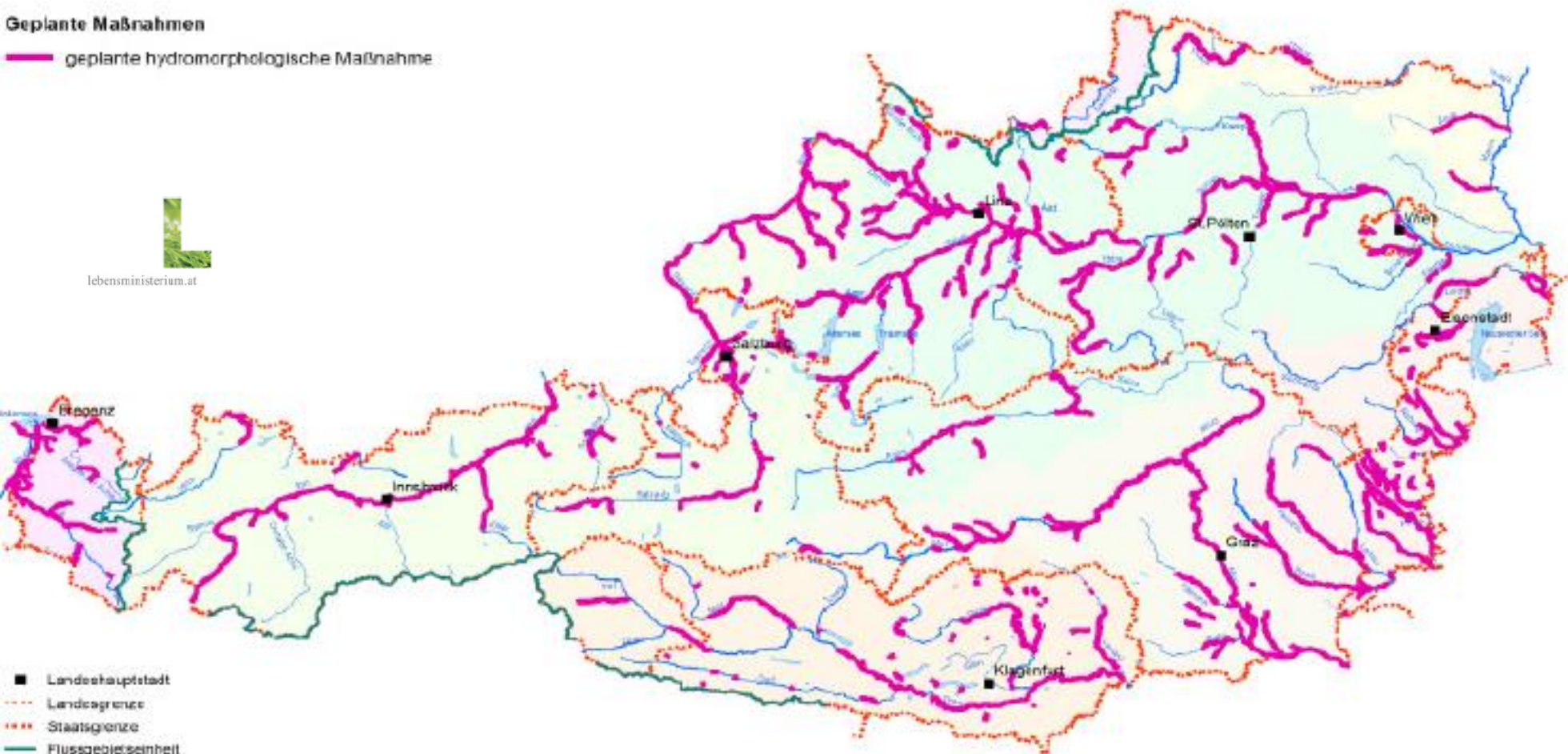
0 25 50 100 150 200 Kilometer



Priority rivers

Geplante Maßnahmen

geplante hydromorphologische Maßnahme



Austrian fish pass guideline



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

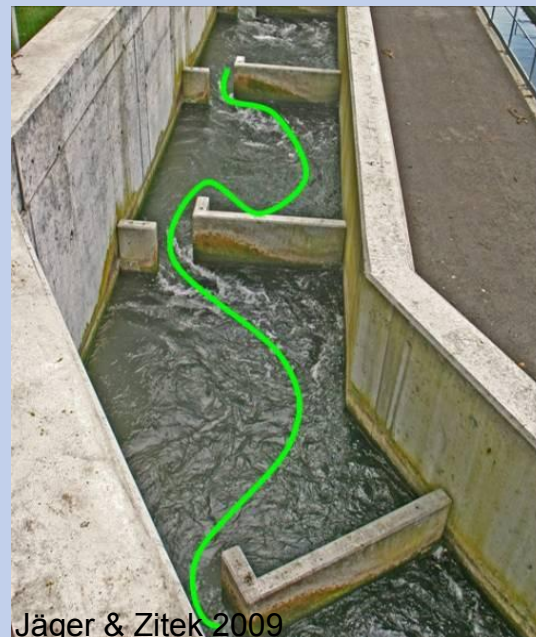


Fish passes - Types

- 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 differenzen 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

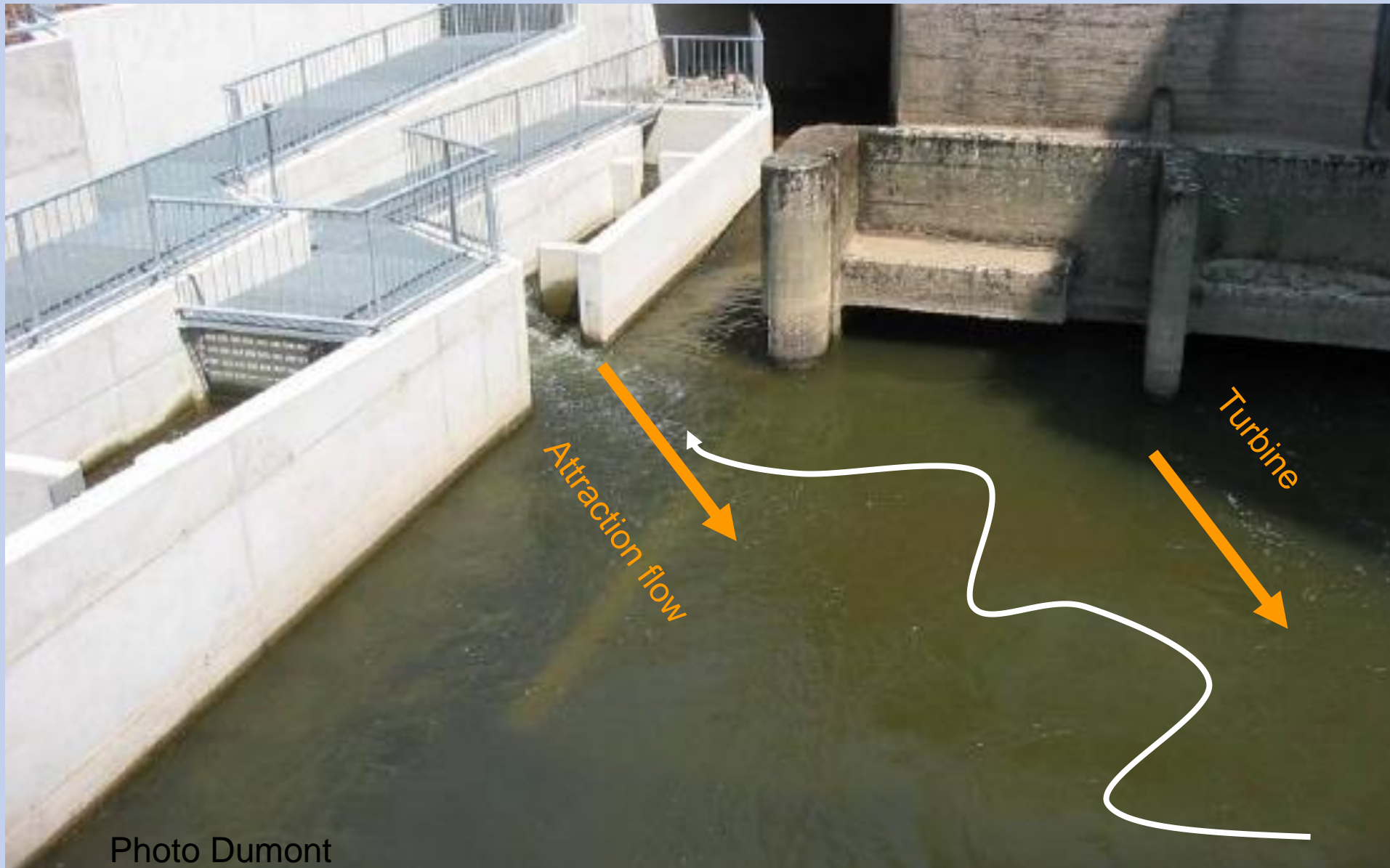


Photo Dumont

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



Maintenance



Foto Jäger

Examples

VERBUND (since 2000)

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



KW Melk

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

Measures for ensuring fish migration at transversal structures

Technical paper

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

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

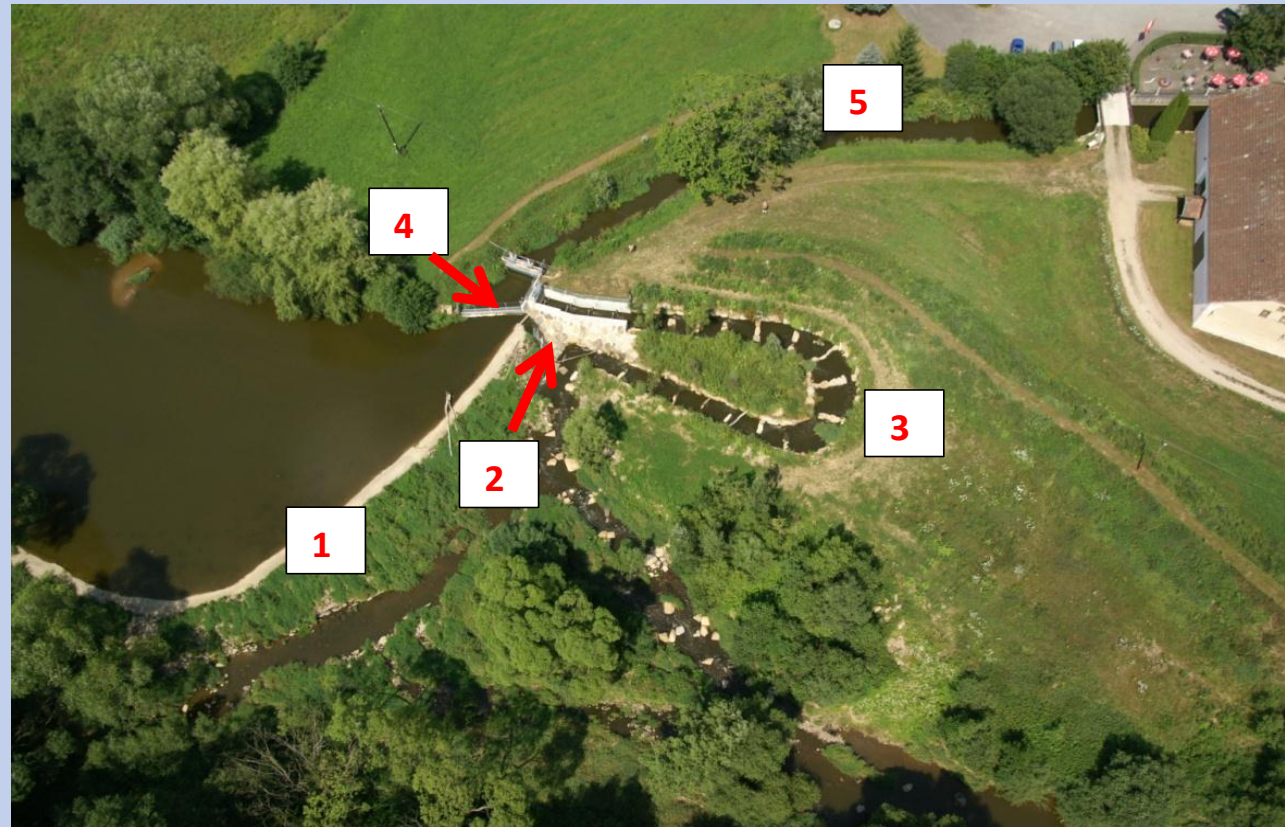
Planned case studies

- **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?

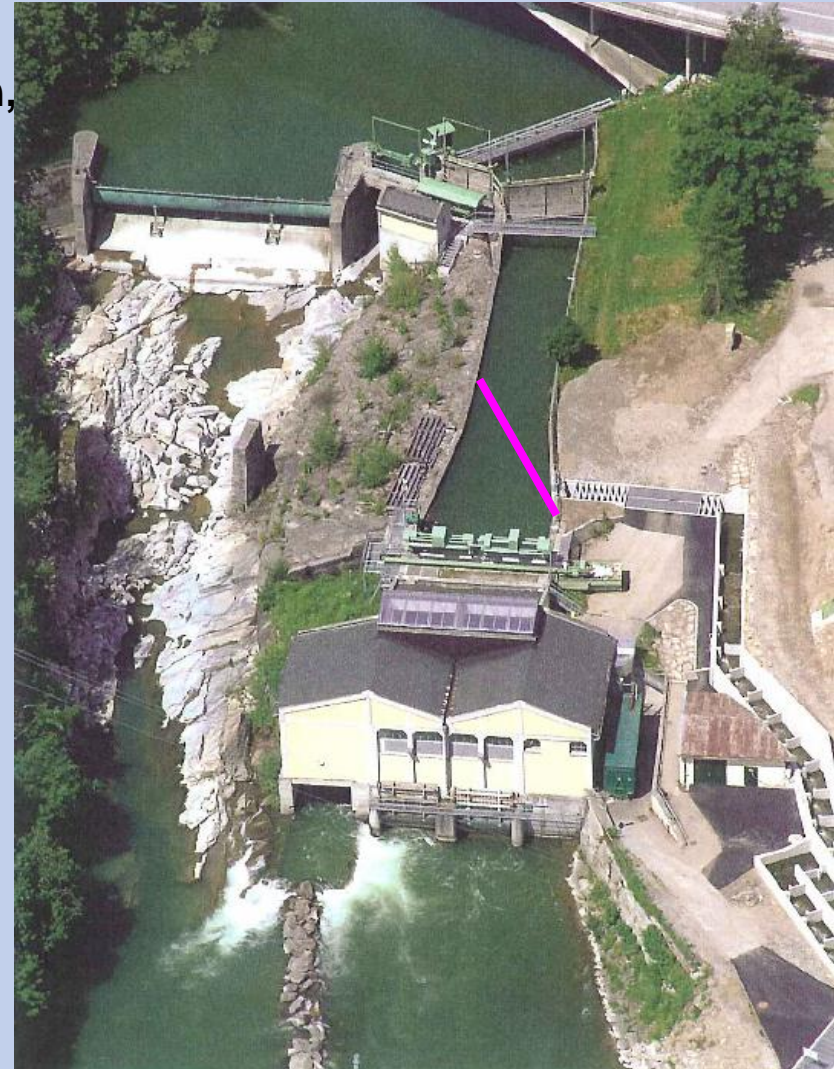


Murau – Mura river

- >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



„HYDROCONNECT“ - „Albrecht fishLift inside“



- $\Delta H = 3,15\text{m}$
- $A\varnothing = 1,4\text{m}$ $I\varnothing = 0,8\text{m}$
- $Q = 200 \text{ l/s}$
- 20 U/min
- Power $> 4\text{kW}$





Video – Upstream



HYDROCONNECT
GmbH

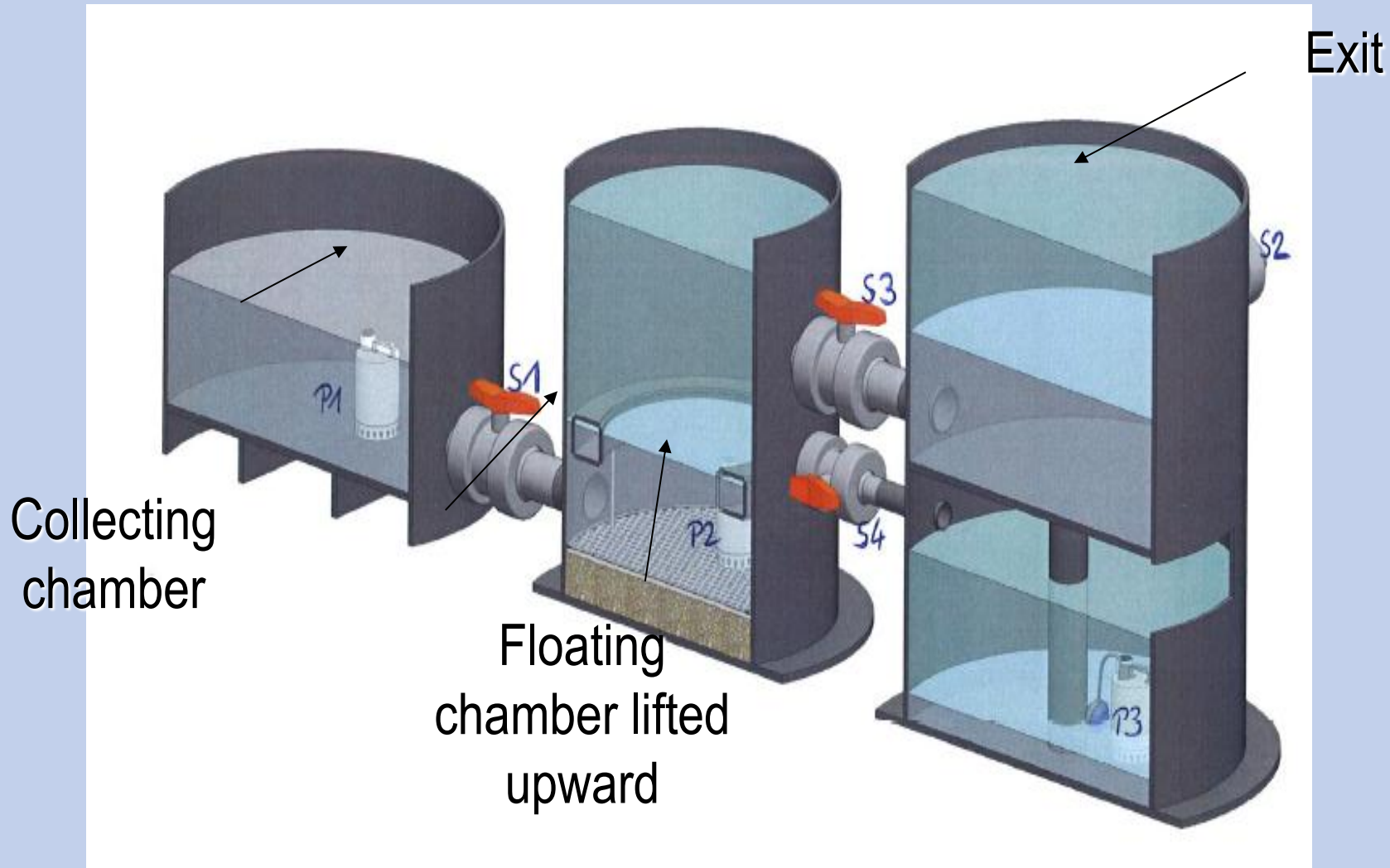


Video – Downstream



Innovative Fish-lift-lock-system

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



Dead ends?

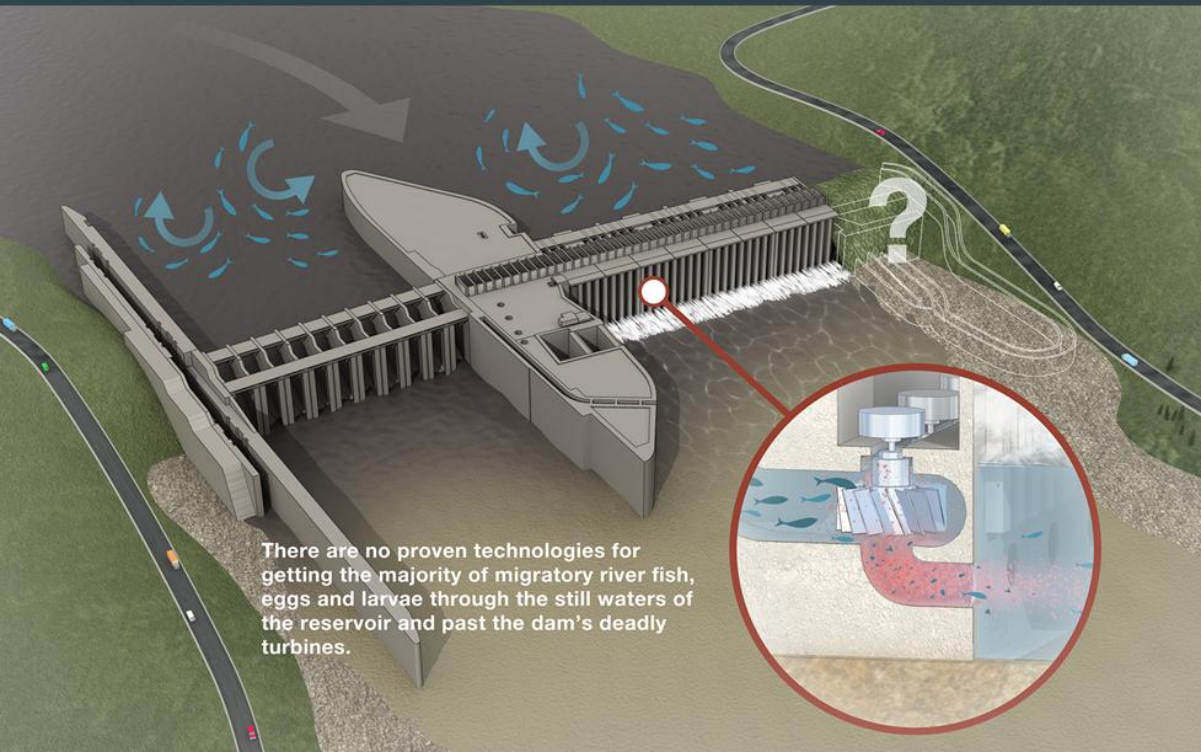
Mekong river



- 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



The Xayaburi Dam and Reservoir: Massive Obstacles to Fish Moving Downstream



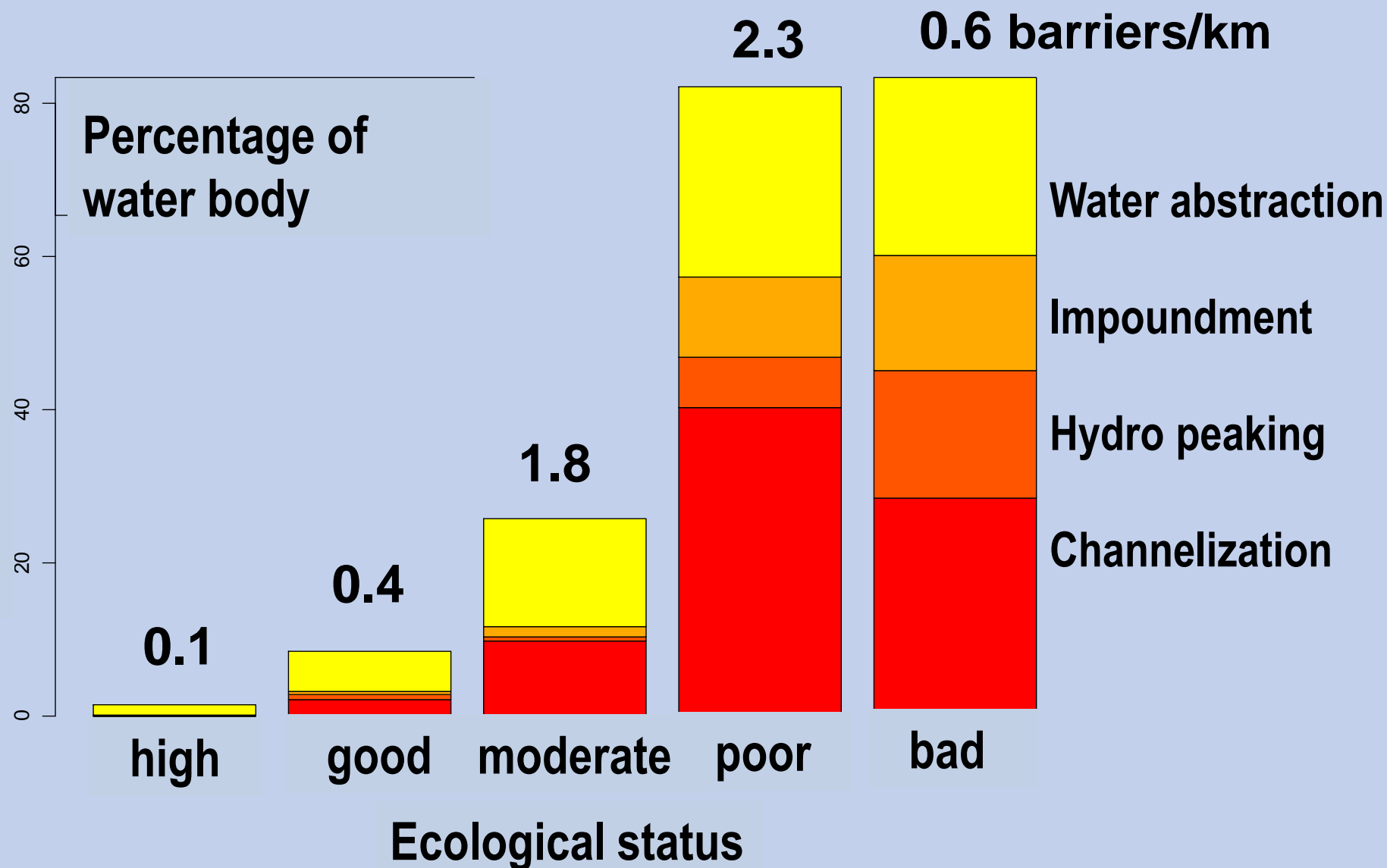
There are no proven technologies for getting the majority of migratory river fish, eggs and larvae through the still waters of the reservoir and past the dam's deadly turbines.

Are pumps the solution?



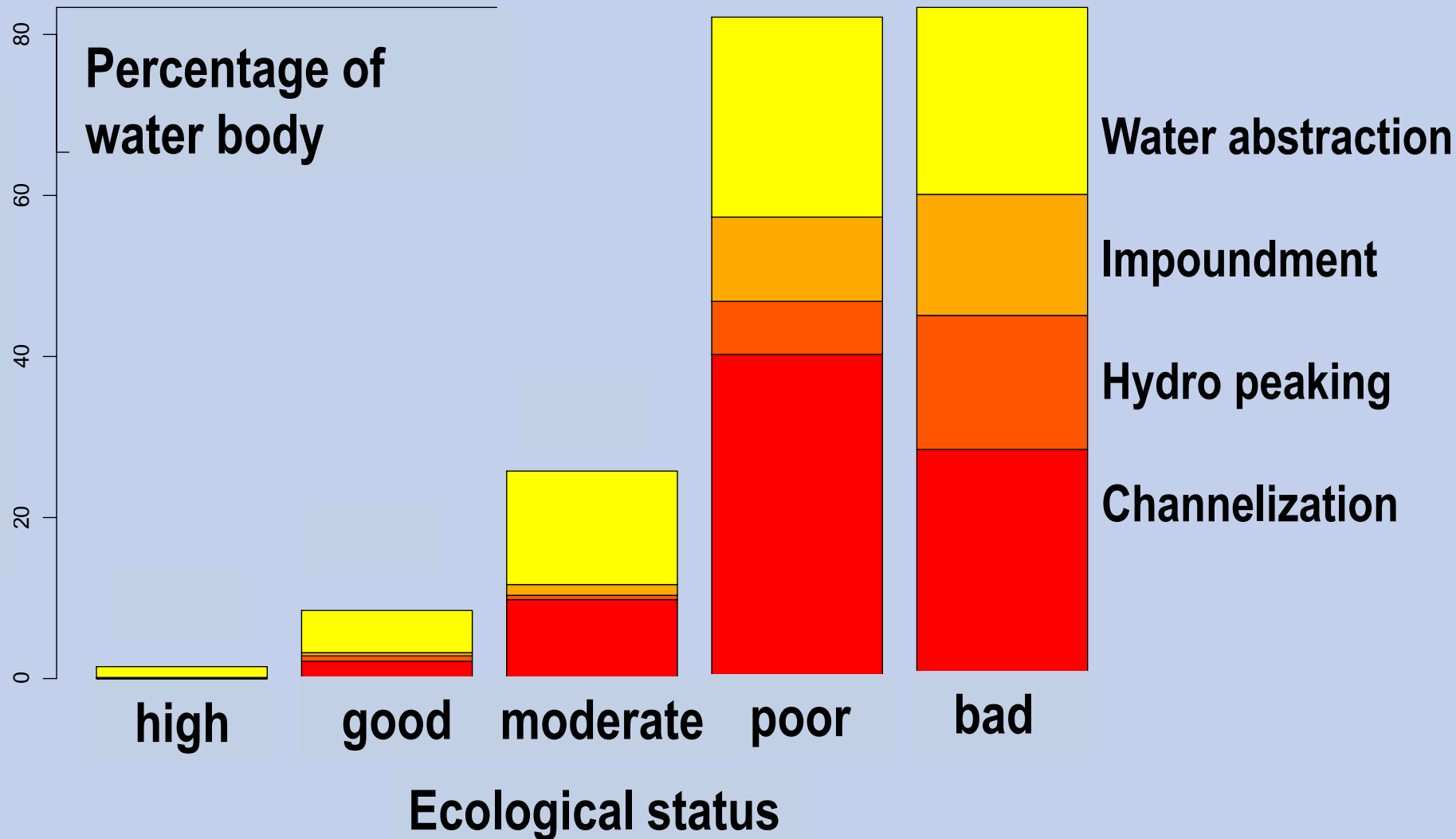
**Do we achieve the good ecological status
after having restored continuity?**

Multiple pressures in Austrian rivers



Multiple pressures in Austrian rivers

Without continuity interruptions



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