Session:

Connectivity for aquatic species
Expert discussion

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For more information: www.hydropower.org/congress
State of the art – technical mitigation

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Fish pass types

Upstream
- Nature-like
  - Bypass channels & rock ramps
- Technical
  - Vertical slot fish passes
  - Large scale bypass systems

Downstream
- Fish protection
  - Screens
- Fish passage
  - Bypasses
  - Fish-friendly turbines
  - Spill flow
Fish pass functionality

Dimension and type depends on

- Swimming capabilities
- Largest species
- Amount of migratory fishes (peaks!)

Attraction

- Perception of fish pass entrance

Passage

- Hydraulic conditions
- Dimension of fish pass
Nature-like bypass channel
Example: HPP Melk, Danube, Austria

- FP length: 1 040 m
- FP width: 12 m
- Head of dam: 12 m
- HPP discharge: 2 700 m³/s
- FP discharge: 1.4 - 3.2 m³/s
- Proved fish passage of all occurring species, i.e. 42 species incl. small, large and juvenile fish
- FP colonised by 2 550 ind./100 m
Vertical slot fish pass
Example: Geesthacht, Elbe River, Germany

- FP length: 550 m
- Weir head: 4 m
- 45 pools (9 x 16 m), 2 slots (1.6 m)
- Max. discharge of 15 m³/s (2% of MQ)
- Passage of 43 species, 300,000 ind./year
- Also large individuals of Atlantic salmon, sander, European catfish
- One 3 m long sturgeon passed
Bypass system
Example: Danube, Austria

Near natural channel to circumvent the entire reservoir

- Substitutes lost fluvial habitats (floodplains)
- Important for multiple dam systems

Currently constructed at Danube River
15 km long, discharge 2.5 - 20 m³/s
Solutions for downstream migration

- Fish protection (prevent migration through turbines)
  - Behavioural barriers
  - Physical barriers

- Construction of suitable downstream fish pass systems
  - Fish-compatible turbines
  - Bypass systems
  - Spillway passage
  - Trap&truck

- Widely lacking for large, multi-species rivers
- Solutions for passive downstream drift of fish larvae through reservoirs?
Large rivers / large dams

- Most fish passes for small-medium sized dams (<15 m height)
- Mainly for upstream migration
- Most downstream fish passes for small-medium sized rivers

Challenges for large rivers

- **Large fish** species
- Migration peaks with **high biomass**
- **High diversity** of species (with different requirements)
- Limited knowledge on migratory species (e.g. Mekong)
- High discharge variations
- Fish passage efficiency (multiple dams!)

292 m high Xiaowan Dam, Mekong, China
Innovations
Example: Hydroconnect

Upstream passage

Downstream passage
From fish ladders to integrative fish pass solutions

Fish ladder

Integrated mitigation solutions

Jungwith et al. 2005
From fish ladders to integrative HPP mitigation solutions

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HPP - conservation conflict goes beyond connectivity

Hy:Con methodology

Hydropower attractiveness

Conservation needs

Mielach et al. 2014, Muhar et al. 2014; WWF Austria 2014
Thank you for your attention!

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