Goals of watercourse restoration in Finland – how to revive rivers with power generation?



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History of watercourse restoration in Finland

- Pollution and euthropication of lakes in 1960's
- Heavy construction of watercourses for hydro power and flood control in 1960's
- National Board of Waters was founded in 1970, 13 water districts
- All water related activities were combined (except waterways)
- SYKE and ELY-centres are the continuation, together with other environmental issues
- Ceasing of timber floating responsibility of restoration of rivers and brooks was given for environment centres in 1980's – last cases are almost ready in 2012



Restoration or environmental river engineering?

- Environmental approach for normal river engineering from 1970's, management of water landscape 1971
- Guidelines for submerged weirs 1985
- New guidelines for landscaping 1991
- Guidelines for environmental hydraulic engineering 1998 and 2003
 - contained planning principles of restoration, drainage, flood conrol, fishways and bypasses, urban stormwaters, ecohydraulics
- Adopted as requirement in permitting from 2000
 - Finland was well prepared for WFD



Watercourse restoration strategy 2011

- Overall goal: Responsibility and financing of restoration will be widened, the state will provide mainly guidance
 - Comment: Danger of decreasing of state financing and good competence in the ELY-centres
- Finnish watercourse restoration network was established 2012
 - promoting associations and municipalities for local restoration
- Initative for compensation of lost habitats into legislation
 - Who causes he pays -principle, by restorative construction
- Efficiency of restorations will be monitored, also socio-economy
 - Several Ph.D thesises lately

- International cooperation and export
 - Finland active in European Centre for River Restoration ECRR
 - RESTORE Life+ 2011-13, SYKE leads North Region
 - HEALFISH Interreg 2011-13, Gulf of Finland migratory fish project

Power generation and salmon in Finland



- Rivers and lakes with existing
- Kymijoki with stock from R.Neva,

Change of migratory fish policy – reviving of Salmon in the Baltic Sea area

- Original salmon Salmo Salar stock only in few rivers, which produce most of salmon catch in the Baltic Sea (blue)
- Sea run brown trout Salmon trutta is highly vulnerable
- Fish farming and stocking of salmon is no more rentable - not viable juveniles
- Change of policy towards natural reproduction, potential rivers (yellow and red)



National fish pass strategy 2011

- Reviving the vulnerable and endangered migratory fish stocks
- Solving the problems of conflicting goals of fisheries and renawble energy policy by hydro power
- Creating migration routes
- Changing compensation by stocking to natural reproduction, including compesation of reproduction areas
- Prioritizing fish pass needs according to existing reproduction areas
- Fishing policy
- EU- parlament decision coming soon: Salmon management plan for Baltic Sea
- Stockings should be stopped in 7 years because of genetic decline

Priorities in the fish pass strategy

- Rivers with good potential for salmon and sea trout were named
- Fish passes are required
- Nature-like fish passes will be preferred
- All stakeholders support, also power generation (except defining environmetal flows)



Measures for "desperate" heavily modified rivers with little amount of natural reproduction area

- Loss of big salmon in river valleys still causes bitterness
- Regional fish pass programs outside the fish pass strategy (R. Oulujoki)
- Creating totally new reproduction areas would be necessary
- Problems:
- - No evidence of performance yet need of stocking in future?
- Need for discharge also for winter power companies are not willing to give water for free



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YKF

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Linkages of fish passes to EU Green Infrastructure and other measures needed in HMWB's

Impact

- Loss of connectivity <
 - \circ fish, good/weak swimmers 🤶
 - Invertebrates, mammals
- Loss of reproduction habitats
 - damming rapids to stagnant, lacustrine areas
 - Dredged and filled channels
- Discharge patterns
 - o regulation
 - dry old channels
 - flow to fish passes/ habitats summer/winter

Mitigation or compensation

- Fish passes
 - Nature-like bypass channels

Constructing new compensative habitats

- spawning channels
- rearing channels
- new side channels
- Restoration of existing rapids
- Environmental flows
 - Minimum flows in hydropower permits
 - Requirements for migration and juvenile habitats

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Examples: Bypass mainly for migration Biron, Gave de Pau, France

- 5,5 m/200 m, gradient
 2,7%
- Discharge 5 m3/s
- 100% success in migration
- 80% of Salmon in one day, 20 % within a week (Monitoring by Michel Larinier)



Constructed spawning and rearing channels to increase reproduction – Canada from 50's

Weaver Creek Spawning channel for Sockeye or Red salmon Oncorhynchus nerka

 regulated discharge 0,43 m3/s, depth 0,24 m, gradient 0,065% length 2,8 km

- maximazed area by meandering channel

Results

- incubating rates of eggs many fold compared to natural rivers

- saved the declining stock

- added value for cathes in the sea



Rearing channels - Canada 2000's

Seton river rearing channel

Originally spawning channel for Pink salmon

Onchorhynchus gorbuscha 2003 complexing to become rearing channel for Chinook Oncorhynchus tshawytscha and Steelhead Oncorhynchus mykiss,

- discharge 1,12 m3/s, depth 0,38 m, gradient 0,1% to 0,7%, length 3,8 km

Results

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Juvenile amounts of Pink exceeded the original reproduction Succeeded compensation to

powerplant construction of

British Columbia Hydro



Constructed side channels - Canada 2000's Chilliwack River



Spawning and rearing channel for Atlantic salmon - Dunglass side channel, Conon river, Scotland

- Gradient 0,33 %, minimum flow 0,5 m3/s, length 1 km
- Juvenile rates:

age 0+ 160 /100m2 age 1+ 70 /100 m2

Data and photo Simon McKelvey



Separate channels for migration and habitats Ruppoldingen, Aare, Switzerland

- Nature-like fish pass with good entrance location near turbines
- Channel for spawning and reproduction habitats
- Fulfils best requirements of renewable energy in CH
- Monitoring of the reproduction channel:
- - juveniles of grayling *Thymallus thymallus*
- - migration of big fish like Wels catfish Silurus glanis







Reproduction channel, nature-like fish pass and vertical slot at power plant Rheinfelden above Basel, Rhine









New standard for compensative habitats Rheinfelden

Lenght h 900 m , width 60 m, 10-30 m3/s



Area 5 ha

Sensation: Lachs wandert bis nach Rheinfelden





May 2012 (An other June 2012)

Opened March 2012

Combination: Bypass channel as fish pass with habitat sections Wettingen, Switzerland







Combined bypass channel for migration and reproduction Sågarsfors, R. Siuntionjoki, Finland

- Powerplant was stopped, dam was opened
- Nature-like side channel was constructed to pass waterfall

 new spawning and rearing habitat
- Height 8,5 m, length 250 m, gradient 3,4%, 2 m3/s
 December 2007 during and after construction







Sågarsfors bypass 2012



2 D flow and habitat modeling of a planned bypass channel Maximum habitat area and quality with limited discharges





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Montta bypass plan R.Oulujoki, Finland

- A velocity
- B depth
- C Salmon spawning
- D Salmon rearing
- E Brown trout spawning
- F Brown trout rearing
- Modeling: Simo Tammela 2008

Fish preference data based on research of Aki Mäki-Petäys and Pauliina Louhi



Hydropower and Fishery themes in RESTORE http:/restorerivers.eu/



More river restoration cases from Sweden and Norway needed!



Conclusions: Need for cooperation in research

- Reviving Salmon and Sea trout is a common Nordic interest
- Compensative reproduction habitats should be required in power plant permits how to improve legislation?
- Compensation will be added to the Nordic guidelines for Programs of Measures in the RBMP's
- EU promotes Green Infrastructure
- Basis for cooperation:
 - Denmark : long tradition of bypass channels from 1990's
 - Finland: urgent need of convincing examples
 - Sweden: good research on fish passes and bypass channels
 - Norway: good practices in the renewal of permits
- Combined research projects with SYKE about
 - bypasses ?
 - environmental flows?

Reference and links

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Thank you for your attention!