

Increasing biodiversity in heavily modified rivers without affecting production or balancing capacity of hydropower

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- Vattenfall is one of the leading hydropower producers in the Nordic region and the third largest in Europe.
 - Vattenfall run and owns ~90 hydro plants in Sweden and Finland
Most of them are situated in the north of Sweden.
 - We are ~ 500 employees in Sweden and 4 in Finland.
 - Annual turn-over ~ 9 BSEK (11 SEK ~ 1 USD).
 - Production and capacity 30 - 35 TWh/year – 8300 MW.
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- Vattenfall annually invests about 1 BSEK in the hydro fleet.

Vattenfall and biodiversity

- Biodiversity is a priority at Vattenfall [Biodiversity considerations - Vattenfall](#)
- Biodiversity is one of the focus areas in our Environmental Policy and a central part in our environmental work.
- By 2030, biodiversity enhancing measures are an integrated part of all activities with an impact on nature.
- A new project with focus on hydropower and biodiversity is in a planning phase during 2023.
- The major parts in the project will include:
 - ✓ R&D for new measures
 - ✓ Test of new measures
 - ✓ Maintenance measures on properties and establishments.



Introduction

- About 45% of the Swedish electricity production comes from hydropower. Large-scale hydro produce about 95%.
- Introducing more intermittent production as wind and solar in the system makes hydro more important for balancing of the electricity system.
- To fulfil demands connected to the Water Framework Directive a National Plan in Sweden for revision of hydropower plant licenses have been decided.
- Most of Vattenfall's large-scale hydropower plants are situated in waterbodies that are classified as heavily modified.
- Therefore, it is important to find measures that increase biodiversity without affecting production or balancing capacity.



Hydropower in heavily modified rivers (HWMB)

- Large-scale hydropower has made major changes in rivers. Some of the negative effects are listed.
 - ✓ Riparian vegetation in hydropower reservoirs are affected from erosion from short-term regulation.
 - ✓ Littoral zone and benthic habitats in hydropower reservoirs are affected from seasonal variations.
 - ✓ Species composition of benthic and fish fauna has been changed.
 - ✓ Connection to tributaries have been affected.
 - ✓ Fish migration have been affected.
 - ✓ Stream habitats have been reduced.
- We believe it is still possible to improve biodiversity without affecting production or balancing capacity of hydropower.
 - ✓ Examples of ongoing measures are presented.
 - ✓ Planned tests of new measures are presented.



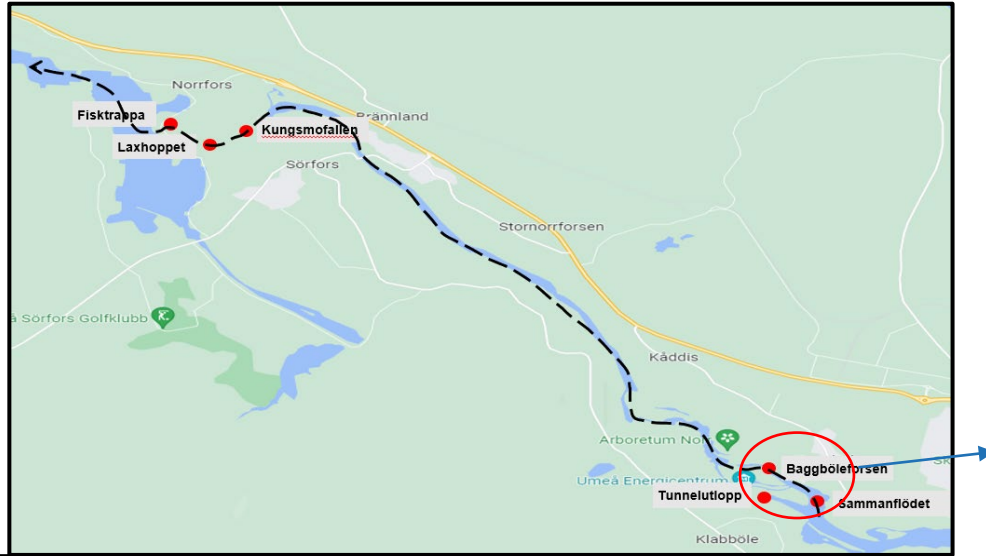
Completed measures

- connectivity to tributaries

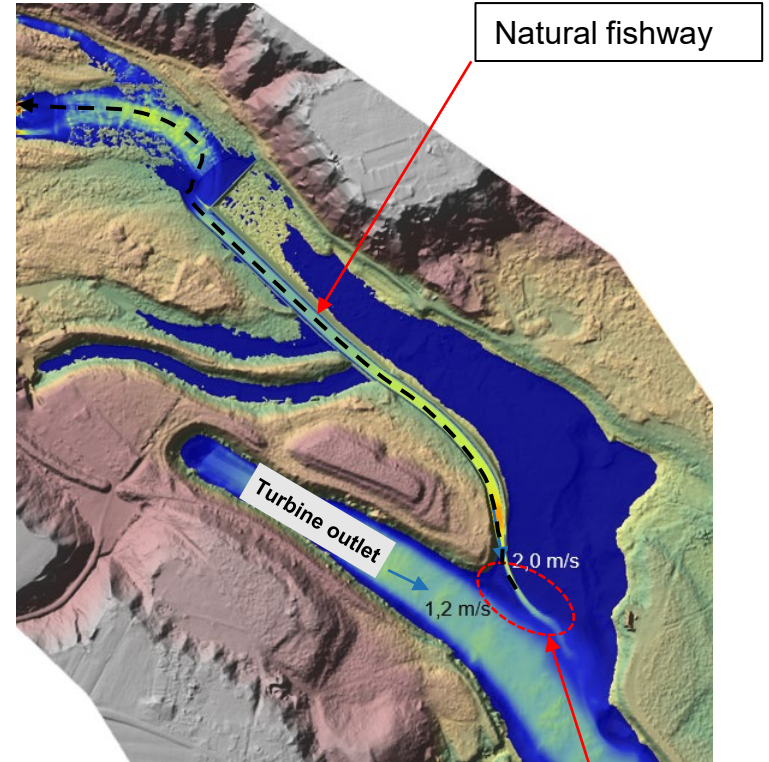
- Tributaries to hydropower reservoirs are important reproduction habitats for grayling and trout.
- Connectivity to tributaries are often reduced because of seasonal low water levels in reservoirs.
- Using excavators stream mouths can be made more defined and stabilised against erosion.
- Restoration is a measure with significant ecological effects but with no effects on hydropower production and balancing capacity.
- Can often be logistically complicated to perform and maintain.



Ongoing measures – fish migration (Stornorrfors Ume river)

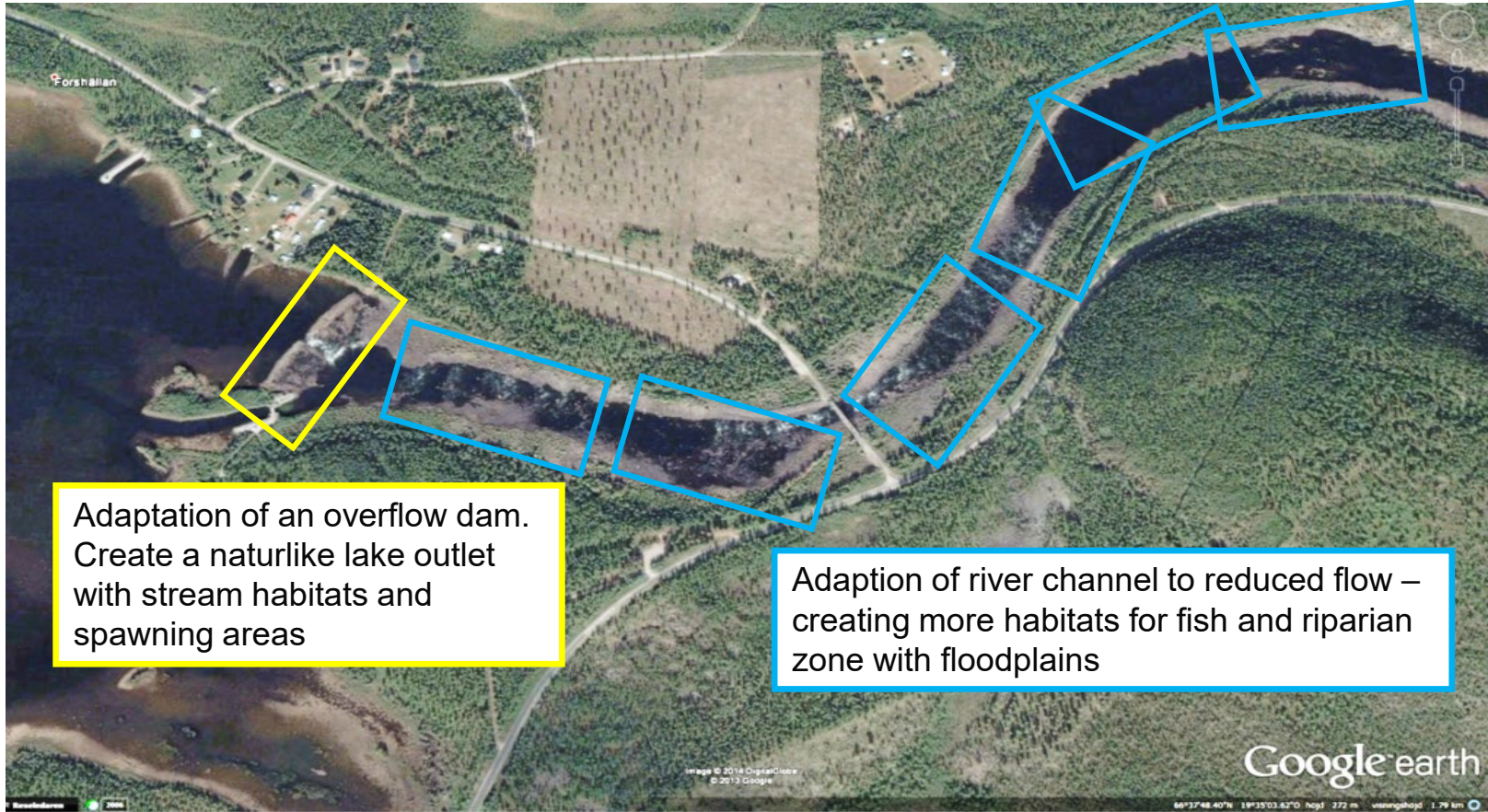


Reproduction habitats salmon and sea trout



Place of residence for salmon and sea trout

Ongoing measures - site-specific restoration (Purkijaur Lule river)

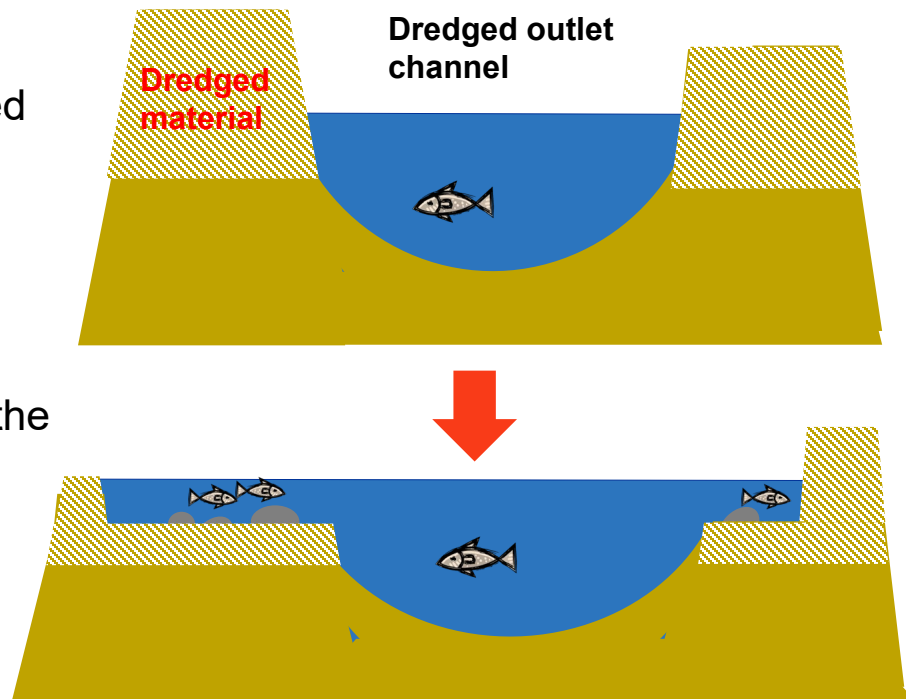


Adaptation of an overflow dam.
Create a naturlike lake outlet
with stream habitats and
spawning areas

Adaption of river channel to reduced flow –
creating more habitats for fish and riparian
zone with floodplains

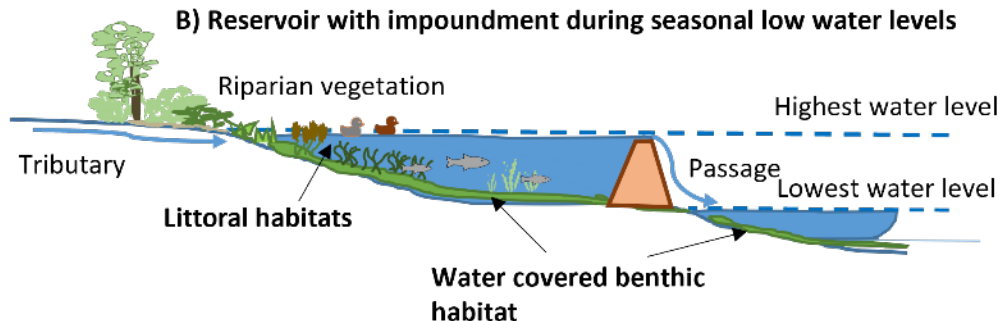
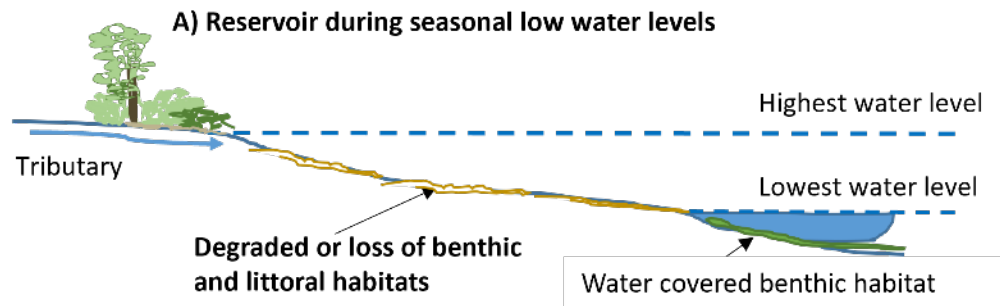
New measures - habitats for stream living fish in outlet channels

- In heavily modified rivers stream habitats are often scarce and difficult to create due to negative impact on power production.
- Most of our hydro power stations have dredged outlet channels to increase the head at the turbine outlet (discharge) point.
- In dredged outlet channels the flow is concentrated and water velocities higher compared to reservoirs.
- Stream habitats can be created by modifying the width and structure of the channel.
- Success depends on the regulated flow and frequency of hydropeaking.



New measures – impoundments within a reservoir

- Seasonal storage reservoirs are a crucial part of large-scale hydropower. Storage of water is the “battery” in the regulated river and is gradually emptied during winter.
- Low water levels during spring and early summer have a negative impact with degradation or loss of riparian, benthic and littoral habitats.
- A possible measure is construction of overflow dams in shallow bays or estuaries to ensure a stable water depth.



Conclusions

- Test of new measures is needed to increase biodiversity without affecting production and balancing capacity of hydropower.
- In hydropower reservoirs focus is to restore riparian, benthic and littoral habitats.
- In stream habitats affected by hydropower focus is to improve connectivity and restore habitats.

