Environmental design of hydropower

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Dams

- Migration barrier
- Loss of connectivity
- Less access
- Loss of biodiversity
Degraded habitat in bypassed sections
Change in downstream flow regime
Landscape effect
Impacts on wildlife
Greenhouse gas emission control
Resettlement
Lack of undisturbed nature?
How much water is needed for hydropower and ecology?
Flow and the environment
Flow and the environment
Variation important

Spring flood

Stable low flow in winter
Eco Hydrology

Hydropower
► 10 large research projects – two more from 2015
► 7 Norwegian research partners
► 16 Industry partners and 2 management partners
► Budget: ~350 MNOK (47 MNOK in 2014)
► 21 PhD and 7 Post-doc positions
► International student and professional exchange

Renewable energy respecting nature
Hydropower technology

Environmental impacts of hydropower

Environmental impacts of wind power and power transmission

How to reconcile energy and environment policy?
Mitigation
Fishway for upstream migration
Avoid fish coming into turbines and intakes when migrating downstream.
Minimum flow and weirs limit loss of water covered area - but do they create natural riverine habitats?
Mitigation by constructing habitat in combination with compensation flows
Weirs, diverters, artificial pools and riffles, substrate changes, etc - must be maintained
• Guidance developed for Atlantic salmon
• Methods suitable for other species and end users
• Download free copy: www.cedren.no
Data collection and tools

The salmon population
The hydropower system

Diagnosis

Design solutions

Tools

...take the river system to the doctor!
Design solutions

Sometimes the use of water is most important, sometimes habitat mitigation measures are more important – in most cases both are necessary
Design solutions – use of water

Discharge (m³/s)

Before regulation

After regulation

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Water release \[+\] Habitat mitigation

= Hydropower production

Before regulation

After regulation

Flow [m$^3$/s]

Renewable energy respecting nature!

CEDREN Centre for Environmental Design of Renewable Energy