



Present and future environmental impacts of hydropower on Norwegian lakes

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CEDREN

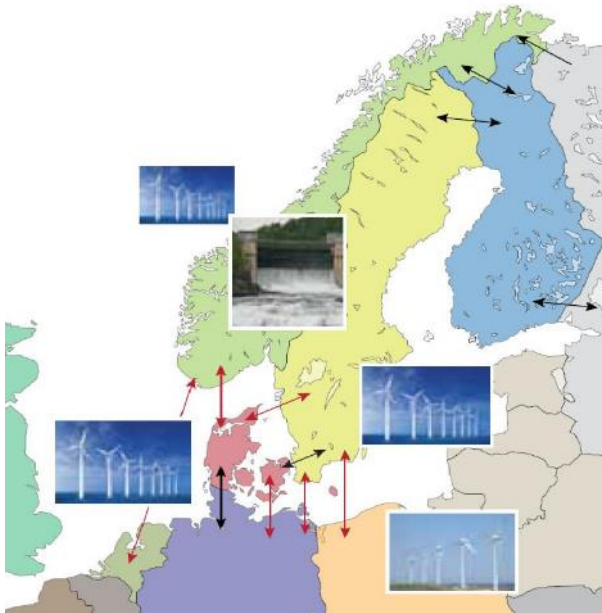
Centre for Environmental Design of Renewable Energy

www.cedren.no/Projects/HydroBalance

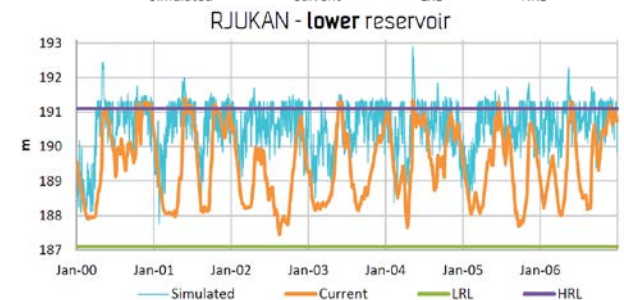
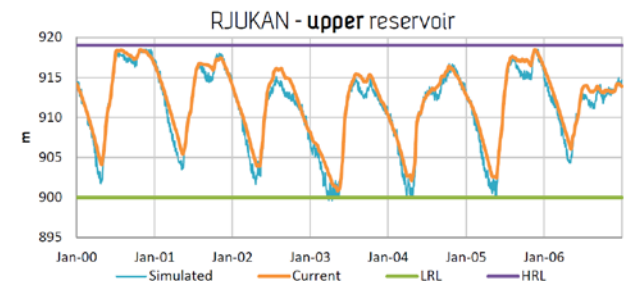
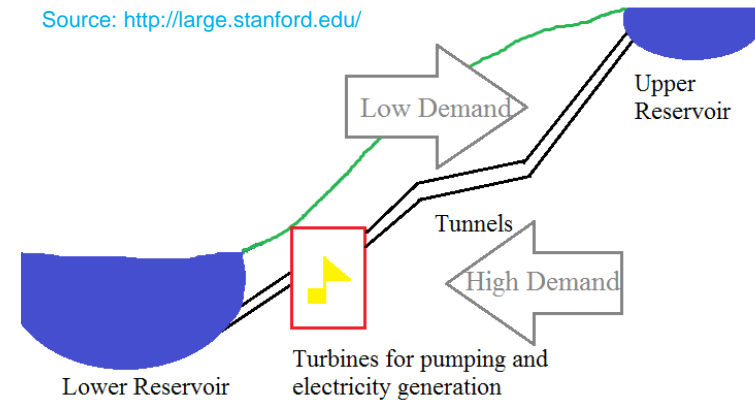


HydroBalance

- Economical, technological, social and environmental potential for "Green Battery"



Source: <http://large.stanford.edu/>



HydroBalance WP4:

Environmental impacts of new operational regimes

Task 4.1

Modelling ecological consequences along environmental gradients

→ Biotic effects

Task 4.2

Modelling hydro-dynamic changes introduced by new operational regimes

→ Abiotic effects

Task 4.3

Mitigating environmental effects of new operational regimes

→ Combined model



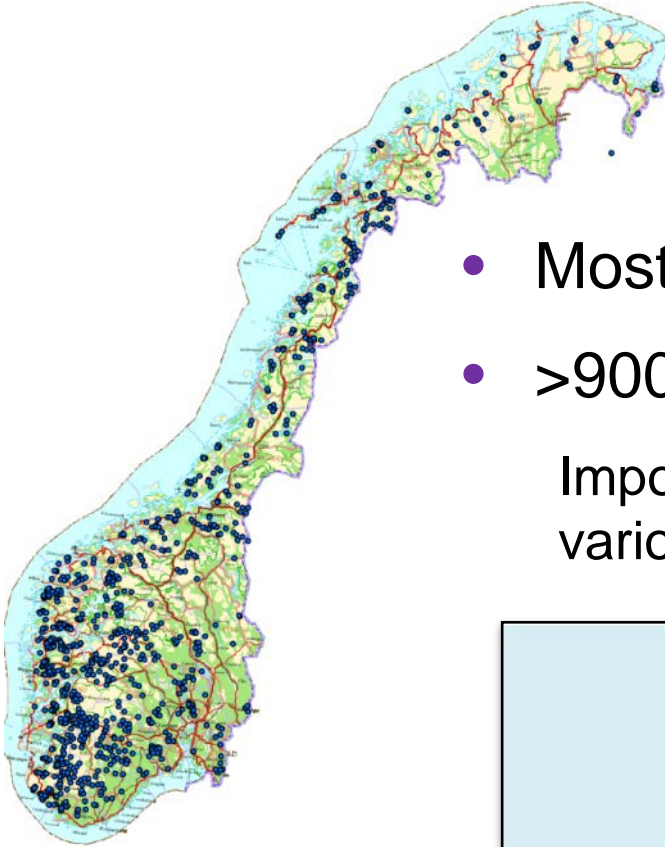
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Julie Charmasson

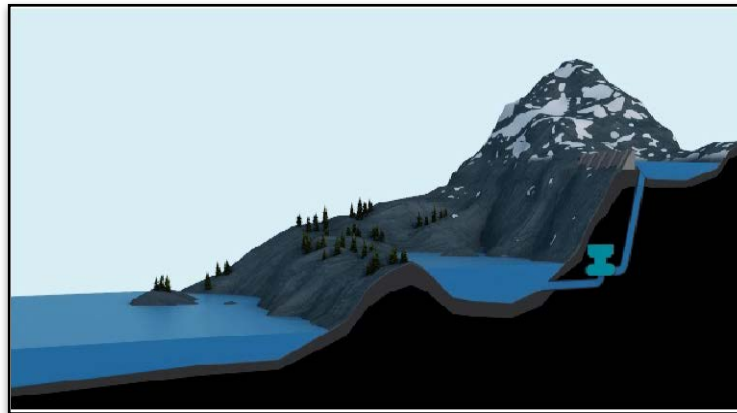


WP4 focuses on reservoirs

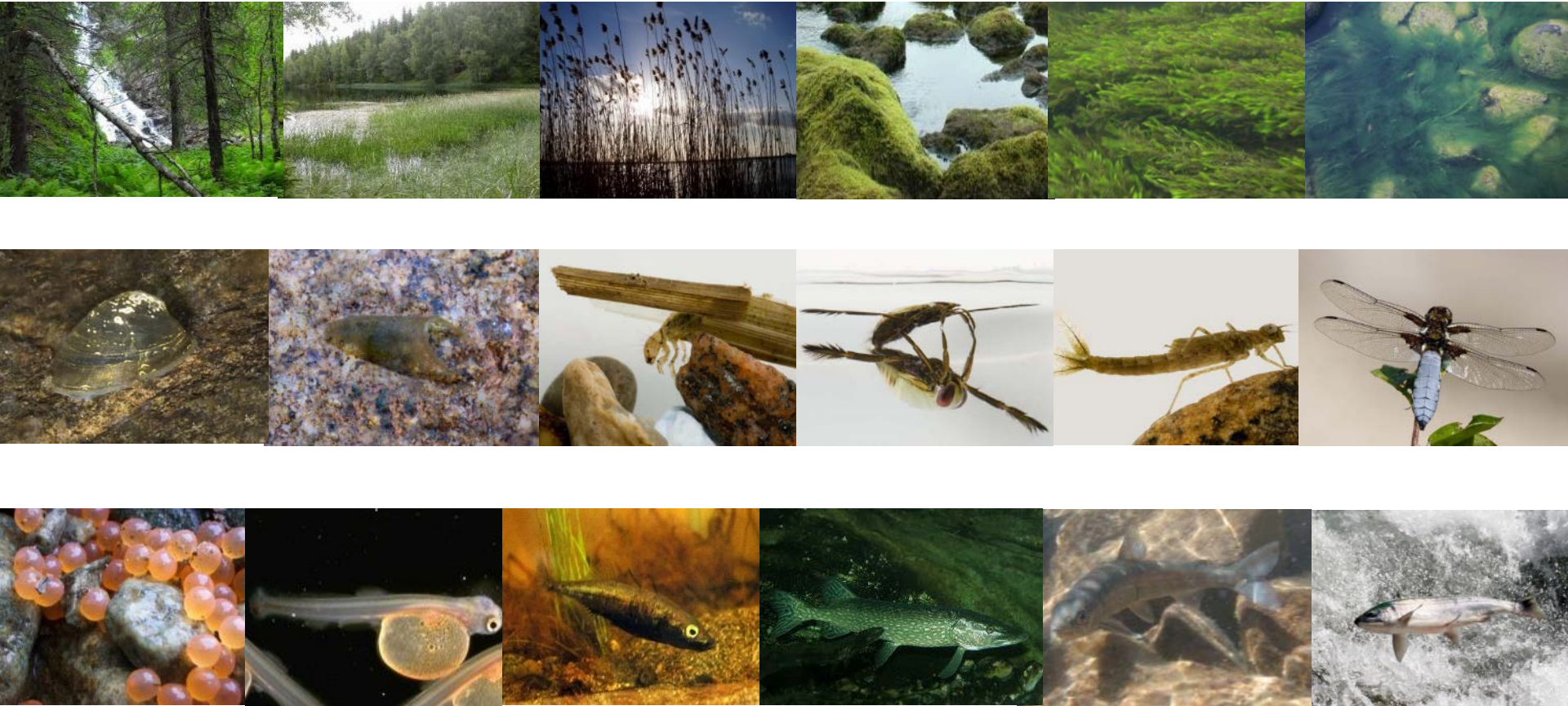


- Most studies done in rivers
- >900 reservoirs in Norway

Important recreational areas providing various ecological services

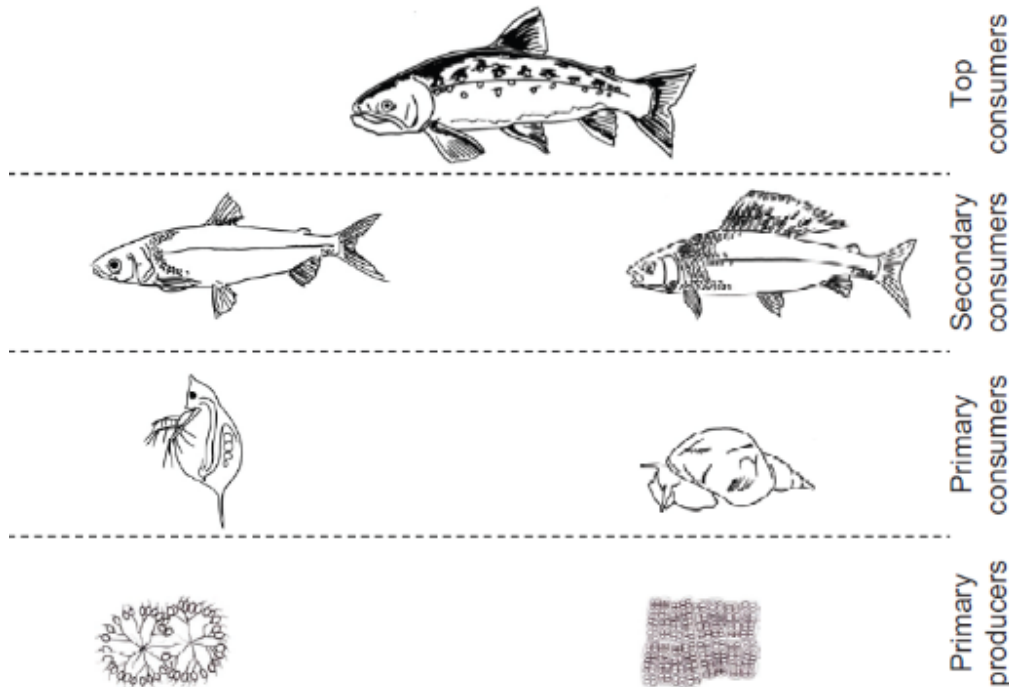


Biological effects



Focus on fish

Fish as a top predator – Bioindicator of the reservoir's ecological status



Focus on present...

... before future



Ecological consequences
of today's regulation
patterns

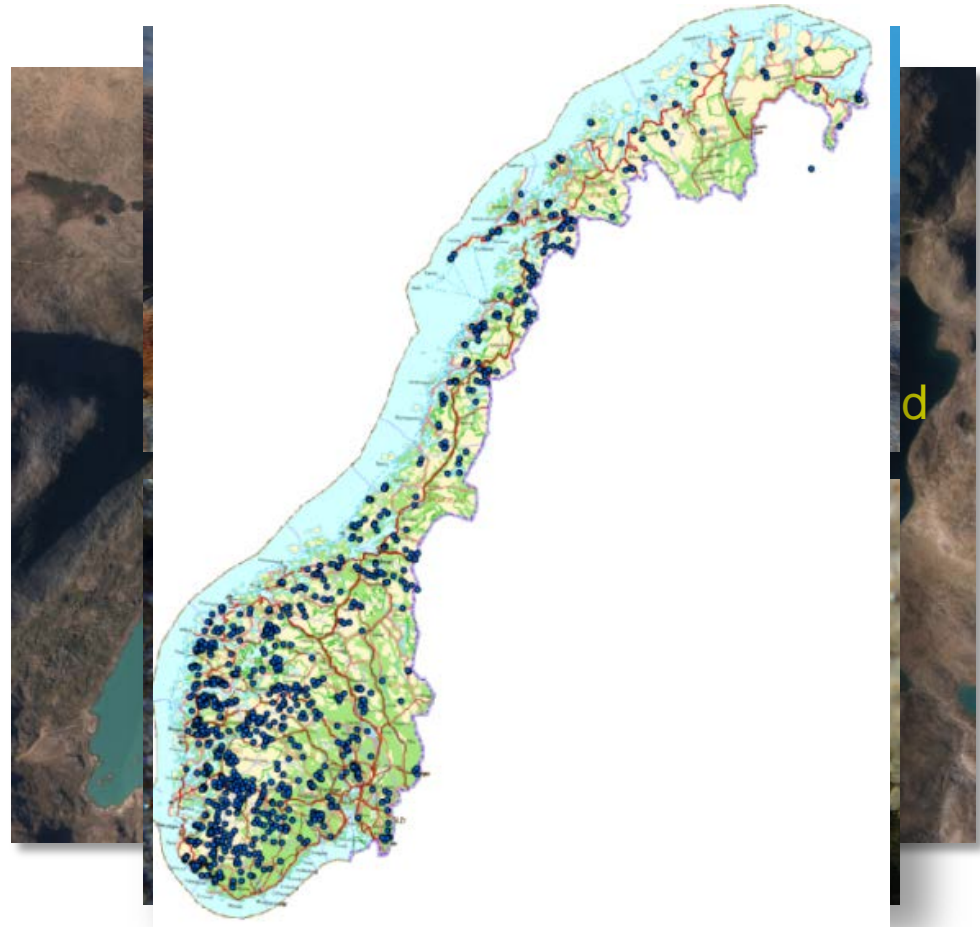
+

Hydro-dynamic changes
introduced by new
operational regimes

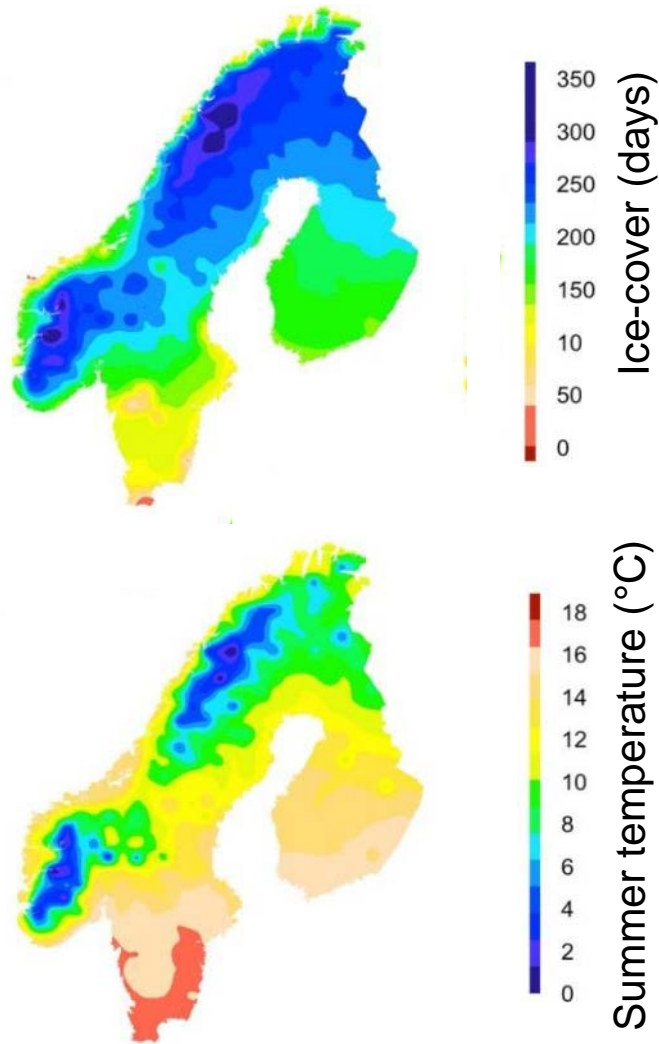
- Predict environmental effects of future regime
- Mitigate environmental effects in future

Potential impacts of rapid water level fluctuations in reservoirs

- Abiotic changes
 - Lake shoreline, water quality, temperature, ice-cover period...
- Biotic changes
 - Biological productivity, species composition, fish diet, growth and abundance...



Natural variation in climate

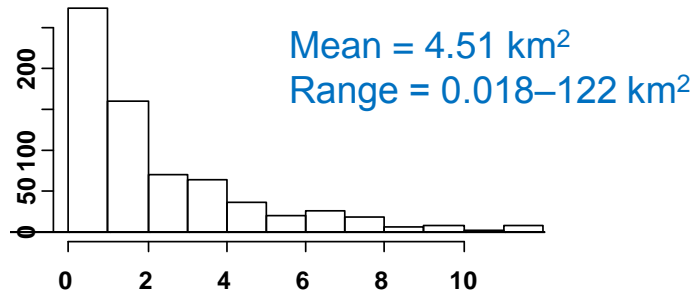


Natural variation in catchment

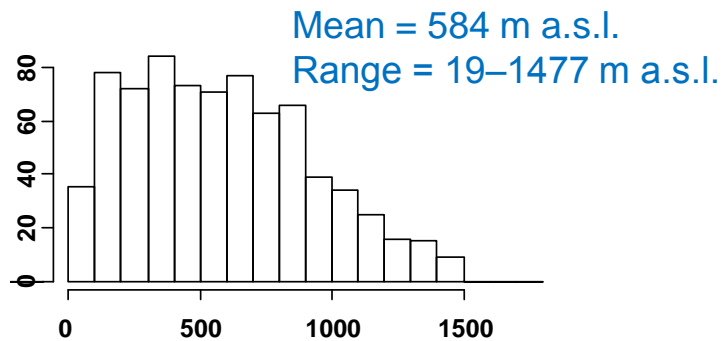


Natural variation morphology

Area

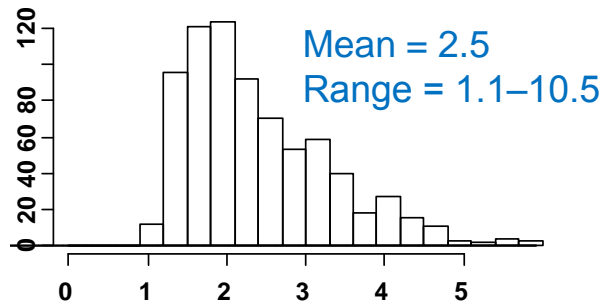


Altitude



Shape

$$Shape = \frac{L}{2\sqrt{\pi A}}$$



Natural variation in fish growth



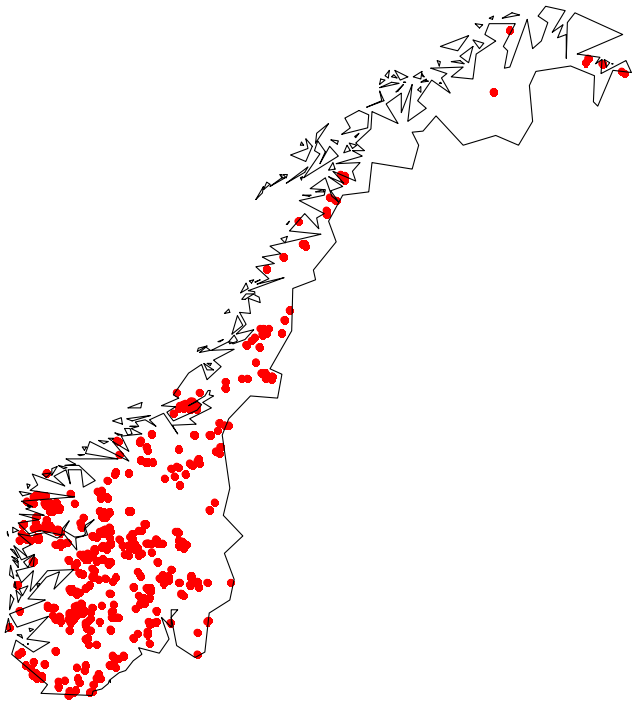
How to separate effects of hydropower from natural variation?



Data collection

Large datasets of previously collected data:

- Compare high numbers of lakes and reservoirs
- Understand large-scale patterns across environmental gradients



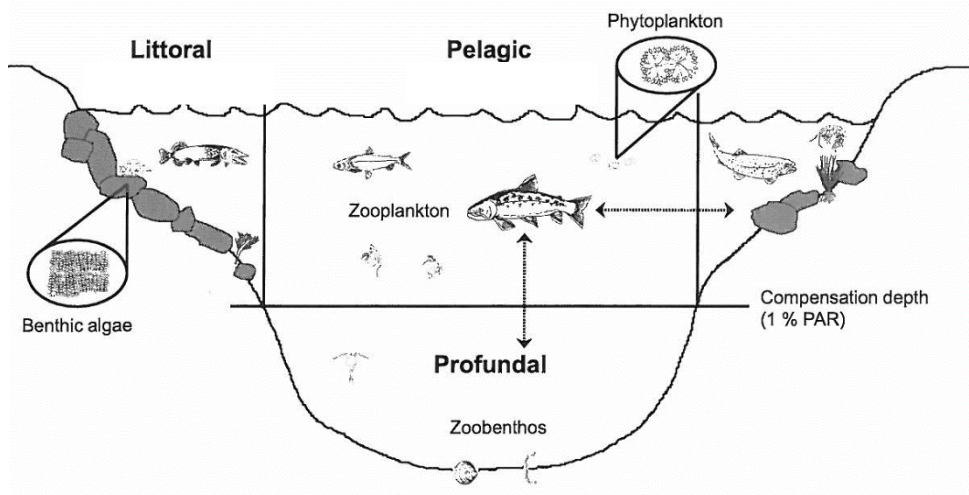
New field work:

- Details of individual fish
- Understand local ecosystems

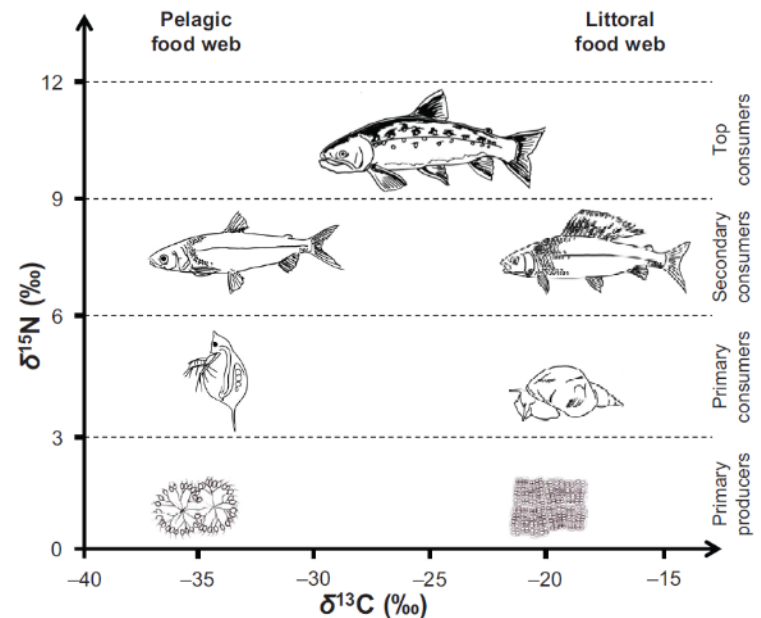
Fish population data

- Abundance, growth, reproduction, diet and habitat use
- Understand the structure and function of ecosystems
 - Stable isotope analyses

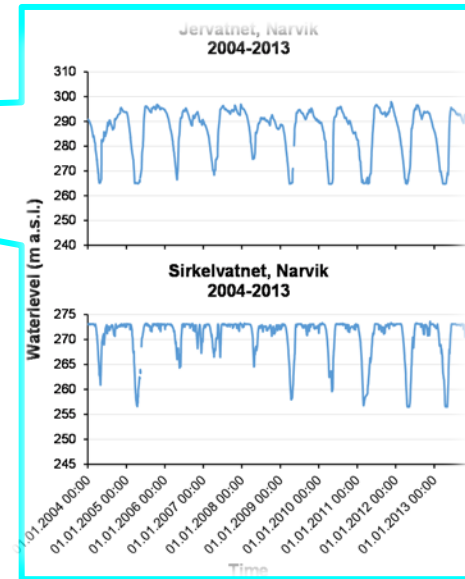
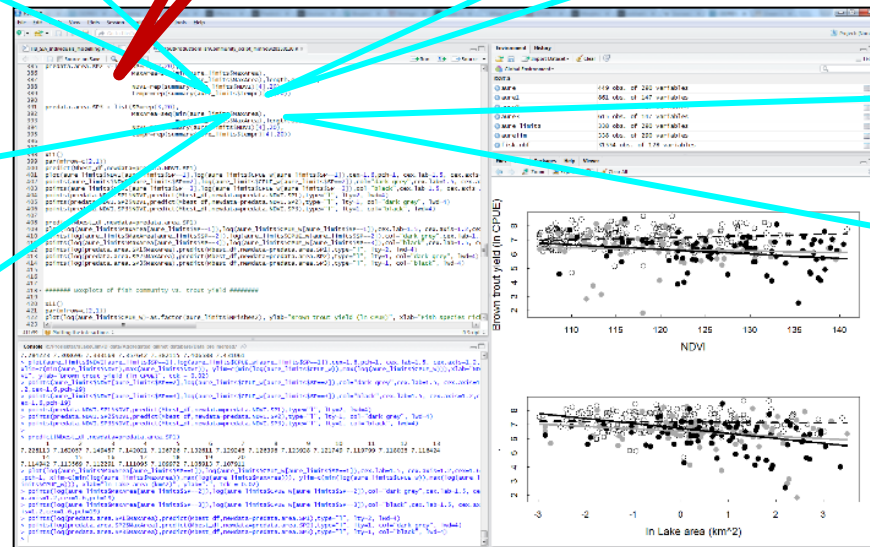
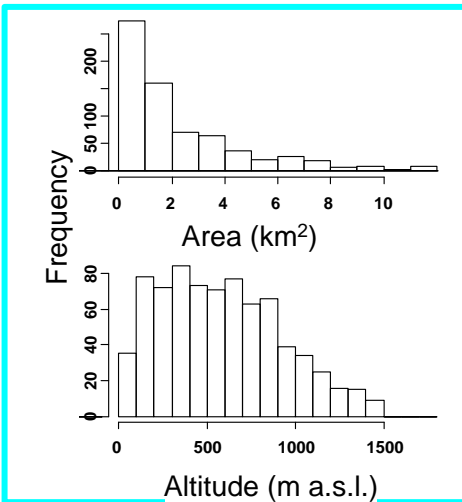
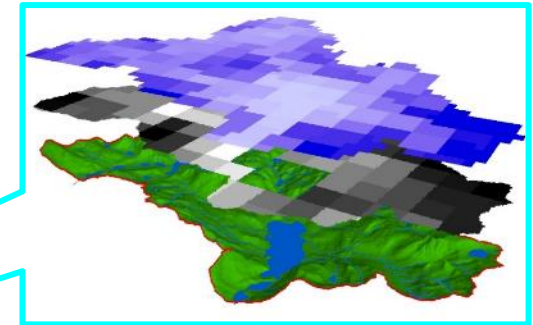
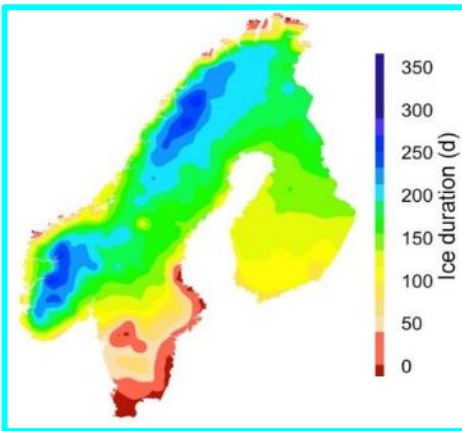
Habitat use



Food webs



Ecological models can help us to disentangle hydropower impacts from natural variation



Publications

Community structure influences species' abundance along environmental gradients

AP Eloranta, IP Helland, OT Sandlund, T Hesthagen, O Ugedal, AG Finstad

Journal of Animal Ecology, 85: 273-282.

Water level regulation affects niche use of a lake top predator

AP Eloranta, J Sánchez-Hernández, PA Amundsen, S Skoglund, J Brush, EH Henriksen, M Power

Manuscript submitted to *Freshwater Biology*

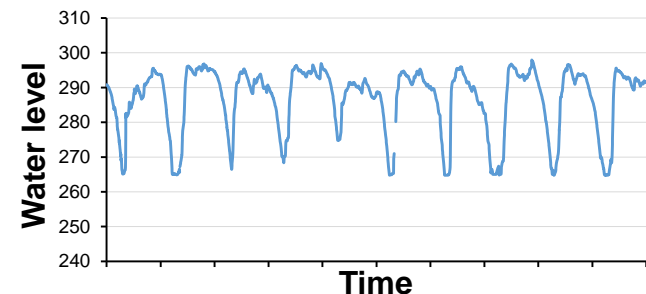
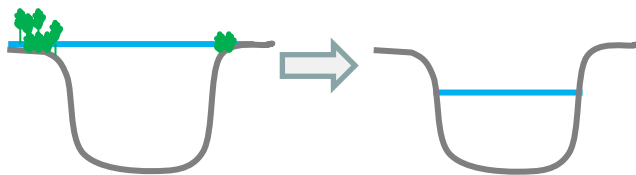
Effects of anthropogenic water level fluctuations in hydropower reservoirs – an ecosystem approach

PE Hirsch, AP Eloranta, PA Amundsen, Å Brabrand, J Charmasson, IP Helland, M Power, J Sánchez-Hernández, OT Sandlund, J Sauterleute, S Skoglund, O Ugedal, H Yang

Manuscript submitted to *Ambio*

What next?

- Modelling impacts on food webs across reservoir types
- Using long-term data from 1-3 reservoirs to find metrics for critical water level patterns (time-series analysis)
- Modelling fish abundance in reservoirs with different operational regimes (space-for-time analysis)



Expected final outcome of WP4

Combine ecological models with hydro-dynamic models

- Predict how future operational regimes influence ecological communities
- Identify potential mitigation measures



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Thank
you!

