



What's up the dam?

Ecological impacts of water level fluctuations in reservoirs

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www.cedren.no/Projects/HydroBalance



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HydroBalance

Why focus on reservoirs?

- >900 reservoirs in Norway
 - "Green batteries" for Europe?
 - Provide important ecological services
- Most studies done in rivers



HydroBalance WP4: Environmental impacts of new operational regimes

- **Task 4.1:** Modelling present ecological variation along environmental gradients
- **Main idea:** Disentangle **present** effects of natural variation and hydropower on fish and food webs
- **Combine** ecological models (Task 4.1) and hydro-dynamic models (Task 4.2) to **predict future ecological effects** (Task 4.3)

Potential impacts of rapid water level fluctuations

- Physical and chemical changes
 - Lake shoreline, water quality, temperature, ice-cover period



Source: <http://www.ft.com/m/html/expandable-picture.htm>

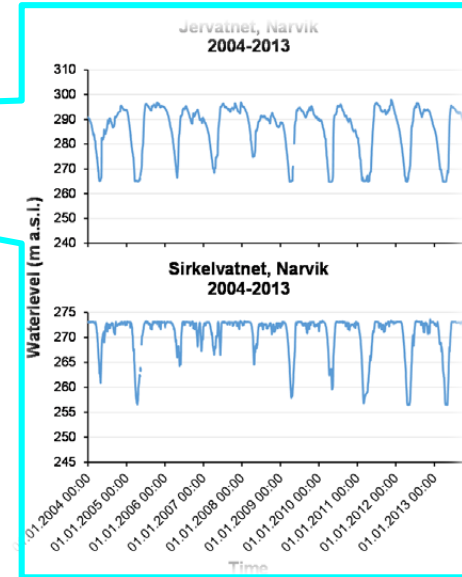
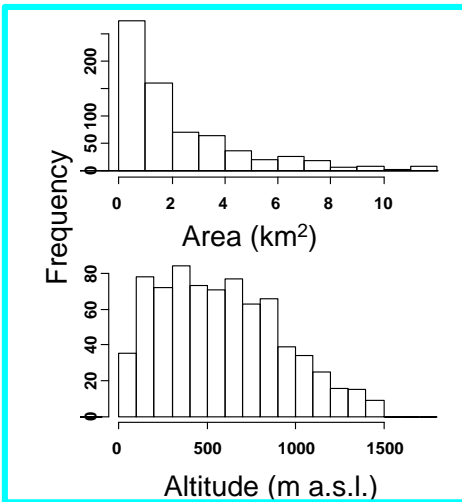
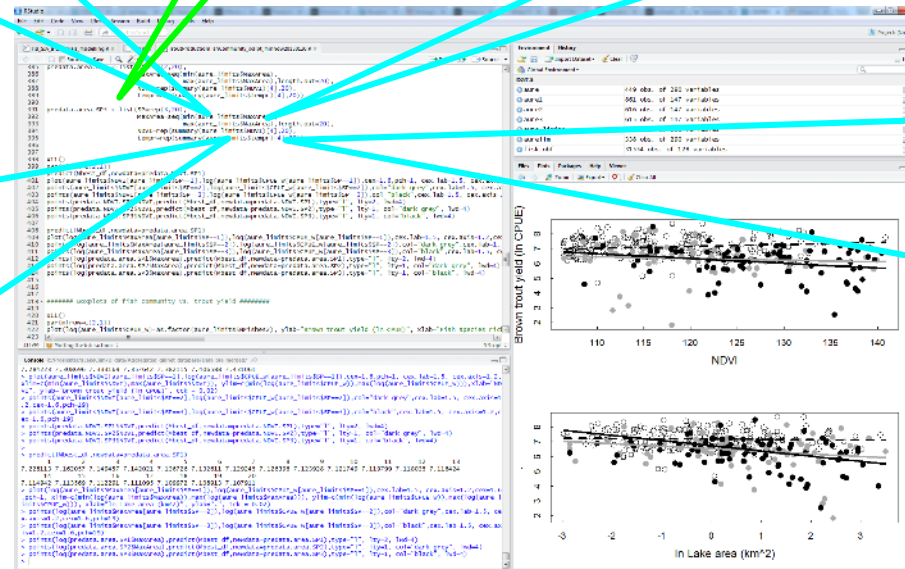
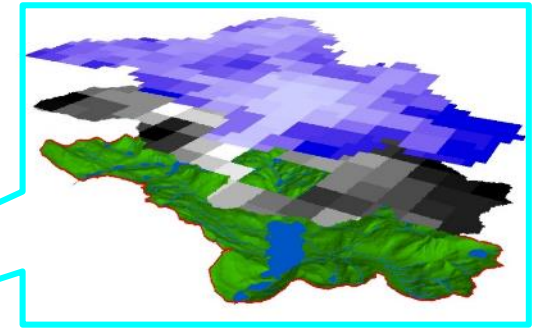
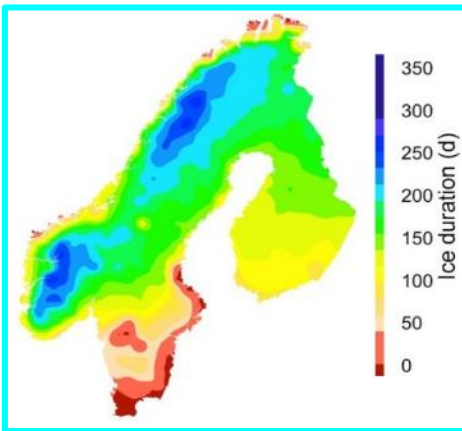
Potential impacts of rapid water level fluctuations

- Physical and chemical changes
 - Lake shoreline, water quality, temperature, ice-cover period
- Biological changes
 - Lake productivity
 - Species composition
 - Fish diet, growth and production



How to study ecological impacts?

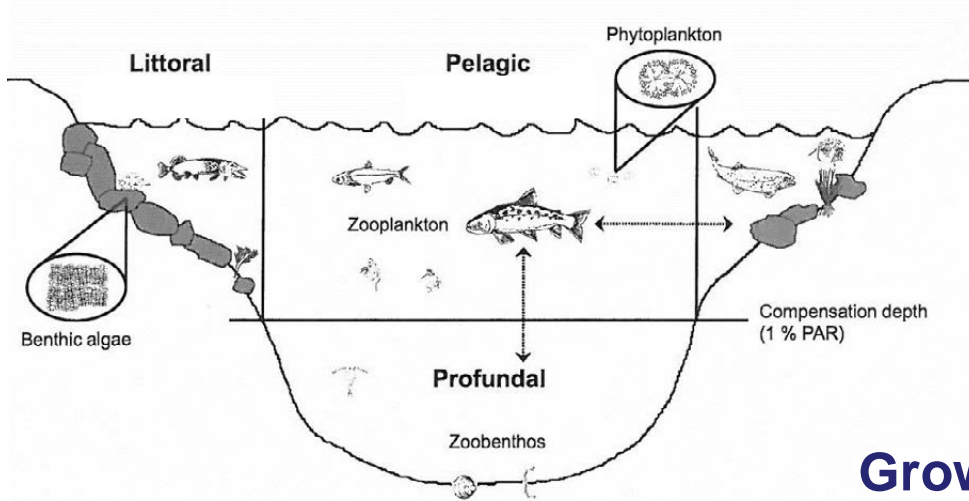
Modelling environmental gradients



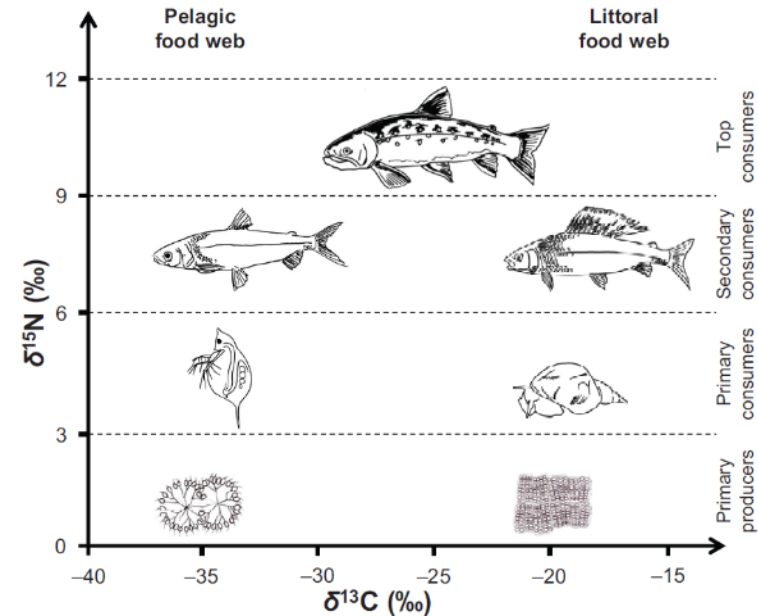
How to study ecological impacts?

Detailed food-web studies

Habitat use



Food webs



Growth



Modelling = large-scale environmental gradients

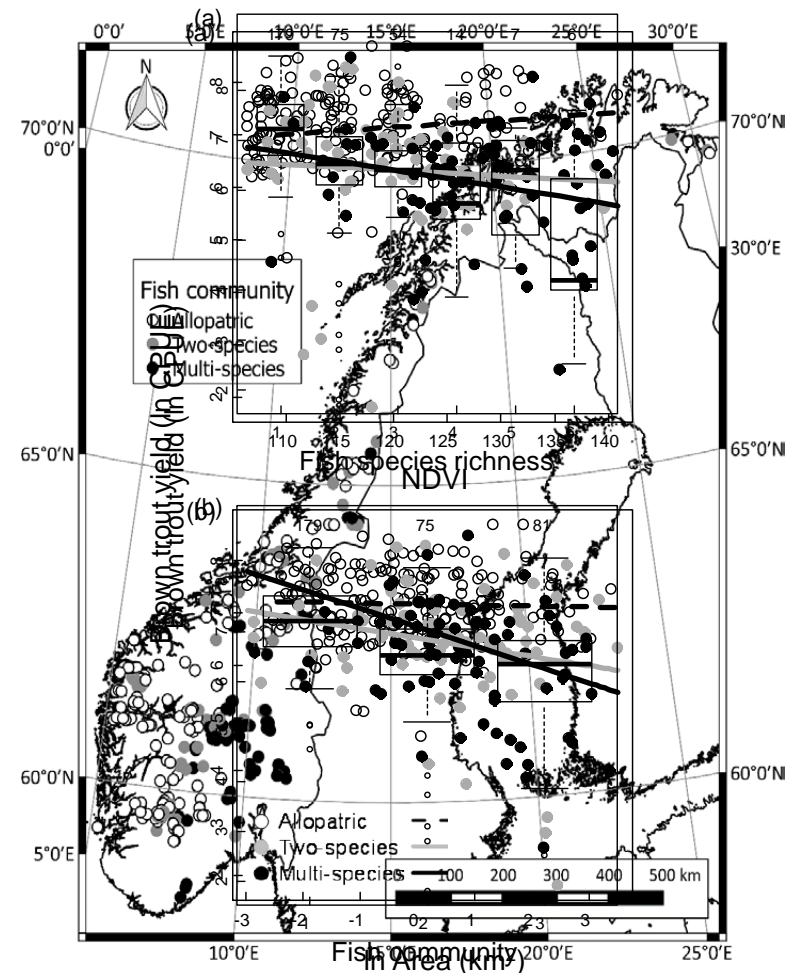
Food webs = information about individual fish and ecosystem

Drawings from Eloranta's PhD thesis (2013)

Initial results

Trout yield along environmental gradients

- Modelling catches from standardized test fishings in 335 lakes
- Trout yield decreases with increasing fish diversity
- Fish diversity shapes the response of trout yield to environmental variation

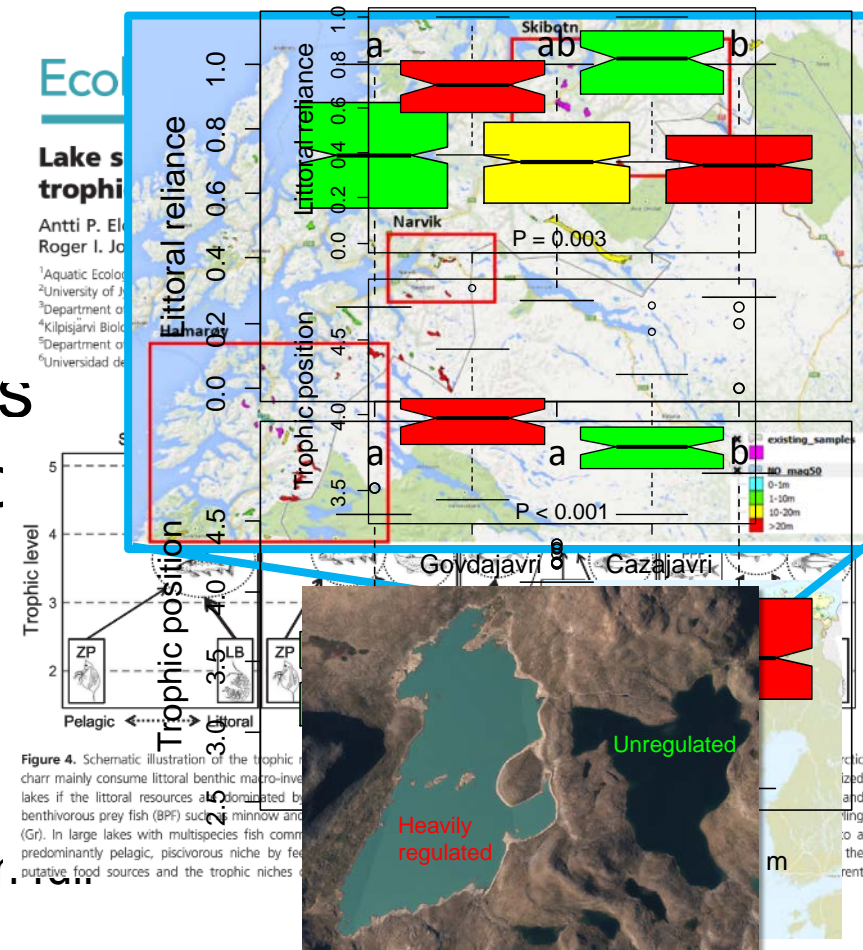


Submitted to *Journal of Animal Ecology*

Initial results

Impacts on lake food webs

- Lake size and fish diversity shape food webs in natural lakes
- Does water level fluctuations influence energy flow & food chain length in reservoirs?
- Yes, but only slightly
 - Lake characteristics and fish species, habitat, size etc. needs to be included in food web modelling



Future plans & studies

- More lakes and reservoirs
 - Both for modelling & food-web studies
- Fish yield against actual regulation patterns
- Impacts on fish growth and parasites



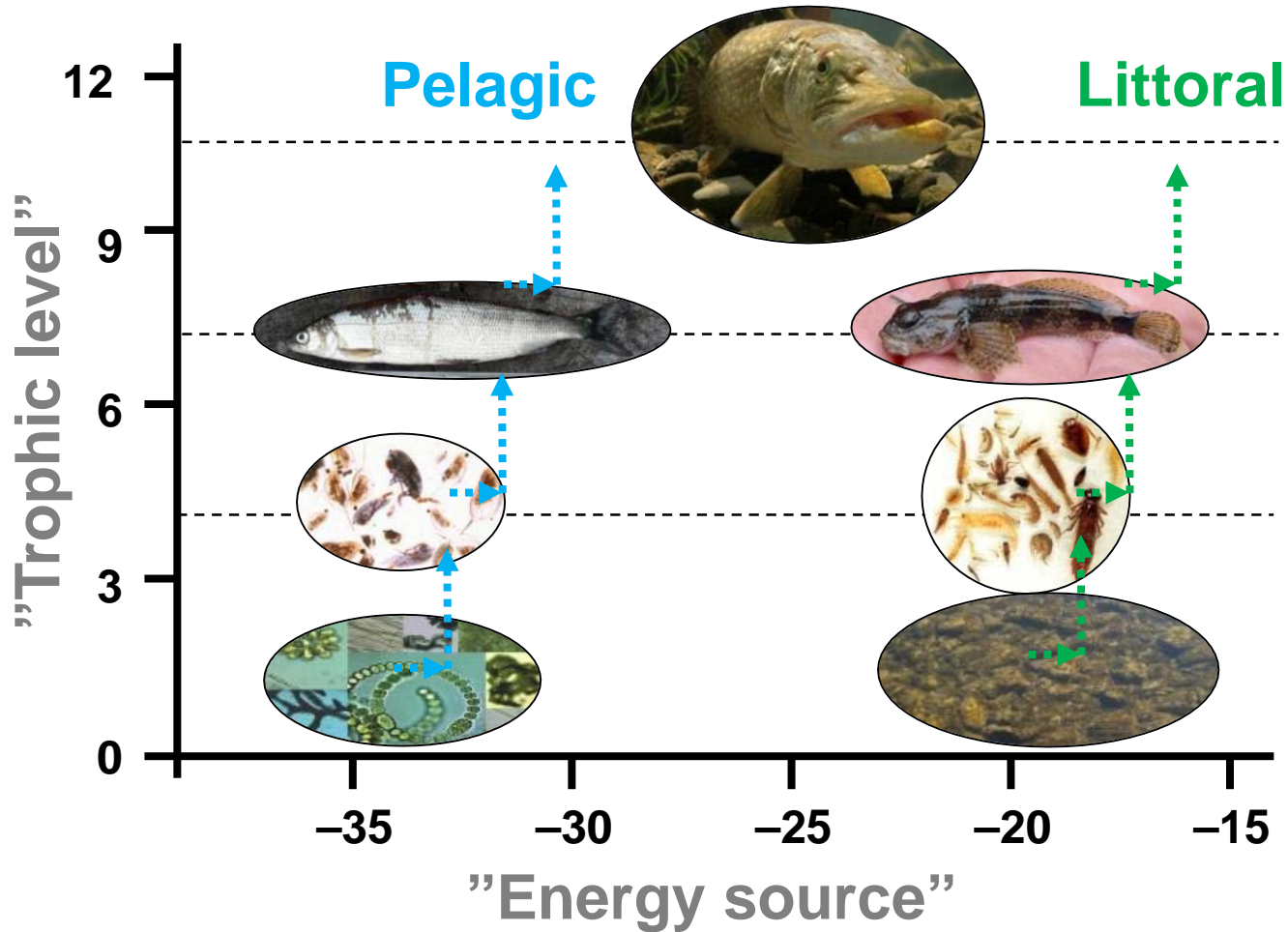
Tusen
tak!



Studying food webs

Stable isotope analysis

Trophic fractionation:
 $\delta^{13}\text{C}$: 0-1 ‰
 $\delta^{15}\text{N}$: 3-4 ‰



Initial results: Fish diets in reservoirs

- Benthic (and terrestrial) invertebrates more important food than pelagic zooplankton
- Trout and charr have often different diets when living in the same lake
- No clear pattern from littoral to pelagic diet with increasing regulation level

