Impacts of new operational regimes on fish populations in reservoirs

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Outline

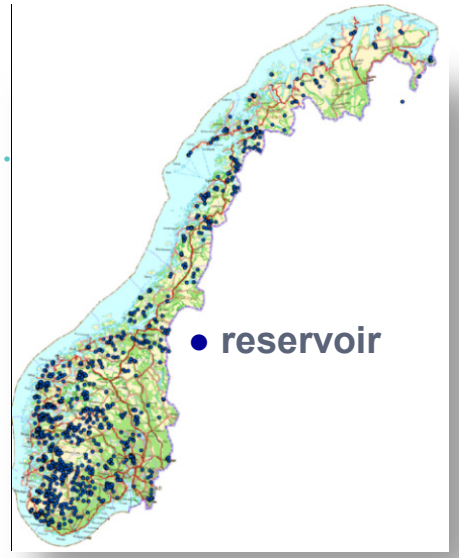
1) Introduction to WP4
2) Potential ecological impacts of water level fluctuations
3) How to study ecological impacts?
   - Modelling environmental gradients
   - Food web analyses
4) Initial results & future plans

WP4: Environmental impacts of new operational regimes

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

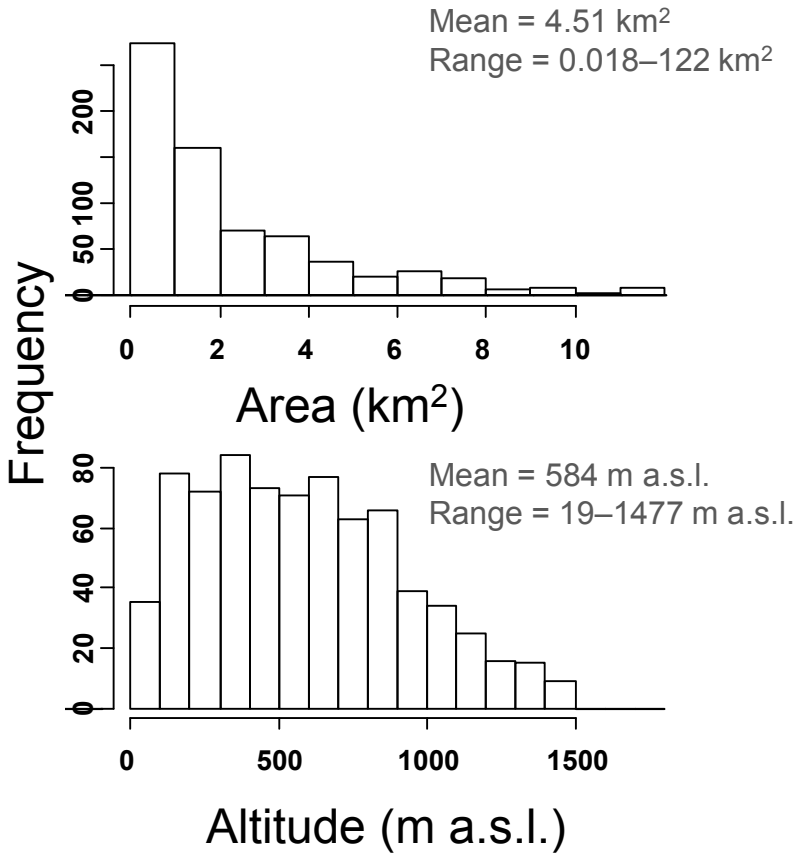
Why focus on reservoirs?

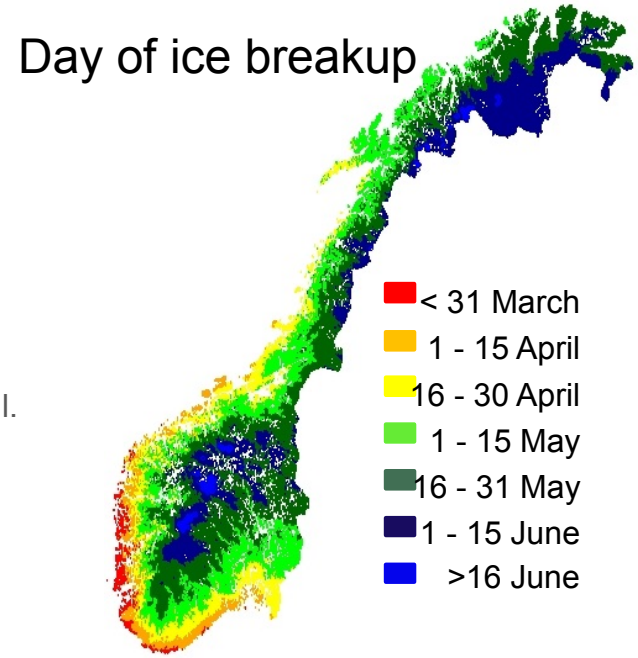
- >900 reservoirs in Norway
  - Provide important ecological services
- Most studies done in rivers



HydroBalance is the only CEDREN project focusing on reservoirs

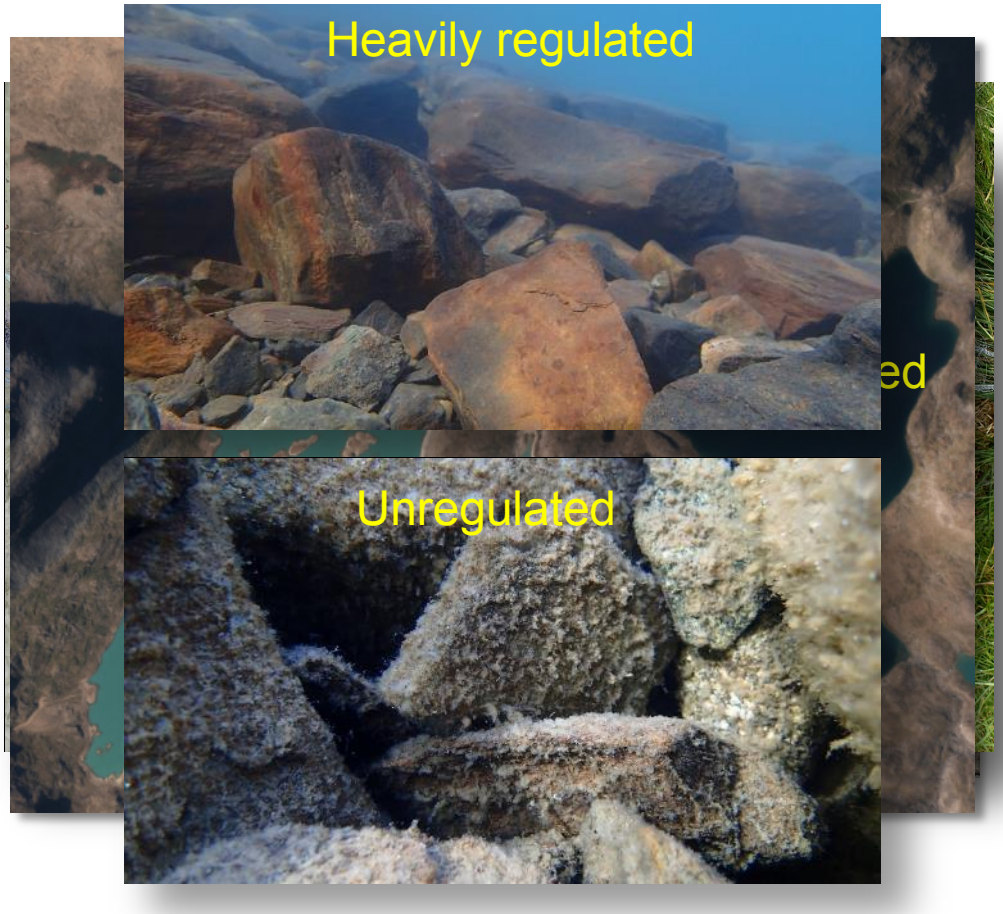
Why studying environmental gradients?





Potential impacts of rapid water level fluctuations

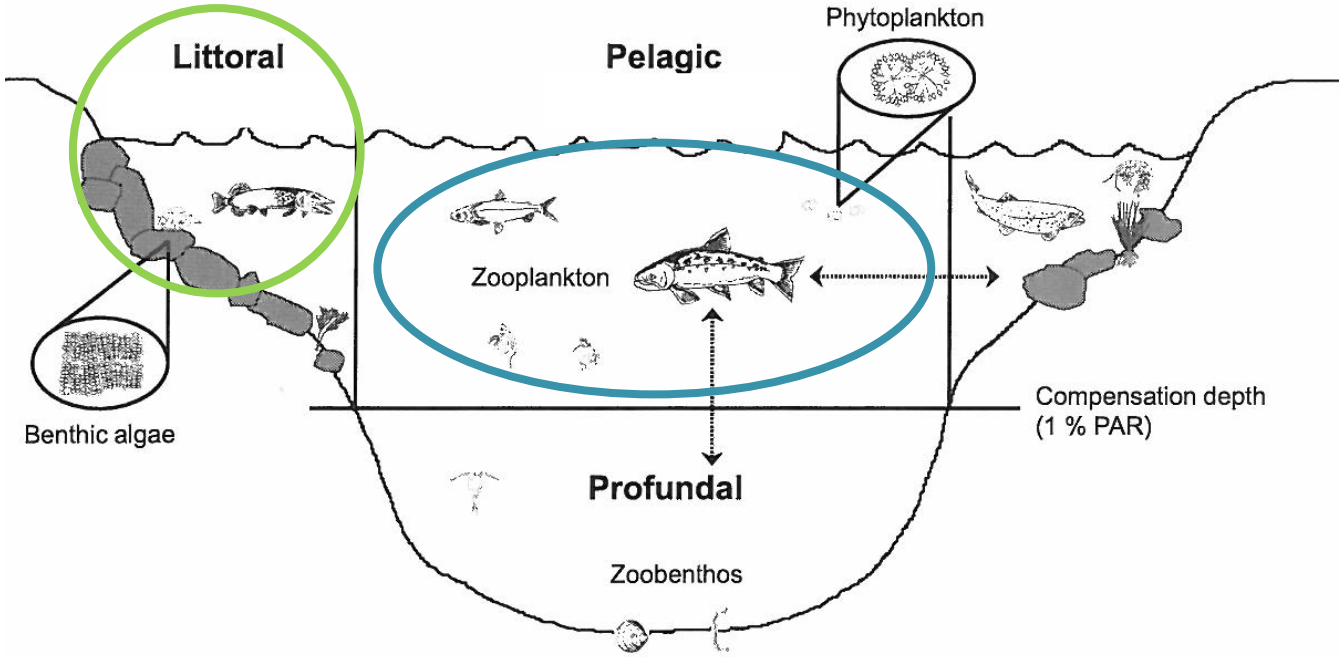
- Physical and chemical changes
  - Lake shoreline, water quality, temperature, ice-cover period
- Biological changes
  - Lake productivity
  - Species composition
  - Fish diet, growth and production



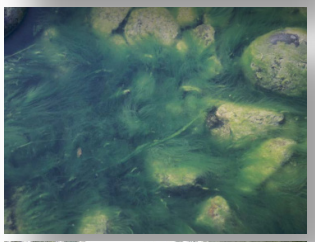
Water level changes in reservoirs

- The ecological impacts depend on how **biologically productive areas** are influenced

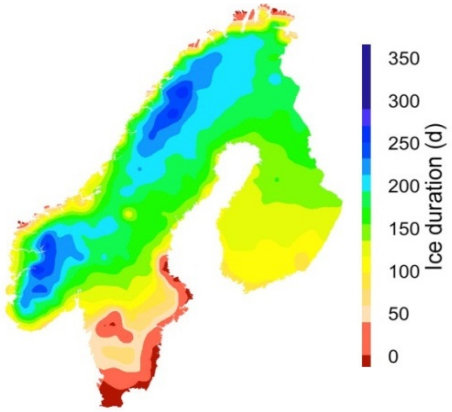
Littoral zone Pelagic zone

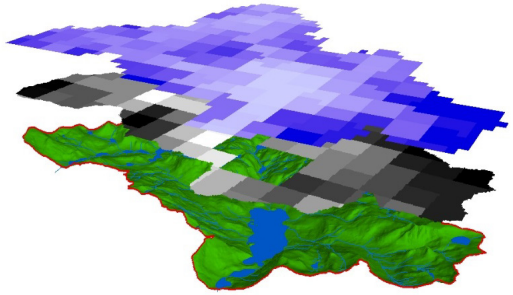


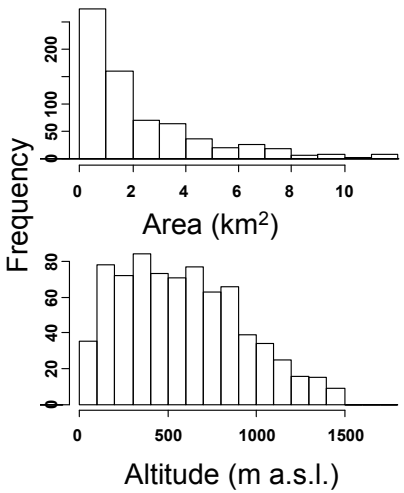
What means biological production?

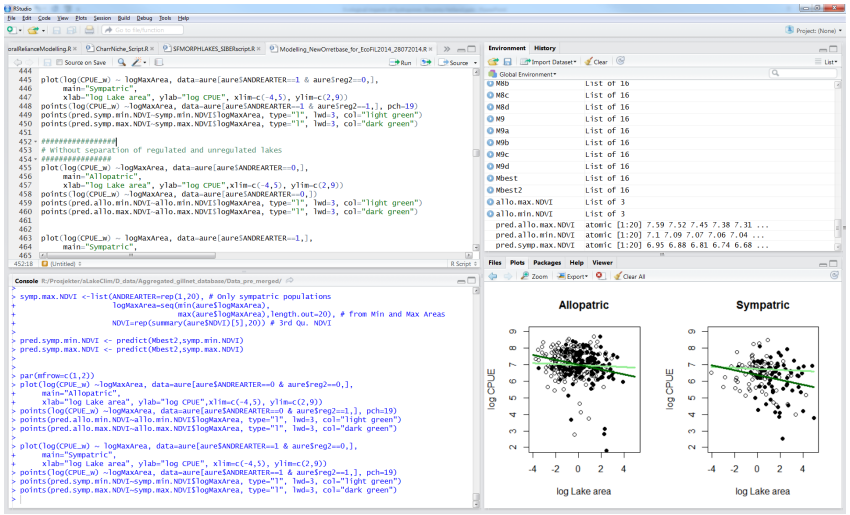


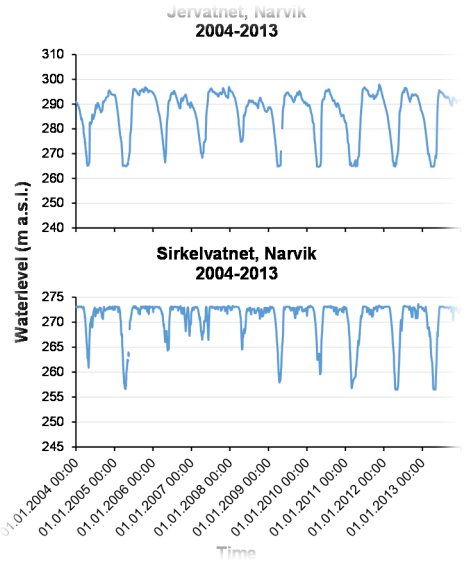
How to study ecological impacts?
Modelling environmental gradients





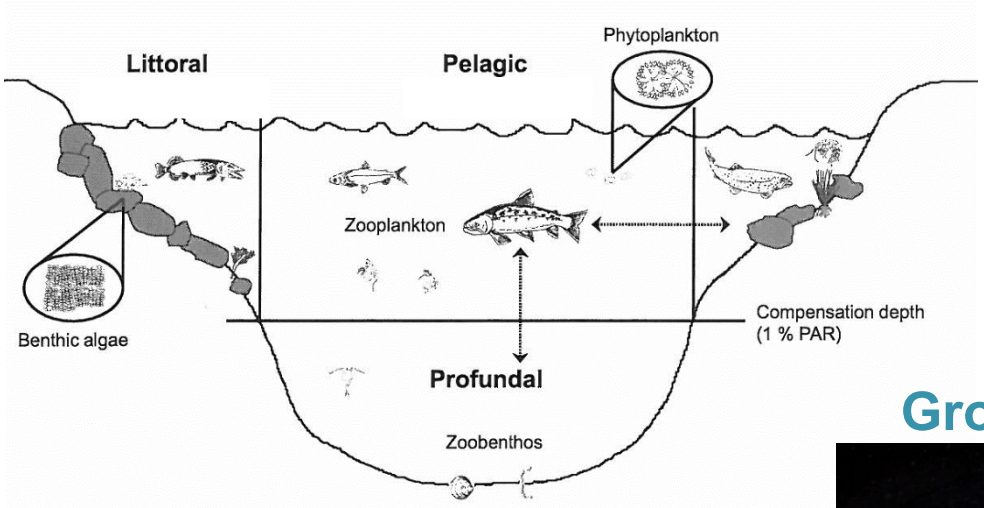






How to study ecological impacts?
Detailed food web studies

Habitat use

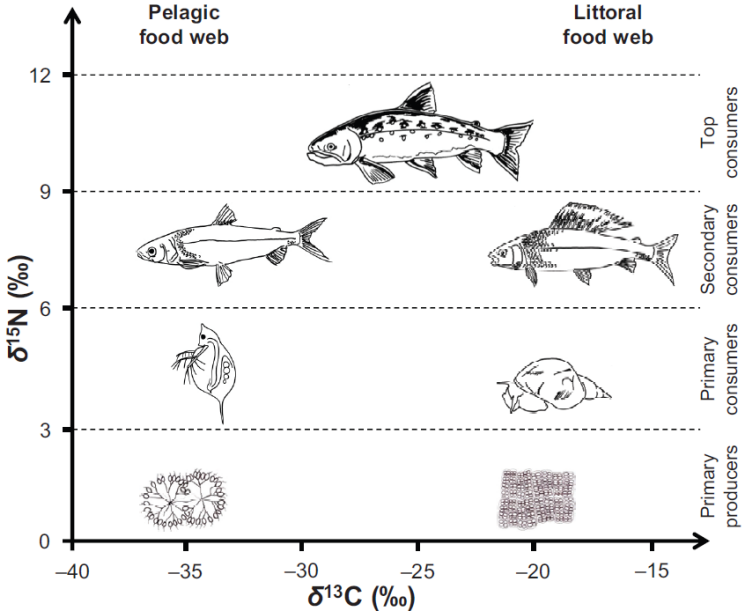


Modelling = large-scale environmental gradients

Food webs = information about individual fish and ecosystem

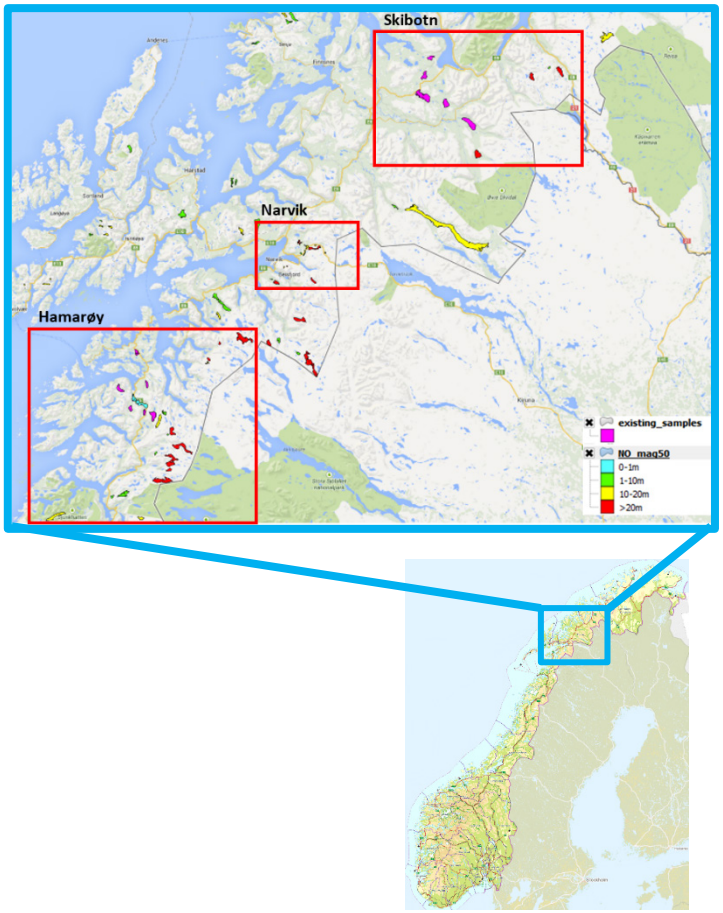
Growth

Food webs



How to study ecological impacts?
Detailed food web studies

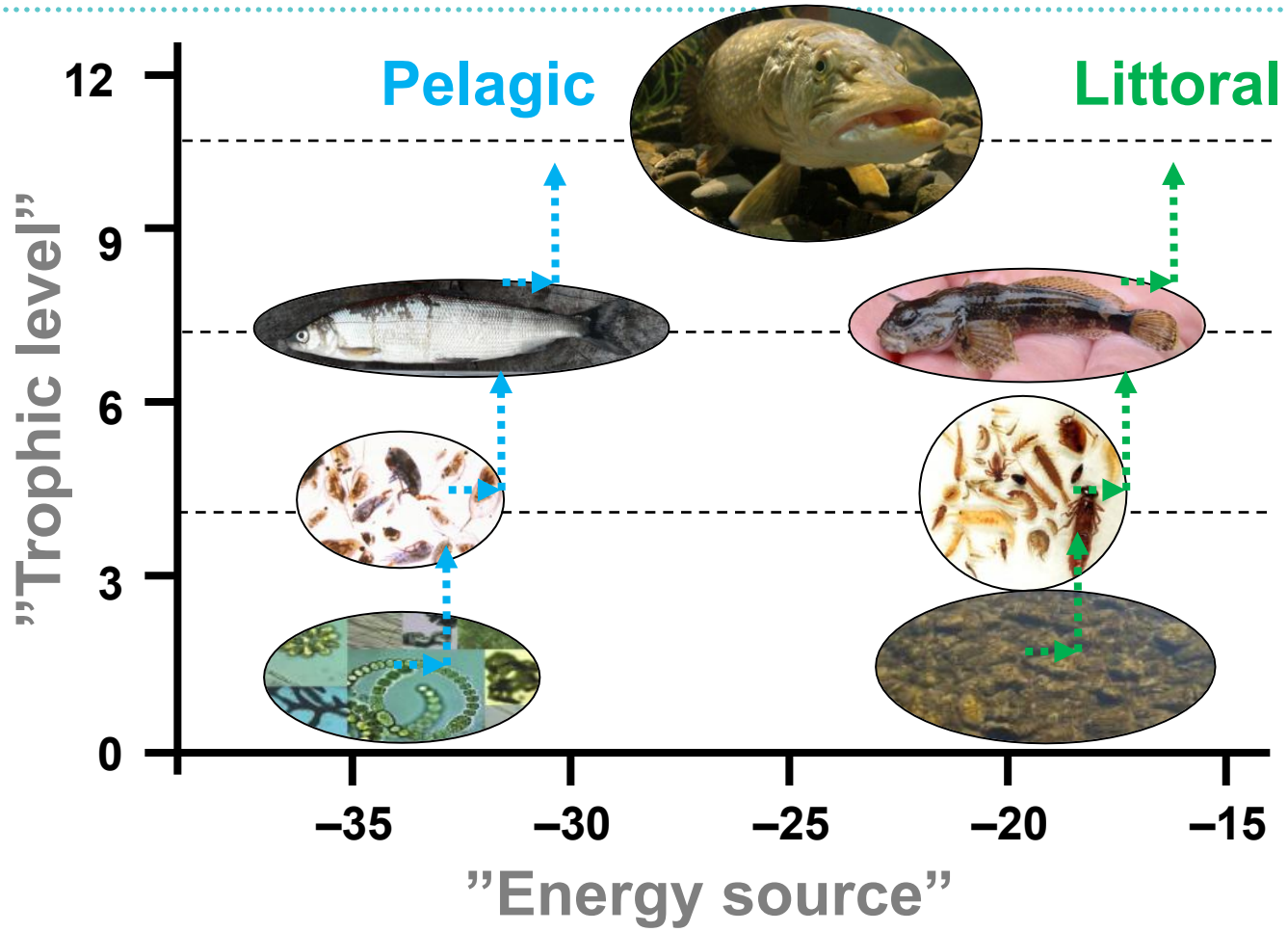
- **Field studies** in lakes and reservoirs:
  1) Unregulated
  2) Slightly regulated (Max_{wlf}<20m)
  3) Heavily regulated (Max_{wlf}>20m)
- Why reservoirs in North?
  - Simple fish communities
    = more reliable results
  - Previously collected data



Studying food webs

Stable isotope analysis

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



What do we expect to find out?

Modelling trout catches

- How abiotic and biotic characteristics and water level fluctuation affect fish production in reservoirs and lakes?
- **Hypothesis**: The magnitude and timing of water level fluctuations affect fish production in reservoirs

Food web studies

- How water level fluctuations affect littoral and pelagic food webs in reservoirs?
- **Hypothesis**: Fish feed more on pelagic food and grow slower in heavily regulated lakes

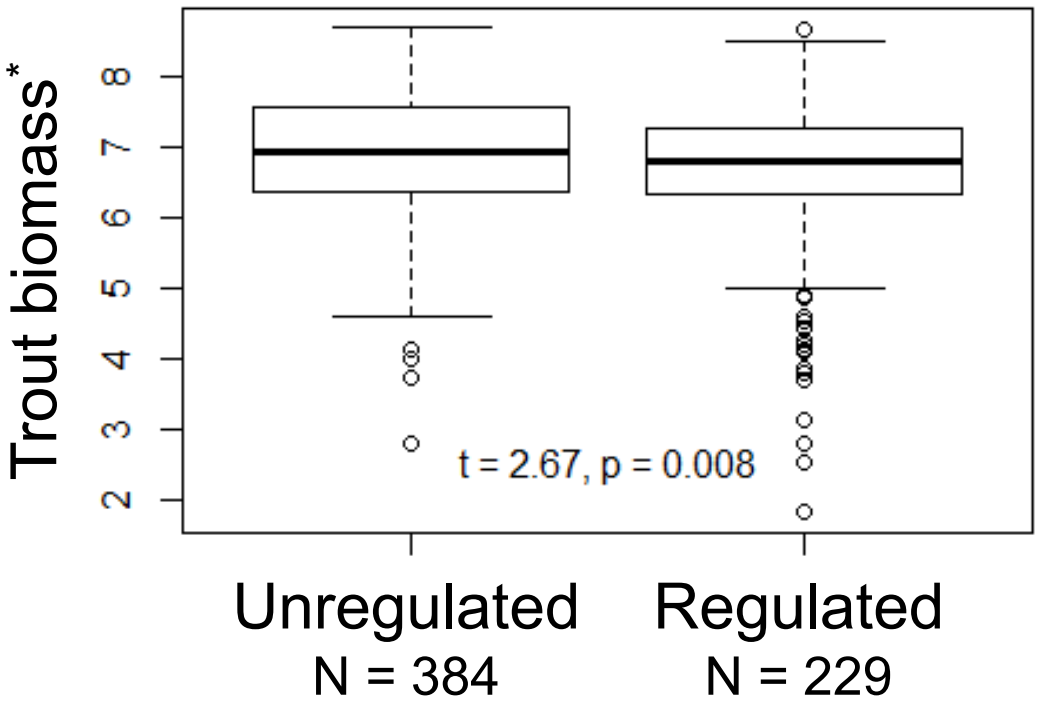
Initial results:
Modelling trout catches

- **Modelling trout production** in >470 lakes and reservoirs
  - Trout catches/biomass (CPUE*)
  - Regulation (unregul. vs. regul.)
  - Lake area and shape
  - Fish community composition
  - Catchment productivity (NDVI*)
  - Ice cover period

* CPUE = Catch Per Unit Of Effort (g fish / 100 m^2 net / night)
* NDVI = Normalized Difference Vegetation Index

Initial results:
Modelling trout catches

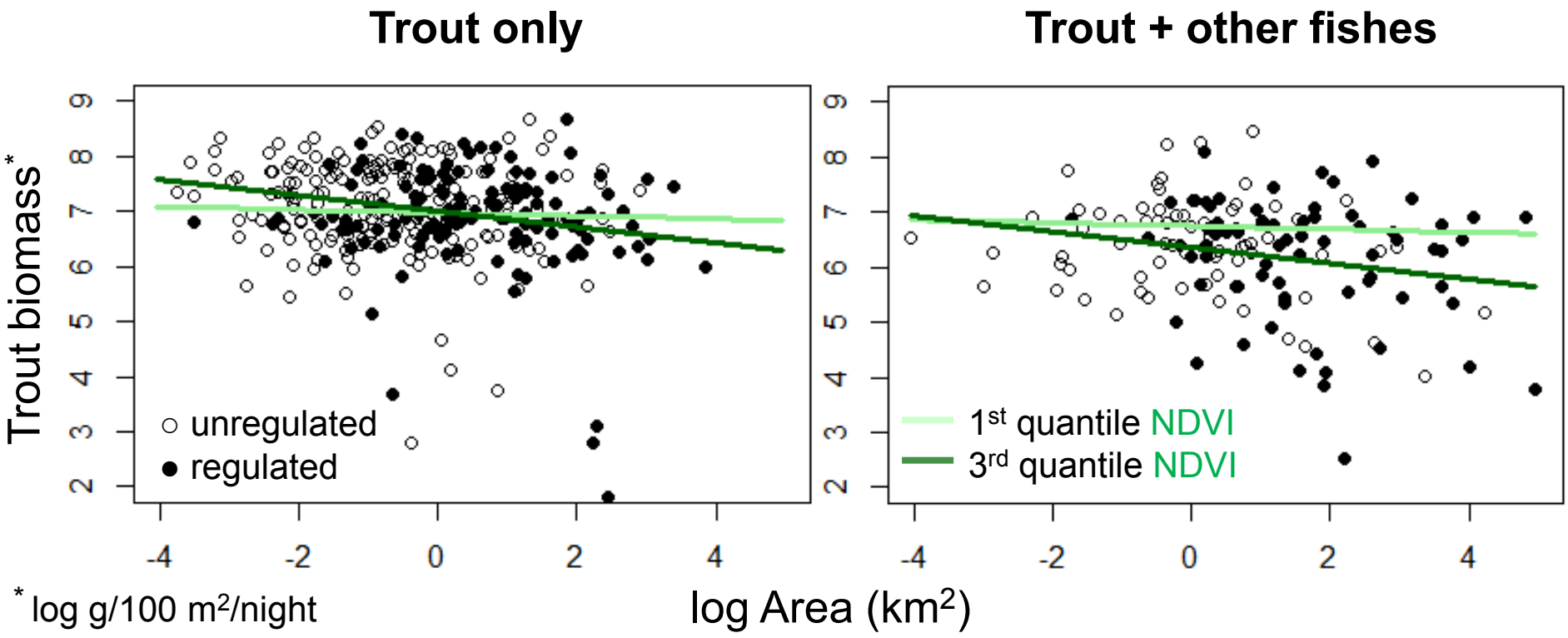
- Trout catches slightly smaller in regulated lakes
- Variation large both in unregulated and regulated lakes
  - **Why?**



* log g/100 m^2/night

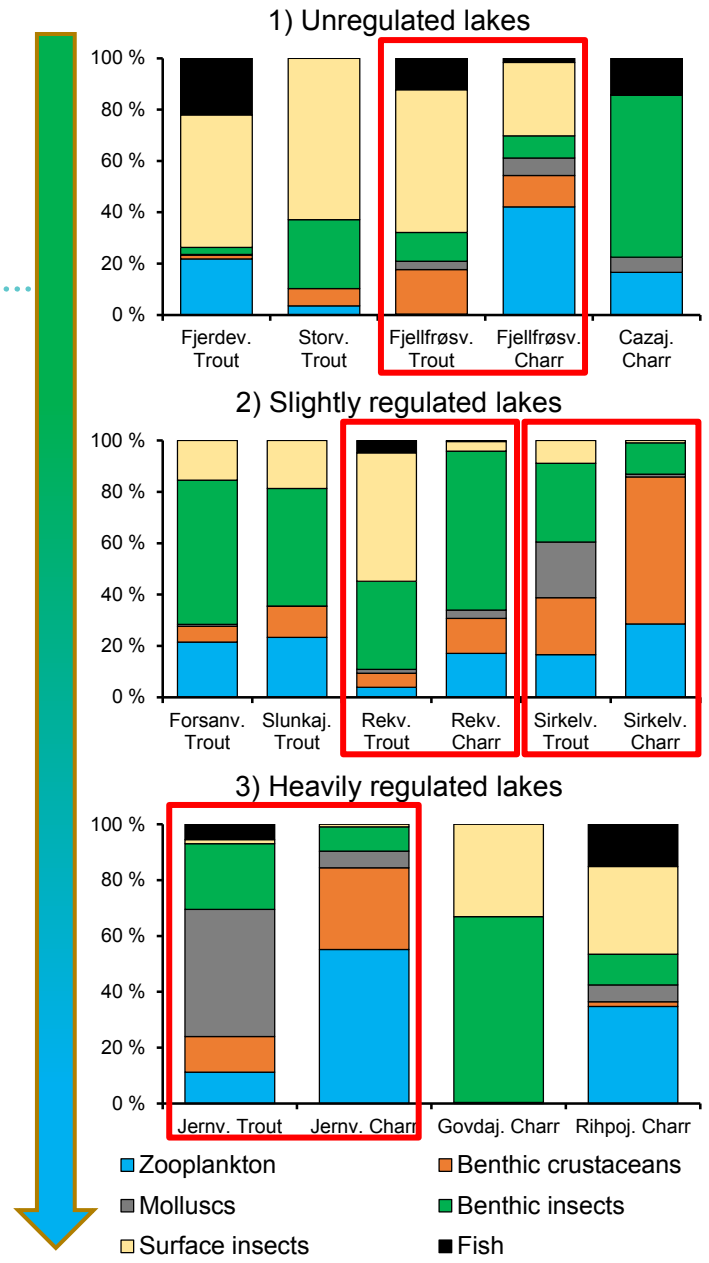
Initial results:
Modelling trout catches

- **Lake area** and **presence of other fish species** have stronger impact on trout catches than hydropower



Initial results: Fish diets in reservoirs

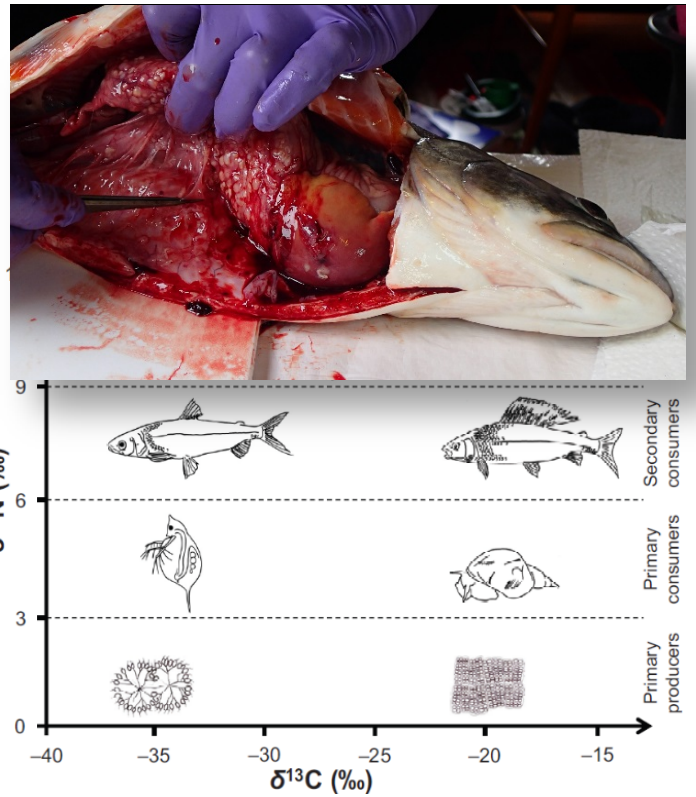
- Benthic (and terrestrial) invertebrates more important food than pelagic zooplankton
- Trout and charr have often different diets when living in the same lake
- No clear pattern from littoral to pelagic diet with increasing regulation level



Only initial analyses and results!

- Future modelling will include
  - More lakes and reservoirs
  - Actual regulation patterns
  - Fish stockings
- Food web studies
  - Stable isotope analyses running in Canada
  - Results will tell about energy flow patterns in reservoirs

→ **So what?**

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Fare for dårlig is

Tusen takk!