

Behaviour of post-spawned Atlantic salmon (*Salmo salar*) migrating past a hydropower dam

Olivia Simmons, David Aldvén, Rémi Carmigniani,
Stephanie Mueller, Patrik Andreasson, Olle Calles,
Torbjørn Forseth, Ana Silva

14 June, 2023



Atlantic salmon kelts

What is a kelt?

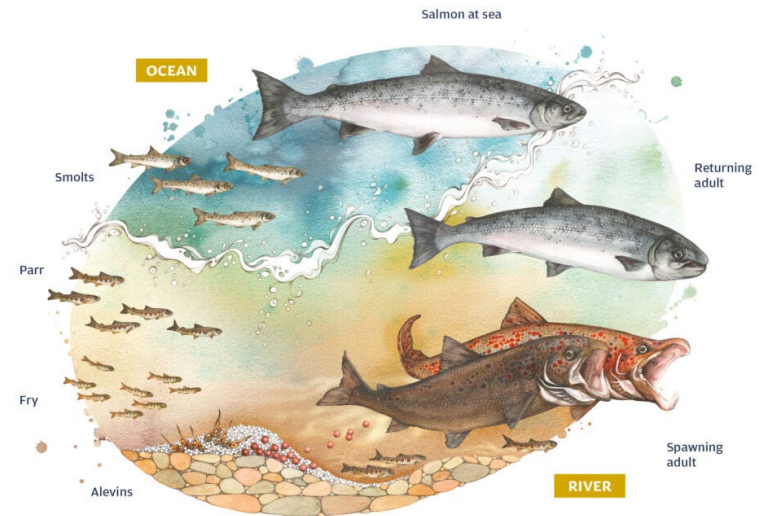


Photo: NASCO

Atlantic salmon kelts

What is a kelt?



Why are kelts important?

- Repeat spawners
 - ▶ High fecundity
 - ▶ Important genetic contributions
 - ▶ Buffer against years with poor maiden spawner return rates

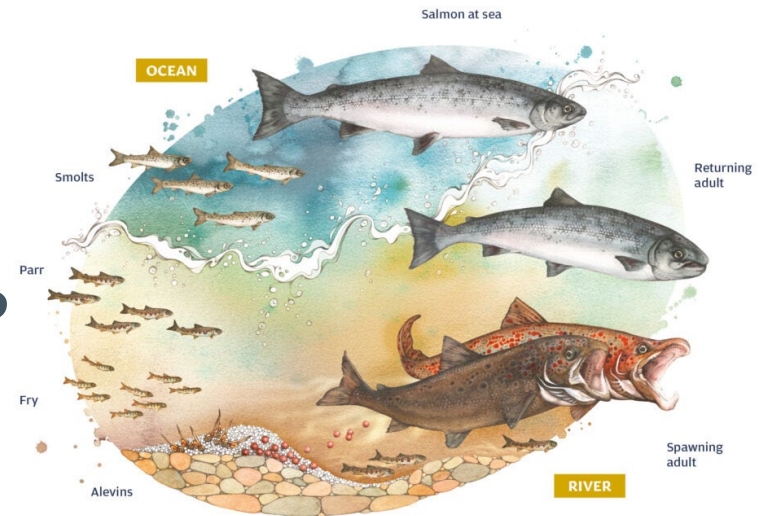
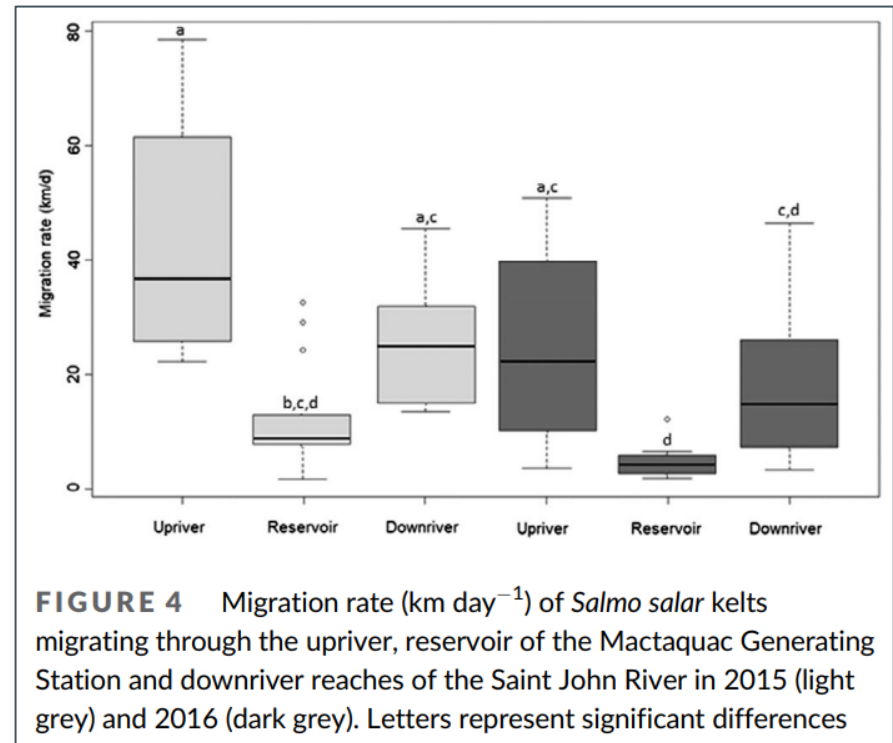


Photo: NASCO

Atlantic salmon kelts

How are kelts affected by HPP?

- Migration delays
 - ▶ Slower swimming through reservoirs
 - ▶ Difficulty finding safe passage routes
 - ▶ Energy depletion

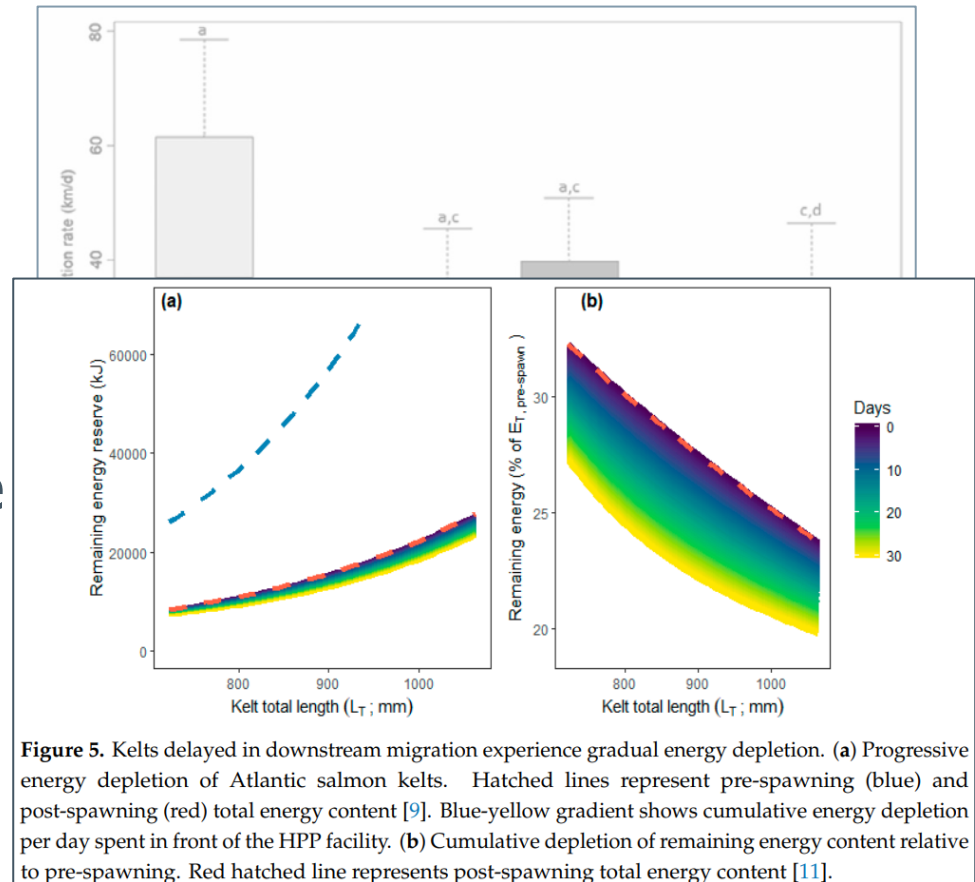


Babin et al. 2021

Atlantic salmon kelts

How are kelts affected by HPP?

- Migration delays
 - ▶ Slower swimming through reservoirs
 - ▶ Difficulty finding safe passage routes
 - ▶ Energy depletion

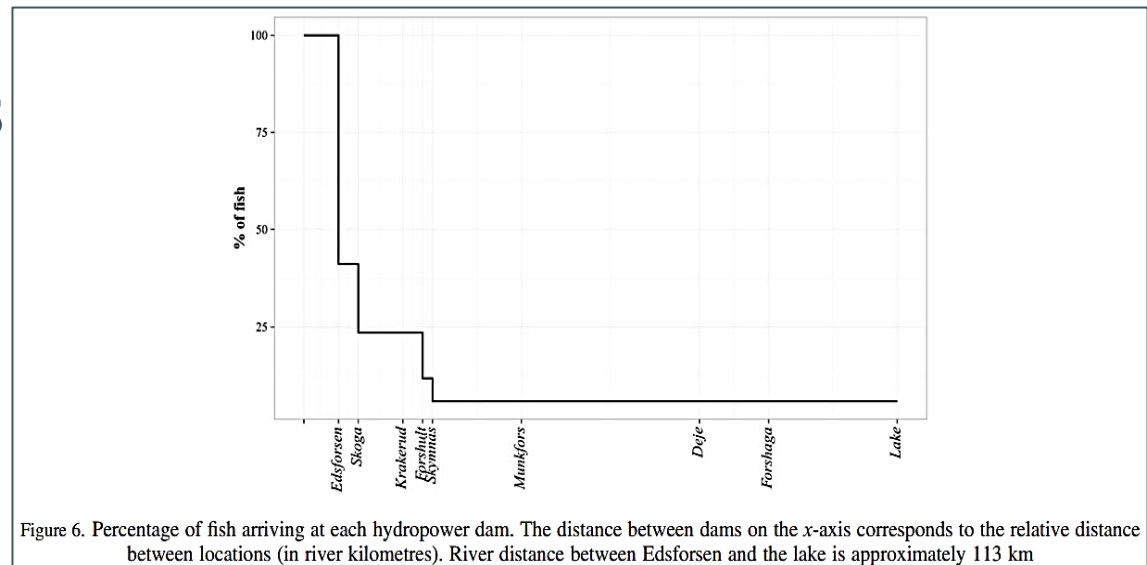


Baktoft et al. 2020

Atlantic salmon kelts

How are kelts affected by HPP?

- Migration delays
- Passage injury/mortality
 - ▶ Turbine strikes
 - ▶ Impingement
 - ▶ Multiple HPPs passage



Nyqvist et al. 2017

Atlantic salmon kelts

How are kelts affected by HPPs?

- Mortality
- Passage time

Yet, much remains unknown about kelts!

- ▶ Impingement
- ▶ Multiple HPPs passage

Figure 6. Percentage of fish arriving at each hydropower dam. The distance between dams on the x-axis corresponds to the relative distance between locations (in river kilometres). River distance between Edsforsen and the lake is approximately 113 km

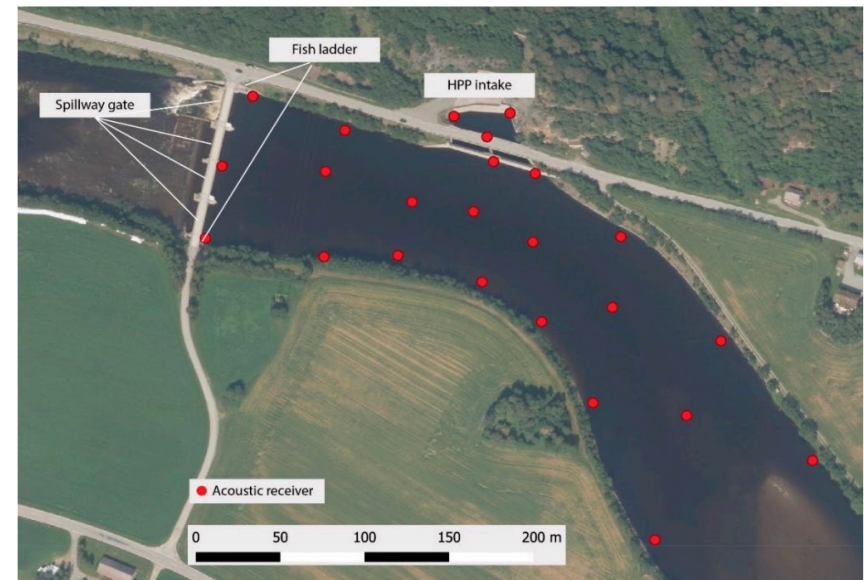
Nyqvist et al. 2017

Kelt2Sea project goals

- Better understanding of swimming behaviour:
 - ▶ In relation to hydraulic variables
 - ▶ In vicinity of HPP structures
- Better ability to predict swimming behaviour:
 - ▶ Help develop new cost-effective measures for downstream migration in the future

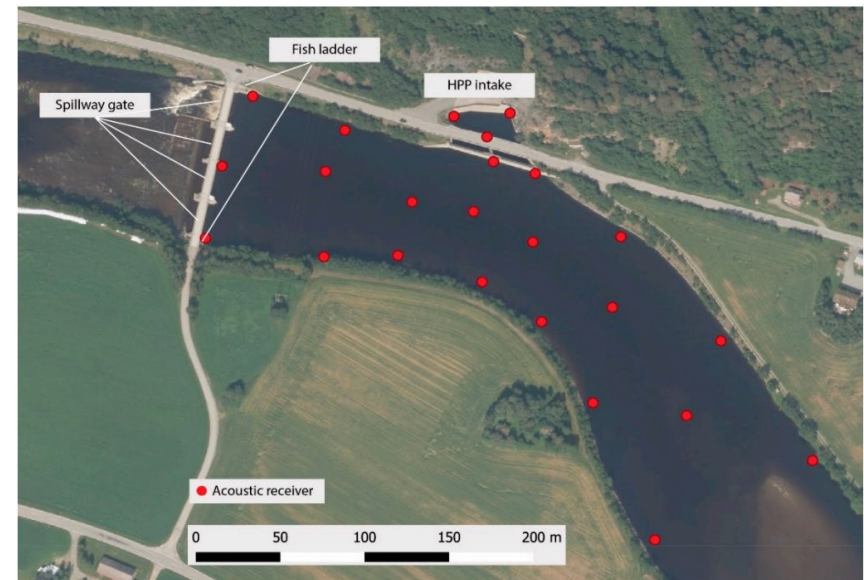
Field data

- River Orkla, Norway
 - ▶ Bjørset dam
 - ▶ Four spillways
 - ▶ Two fish ladders
 - ▶ HPP intake



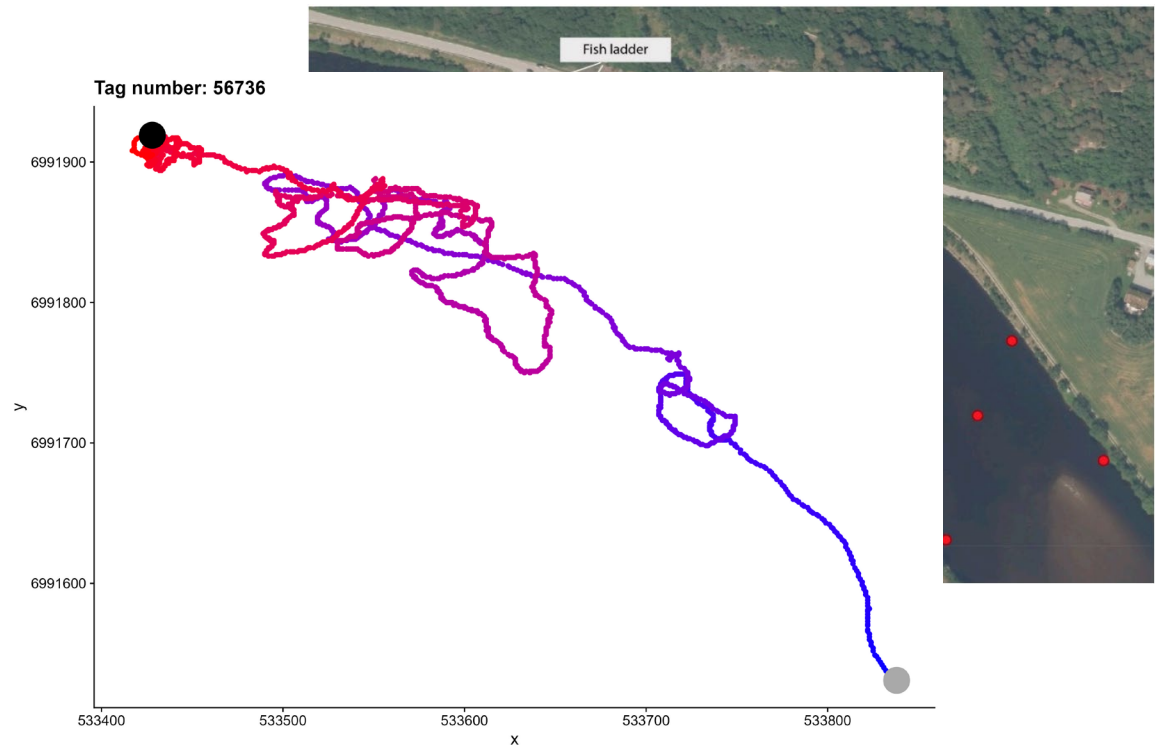
Field data

- River Orkla, Norway
- 48 kelts
 - ▶ Acoustic tags



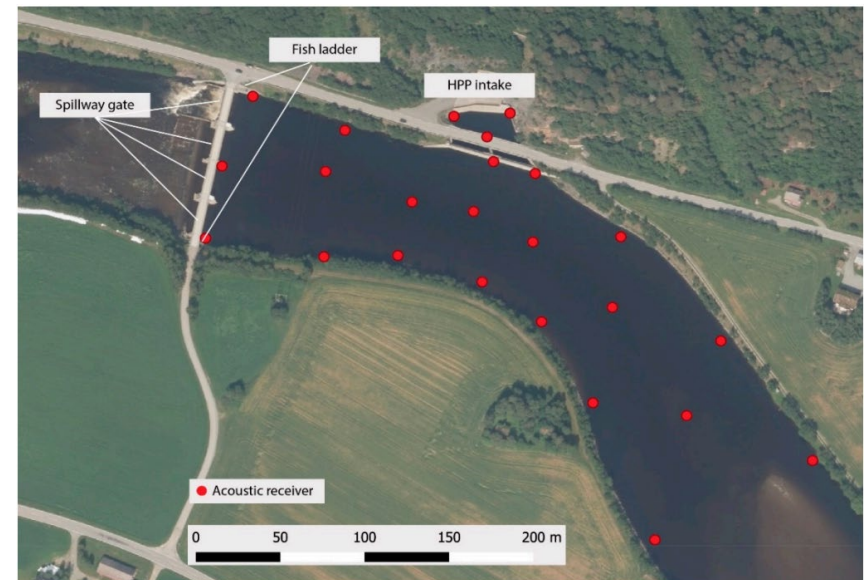
Field data

- River Orkla, Norway
- 48 kelts
 - ▶ Acoustic tags



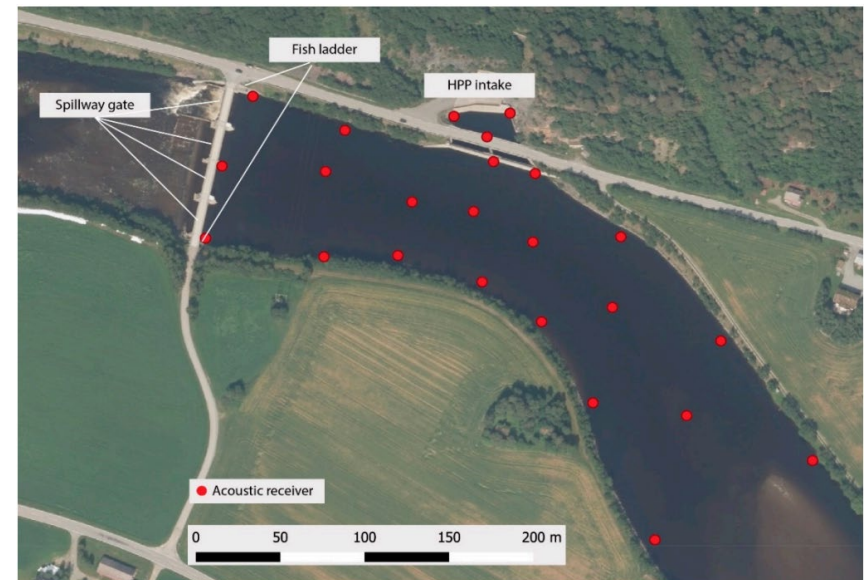
Field data

- River Orkla, Norway
- 48 kelts
 - ▶ Acoustic tags



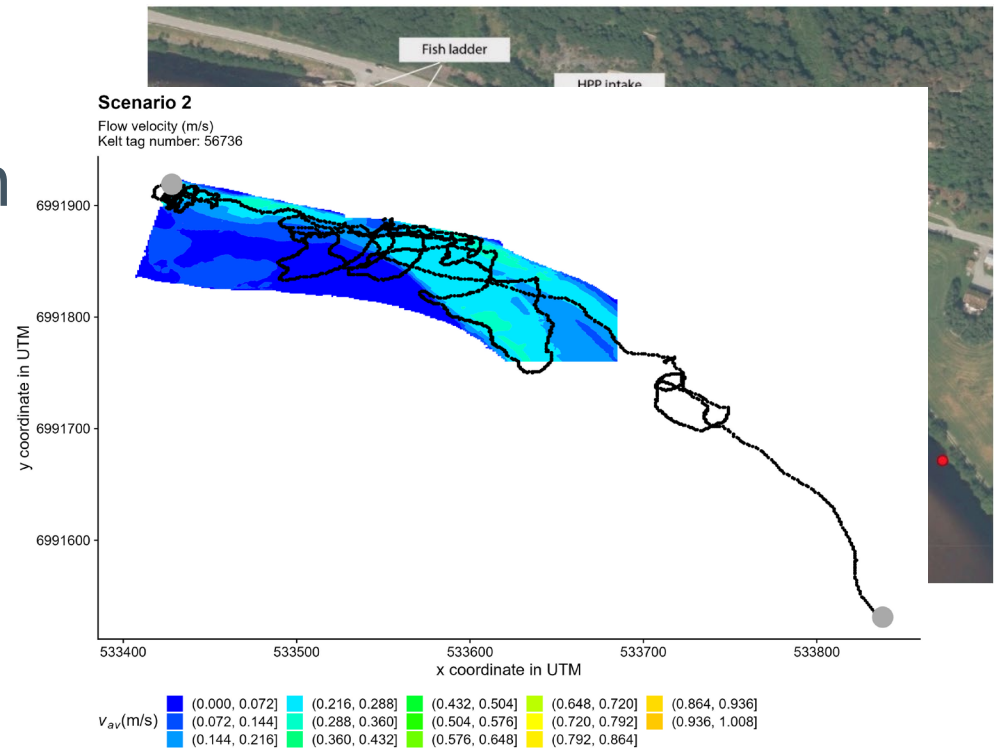
Field data

- River Orkla, Norway
- 48 kelts
- Hydraulic data from CFD modelling
 - ▶ Velocity
 - ▶ Turbulence



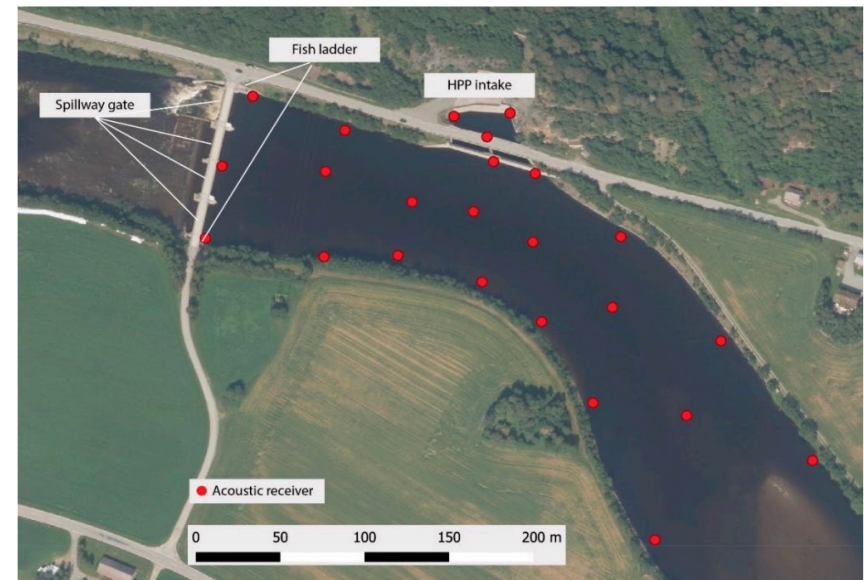
Field data

- River Orkla, Norway
- 48 kelts
- Hydraulic data from CFD modelling
 - ▶ Velocity
 - ▶ Turbulence



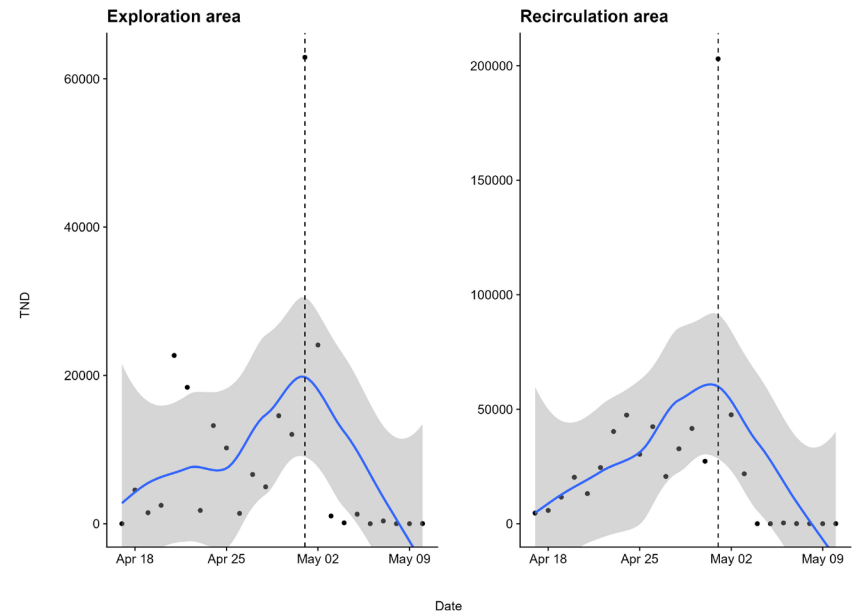
Field data

- River Orkla, Norway
- 48 kelts
- Hydraulic data from CFD modelling
 - ▶ Velocity
 - ▶ Turbulence



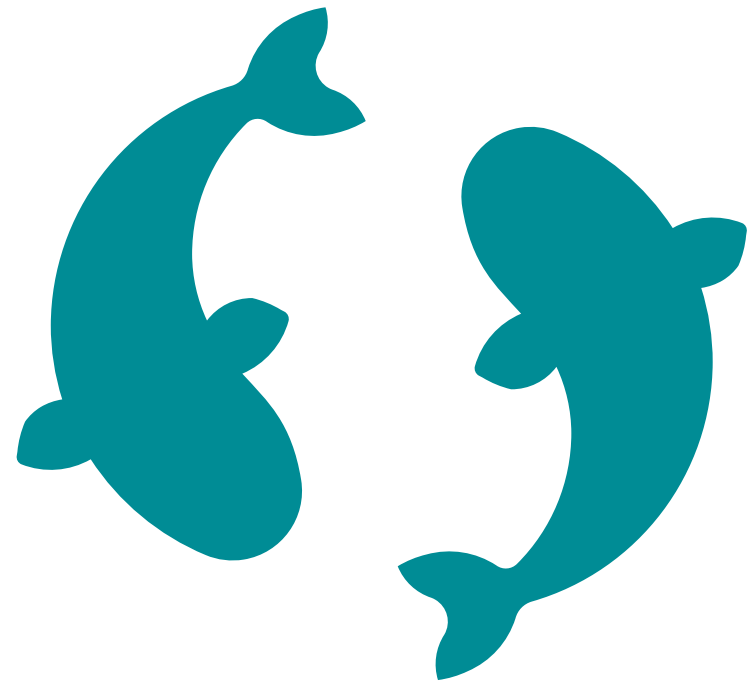
Preliminary results

- Only one kelt passed the dam before May 1
- # detections in front of dam highest on May 1
- 75% of kelts passed on May 1 and 2



Next steps...

- Passage efficiency and time
- Swimming speed
- Swimming depth
- Swimming orientations & directions



To conclude...

- Kelts have high conservation importance
- But can be negatively impacted by hydropower...
- Learning more about their swimming behaviour in regulated rivers is a priority!

Thank-you!

Questions?

