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

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#### What is a kelt?



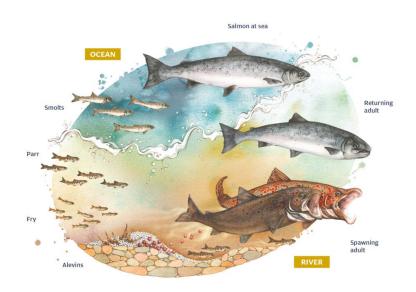


Photo: NASCO



#### What is a kelt?



#### Why are kelts important?

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

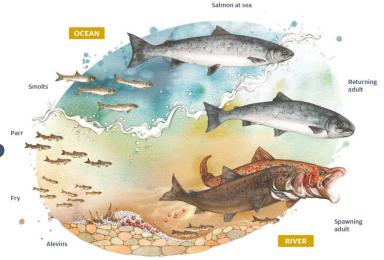
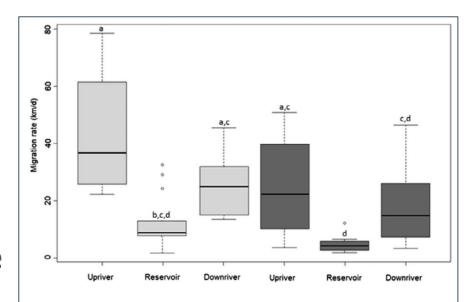


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# How are kelts affected by HPP?

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



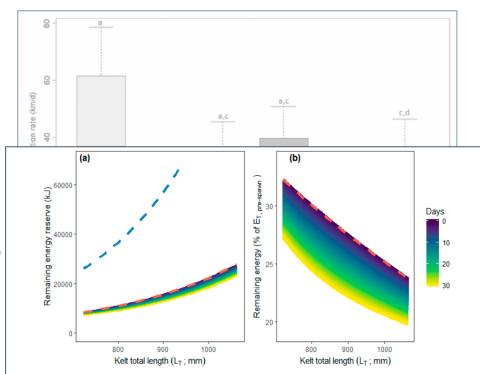
**FIGURE 4** Migration rate (km day<sup>-1</sup>) of *Salmo salar* kelts migrating through the upriver, reservoir of the Mactaquac Generating Station and downriver reaches of the Saint John River in 2015 (light grey) and 2016 (dark grey). Letters represent significant differences

Babin et al. 2021



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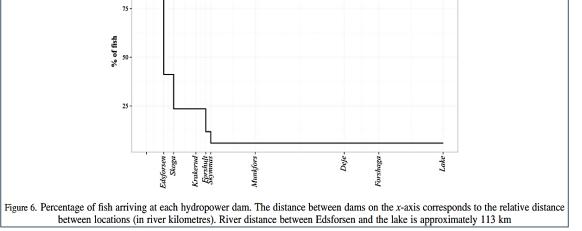
**Figure 5.** Kelts delayed in downstream migration experience gradual energy depletion. (a) Progressive energy depletion of Atlantic salmon kelts. Hatched lines represent pre-spawning (blue) and post-spawning (red) total energy content [9]. Blue-yellow gradient shows cumulative energy depletion per day spent in front of the HPP facility. (b) Cumulative depletion of remaining energy content relative to pre-spawning. Red hatched line represents post-spawning total energy content [11].

Baktoft et al. 2020



# How are kelts affected by HPP?

- Migration delays
- Passage injury/mortality
  - Turbine strikes
  - Impingement



Multiple HPPs passage

Nyqvist et al. 2017



# How are kelts aff

- Yet, much remains unknown
- about kelts!

▶ Impingement

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

Multiple HPPs passage

Nyqvist et al. 2017

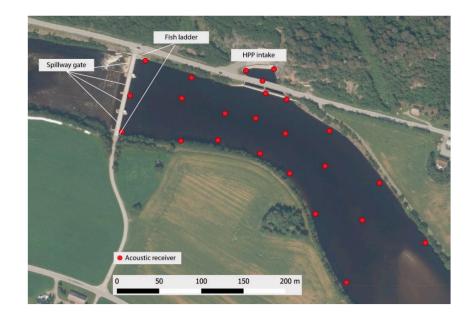


# Kelt2Sea project goals

- 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

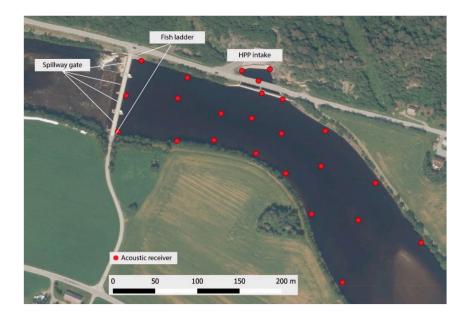


- River Orkla, Norway
  - Bjørset dam
  - Four spillways
  - ▶ Two fish ladders
  - ▶ HPP intake



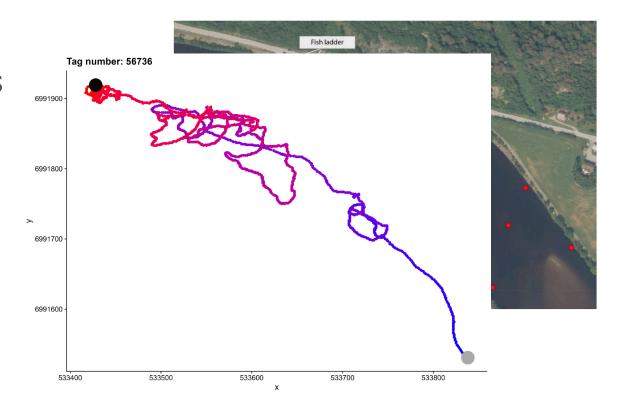


- River Orkla, Norway
- 48 kelts
  - Acoustic tags



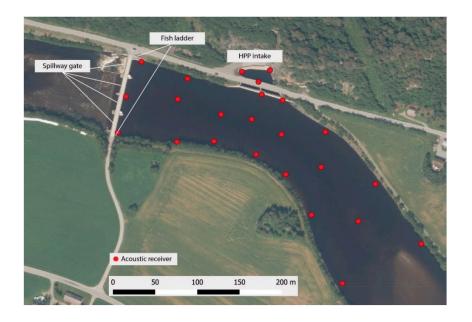


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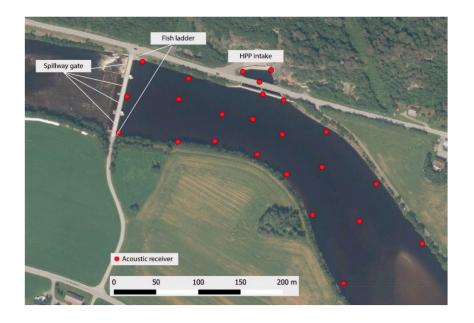


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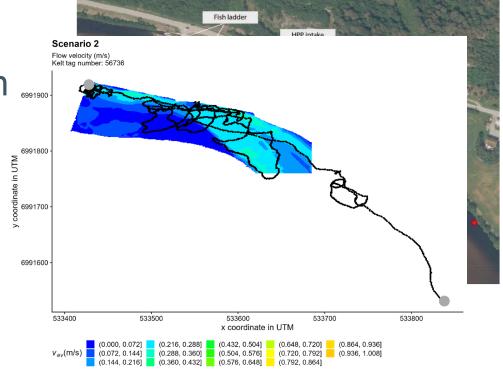


- River Orkla, Norway
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- Hydraulic data from CFD modelling
  - Velocity
  - Turbulence



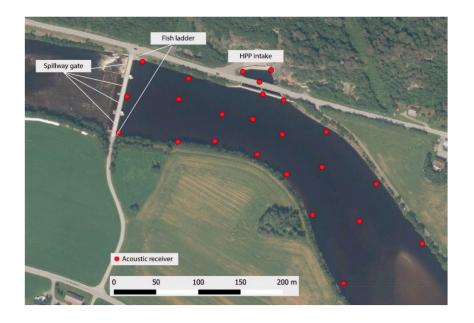


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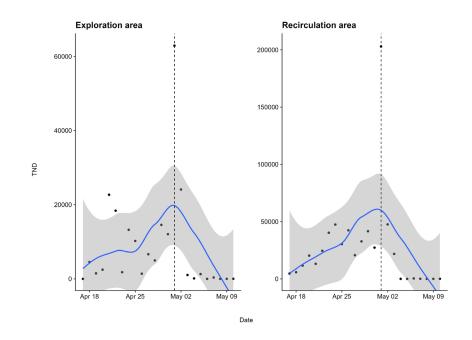
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# Preliminary results

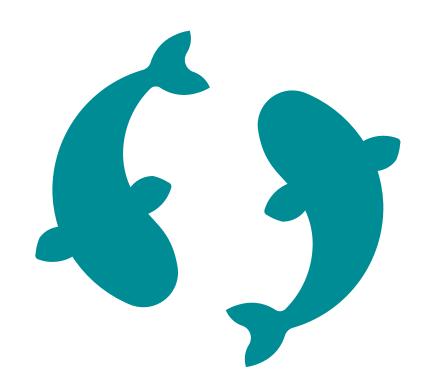
- Only one kelt passed the dam before May 1
- # detections in front of dam highest on May 1
- 75% of kelts passed on May 1 and 2





# 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?

