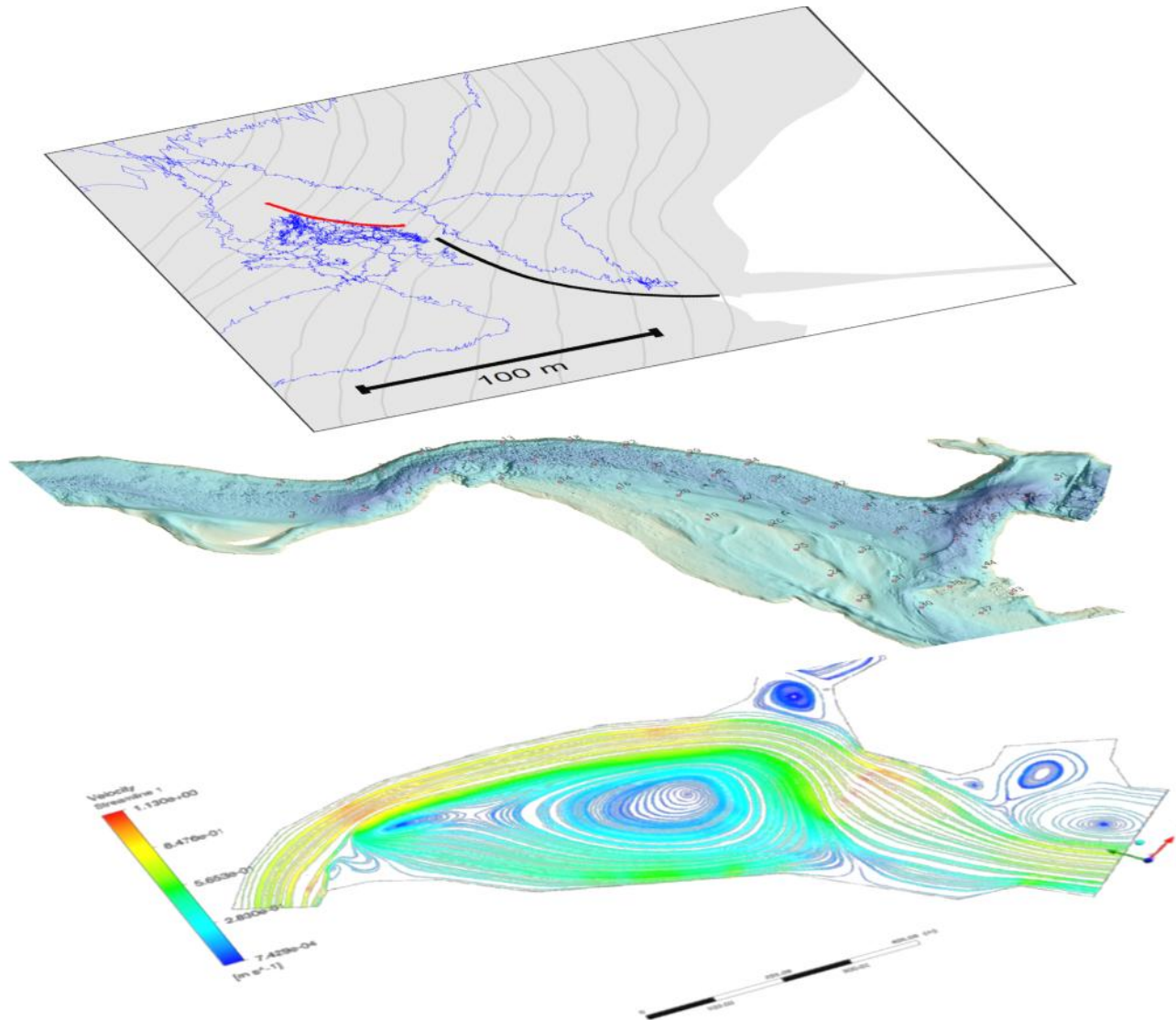




SCIENCE AND
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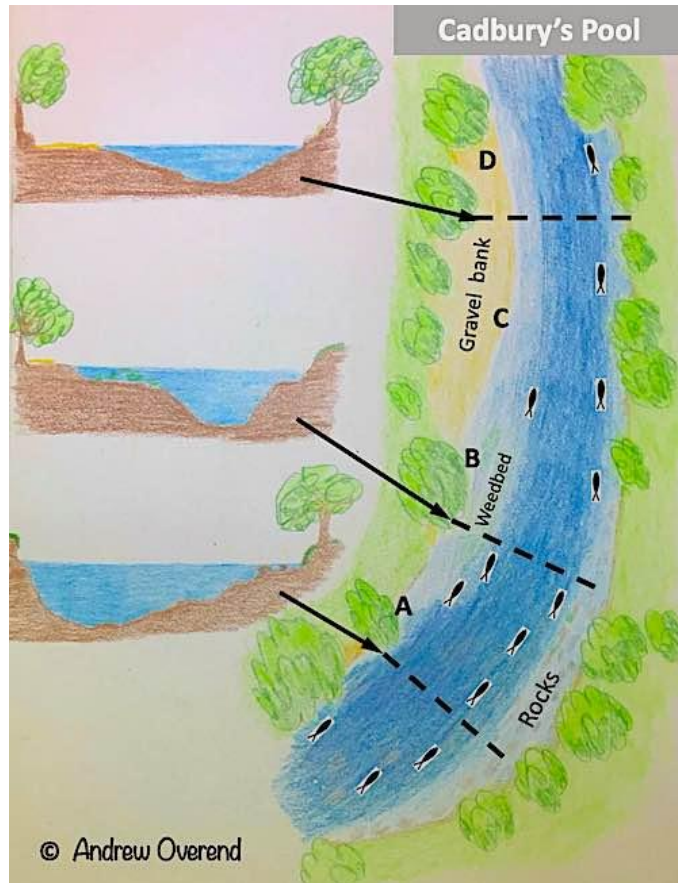
Predict salmonid migration pathways from flow simulations in rivers



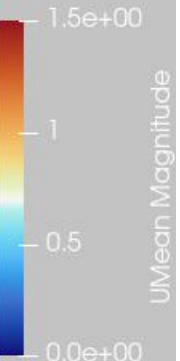
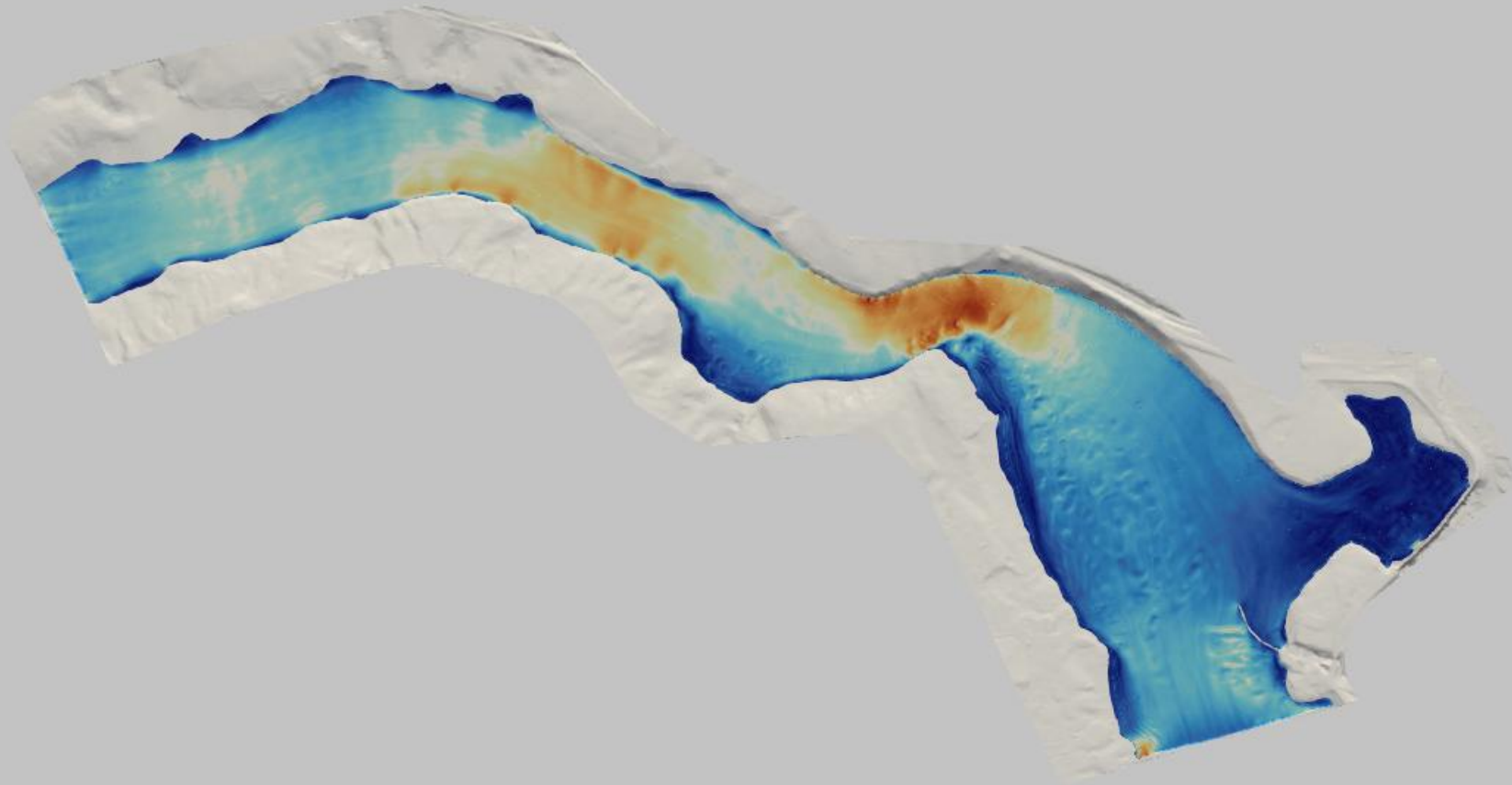
Johan Leander, SLU Umeå



Reading the water



3D flow conditions from CFD-simulations





Downstream passage of adult salmon and trout at Stornorrfors HPP

227 kelt were tagged with acoustic transmitters in 2023 and 2025 and released upstream the dam in end of may

109 salmon

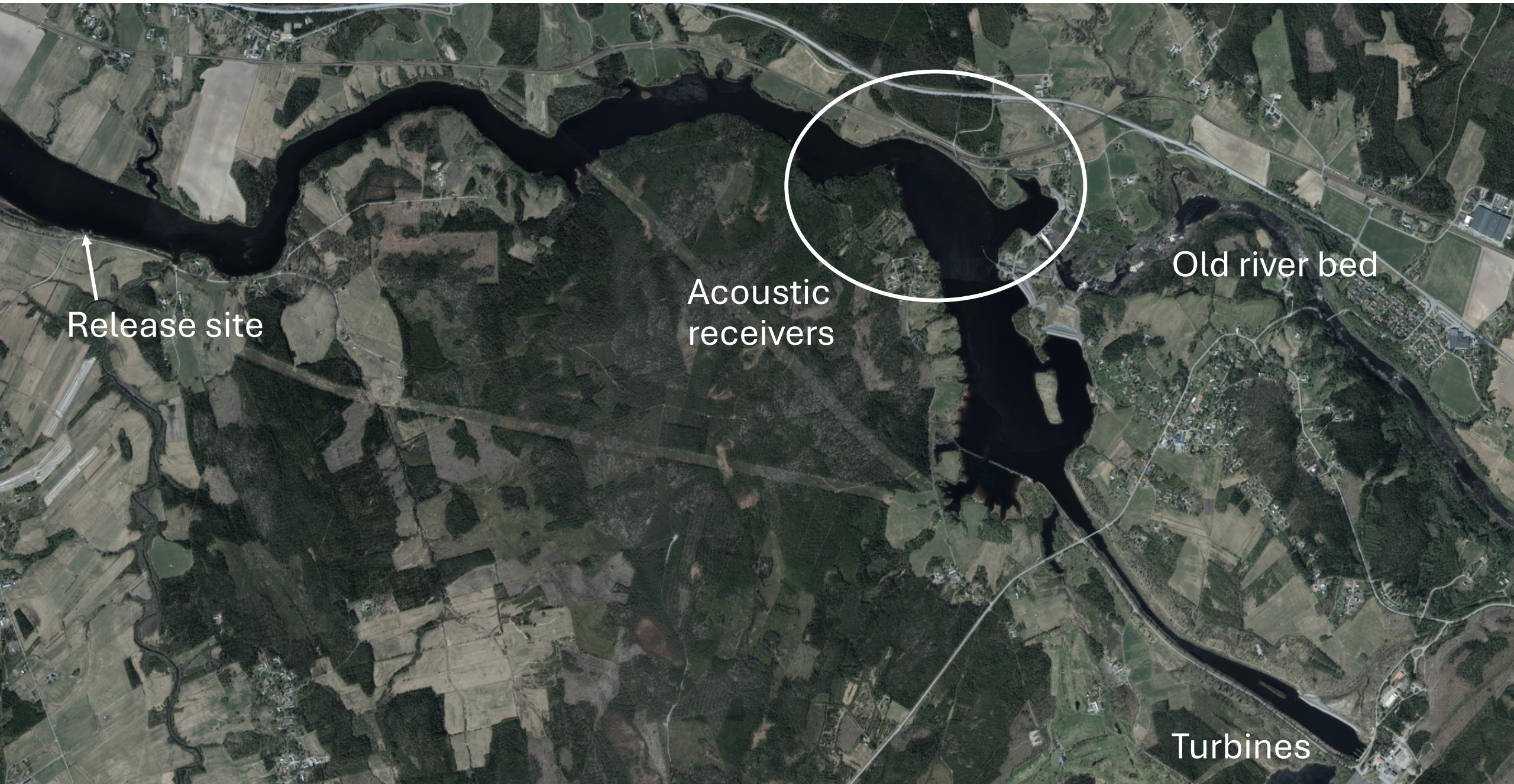
118 trout

Between 48 and 116 cm (mean 68 cm)



Release 6 km upstream the hydropower station





Release site

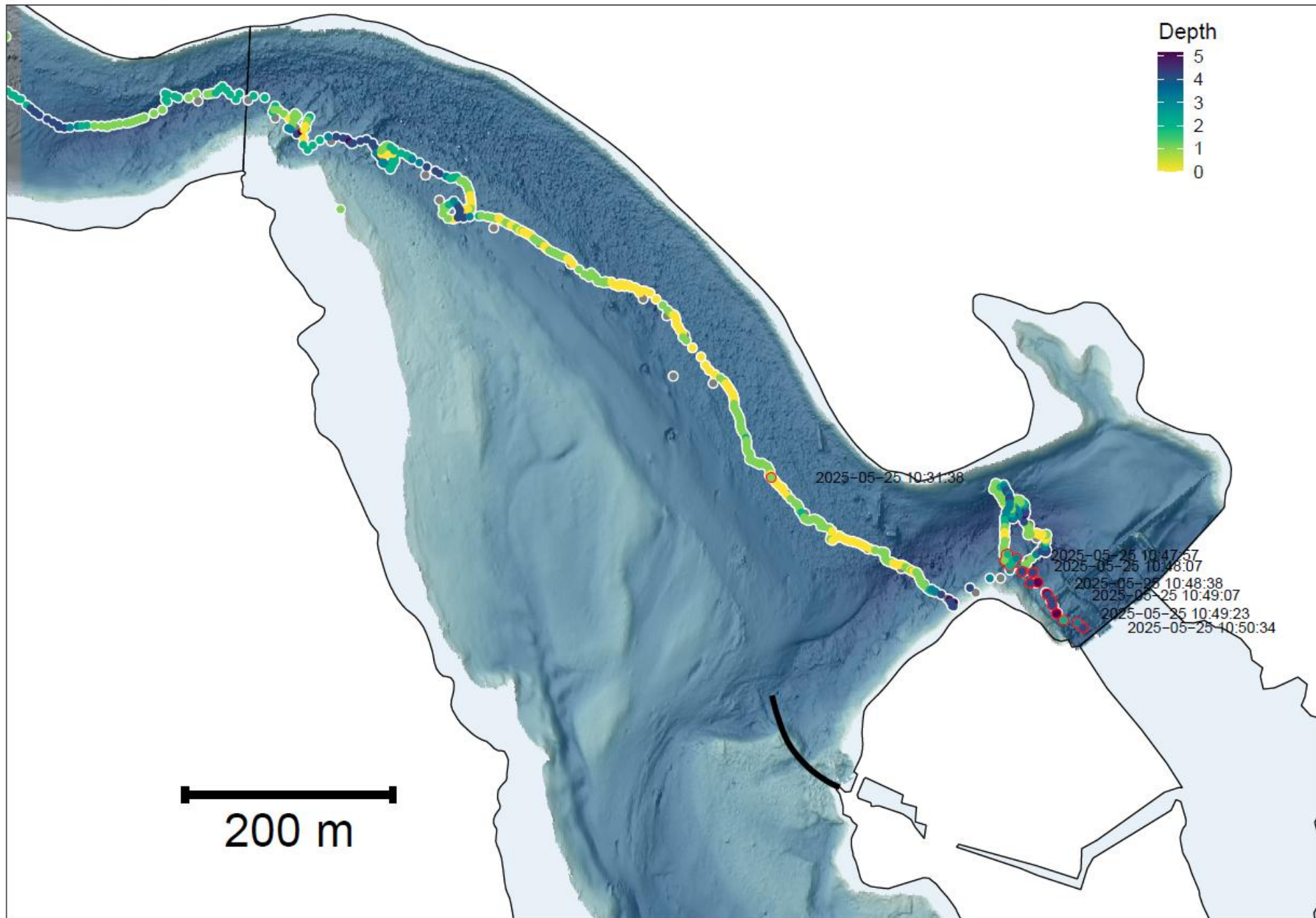
Acoustic receivers

Old river bed

Turbines

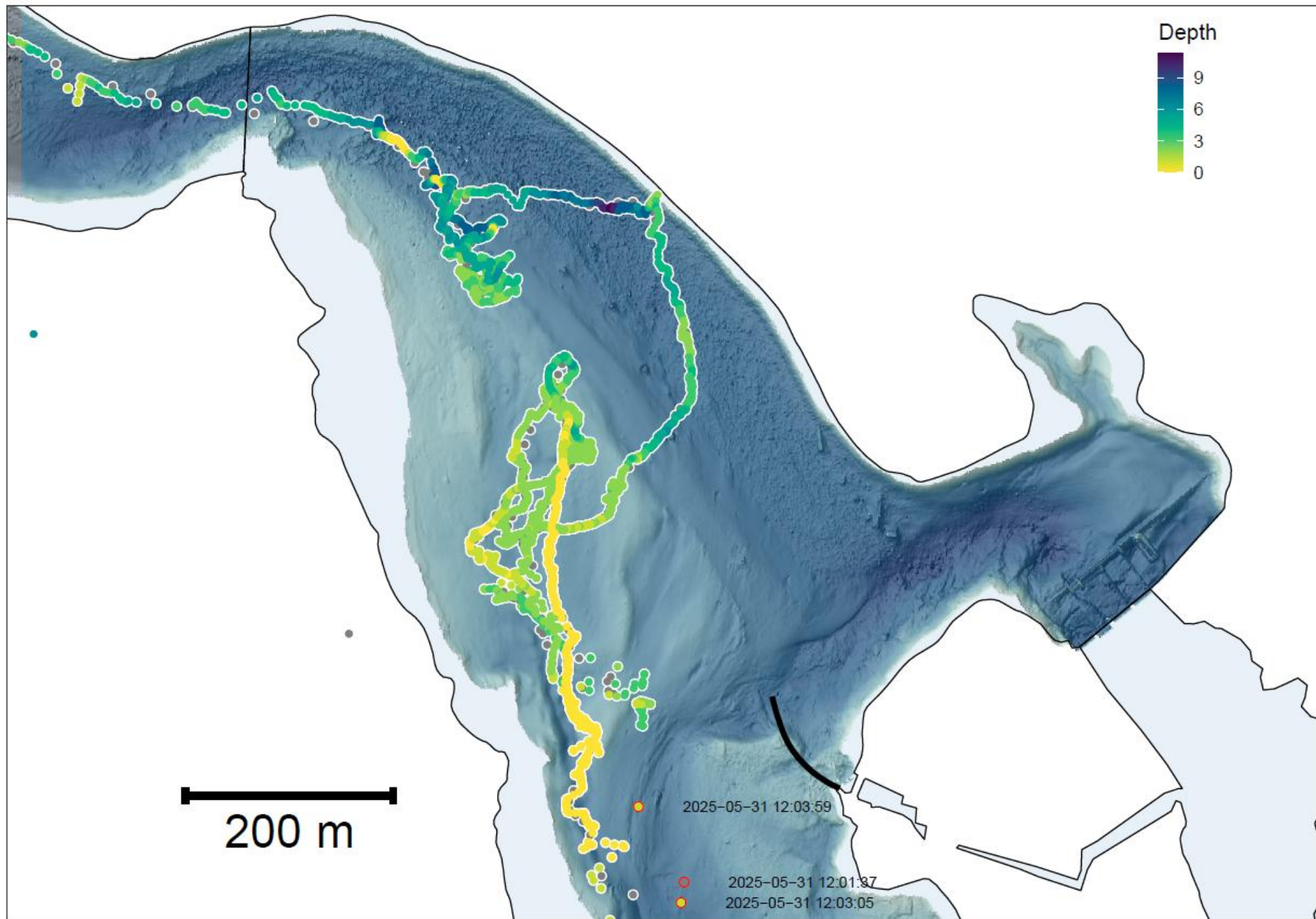
Tag97_filtered

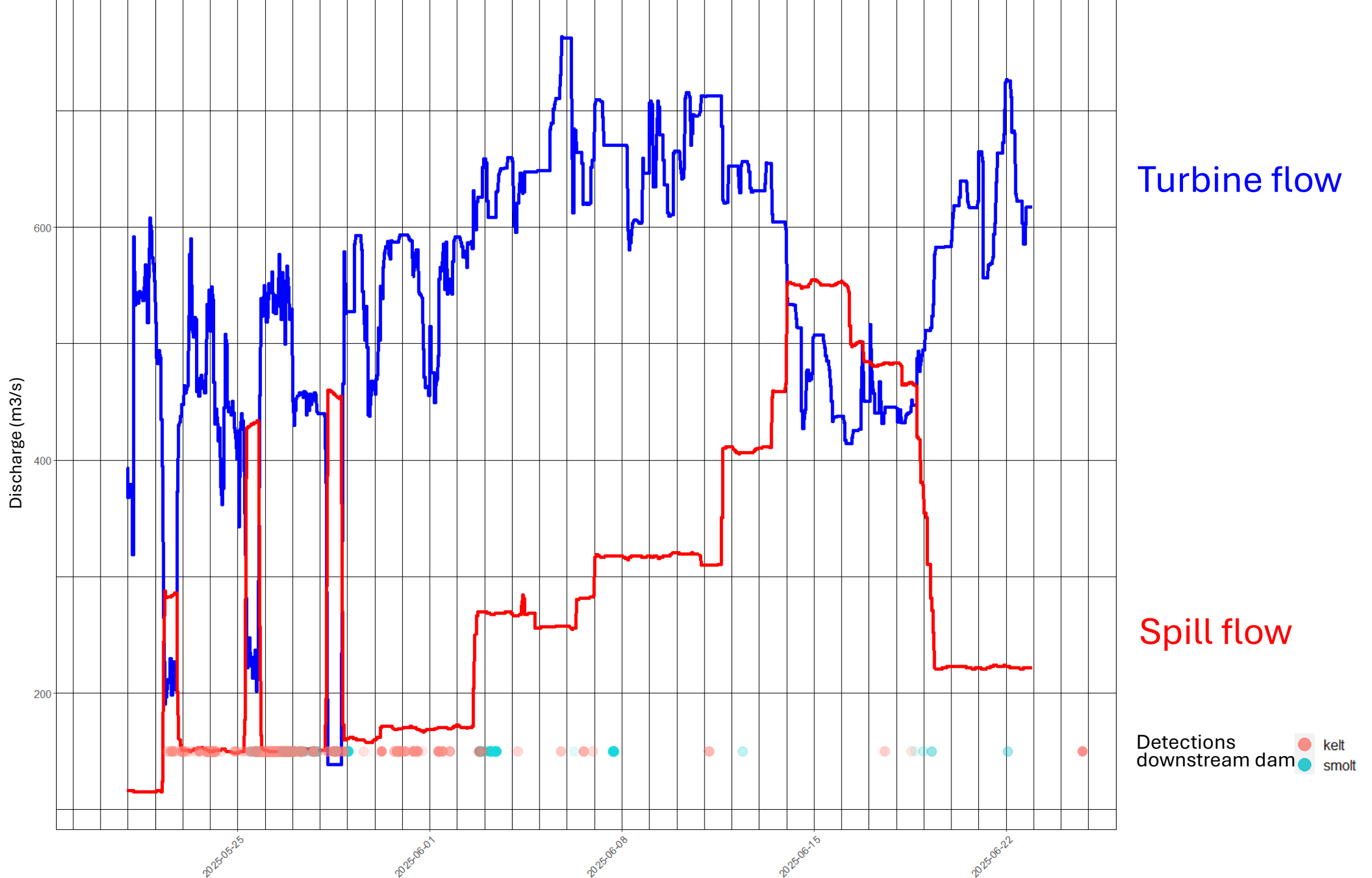
Tag97	2025-05-25 10:32
Total vattenföring	667.65
Spillvatten	418
Dammnivå	74.62

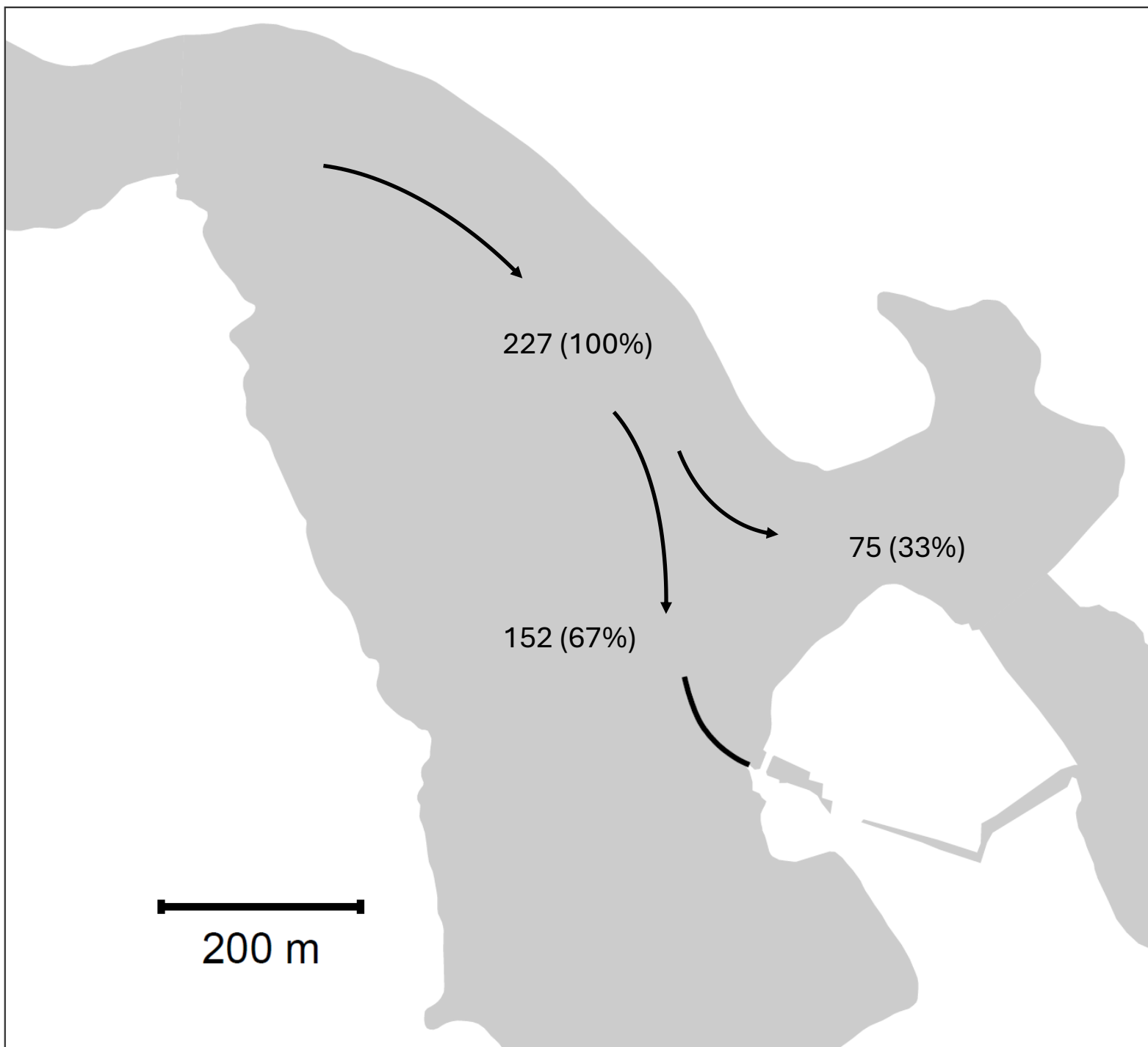


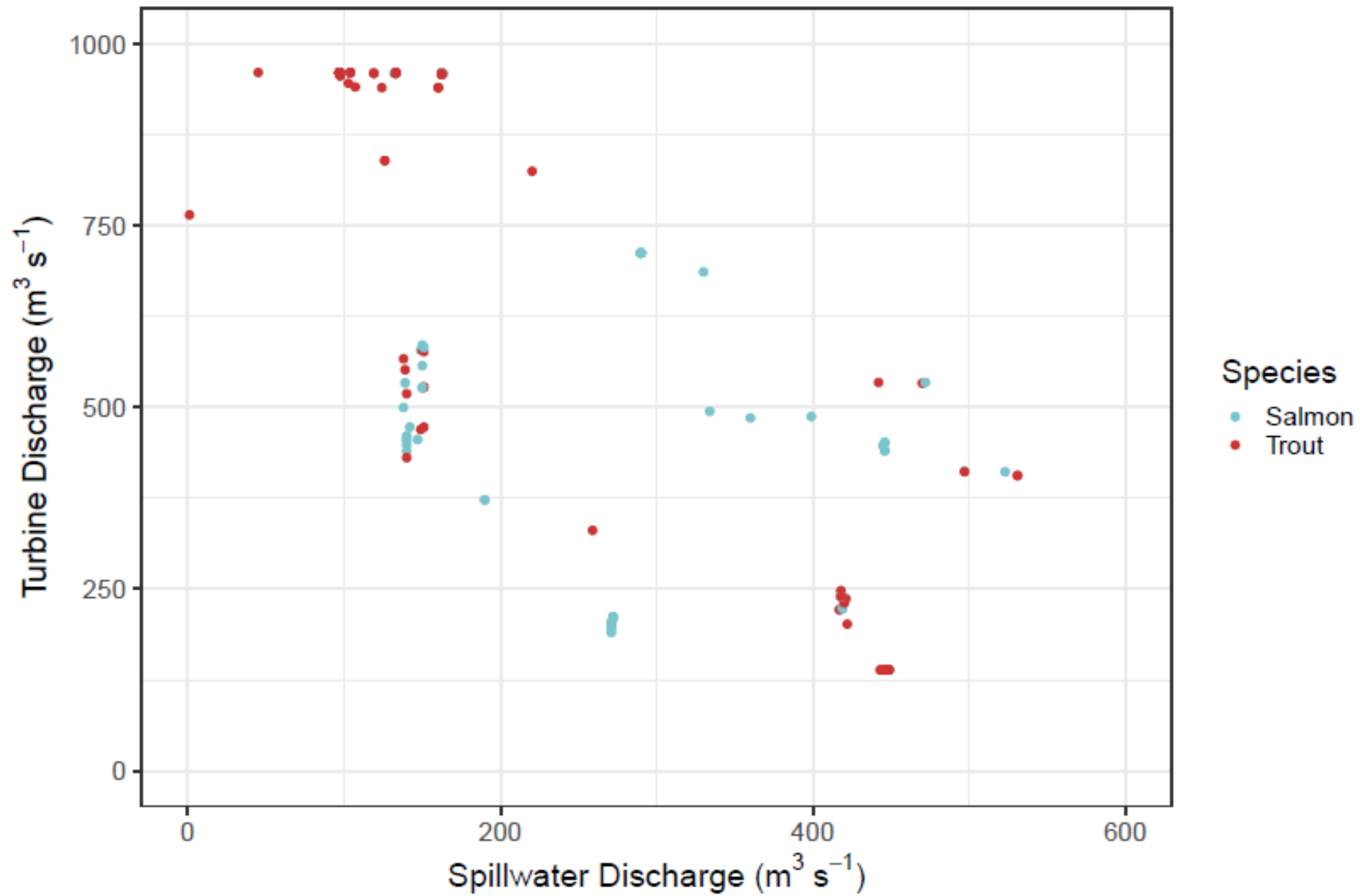
Tag106_filtered

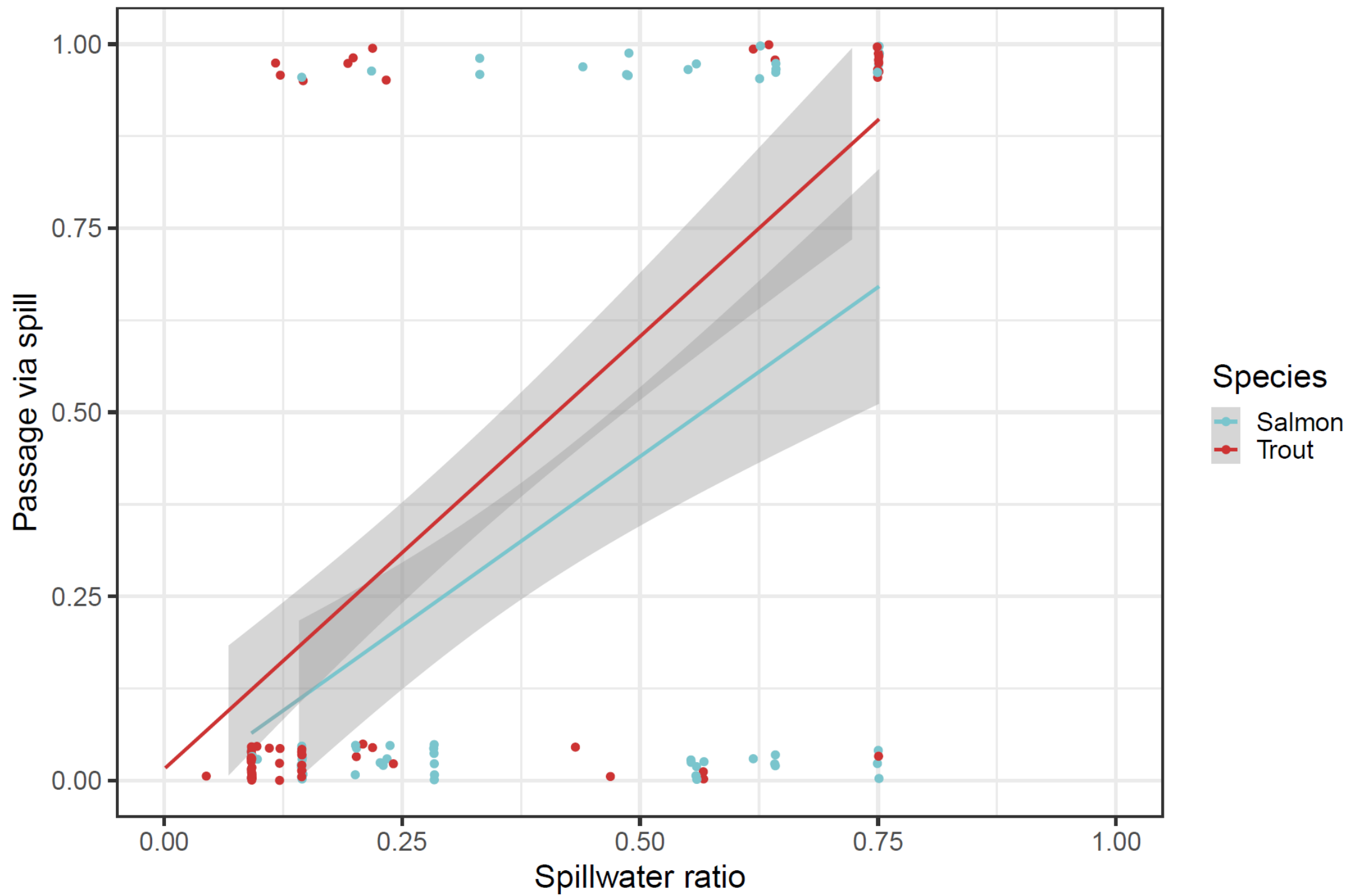
Tag106	2025-05-31 10:30
Total vattenföring	727.38
Spillvatten	150
Dammnivå	74.67





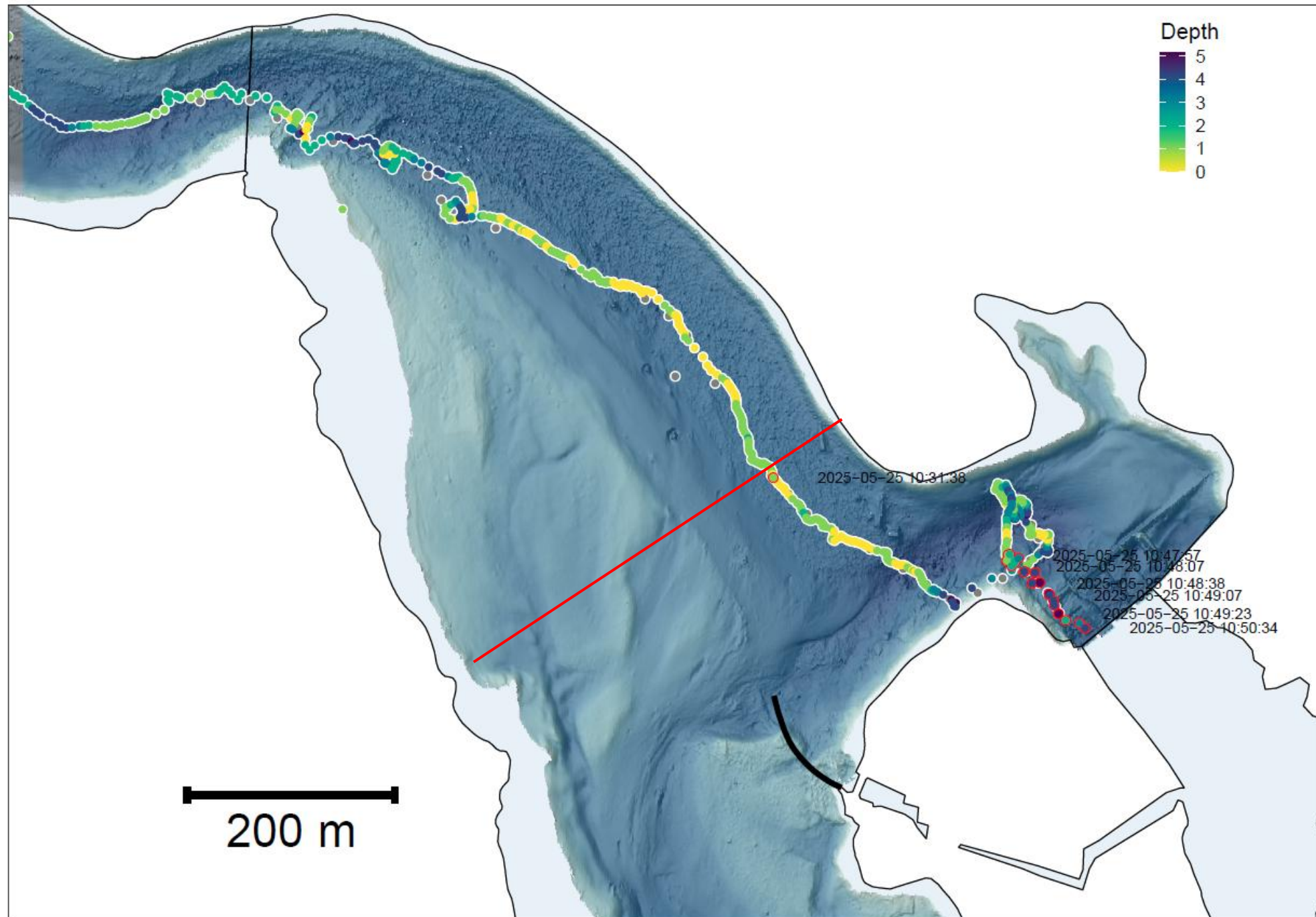


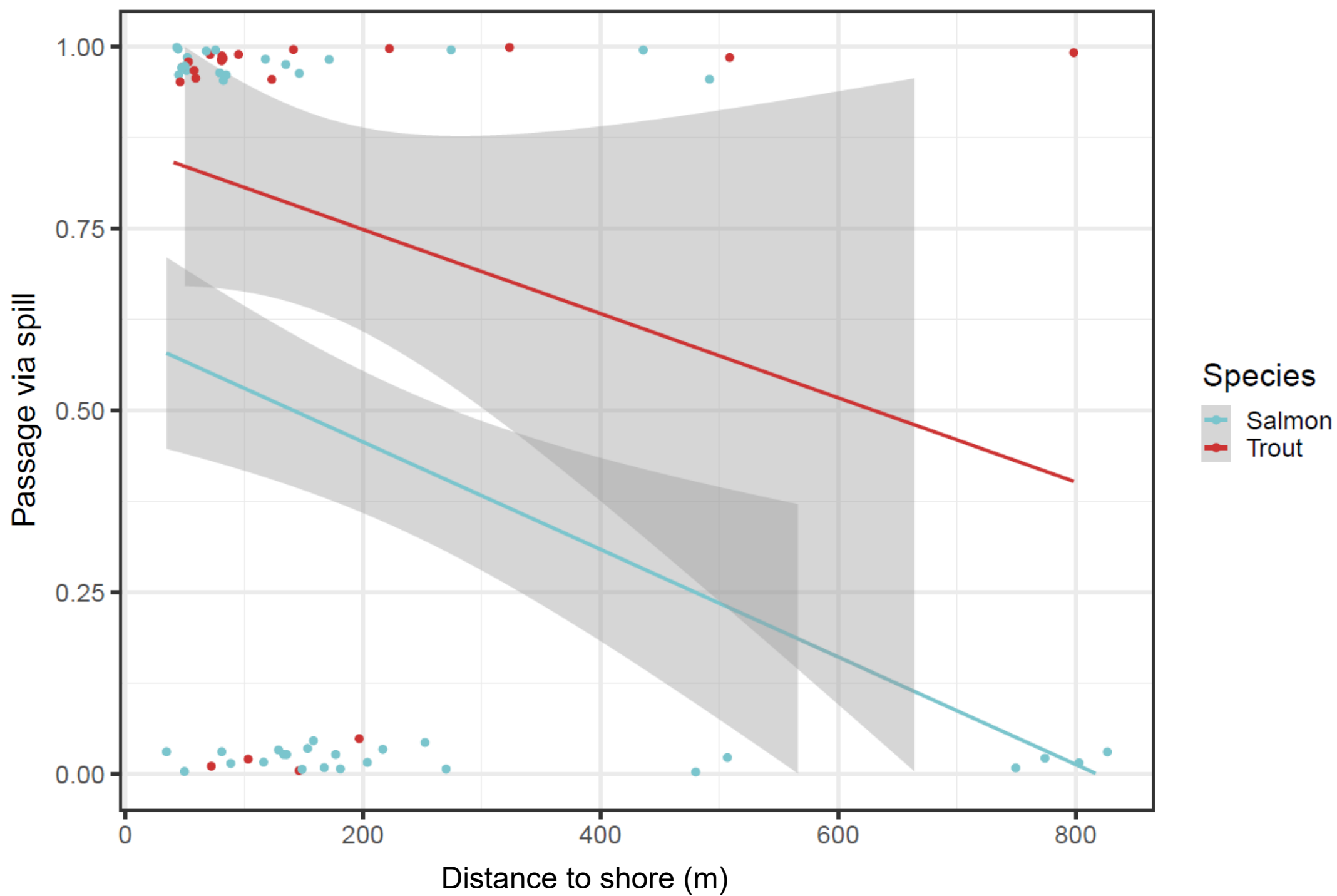




Tag97_filtered

Tag97	2025-05-25 10:32
Total vattenföring	667.65
Spillvatten	418
Dammnivå	74.62





The fish meets a water velocity greater than the critical attraction velocity U_{\min}

No

p_2

$1-p_2$

Yes

p_1

$1-p_1$

Adopt random walk to simulate searching behaviour for areas with higher water velocities

Continue in same direction as before

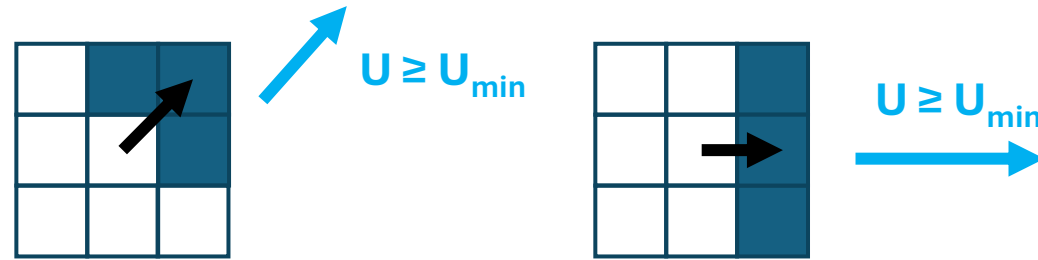
Choose the adjacent cell forward ($\pm 45^\circ$) with the highest water velocity

Adopt correlated random walk. The correlation is given by standard deviation in von Mises distribution, which is negative correlated to the water velocity in the current cell

Adopted from Jansson et al. 2022. Note that p_1 and p_2 are probabilities

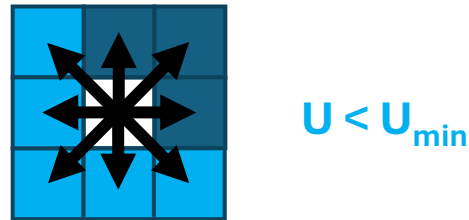
Behavioral Rules

1. If the fish encounters a flow velocity that **exceeds the minimum attraction velocity**, it will, with probability **p1**, choose the **cell in the forward direction ($\pm 45^\circ$) that has the highest flow velocity**.

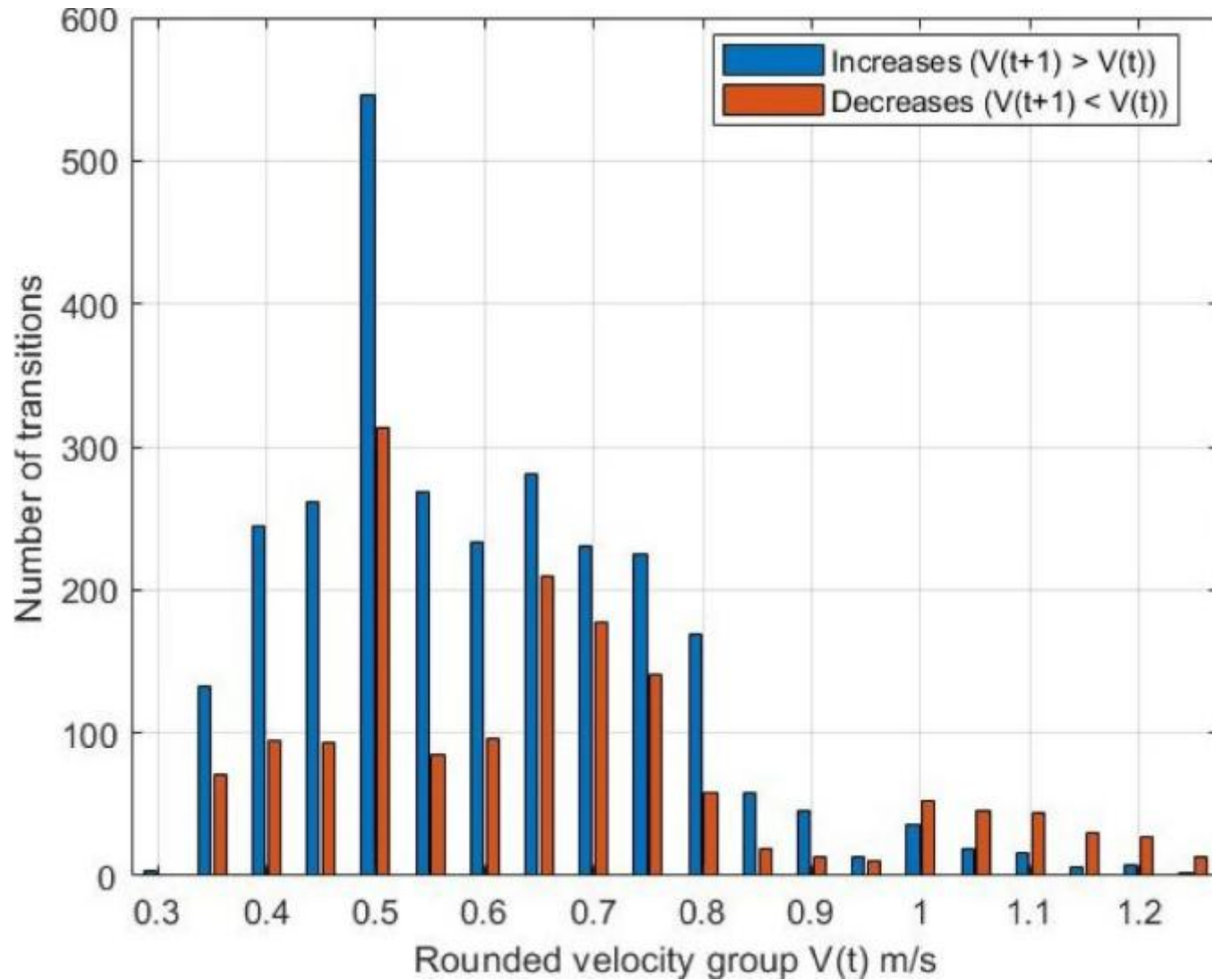


2. Given rule 1, but with probability **(1 - p1)**, the fish will instead choose a **“correlated random walk”**. The influence of randomness increases as the **flow velocity decreases**.

3. If the fish encounters a flow velocity that **is lower than the minimum attraction velocity**, the fish uses a **pure “random walk”** with probability **p2**. This aims to mimic **search behavior** to relocate areas with **higher flow velocity** in order to continue moving **upstream**.



4. Given rule 3, but with probability **(1 - p2)**, the fish will **continue in the same direction as in the previous step**



Maximum velocity may be needed as well

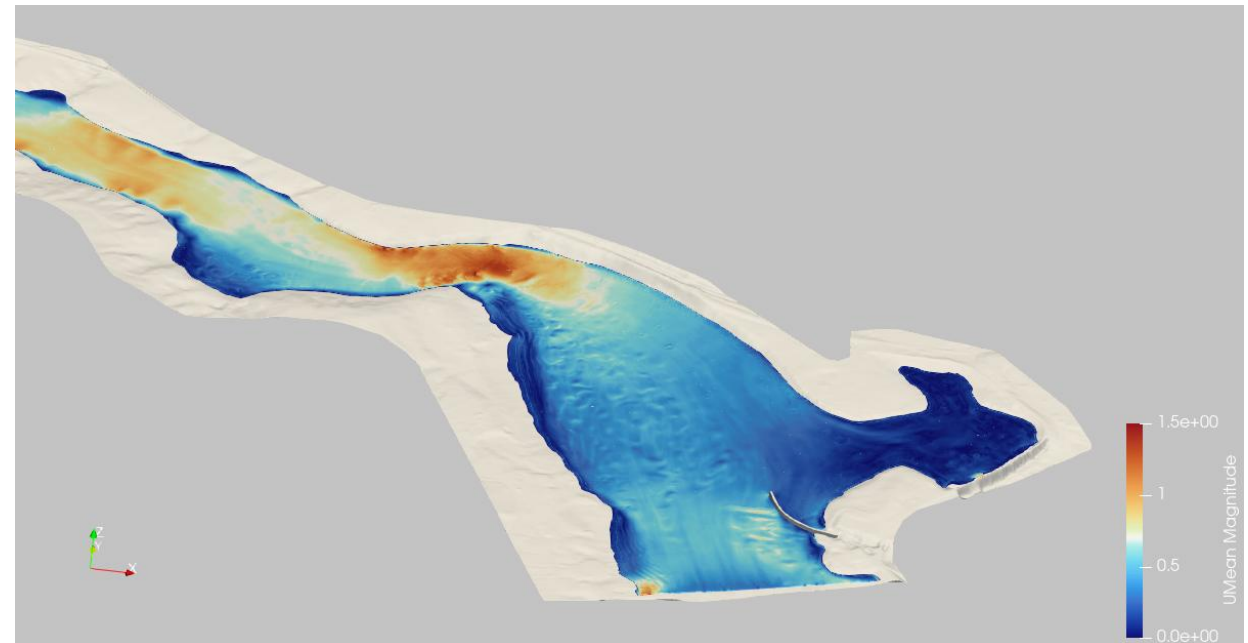
Coupling of CFD and Telemetry to Characterize Velocity-Based Behavioral Rules for Downstream-Migrating Salmon Smolt in a Large River Reach

[M. Lovisa Sjöstedt^{1,†}](#), [Johan Leander^{2,†}](#), [Anders G. Andersson^{1,†}](#) and [J. Gunnar I. Hellström^{1,†}](#)

Current status and what's to come

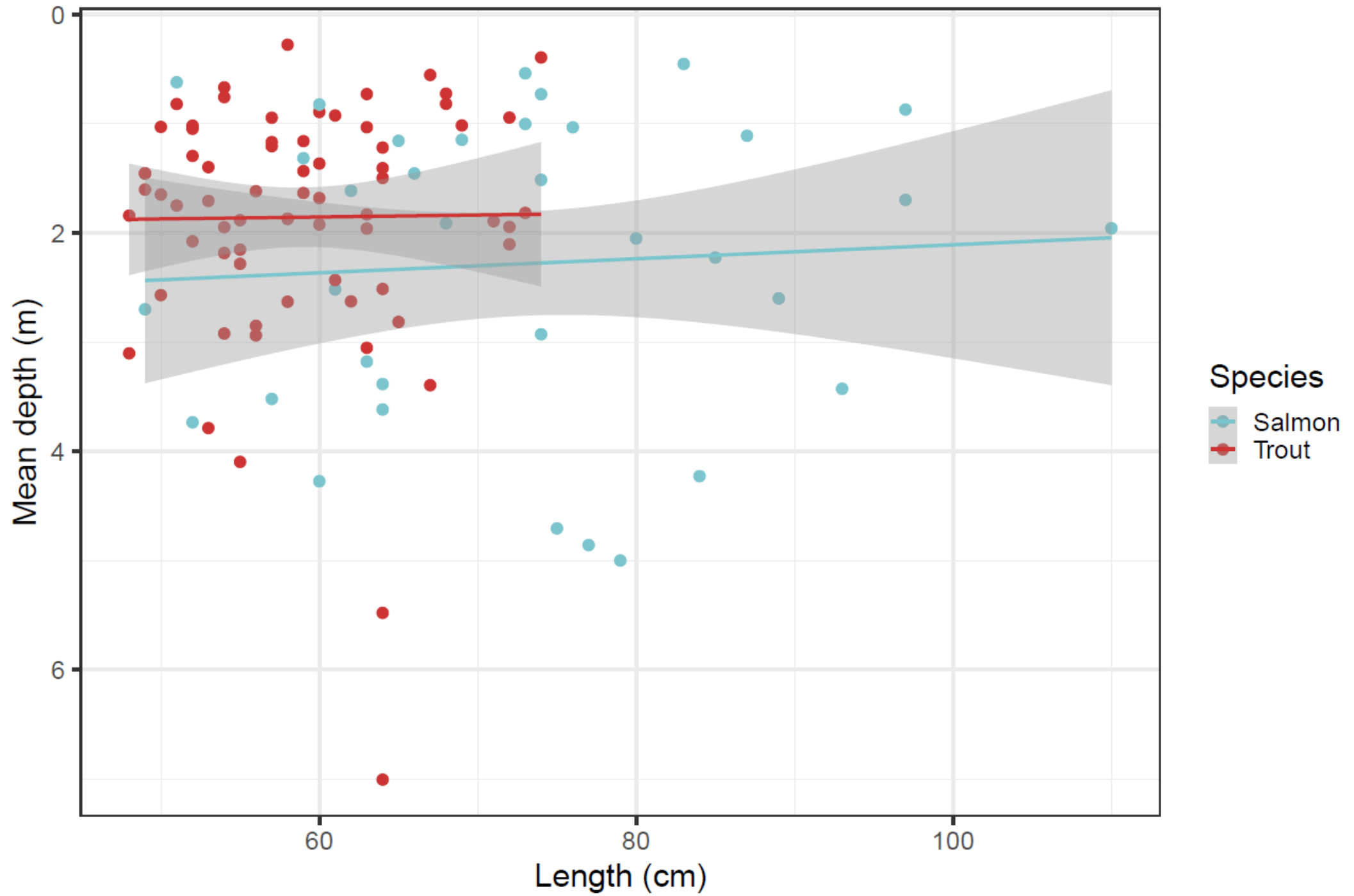
Master student, Aliko Fornier, analysing probability of spill gate passage and survival via different routes

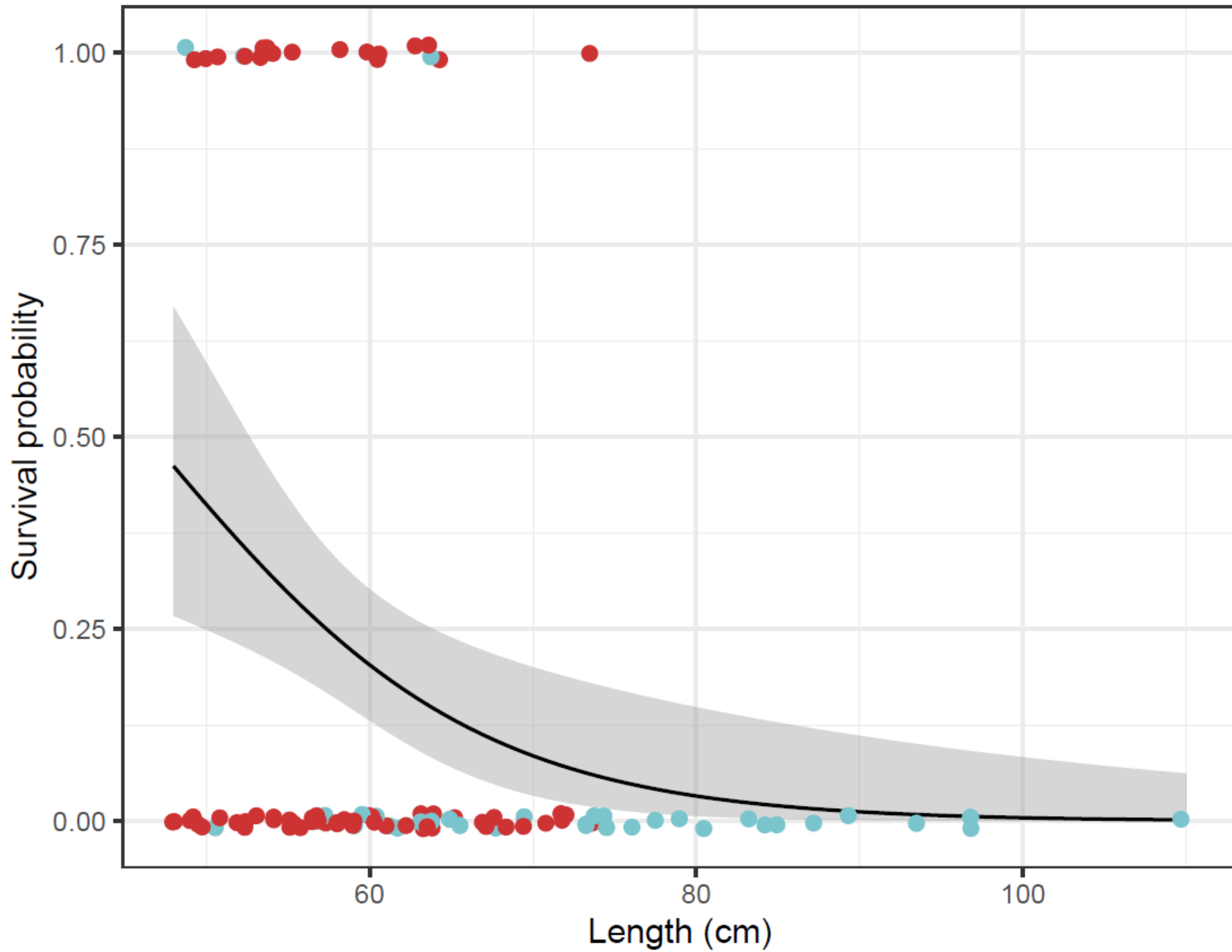
Recently completed the CFD-modelling for the first flow scenario, three more to come (Mikaela Larsson, Vattenfall R&D)



Thank you for your attention







Species

- Salmon
- Trout

Average survival

Salmon: 0.133
Trout: 0.337
Total: 0.266