Environmental and biological factors influencing residence duration of wild sub-yearling Chinook salmon in a fjord estuary of the Salish Sea using micro-acoustic transmitters

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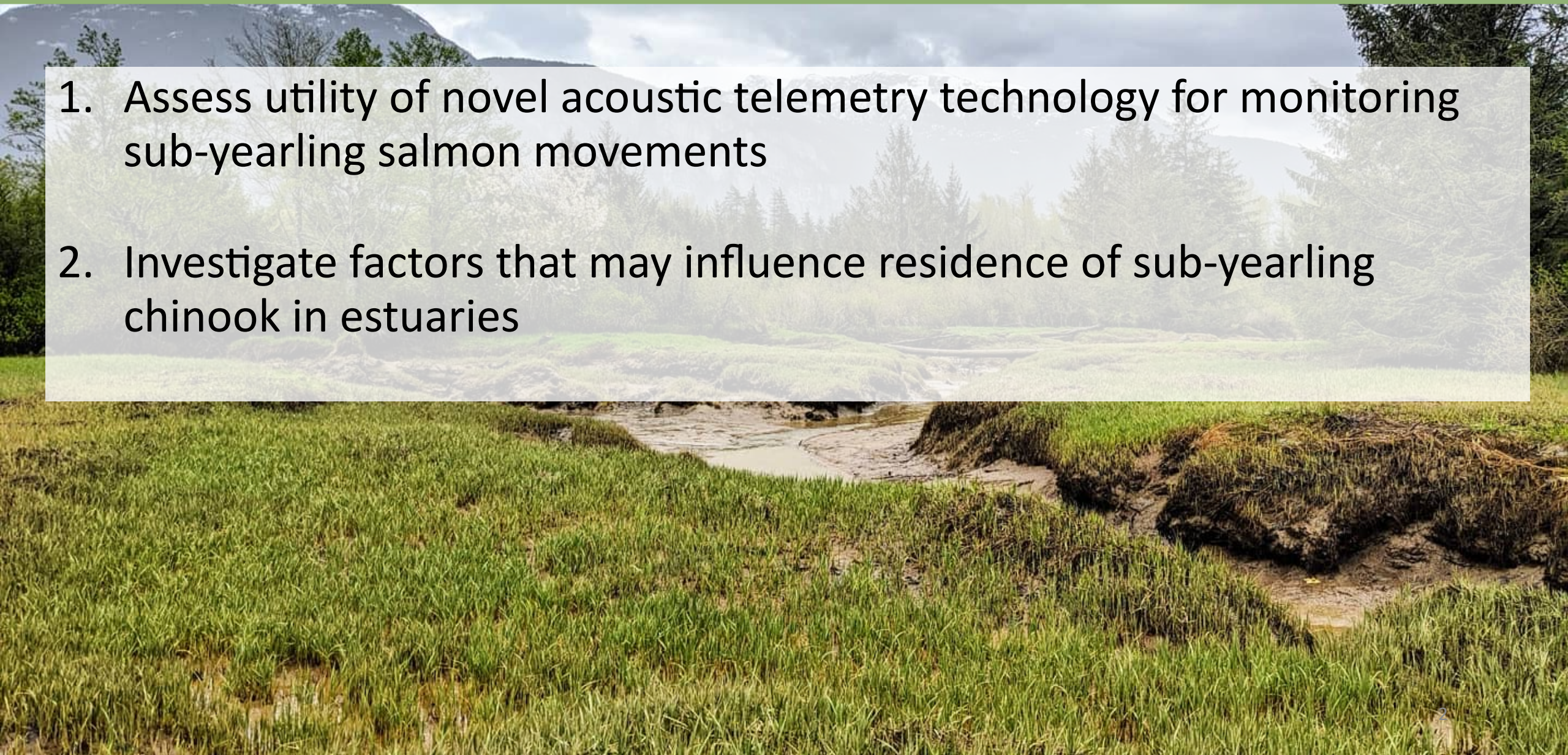
Study Objectives



1. Assess utility of novel acoustic telemetry technology for monitoring sub-yearling salmon movements

2. Investigate factors that may influence residence of sub-yearling chinook in estuaries

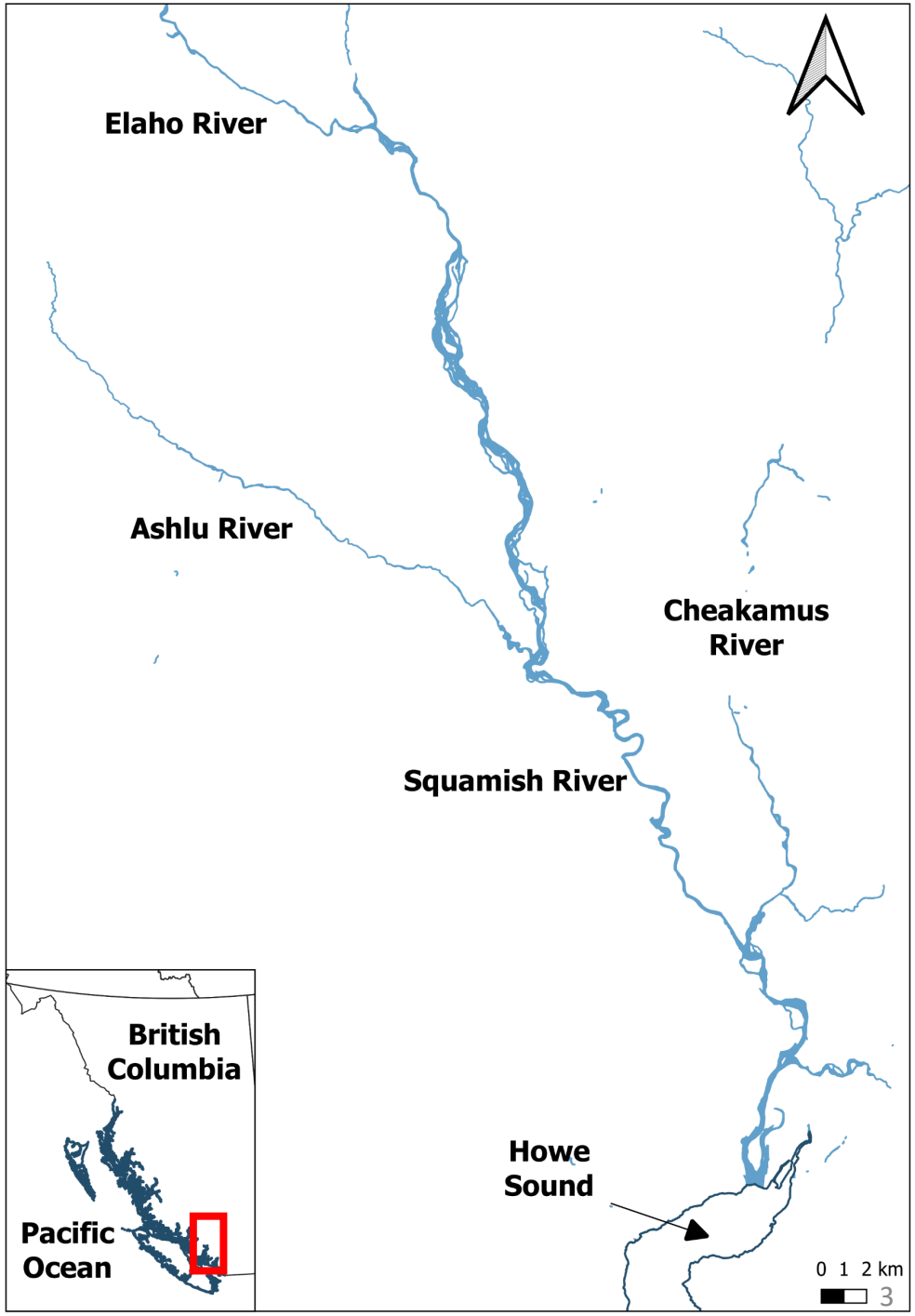
Study System

Squamish River:

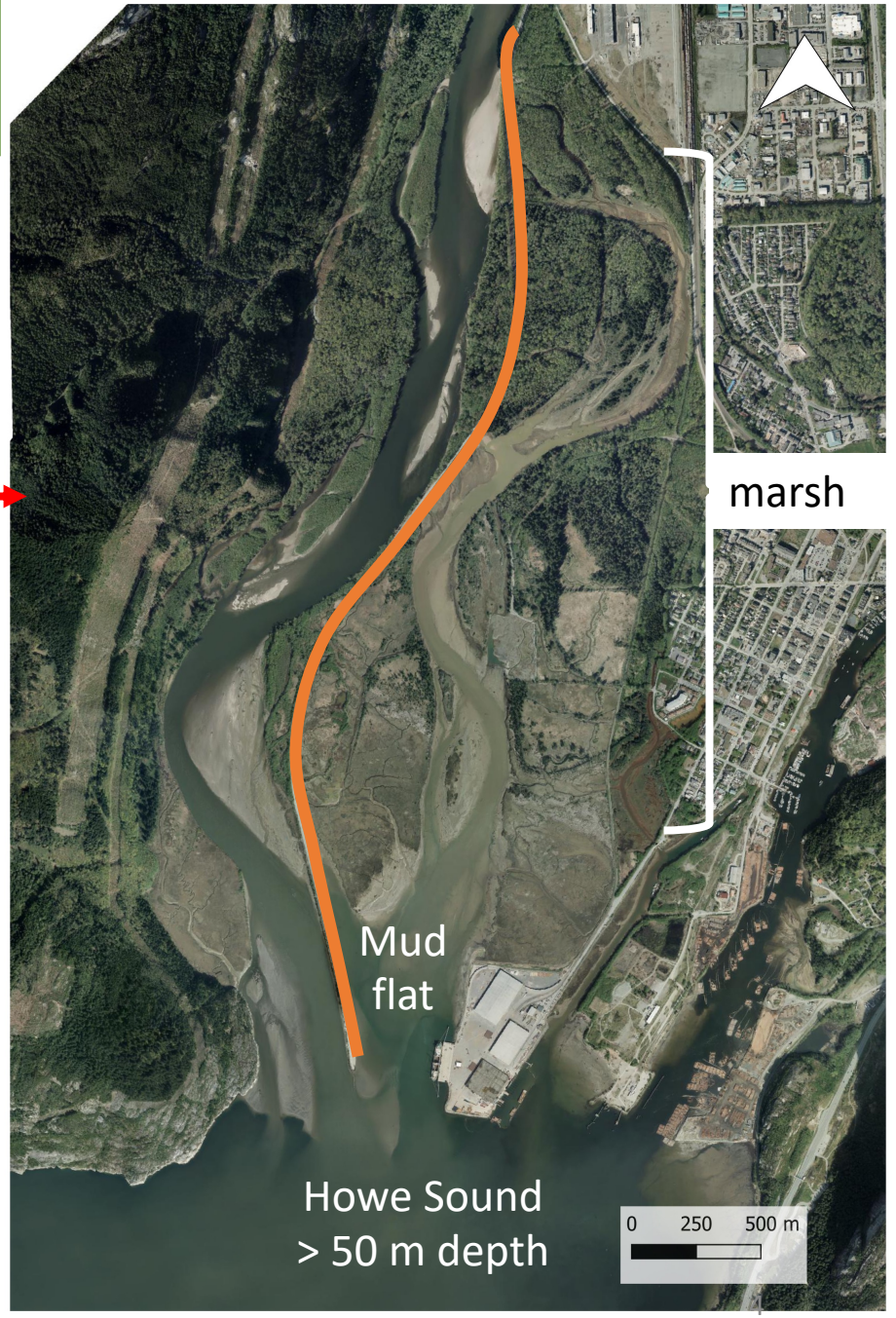
- Coastal watershed (3,600 km^2)
- Mean discharge: 300 m^3s^{-1}

Chinook Salmon Populations:

- Summer – native
  - Spawn: Aug- early Sept
  - Migrate as sub-yearlings and yearlings
- Fall – different stock
  - Spawn: mid-Sept – early Nov
  - Migrate as sub-yearlings



Squamish River Estuary

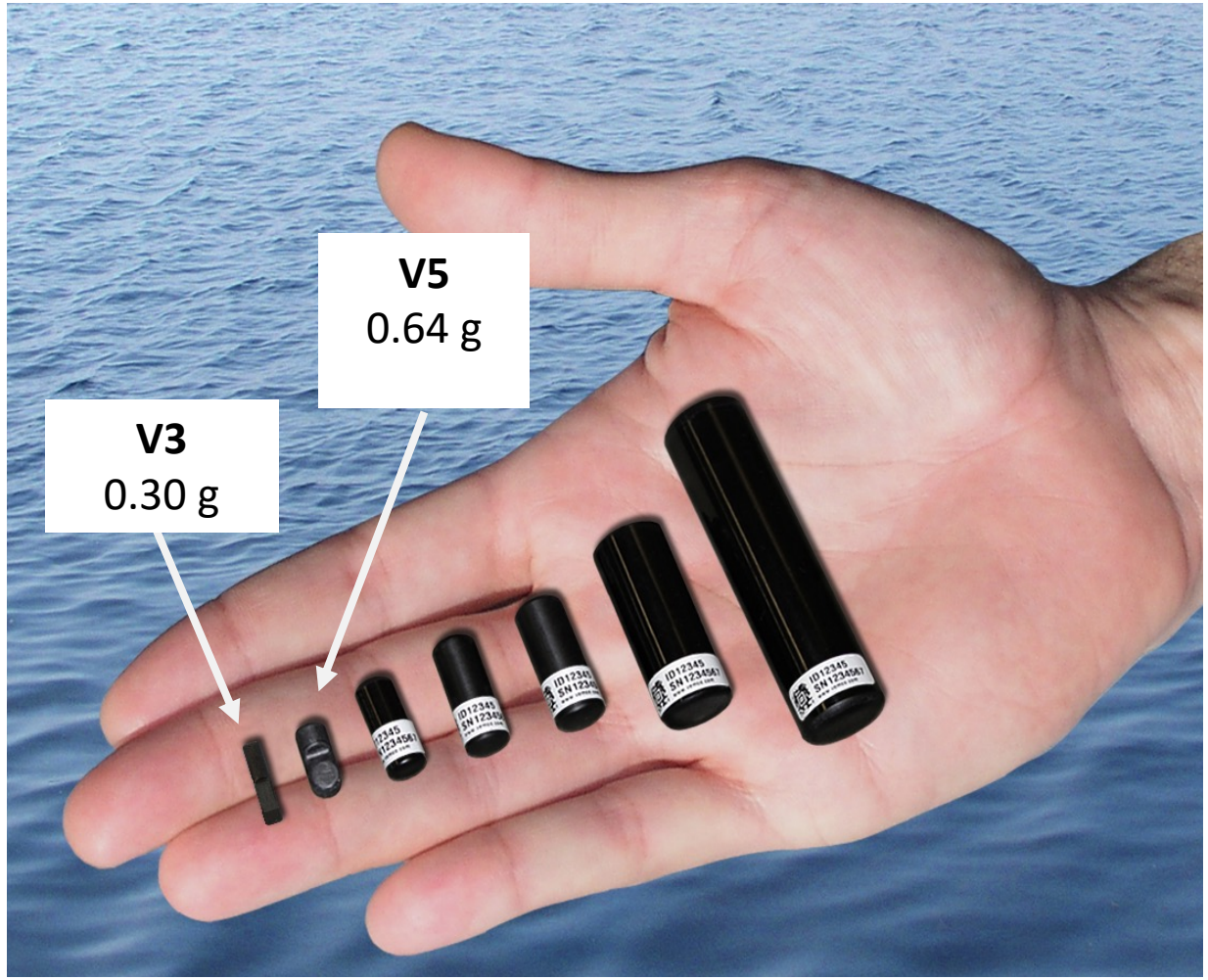


- Howe Sound is a fjord estuary

Innovasea 307 Hz Acoustic Telemetry System

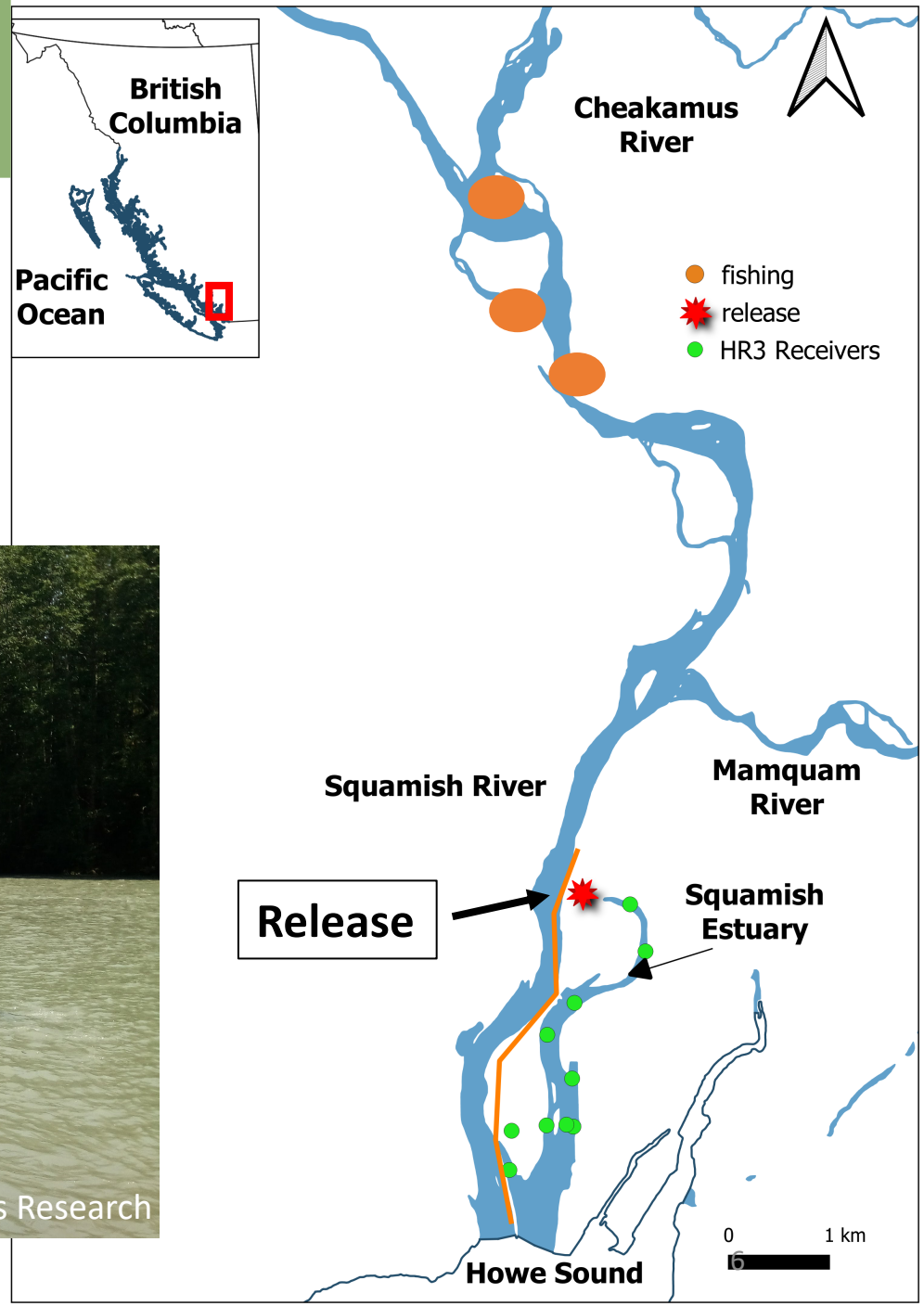
V3 - 307 Hz acoustic transmitter and HR3 receivers

- Transmitter < 50% weight of V5 but similar dimensions
- 100 - day tag life with 3 - 5s transmission rate
- Up to 100 m of range (depending on tide)



Field Method:

- Wild fish captured in river via beach seine
- River side surgical application of tags
- Fork length 67 to 95 mm (mean=77.8; SD= 6.7)



Holding Study

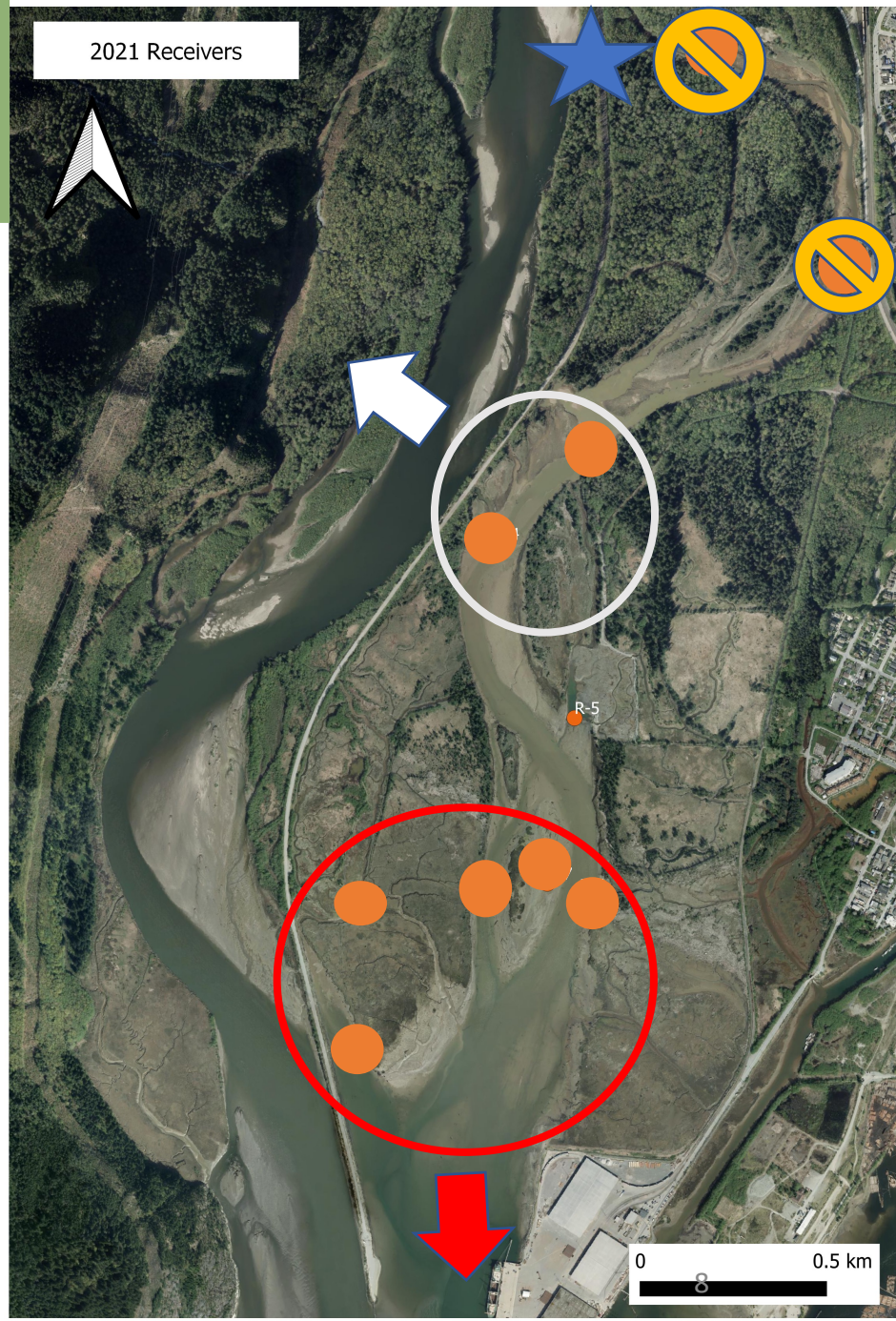
Objective: examine effects of tagging on short term survival

- Dummy tagged (*n*=10) and control (*n*=10)
- Fish held in river for 7 days
- Mortality: 10% (*n*=1) dummy tagged fish died in the first 24 hours

Defining Residency

Fish released in the estuary (*n*=49)

- South receivers last: successful (59%)
- Central receivers last: successful (14%)
- North receivers last: unsuccessful (27%)
- 36 inferred to be successful (73%)



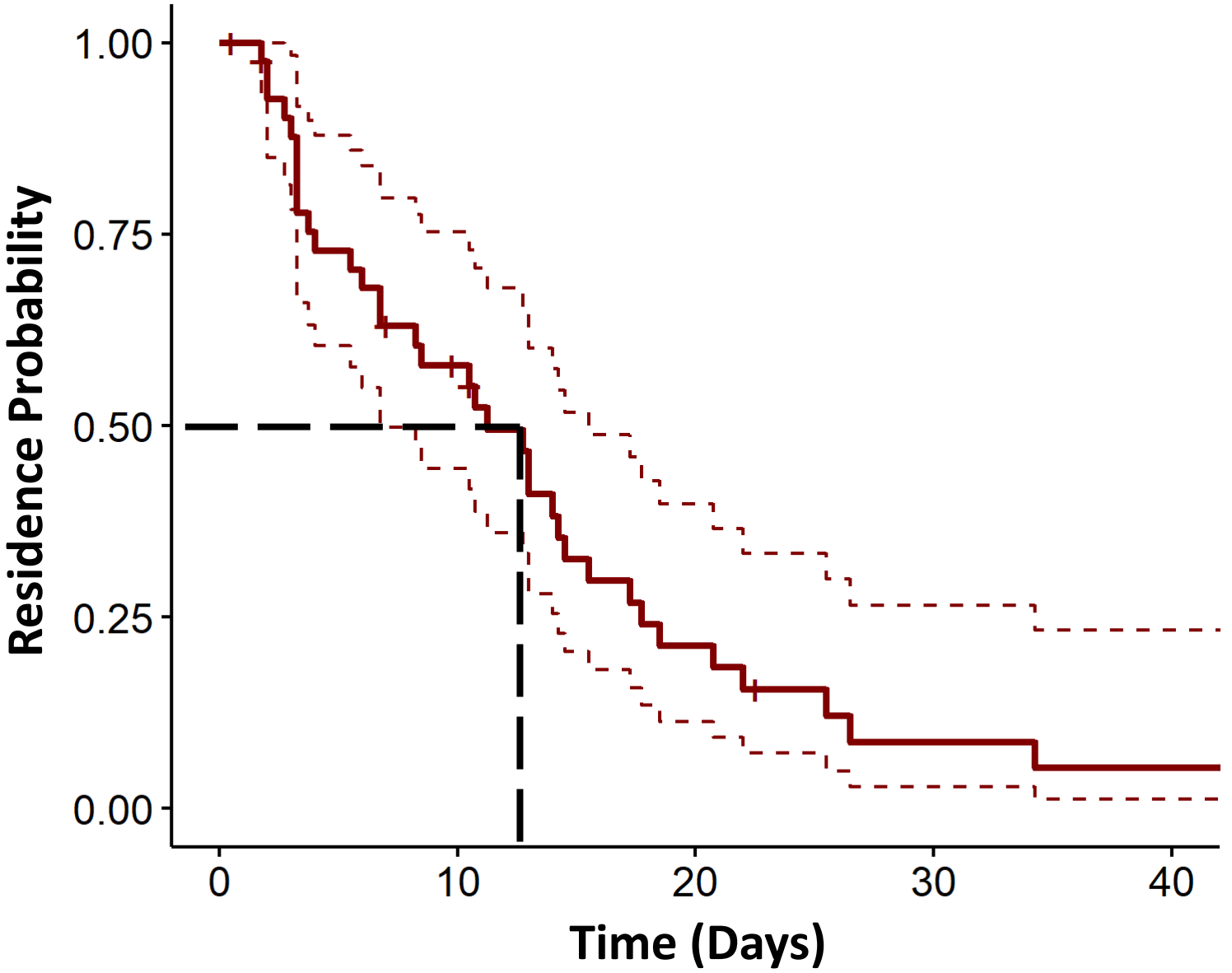
Residency Duration

Non-Parametric Survival Analysis (Cox Regression)

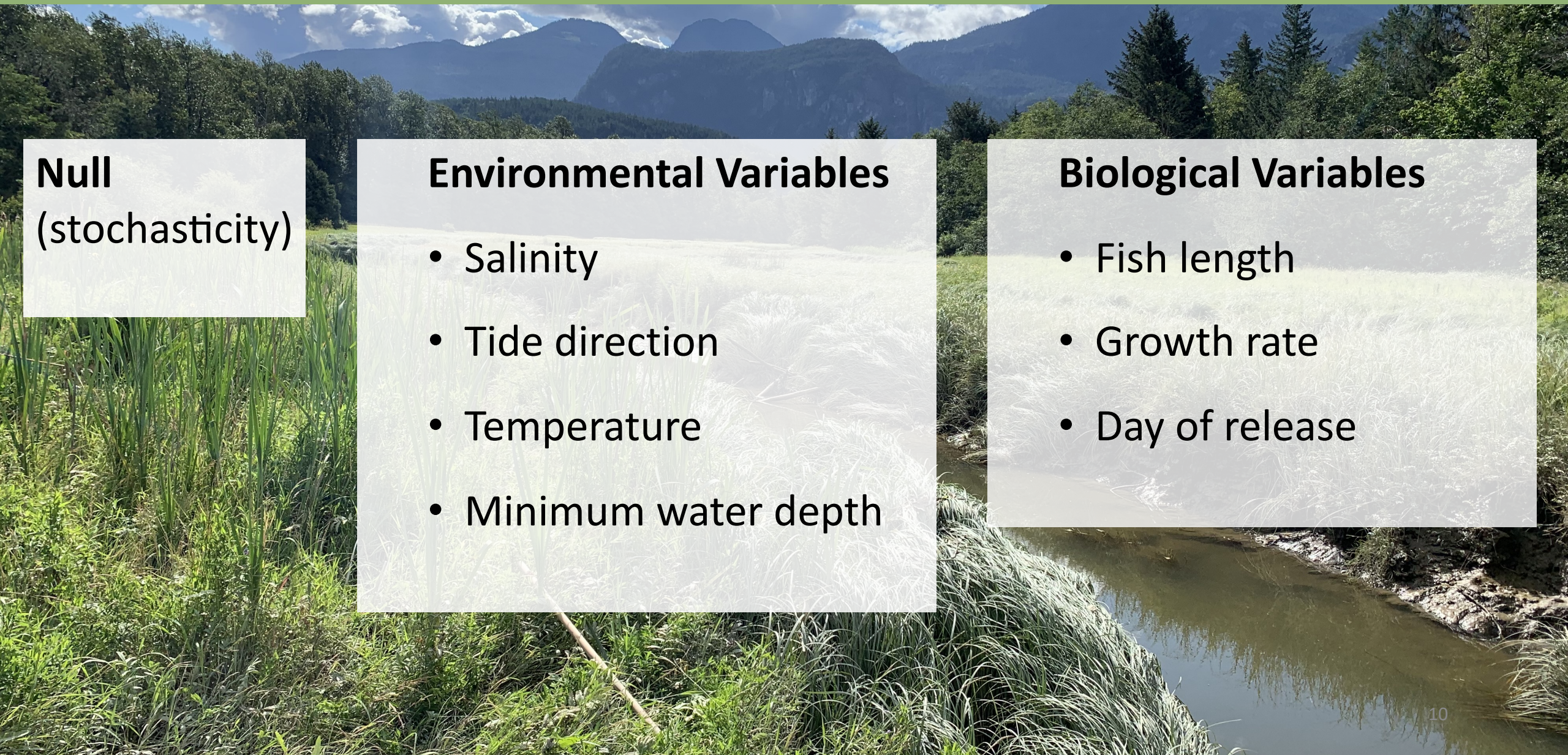
- **Median residence time:**
  - 11.2 days

  (95% CI: 6.8 - 15.5)

- **Residence duration range**
  - 12 hours to 43 days



Influence of Factors on Residence



Null
(stochasticity)

Environmental Variables

- Salinity
- Tide direction
- Temperature
- Minimum water depth

Biological Variables

- Fish length
- Growth rate
- Day of release

Influence of Factors on Residence

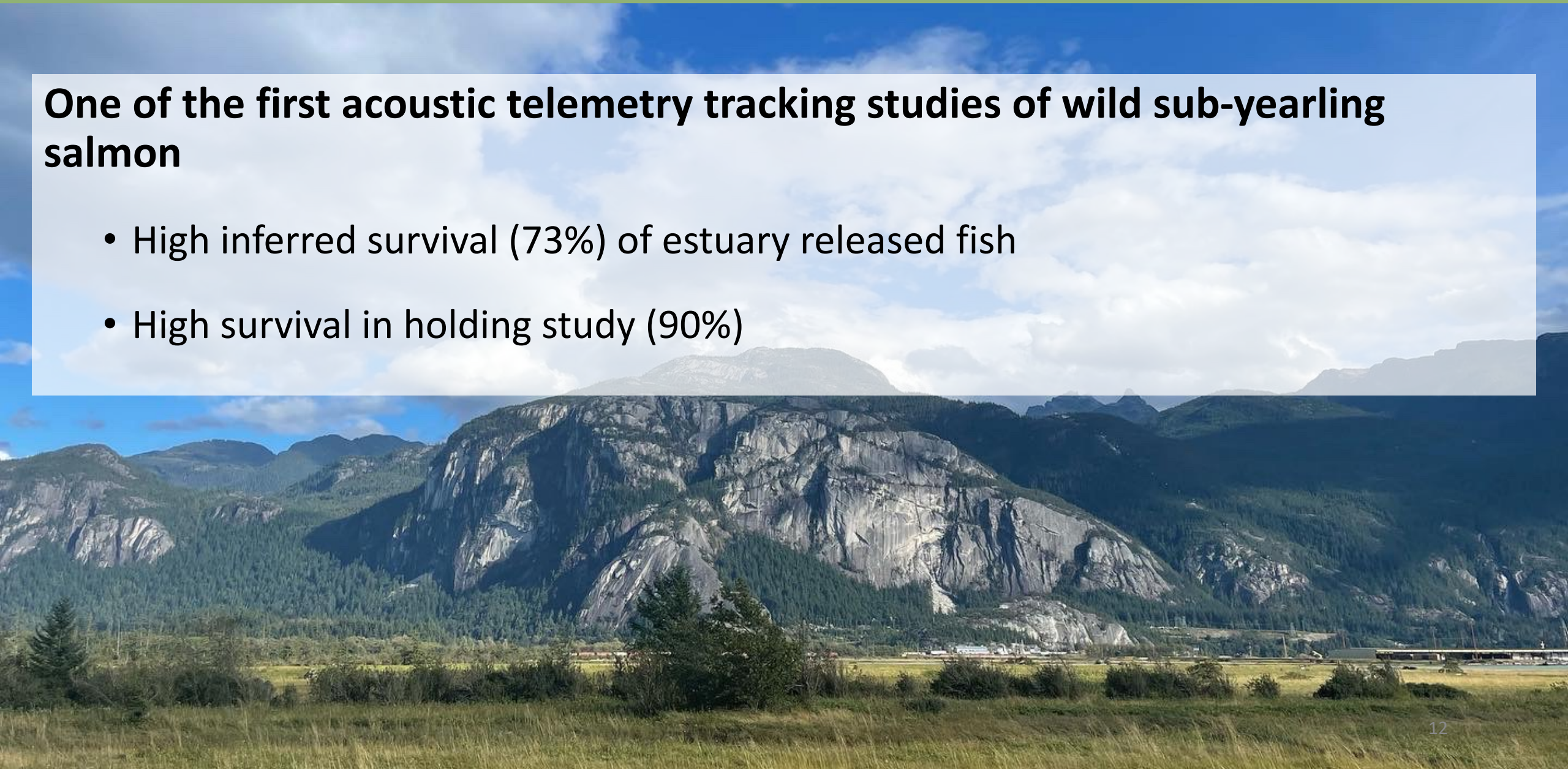
Model with Tide Direction fit data best

- No others with in with ΔAIC < 7

Hazard Ratio (similar to odds ratio):

- Fish were 79% more likely to leave the estuary on an ebb tide
- Only in first 3.5 days

Key Points



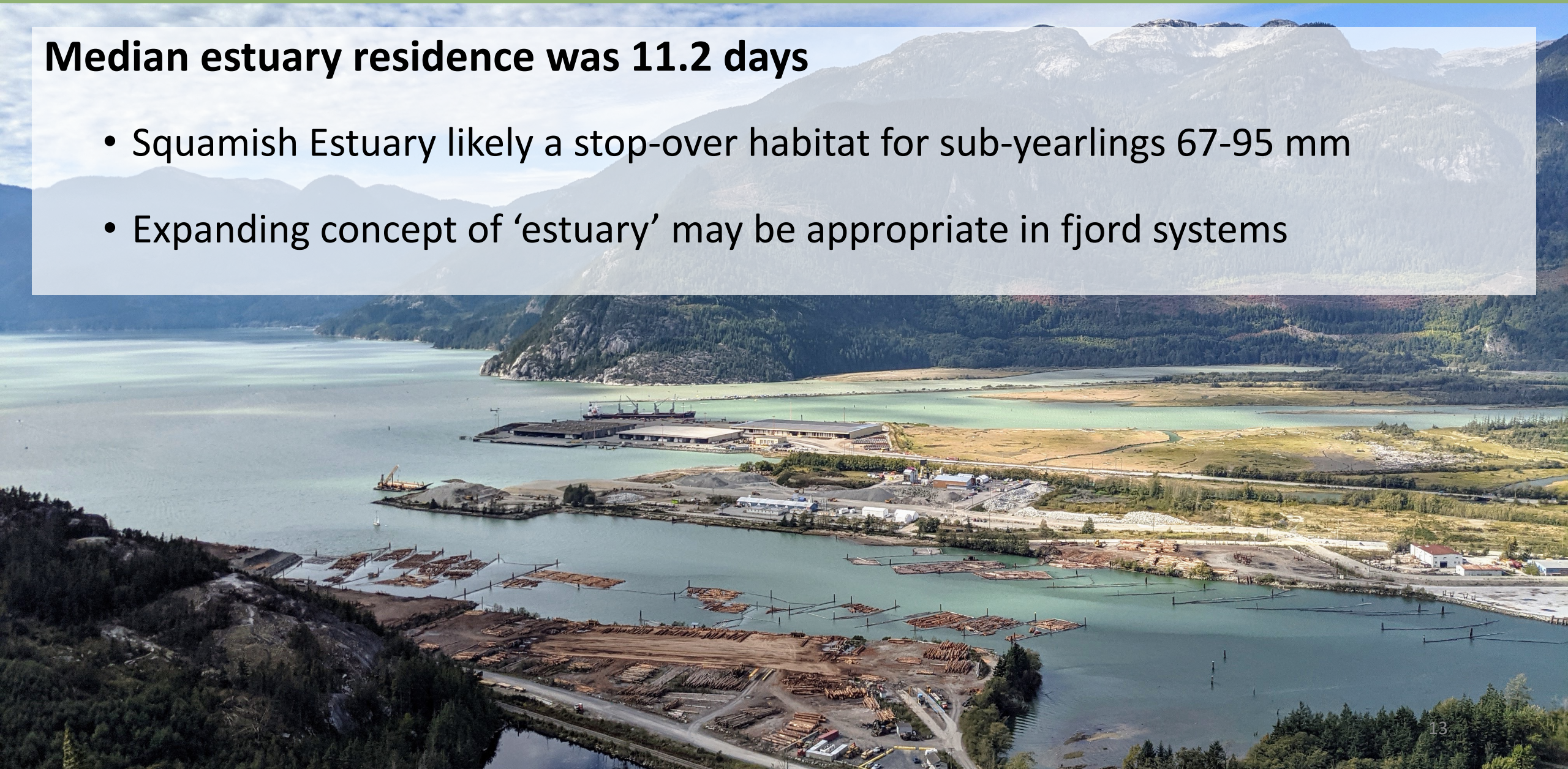
One of the first acoustic telemetry tracking studies of wild sub-yearling salmon

- High inferred survival (73%) of estuary released fish
- High survival in holding study (90%)

Key Points

Median estuary residence was 11.2 days

- Squamish Estuary likely a stop-over habitat for sub-yearlings 67-95 mm
- Expanding concept of ‘estuary’ may be appropriate in fjord systems



Key Points

Tide (current) direction in the first few days of residence influences habitat use

- Highlights importance of habitat connectivity and operation of flood protection structures in estuaries

Thank you!

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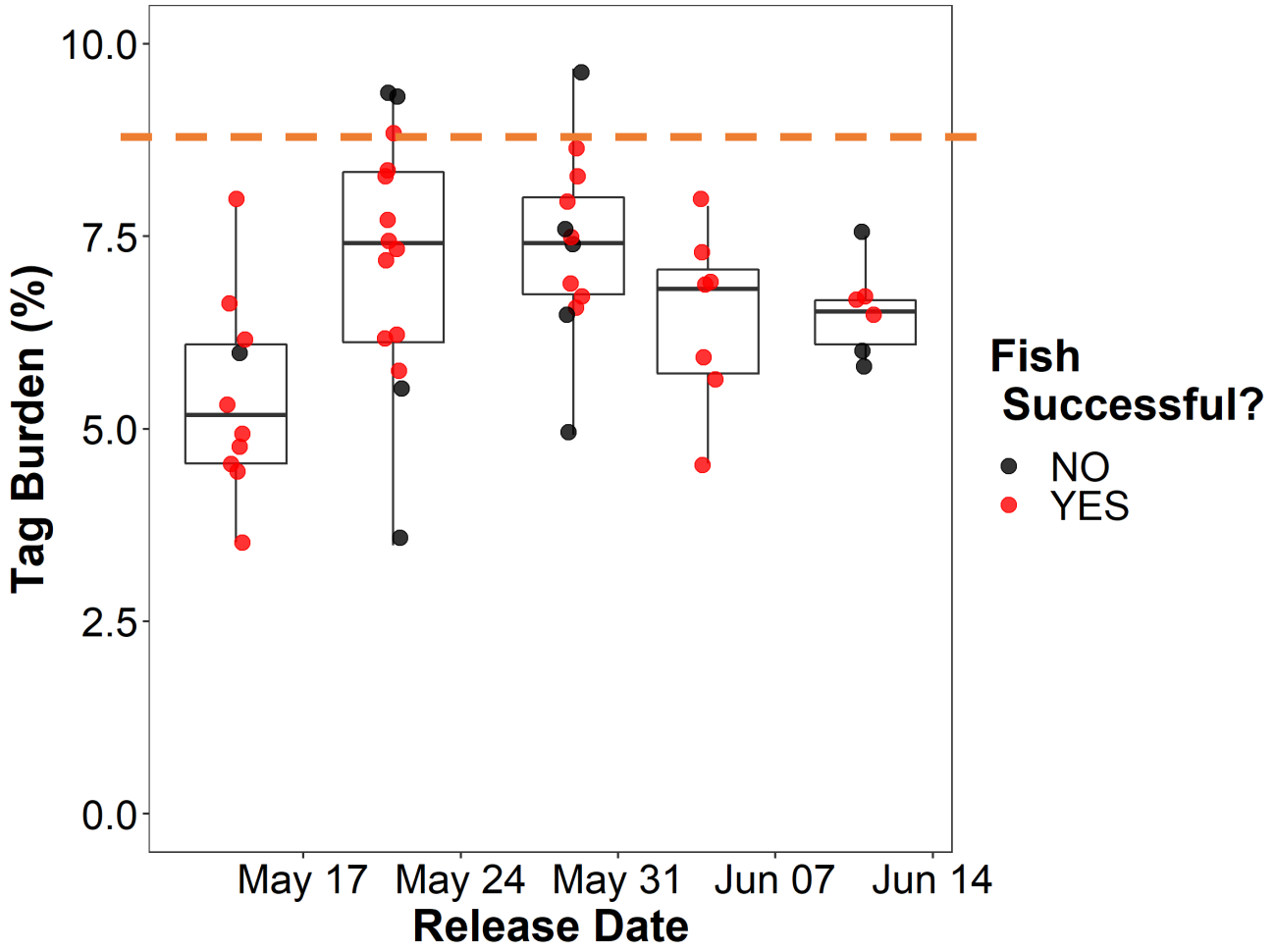
Extra Slides

Tag Burden


10.0
7.5
5.0
2.5
0.0
Tag Burden (%)
May 17
May 24
May 31
Jun 07
Jun 14
Release Date
Fish Successful?
NO
YES