Quantifying the fine-scale behaviour of spawning run river lamprey (Lampetra fluviatilis) approaching a low-head weir retrofitted with studded tiles

AMBER

UNIVERSITY OF Southampton

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Quantifying the fine-scale behaviour of spawning run river lamprey (*Lampetra fluviatilis*) approaching a low-head weir

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ICER

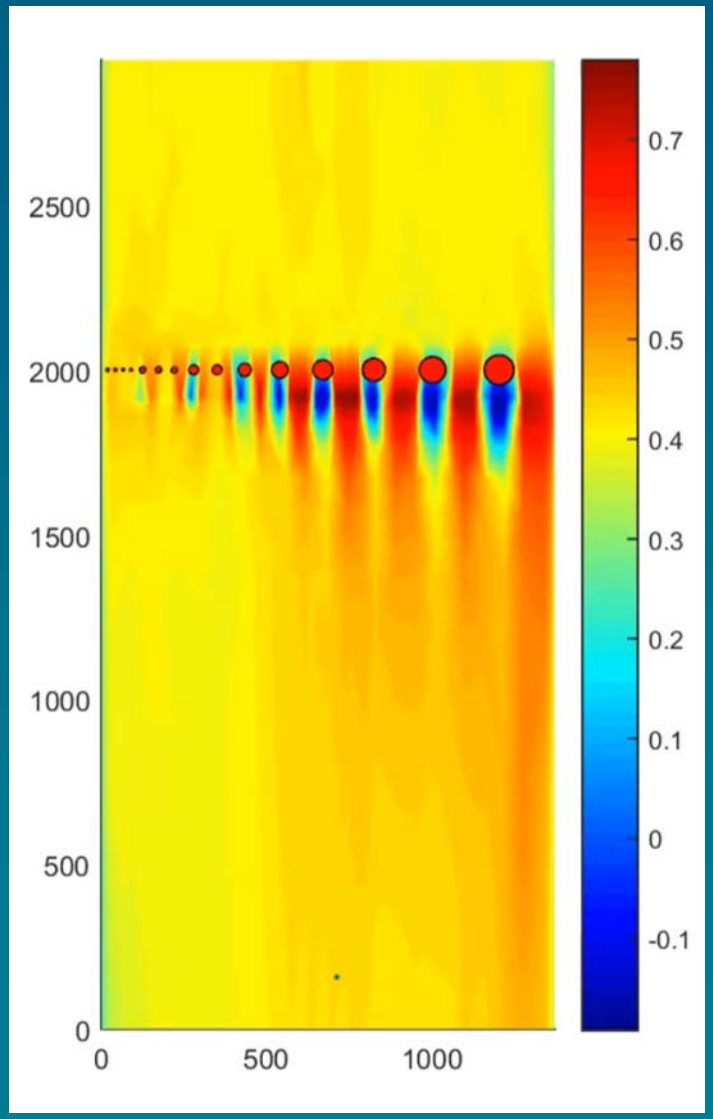
International Centre for Ecohydraulics Research

Aims and objectives

- Aim: Create a model to predict the upstream movement of river lamprey (*Lampetra fluviatilis*) as they approach a riverine barrier

- Objectives:
  - Quantify lamprey upstream movement parameters (e.g. speed/tortuosity)
  - Link movement to environmental factors (e.g. depth/velocity)
  - Develop behavioural rules
  - Integrate behavioural rules into an ABM

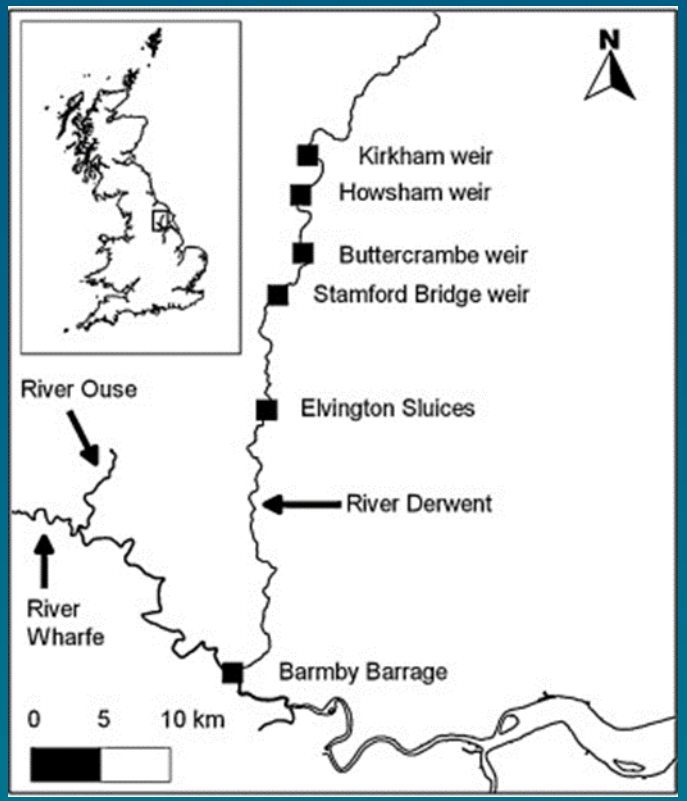
Upstream migrating river lamprey movement model



- 2D Model includes:
  - Advection
  - Swimming
  - Reflection
  - Tortuosity/persistence
- Aim to incorporate:
  - Behavioural preferences to certain hydrodynamic conditions
  - Rules learnt from telemetry study

Quantifying movement parameters:

- Field work site:
  - River Derwent, Yorkshire, UK
    - SAC
    - Multiple anthropogenic barriers
  - Buttercrambe weir
    - Gauging weir (1973)
    - Ineffective fish passage options (2013)
    - Microhydropower (2017)



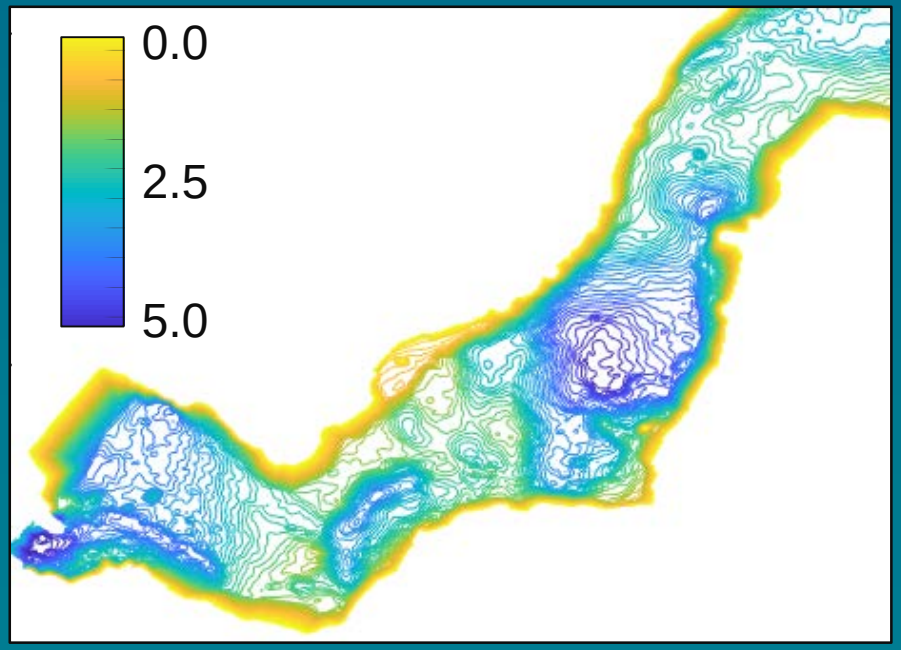
Monitoring equipment downstream of the weir

✦ Acoustic hydrophone ★ PIT Antenna

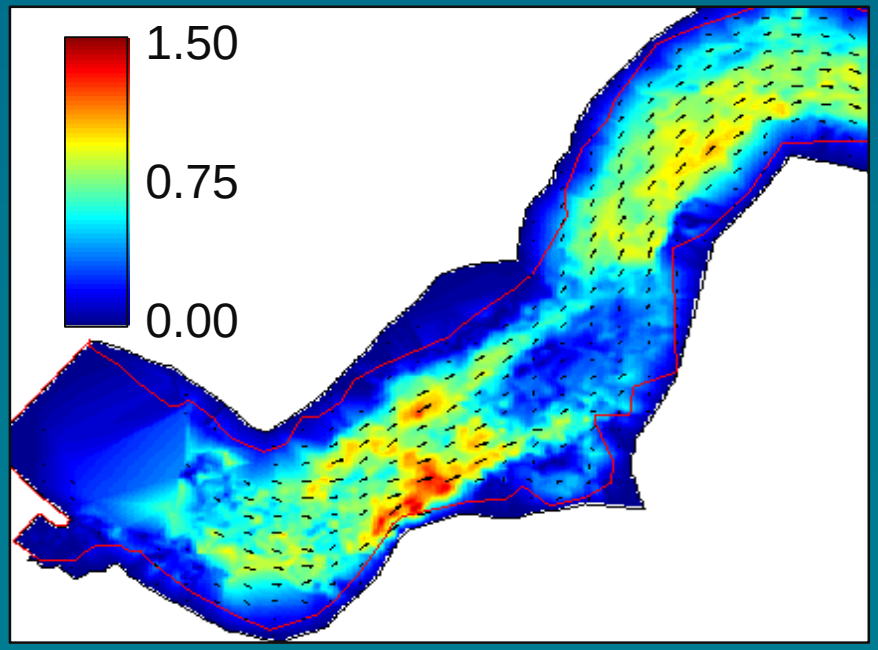
Bathymetry and hydraulics:

- ArcBoat
- GPS
- ADCP

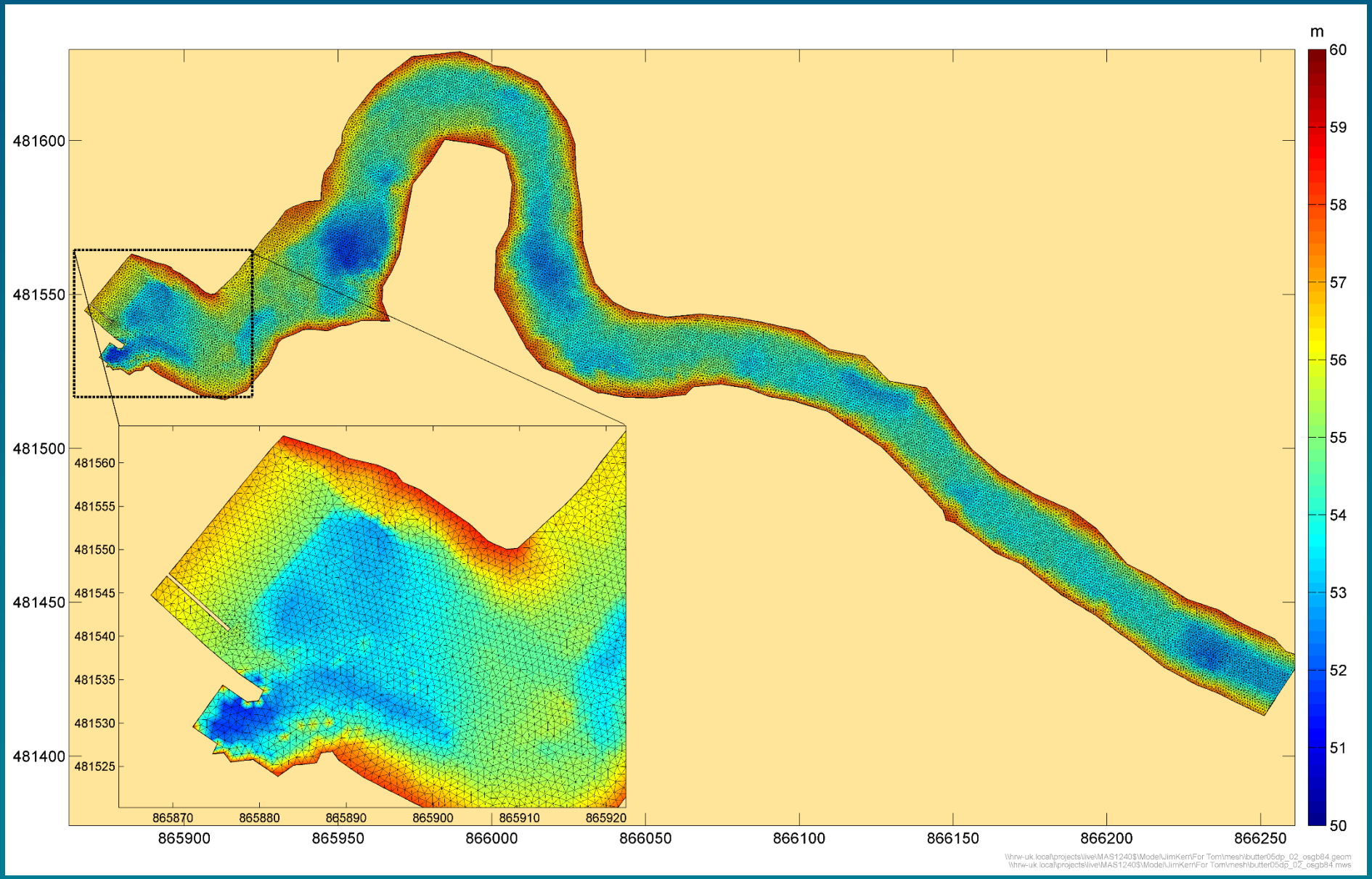
Depth (m)



Depth averaged velocity (m s^{-1})



Hydraulic model mesh:

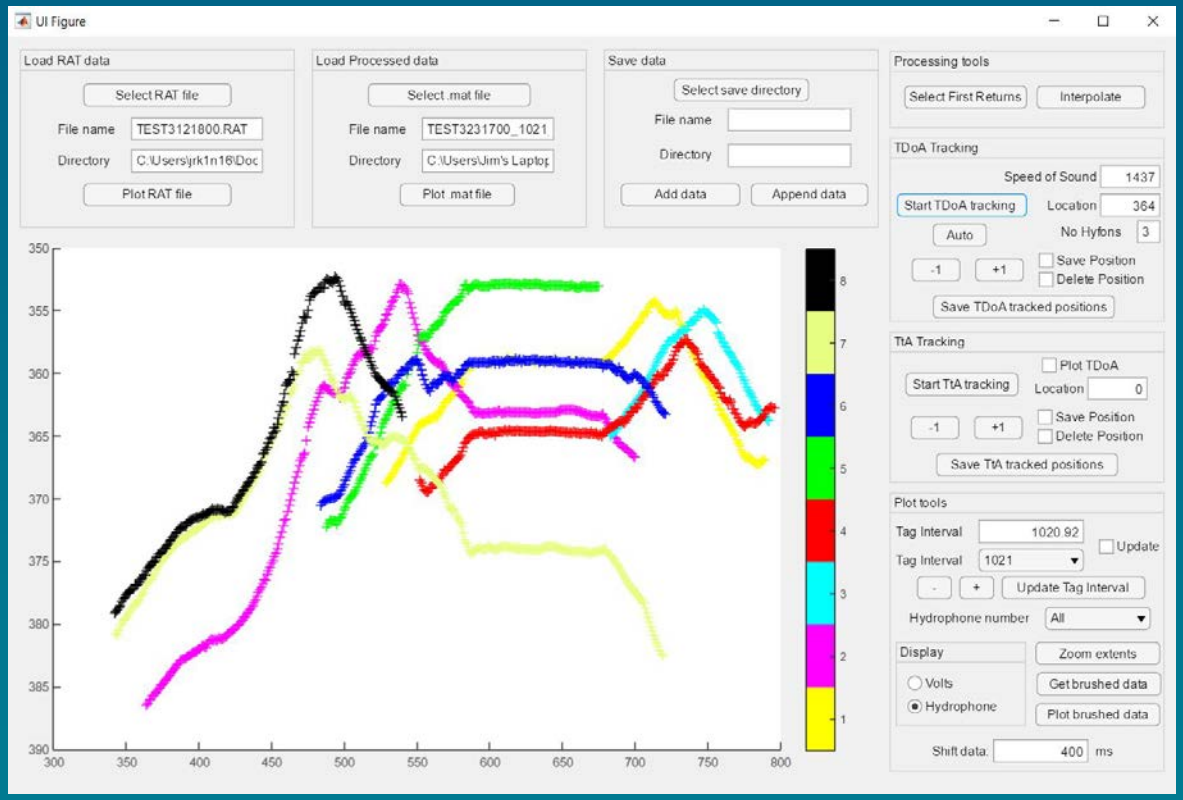


- 395 lamprey captured and released over 10 release events November/December 2017.
  - All lamprey PIT tagged
  - 34 lamprey double tagged with acoustic and PIT tags

Acoustic 2D tracking

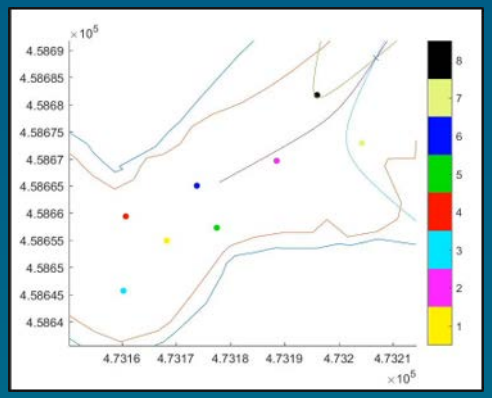
- Multiple issues with acoustic telemetry at the site
  - Air entrainment
  - Depth
  - Bed structure
  - Solid surfaces

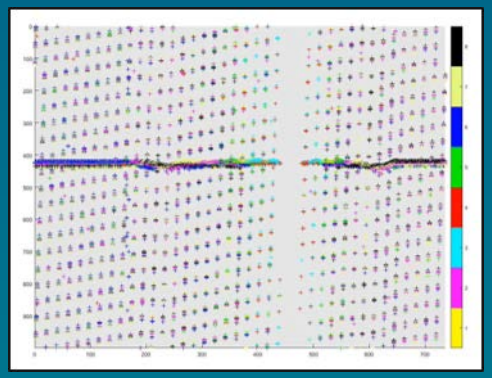
- Conventional tracking software wasn't effective:
  - Failed
  - Errors
  - No transparency

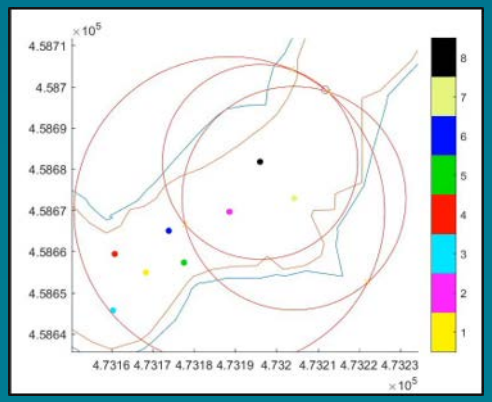


Acoustic 2D tracking

- 1) Select and clean the required data
- 2) Track fish position based on ‘time difference of arrival’ calculations
- 3) Calculate exact ping time of the tag
- 4) Track fish position based on ‘time till arrival’ calculations

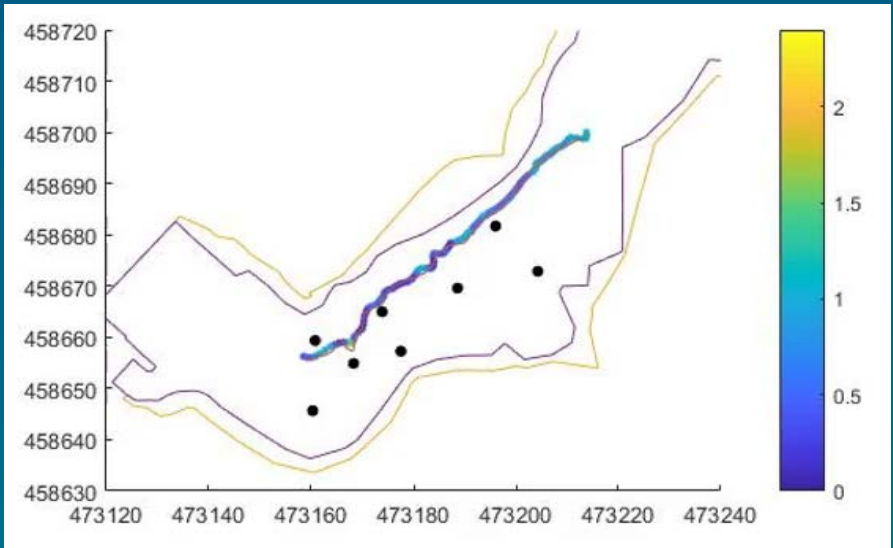




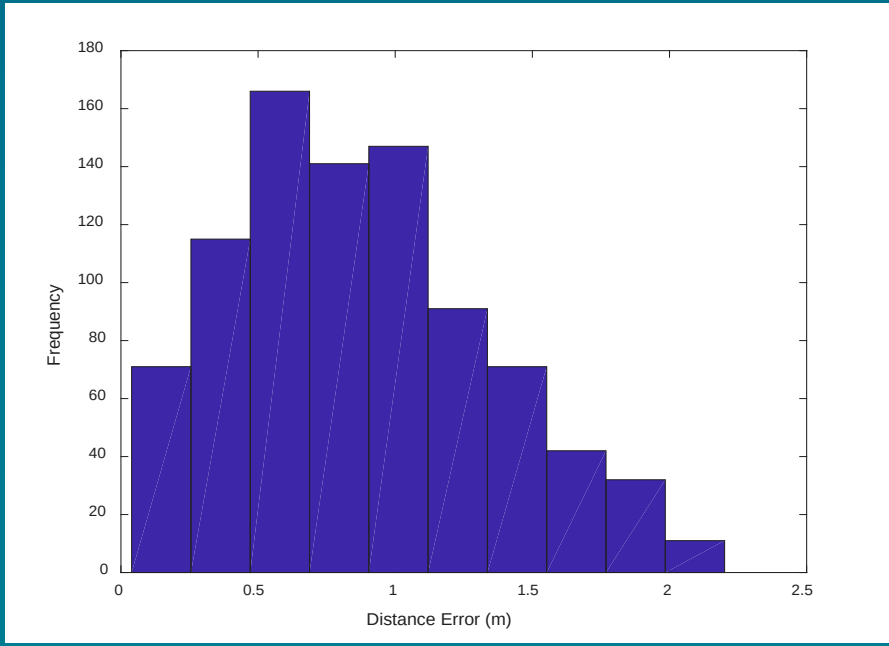


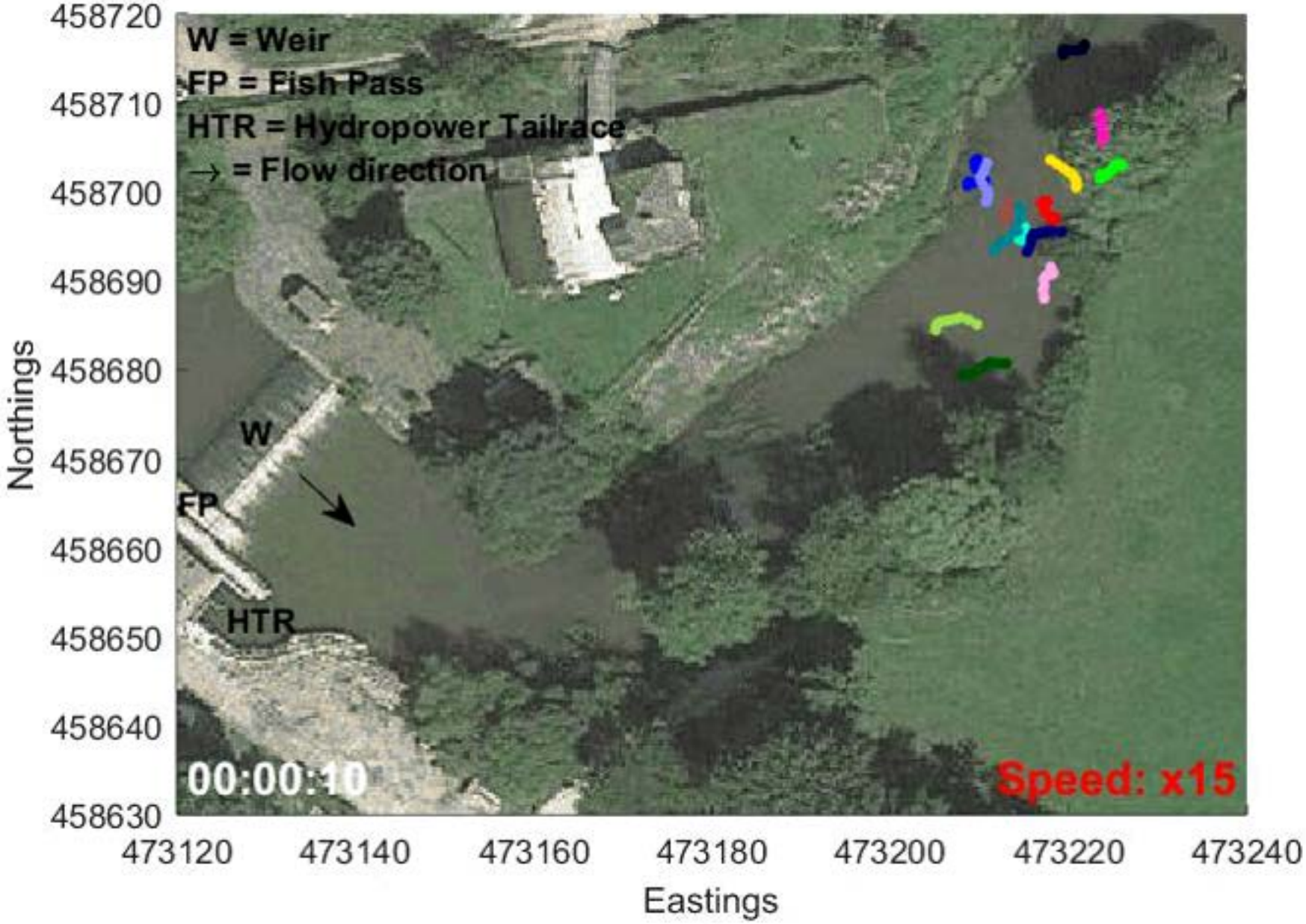
Tracking accuracy

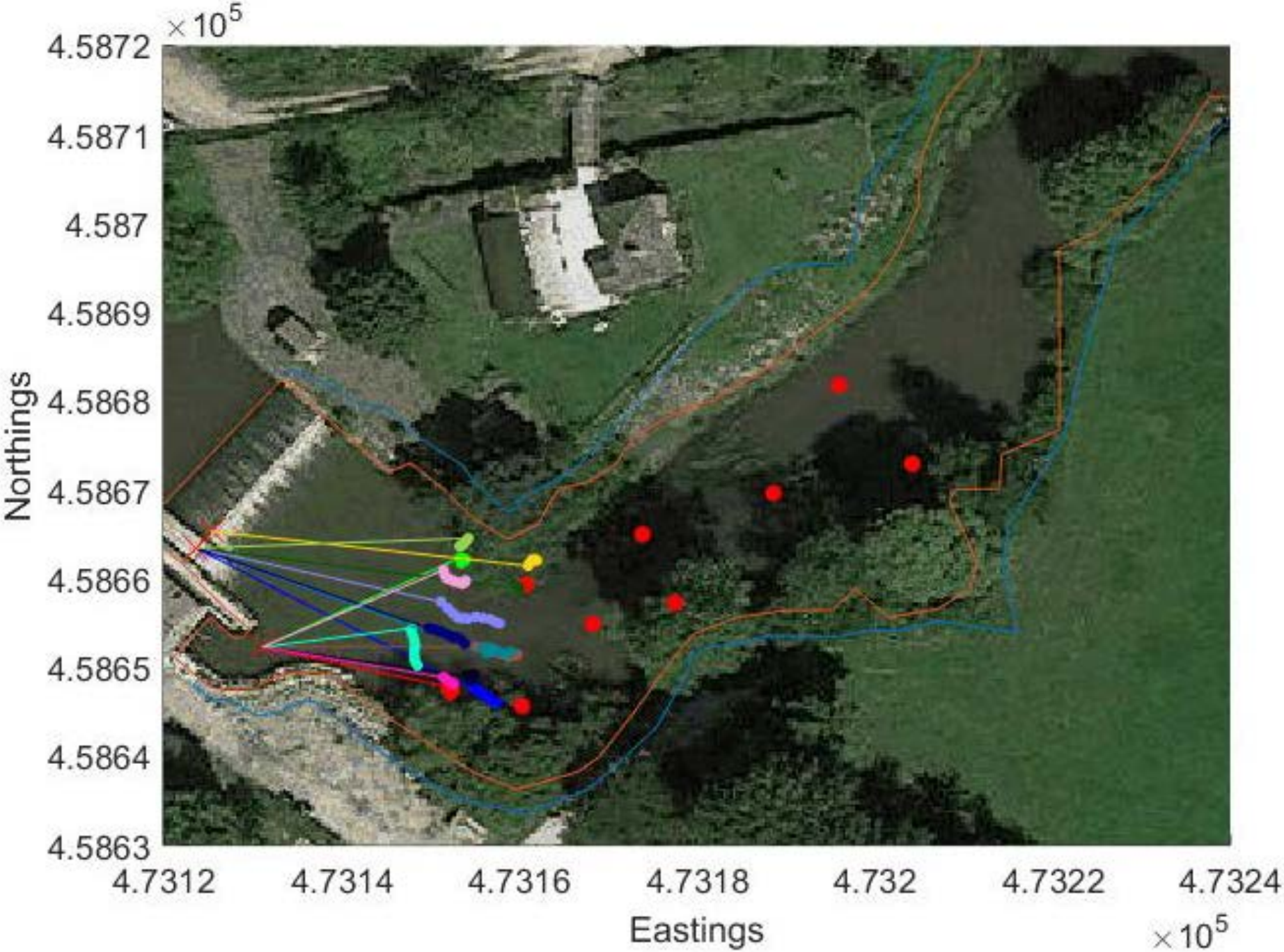
- Five ArcBoat transits through the array blind tracked.



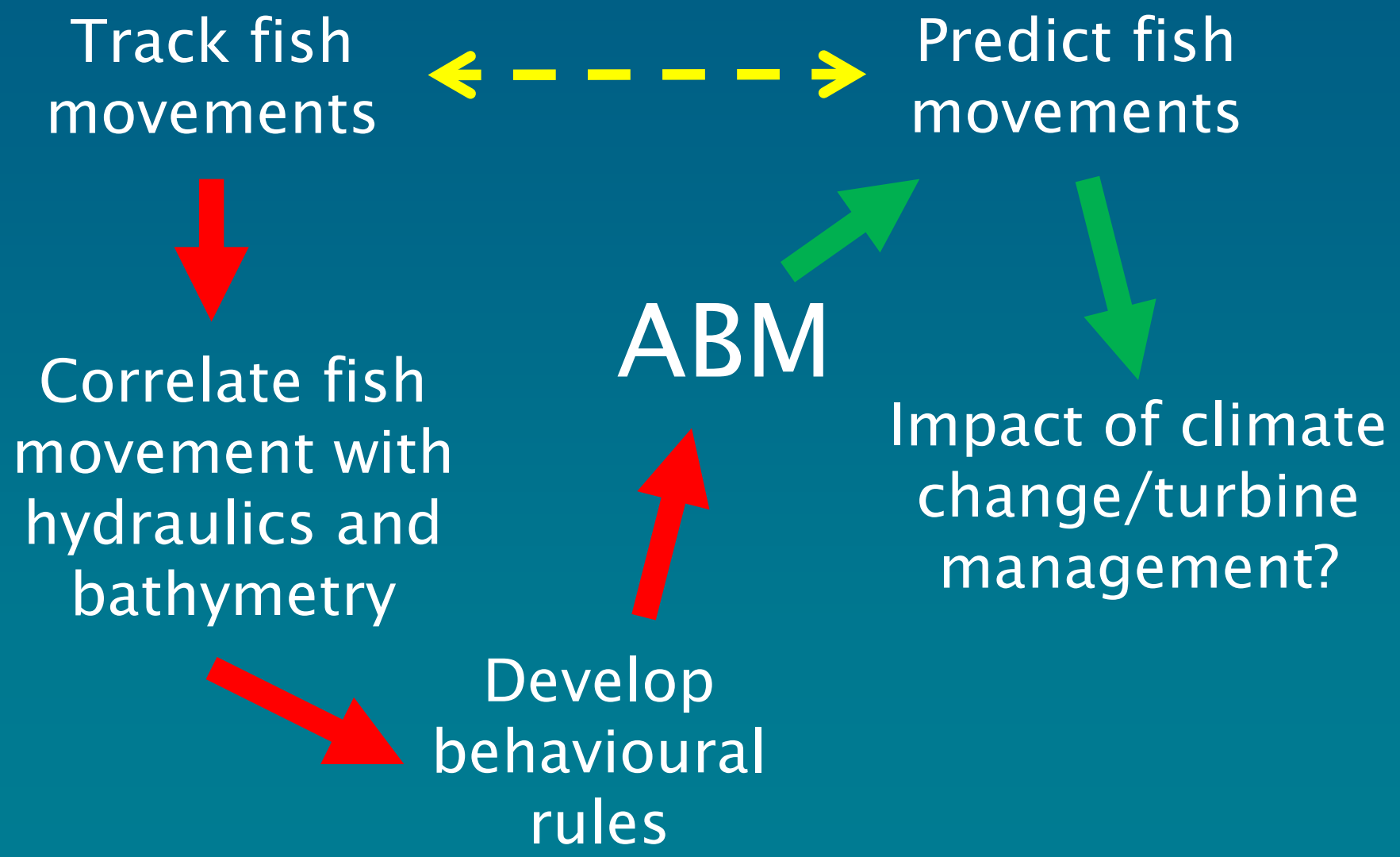
- Median error:
  - 0.83 m
- Maximum error:
  - 2.20 m




W = Weir
FP = Fish Pass
HTR = Hydropower Tailrace
→ = Flow direction
W
FP
HTR
00:00:10
Speed: x15
458720
458710
458700
458690
458680
458670
458660
458650
458640
458630
Northings
473120
473140
473160
473180
473200
473220
473240
Eastings


×10^5
4.5872
4.5871
4.587
4.5869
4.5868
4.5867
4.5866
4.5865
4.5864
4.5863
Northings
4.7312
4.7314
4.7316
4.7318
4.732
4.7322
4.7324
Eastings
×10^5

Predicting lamprey movement



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Thank you. Any questions?

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