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

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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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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

2D tracking possible
Bathymetry and hydraulics:

- ArcBoat
- GPS
- ADCP
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
$W = \text{Weir}$

$FP = \text{Fish Pass}$

$HTR = \text{Hydropower Tailrace}$

$\rightarrow = \text{Flow direction}$

$\text{Speed: } x15$
Predicting lamprey movement

Track fish movements

Correlate fish movement with hydraulics and bathymetry

ABM

Develop behavioural rules

Impact of climate change/turbine management?

Predict fish movements
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  - Greg McCormick

- **Albury Park Estate:**
  - George Winn Darley, Shane Collier

Thank you. Any questions?

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