ICER
International Centre for Ecohydraulics Research

UNIVERSITY OF Southampton

Considerations of multiple species fish passage associated with the development of small-scale hydropower

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Welcome

International Centre for Ecohydraulics Research (ICER)

Rivers and lakes have been modified by man for centuries. Although the impacts of development on freshwater ecosystems are recognized, the mechanisms that underpin the negative effects observed are often poorly understood.

At the International Centre for Ecohydraulics Research (ICER) at the University of Southampton, an interdisciplinary team of scientists collaborate with both domestic and international partners to bridge the gap between hydraulics and ecology.

Experimental tests conducted by ecologists, engineers, biologists, and geomorphologists are designed to find solutions to the problems created when aquatic environments are developed.

Current research is conducted in the following areas:

- Fish passage
- Traditional water wheels for environmentally friendly renewable energy generation
- Hydraulic habitat modelling
- Flow regime modelling
- River restoration
- Fluvial sediment dynamics

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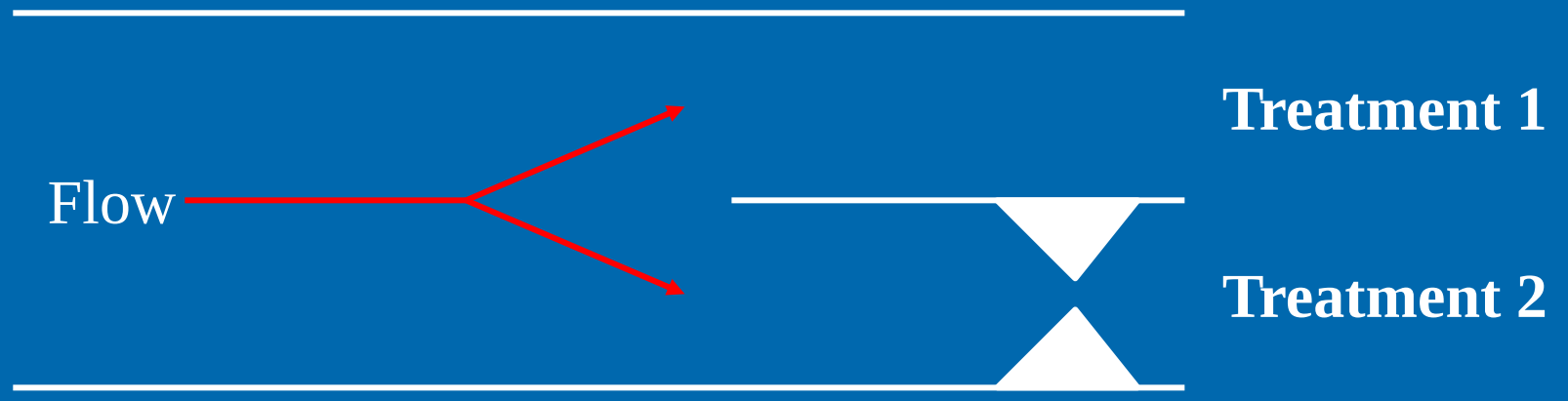
Small scale Hydropower Development and Environmental impacts

EU FP7 funded

Behavioural response of fish to fish passes

Experiment 1: **Flow acceleration**



Treatment 1 = Open Channel

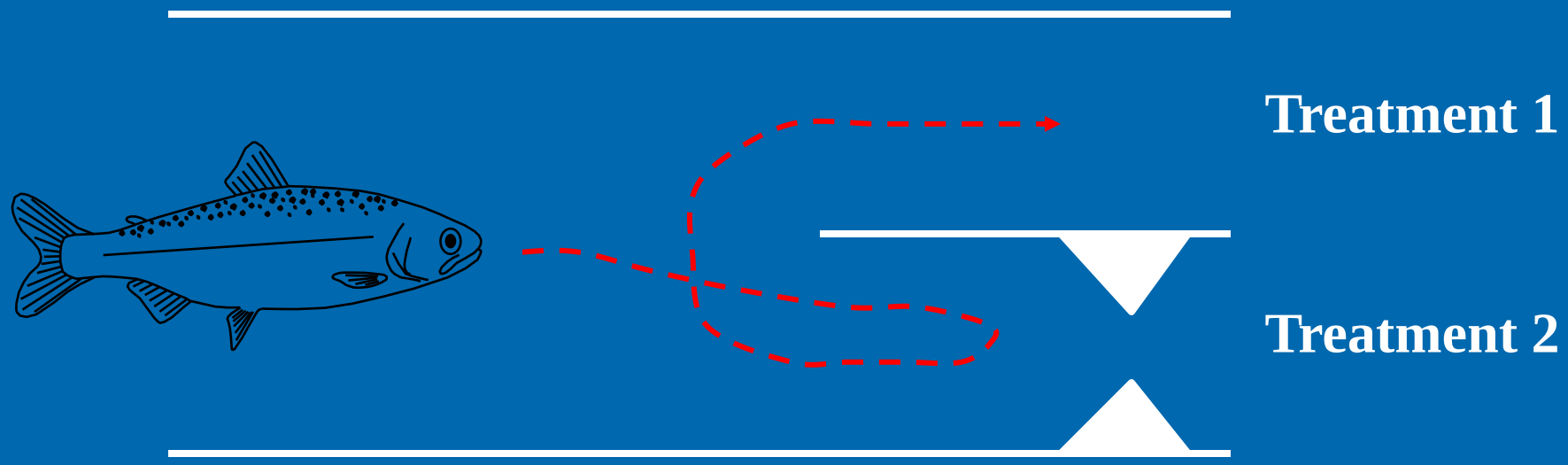
70% Q
Constant velocity

Treatment 2 = Constricted Channel

30% Q
Accelerating flow

Smolts encounter a choice of constricted (low flow but high acceleration) or open (high and constant flow) passage route.

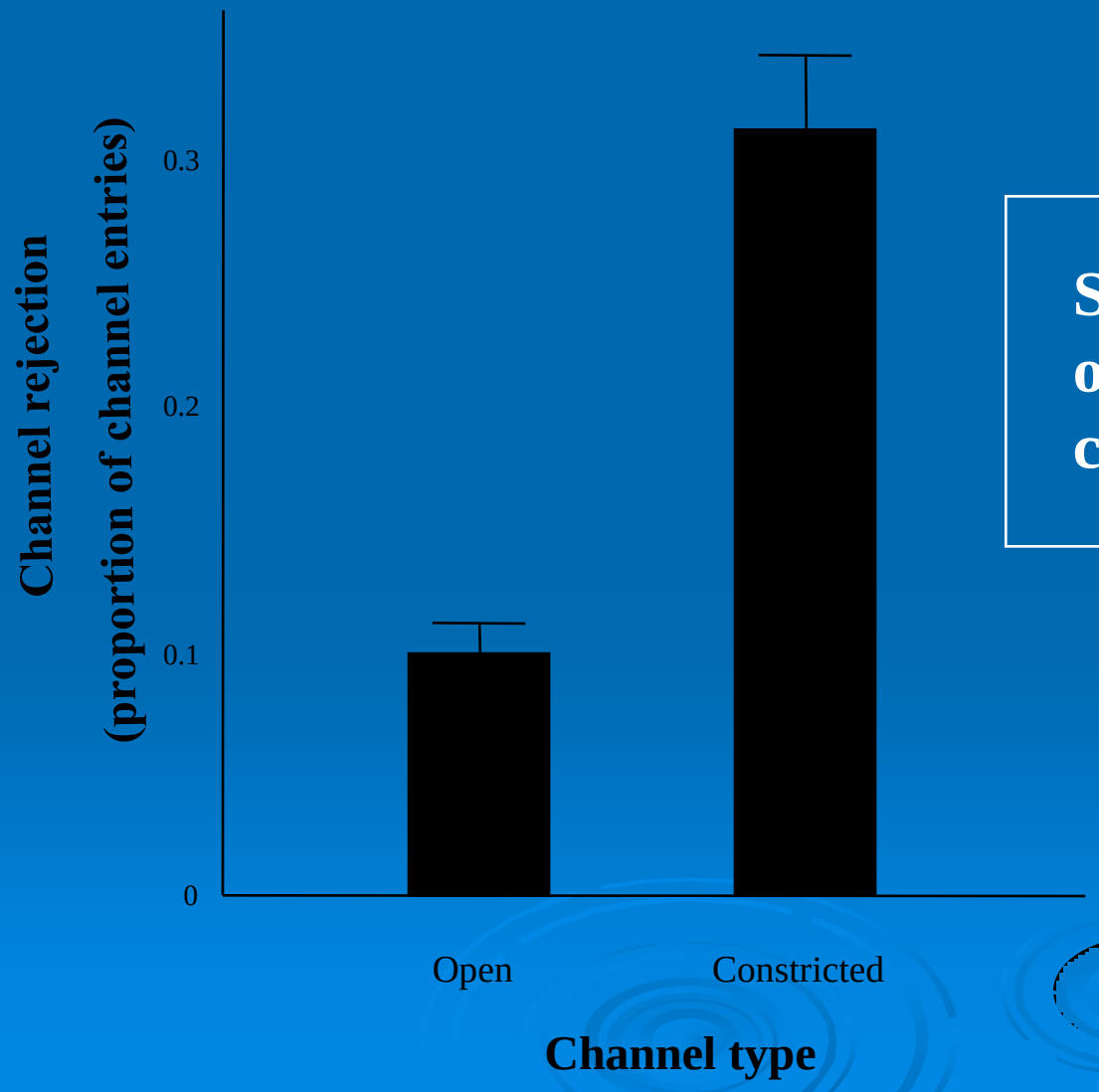
Experiment 1: **Results**



1. **Initially higher preference for the constricted channel.**

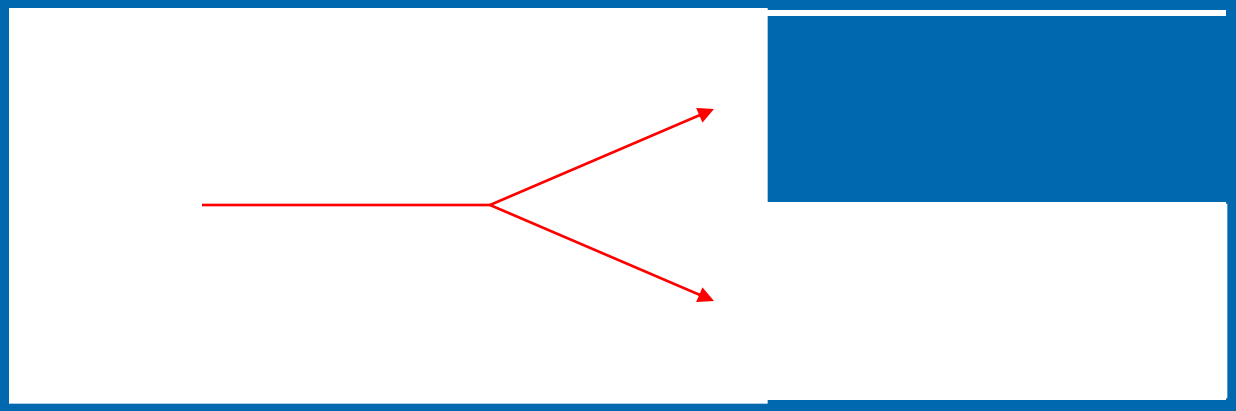
2. **But on reaching zone of acceleration, high rejection of constricted channel.**

Experiment 1: **Results**



Significant rejection of the constricted channel.

Experiment 2: **Overhead cover**

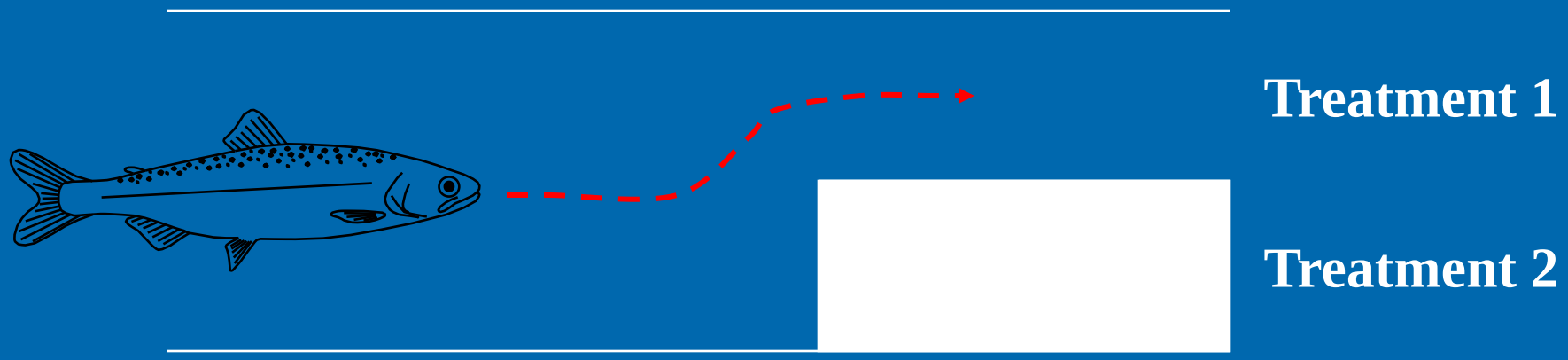


Treatment 1 = Uncovered Channel (50% Q)

Treatment 2 = Covered Channel (50% Q)

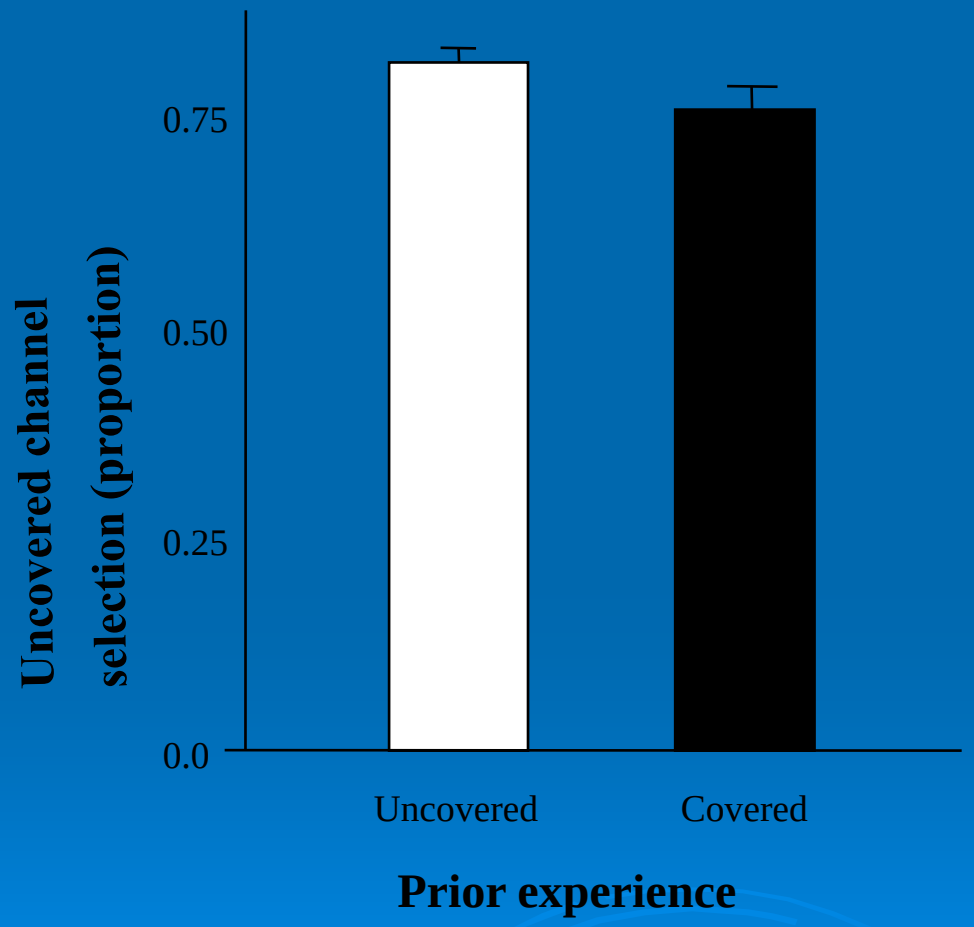
Smolts encounter a choice of covered or uncovered passage route after prior covered or uncovered passage.

Experiment 2: **Results**



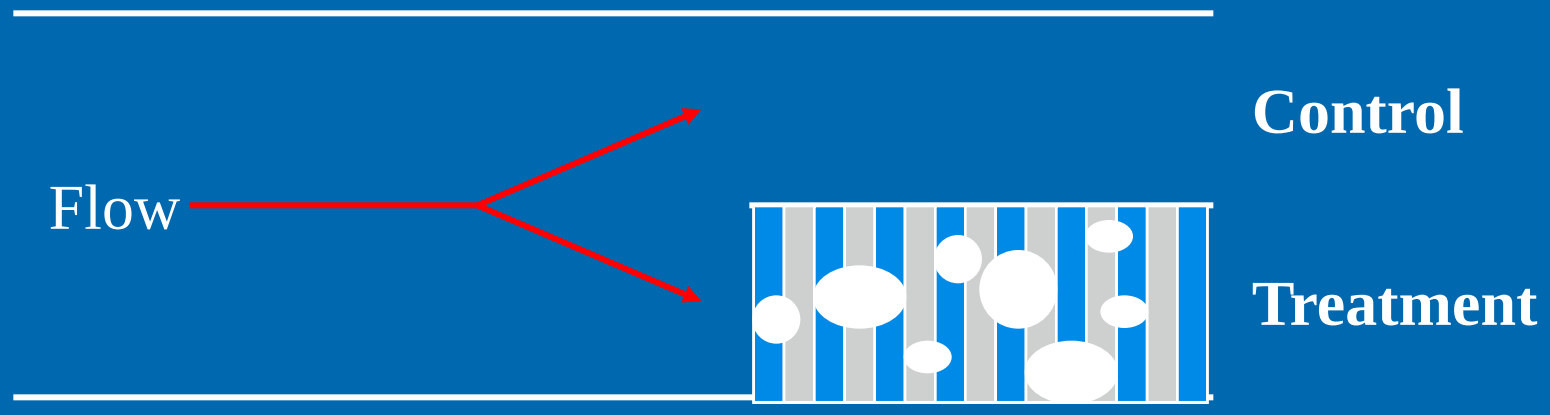
> 75% of smolts rejected the covered route independent of prior experience.

Experiment 2: **Results**



Significant rejection of the covered channel.

Experiment 3: Substrate complexity

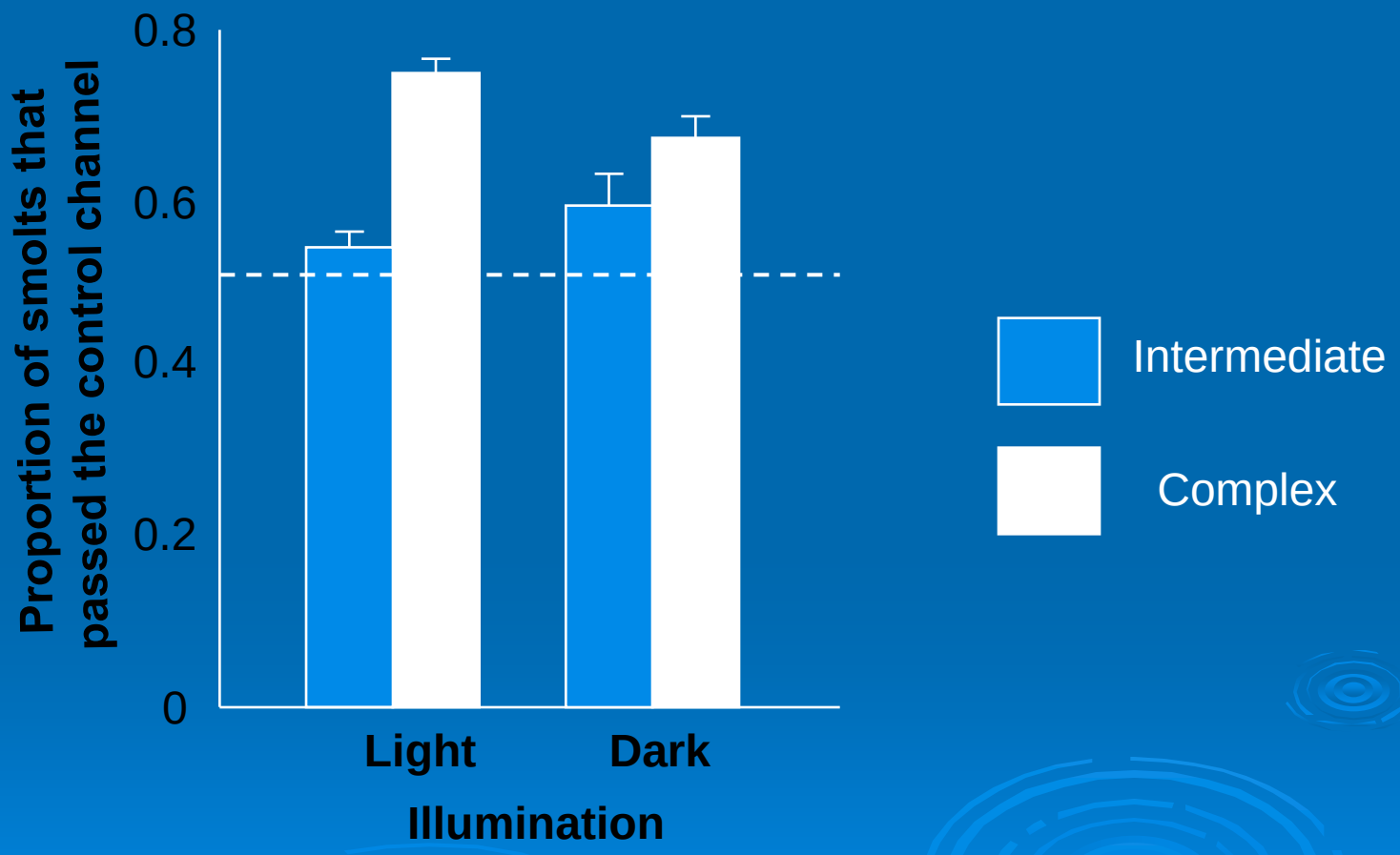


Control = Uniform aluminium channel

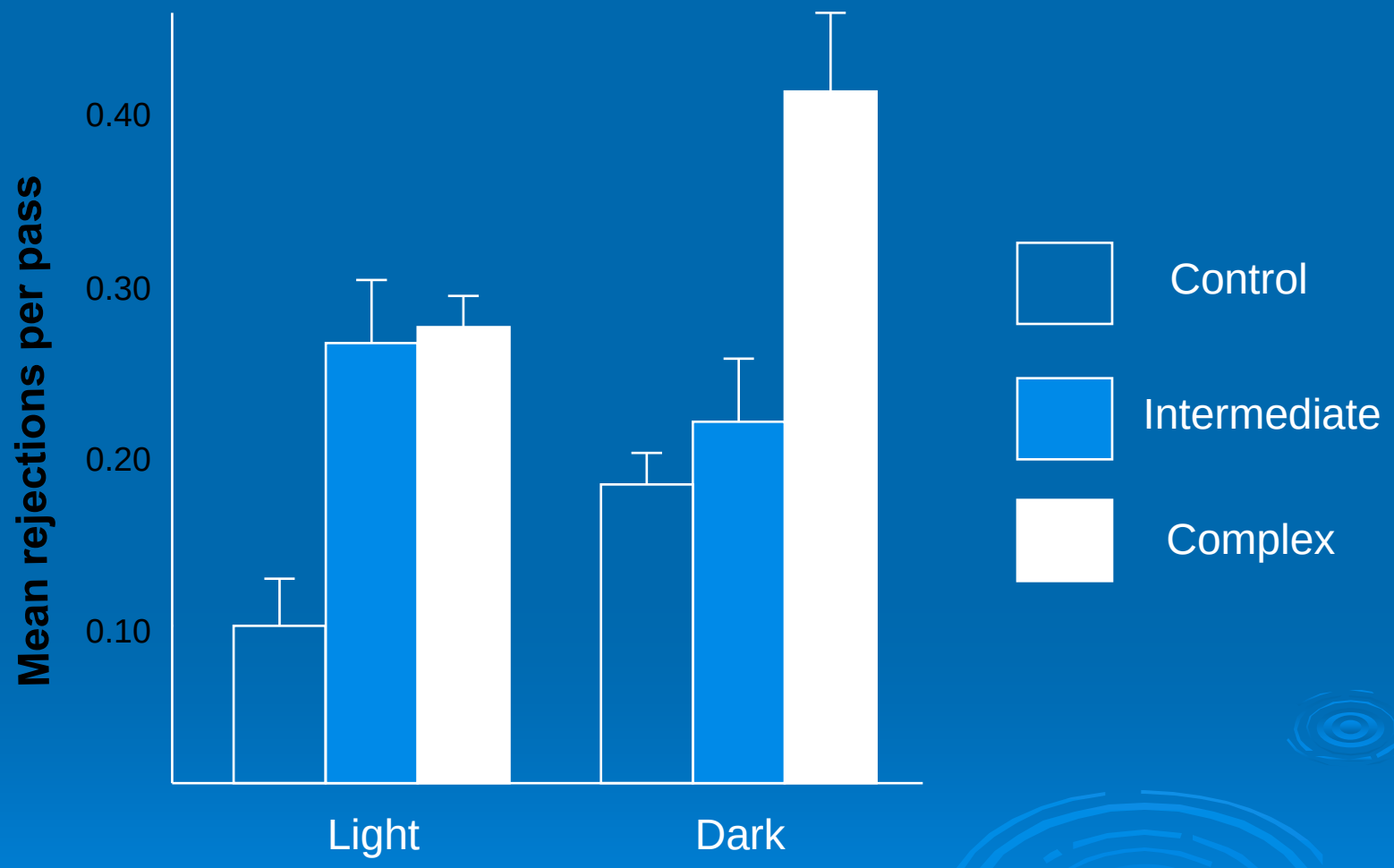
Treatment 1 = Intermediate i.e. corrugated lining

Treatment 2 = Complex i.e. additional boulders

Experiment 3: Results



Experiment 3: Results

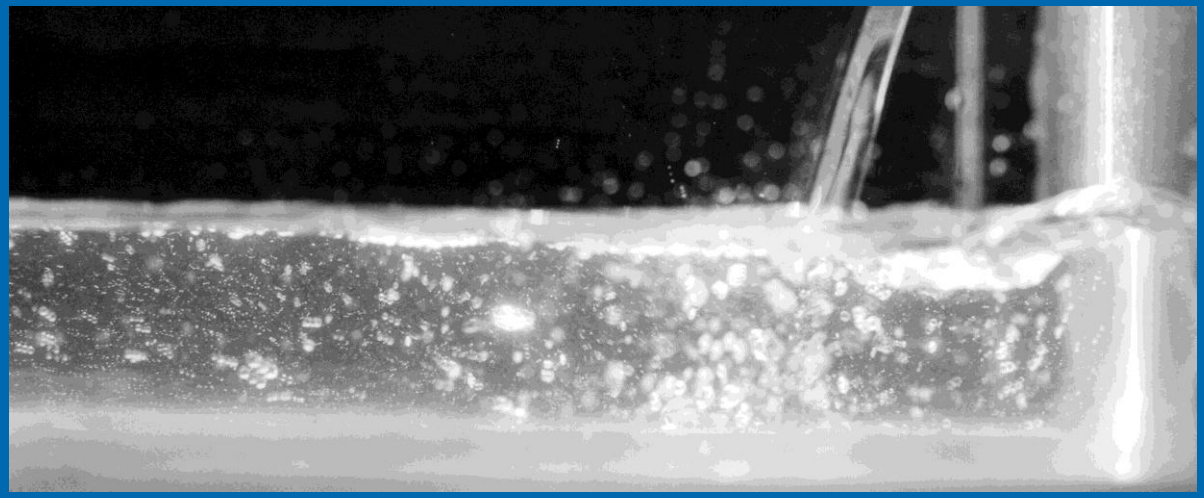


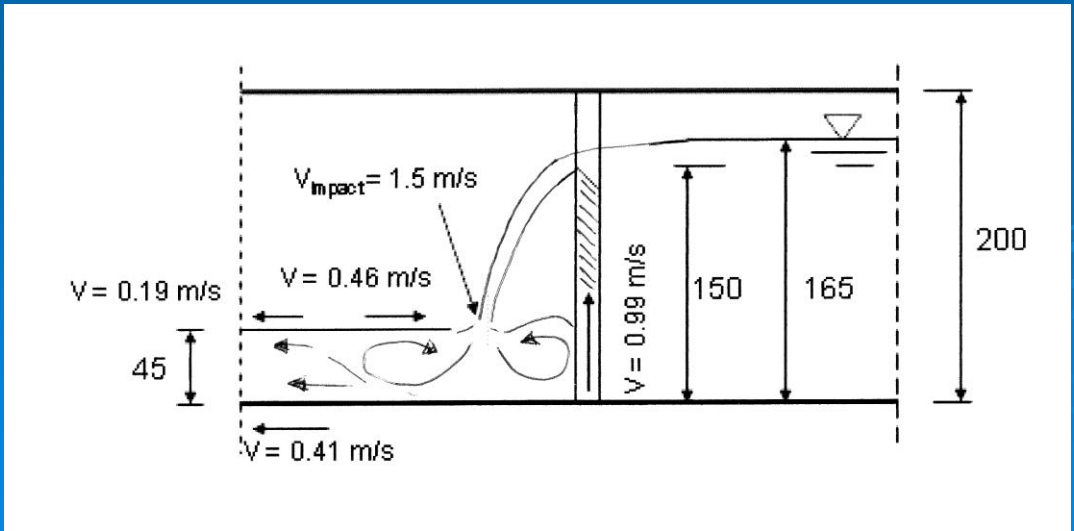
Fish passage research

- Economically significant species
- Upstream migrants
- Most usually adult salmon in Northern temperate climates

Linking fish behaviour with hydraulics:

- Electromagnetic velocimetry
- Acoustic Doppler velocimetry (ADV)
- Partical Imaging velocimetry (PIV) and other flow visualisation techniques
- Computation Fluid Dynamics (CFD) modelling

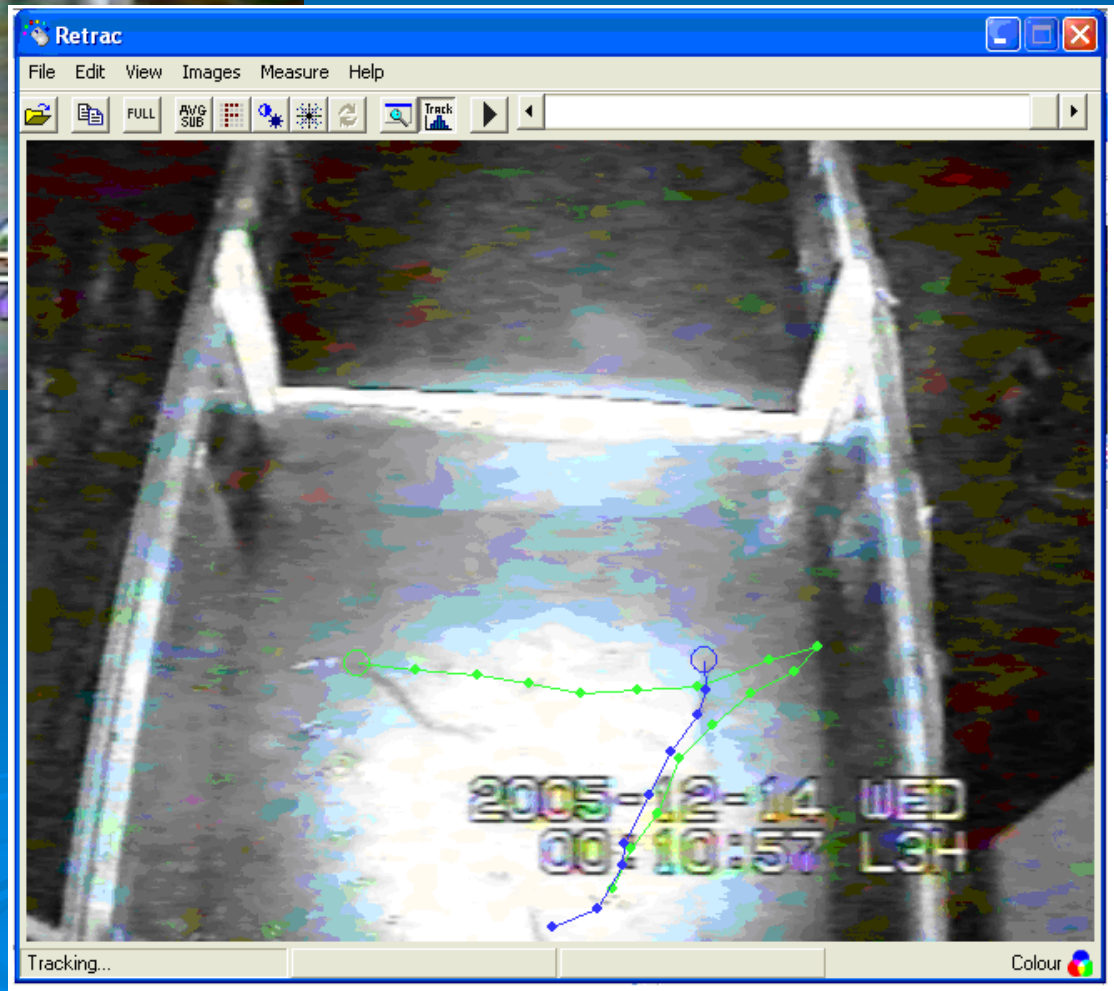




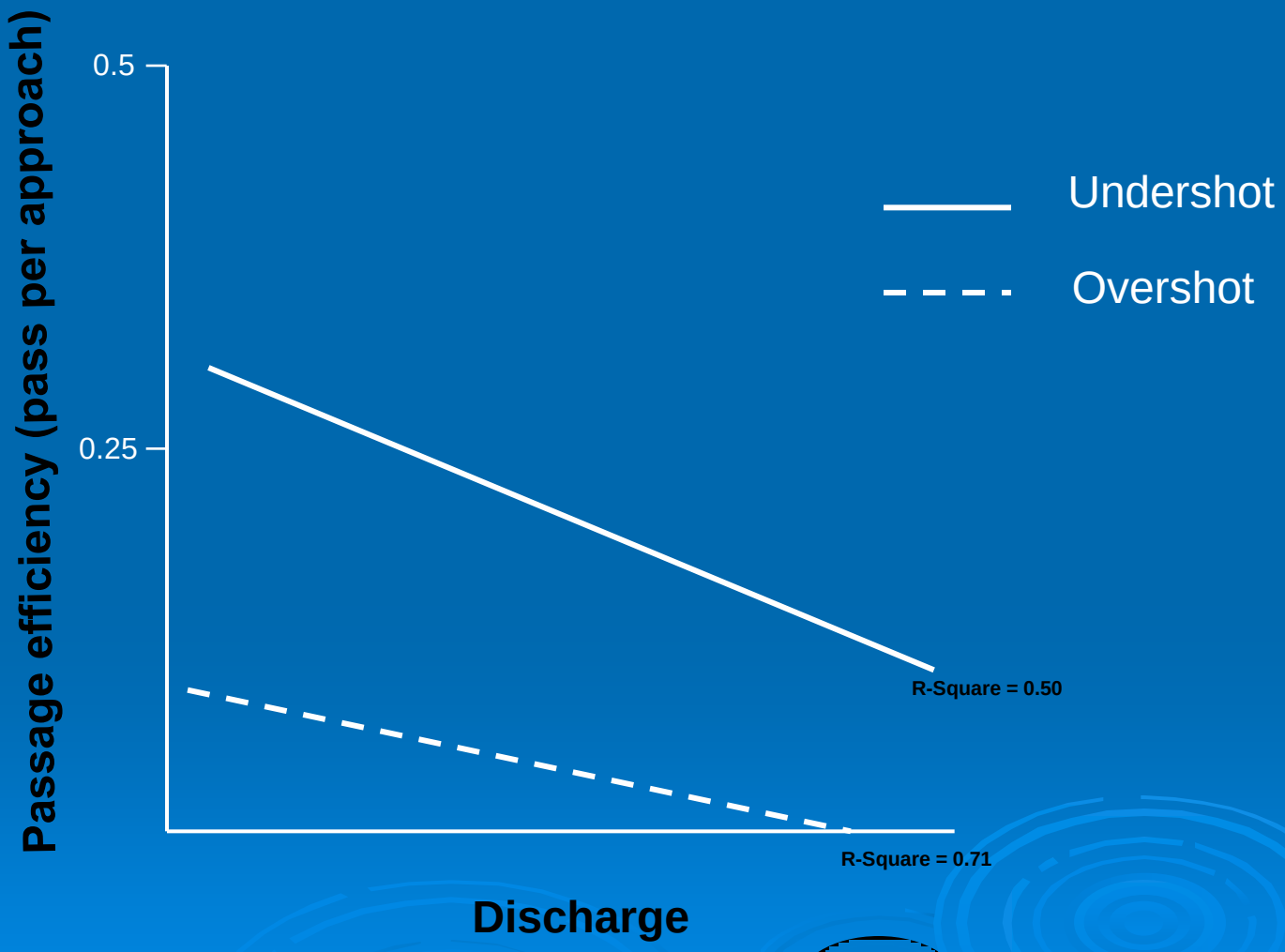
Influence of discharge and weir type on lamprey passage

- Passage efficiency
- Frequency of approach
- Nature of approach

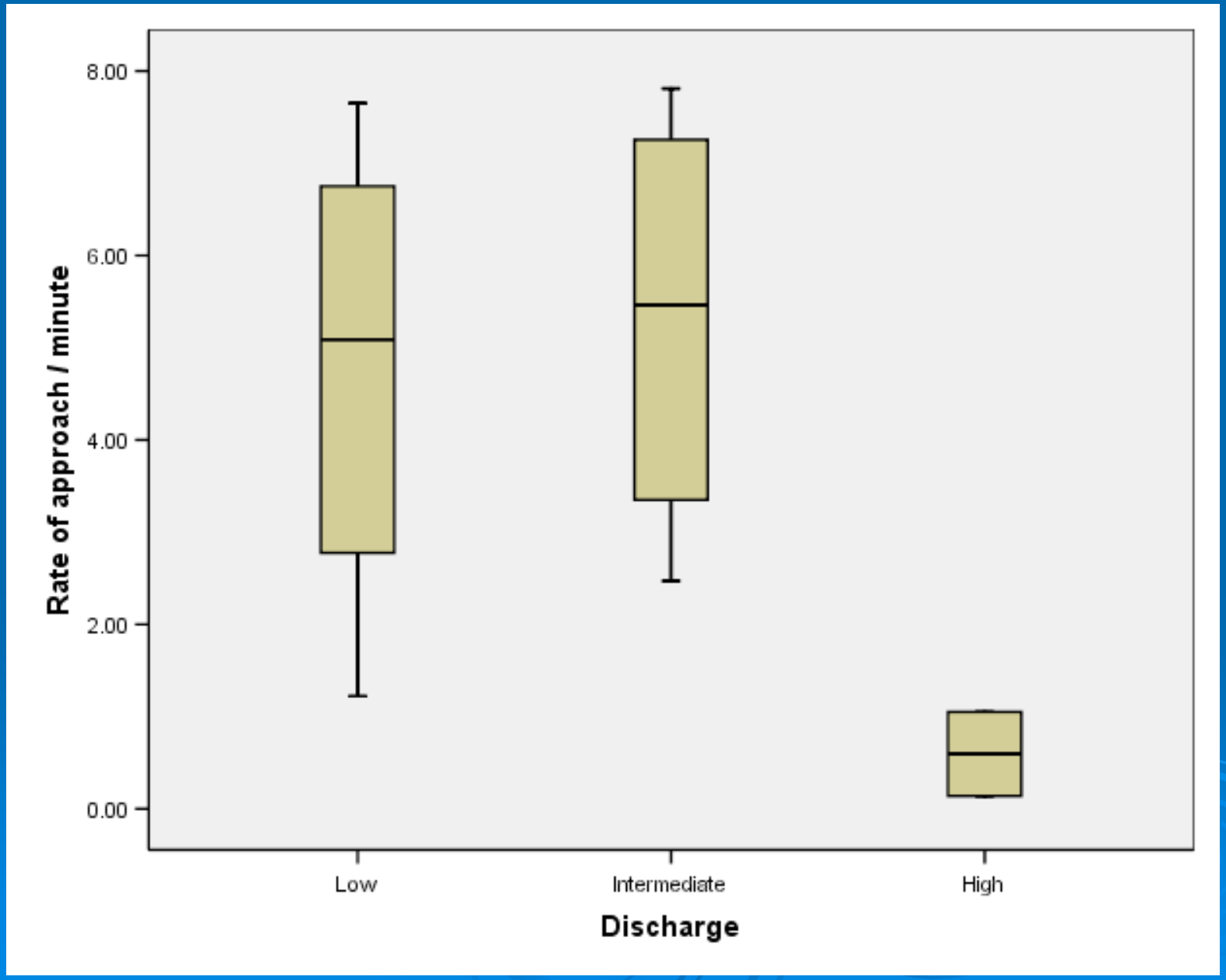
Tracking fish trajectories



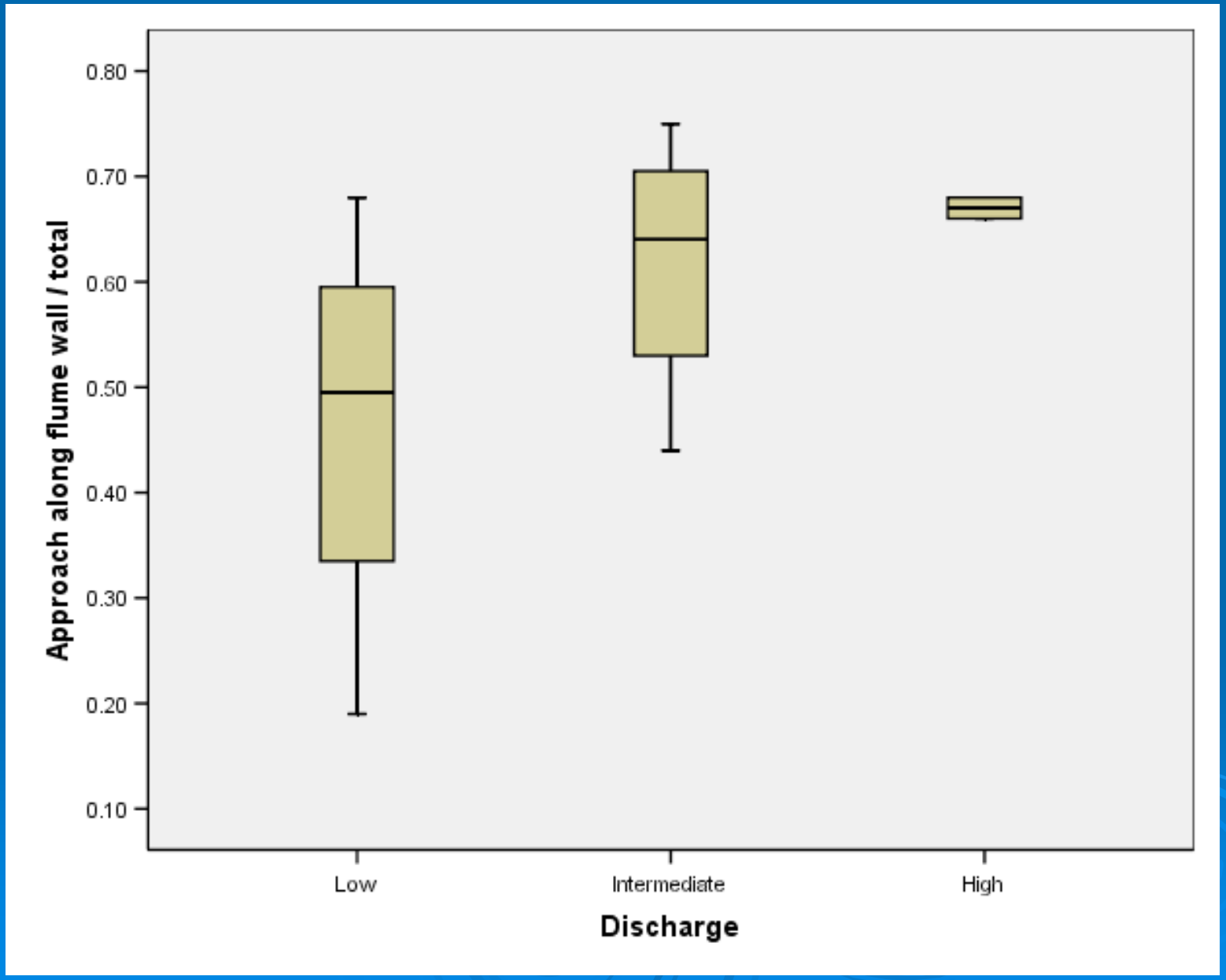
Lamprey passage efficiency



Frequency of approach to the weirs



Energy minimizing tactics – paths of least resistance



Conclusions

1. The influence of hydraulics on fish behaviour has important implications for fish passage efficiency

2. Current legislation requires that more attention is focused on multiple species when designing fish passage criteria