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Passage Behaviour of Potamodromous Cyprinids Negotiating a Small Experimental Weir: Passage by Swimming or Jumping?

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Presenter Information

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PASSAGE BEHAVIOUR OF POTAMODROMOUS CYPRINIDS NEGOTIATING A SMALL EXPERIMENTAL WEIR: PASSAGE BY SWIMMING OR JUMPING?

Susana D. Amaral; Paulo Branco; Christos Katopodis; Maria T. Ferreira; António N. Pinheiro;
José M. Santos





Outline

- Introduction
- Objective
- Experiments
- Methods
- Results
- Conclusions
- Acknowledgements

INTRODUCTION

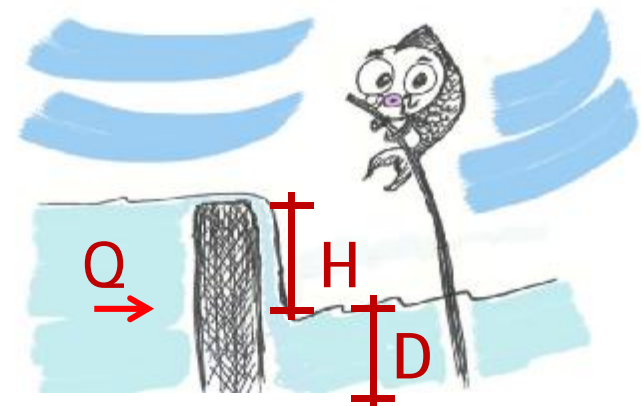
River fragmentation represents a serious threat to the sustainability of fish populations”

Small weirs considered, a priori, “permeable” to fish movements may negatively affect potamodromous cyprinid species



INTRODUCTION

- ∅ Potamodromous cyprinids are the predominant fish fauna in Iberian rivers
- ∅ They are considered as “non-jumping species”
 - è usual passage behaviour is to swim along the water nappe formed in the downstream face of small obstacles
- ∅ Weirs may **partial or total block** migratory routes
 - è effect of key hydraulic parameters on passage success
 - ... and what about passage behaviour ?



INTRODUCTION

Abrantes inflatable weir



INTRODUCTION

Abrantes inflatable weir



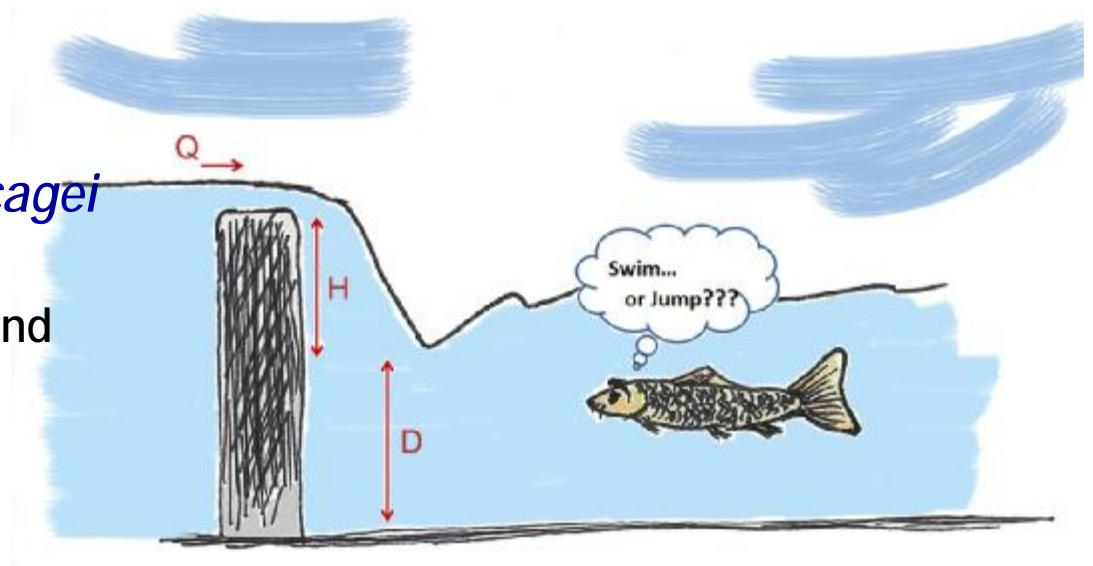
OBJECTIVE

Assess the **upstream passage behaviour** of potamodromous cyprinids when facing an experimental small broad-crested weir considering the interaction of:

- § Plunge Pool Depth (D)
- § Waterfall Height (H)
- § Discharge (Q)

Target species:

Iberian barbel - *Luciobarbus bocagei*
representative of medium-sized
potamodromous cyprinids in Iberia and
Western Europe



Weir made of PVC modules

EXPERIMENTS

è 16 configurations of D ; H at a constant $Q = 50 \text{ L/s}$

D (cm)	H (cm)
10	5
20	10
30	15
50	25

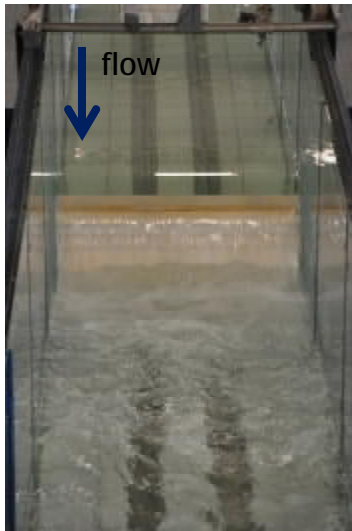


è 3 other discharges tested on the configuration that showed the highest passage success

è $Q = 25 \text{ L/s}$

è $Q = 75 \text{ L/s}$

è $Q = 100 \text{ L/s}$



Flume

METHODS

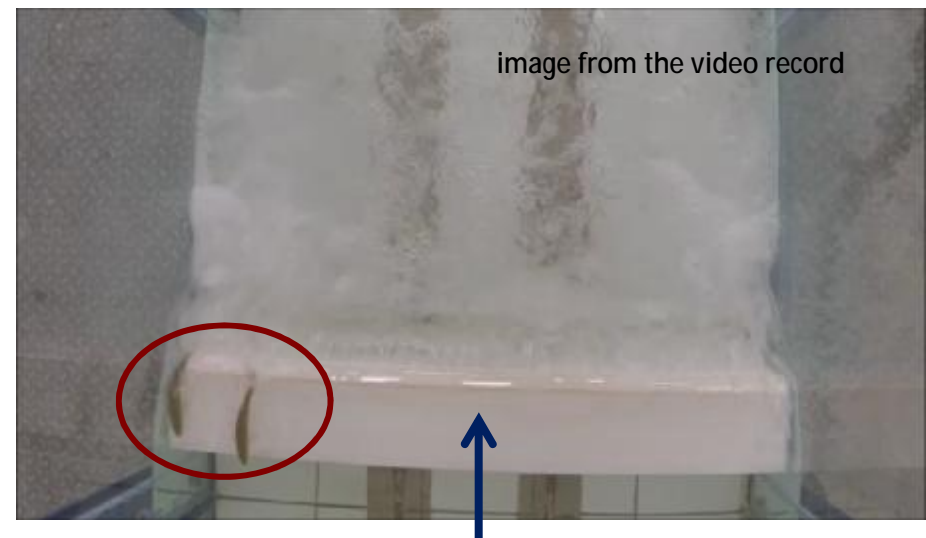
- Ø 380 Iberian barbel were captured by electrofishing
(TL = 18.7cm ± 3.3cm)



- Ø Fish movements were monitored by direct observation and recorded by video camera
- Ø Each configuration was tested (D x H) with 4 replicates carried out with schools of 5 fish
- Ø 15 min of acclimation + 60 min of trial

Observations:

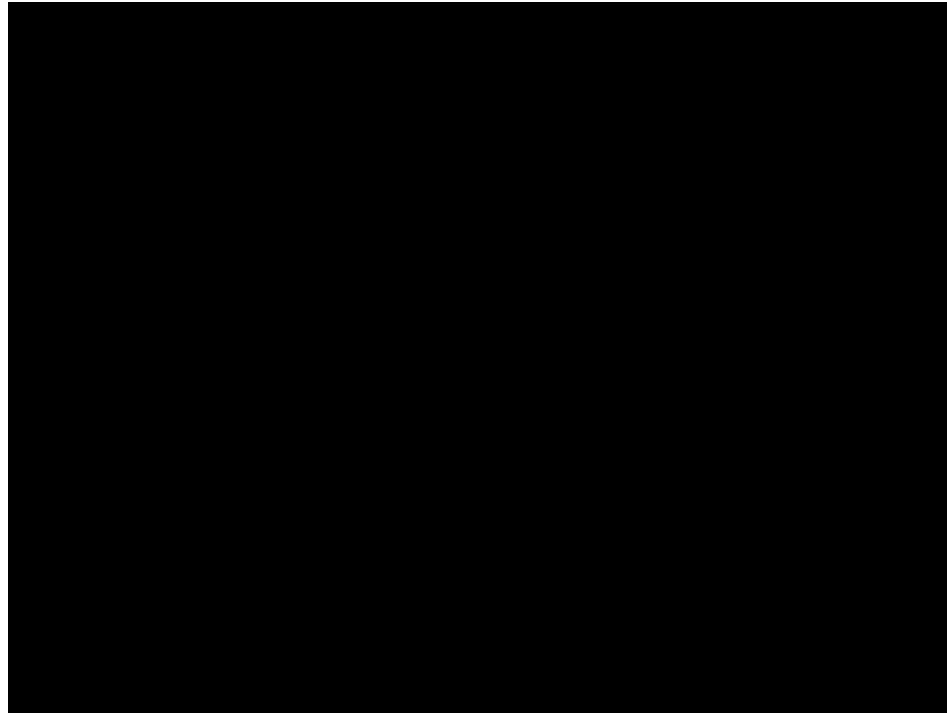
- ü Passage attempts (AT)
- ü Passage successes (N)
- ü Passage behaviour (Swim or Jump)



RESULTS

Overall numbers...

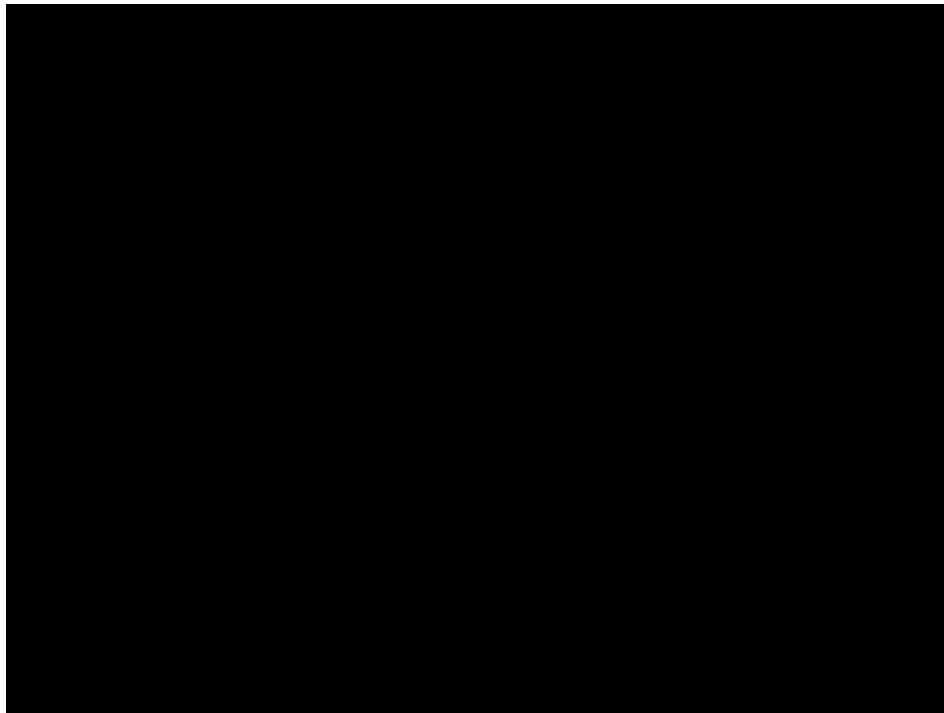
224 passages by **Swimming** (81%)



RESULTS

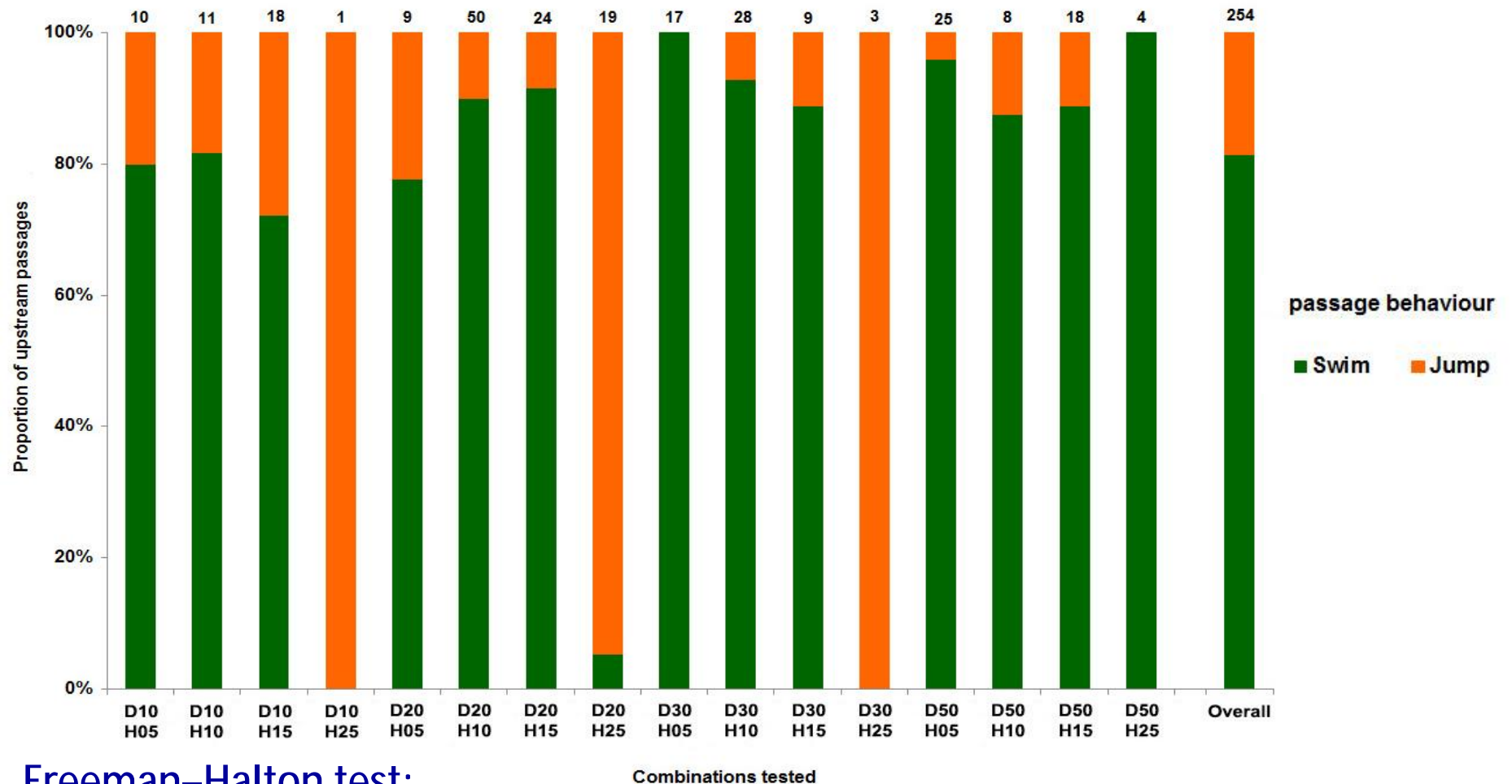
Overall numbers...

53 passages by **Jumping** (19%)



RESULTS

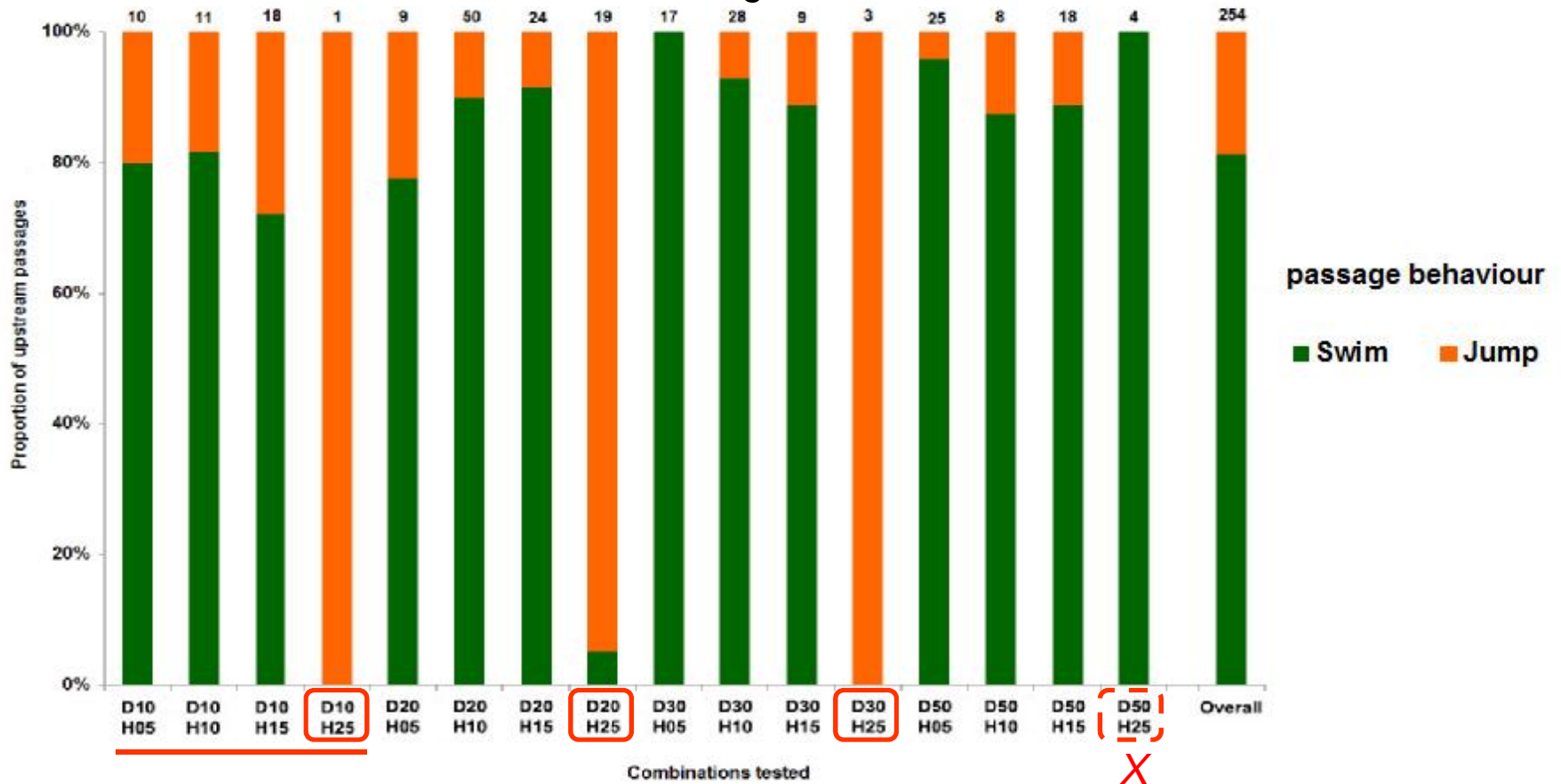
Upstream passages (%) by **swimming** or **jumping** for the 16 combinations



Freeman-Halton test:

Type of passage behaviour was **highly dependent** on the combination of D and H ($p < 0.0001$)

Proportion (%) of upstream passages by swimming or jumping for the 16 configurations



2 way PERMANOVA results

Source	d.f	SS	MS	F	P
D	3	83.97	27.99	3.10	0.01
H	3	228.47	76.16	8.43	0.001
D x H	9	286.03	31.78	3.52	0.001

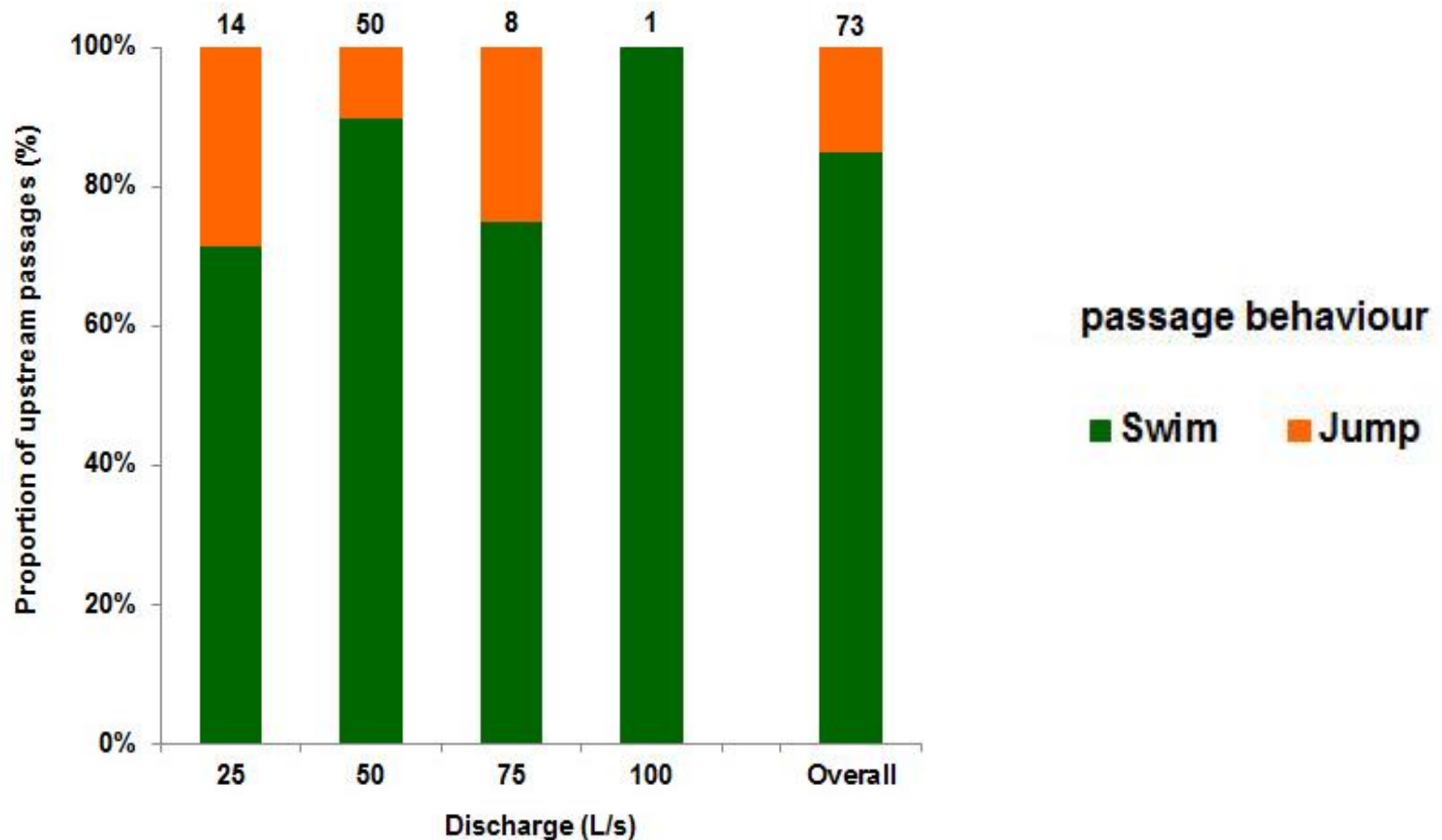
Pairwise comparison

H25 – highest proportion of successes by jumping
 D10 – highest proportion of successes by jumping

(PERMANOVA, $p < 0.01$)

RESULTS

Proportion (%) of upstream passages by **swimming** or **jumping** for the tested discharges



Freeman-Halton test

No evidence that the type of passage behaviour was discharge related
($P > 0.05$)

CONCLUSIONS

- ü Passage behaviour was **highly conditioned by the hydraulic parameters**
- ü Barbel negotiated most configurations **by swimming**
- ü Higher waterfalls stimulated a **switch of passage behaviour from swimming to jumping**
- ✗ Contrarily to what was expected, **for the range tested, discharge did not significantly influence** passage behaviour,
- ü These results **may help** to determine **if obstacles are problematic** for migration, and
- ü to set design criteria **to modify small barriers**, in order to improve fish passage and habitat connectivity.



ACKNOWLEDGMENTS



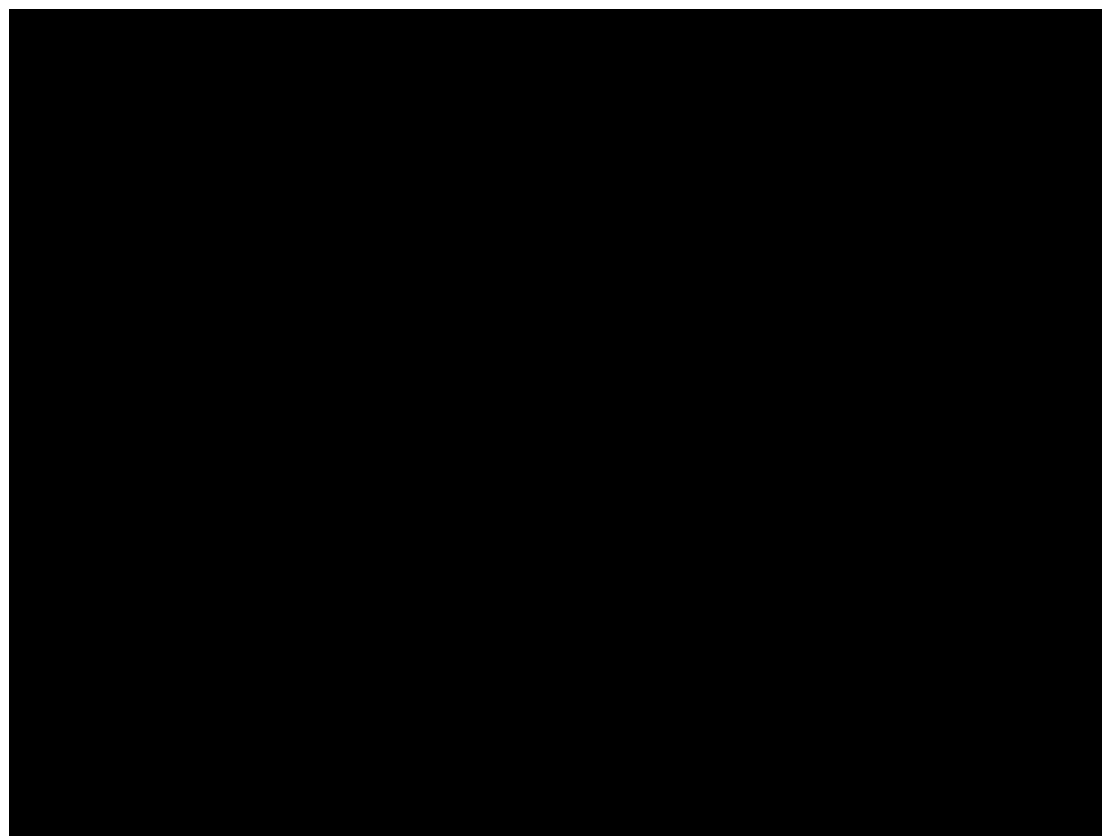
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THANK YOU!

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