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

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CERIS
CIVIL ENGINEERING RESEARCH AND INNOVATION FOR SUSTAINABILITY
TÉCNICO LISBOA

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cef Centro de Estudos Florestais

Katopodis
Ecohydraulics Ltd.

Outline

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

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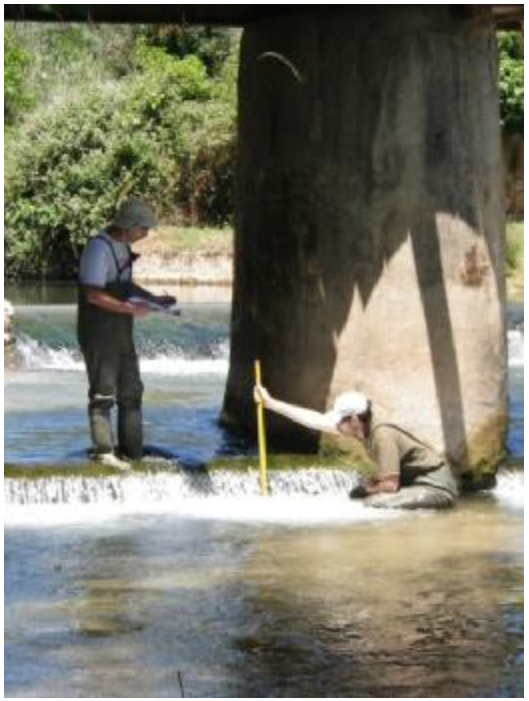
INTRODUCTION

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

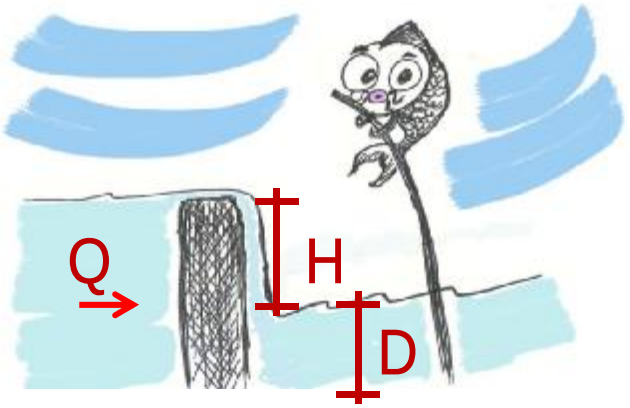
- They are considered as "non-jumping species"

  - 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

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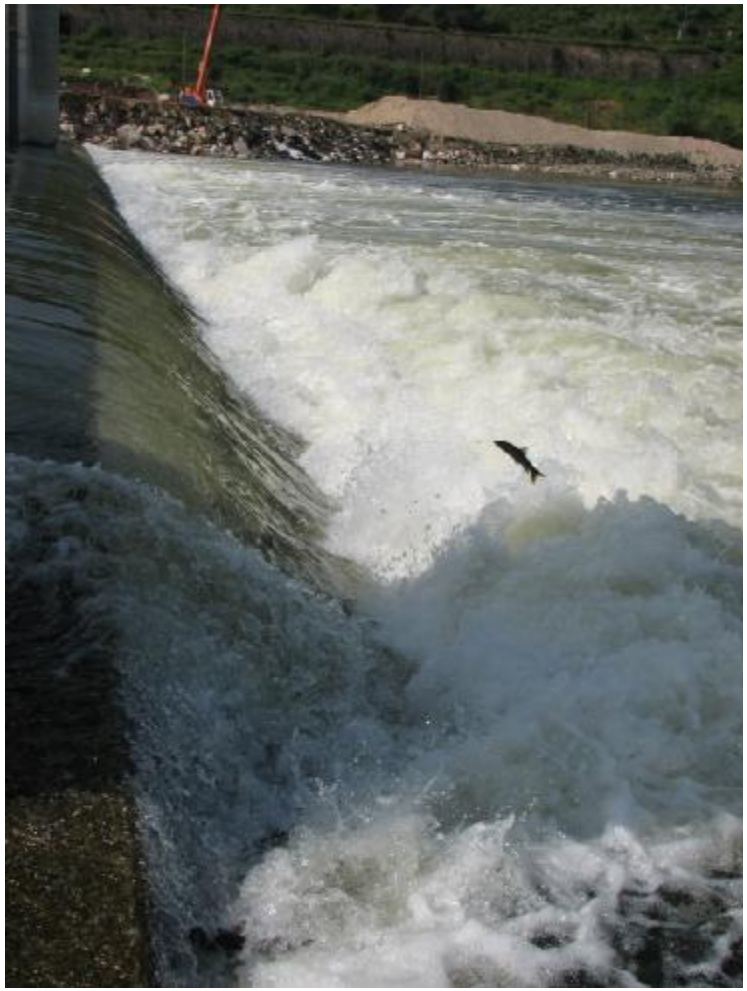


OBJECTIVE

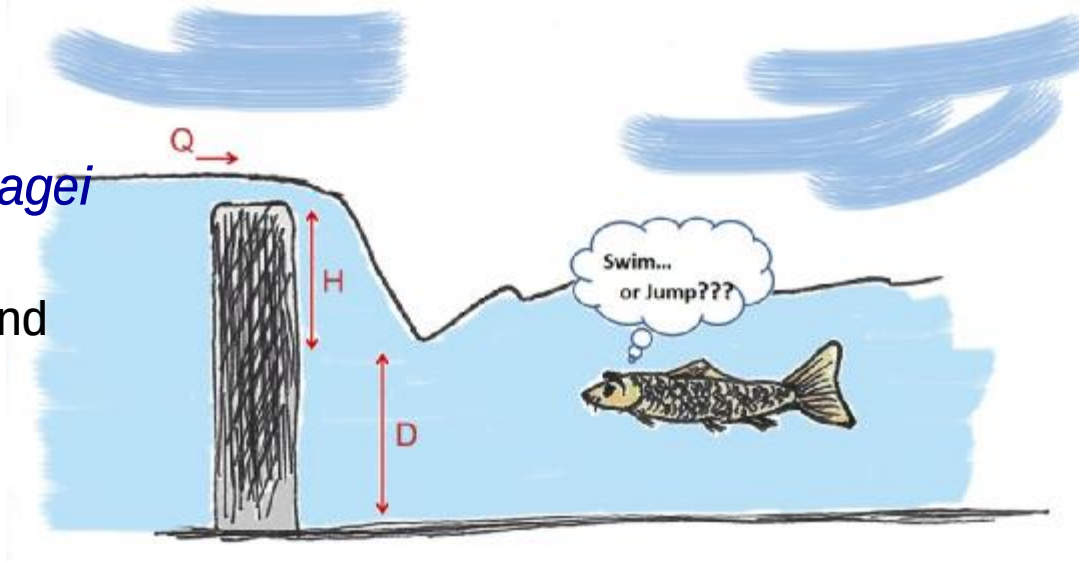
Assess the upstream passage behaviour of potamodromous cyprinids when facing an experimental small broad-crested weir considering the interaction of:

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

Target species:

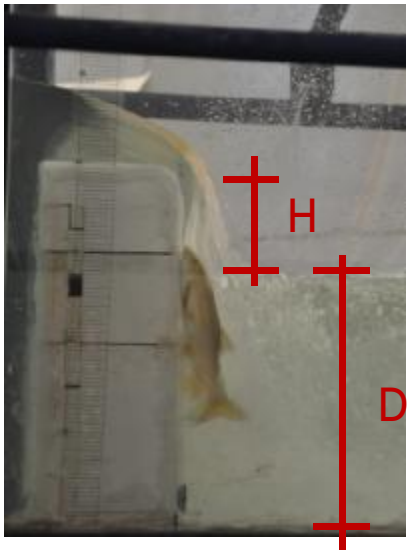
Iberian barbel - *Luciobarbus bocagei*

representative of medium-sized potamodromous cyprinids in Iberia and Western Europe



EXPERIMENTS

Weir made of PVC modules



è 16 configurations of D ; H at a constant Q = 50 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 L/s
- è Q = 75 L/s
- è Q = 100 L/s

Flume

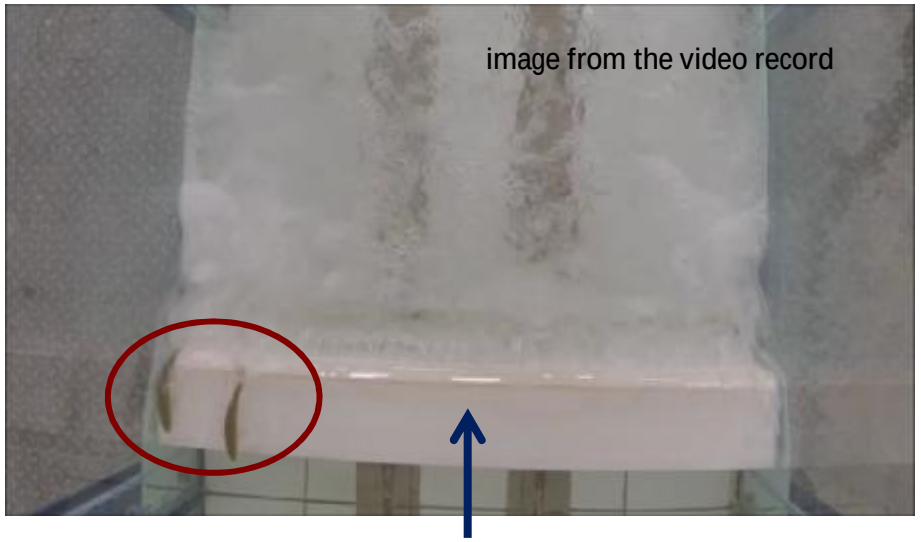
METHODS

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

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

Observations:

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



RESULTS

Overall numbers...

224 passages by Swimming (81%)

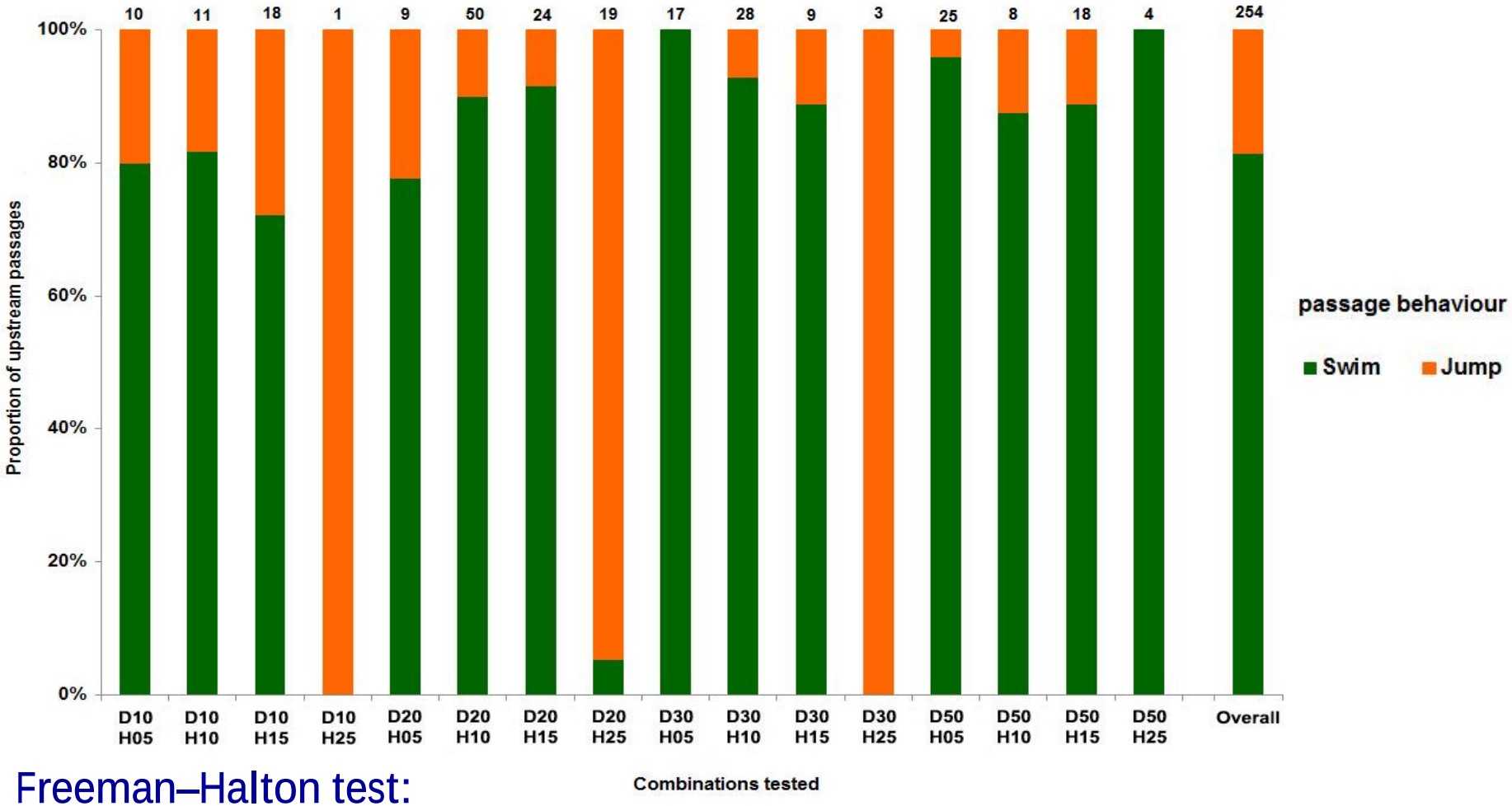
RESULTS

Overall numbers...

53 passages by Jumping (19%)

RESULTS

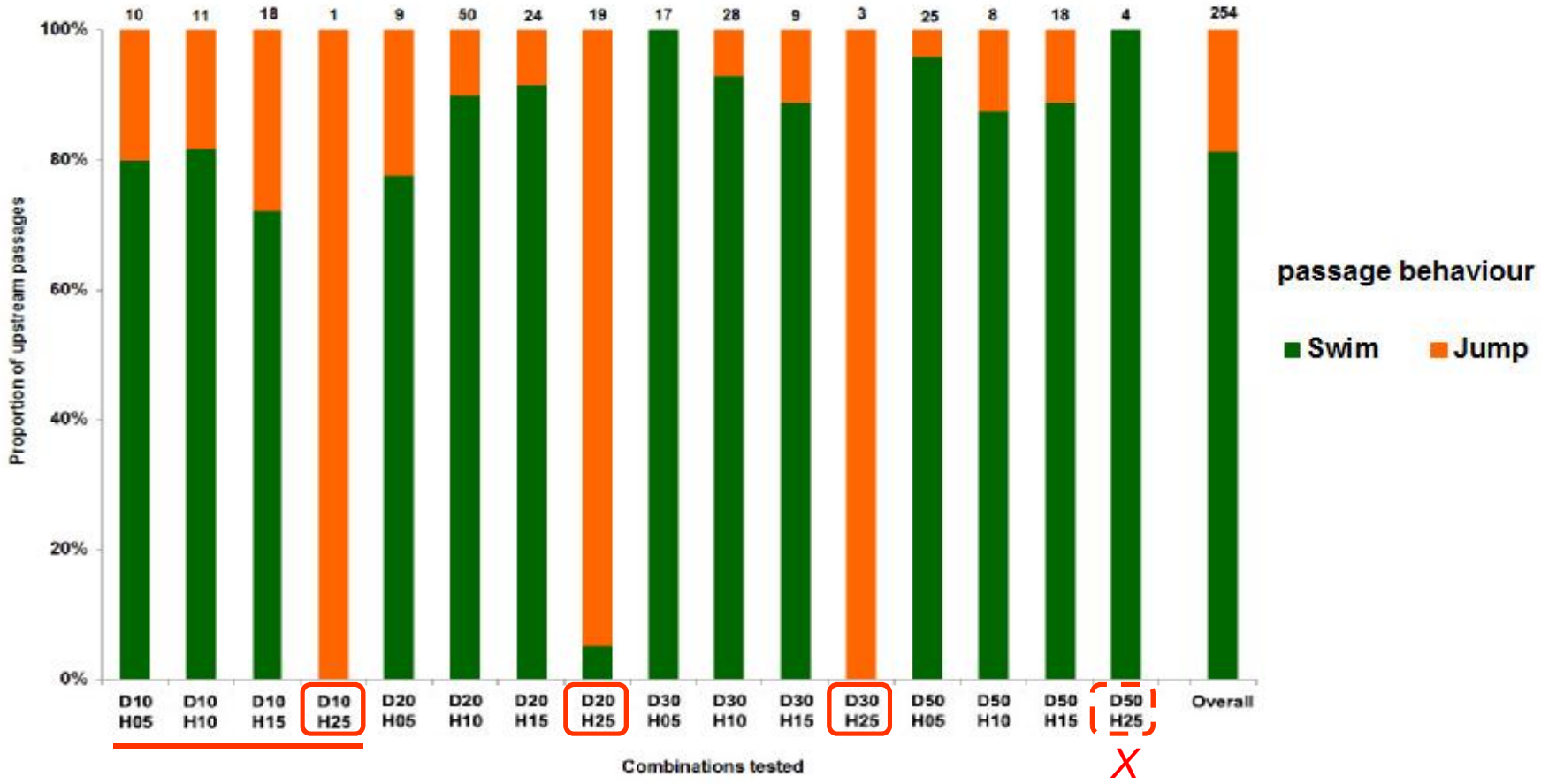
Upstream passages (%) by swimming or jumping for the 16 combinations



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

(PERMANOVA, $p < 0.01$)

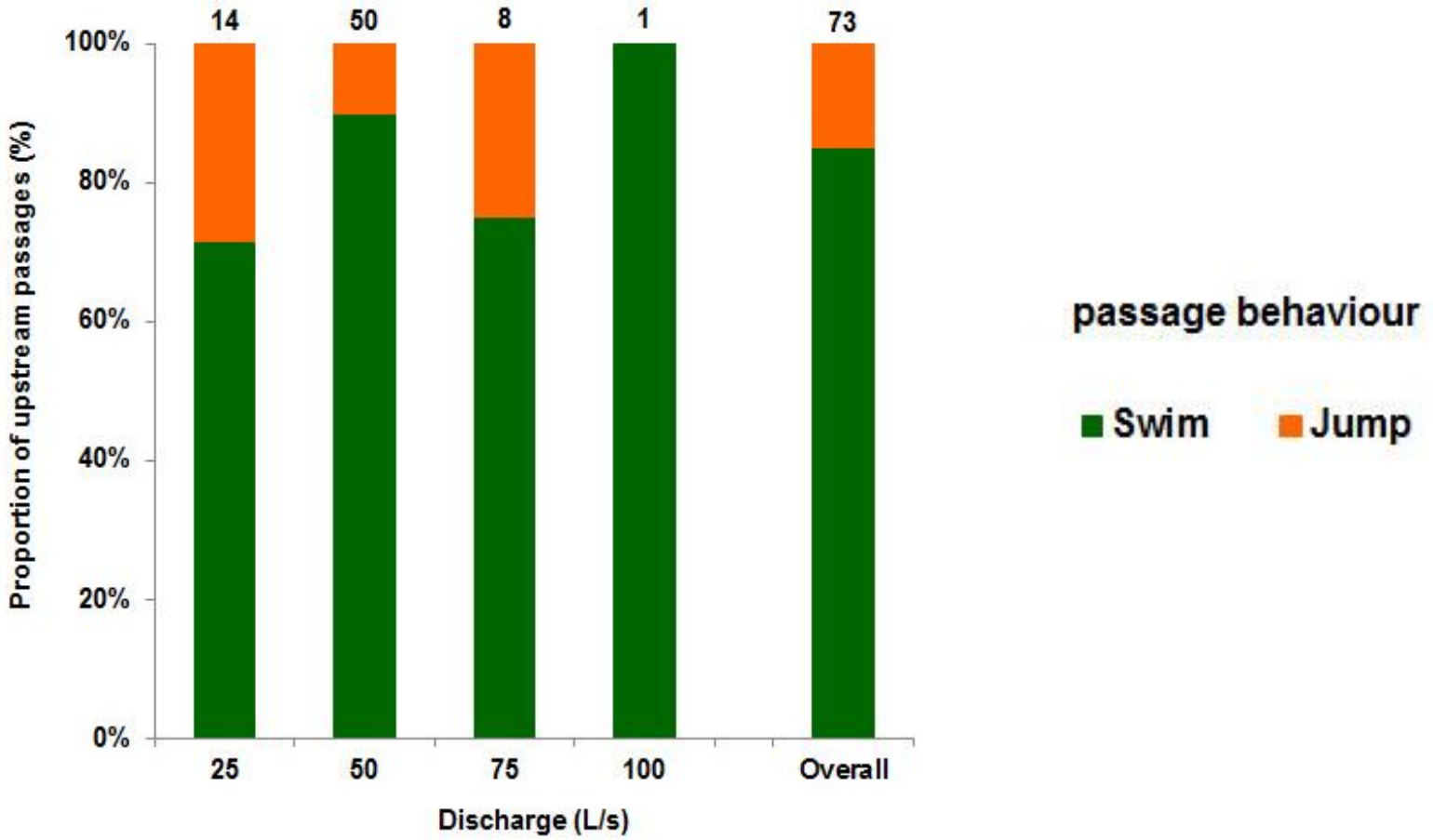
Pairwise comparison

H25 – highest proportion of successes by jumping

D10 – highest proportion of successes by jumping

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
- *X* 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.

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[redacted]

THANK YOU!

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