Passage Performance of two Cyprinids with Different Ecological Traits in a Fishway with Distinct Vertical Slot Configurations

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INTRODUCTION

Worldwide, anthropogenic obstructions on watercourses have negative impacts on migratory fish:

- Blocking migratory pathways
- Loss of habitat and degradation
- Isolating fish populations
- Changes in water quality and temperature
- Decline in fish diversity and abundance or even extinction
INTRODUCTION

Fish Passage Facilities

- Pool-Weir
- Denil
- Vertical Slot
- Nature-like
- Fish Locks
- Fish Lifts
- Collection and Transportation Facilities

- Delay the migration of target species
- Lack of flow to attract fish to the entrance
- Unsuitable entrance location
- Inadequate maintenance
- Poor hydraulic conditions
INTRODUCTION

Vertical Slot Fish passes

• One of the best type of technical fishway

• Remain operational with water depth changes

• Fish can swim through the slot at any desired depth

• Accommodate a wider range of species

• Reduce their operational costs
OBJECTIVE

Assess the passage performance of two cyprinid species with different ecological traits in VSF with distinct slot configurations

Iberian Barbel
(*Luciobarbus bocagei*, Steindachner, 1864)

Iberian Chub
(*Squalius pyrenaicus*, Günther, 1868)
METHODS

Fish trials

• Acclimation period of 30 minutes

• Experiments lasted 90 minutes per trial (n=100)

• Visual and video monitoring

• Number of upstream movements

• Timing and number of successful fish ascending the fishway

• Entrance time

• Entry efficiency
METHODS

Hydraulics

- ADV (model Vectrino 3D, Nortek AS)
- 2 horizontal planes, h1 (50 cm) and h2 (62.5 cm)
- 110 sampling points (25Hz, 180s)
- Velocity, TKE and RSS
RESULTS

Hydraulics - Velocity

- Slot C1 – max. vel. 1.6 m.s\(^{-1}\)
- Slot C1 – mean vel. 0.51 m.s\(^{-1}\)
- Slot C2 – max. vel. 1.7 m.s\(^{-1}\)
- Slot C2 – mean vel. 0.37 m.s\(^{-1}\)

\[ \left( \overline{U}_{xy} = \sqrt{\overline{u}^2 + \overline{v}^2} \right) \]

\[ V_s = \sqrt{2g\Delta H} \]
RESULTS

Hydraulics – TKE ($k$)

- $k$ has a higher mean magnitude in C1
- Max. values were found in h2 in C1

\[
k = \frac{1}{2} \left( \overline{u'^2} + \overline{v'^2} + \overline{w'^2} \right)
\]

\[
V_s = \sqrt{2g\Delta H}
\]
RESULTS

Hydraulics – RSS

- RSS has a mean higher magnitude in C1
- Max. values were found in C1 at h2

\[ \tau_{uv} = -\rho \bar{u}' \bar{v}' \]
\[ V_s = \sqrt{2g\Delta H} \]
Fish trials

• Chub – C1 (36.4%) and in C2 (63.6%)
• Barbel – C1 (52.5 %) and in C2 (47.5%)

• No differences were detected
Fish trials

- Chub – C1 (15%) and in C2 (28%)
- Barbel – No differences detected

No differences were detected
CONCLUSIONS

- C2 requires lower discharge (26%) to operate for the same mean water depth
- C2 is a more cost-effective VSF design than C1
- C2 is a better option in areas where water resources are scarce
- C1 and C2 are equally suitable for cyprinids with different ecological traits
- C2 may be a better option for rheophilic stream-dwelling cyprinids in Mediterranean regions
References


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Thank you for your attention!

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Questions?