Schooling behaviour of Telestes muticellus under different flow velocities

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River fragmentation caused by dams, culverts, and weirs is among the main drivers of the decline of migrating freshwater fish species worldwide. In order to address this issue, engineers and biologists have been developing structures to ensure the safe passage of fish over these barriers, so-called fishways. These structures are designed to allow fish to overcome the barrier without injury, stress, nor significant delay, which might impact their behaviour during critical life stages.

Fishway design requires understanding how fish can approach, enter, and pass through a fishway, a series of events involving both behaviour and swimming capabilities. These aspects have been extensively studied in the last decade, focusing mainly on individual fish. However, some migrating freshwater species exhibit collective behaviour throughout their entire life-cycle or during migration. Our study aims to integrate this key aspect into the existing research, investigating how hydrodynamics, particularly mean flow velocity, affect fish collective behaviour.

Experiments were conducted on 100 individuals of Telestes muticellus (5±0.5cm Fork Length). Different group sizes (1,2 and 6) were exposed to different mean velocities (10, 20 and 35cm/s) in a custom-made portable flume designed to generate specific flow fields. Fish motion throughout the experiment was recorded with cameras placed on the bottom and the side of the flume.

Results show that fish tend to explore the space available to a greater extent as a group than when solitary. At low flow velocities, fish tend to stay near the upstream grid and move along the transversal direction for all group configurations. At high flow velocity, they tend to stay in the back region of the swim tunnel and swim close to the sidewalls, most likely to exploit favourable hydraulic boundary conditions. Tests with a group configuration of six show that fish prefer to stay compacted altogether regardless of the velocity.

Our results demonstrate that laboratory studies focusing on species that exhibit gregarious behaviour in the wild should integrate collective behaviour variables. After investigating mean flow velocity, future research will focus on the role of turbulence. Among others, outcomes of this research could provide design criteria such as threshold and preferred hydraulic parameters for developing fishways that address the passage of gregarious fish species.