



Abstract

# Effectiveness Monitoring of Five Fish Ladders in Catalonia, NE of the Iberian Peninsula <sup>†</sup>

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**Abstract:** In recent years, a remarkable effort has been made to recover the connectivity for fish in the rivers of Catalonia, mainly through the construction of new fish ladders, or river connectors. However, evaluating the effectiveness of new fish ladders is not yet a common practice, although knowing how it works is a key aspect of improving the design of new river connectors in other infrastructures. For this reason, the Catalan Water Agency has launched a study to monitor the effectiveness of several recently built river connectors. A total of five fish ladders were selected in the rivers Anoia, Ripoll, Brugent, Llémena and Borró, placed in four different watersheds (Llobregat, Besós, Ter and Fluvià, respectively). These rivers have a similar hydrology (average river discharge inferior to 1 m<sup>3</sup>/s), and a similar potential fish assemblage (*Barbus haasi* or *B. meridionalis*, *Squalius laietanus*, *Anguilla anguilla*, and in some cases *Salarias fluviatilis*). Several exotic species are also present in some of these rivers: *Gambusia holbrooki*, *Lepomis gibbosus*, *Phoxinus* sp., *Barbatula* sp. During 2021, between two and three monitoring campaigns (spring, summer, fall) were carried out. The methodology used consisted first in the installation of permanent traps at the top exit of ladders to obtain direct estimates of pass rate by species, and on comparative fish sampling on each side of the barrier. Additionally, regular monitoring of several hydraulic variables (water velocity, draft, and elevation) was performed at a selection of internal points on each ladder. Finally, the expected mobility per species was also estimated using the package Fishmove (Radinger, 2013), to compare it with experimental estimations and determine the efficiency of ladders. The results demonstrate the effectiveness of the evaluated ladders, at least for some of the species present. Among native species, barbels (*B. haasi* and *B. meridionalis*) showed the highest rates of passage. Some exotic species were also able to occasionally use the ladders. The efficiency of the ladders is mostly high but decreases when there are internal points with excessive speeds, or other failures with respect to the optimal design.

**Keywords:** fish ladder effectiveness; river connectivity; ecological rehabilitation; Mediterranean rivers; *Barbus meridionalis*; *Barbus haasi*



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