

Hydropower Production and Fish Habitat Suitability: Impact and Effectiveness of Environmental Flow Prescriptions

Serena Ceola (1), Alessio Pugliese (1), Giorgio Galeati (2), and Attilio Castellarin (1)

(1) Dipartimento di Ingegneria Civile, Chimica, Ambientale e dei Materiali, Università di Bologna, Bologna, Italy.
(serena.ceola@unibo.it), (2) Water Resources Engineer, Via Duca degli Abruzzi 16, Padova, Italy

The anthropogenic alteration of the natural flow regime of a river for hydropower production can significantly modify the processes and functions associated with fluvial ecosystems. In order to preserve the fluvial habitat downstream of dams and diversion structures, environmental flows are commonly defined. Such environmental flows are generally computed from empirical methodologies, which are seldom based on site-specific studies, and may not be representative of local ecological and hydraulic conditions. Here we present the results of a quantitative analysis on the effectiveness of two alternative environmental flow scenarios prescribed in Central Italy (time-invariant experimental and empirically-based flow release versus time-variant hydrogeomorphologically-based flow release) and their impact on hydropower production and fish habitat suitability. The latter is examined by means of several models of habitat suitability curve, which is a well-known approach capable of analysing fluvial species preferences as a function of key eco-hydraulic features, such as water depth, flow velocity and river substrate. The results show an evident loss of hydropower production moving from the time-invariant experimental flow release to the hydrogeomorphological one (nearly 20% at the annual scale). Concerning the effects in terms of fish habitat suitability, our outcomes are less obvious, since they are species- and life stage-specific. The proposed analysis, which can be easily adapted to different riparian habitats and hydrological contexts, is a useful tool to guide the derivation of optimal water resource management strategies in order to ensure both hydropower production and fluvial ecosystem protection.