



Meso-scale habitat models for the mitigation of hydro-power impacts in high gradient streams

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The study aims to set a possible methodology for the mitigation of hydro-power impacts in high gradient streams located in Apennine and Alps mountain range in NW Italy, watercourses which experience a continuously increasing exploitation by water abstractions. The proposed methodology, based on the habitat-hydraulic models of the MesoHABSIM approach, allows the assessment of environmental flows and the definition of habitat restoration measures for a target fish community. Data from 30 headwater streams, located in the mountainous areas of Valle d'Aosta, Piemonte and Liguria regions, are used in the analysis. The considered streams are mainly characterized by gradients varying from more than 20% to less than 5%, rocks and boulders substrate and step-pool or step-step riverbed. The use of the meso-scale approach displays several advantages in modelling habitat for fish, encompassing a range of scales. Firstly, the applied meso-scale modelling uses GIS and mobile mapping techniques as a quick data collection strategy, to describe and determine the spatial proportions of mesohabitats units in stream reaches. Within the data acquisition phase, the field data collection does not require detailed transect measurements, not emphasizing the cross-sectional variation over longitudinal variation and allowing a larger coverage of surveyed streams. The meso-scale approach involves a large range of habitat variables in biological models, enabling the analysis of fish behaviour at large spatial scale and the habitat assessment for functional groups or the entire fish community. Finally, not requiring hydraulic discharge simulations, the meso-scale habitat models adapt particularly well to the mountainous watercourses, being the only feasible way to model the hydrodynamic and habitat variations over the analyzed range of discharges. The proposed approach can be easily carried out in hard environments without overloading the field data collection, addressing issues relevant to river restoration actions in high gradient streams.