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Defining environmental flows requirements at regional scale by using meso-scale habitat models and catchments classification

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The alterations of the natural flow regime and in-stream channel modification due to abstraction from watercourses act on biota through an hydraulic template, which is mediated by channel morphology. Modeling channel hydromorphology is needed in order to evaluate how much habitat is available for selected fauna under specific environmental conditions, and consequently to assist decision makers in planning options for regulated river management. Meso-scale habitat modeling methods (e.g., MesoHABSIM) offer advantages over the traditional physical habitat evaluation, involving a larger range of habitat variables, allowing longer length of surveyed rivers and enabling understanding of fish behavior at larger spatial scale. In this study we defined a bottom-up method for the ecological discharge evaluation at regional scale, focusing on catchments smaller than $50\ km^2$, most of them located within mountainous areas of Apennines and Alps mountain range in Piedmont (NW Italy). Within the regional study domain we identified 30 representative catchments not affected by water abstractions in order to build up the habitat-flow relationship, to be used as reference when evaluating regulated watercourses or new projects. For each stream we chose a representative reach and obtained fish data by sampling every single functional habitat (i.e. meso-habitat) within the site, keeping separated each area by using nets. The target species were brown trout (*Salmo trutta*), marble trout (*Salmo trutta marmoratus*), bullhead (*Cottus gobius*), chub (*Leuciscus cephalus*), barbel (*Barbus barbus*), vairone (*Leuciscus souffia*) and other rheophilic Cyprinids. The fish habitat suitability criteria was obtained from the observation of habitat use by a selected organism described with a multivariate relationship between habitat characteristics and fish presence. Habitat type, mean slope, cover, biotic choriotop and substrate, stream depth and velocity, water pH, temperature and percentage of dissolved oxygen were collected for each sampled area and considered as independent variables. According to the MesoHABSIM method, we performed a stepwise forward logistic regression in order to build up a biological model identifying the habitat characteristics mostly used by a target fish. For each stream we predicted changes in habitat area over a range of discharges by building the habitat-flow rating curves. Finally, in order to define a regional criteria needed to fulfill environmental flow requirements, we split the study domain according to the regression tree classification criterion defining homogenous sub-regions distinct on both environmental flows and catchment characteristics.