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Meso-scale habitat simulation for the conservation of the endangered crayfish *Austropotamobious pallipes* complex in Italy

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Crayfish are the largest mobile freshwater invertebrates, being often considered key species in the aquatic ecosystems of small streams and creeks in Italy. Specifically, *Austropotamobius pallipes* complex is currently classified as an endangered species, and Italian local populations significantly decreased over the last decades due to habitat modifications and introduction of alien species. Information on *A. pallipes* ecological requirements is then needed to quantify habitat loss, to simulate restoration scenarios and to implement effective conservation measures. In this work we analyze mesohabitat use of *A. pallipes* in reference streams and creeks located in the Italian pre-Alps (Lombardia region) and in the mountainous areas of the Gran Sasso e monti della Laga National Park (Abruzzo region). Data from seven morphologically different streams were used to calibrate and validate habitat models for the endangered crayfish *A. pallipes* complex. The Random Forests algorithm was used to identify the best and the most parsimonious habitat model, to define the lowest number of variables to be surveyed in future model applications. The obtained habitat models were then applied to each stream in order to classify each mesohabitat into suitability categories, and to develop habitat-flow rating curves. Finally, habitat time series analysis was used to define detailed schemes of flow management for individual water diversions in order to represent how physical habitat changes through time and to identify stress conditions for *A. pallipes* created by persistent limitation in habitat availability. Results indicated that fine substrate (as proportion of gravel and sand), shallow water depth and cover (as presence of boulders, woody debris and undercut banks) revealed to be significant variables for the occurrence of *A. pallipes*. Habitat models, performing well in both model calibration and validation phases (accuracy ranging from 71% to 87%), are regarded as valuable tools being transferable among different streams with different morphologies. Establishing flow recommendations for small streams that may not have available ecological and flow data is important, and this methodology provides a tool where few are currently available. As such, it can be used for development of regional rules for the conservation of the endangered *A. pallipes* complex, as well as for defining more site specific flow management criteria.