



Fuzzy modelling of Atlantic salmon physical habitat

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Fish habitat models typically attempt to quantify the amount of available river habitat for a given fish species for various flow and hydraulic conditions. To achieve this, information on the preferred range of values of key physical habitat variables (e.g. water level, velocity, substrate diameter) for the targeted fish species need to be modelled. In this context, we developed several habitat suitability indices sets for three Atlantic salmon life stages (young-of-the-year (YOY), parr, spawning adults) with the help of fuzzy logic modeling. Using the knowledge of twenty-seven experts, from both sides of the Atlantic Ocean, we defined fuzzy sets of four variables (depth, substrate size, velocity and Habitat Suitability Index, or HSI) and associated fuzzy rules. When applied to the Romaine River (Canada), median curves of standardized Weighted Usable Area (WUA) were calculated and a confidence interval was obtained by bootstrap resampling. Despite the large range of WUA covered by the expert WUA curves, confidence intervals were relatively narrow: an average width of 0.095 (on a scale of 0 to 1) for spawning habitat, 0.155 for parr rearing habitat and 0.160 for YOY rearing habitat. When considering an environmental flow value corresponding to 90% of the maximum reached by WUA curve, results seem acceptable for the Romaine River. Generally, this proposed fuzzy logic method seems suitable to model habitat availability for the three life stages, while also providing an estimate of uncertainty in salmon preferences.