# MODELLING MACROINVERTEBRATE MICROHABITAT SELECTION: RELEVANCE, GENERALITY AND FUNCTIONAL INTERPRETATION

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Author Speaker
FORCELLINI Maxence
Affiliation
(IRSTEA, UR-RiverLy, Centre de Lyon-Villeurbanne, Villeurbanne Cedex, France)
Co-authors

PLICHARD Laura, (IRSTEA, UR-RiverLy, Centre de Lyon-Villeurbanne, Villeurbanne Cedex, France); (Ecogea 352 avenue Roger Tissandié 31600 Muret)DOLÉDEC Sylvain, (Univ Lyon, Université Claude Bernard Lyon 1, CNRS UMR 5023, ENTPE, Laboratoire d'Ecologie des Hydrosystèmes Naturels et Anthropisés, F-69622 Villeurbanne, France)MÉRIGOUX Sylvie, (EDF R&D, LNHE Department, Chatou Cedex, France)OLIVIER Jean-Michel, (Univ Lyon, Université Claude Bernard Lyon 1, CNRS UMR 5023, ENTPE, Laboratoire d'Ecologie des Hydrosystèmes Naturels et Anthropisés, F-69622 Villeurbanne, France)CAUVY-FRAUNIÉ Sophie, (IRSTEA, UR-RiverLy, Centre de Lyon-Villeurbanne, Villeurbanne Cedex, France)LAMOUROUX Nicolas, (IRSTEA, UR-RiverLy, Centre de Lyon-Villeurbanne, Villeurbanne Cedex, France)

Abstract

Among the multiple environmental parameters influencing freshwater species abundance, microhabitat hydraulics have received a particular attention due to their modification by river regulation (water abstraction, channelization) and/or restoration (morphological restoration, environmental flow implementation). Microhabitat selection is a complex process that varies across taxa and individuals, along the life cycle and according to the environmental context. Consequently, the relevance and transferability of microhabitat selection models has often been debated. Therefore, regular updates on microhabitat selection models and comparisons among rivers and seasons are required for improving management decisions.In this study, we analysed a unique database of 2156 invertebrate microhabitats collected (using Surber or Hess samplers) during 91 surveys (rivers x dates) distributed in 10 small streams to large rivers of Germany and France. This database included 259 invertebrate taxa, among which 141 were identified at the species level. Microhabitats were characterized by four hydraulic variables: water depth, water column velocity, bottom shear stress and Froude number. We examined the impact of each hydraulic variable on invertebrate abundance using mixed-effect models, and compared their relative performance for explaining microhabitat selection. Our modelling approach accounted for the overdispersion of observed abundance (e.g. due to spatial aggregation), and quantified the variability in microhabitat selection across rivers and seasons.Most taxa had significant responses to hydraulics, with response forms highly variable among taxa. Models based on velocity, Froude number and shear stress showed comparable results and were stronger than models based on water depth. Average microhabitat selection models, with a response form common to all surveys, explained around 70% of the variability explained by more flexible models that allowed variations between surveys. However, the performance of average selection models was variable among taxa.We related observed microhabitat selection to a combination of taxa biological traits (e.g, morphology, locomotion types, feeding habits and longevity) to provide a functional interpretation of observed patterns and discuss how they result from general biological processes.As our data cover a wide range of taxa with variable biological traits, our synthesis on microhabitat selection patterns can be useful for a wide variety of applied ecological studies (e.g., habitat modelling, environmental flow determination) as well as more basic research on the complexity and the diversity of microhabitat selection processes.

Keywords
stream invertebrates, hydraulic variables, preference curves, nonlinear mixed-model, biological traits