Incorporating water temperature and discharge into climate change models of freshwater invertebrates across Europe

Julie Crabot*[1], Jukka Aroviita[2], Helena Bayat[3], Angela Boggero[4], Núria Bonada[5], Thibault Datry[6], Sami Domisch[7], Maria Joao Feio[8], Mathieu Floury[9], Riccardo Fornaroli[10], Virgilio Hermoso[11], Jonathan Jupke[3], Alex Laini[4], Heikki Mykrä[2], Narcís Prat[5], Ralf Schaefer[3], Astrid Schmidt-Kloiber[12], and Miguel Cañedo-Argüelles[13]

[1]FEHM-Lab (Freshwater Ecology, Hydrology and Management), Institute of Environmental Assessment and Water Research (IDAEA), CSIC, Barcelona, Spain – Espagne

[2]Freshwater Centre, Finnish Environment Institute, Oulu, Finland – Finlande

[3]iES Landau, Institute for Environmental Sciences, RPTU Kaiserslautern-Landau, Landau, Germany – Allemagne

[4]Department of Life Sciences and Systems Biology, University of Turin, Torino, Italy – Italie

[5]FEHM-Lab (Freshwater Ecology, Hydrology and Management), Department of Evolutionary Biology, Ecology and Environmental Sciences, Facultat de Biologia, Institut de Recerca de la Biodiversitat (IRBio), University of Barcelona, Barcelona, Spain – Espagne

[6]National Research Institute for Agriculture, Food and Environment (INRAE), Villeurbanne, France – UR RiverLy, 5 rue de la Doua, 69625 Villeurbanne, France – France

[7]Department of Community and Ecosystem Ecology, Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin, Germany – Allemagne

[8]Department of Life Sciences, University of Coimbra, Marine and Environmental Sciences Centre, Associated Laboratory ARNET, Coimbra, Portugal – Portugal

[9]University of Paris-Saclay, INRAE, UR HYCAR, Antony, France – Université Paris-Saclay, INRAE, HYCAR Research Unit, Antony, France – France

[10]Department of Earth and Environmental Sciences – DISAT, University of Milano-Bicocca, Milan, Italy – Italie

[11]Departamento de Biología de la Conservación y Cambio Global, Estación Biológica de Doñana (EBD-CSIC), Sevilla, Spain – Espagne

[12]Department of Water, Atmosphere and Environment, Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Life Sciences, Vienna, Austria – Autriche

[13]FEHM-Lab (Freshwater Ecology, Hydrology and Management), Institute of Environmental Assessment and Water Research (IDAEA), CSIC, Barcelona, Spain – Espagne

Résumé

Freshwater organisms are expected to be profoundly impacted by the predicted increase in water temperatures and discharge alterations associated with climate change. However,

*Intervenant

available models focus mostly on changes in air temperature, potentially failing to incorporate these impacts. Given that freshwater biodiversity is declining at an alarming and exponentially increasing rate, there is an urgent need to assess the relation of this biodiversity to water temperature and discharge to plan effective management and conservation actions. Here, we modeled the distribution of freshwater macroinvertebrates across Europe for present and future conditions including recently available data on water temperature and discharge. We also included other environmental variables that might be relevant in understanding the current spatial distribution of invertebrates (e.g. geology, adjacent land use). We used 40 datasets of standardized monitoring protocols of freshwater invertebrates spanning 23 years. The study includes a comparison of the predictions for the future at different taxonomic resolutions, from species to family level, to discuss the high variability of response to water temperature between species of some genera and families. This work is a first step towards the selection of taxa sensitive to climate change, the final aim being to build a multimetric macroinvertebrate-based index that could serve to monitor the effects of climate change on rivers and streams at the European scale.

Mots-Clés: distribution models, random forests, rivers, warming, range shift, suitable area